



Augmented Digital Audio Broadcast Home Trial♦

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Hewlett Packard Laboratories, GWR (now GCAP), ASL, Panasonic Semiconductor and the University of Bristol are collaborating in a Mobile Bristol project to explore the potential of Digital Audio Broadcasting (DAB) through a series of user trials. Our iPAQ-based prototype allows listeners to GWR-Bristol FM to interact with a set of web pages broadcast alongside the digital audio stream and displayed on a small colour display via a wireless backchannel, for example to vote or buy a tune they hear on the radio. We conducted a field trial, where nine households used the radio for a week. We saw a consistent use throughout the period of the trial and the prototype seemed to be quickly integrated into people's lifestyles. For the participants, the DAB radio has value because the information, at a glance, comes to you, effortlessly as part of the broadcast, without having to spend time booting up a computer. An enhanced DAB radio will benefit the radio station by extending its brand, through branded free services, as well as offering commercial opportunities, such as selling music. Sometimes the relationship between the audio contents and the visual information is loose: people explore the plus pages as a separate activity often without the sound on, in particular in the evening. Other times it is tight, a listener hears a tune and then buys it. When the sound is off, a quick glance at the DLS screen might lead them to switching the audio on in order to hear a particular song. Vice versa, when listening to the radio a user might walk up to the screen to see who the artist is. Critical success factors for a successful product that incorporates an enhanced DAB relate to having a backchannel, good interface design, providing information at a glance, where the frequency of updating the information will be important to keep users interested. In our trials we benefited from a good quality and size screen that was always on, which attracted participants, even when the sound was turned off. It is unlikely that future products could match such an always-on, right size and quality screen. The popularity of Digital Multimedia Broadcast (DMB) implemented in mobile phones in Korea, might indicate that currently there are more opportunities in mobile rather than fixed radios.

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1. Introduction

The Digital Audio Broadcast (DAB, <http://www.worlddab.org/>, Eureka, 2004) standard has been adopted in a number of countries across the world, with the U.K. taking a leading role. Not only does DAB provide a better quality of (digital) audio reception, the broadcast is enhanced with strings of scrolling text (of up to 128 characters) that update every few seconds and which are displayed on the small screen of a DAB radio (figure 1). This so called Dynamic Label Service (DLS) is used to display for instance which show is on, which song is playing, what is coming up next etc.



Fig. 1: DAB radio with DLS display

It is also possible, via the Multimedia Object Transfer protocol (MOT), to ship richer data with a digital audio broadcast, such as image files or html pages. However these possibilities have not been explored yet by the industry or the research community. If there were such products that took advantage of the MOT protocol, then a DAB radio would need a bigger screen to display these richer data, requiring a big investment of the industry. Is there a compelling case to justify such an investment? Normally radio is listened to in the background of our daily activities. Why would people want to look at their radio? Moreover TV and Internet are readily available to receive rich data and provide interaction. Why would there be a need for yet another information channel?

In a collaboration between Hewlett Packard Laboratories, GWR-Bristol, Bristol University, the Appliance Studio and Panasonic Semiconductors (as part of the Mobile Bristol program, www.mobilebristol.com), we investigate the potential of enhanced DAB through a series of user trials. GWR owns 35 local radio stations across the U.K., amongst which, GWR-Bristol.

A previous study (De Bruine et al, 2004) in a laboratory setting using an iPAQ based prototype, explored the user value of augmenting Digital Audio Broadcast (DAB) with a set of HTML pages providing information on the weather, news, local events, films and music. In the study we asked them about their local radio listening habits, participants explored the handheld prototype and we gauged their reactions.

Local radio evokes a strong community feel and presenters are valued for their lightweight “chat and banter” about local people and places and up and coming local events. An enhanced DAB service such as the one we presented to the interviewees, seemed to provide value because the information would be available quicker and with less effort than using a computer; at a glance rather than through lengthy booting up. Local news, weather forecasts, event listings, and details of the last ten songs broadcast proved especially popular.

In addition interacting with a radio program, traditionally done by telephone accompanied by such barriers as phone queues and perceived relatively high costs, has the potential to be more immediate, provide feedback how others had interacted (e.g. in a vote) and would take place on the same appliance as the broadcast is received.

The results of the interview study suggest that there are opportunities for enhanced DAB in the home, where there are a great many radio appliances, and in the car. On the mobile appliances side, good candidates to incorporate enhanced DAB seem to be mobile phones, handheld computers and MP3 players as dedicated mobile radios are seldom used.



Fig 2: Fixed enhanced DAB radio prototype.

Here we report back on our next step, a field trial using a relatively robust prototype, a fixed radio in a home setting (figure 2). We anticipated that the audio broadcast would trigger the use of the visual interface, i.e. the extra information would be (at a glance) closely tied to the thread or narrative of the radio broadcast it accompanied.

2. Method

2.1. Prototype & Interaction

Figure 3 shows the layout of hardware components inside the radio's case: an iPAQ model 5450, a PCMCIA based DAB receiver, two good quality speakers, a power supply and power adaptors (Jeffries, 2005). The MOT decoding software library is provided by Panasonic Semiconductor. The iPAQ ran under the PocketPC2003 operating system. The software and hardware integration of the various components was written in C++. Interaction (buying tunes, voting, quizzes) was facilitated through a wireless connection (Lynksis Wireless-B Broadband Router, Model BEFW11S4) between iPAQ and participants' home broadband connected PC's.

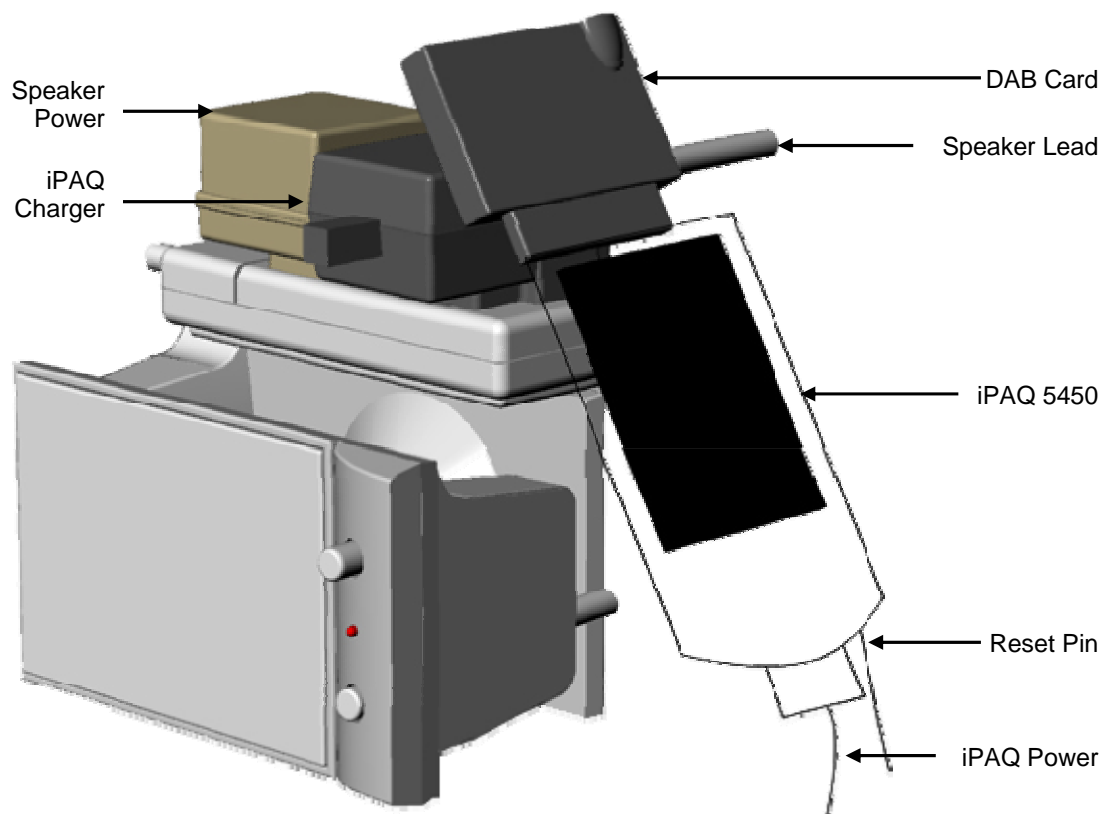
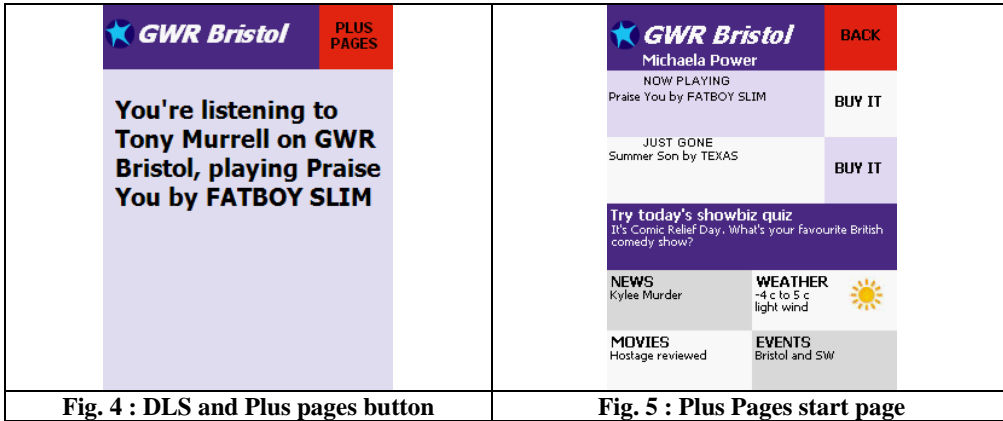


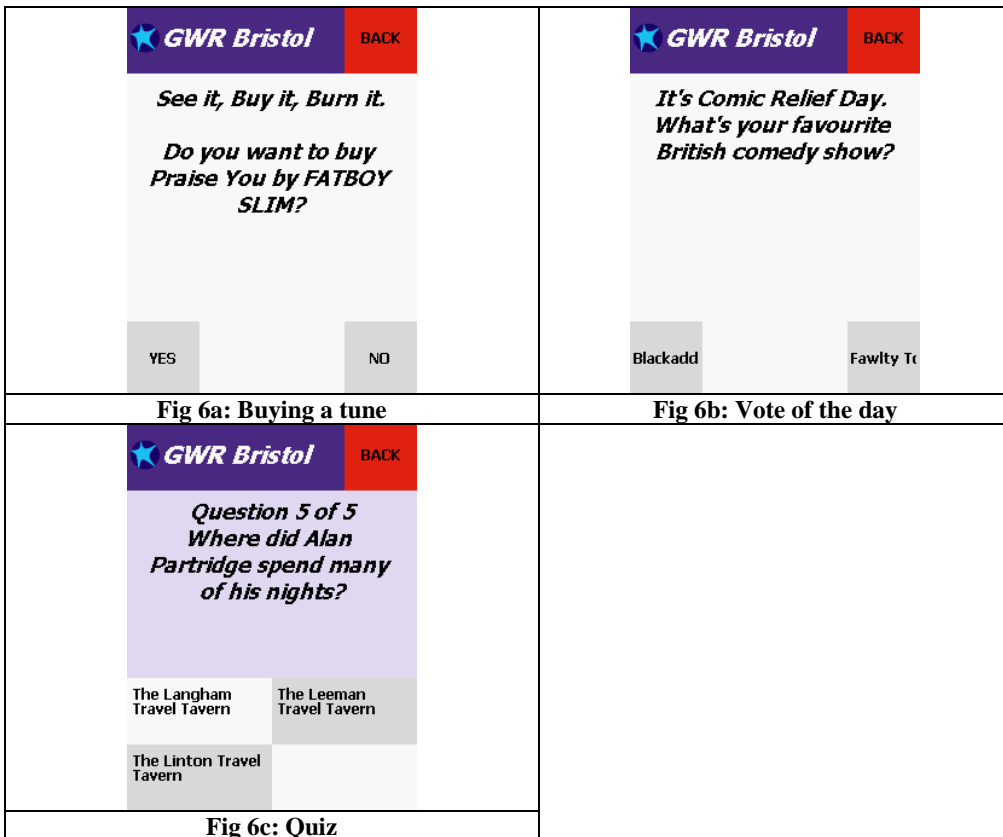
Figure 3: Inside the radio

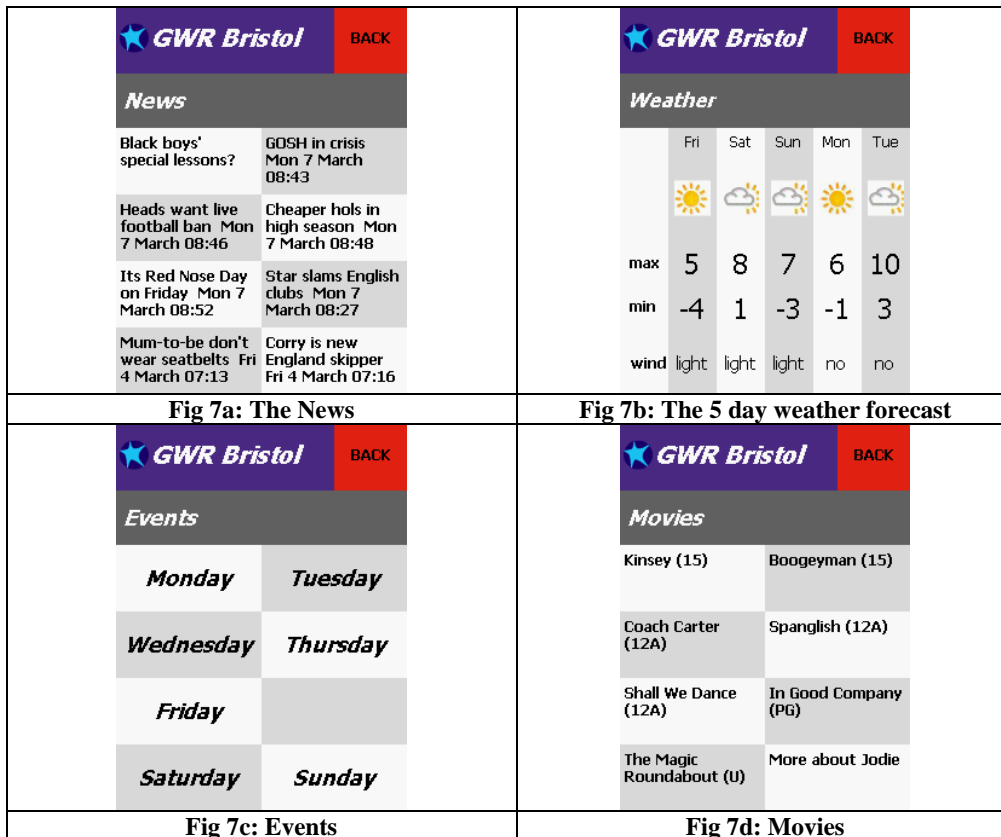
2.2. Services and Interface design

The prototype's initial screen displayed the DLS text in bold using a large font size (Figure 4). There was also the red "*plus pages*" button (top right, figure 4), which, once pressed, displayed the plus pages start page (Figure 5).



The plus-pages screen consisted of two main areas: [1] the interaction area (centre and top with purple tints), which offered options to buy a tune (figure 6a), cast the vote of the day (figure 6b) and take part in a quiz (figure 6c) and [2] the information area (bottom with shades of grey), where users could get the news (figure 7a), the five day weather forecast (figure 7b), listings of local events (figure 7c) and movies (figure 7d).





One of the central design goals was that the information would have a different look and feel as a web site. The information had to be contained in a limited collection of pages with a shallow, quickly accessible structure (at a glance) that was closely tied to the thread/narrative of the radio broadcast it accompanied. The expected user behaviour was the 'pearl fisher' model; users would be listening to the radio and would be able to quickly dive in, get a chunk of information and then dive out again.

The information was to come from the existing pool in the content management system that drove the web site. This excluded traffic information. Certain services that were used on the web-site could not be used on the DAB prototype radio because there was no keyboard input and alternative text input methods (such as the iPAQs on-screen keypad) were deemed to be too cumbersome to be used when interacting with a finger-tip rather than a stylus.

Effort was put into adapting some of the services to operate in a selective, rather than a descriptive manner. Thus instead of saying; 'key in a record to request' the system would say; 'these are the two songs that have just been played, select one if you want to buy it'. In this way the suite of services was eventually narrowed down to the following:

1. Track playing now, track just played (with the ability to buy the tracks)
2. News headlines and stories
3. Weather summary for today and the next five days
4. Movie reviews and pictures
5. Local events – a weekly listing
6. Current competitions and votes

The visual information was designed to consist of two parts: The DLS text page and the Plus-pages. The navigational paradigm was limited by the amount of screen estate that could be used for buttons. Also there were problems with the concept of HOME, it was not clear which page was home since the DLS screen could be considered as home as too could the home or start page of the plus pages. The time out function described below was coupled with a simple BACK button in a way that allowed the user access to the entire structure of the interaction just by making choices from the buttons available on screen and using the back button.

“Back” actually operated as an “up structure” function rather than as a true history-path back. Thus there were occasional times when the behaviour of the back button was not quite as expected. These instances involved interaction that, although required by the user, was not the usual path of interaction (for example stepping through a news story and then using the back button to go to the page you had just left). Back in this case as in all other cases simply moved you up the structure and put you at the overview page of news stories rather than the expected back-a-page in the news story.

The back button saved large amounts of screen space, making the interface simpler. The only cost was a sometimes slightly unexpected interaction caused by users assuming it was historical, similar to the back button on conventional web browsers. To be accurate the button should have been labelled “up structure” or have an upwards arrow (the Explorer in the Windows file system uses both back and up structure buttons). However this would immediately make the interface more complex as users would have to acknowledge and understand that there was an information structure.

One other limitation was that this arrangement meant that it was best to avoid cross-links as the back button didn't take you back along the route that you had just come in on but took you up the structure. Fortunately, the only place where such cross-links were considered was in the events section where the user could check the five day weather forecast for the day in question. With more time for implementation a better solution would be simply to combine the weather information into the “what's on” detail so that when viewing what was on for Wednesday the user could also see the small overview of what the weather would hold for the day. The button was placed in the top right of the screen for 3 reasons:

1. This was the same place as the plus pages buttons, thus reinforcing the idea that on pressing the plus pages button the users could easily get back to the DLS page. This was necessary because novice users could then easily get out of the service once they got into it and so would be encouraged to explore further.
2. The top left position was occupied by the radio channel identity (name and logo). This is conventional for the web and other digital media; that position is also the most visual and thus the best place for branding. Having both the back button and the branding in the top left corner would mean piling them up one on the other which would interfere greatly with the rest of the screen layout.
3. Having the back button on the right was counter to the normal expectation of web browsers where the back button was top left, going against the convention like this helped support the idea that the back button did not quite behave like the back button in web browsers.

The simplicity of the interface and the forgiving nature of it (good feedback for button presses, time out, location of back button upon entry etc.) meant that it was possible to have it operate without a help button, thus simplifying the interface even further. An effort was made to ensure that there was some content at every point in the interaction structure, thus the home page did not just say news, weather, etc but it actually had small sections of content at this level that was expanded upon as the user went deeper. The only part of the interaction where it was not possible to do this was the local events page where the user is just presented with a flat menu of days of the week.

Further restrictions then came into play due to the target size of buttons required to make selections. A rapid prototype of different sizes of button was constructed and a few subjects gave qualitative judgements on their use. Eventually a button size was chosen that fitted into a possible layout grid for the screen, if space permitted buttons were fitted in by making them twice the width of the standard button, and in some cases the height of the buttons were increased minimally where this could be done while still fitting into the overall layout grid.

Technical limitations meant that much of the button implementation had to be written in Flash. This led to some time delay issues when users had pressed buttons. This delay coupled with the lack of tactile feedback meant that users sometimes were unsure that they had pressed the button. Therefore an exaggerated visual feedback was built into the buttons and triggered on first touch so that the button changed and remained on yellow while the necessary content was being loaded.



After selecting “News” for example, smaller and longer text was shown (figure 8). The design decisions for long texts were based on the fact that since the user had navigated to them they probably wanted to read them and so would be willing to work with smaller fonts than in the rest of the interface. Various forms of scrolling were tried but in order to make a scroll bar functional it would have to occupy a substantial proportion of the width of the page which lowered the number of words per line making the text more difficult to read. Next and previous arrow buttons would also render the bottom part of the screen unusable and so an unconventional approach was taken of having the user click on the screen to navigate to the next screen. As this was unconventional it was accompanied by an onscreen instruction to this effect at the bottom of the screen; this took up only a thin line of screen space and thus was preferable over the scroll bar or the previous and next buttons.

The interactions were expected to be short and quick. Users would get to the item of information that they wanted and then stop the interaction. Each time they initiated the interaction it was assumed that they would want to start at the beginning and not at the point where they left off. Furthermore, in between such interactions they would probably want to see the DLS text which is dynamic and legible from a distance, and not the last page that they happened to be looking at. To solve this, a ‘time-out’ was built into the interaction. If the user didn't interact in any way for a certain length of time then the system reverted to displaying the DLS text.

The visual design of the interface was restricted by the size of the buttons and the legibility of text that would fit in these buttons. The visual language was drawn up with attention to the context it would operate in, in particular the exterior housing of the unit and the house style colours associated with the radio stations visual identity. As well as the colours it would have been nice to use some of the visual geometry of the unit, in particular the large front oval and the row of small circular holes on the side of the casing, but the lack of space and the fact these were all circular shapes made this approach inhibitive.

2.3. Participants

Prototypes were placed for one week in a total of nine households. For each household there was one responsible person (7 females and 2 males) who was interviewed at the end of the trial. Five interviewees (in red in table 1) had taken part in the first study and were acquainted with what the prototype had to offer. Table 1 also shows where in the house the prototype was placed.

H# & Gender	Household	Place
H1 Male	Five males in shared household	Kitchen on top of the beer fridge
H2 Female	Single female	Living room next to TV
H3 Male	Couple	Living room
H4 Female	Couple with new baby	Living room
H5 Female	Couple	Living room close to TV
H6 Female	Family with baby	Living room
H7 Female	Female living at home (parents and five children)	Bed room
H8 Female	Two females in shared household	Living room
H9 Female	Female living with parents	In study next to computer

Table 1: Details of participating households

However, the trial in household 4 (H4) suffered from technical problems and the data were not suitable to be implemented in the analysis.

2.4. Diary forms and Interviews

At the end of the trial either on the sixth or seventh day (and in one case the ninth day), participants took part in a recorded interview about how, where, what for and when they “used” the prototype, what their likes, dislikes and wishes were (Appendix 1). The interviews were relatively short, seldom longer than 30 minutes and were later transcribed.

We also asked people to fill out a very short questionnaire (Appendix 2) at the end of each day, consisting of graphic rating scales (Stone et al 1974) and a space to enter written comments. This did not take more than 2 minutes per day.

2.5 Log files

For each household a number of date and time stamped “events” were logged onto the iPAQ. These events included when the plus pages were accessed, the selection of the movies, weather, news and events (what’s on) pages, as well as the interactive services: competitions (daily vote, quiz) and buying tunes.

From this information, we could establish the frequencies, duration and the days and times of the selected “plus” pages. In the example above (table 2) for household 5, on Friday 4th March, the “weather” was selected at 10:57:43 and after that the “Back” button (registered as #plus) was pressed at 10:57:58 making this short interaction last 15 seconds.

Date	Time	Event
04/03/2005	10:51:54	file:///PERMANENT/___dlstext.html
04/03/2005	10:56:00	file:///MOT/DAB/index.htm
04/03/2005	10:57:43	file:///MOT/DAB/#weather
04/03/2005	10:57:58	file:///MOT/DAB/#plus

Table 2: Short fragment of logged events

2.6. Procedure

The installation of the prototype in each household was usually carried out by one or two people of the research team. This was also the time to explain to a participant how the radio worked and how it could be reset in case of malfunctioning. People were shown the DLS screen, the plus pages and how to access the information, how to vote or take part in a quiz. The buying procedure was slightly more complicated as it involved users to sit down at their PC after they had bought a tune on the prototype, requiring them to log in into GWR’s website and download the tune to their PC’s. People were given a credit of 11 pounds which would enable them to buy up to eight tunes. They were also asked to keep the radio (with the sound off if required) and their PC as well as their wireless system powered on at all times.

2.7. Statistical techniques: ANOVA and p-value

In this report you will find the term Analysis of Variance, commonly abbreviated as ANOVA. The statistic associated with ANOVA is the F-ratio, accompanied by degrees of freedom. There are several flavours of ANOVA. However, it is not essential to understand the ins and outs of these, except that for ANOVA (as well as for most other statistical techniques) the statistical significance is given by its probability, its p-value. For instance, we found the results of one ANOVA to be: $F_{(1,116)} = 6.2$, $p = .014$. The p-value indicates that this result could have come about purely by chance in 14 out of 1000 cases. If $p > .05$ then the result is non significant (n.s.) and the smaller p gets, the more significant the result is.

3. Results

In the results we will first report on the analysis of the log files (section 3.1) and the diaries forms (section 3.2.). In the process we hint at some of the conclusions we drew from these analyses. The third section (3.3) where we analyse the interviews will then throw more light on these preliminary conclusions.

3.1. Log files analysis

Below, in figure 9, we show how for household 5 we derived a time line across eight days, from Friday to Friday, with the various categories of interactions - buy, movies, news, weather, events and competition – per day and per time of day. The height of the bars indicates the duration of the interaction in seconds. However, since there was a “timing-out” mechanism (as described above in the interaction-design rationale) such that after three minutes the display reverted to the DLS text, it was not always clear how long the actual interactions lasted.

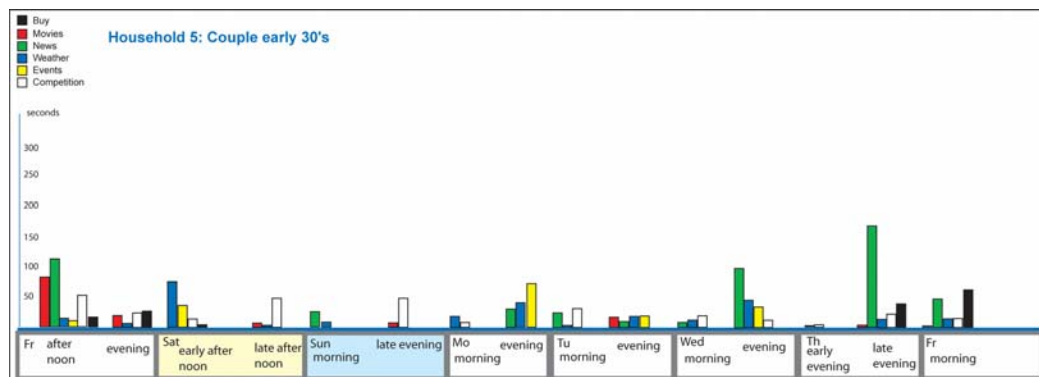


Fig. 9: Use of prototype across a week for household 5

From this example (typical for the rest of the group), it is clear that the use of the prototype across the week is constant. This in itself is an important finding as in field trials there is always the possibility of a drop off in usage after the initial novelty effect has worn off. For most weekdays there is usage in the mornings and in the evenings.

After some experimentation, we decided that the most meaningful analysis would focus on the frequency (rather than the duration) of the selected plus-pages and the time of day when this took place. In addition, participating households had the prototype radio across a varying number of days (between 6 and 9 days), which prompted the decision to calculate the mean number of times per day that a certain page/service was accessed. So, for each item (weather, buying etc.) we calculated the mean number of times per day and we divided the day into: morning (6am-9am), day (9am – 5pm) and evening (5pm-9am).

From the interviews we know that plus-pages were selected by different members of a household or by visitors. In one household the main participant worked a night shift and another consisted of a number of young people, of whom some were active during the late evening. This all affected the times of day when the plus pages were accessed.

3.1.1. Plus pages

Since one log file was partly corrupted, the log files of eight households were analysed. On average individual sessions were short, mostly around 2 or 3 minutes (probably shorter given the time out mechanism, we mentioned above) and the usage across the week (across the group) remained constant, although some used it less over the weekend.

Service	Mean	S.D.
Weather	1.7424	1.51
News	1.7406	1.03
Competition	1.64	1.14
Events	0.75	0.45
Movies	0.63	0.46
Buy	0.49	0.42

Table 3: Mean frequency of services selected per day

Table 3 and figure 10, show (for these eight households) the mean number of times per day that an item or service was selected, across the week of a trial, and accompanying standard deviations (S.D.). Thus weather, news and competition were selected most and events, movies and buying tunes least.

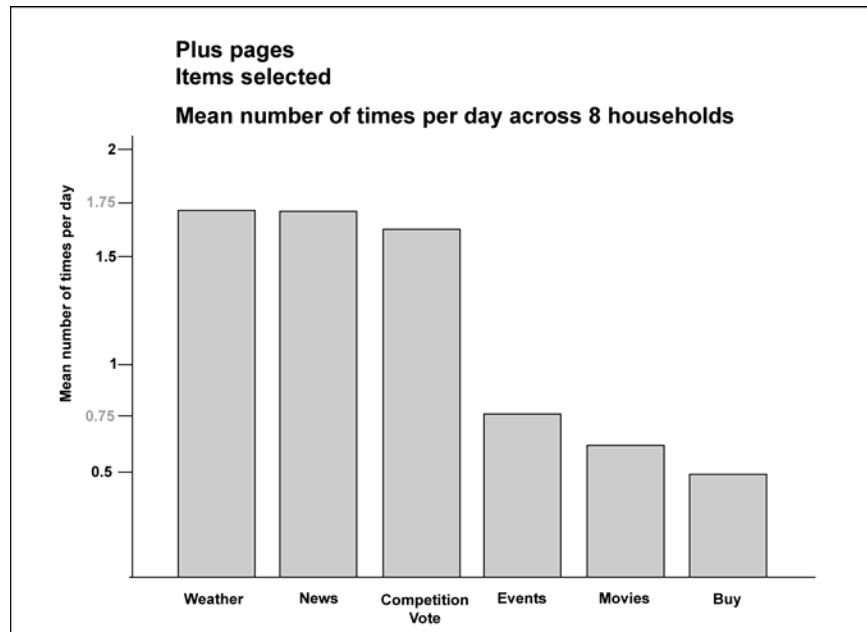


Fig. 10: Mean frequency of services selected

To quantify the level of differences, its significance, between all the services, we conducted an analysis of variance (ANOVA), which was highly significant: $F_{(5,25)} = 6.297$, $p = .001$. Although this is a strong indication that there *are* differences, it does not tell us much about *which* services differed. To shed light on this we conducted ANOVAS between all the possible pairs of services.

Table 4 shows how significantly pairs of services differed. Thus the statistical difference between Movies and News was highly significant ($p = .005$), whereas the difference between Movies and Events was non significant (n.s.). In simple terms

when inspecting figure 10, it is clear that there are two groups of items: the group consisting of weather, news and competition/vote has been accessed significantly more frequently than the group consisting of Events, Movies and Buying. A close inspection of table 4 highlights that the difference between Weather and Events does not quite reach significance ($p = .064$), partly due to the relatively larger standard deviation for weather.

	Weather	News	Competition	Events	Movies
News	n.s.				
Competition	n.s.	n.s.			
Events	0.064	0.019	0.037		
Movies	0.043	0.005	0.012	n.s.	
Buy	0.038	0.019	0.029	n.s.	n.s.

**Table 4: Paired comparisons between services.
Significant p-values are in bold.**

The difference could have something to do with News, Weather and Voting changing more frequently, whereas Events and Movies by and large remained the same across a week, not necessitating frequent inspection. To paraphrase: The urge to glance benefits from frequent changes. However it might also be that Weather and News were considered to be more important than Events and Movies, or, looking for Events and Movies might be better suited to an internet activity, something you take your time for rather than glancing. Whatever the case, there is strong evidence here that voting activities are strongly benefiting from the interactive DAB radio.

Buying tunes was not done by some (see interviews in section 3.3.) as it was seen as cumbersome and was more susceptible to technology failures.

3.1.2. Time of day

The plus pages were accessed more in the evening than in the morning (table 5 and figure 11), with day time access taking an intermediary position, but the differences did not reach significance (due to a relatively large standard deviation for “evening”).

Time of Day	Mean	S.D.
Evening	1.28	1.25
Day	0.72	0.39
Morning	0.51	0.39

Table 5: Mean frequency of time of day access

We had expected a fairly close coupling between the audio broadcast and the visual information, in particular during the breakfast show, e.g. the daily vote, quiz, but as will become clear from the interviews, this was not always the case and in the evening the Plus pages were accessed more, as a separate activity from listening to the radio.

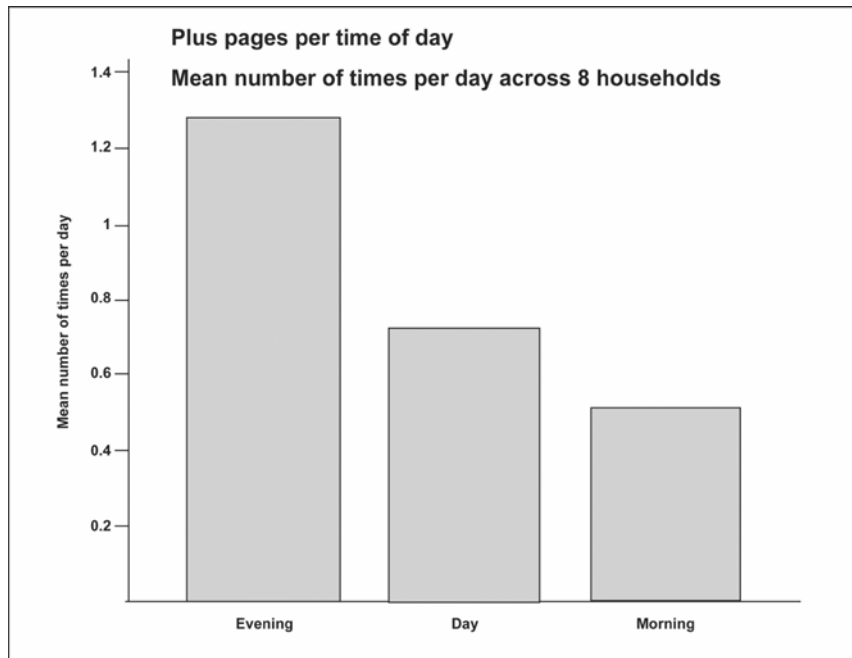


Fig. 11: Accessing Plus pages per time of day

3.2. Diary forms analysis

The analysis of the diary forms questionnaire yielded interesting results. We evaluated a six day period as on the seventh day most people returned the radio. In the shared households more than one person kept a diary. As a result we analysed 11 diary forms.

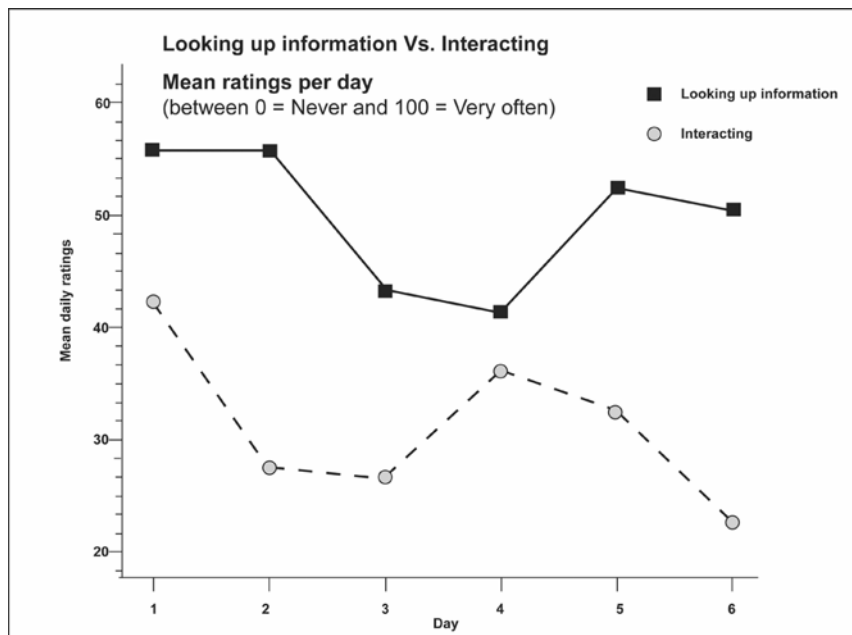


Fig. 12: Looking up information Vs. Interacting

Participants were asked to mark on a 100 mm graphic rating scale (between never = 0 and very often = 100) how much they used the prototype for looking up information

on the 'GWR mini-web' and how much for interaction with GWR. People reported significantly more looking up of information than interacting with the radio station across the six days: $F_{(1,7)} = 35.7$, $p = .001$ (see figure 12). There were no significant differences between days.

This is in concordance with the log-file analysis (figure 10) where weather, news as well as voting were selected most, i.e. two information services vs. one interaction service. We could also speculate that it is an indication that interacting was quick, quicker than checking out the weather and the news; a positive result.

Participants were asked: "Did you use the prototype to look up information you would otherwise have looked up on teletext, the internet or the newspaper?"

ANOVA (Repeated Measures) across all six days yielded an unexpectedly significant "day" effect for how participants rated this question: $F_{(5,35)} = 2.8$, $p = .03$. Figure 13 shows a consistent lowering of the (mean) ratings. ANOVA comparing the first and the sixth day was even more significant: $F_{(1,10)} = 17$, $p = .002$. So, by the end of the trial and day by day in its progress(ion) people judged that they used the radio less and less to look up information that they would normally get elsewhere.

This could indicate that people used the radio less and less, i.e. the novelty value had quickly worn off. However the log files revealed a consistent usage, short sessions in the morning and again in the evening. In addition, in their interviews there were no indications of a lessened enthusiasm or of a slowly declining interest.

As we observe consistent usage coupled to positive feedback, there is a suggestion that DAB services such as the ones we incorporated in the field trial quickly become part of people's sets of daily behaviours, activities, in other words it becomes integrated into people's lifestyles. They no longer look up the five day weather forecast on the internet, or cast the vote of the day on the GWR website, but use the radio instead.

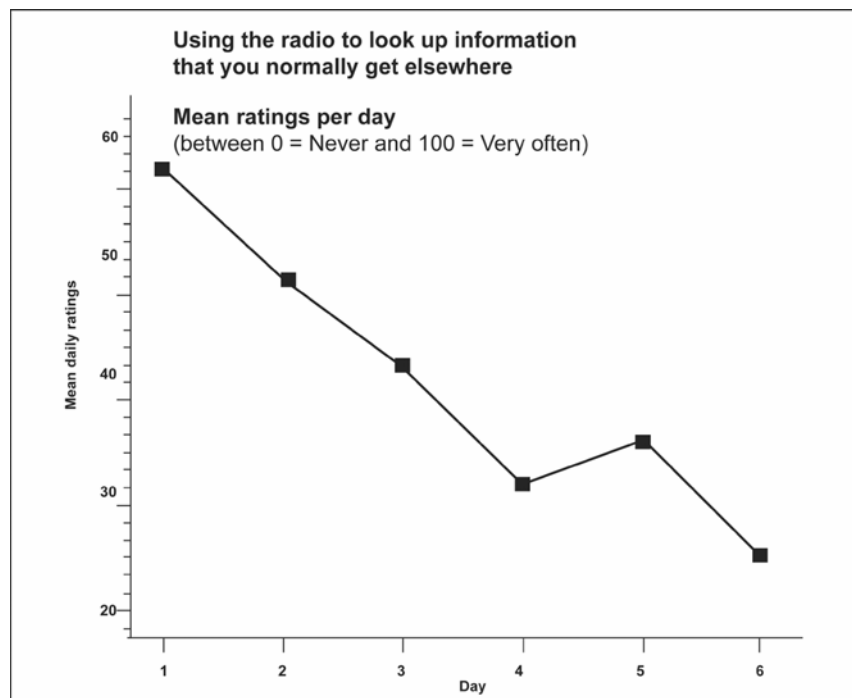


Fig. 13: The radio coming into its own

3.3. Interviews

In this section we present the results of the interview analysis.

3.3.1. Where

The prototype radio was in a variety of places, although mainly in the living room; in the same room as the TV and HiFi and, in two households, right next to the TV (table 1). This was, however, not necessarily the preferred place:

H2: *“It was in the lounge because it was the only place I could put it at the moment because my house is upside down.”*

H5: *“I had that down in the living room, because of the size of it whereas it had been smaller I would have had it in the bedroom. Yeah, in the corner of the room, I’d prefer to have it in the bedroom.”*

In household 3 the radio was originally in the living room but was moved to the kitchen dining room:

H3: [So you moved it to the kitchen] *“Because we’re either cooking or eating in the dining room, especially in the mornings. We come down for breakfast and probably eat breakfast standing up rather than in the living room, so, it’s not a relaxing morning, normally, so we just moved it into the kitchen which is where we spend quite a bit of our time.-- What I found I ended up doing was coming down for breakfast and I would eat breakfast while looking at different things.”*

In household 1, a shared house, the rather large kitchen, in which residents and visitors congregated at all times of day and night, featured two fridges; the prototype radio was on top of the “beer” fridge:

H1: *“The kitchen is a good place, because people don’t necessarily do any other media, they don’t watch the television. I spend quite a lot of time in the kitchen. I’m quite happy to chill out in the kitchen as I would in the lounge.”*

3.3.2. Ease of use

The prototype was easy to use. The information was available literally at their fingertips and it didn’t take long before all or most of the information was scanned. Participants commented how not having to boot up a computer and then go to the Internet was a major advantage. In addition visitors, friends and family that saw the prototype were taken by its simplicity.

H5: [How was it?] *“Easy to use. As a concept I like the idea of being able of getting the information quickly without log on to the internet or switching the TV on or anything like that. ‘t didn’t take long to look at all the information that was there.”*

H7: *“It was a very enjoyable experience being able just to fiddle around and everybody I showed it to first commented on the simplicity of it and my Mum hates technology, doesn’t want a mobile phone, doesn’t use computers. She was sat there for about twenty, twenty five minutes fiddling around with it, and even she said, No,*

I'll get one of them. So it was quite amazing how someone who is a complete technophobe was the one to interact with it like that."

H8: *"She [her flatmate] liked it more than I did. 'Cos it is easy to use and she is not very educated. It's very easy to use, extremely, a two year old can use it."*

Prototypes, inevitably, have teething troubles which participants have to deal with and since our recruits were mostly non-technical, ordinary Bristolians, there was the risk that the radio would not be used because it did not perform well. However, people were competent in resetting the prototype, confirming the ease of use:

H2: *"I found it really easy to use; I was a bit worried about that. I thought you might need to be technical. ---- It was playing up yesterday, so I reset it twice. But for the rest of the week it was working fine. I think everybody should be able to use it, it was pretty straightforward, I had no problems with it all. I thought it was really good."*

3.3.3. Irresistible to glance at and then explore

The fact that it was easy and quick to use, probably led to participants having a quick glance every now and then in between their daily activities, even when the TV was on or as they sat at their computer with their internet browser running.

H2: *"It was quite funny because if I was sat watching TV or something, every now and then I would glance at it sometimes to see what was playing. Sometimes it would a song I liked and I quickly listened to that. You can't help glancing, to check out, because you know it is kind of updating all the time. Quite good to keep track of things."*

H3: *"It would catch your eye when you walked into the room. I was surprised because having that on all the time; it did focus your attention to it. I don't know whether that will wear off."*

H5: *"I have to admit, I sat there just watching telly, I don't realise how much you do glance around and think oooh"*

H7: *"I didn't realise how much I look at the DLS screen to see, what was coming up next, and things like that, and sometimes I found myself watching it to see what artist it would be, like next, so, eh, I really enjoyed it."*

The occasional quick glance at the DLS led them to invoking the plus pages.

H5: *"[DLS, did you look at that?] I must admit for glancing over and then straight onto the [plus] pages. I thought, oh, have a quick look, see what's playing or just go and see what there is, in particularly having the added bonus of having the money to buy it."*

H6: *"I just used it mostly for interacting with the screen, rather than listening to it, so most of the time the volume's been turned down."*

H9: *"Because of where it was, it would catch my eye."*

Other times glancing at the DLS when the sound was turned off (something that happened regularly) an artist name would catch their eye and as a result they turned the sound up. This might sometimes lead to them buying (or attempting to buy) the tune. In other words glancing at the screen led them to the audio.

Although less frequent, the reverse also happened, they heard something on the radio and then wanted to know who the artist was and therefore they went over to the screen and checked who was playing.

H2: *“And it was funny, my friend came round and she was helping me decorate and I said; my God, is that so-and-so? Because we recognised the voice but it was like a cover of a song and we really didn’t think it was this person. And I went; hang on, and we can go and have a look. And we walked over and we checked it out and it was the person we thought it was. That was a really good example of that. Because I was convinced it was that person, she was convinced it wasn’t. And of course normally, when you are listening to the radio, you forget, that it might not be at the end of that song, it might be at the end of another two songs when they actually tell you who the artist was. By that time you’ve forgotten. So it’s quite good, it’s like instant confirmation of who that person is singing.”*

H6: *“If I was listening to the radio, and I didn’t recognize it, I would, eh, who’s that.”*

3.3.4. When

In addition to serendipity, participants also allocated particular times of day to spend with the prototype. Regularly this meant a brief check in the morning before going to work. In the evening, just after coming home from work, when they sat down with a cup of tea and had a slightly longer browse.

H9: *“Normally in the evening, because I was out during the day and I wouldn’t use it as much in the morning, [mornings] I’d have it on because of the weather”.*

H5: *“Probably between about six o’clock and seven o’clock, as soon as I got back from work, sat down and got myself a cup of tea. If it had been in the bedroom then it would have been in the morning.”*

H3: *“I definitely used it more in the evening than I did in the morning with two people getting up in the house you just don’t, you co-ordinate everything. If we spend fifteen minutes downstairs having breakfast that’s about as long as we have. I would eat breakfast while looking at different things, I tended to look at the news and maybe do the quiz if I had time. Generally I’d do that in the evening, because I would have more time in the evening.”*

H2: *“I have the radio on, normally when I get up, when I’m getting ready for work. And then when I come home from work, I normally have it on for a while, when I’m tidying up or when I’m cooking. Once I’m finished in the kitchen I listen to CDs or put the TV on. I think I would use the DAB radio the same. Coz it was really good. I used to put it on the morning and I didn’t always have time to go through the whole thing. I would quickly check the weather or the news, but then I normally really have a play with it when I got back from work. The first thing I would do was like, - oh, let’s go and check it out, see what’s on there. Look at the news and check out the competitions*

on the DAB thing; that was good. Normally I've got the radio on in the background anyway. It is normally short sections of time that I am listening, an hour here, an hour there. So it was normally just radio, music on in the background, and then when I had time, not so much in the morning, just like a quick look in the morning, just to check the weather, quickly see the news, but then when I got home from work, the first thing I do is switch the radio on. Because normally I listen to the radio in the car, so there is normally a song I'm listening to it. So I pull up on my drive, run in and switch on the radio and keep listening to it. And I kind of make a drink and I have a good look through; what's happened to the news today, what has changed since this morning and then check out the quiz, the competition, vote for whatever they were asking for. Different times of the day, depending on what I was using it for really."

The rush of the morning meant that they had to get the information, weather and news in particular, very quickly; the prototype proved very suitable to this kind of hasty information gathering.

H7: *"I always listen first thing in the morning, and round about tea-time-ish I was listening to it a lot when they got the drive time on it, especially if I was going out, keep an eye on it to see if something major was going on, ehm, but I would say mostly morning or in the early evening. The weather button that's the one I pressed in the morning mostly."*

For a mother of a young baby, for whom (sparse) free time was fragmented, there was no particular time of day when she would check out the radio. It was any time there was a gap. For another it was every time they boiled a kettle.

H6: *"No particular time of day, it's ehm, if A. [the baby] just gone down and I want a cup of tea and I want five minutes just for myself. My brother came by and it was like "what's that?". So, I went through it with him, no set time of day, just a gap in the day."*

H3: *"I know when I make a cup of coffee in the kitchen I switch the kettle on, it takes maybe a minute to boil, so just have a quick play around, and see what's going on, specially because we put it pretty much next to the kettle. When I tended to vote for the news story, that's the one I tended to do just waiting for the kettle to boil."*

3.3.5. Accessing Information

The news headlines were often scanned and, again, not having to go to the Internet was a major reason:

H9: *"I really liked, ehm, having the screen, being able to go to the news and weather and stuff, because, it was nice, there are things on there you can look at without ehm, you're going to the internet for, so that was really handy."*

However the absence of local news was noticed:

H6: *"I looked at the news everyday but I felt I wanted the news more like Evening Post news, there's lot like eh Michael Jackson stuff like worldwide stuff whereas I'd rather, if it were local stuff I'd look at it all the day."*

H8: *“And also, on eh, where it says local news, when we click on the local news, it gave us the national news, there was a little headline, but it did have eh, you know the murder that went on in Barton Hill, there was a bit on there, I wanted to read on that, so I clicked in, but then it gave me like, eh, all the choices like, the FA cup, and eh the Shipman, you know, that’s an example now today. So it wasn’t actually giving me what I wanted and because it is GWR Bristol, I want the local news.”*

The value of having the local five day weather forecast has been discussed extensively in our previous report. The log files analysis confirmed the value of being able to frequently access the weather forecast and in the interviews this was confirmed again.

H1: *“I used it to check the weather a few times, especially because there is a real cold spell at the moment, it was interesting to see what it was going to be like.”*

H3: *“Because it was so cold these last few days, it was interesting to see, oh yeah, it’s going to be minus seven.”*

H7: *“The weather button that’s the one I pressed in the morning mostly, what shall I wear today, what’s the weather going to be [laughs].”*

H8’s Flatmate: *“And actually Friday I was on my own, and I am afraid of technology, and am I going to break this, touching the screen, and I was oh, oh, and I didn’t have a step by step instruction, and it was so easy, for somebody like me, to use. I’ve just looked at this and I made up those. It came in handy because [she manages a crèche] it’ll be raining today, so you can’t have the garden open.”*

The log files show that the movies page was visited less often, but all the same:

H2: *“It did have reviews on films on it, that was quite good”*

H6: *“Only a couple of times, and I did that, not to see what’s on, at the movies, but because one of the kids went to see one and I thought, I wanted to see what they write about that, and that’s eh, what’s his name, eh, Samuel Jackson’s film, where he is a coach, so I did that.”*

H8: *“The thing that I liked actually, that it had film reviews on and there was much more variety on there than you get in the papers. That was interesting. It was good to have a more detailed write up.”*

The “what’s on” pages, after an initial look, weren’t visited as often, mostly because they didn’t update that frequently and did not always cover the kind of information that participants were interested in:

H2: *“I did look at the what’s on, but it didn’t have – the information on there wasn’t that clear on the event section. That could have been a bit better. But it is a good idea though. It would have been if they would have listed local bands and things like that playing. That’s what I thought when I got into it, that’s what I thought it was going to*

be. Friday night The Fiddlers and dadida playing and stuff. It might be good to have different sections.”

H5: [events page] *“I’m not convinced I’d do that via the radio. [What do you do at the moment?] Hear-say, a lot of it.”*

For two participants however the “what’s on” proved to be a valuable feature:

H6 *“The most thing I did with it, was to look at the what’s on. Because the what’s on stuff is really good. There’s lots to do with stuff for kids to do for him [baby]. Things like, to go down to the pottery centre, design eh, putting templates on the plates and then painting it and stuff like that and like café’s to go to, which I thought was absolutely brilliant, so I looked at that every day. I shall really miss it, the “what’s on”, I tell you that much.”*

H8’s Flatmate: *“Just the fact that you could go in if you’re stuck for something, because we personally don’t have a paper every night. Because I can’t use the computer, I can’t use the teletext, I don’t buy the Evening Post, that [events] --- everything was there, for me personally, it did the job.”*

3.3.6. Instead of internet

What we suspected, as a result of analysing the diary forms, became clear in the interviews: The prototype was used regularly instead of the internet, even in the case of where the radio was next to the computer. In previous sections this was already mentioned but here we look at this issue in a bit more detail. The first quote (H1) is interesting as it starts out with the realisation that all this sort of information is readily available elsewhere and then goes on to confirm the value of not having to go to the internet:

H1: *“I didn’t look at it a lot. When the radio was on and I have access to a computer at home and at work, it is not, there is nothing on there that I don’t already know. --- I might quickly check news headlines, you don’t have to sit behind your computer and it’s scaled down.--- It’ll be quite easy just to find general information without having to go online or the telly or something like that. It is instant.”*

H2: *“I normally check the weather online, but I could quickly check it on there, it’s a lot quicker, so I don’t have to. Normally I look at it at work. The weather was good, quick and easy.”*

H6: *“What it is, because the PC is at the top of the house, that always puts me off, because it is a long way to go, I would much rather go to this [prototype], because with the internet you always need to log in, and find whatever station you want to log on, whereas with that it’s already localised, I would much prefer to use that, than put the PC on.”*

H7: *“Ehm, Yes, I find myself not looking at the GWR website this past week, because if I want to take part in the daily quiz I can do that on the radio, and the music I wanted to know about, artists and that, came up, and also the news and the weather, and also it had events on there, so I find myself not needing to look on the net, if they*

mention something on the radio and it was then coming up on the screen anyway on the plus pages, so I didn't feel the need to actually look on the website this week."

H9: [So even though you were sat at the computer and you had the internet] *"Nah, I still clicked on the weather and news and stuff like that, I found that really handy, because it is so quick, it's ten seconds, not even that, a couple of seconds. It is, anyone can go in, and tap around in it."*

Someone else compared it to a magazine rather than something instead of the internet:

H3: *"It was much more like a magazine than the internet."*

For one person's flatmate it was an opportunity to access internet-like information:

H8's flatmate: *"She [H8] is used to the internet and teletext, I'm not that bright. So literally, just to press the button, was lovely, I probably have used it a lot more than you have, really, cos I'm up in the morning."* [K. works night shifts].

Sometimes people do want a bit of extra information, such as a breakdown of the weather, in addition a lack of update is damaging for such an enhanced DAB radio service:

H5: *"Particularly for the weather that was instead of. I normally go to the BBC website where you can then break it down, that's the only thing I really missed. The extra breakdown. And "News" I used more but the only thing I noticed the news didn't seem to update very regularly. That was the main reason perhaps I would still watch it on telly. But I could definitely use the news on there instead, if it was up to date, had the main stories."*

H3: *"There wasn't any information on there which wasn't there in the evening either so I didn't actually find any difference doing it in the morning or in the evening. There was a number of days as well when there was no information updated."*

There was one participant however who said, because she had the Internet on all day, i.e. it was booted up already and fully available:

H8: *"It seems too little too late, because, I don't know, you can get everything on there that you can get on the internet. The internet is in your house anyway. It's on the TV."*

3.3.7. Interaction

Voting and Quizzes.

Most people enjoyed taking part in the daily vote and quizzes, perceiving it also as easier and cheaper than phoning or texting, although the vote update wasn't always that smooth and some suspected that they would eventually get bored with it. However, participants recalled very well what the votes of that week were, which could be considered as a measure of lifestyle integration of this particular feature.

H1: *“And a couple of times you could enter a couple of mini-quizzes. Not that you could win anything. That was a laugh, enjoyable”*

H5: *“Yeah, I used that, not convinced that’s something I would, it was nice to have but I probably get bored of it. I do remember, oh, who do you think would win the Eurovision song contest, that was over the weekend, yeah, about teaching eh, black boys in a different class, things like that, and the one got stuck on for the last two days, do mothers get enough help from the government.”*

H6: *“There was a vote about whether black people, eh, black kids should be taught separately and I voted on that with a massive NO! Absolutely not. Who came up with that?”*

H8’s flatmate: *“I did that one, the things they said on abortion, I voted for those. It was easy just to press the button.”*

H9: *“The daily vote I did, the daily quiz I got it wrong pretty much every time”*

Some also indicated how the ease of pressing a button to vote lowered their interaction barrier:

H2: *“Yeah, I think it did, it made it a lot more interesting instead of just the radio. Definitely more with the interaction, putting in your vote, entering a competition. I would have never, I don’t think I ever phone up to do that, it’s probably too much hassle. I might have done it online, but I’d have to go into the web site and search. --- Cost is probably an issue as well. These phone lines can be quite expensive. Definitely easier. And cheaper. Yeah, I think it has a lot of potential. All that kind of entertainment thing would be really good. If they at least have local bands – that kind of events information. If they have local bands playing and you can reserve tickets for them, that would be really good. [touch screen to enter this/win this] Yeah, I think you get a lot more people doing that because it is so easy. The fact that you could just go in and quickly do a competition. I think you get a lot more people racing to the radio rather than to the phone.”*

Two participants commented how the coupling between radio broadcast (in the car) and his subsequent action of voting upon returning home was sometimes tight. They also realised that going to the website or sending off a text message would pose too much of a barrier:

H3: *“The two that I used most often would be the news stories and the quiz. I pretty much did that every day. One of the voting buttons, I think they actually mentioned it on one of the days, when I was driving home, I think it was whether Michael Jackson would have a fair trial and I thought ooh I could vote on that one. And I came home and so that was quite good. If I had to come home turn on the computer to go the website I probably wouldn’t bother. Most of the time with the text message options I forget the number.”*

H8’s flatmate: *“It was nice to go in, they were having a discussion and they right yeah, the vote is and sort of, and I wouldn’t necessarily stand and ring up on the phone.”*

We also asked whether they would vote for a song to be played (again). Reactions were mixed and with cost in mind:

H2: *“Voting for the play list would be a good idea. I know you can phone on certain shows, and then it’s like the top 10 or top 5 to vote on it. It would be really useful if you could do that on there as well. Instead of having to phone up and say your favourite song, you just go in and pick out from a list of however many they can fit on there. And it can change with each show. So you know, they are listing what show this is and what shows comes up next, you know what song you want to hear, when. Yeah, like the vote. How was it today, good or bad.”*

H5: *“If it was going to cost me then I wouldn’t, I’m not that sort of ---, if it was free, possibly.”*

People did not always realise that you couldn’t take part in competitions via the interface of the prototype, but at the same time they were aware that to win ten thousand pounds might require paying for the interaction, should this be available. Ten pence per interaction was seen by one as acceptable, whereas another remarked that the ease of interacting would lead to temptation:

H5: *“I might enter if there was something to win at the end of it. I’d do it if it was ten P or something but not if it was much more.”*

H9: *“I went on to the fifteen thousand pound cash thing I thought you could enter it but you can’t, can you --- [would you have liked to?] If it was so that you didn’t have to pay for it, see what I mean, because it is touch screen, because the temptation is there to keep on going into it.”*

Buying a tune.

Buying a tune regularly resulted in successful downloads:

H1: *“Buying tunes was a doddle. You just heard it playing on the radio, and it said now playing or just played or about to play and you could buy any tune that flashed up ‘buy now’ and you pressed buy now, are you sure you want to buy this, yes or no, click yes. Congratulations and you have bought it, go to the web site and pick it up.”*

H5: *“I think I managed to get up to about eight. The only thing I managed to do was buy the same song twice. I think I must have been impatient. The screen, I must have pressed it too many times.”*

As well as some unsuccessful ones:

H7: *“Ehm, I downloaded another song, it was quite funny, because I wasn’t sure of the song, and I didn’t quite know whether I’d wanna buy it. That was really a convenient way in which I could buy it while at home, but the majority of the songs I couldn’t buy [laughs] always the way.”*

There were also other problems with buying a tune (other than the lack of update inhibiting a buying opportunity), so although the actual frequency of buying was much (and significantly) lower down than voting and taking part in the quiz, subjects would have liked to be able to buy. There were technical problems with buying. In addition, having to log onto the computer and accessing the website was a barrier. Three participants resolved this by going straight to the Buy-it-burn-it website on their computers and spend their credit in that way, with less effort.

H8: [Did you download tunes?] *“I actually done it on the internet because I really didn’t want and wait for something to come on that I wanted. Cos you could be here all day, you know, I got a particular musical taste, and I like more of the eighties, early nineties.”*

H3: *“The thing that I’ve tried the last couple of days is download the music and from the machine itself it wasn’t as easy as it could have been, the last time I tried it you could only choose from one or two tracks to download, I couldn’t find the way of downloading anything else from the catalogue through the DAB radio which is a little bit frustrating. But I did manage to use it, I ended up going to the website and having a look up there instead.”*

H9: *“Whenever I clicked ‘buy’, it didn’t work, so I bought them off the website, cause I clicked buy it and it would take me to the next screen and say, are you sure, and I say, yeah, but it just wouldn’t, it was never there, other than that it’s been fine.”*

And then there were some for whom it was too much hassle to log on with user name and password:

H2: *“I didn’t purchase any records. Because I guess, when I’m listening to the radio I’m normally busy, doing something. So it’s in the background. And I think you can only purchase the records that are playing there and then. So for me, that would have been like; stop, trying to purchase that, log-on. That would have been a bit of a nightmare for me. I guess it is easier when people are just sitting there and they are working, It is easy if they already have their PC on.”*

3.3.8. Missing

Although expected, as the prototype deliberately aimed for quickly accessible information, people commented on how the information on the plus pages lacked depth, extra information.

H1: *“I would like to download trailers, even though it’s a bit geeky, I like technology. Would you be able to reserve a cinema ticket? Would you have to enter your credit card details? Maybe you can set up an account with the cinema company or something. You’re information won’t be stored on your DAB radio, they are just sending a code to them and take some money out and reserve your ticket. Would you reserve them or buy them, because that makes a difference, when you reserve a ticket you don’t have to pay if you don’t show up.”*

H2: *“Suppose as the week went on, I was hoping that there were more things I could go searching for but in principle it is a really good idea. But from my point of view*

there could be more ideas on there for me to check out.--- It would be good to have TV listings on that as well. Like the Radio Times thing. All they have to do is list the TV that is on in the next 2 hours. At 6 o'clock they can list from 6 to 8 or something."

H5: "The weather, it would have been nice to actually have a bit more of a breakdown, but I did like having that at the touch of a button. --- but on day two because I had had a look at it, I'd run out of information to look at, so if there was any way to expand it, that would ----"

Along the same lines, cinema times were missing:

H7: "The only other thing I was possibly thinking with the cinema reviews, with View, because GWR do the View cinemas, the old Warner Brother place, possibly putting the times down with some of the reviews for that."

People also expressed the wish to see more than two songs to buy.

H5: "Chance to have a look, eh, because once I get into the mood for looking for music, and then you're given two songs, chance to perhaps a few more, sort of scroll through, have a look, oh, when buying, it didn't tell me how much it actually is going to cost."

Or the lottery numbers:

H8's flatmate: "Can you put the lottery numbers on?"

Of minor importance but interesting all the same, was the comment that a clock was missing from the interface.

H7: "The only thing that I really noticed, was, having the screen there I looked for a clock, automatically, I wanted something to tell me the time, I was sat there, I would have to look at my watch or my phone whatever, so I'd have to wait till something would come on and I'd know the time, but a clock was the only thing, I missed, a visual, a visual aid."

Traffic information was badly missing. Several times people mentioned how useful it would be to **"Know before you go!"**

H1: *"Traffic would be useful. It will work better in your car. Yeah, traffic and weather are quite important. People do set their daily schedule around the traffic. They go to work early or leave early, or not bother to do anything in the weekend because the weather is going to be awful. People want to be updated of the local traffic. It would be good to hear it and see it.--- It would be good if the DAB radio would know your route to work with Autoroute and tell you not to go that way today. That they are interlinked, connected with your iPAQ. SatNav and Autoroute and your DAB route, you have all the information there."*

H2: "I also thought they could have done that with traffic reports. They could have done it by north, east, south and west and so that you know which area you're travelling to. It could just list the roads that were problems on if you choose your

area. And then you can avoid that before you even left the house. I was hoping that would be on there.--- It would be a big attraction. Traffic in the city is such a nightmare at the moment. I listen to that station because of the travel update, they give them about every 15 minutes. So I can guarantee once I'm in my car that I have about 2 or 3 traffic updates on my way to work. And if it was a case of, just as I'm leaving, I mean it is so quick to check the weather, if it was that quick to check the problem roads on route, I could avoid them right from the start. I know which way to go and not get stuck in traffic and not get stressed before getting into work."

H3: "We listen to the traffic reports anyway but the fact they're on only fifteen minutes means you have to catch it at the right times The alarm is set to come on at ten to so you get a better chance at catching. 'Cos we found before if the alarm is just set at seven you could have missed the report and you wouldn't get one for fifteen minutes so we set a little bit earlier. Yeh, so, if it was as up to date as the reports you get on the radio then we would definitely look at that first thing, just before leaving the house would have a look at what the traffic reports are. --- You know we've had problems on the M4 where they diverted traffic through town and that was gridlocked, a major incident would be really useful to see on the DSL, as you walk through the kitchen you immediately see there are traffic problems."

H5: "Oh actually, that was one thing I thought would be useful information, travel information, and it's always the last thing I think off before going out of the door, going somewhere, oh, I should have checked that and I can't be asked to log on to anything I normally just risk it, especially (prototype) you don't have to turn anything on you just go and press the buttons."

H6: "Ehm, traffic. Things like knowing what's going on on the M32, affects me, if anything happens on the M32, I can't get out my drive. So that's the only thing and if you could personalise it, that would be brilliant."

H7: "I was listening to it a lot when they got the drive time on it, especially if I was going out, keep an eye on it to see if something major was going on, ehm.--- I suppose having that on screen would be good, if there was something major, because with "Drive Time" they do that very fifteen minutes in the morning they do that anyway, maybe just on the DLS screen, if you've missed it, blah blah, blah."

H9: "The other thing, I did think, it would be good to have the traffic, the traffic on the radio, on the screen, or if you're about to go out or something, rather than wait for the every fifteen minute news update, **you know before you go**, by the time that comes on, I'll be on the motor way and I've hit a problem."

When we suggested the possibility of personalised traffic information, this got an enthusiastic reaction.

H5: "That would be fantastic, just get up in the morning check it, how long will it take me this morning?"

3.3.9. Screen size & Mobile possibilities

The size of the screen proved to be just right. Any bigger and it would be intrusive. Any smaller and some of the letters would be too small in the more detailed sections of the plus-pages. There was also a realisation that because participants were asked not to switch the system off, the screen was always on, and one might wonder how this affected the irresistibility of glance.

H5: *“Personally I would not want it that much bigger, just for the fact that I think it would become then intrusive. And I think radio’s should be tucked away, particularly if it is where I would want it, that is the bedroom. It was a fine size except some of the text ended up very small, but I could still read it, so.”*

H6: *“I wouldn’t want it any bigger than that, it would be too intrusive. I don’t know how it affects the fact that I wasn’t allowed to turn it off, the thing it self, it makes me wonder, if it would have been different, if I had turned it off. I know that I would have definitely switched it on for the “what’s on”, but I wonder at what rate I would have -- Some of the time I would come in and I thought “oh yeh” look at “what’s on”.*

H7: *“I found the screen was a good size. [Would you want it any bigger or smaller?] I don’t know if I want it smaller, bigger wouldn’t bother me, the size as it is at the moment, is fine. My worry if it were smaller would be that some of the information you clicked on like the news would get too small, everyone in my family wears glasses. For me the screen was a perfect size.”*

H9: *“I think it’s fine, I think any bigger and it would ehm, be like a computer, but just as it is, I think that’s fine, really handy”.*

All the same participants mentioned that they could see the visual radio being implemented in a mobile phone or an MP3 player and even as a separate item.

H1: *“It would be much better if it was mobile, if it was a handheld radio.--- Maybe if it is mobile you can have it in your car, having a screen on the dashboard in your car would be quite useful, just glance at the information. If you pulled over you can draw the information up via the touch screen. Part of an iPAQ or an iPod with this feature, than it is. It is a good idea on the iPod; the more you can do on an iPod, the better. You can only store music on it now.--- And if it would be on an iPAQ, iPod or something handheld and you had it with you all the time, it would be very useful, to be able to get the news or the weather pretty much instantly. Check the weather from inside you tent on holiday; excellent.--- I want an iPod, DAB radio, GPS, the whole thing in one handheld unit.”*

H2: *“Mobile would be good. If you could take it out in the garden, cos I quite often take a radio or CD player with me in the garden in summer. That would be quite good. I think I would buy a radio like this with a screen. [Would you pay more for a mobile radio with a screen?] It depends, because in the summer when you’re going camping and if you can tune it in to the local radio station wherever you go, then I think that would be quite a good idea. [buy radio] I probably want something. Mobile would be better, unless you have two options. I probably would buy a mobile radio. If*

you have an option of static or mobile, most people will choose mobile because you may need to take it somewhere else.”

H5: *“Depending on whether it came with other functionalities, MP3 player, and stuff, then yeah, I don’t have a radio that I take with me anywhere at the moment. I’ve got a Sony little MP3 portable thing, it’s quite small, quite dinky, it’s almost credit card, quite thin, no colour display. [If it had radio would you listen or even look at some of the information?] Ehm, possibly not, I have to admit, generally, the times that I’m using MP3 player is when stuff I don’t like on the radio anyway [laughs] and things like that for exercise and then I need to have music rather than people talking.”*

H6: *“I don’t like mobile phones, it’s loose-able, I’m terrible [MP3 players?] The kids do, and their mobiles, I couldn’t tell you where my mobile phone is right now, but the kids for them their phone is like a second organ, if their heart’s there their phone is as well, it’s not like that with mine, I’d rather have mine [radio] where it’s there all the time.”*

H7: *“I would, especially if it was portable, if I could take it places, that would be a definite bonus. I realise when I’m in Uni, I like to have a good quality radio, something I could interact as well with me, really like great and that, and at work, it would be nice to listen, maybe interact, whatever. [Would you want it on your phone?] Ehm, yes, possibly, but I think I’d prefer it as a separate item.”*

H8: *“I think, we were talking about that last week, it would go in the car, I don’t know whether it would be something the size of mobile phone that would then slot in the car, because, again, if the traffic reports, or the weather, or whatever, because in Bristol, in Hartcliff it could be sunny but in Fishponds you got gale winds. So you would be able, driving along, thinking, why is all this traffic, because they don’t always during the day, they are not as often as during the morning. So the fact that you could subscribe, you could take it on holiday, because I know you can get GWR down, whatever, because we always laugh when we come back from the south, don’t we, because we always say, right, we know we’re nearly home, because GWR changes over, in the car, it’s like, YEH!”*

H9: *“I think it could, it could almost be handheld, portable, [if a mobile phone] had all those things. Yeh, ehm, I suppose that would be quite handy except it would be quite big, wouldn’t it and it would have a smaller screen.”*

3.3.10. Prototype problems

The prototype and the services didn’t always work seamlessly. We list these problems here and regularly the comments indicate awareness of what their expectations were of how the prototype *should* perform, highlighting their user needs / values. So the lack of regular updates, e.g. which song was playing, or the vote of the day was still yesterdays, was noticed and indicates that regular updates of a glance-able information service is crucial in order to provide high user value in general and more specifically that it was important to know which song was playing now, so that they could buy it if they wanted to.

H2: *“I’ve got a feeling that the quiz didn’t change every day. I think it was the same over the weekend.”*

H5: *“I noticed it didn’t update with what was actually playing, the whole time, a lot of the time it got stuck on the same two songs.”*

H7: *“I wasn’t sure what time of the day it changed the vote but it didn’t seem to be, although I’d look at the same time of day, sometimes it would be the same vote, like yesterday and today was the same vote.”*

H9: *“The show-biz quiz is still from yesterday.”*

There was often a delay in changing from the DLS mode to the plus pages, although the interface design helped by providing a colour change in buttons, this didn’t always prevent people from pressing twice.

H5: *“Sometimes a bit slow, pressing the buttons, it took a while to think about it.”*

The sound quality, reception in certain homes was poor, due to the DAB-cards being a few years old and this contributed to a mute operation of the prototype.

H5: *“The sound quality wasn’t that good, I would want better sound quality if I was to go out and buy one.”*

H6: *“I didn’t like the radio [it is playing] actually that’s very good, that’s the best quality, that’s the best it’s been, eh, one day it was so static, you couldn’t hear a thing, but, eh, I think the system, it’s brilliant.”*

4. Discussion

Following on from the interview study we carried out a field trial with the enhanced DAB radio prototype in nine households (the results for eight households are presented here) . We implemented some, but not all of the features, services and ways of interacting, that were explored in the interview study, i.e. on offer were: the weather, film reviews, event listings and the national news headlines and voting, taking part in quizzes as well as buying the last two tunes that were played. For a variety of reasons we did not offer traffic information, cinema listings, the last ten songs played or the local news. We realised that some these would be sorely missed and indeed traffic and local news were noticeable omissions.

The prototype came about as a result of carefully thought-out iterative technology development closely linked to user research. However, this did not mean that the field trial would automatically be a success. Therefore it is good to consider what measures, indicators for a successful trial, we have found.

The comments of the participants are a good start and, indeed most of them in the post trial interviews were enthusiastic about the prototype and we heard in detail how the radio was used consistently across the week of a trial. In a field trial there are always novelty aspects that encourage use and which may wear off in the course of a trial if the prototype does not quite fit into people's lives. What we see in the log files analysis is a sustained use throughout the week of the trial. Thus, whatever the initial novelty values of the device, its usage did not wane. The radio offered information that users can get from other sources, e.g. the internet, TV, newspapers or even the audio channel of the prototype radio. In the diary forms analysis we see that the information from the DAB radio steadily becomes a valuable source of information on its own: across the week, day by day, people rate that the information they look up is less and less like the information they get from other sources. It seems that there is support for our hypothesis that one of the values of an enhanced DAB radio lies in not having to go to the internet as the internet comes to you, effortlessly as part of the broadcast of your favourite radio station. In fact, we suggest that the prototype has very quickly been integrated into their lifestyles and as such the field trial was successful. Of course, what this means for future products, is a different matter.

We deliberately focused on providing information at a glance and we expected user interactions to be short. Thus the information did not go into great depths. On average individual sessions were short, mostly around 2 or 3 minutes. The plus pages timed out after 3 minutes and reverted to the DLS text. Therefore, most of the time, the starting point for interaction was the DLS screen with or without the sound on. Below (figure 14) we describe an interaction model (interaction with the device) covering both "information access" and "interacting with the radio station", buying, voting and taking part in quizzes via the back channel. This interaction with the device occurred in one the following ways:

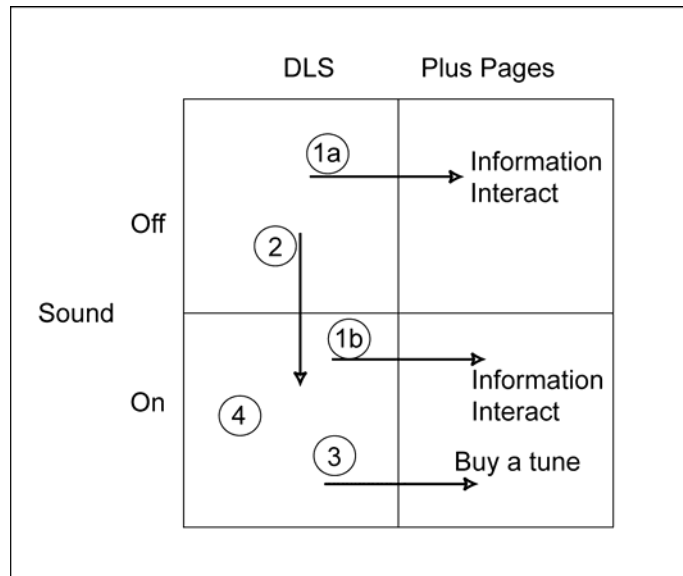


Fig. 14: Interaction model

1a: The radio was regularly used with the sound turned off and users pressed the plus pages button to quickly access information or vote, as a very short activity, for instance when coming home after work and sitting down with a cup of tea.

1b: Similarly, with the radio on people pressed the plus pages.

2: The radio's sound was turned off; a participant couldn't help looking at the DLS, would notice that an artist of interest was playing and as a result turned the sound on to listen and then, on occasion [3], continued evoking the plus pages to buy the song. Here there could be great value for the radio station, as non-listening turns to listening.

3: The radio was on. People heard a song, possibly checked the DLS, and then bought a tune.

4: The radio was on, people were curious who was playing and then consulted the DLS, without further action.

The fact that the screen was on continuously and was of a particularly good quality *and* of a size that fitted the type of information on offer, no doubt, contributed to people being attracted to explore the screen. Less obvious was, that whilst people were watching TV in the evening, they would be drawn to the display and quickly check who was playing on the radio and then mute the sound of the TV in order to listen to the song. Even more unexpected was the use of one participant who, whilst working (word processing) on her computer with an internet browser window in the background, whilst listening to GWR Bristol on the prototype next to the computer, would quickly interact with the DAB radio, accessing information that was available via the Internet. Of course we should contrast this with a similar user, who stated that there was no need for her to check out the radio as all the information was available on the GWR website, although her prototype was in the living room and not next to the computer.

Thus, the screen in itself is literally attractive (or attracting). In a future fixed radio product scenario, however, we must expect that the information and interaction possibilities will take place on a smaller lower, quality screen *and* a screen that is not necessarily on continuously. It is not impossible that the value of information at a glance will suffer in this scenario. However, the iPod phenomena will probably have a

disruptive effect on the HiFi industry. Future stereo systems might feature large digital storage capacity accompanied by a larger display. In this way home-stereos and DAB radios could well have bigger screens to allow the kind of extra information, media that the MOT protocol provides.

A mobile scenario might offer better opportunities: the screen of a car radio could be on all the time, an MP3 player with DAB capabilities, could, battery life permitting, keep on displaying the radio station's plus pages even when the sound is off or when listening to one's personal music collection.

For decades, across the industry and in academia, there have been brainstorming, product designs and even actual products featuring the fridge display. Without going into what type of internet linked or appliance (fridge) related information screens could display, it seems clear that the thinking about such displays reflects a general wish about incorporating an always-on display into our lives. Brainstorms about digital screens on our walls, as picture frames or otherwise, have followed a similar pattern. To date such displays have not resulted in successful products and thus have not found their ways into our households. This could have to do with all sorts of economical and technical factors; after all, the screen would somehow need to have some sort of box with electronics and a connection to an information source in it. What makes an enhanced DAB radio interesting (and thereby creating an opportunity) is, that the existing small screen of a current DAB radio might have paved the way to a certain extent. In addition, the broadcast nature of radio (in contrast to the dumb fridge or wall) and the broadcast nature of the plus pages (in contrast to the internet on a computer) seem to go hand in hand. In other words the step from existing DAB radio to an enhanced DAB radio could be a lot smaller (economically, technologically as well as psychologically) than adding a display to your fridge door or hang a stand alone screen on your wall.

The value of fairly concise information at a glance is dependent on the frequency of updating the information. From the field trial it seems perfectly acceptable for this updating frequency to be once a day, i.e. the five day weather forecast, the news headlines, the quiz and the vote of the day. When through technical problems there is a delay in update, participants noticed immediately and their comments are unequivocal: they get bored with the prototype. Information that updates less frequently such as events and film reviews is also accessed less frequently. Information services such as celebrity gossip, traffic updates, in particular localised and personalised traffic updates ("so you know before you go") would be frequently updated and, therefore, in addition to the actual topic, genre, provide high value because "**with every glance there is a chance**" that something has changed.

We had expected a fairly tight coupling between the audio stream and invoking the plus pages, i.e. a participant would hear something on the radio which then triggered checking out the plus pages. However, this rarely occurred. One situation in which this did happen was when people would hear a song, rather than a piece of information, on the radio and then checked out who it was, occasionally followed by buying the song. Therefore we suggest that although the information and interacting with the radio station is associated with the GWR brand or community feel in general, the link to the contents of the audio broadcast is often indirect.

On the topic of possible commercial opportunities, it is good to realise that audio broadcast traditionally has been for free and users are probably not willing to pay for services such as the weather forecast, the headlines etc., since this type of information is available for free elsewhere. However, to receive this free information strengthens the brand and indirectly might lead to commercial benefits. Similarly

quizzes and the vote of the day will not be money spinners. However, the radio is uniquely placed to bridge the gap between intention to buy and action (Gershman et al. 1999), short circuit that otherwise lost impulse of music buying (O'Hara and Perry, 2003) when or just after you've heard it on the radio via the buying a tune service, where every enhanced DAB radio becomes a point of sale. Taking part for a small fee (e.g. 10 pence) in competitions where you can win a large price could in principle attract a larger audience, because of the simple and direct interface, you enter the competition on the same device as you are (or have been) listening to, even though the link between radio broadcast and competition might be loosely coupled rather than tightly coupled.

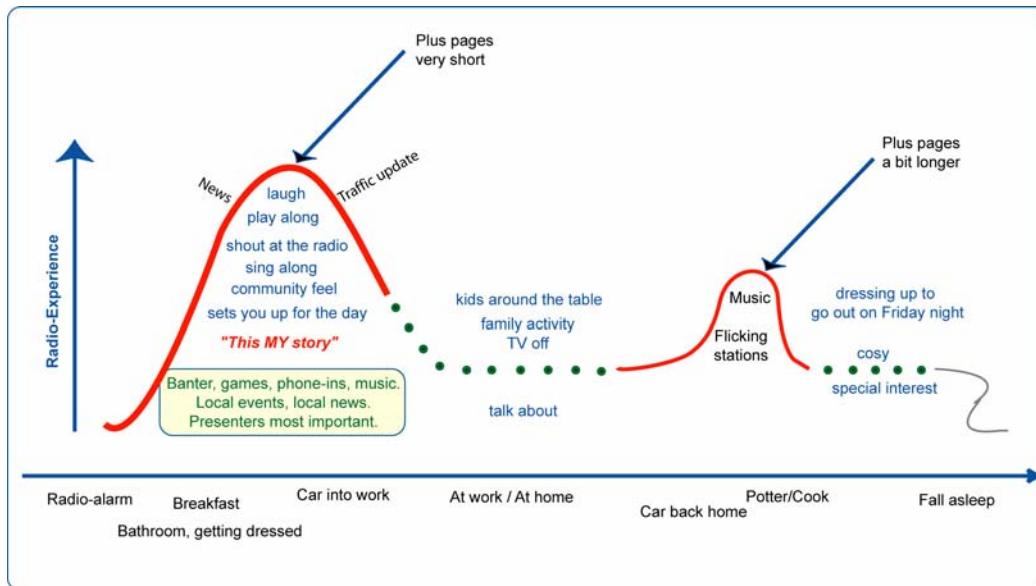


Fig. 15: Radio experience revisited

In the interview study we described the radio experience, from waking up to going to bed, where in particular the GWR morning slot engages listeners, sets them up for the day and makes them feel part of the local community. The prototype delivers value in the morning by providing them with the five day weather forecast and news headlines at a glance in very short sessions and possibly a quick vote of the day. In the morning, we speculate, the link between the audio content and visual aspects could be fairly closely coupled. Participants spent longer with the radio on their return from work, a time that normally is less likely to be spent with listening to radio to explore the full range of interaction possibilities that the plus pages offer, extending the brand value of the radio. Even if they put on a CD, they could still browse the GWR pages.

On the mobile side there are currently some interesting developments in South Korea. Digital Multimedia Broadcast (DMB) chips have been added to mobile phones, which enable users to receive MPG4 encoded Broadcast TV on their mobiles as well as TV program guides, traffic information and the availability of parking spaces. The cell phone companies and providers drive this development and their services are very popular. Interaction is enabled via SMS. In addition there is the Visual radio venture between Nokia and HP using Nokia's first dedicated media phone that can receive digital TV transmissions with the new DVB-H standard. With Visual Radio the

listener will not just receive the FM sound signal, but also images and text on the LCD handset display screen. Comments from the interviewees certainly indicate that Visual radio or a mobile enhanced DAB radio, standalone or as part of an other appliance such as mobile phone or MP3 player, stand a good chance.

To conclude:

We conclude that following on from the initial interview study we conducted a successful field trial in which we saw a consistent use throughout the whole period of the trial. We feel strengthened in our belief that an enhanced DAB radio, along the lines that we have developed, would quickly be integrated into people's lifestyles.

The **user values** of an enhanced DAB radio can be described as follows:

1. **Instead of Internet.** The information comes to you, effortlessly as part of the broadcast, without having to spend (more) time with a computer.
2. **Information at a glance, different from Internet.** The prototype is very well suited to short interactions where, at a glance, people access lightweight information, e.g. the five day weather forecast, the news headlines. It seldom takes more than three clicks. These short sessions make it different from internet.
3. **Interaction at your fingertips.** Similarly, interacting with the radio-station, voting, buying tunes, quizzes is (or could be) quick and easy. Feedback about how the rest of the locality has voted strengthens the community feel.

For the local **radio station** there are potentially some considerable **benefits**:

1. **Extending the brand.** It is unlikely that people would pay for services that they can get elsewhere for free, e.g. the five day weather forecast or the vote of the day. However, the branded plus pages as well as the strengthened community feel of an enhanced DAB radio benefits the brand of the local radio. In addition in a scenario where the screen is on but the sound is off, the screen could draw people to the audio.
2. **Direct commercial benefits.** It is possible to charge people for services that they are already used to having to pay for, e.g. taking part in a competition to win £10,000 or voting for big brother. In addition, there might be commercial opportunities for personalised and/or localised traffic information. The prototype is uniquely placed to short circuit otherwise lost impulses to buy a tune when a listener hears it on the radio, or just after hearing the tune. Here there is a tight coupling between audio contents and (visual) services, i.e. the audio brings the listener to the screen. It is still speculative how other ways of selling goods (e.g. cinema tickets as part of the cinema listing service) might benefit from an enhanced DAB radio and similarly we have not researched the benefits for advertisers.

The **relationship** between the **audio** stream and the **visual** contents is remarkably diverse, given the simplicity of the device:

1. **Loosely coupled.** Most of the time this relationship seems fairly loose. People explore the plus pages as a separate activity, in particular in the evening, when the sessions are also relatively longer.
2. **Tightly coupled.** In the mornings there is a stronger relation, it is a time when they *and* listen to the radio for the weather, news headlines and vote of the day *and* quickly want to find out about the weather, the news headlines, do the vote of the day via the screen. Independent of time of day, the tightest relation occurs when hearing a tune and then buying it.
3. **Screen to audio.** When the sound is off, a quick glance at the DLS screen might lead them to switching the audio on in order to hear *that* song.
4. **Audio to screen.** When listening to the radio a user might walk up to the screen to see *who* the artist is, followed sometimes by buying the tune.

With all these points in mind, the **critical success factors** for a product that incorporates an enhanced DAB might be as follows:

1. **Backchannel.** The interaction with the radio station can only work via a backchannel. For the type of services we have explored (via 802.11b in our trials) this can be of a modest bandwidth, e.g. GPRS.
2. **Simple User Interface design.** Although we state the obvious here, the user interface is often still an after-thought. We like to emphasize that spending considerable effort and time simplifying the user interface contributed to the home trials being so successful. As a guideline: The information and interaction should be available within three “clicks”.
3. **At a glance.** The value of information at a glance and interaction at your fingertips has been demonstrated clearly in our research. It is of benefit to realise that the information (and interaction) is not like the Internet but is used instead of the Internet. The frequency of updating the information will be an important consideration in order to keep users interested, good candidates are: weather, news, gossip, traffic information.
4. **The screen.** In our trials we benefited from a good quality and size screen that was always on, which attracted participants, even when the sound was turned off. It is unlikely that future products could match such an always-on, right size and quality screen. Although we cannot anticipate how the screen of a future product can be optimised to attract users, it is clear that care and consideration should be given to these issues. It might well be that a modestly sized monochrome screen is sufficient. The fact that DAB radio’s already have a small screen might pave the way for a bigger screen of an enhanced DAB radio.
5. **Mobile opportunities.** The developments of similar broadcast based related standards like DMB, implemented in mobile phones in Korea, might indicate that the future lies in mobile rather than fixed radios. Our interviewees confirm this.

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Appendix 1: Interview script

POST INTERVIEW

[Informal] How did you like the radio in your home? Was it easy to use?

RADIO

Was the radio in a convenient place for you to listen to it? And to look at the Plus Pages? If you would be able to buy a radio like this, where would you put it in your house? What would be the best place for you to look at it most [Kitchen, bed room, living room]

When did you use the radio most – what time of the day? [Gap time - waiting for potatoes to boil, after dinner when there's nothing on TV, after getting up, in the morning instead of watching the morning news or reading the paper]

Did you use the radio mainly for listening to the radio or to look at the screen?

VISUAL DATA

(DLS)

Did you glance at the DLS text a lot in the week of the trial? Did it give you the information you expected?

What was good about the DLS? What did you miss?

Was any information on DLS worth waiting for?

(Plus Pages)

Did you play with the prototype? Use it as a magazine? As a source to look up (local) information?

Did you use the device instead of internet, TV or teletext?

What information did you look up on the screen?

Did you use the device for the weather forecast?

SMALL SCREEN

Did the information on the screen add to your enjoyment of listening to the radio? Did the radio instigate you looking up information on the screen?

Was the screen big enough? Was it easy to use [buttons big enough, clear menu structure]

INTERACTIVITY

Did you interact with GWR through the prototype? Enter competitions, vote, download music or book cinema tickets? [vote on play list, play a song again]

Do you think this device made it easier to interact? Did you think that barriers were lower and that you interacted with the radio – would you enter more competitions? [Easier, cheaper, quicker – ‘effortless’]

LOCALITY

Do you think the device was good to look up local information? [What’s on, news]

What did you miss? (Email, games) – What should be added for you to use the device more often?

Would you want it mobile (on phone, combi SatNav, iPac, iPod?) Would you have used it more if it would have been mobile – think you would have taken it to another room?

[Any closing remarks?]

Appendix 2: Diary form

DIARY FORM

Please fill in this form every evening (or the next morning). There are no right or wrong answers; we just want to know how often and how you are using the prototype every day of the week of the trial.

Name:

DAY 1 Wednesday (number + user number (member of household))

Instructions:

In the questionnaire below, we ask you to make a mark on a line. So for instance:

- How thirsty are you?

Not at all

Very much

| _____ / _____ |

The mark close to **Very Much** indicates that you are quite thirsty indeed.

Did you use the prototype today for:

- listening to the radio

Never

Very often

| _____ |

- glancing at the changing text (DLS)

Never

Very often

| _____ |

- looking up information on the 'GWR mini-web'

Never

Very often

| _____ |

- interaction with GWR

Never Very often

Did you use the prototype mainly for listening to the radio or more for visual information?

Radio Visual

Did you glance at the DLS information more or sat in front of the prototype to search information on the plus pages?

DLS Plus pages

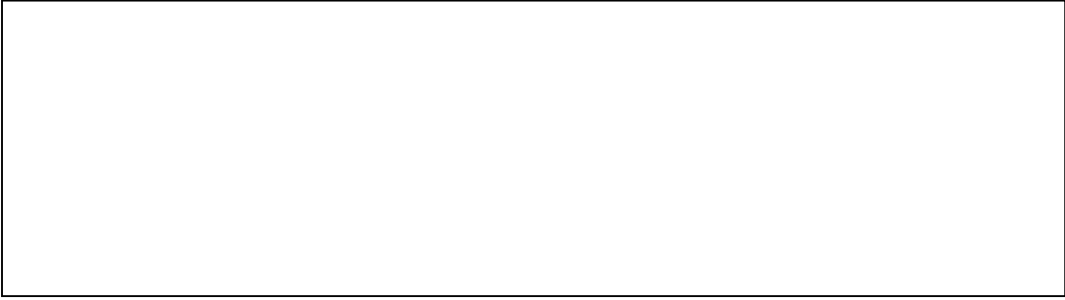
Did you use the prototype to look up information you would otherwise have looked up on teletext, the internet or the newspaper?

Never Very often

Overall score for the DAB radio with small screen for today

Very poor Very good

If you have any remarks or comments about the prototype, please feel free to write them in the box below?



Thank you very much!