Probing Technology with Technology Probes *

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1. INTRODUCTION: INVESTIGATING TEXTING

In 'Smart Mobs' Howard Rheingold [22] makes dramatic claims about the social and political impact of texting, drawing particular attention to the emergence of 'thumb tribes' and 'generation txt' and the potential impact of texting on practices as diverse as teenage mating rituals and demonstrations. Like Rheingold we are equally interested in one of the most surprising phenomena to have occurred within the field of mobile computing within recent years - the uptake of SMS (or Short Message Service) text messaging. According to the Mobile Data Association [18], the total number of chargeable person-to-person SMS text messages sent across the main four UK GSM network operators between 31st December 2003 and 1st January 2004, was 111 million, an 8% increase compared to figures over the same period the previous year (http://www.text.it/mediacentre), and new uses of SMS messaging are emerging in conjunction with interactive TV services, for example. Unlike Rheingold we are rather reluctant to speculate wildly on what exactly this development might amount to or mean. There are, of course, various well-known problems involved in interpreting statistical data [3] [2], along with associated issues concerning what data is appropriate and how it might be collected [17]. In this paper we wish to consider some of the *technical difficulties* involved in data collection.

Our studies are particularly concerned to understand a use of SMS texting that has received little investigation to date, largely due to its novel character. The topic we have in mind is the use of texting as a means of enabling people to send messages to displays *situated in the fabric* of a setting rather than to another mobile device owned by a particular individual. Such a facility has clear potential in cooperative work settings where the need to distribute awareness amongst members [9] means that messaging to a place may be more appropriate than messaging directly to a particular individual. The potential utility of 'situated displays' is articulated by O'Hara et al. [20] -

> *In recent years, more and more information is being presented on dedicated digital displays situated at particular locations within our environment. At their most basic, digital display technologies allow information to be more easily updated dynamically and remotely. However, these new kinds of interaction technologies also allow people to use these situated displays in novel ways both as for the individual's purposes and in the* ***support of group work****.*

O'Hara et al.[20] draw particular attention to the potential for texting to and updating situated displays remotely, and it is this functionality and how we might *measure* and *assess* it that forms the focus of this paper.

2. TEXTING TECHNOLOGIES: HERMES AND SPAM

In this paper we describe two applications. Hermes ([4],[5],[6],[11]), which was deployed in a university, and SPAM [8], which was deployed in a residential care setting. Both of these applications enable users to text to and update situated displays remotely. The Hermes system enables users to interact remotely with office door displays via their mobile phone using SMS. The SPAM messaging system evolved from our experiences with Hermes and also enables users to remotely update situated displays (using SMS) in order to facilitate coordination and cooperation with remote work colleagues. In texting to situated displays users of the Hermes and SPAM systems may make available to others their location, plans, and activities, and thereby draw upon and reflect social aspects of everyday life that are essential to collaboration and coordination. Another way of thinking about the Hermes and SPAM technology is in terms of 'affordances' [1] and the notion that we can treat technology as affording knowledge and as having been designed with this possibility in mind. Here our interest is in how the different features of the assembled systems are constructed so as to 'afford knowledge' to, for example, the working division of labour through the reflexive articulation of which the various workaday activities in a setting are coordinated and performed [24]. Accordingly, texts (to both Hermes and SPAM) become both the focus of work and a visible record of work that has been done, put on hold, remains to be done, and so on. By embedding messages in the fabric of the workplace, by *putting the work on display* so that *others may be aware of it*, these textual representations make everyday work 'visible' so that it can be 'taken note of', 'reviewed', 'queried' and in other ways be made accountable by and for others involved in the work.

2.1 Hermes and SPAM: Overview and Requirements

This section provides some technical details of the Hermes and SPAM systems. The Hermes system supports remote interaction by

allowing messages to be created and read via the web or a mobile phone. We hoped that by supporting remote interaction and observing how the new system was used over a significant period of time we would gain some useful insights into the relative importance and interaction of 'place' 'space' and 'text' within this application domain. For example, what kinds of messages would members of university staff post on their door when texting remotely?

The Hermes system comprises a central server and a number of wall or door mountable units (referred to as Hermes displays). At present we have 10 units deployed on one floor of the Computing Department at Lancaster University. Our intention was for Hermes displays to have the ease of use and dependability associated with an information appliance - i.e., to perform a small number of tasks simply and well. The system provides the owner of the Hermes display with two key functions:

1) The ability to create a message to appear on the display.
2) The ability to read messages left by visitors.

Typically, the owner will create a message to appear on their Hermes display by entering some appropriate text using the web interface (Figure 1.) The web interface can also be used to upload a graphical image for display, such as an animated GIF.

The overall system architecture of the Hermes system is illustrated in Figure 2. In this figure, the yellow oval represents the typical entities associated with a given user. At the heart of the system is a single central server application written in Java that runs on the Linux platform and provides the following key functions:

1) Centralized storage for messages and user profile information.
2) Communication with the SMS Gateway.
3) Hosting of the web portal.

Figure 1. The Hermes Web Interface [5]

The system utilizes both wireless (802.11b) and wired Ethernet network infrastructures. In order to support the reception of SMS messages, the central server communicates with a Wavecom DB02 GSM terminal. The web portal is implemented using Java Servlets and this enables the dynamical generation and publication of html web pages. The Hermes displays themselves use the CrEme Java virtual machine, and run the PocketPC operating system.

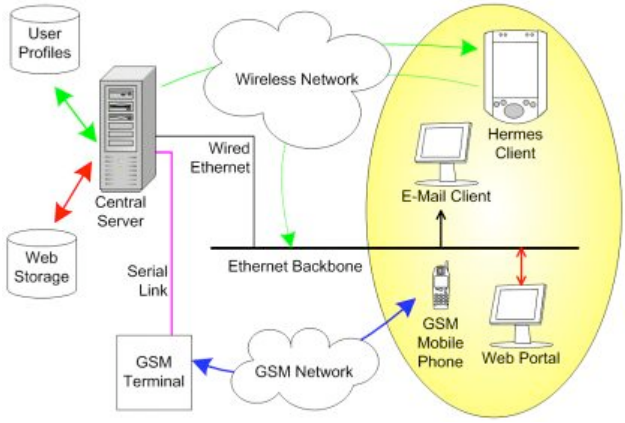

Figure 2. The System Architecture of Hermes [5]

The SPAM system has been developed to support cooperation between staff working at two associated sites located in Carlisle, a small city in the North of England. The requirements for SPAM were obtained through ethnographic study, informational probes [7] and design workshops with the staff. The overall response to the idea of a messaging system was extremely positive. In particular, such a system was viewed as another, alternative, tool for communication capable of supporting staff in their everyday work and interaction with residents. This then became the rationale for the construction, testing and deployment of the SPAM system.

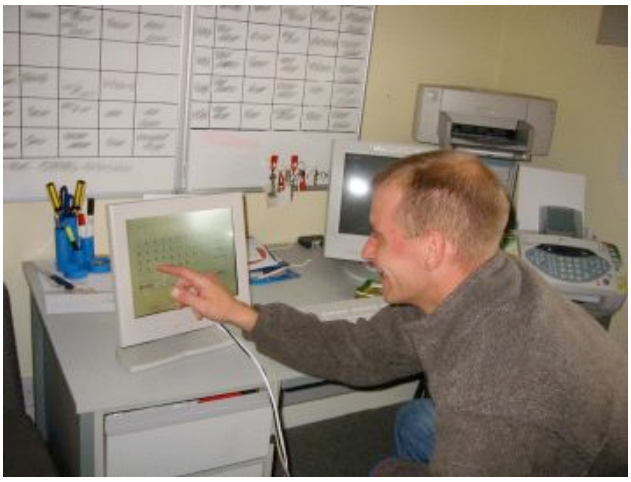

Figure 3. One of the SPAM Displays

The SPAM system has been designed to run an SMS messaging application, allowing staff from the hostel office to communicate easily with staff from the semi-independent living accommodation office (and vice-versa) by composing messages using an on screen keyboard displayed on a touch sensitive screen (Figure 3). When messages are received by a SPAM unit they are displayed on the screen until deleted by a member of staff. Staff can also use their own mobile phones in order to send text messages to the SPAM displays when they are out of the office and to receive messages originating from a SPAM display.

The overall design of the system architecture is shown in Figure 4. This highlights the way in which SMS messages sent via mobile

phones and by the SPAM units themselves are handled by the system.

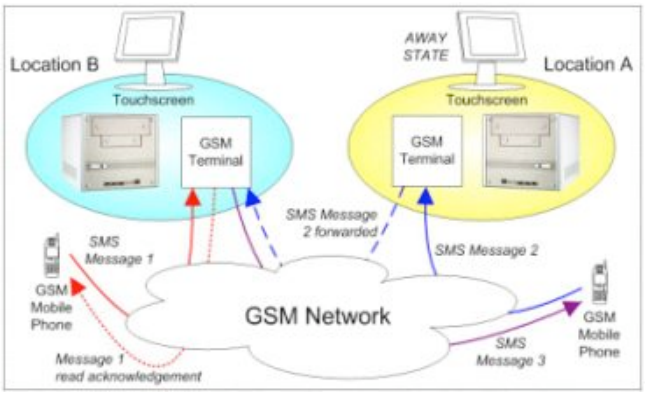

Figure 4. Architecture of the SPAM system

The typical use scenario is illustrated by SMS Message 1 - i.e., the message originating from a mobile phone is successfully delivered to the permanently staffed hostel (Location B) and the transmission of a 'message read' acknowledgement is triggered by a member of staff reading the message. Message forwarding is performed by the system if a message is sent to the semi-independent living accommodation (Location A) at a time when no member of staff is providing cover (denoted by AWAY STATE). In this case, the message (Message 2) is automatically forwarded to the display of the hostel with 24-hour cover. The two SPAM displays were deployed in the two offices in October 2002. Since that time the units have been used on a daily basis.

3. TECHNOLOGY PROBES: GETTING DATA FROM HERMES AND SPAM

In a number of papers ([7],[8]) we have outlined a range of factors that conspire to render our usual ethnographic data collection techniques inappropriate and how we have sought to supplement our understanding of the care setting 'from within' by adapting Cultural Probes. Cultural Probes [13] have achieved some prominence in interactive systems design, where they have been employed to *inspire* design as computing moves out of the workplace and into everyday life more generally. In contrast, we have elected to adapt Cultural Probes through the incorporation of social science research methods to *gather data* about participants' daily lives. Our Informational Probes have been employed to sensitise parties involved in design to the local cultures within which new technology will be embedded and to elaborate the needs of users. As SPAM and Hermes have been put to use in their respective settings we have found that the technology also acts as a probe – i.e., as a means of gathering data. The text logs generated through the technology's employment provide us with a complementary source of information, which may be used to measure and assess the functional value of our systems from the point of view of day-to-day use.

3.1 Technology Probes

The notion of Technology Probes has recently been employed in the Interliving Project [15]. In this context Technology Probes are adaptations of Cultural Probes that seek to embed inspiration *within* the design process, in contrast to providing inspiration *for* design. Hutchinson et al's Technology Probes situate existing technologies in real homes rather than 'lab houses' in order to inspire design by exposing inhabitants to new experiences. While there is merit and value to this approach, this is not what we mean when we invoke the notion of a Technology Probe. Our take on Technology Probes is different and perhaps simpler, involving the embedding of a logging system into the technology itself.

3.2 Logging Hermes and SPAM Usage

Both Hermes and SPAM perform their logging functions by appending messages to a text file, though the source of these messages differs between the two systems due to their design and implementation.

In Hermes we log many aspects of the system ranging from user interfaces actions to messages sent to the system via SMS. Due to the multitude of devices generating messages to log, we provide a central logging agent accessible over a network.

The SPAM application runs on a stand-alone miniature PC and all messages to log are generated by the SPAM main application. The GSM terminal is interfaced though a Java class sending and parsing AT commands (a separate piece of 3rd party software is used in Hermes), so much more debugging information about communication with the GSM terminal is available. This enables all information sent to and from the GSM terminal to be logged.

In the Hermes project the emphasis has been on logging the user interactions which occur, as we provide many different mechanisms for interactions. While with SPAM there are fewer mechanisms for interactions, consequently we concentrate on logging the messages sent and received.

3.3 Examples of Raw Log Data

Figure 8a shows a sample of the log file entries generated by the SPAM system for a message sent to Location A from Location B, figure 8b shows a sample of the log entries generated at Location A when this message arrives. This is a mixture of debug output from communication with the GSM terminal, and 'higher-level' messages indicating that a message has been sent, received etc.

Figure 9 shows a sample from the Hermes log. This logs stores user interface actions from the Hermes doorplate appliances, along with information about the appliance from which the message originated and a timestamp. The log also explicitly stores messages about other actions which occur such as messages sent and users logging in/out.

```
ok_pos
Waiting for lock on JGateServer
Got lock on JGateServer, about to send: ps would you like any pizza for tea to
2:-1:-1:-1:-1
2:10:-1:-1:-1
ok_pos
set text mode - OK
2:18:-1:-1:-1
ok_pos
set TE notification - OK
About to send: ps would you like any pizza for tea to: 07766345014
Got is now: AT+CMGS=
1:-1:-1:-1:-1
Got is now: AT+CMGS="0776634
1:-1:-1:-1:-1
Got is now: AT+CMGS="07766345014"

1:-1:-1:-1:-1
Got is now: AT+CMGS="07766345014"
>
1:-1:-1:-1:-1
sms_prompt_pos
Got is now: ps would
```

Figure 8a: Log of message sent from Loc. B to Loc. A

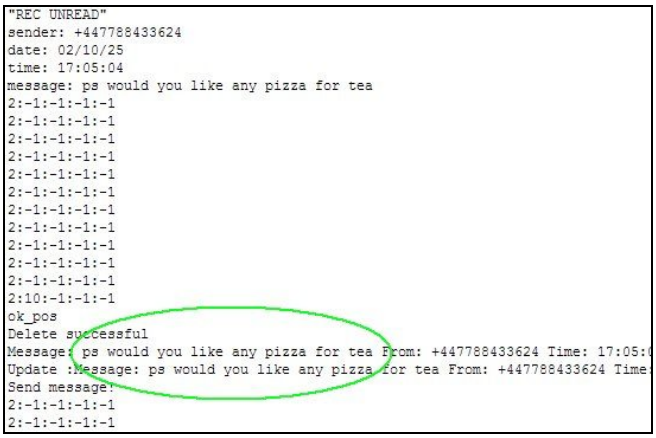

Figure 8b: Log showing message received at Loc. A

```
User fittond logged in
dyn196.dhcp.lancs.ac.uk/148.88.241.150
14:22 07/05/02
actionPerformed - source: java.awt.Button[button6,117,0,117x23,label=Log Out]
dyn196.dhcp.lancs.ac.uk/148.88.241.150
14:22 07/05/02
User fittond logged out
dyn196.dhcp.lancs.ac.uk/148.88.241.150
14:22 07/05/02
actionPerformed - source: java.awt.Button[button7,0,0,117x23,label=Note]
dyn196.dhcp.lancs.ac.uk/148.88.241.150
14:22 07/05/02
actionPerformed - source: java.awt.Button[button8,0,0,78x23,label=Back]
dyn196.dhcp.lancs.ac.uk/148.88.241.150
14:22 07/05/02
actionPerformed - source: java.awt.Button[button7,0,0,117x23,label=Note]
dyn196.dhcp.lancs.ac.uk/148.88.241.150
14:22 07/05/02
actionPerformed - source: java.awt.Button[button9,156,0,78x23,label=Send]
dyn196.dhcp.lancs.ac.uk/148.88.241.150
14:22 07/05/02
Anonymous note sent to 764066420633315216067
dyn196.dhcp.lancs.ac.uk/148.88.241.150
14:22 07/05/02
```

Figure 9 – A sample from the Hermes log

3.4 Working with Logs: Technical Issues

One of the initial technical issues encountered was that of what information to log, as it is difficult to predict which information may be useful in the future. It is sometimes obvious from the outset which information will give the best clues about use (etc), though it may not be apparent until thorough analysis of the logs what additional information it would have been useful to collect. When collecting information there are usually limits on the amount that can be collected, so a balance is necessary between what is essential and what is possible to store. For example, for the Hermes doorplate appliances most user interface actions are logged, but the pen movements (i.e. a user drawing a note) are not, as this would require large amounts of network bandwidth between the appliance and the logging agent, and place a high processing load on both devices. The doorplate appliance would definitely not be able to cope with the additional load and the 'leaving a note' process would be so un-responsive it would be unusable. However, in general our policy is a prudent one, i.e. to collect more information than may at first appear necessary.

The safe storage of the logs is another important technical issue which needs to be addressed. Initially all the logs were stored on single computers, but (typically!) we experienced hard disk failure with both the Hermes and SPAM systems. Our initial solution had been to make backups of the logs as regularity as possible and replicate these across many machines. The opportunity to backup logs also provides a good point to start a new log file, we do this as our logs file tend to reach several hundred megabytes in size which can introduce problems for analysis. As the Hermes system is located inside the computing department we are in the process of altering the logging system to store an additional copy of the log file on a departmental fileserver, which is regularly backed up. However this approach cannot be used for the SPAM system, as the two end units are located geographically far from the university (approximately 90 miles) and currently have no (reasonable bandwidth) connectivity with the university. Obviously this factor means that collection of the logs is difficult. The SPAM units are also very compact machines, making it very difficult to add additional redundant storage, e.g. extra hard drives etc.

Reliability of the logging functions can also be a problematic issue. This is especially true of Hermes where the logging is done by a separate agent. If the Logging Agent stops functioning or crashes there is currently no easy way to detect that this has occurred. This is a scenario we have already encountered and are working on implementing a 'watcher' to monitor the Logging Agent. Furthermore, we do not have an active feedback mechanism to monitor free disk space available for the logs or any other problems which may occur while attempting to write to a file. The aforementioned problems must be solved to increase the dependability of the logging function. Furthermore, clearly when either system is not running then no information will be logged. Both Hermes and SPAM systems have suffered unscheduled 'downtime'.

3.5 Experiences Analysing Log data

To date, we have done a preliminary analysis of 300 messages set by the owners of Hermes displays over a continuous period of approximately five months. The goal of this analysis was to obtain a rough approximation of the proportion of messages which shared personal context in some way, and the breakdown of these messages in terms of their containing location, activity or temporal information. For example, through analysis we found that 250 (83 %) contained some aspect of sharing context [5], the breakdown of these messages is shown in figure 10.

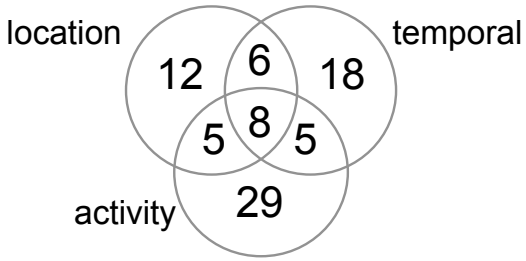

Figure 10: Analysis of Hermes messages according to the categories of shared context [5]

In order to obtain this statistical breakdown from the Hermes logs several phases of parsing and analysis were required. It was first necessary to extract all the parts of the log concerned with users setting messages on their doorplates (this was achieved using the standard Unix 'grep' command). A program was then written to parse the remaining parts of the log, separating the entries and formatting the text. The fourth phase was then to perform a search to replace the user identifiers used by the system with users full names. The fifth phase was to go through each entry by hand looking at the message and categorising (using tags) its context. A sample from the log including tags is shown in figure 11. The final

phase was to write a program to analyse the context each message was tagged with and produce the statistics, which could then be used to generate figure 10.

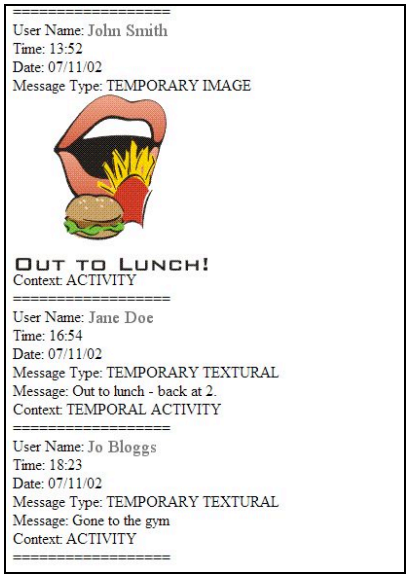

Figure 11: Part of the Hermes Message Log including Context Tags [5]

Clearly the analysis of logs such as those produced by Hermes can be a difficult and time consuming process. Performing the analysis in phases is useful as the information generated at each phase can be used for different types of analysis and to look at different factors.

The manual tagging of entries was an unfortunate but necessary step which required a large degree of human judgement. In more detail, some messages required careful consideration to decide what types of context they actually shared. For example, the message: 'At CSCW'02 back Monday 25th Nov' has been categorized as containing activity + location + temporal but it could be argued that the message only contains temporal and location attributes.

When we attempted to analyse the SPAM logs to look at the dialogue taking place we found this to be an unexpected challenge. After attempting various means to parse the logs in different ways, programs were written to extract messages sent and received from the SPAM logs and place them in separate text files, separating and formatting the entries. An example of the results from this process for Location A's log file can be seen in figures 12a and 12b, this sample includes the messages which can be seen in figures 8a and 8b. It is interesting to note that we only have to look at the log file at one of the locations (in this case Location A) to see all the messages sent between the two.

```
--
sender: +447788433624
date: 02/10/24
time: 20:13:10
message: a lot of banging going on up here too
--
sender: +447788433624
date: 02/10/25
time: 13:24:03
message: $AK Message sent at 13:23 on 25/11/02 from +4477
--
sender: +447788433624
date: 02/10/25
time: 17:01:02
message: dear david hope you are ok can you put in the di
--
sender: +447788433624
date: 02/10/25
time: 17:05:04
message: ps would you like any pizza for tea
--
```

Figure 12a: Messages Received at Location A

```
send: Mike. email for you to view tonight from brian. to:
send: PENNY. please check email from me about fire precaut
send: $AK Message sent at 17:05 on 25/11/02 from +44778843
send: No thankyou. to: +447788433624
send: $AK Message sent at 17:01 on 25/11/02 from +44778843
send: IT IS IN THE DIARY FOR TOMORROW. THERE IS A TENANTS
send: I'm coming home, i've done my time.DG. to: 077884336
send: Electricity reading 128 Total 066758 rate 1  021834
send: Do you want anything from the bakery? to: 0778843362
send: $AK Message sent at 12:02 on 26/11/02 from +44778843
send: Is that just plain crisps or do you want a sandwich
send: $AK Message sent at 12:09 on 26/11/02 from +44778843
send: $AK Message sent at 14:07 on 26/11/02 from +44778843
send: Have done as requested regarding meater readings :-)
send: $AK Message sent at 14:33 on 26/11/02 from +44778843
send: Sorry about the delay but although the mesage machin
send: im lockng up now. alison to: 07788433624
send: $ARShe has started phoning the botchery office now :
send: $AK Message sent at 19:39 on 27/11/02 from +44778843
send: report copied, 1 put into her file, and 1 put into i
send: $AK Message sent at 16:09 on 28/11/02 from +44778843
send:  YES WHAT to: +447788433624
send: resident at 136 in bed sleeping well. said he was ok
send: brian has now gone off site. MDT. Will call into hou
send: sf hs just arrived back now panick over to: 07788433
send: Sorry Penny David called back and it is Connor's par
```

Figure 12b Messages Sent by Location A

Initially it was very hard to follow the chronological order of dialogues using two separate files for messages sent and received, so the analysis program was modified to output to a single file. Unfortunately we found that only the time and date of messages received had been logged, not the time and date that messages were sent. The SPAM system does provide an acknowledgement reply SMS message when a message has been read, this means that usually the next entry in the log gives a good approximation of when the previous message has been sent. This is obviously not ideal, and makes analysis of the logs more difficult, as the acknowledgement messages entries in the logs tend to make it harder to see the actual messages being sent and received (and should ideally be filtered out). Our solution to this problems has again been to modify the analysis program to make the acknowledgement entries much smaller (so they only take up a single line), and to highlight by hand the messages sent and received using different coloured marker pens. Additionally we performed a search and replace to add names to known mobile phone numbers. The final result can be seem in figure 13 where messages received are highlighted in green and messages sent in yellow, this makes it much easier to see dialogue taking place than in figures 12a and 12b.

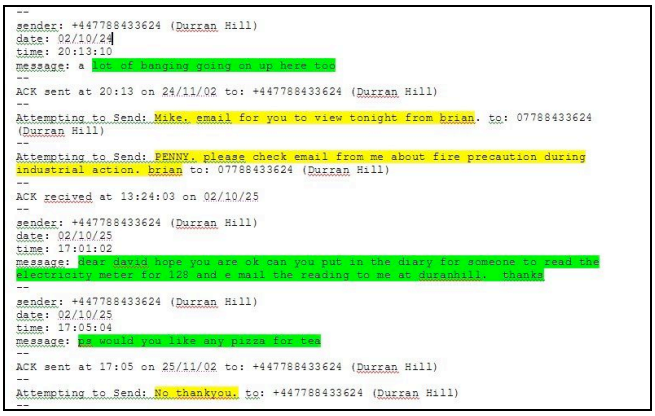

Figure 13: Manually amalgamated (and annotated) log file showing dialogue between SPAM units at Loc. A (Durran Hill) and Loc. B (Botcherby)

3.6 Future Work

We hope to further analyse the SPAM logs, using a similar approach as with Hermes, to tag and analyse messages sent (e.g. one category might be a request to switch communication mediums) and dialogues taking place. This will help us to explore how the SPAM systems is actually being used; and how this use has changed over time and whether or not the types of usage follow regular patterns.

It is crucial that we strive for an overall improvement in the dependability and flexibility of our logging systems. To this end, we plan to investigate the approaches adopted by other systems (e.g. safety critical control systems) for managing the production of log files, and this should reveal some useful insights into how we might improve the reliability of our logging processes, e.g. through the use of monitoring and notification mechanisms.

3.7 Human Troubles Involved in Getting the Data

One of the key issues with both texting systems, and particularly the ability to collect any worthwhile data from them, is the need for users to have a strong trust in the reliability of the system - i.e., a strong belief that any SMS text message that they send to a situated display will (indeed) appear on the situated display and remain there for an appropriate period of time. In the absence of such dependability any interpretation of the data from the technology probes is, at best, problematic. In the case of Hermes this means messages staying there until removed or replaced by another message while in the case of SPAM it means staying visible until deleted by a member of staff. Of course, in order to encourage users to trust the system, they need to see the system functioning correctly over a protracted period of time - i.e., months rather than minutes. We have found achieving this kind of dependability difficult, especially for the Hermes system. The ideal situation would be to develop a system in which all components work faultlessly or at least have an extremely long mean-time to failure (MTF). However, such a situation is indeed ideal. For example, SMS messages are not always delivered in a timely way by a given GSM service provider (especially where a message requires routing between different service providers). It has been interesting to observe how some users have developed coping strategies to deal with early reliability problems. For example, on one occasion, a user's Hermes display did not update properly so that for a week while he was away his door displayed "I am in! Alan". Now he always includes with such messages an explicit date, e.g. "Alan in all day today, Thurs 13th". In this case because Alan possesses a good 'mental model' of the Hermes system he was able to adapt his behaviour through a subtle change in message composition to overcome the potential problem caused by a Hermes update failure [4]. Providing users with appropriate feedback is of paramount importance when supporting such interaction and is one means for tackling the complex dependability requirements inherent in systems such as Hermes and SPAM - the quantum leap in difficulty of building and deploying systems that need to be operational on a constant basis. Crucially, we believe that it is important to deploy such systems in the long term. This is necessary in order for users to have sufficient time to domesticate the technology by adapting it to particular features of the domain and/or to develop new forms of use ('innofusion' in [12]).

4. UNDERSTANDING USER EXPERIENCE WITH HERMES AND SPAM

This section presents some reflections on the data we have obtained from the 'technology probes' in the Hermes and SPAM systems. Despite the difficulties of extracting coherent data from the probes we believe that some interesting and important material has been produced. Our emphasis has been on studying technology in use, reflecting a longstanding tradition if not research orthodoxy in the field of Computer Supported Cooperative Work ([14],[21],[10]). Our interest is in understanding the data on texting as 'everyday occurrences', as constituent features of ordinary workaday activities. The point of this is, as the late Harvey Sacks might say, is to examine the data to see what details it provides of how the technology is 'made at home' in the settings it inhabits and how it comes to fit into and resonate with a domain of practical action 'that has whatever organization it already has' [23]. Our concern, then, is with how this technology finds a place within the day-to-day work of a setting and is responsive to the 'working sensibility' of those under study. This interest and the kind of data collection it requires is, perhaps, remote from the kinds of general *reflections* that someone in an occupation (e.g., a university lecturer or care worker) can produce, and much more attuned to their consciousness and attention when they are actually *engaged* in their work. In particular we are interested in the use of texting in the exercise and development of users working sensibility and especially how and in what circumstances they react to or decide to initiate text messaging. The development, deployment and evaluation of the Hermes and SPAM systems have revealed a number of interesting issues in this regard.

Having installed the text messaging equipment, ensured it functioned adequately, and demonstrated it to users, the systems have now been in constant use for over a year. Without necessarily subscribing to the fetishization of quantitative data, our analysis to date has been hampered by an inability to easily compile statistical data on usage and so our analysis has largely been based on a time-consuming manual examination of the logs. Manual examination of the logs suggests that current usage seems focused on:

Awareness (e.g., "Has fax, email got through? Has X left yet?").

Coordination between sites *(e.g., "I keep ringing and nobody answers? Can you ring me please"; "Pizza & and chips ready come on in ☺").*

Coordination between staff (e.g., "Please ring car wont start"; "Alison can you ask terri to ring me when she comes in about the swop").

Tracking schedules (e.g., "What shift is steve doing tomorrow and where"; "Alison on visits and has mobile. Brian out with hh and has own mobile"

Queries (e.g., "Which keys should we hand over?"; "Can I possibly get a lift into town").

The SPAM logs reveal a growing familiarity with SMS or 'textspeak' (e.g., "What does 18tr mean?" - "Later in SMS speak, get with it babe") and its use to tell jokes (e.g., "how do u turn a duck in2 a soul singer: put it in the microwave until its bill withers") suggests the technology is slowly but surely becoming *organizationally embedded* in the day-to-day work of the residential care setting, as the following extracts also indicate:

"SORRY IM GOING 2B LATE DARRIN"

"Blocked in snow will be late"

"Snow problem please ring Barbara"

"Penny am with mr gate closed bvt not locked"

"Hold up with s m money will be delayed back a s a p Barbara"

The organizational character of texting has also become evident in the use of Hermes, as the following extracts make perspicuous:

"Am running 20 mins late"

"On bus - in shortly"

"Gone to the gym"

"Johm - in ww burger joint."

"Maomao going to be late – will catch up later. A."

" In big q at post office ... Will be a bit late"

As these examples illustrate, the organizational character of texting consists of an explicit *sharing of context* in order to support (or potentially support) collaboration with others.

Like Nardi et al. [19] and Isaacs et al. [16], when examining the sharing of context we are interested in the communicative *functions* of texting - of the use of texting for quick questions and clarifications, for example (e.g., "Do you know if Helen has any medicine"; " Wot time is Paul calling to c hh"). Similarly, there is evidence in the logs that texting is useful for various kinds of coordination. Texting is particularly useful to coordination when immediate responses are required (e.g., "D ... XXX has to have blood test at cc at 10 30 i will take him can you tell him to be ready - let me know if you have got message" - "Got message have cancelled his taxi"). However, the use of text also extends to coordinating the use of technology when, for example, a conversation is complicated and/or involves too much typing (e.g., "Please phone house when you are able"). In other instances texting is relied upon when other technologies (phone, fax, email, etc.) are in use or are being kept clear in the anticipation of urgent use and to alert others on occasions where technical failures occur (e.g., "Put the phone on to answerphone"; "Please switch the mobile phone on"; "u r blocking the phone line after someone telephoned here it sounded like mike. Please sort out as we can not use the mobile if needed").

What becomes obvious in reading the text logs is the flexibility of text messaging in terms of supporting the everyday work of the hostel and the university department. The expressive' character of texting is also noteworthy. Even without the addition of emoticons, our users routinely employ texting for affective communication about work, work crises, jokes and general social banter.

"I can hear a kind of jingley sound and there are animals on the roof what does this mean?" "It means that Santa is passing over the house and making his way down to see me"

"Help please its all too much on my first day back"

"Hello ian i was wondering if everything was alright?"

"A man went to the doctors with a lettuce up his bum and the doctor said its just the tip of the iceberg im afraid"

The affective character of texting has been observed by other researchers in other settings [25]. As Nardi et al. [19] put it,

> *It is interesting that a lightweight technology consisting of no more than typing text into a window succeeds in providing enough context to make a variety of social exchanges vivid, pleasurable, capable of conveying humour and emotional nuance.*

Of particular interest to us is what Nardi et al. characterise as 'outeraction', where text messaging does more than support rapid informal communication but also facilitates practices that make communication possible. Such practices include negotiating the availability of others for conversation (e.g. "Please phone the house when you are able"). Such negotiation requires some sensitivity towards the work and pace of work of others and involves recognizing appropriate and inappropriate times to contact others, appropriate modes of interruption, and so on. Texting allows people to address the kind of issues on which communication turns in that it is less obviously 'in your face' than some other forms of communication. It permits delayed response or easy acknowledgement (pressing the acknowledgement button), for example, and at the same time facilitates multi-tasking, allowing workers to monitor texts whilst engaged in other jobs. The logs suggest that texting in the hostel allows workers to negotiate their availability and maintain their connection with the rest of the staff. Knowing who is around, what people are doing at weekends or during sleepovers at the main hostel, for example, enables workers to establish and project a range of possible interactions, much as the door displays at the university allow people to project appropriate course of action in response to messages left by staff. Texting, in other words, enables users to *plan* joint activities as much as it enables their coordination.

5. CONCLUDING REMARKS

In this paper we have commented on some of the technical difficulties we have faced in our deployment and use of 'technology probes' as an attempt to log activity and use of two SMS applications.

From a technical perspective we have certainly found that managing and maintaining the logging functions of both the Hermes and SPAM systems has raised some unexpected challenges. We have certainly learnt that appropriate support for logging needs to be considered at design time given the potential implications that appropriate support for logging can have on system design. For example, with both the Hermes and SPAM

systems the adopted network infrastructure limits the flexibility with which logs can be maintained.

We believe that the experiences we have had with the logging aspects associated with Hermes and SPAM would generalise significantly with that of other systems in the loosely defined ubicomp domain. In more detail, we believe that logging tools need to be developed to support remote monitoring and/or capturing of logs from different (but related) sources that are potentially producing data 24/7. Clearly, we need to look to the solutions that have been found in domains such as safely critical control systems to provide us with insights, e.g. the need to develop special 'watcher' processes to monitor the correct functioning of the logging function by detecting and warn of potential problems, e.g. approaching storage limits.

One requirement that is perhaps more peculiar to ubicomp systems (given the potential range and number of sources of logging information) is the need to consider the design of appropriate tools to support the amalgamation of separate logs and the need to support human augmentation (e.g. categorising data in the logs) of these logs, we have found this latter requirement to be a key requirement for analysing usage patterns from both Hermes and SPAM. Supporting an automated categorisation process certainly poses an interesting AI challenge.

For the social scientists on the project the logs provided a valued and worthwhile resource that supplemented existing social research techniques. The value of the logs resides in providing a record of and thereby facilitating our understanding social action and the members' standpoint in real time. The logs produced by the technology probes sustain the distinctiveness of our ethnomethodological approach to understanding social action and its insistence upon a conception of social action in real time. Of course, this may seem, and probably is, no more than common sense to those who are not sociologists. Because we are interested in understanding exactly how people carry out their activities the concern to consider their action in *'real time'* is similarly obvious. Our point is that sociological analyses often benefit from hindsight, they often know how things turned out and therefore whether something was (ultimately) a mistake, foolish wise, hopeless and so on. But people cannot know how their activities will turn out - whatever their intentions and best efforts accidents and mistakes sometimes occur - and these happen in real time. Consequently getting a better understanding of the actor's point of view - which is the essence of this approach to usability - requires the examination of the organisation of social action *over its course* - an activity promoted by the logs. This is a basic feature of our ethnomethodological investigations, regarding the social actor as a *practical doer*, needing to get things done. The logs tap into the fact that everyday activities possess an essentially temporal character; for lacking the benefit of hindsight the actor's point of view is always located as some *here and now* within any particular course of action. Even the idea that something is part of a course of action is integral to the *production* of the course of action itself. That is, determinations the actor makes *as part of the means of carrying out the action* as to 'where I am now'?, 'how much have I done?', 'is this course of action working out as I anticipated or do I need to adjust the prepared course', 'how much more is there left to do', 'how can I get from doing what I am doing now to doing what I need to do next?', 'what do I need to do next, exactly', etc. To the extent to which the logs reflect and document these kinds of processes we have found them invaluable. This is not to suggest that either getting or analysing the data is easy, for the data is *indexical* to the activities that generated it. Knowledge of those activities - obtained through our other researches - is brought to bear on analysis of the data and to make sense of it – to make it meaningful. In other words, the data depends for its adequacy on knowledge of the activities in which the technology is embedded and used. That knowledge is used to interpret the data but is *not contained within the data* [3]. Consequently where the measurement and assessment of the functional value of collaborative systems is concerned there remains a need to exercise caution and leave certain tasks to human skill and judgement.

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