

# Digital Identity and Social Networking in Interactive Television

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## ABSTRACT

The emergence of hybrid set-top boxes has paved the way for interactive television services to make use of data acquired over the Internet. Technology developed by BBC Research allows Internet data to be combined seamlessly with traditional interactive TV applications, making it possible to transfer the personalised experience of the Internet to a television viewing environment.

This paper reviews the work that has been carried out so far towards enabling personalised interactive services and then discusses methods for allowing viewers to identify themselves. Possible future developments concerned with identity management and privacy issues are discussed and finally some open questions are presented.

## Categories and Subject Descriptors

H.5.4 [Information Interfaces and Presentation]: Hypertext/Hypermedia; H.5.2 [Information Interfaces and Presentation]: User Interfaces—*input devices and strategies*; K.4.1 [Computers and Society]: Public Policy Issues—*privacy*

## General Terms

Human Factors

## Keywords

Interactive television, MHEG, interaction channel, return path, social networking, digital identity

## 1. INTRODUCTION

Hybrid set-top boxes, which allow access to both broadcast and broadband delivered content, are beginning to emerge on the market. However, many of these devices are unable to present ‘hybrid services’, that is services that are able to integrate content from multiple sources into a single seamless presentation. Technology developed by BBC Research allows interactive applications using the MHEG-5<sup>1</sup> middleware to be authored independently of the means by which any part of the application will be delivered.

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<sup>1</sup>MHEG-5 [1, 5] is a language used for interactive services on free-to-air digital TV platforms in the UK, New Zealand and Hong Kong.

This work forms part of the specification for an interaction channel (or return path) which is being standardised by the Digital Television Group.<sup>2</sup>

As well as allowing the Internet to be considered as an essentially unlimited data source, making it possible to write rich and engaging applications that could not be carried in a broadcast, the interaction channel provides a route away from a passive, ‘lean-back’ experience and towards true audience interaction and personalised services.

However, the ability to include broadband and personalised content not only brings opportunities for new kinds of interactive service, it also opens up new challenges such as how the familiar experience of personalised services on the Internet can be transferred to the restricted world of television set-top boxes.

The convergence of television and the Internet is still a developing area, and much work has centred on trying, not always successfully, to add the experience of one sphere to the other, for example adding live video streaming to a computer or adding a web browser to a television receiver.

The BBC has recognised that the television and PC Internet experiences are fundamentally different and services can rarely be moved between them. Ideally, television viewers want to take advantage of the *capabilities* of access to the Internet while preserving the familiar *experience* of watching television.

The aim is that viewers will be able to participate in voting and social networking and read web content without having to leave the comfort of their armchair to look at a computer.

## 2. HYBRID APPLICATIONS

In order to show how this can be achieved in practice, a number of applications were created to explore how various aspects of Internet content might work in the interactive television environment, in such a way that the existing Web infrastructure can be used to serve both experiences.

### 2.1 Voting

Audience voting is commonly used on the BBC website.<sup>3</sup> An MHEG-5 application was written to interface with an existing audience vote, so that votes could be made via the Web or television. Only a small amount of code was required

<sup>2</sup>The DTG is the industry association responsible for digital television in the UK. See <http://www.dtg.org.uk/>

<sup>3</sup><http://www.bbc.co.uk/>

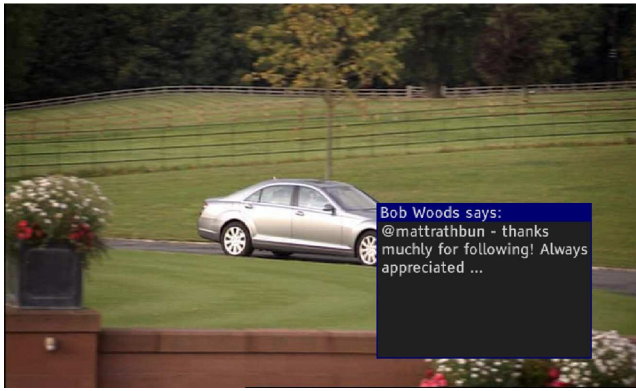


Figure 1: Twitter messaging over TV

to interface with the web voting system and no changes to the server were made.

*Conclusion 1.* MHEG-5 applications can be integrated with existing web infrastructure with minimal effort.

## 2.2 Live News

BBCi, the BBC's interactive TV service, includes news headlines and recent news stories. However, these have to be edited to fit within a limited broadcast capacity. A version of the news application was created that used live data from the BBC News website.

The headlines were taken from an RSS feed of the most recently published stories and the full text of each item was reproduced from the website. The RSS feed could also be polled, generating a pop-up message when a new story was published and offering the viewer the chance to read more.

Although the MHEG-5 language is capable of manipulating strings, it is not well suited to handling large amounts of text. Instead, a script running on a proxy server was used to translate the RSS and HTML data into the format expected by the MHEG-5 application. News data is already published in several formats for various devices; for a live service, MHEG-5 could easily be added as another format.

*Conclusion 2.* MHEG-5 applications can make use of data published as RSS. For less rigidly formatted data, a reformatting proxy can be used.

*Conclusion 3.* Although it is helpful for an editorially complete service, there is no technical requirement for the producer of any RSS feed to know that their data is being used by an interactive application.

## 2.3 Social Messaging

Having demonstrated that an interactive service could make use of a BBC-produced RSS feed, another MHEG-5 application was written to explore the possibilities offered by social networking services. This application used a feed of recently published messages from the social messaging service Twitter (see Figure 1).

Because the RSS data was in a very simple and rigid format, some of the text processing was implemented in MHEG-5 code. A proxy stage filtered out messages which contained offensive words or could not be displayed in the character set available to a set-top box.

Twitter exposes an API that uses the HTTP GET and POST methods and return status codes; any such API can be used by the MHEG-5 interaction channel. To explore this, the Twitter application was modified so that, when a new message pop-up appeared on screen, the viewer could enter a reply by using the remote control to select letters from a grid. Each reply was received as a text message on a mobile telephone.

By changing the RSS feed from public messages to a specific user's messages, the application demonstrates the possibility of adding a social element to the TV experience (rather than trying to add television to the PC experience).

*Conclusion 4.* By making use of standard web APIs, an interactive application can create a 'social television' experience.

## 2.4 Personalisation

A common technique used to manage identities on the Web is single sign-on (SSO). The BBC uses SSO across its website and an MHEG-5 application was developed to show how an interactive service could make use of personal data through SSO. The chosen service was Celebdaq, a stock exchange game in which users buy and sell shares in celebrities.

The MHEG-5 application presented the viewer with some non-personalised information (a stock ticker) and allowed them to log in to see their own portfolio (see Figure 2). The login process sent an HTTP POST request, mimicking the HTTP traffic generated when a web login occurred. The SSO system generated a cookie for the viewer, and up to five of these cookies could be saved to allow regular viewers to bypass the login stage.

*Conclusion 5.* It is possible for an interactive application to access personalised data through an SSO system.

## 3. VIEWER IDENTIFICATION

### 3.1 Text Entry

In order to provide personalised interactive services, there must be a means of identifying and authenticating viewers; this can pose a serious challenge under the restricted user interface provided by a typical set-top box. A number of techniques have been tried:

**On-screen keyboard** A grid of characters which the viewer can select and enter (see Figure 3). Even if restricted to just alphabetic characters, a large amount of screen space is required and the navigation can be confusing and time-consuming for the viewer, especially if mixed-case text is allowed. If implemented in MHEG-5, an on-screen keyboard takes up a significant proportion of an application's code and prevents remote control keys being used for other purposes.

While the on-screen keyboard is sometimes used by a set-top box's native user interface for rarely changed settings, it is far from ideal for interactive applications and can not be used to enter a password as the text is displayed on-screen.

**SMS-style** This text entry method is commonly used for mobile telephones, with "ABC2" allocated to the '2' key and so on. It is much easier to implement in

MY PORTFOLIO				
Hello salmonmonster				
Name	Current Price	No of shares	Purchase cost	Current value
therine Zeta Jon	£413.47	3	£1252.79	£1240.41
Felicity Huffman	£1.99	749	£1498.38	£1490.51
Isla Fisher	£61.47	24	£1489.80	£1475.28
Darnell Swallow	£6.81	218	£1498.59	£1484.58
Gok Wan	£2.34	634	£1497.56	£1483.56
Value of shares		£7174.34	7 day profit/loss	-62.78
Cash available		£2762.88	Weekly gain	0.00%
Total worth		£9937.22	Today's chart position	
Press RED to go back				

(a) Television

MY PORTFOLIO							
portfolio for: salmonmonster (User ID: 412246)							
BUY/SELL	SELL ALL	PRICE	NAME	CURRENT PRICE	NO OF SHARES	PURCHASE COST	CURRENT VALUE
Buy	Sell	£413.47	Catherine Zeta Jones	(-0.47)	3	£1252.79	£1240.41
Buy	Sell	£1.99	Felicity Huffman	(-0.01)	749	£1498.38	£1490.51
Buy	Sell	£61.47	Isla Fisher	(-0.01)	24	£1489.80	£1475.28
Buy	Sell	£6.81	Darnell Swallow	(+0.03)	218	£1498.59	£1484.58
Buy	Sell	£2.34	Gok Wan	(+0.26)	634	£1497.56	£1483.56

(b) Web

Figure 2: Celebdaq: a personalised service presented on television and Web

MHEG-5 than the on-screen keyboard. The allocation of alphabetic characters to numeric keys is standardised [2], but there is no corresponding standard for punctuation and other symbols. The characters assigned to each key must be printed on the remote control device. Like the on-screen keyboard, this method is not suitable for password entry as visual feedback is required.

**PIN** The viewer enters an account number and a short numeric password linked to their full account details. This must be set up in advance when the viewer is in a computer environment. There is no longer any requirement for text entry and the remote control's numeric keys can be used.

**'Remember me'** Once the viewer has been authenticated, they can choose to have their details remembered. This could be implemented by storing a username and password or a cookie value in receiver memory. An application then simply presents a list of known users for the viewer to choose from. However, many platforms (including the UK's Freeview) have limited ability to store data set by an application; access to cookie values may also be restricted.

### 3.2 Future Work

It seems clear that an on-screen keyboard is not appropriate for interactive services and that the SMS-style and PIN

methods are far more suitable. In particular, PIN entry using the numeric keys on a remote control requires no visual feedback, which is desirable for entering a password.

However, it must also be recognised that set-top boxes vary between manufacturers and across different deployment environments and that maintaining this diversity can be beneficial to future developments.

One factor that varies between environments is that of language. Work is currently being carried out to extend the assignment of characters to telephone keys to cover European languages [3, 4] and this may affect the design of viewer identification schemes in different countries.

Another variable factor is the choice of control device. Besides the standard remote control, an increasing range of devices is now available and each may have different privacy characteristics. For example, a set-top box could be controlled by voice, but this might cause problems for entering a password in a shared environment.

A further possibility to consider is that viewers may begin to identify themselves by means other than a username and password. Future set-top boxes may be able to identify viewers by RFID tag, micropayment card or biometric means, among other possible technologies. The voice-controlled television might identify a viewer not by what they say but from their voice itself.

### Questions

- How can interactive applications be authored to run without knowledge of the method that may be used to input personalisation data?
- How might privacy be affected by non-standard entry devices, such as a keyboard, free-space controller or even voice recognition?
- As text entry is closely linked to language, what further considerations are required for internationalisation?
- To what extent can text entry be made consistent and intuitive across the range of available devices?
- Should text entry be part of the native user interface of a set-top box or implemented in the interactive middleware layer?

Select ← for backspace and ✓ to log in  
 To go back, press RED  
 To toggle "Remember Me", press GREEN  
 To toggle upper/lower case, press YELLOW  
 To toggle username/password, press BLUE

Username	<input type="text"/>
Password	<input type="text"/>
Remember Me	<input checked="" type="checkbox"/>

Figure 3: On-screen keyboard

## 4. FUTURE SERVICES

### 4.1 Privacy

Once personal information is held in a receiver, we must consider whether there are any privacy implications. The MHEG-5 interaction channel includes a security model which protects the integrity of application code (so that a malicious application can not be inserted into a broadcast) and protects confidentiality by establishing TLS secure connections where required.

This model is considered secure for non-critical data (particularly where no financial transaction is involved). A service on, for example, a shopping channel that already holds a viewer's credit card details could allow that viewer to purchase goods over the interaction channel, perhaps following an out-of-band confirmation; the viewer's card number is then kept out of the interactive television space.

The security features of the interaction channel are such that it would be difficult to launch a successful technical attack on privacy; therefore our attention should be turned to social factors.

Each person who uses a personalised service may wish to present their own identity, as well as participating in a shared identity, and may be unwilling to grant others access to their identity. The dynamic will vary according to the number of people involved and the relationships between them. In the case of children, television receivers commonly require a 'parental lock' code for access to certain features and this could be extended to personalised services.

An interactive television platform may be able to store a viewer's data for some amount of time and viewers may wish to reassure themselves that their data has been deleted when they no longer want it to be held.

#### Questions

- What are the differences in privacy concerns for a single person, a couple and a family with children?
- How is privacy affected in a shared household such as student accommodation?
- Can a personalised interactive service easily allow for temporary members of a household?
- How can a viewer be certain that they have been logged out once they have finished using a personalised service?

### 4.2 Integration with Other Personalised Services

As the convergence of television with the Internet continues, future interactive services will be much more tightly integrated with other personalised services. If identity management is to follow this pattern of convergence, this poses numerous challenges:

#### Questions

- Should personalised information be associated with—and stored by—a device, a content provider or a third party?
- From the viewer's perspective, with which of these should identity management *appear* to be associated?

- Can Internet-based identity management systems, such as OpenID, be transferred to interactive television?
- How can viewers' identities be shared across multiple broadcasters, or shared with other parties on the Internet, without compromising privacy?

## 5. CONCLUSIONS

This paper has shown that interactive TV services, using the MHEG-5 language, can incorporate content from the Internet. Instead of including a web browser in a television receiver, it is possible to create seamlessly integrated presentations that allow the viewer to have the advantages of the Internet's capabilities without disturbing the social experience of the television environment.

Hybrid interactive services can contain rich and expanded content and, by using standard web APIs, can provide access to live information and social networking without significant technical effort. Personalised services are also possible. This validates a model of reusing existing Web infrastructure and developing interactive TV applications that can act as clients to generic Web services.

In order to achieve a personalised interactive service, the viewer must be able to identify themselves using hardware that may be limited compared to that available to a computer user. In addition, there are social obstacles to maintaining the viewer's privacy. Viewers must also be able to have confidence that their data are secure.

As television and Internet convergence continues, it will become ever more important that people can assert their identities across a range of platforms and, ideally, identity management will be so well integrated into the system that it is not noticed. Some open questions and needs for future developments in this area have been highlighted.

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