BBC

R&D White Paper

WHP 068

September 2003

Broadcast services enabled by local storage and connectivity

T.J. Sargeant

Research & Development
BRITISH BROADCASTING CORPORATION

BBC Research & Development
White Paper WHP 068

Broadcast services enabled by local storage and connectivity

Timothy J Sargeant

Abstract

Local hard disks are changing the way in which users consume audio and video content. Technologies that were previously associated with the computer domain are being investigated to offer rich network connectivity to digital set top boxes, allowing users to simply pass media of different types from home to home. These technologies provide broadcasters and other parties many opportunities for new services, and many challenges.

This document was originally published in the Proceedings of Region 8 EUROCON 2003, The International Conference on Computer as a tool, Ljubjana, Slovenia, September 22-24, 2003.

Key words: Local Storage, Non-linear playback, Peer to Peer, Segmentation, TV-Anytime.

Broadcast Services Enabled by Local Storage and Connectivity

Timothy J Sargeant

BBC Research & Development

Tadworth

UK

email: tim.sargeant@rd.bbc.co.uk

Development to make creative use of the features provided.

Abstract — **Local hard disks are changing the way in which users consume audio and video content. Technologies that were previously associated with the computer domain are being investigated to offer rich network connectivity to digital set top boxes, allowing users to simply pass media of different types from home to home.**

These technologies provide broadcasters and other parties many opportunities for new services, and many challenges.

Index Terms —**Local Storage, Non-linear playback, Peer to Peer, Segmentation, TV-Anytime.**

I. INTRODUCTION

T HE television viewer and radio listener have more than ever a large choice of content available to them from many sources including: off-air, local disk storage in the home, web servers and removable storage media such as CDs, DVDs and solid state storage devices.

The TV-Anytime Forum [1] specifies a common standard for describing content and how to find it, and a data structure to describe segmentation of programmes.

The Share it! project[1] [2] builds upon earlier work of the myTV project [3], which implemented the local storage of broadcast content on a consumer platform. Share it! is developing a system that enables easy access to, and transfer of, personal content between local storage devices using home-to-home networks. It is hoped that these technologies will enable innovative services through a seamless combination of on-line, broadcast, and stored content.

This paper will introduce some of the technologies described in the TV-Anytime specifications, and the Share it! project, and describe and discuss some of the services and applications being explored by BBC Research and

---

II. INTERACTIVE SERVICES USING VIDEO AND AUDIO

In the UK, the BBC has launched a number of interactive applications, using the digital satellite, terrestrial and cable platforms. Popular services include those where the viewer is able to choose from different programme versions, camera shots, or audio feeds. Sports coverage has exploited this technology extensively, for tennis, football and golf. Factual documentary and educational programmes such as *"Walking with Beasts"* have offered enhanced functionality and video extras. These services are provided by a multi-stream technique, where all video and audio assets are broadcast in parallel.

Non-linear audio drama programmes have also been trialled on analogue radio and the web. In one case, "The Wheel of Fortune"[3], multiple story streams were broadcast simultaneously on different radio stations, and the listener could choose to switch to another by retuning their radio at certain points in the narrative. The service was also offered on the Internet, with multiple streams available.

Another approach to delivery of these and other services may be to locally store programme assets in the home, or in a network, and offer an interactive application to present them to the user in a coherent way. Linking to other materials can provide an even deeper and richer user experience.

III. TV-ANYTIME

The TV-Anytime forum is a worldwide organisation consisting of around 80 member companies from many parts of the industry, including consumer equipment manufacturers, broadcasters, content producers and telecommunications companies. Several specifications have been produced, and are available for download from the TV-Anytime website [1]. The TV-Anytime metadata specification [5] defines a document structure in terms of an XML Schema that includes descriptions of programmes, programme groups, programme schedules, user preferences and profiles, and segmentation information. The use of segmentation information to provide a non-linear enhanced application is described.

A. *Segmentation using TV-Anytime*

TV-Anytime's SegmentInformationTable allows definitions of programme segments to be expressed. A segment is a continuous fragment of a programme, with a defined start and optional end point, defined relative to the start of the programme. Segment definitions are not embedded with the programme stream, so there is great flexibility over re-purposing content, and providing multiple segment definitions for a single piece of content. The means by which metadata is synchronised with the content is left to the underlying delivery mechanism. Metadata such as title and synopsis can be provided for each segment, which can be a bookmark (where only a start time is specified), or another type of segment where both start time and duration are specified. Figure 1 shows a SegmentInformation description object, describing title, synopsis, and the location of the segment (based on a reference to a programme, start time and duration.

```
<SegmentInformation segmentId="9861235h21g2">
    <ProgramRef crid="crid://bbc.co.uk/2356669812647"/>
    <Description>
        <Title type="main"><![CDATA[Paraguay]]></Title>
        <Synopsis><![CDATA[1 million years ago. There have been many
species of the Sabre toothed cat, but the largest is the Smiladon. Here we meet
a 7-year old male called half-tooth.]]></Synopsis>
    </Description>
    <SegmentLocator>
        <mpeg7:MediaRelIncrTimePoint>13</mpeg7:MediaRelIncrTimePoint
        >
        <mpeg7:MediaIncrDuration>60784</mpeg7:MediaIncrDuration>
    </SegmentLocator>
</SegmentInformation>
```

Figure 1: SegmentInformation object

Segments can be grouped to create a number of different viewing experiences. A flexible structure is in place, allowing many segments (which may come from different programmes) to belong to any number of groups. Groups may also contain other groups. Figure 2 shows the relationship between segments, segment groups and programmes more clearly.
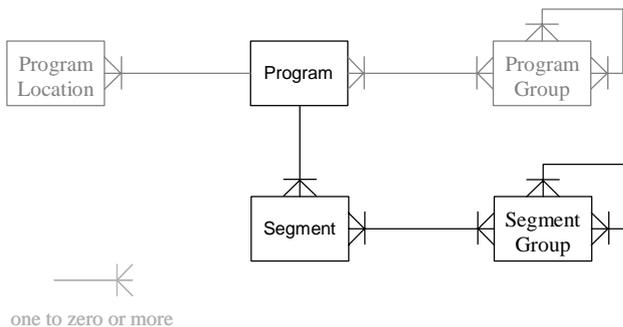

Figure 2: Entity-relationship graph for the segmentation-related components of a TV-Anytime system, where a 'one to zero or more relationship is shown as

One example of use may be a football match, where a broadcaster defines a segment for each goal, each pass, and each tackle. These could then be placed into groups representing 'the best tackles', 'all the goals', and so on.

Another example may be where a viewer consumes segments of video or audio content originating from a number of programmes as a 'virtual programme'.

B. *Implementation of a Prototype Segmented Application*

A prototype interactive television application, based upon the Multimedia Home Platform (MHP) was written. The application runs on a set top box, and uses the television as a display device and a standard remote control as a user input device.

The application runs on a set-top box developed within the myTV project [3]. This extends the MHP platform by providing additional APIs to access content off-disk and metadata from a local database. The Java application sourced the TV-Anytime SegmentInformationTable over an IP connection to a server and used the MHP and myTV APIs to load and control the playback of content from disk. A custom XML parser was written to handle TV-Anytime segmentation data, which was displayed on screen, as shown in Figure 3.
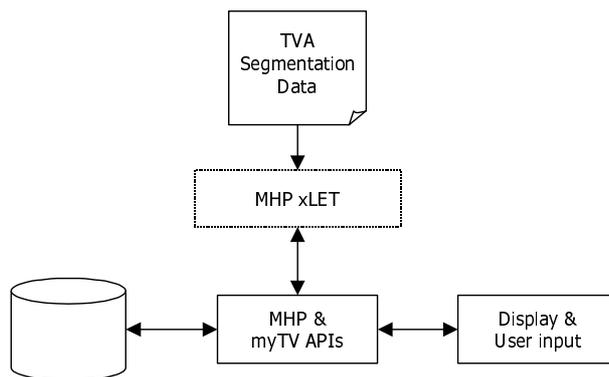

Figure 3: Simplified application overview

The application was built around the BBC's *Walking with Beasts* – a natural history programme that mixes real video footage with CGI generated and puppet representations of prehistoric beasts, which was originally broadcast with an associated multi-stream interactive application. The prototype application described here allowed the viewer to select from a number of different broadcaster-defined segment groups (including the whole programme, an animal overview, and a short review). Once a group had been selected, the viewer could display metadata for each of the segments and skip around the programme. A screenshot from this application is shown in Figure 4.
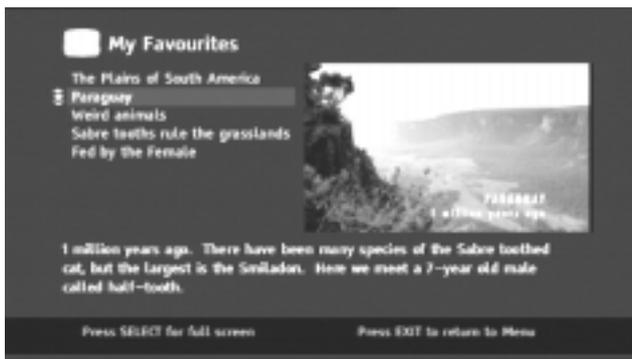
Figure 4: Segmented Application using TV-Anytime data

Whilst the application worked well with the *Walking with Beasts* programme, other programme types are equally suited to this type of application. Some examples include:

- *News programmes.* Topics can be represented by segment groups (local news, international news, business news, etc), and each news article represented by a segment.
- *Educational programmes.*
- *Sport magazine programmes.* Footage of different sports events can be grouped by sport type (e.g. track and field, ball sports, water sports, motor sports).

In effect, the Walking with Beasts application was a generic TV-Anytime segment browser, and could therefore function with other programmes. An enthusiastic response was received when it was shown at the NAB Conference 2003 operating with an American football programme, and news programme.

C. Creating Content and Authoring

Broadcasters are used to producing high quality video and audio content for linear consumption. As tools become available to enable non-linear consumption of this material, a number of issues are raised:

- can editorial consistency be maintained when programme elements are watched in an order other than first intended?
- should 'segmentation friendly' edits be produced (using techniques such as fading video to black or audio to silence)?
- who should produce the segmentation descriptions; the original production team, another skilled team, a third party or home users?

Whilst there are many different opinions on the correct answers to these questions, it is clear that some programmes will be more suited to non-linear presentation than others. Where the experience of watching some magazine-type programmes may be enhanced by segmented viewing, programmes having a strong narrative flow are unlikely to

benefit from segmentation applied in retrospect or in an arbitrary manner.

A number of techniques exist for authoring and delivering segmentation data.

Where a live programme is showing (e.g. live coverage of a sports or music event), TV-Anytime defines metadata fragments to allow incremental updates to be delivered over-air or an IP connection. Under these circumstances, a broadcaster or service provider could mark up and deliver segment descriptions to the viewer in near real-time, allowing the user to review highlights or skip to earlier points in the programme.

For recorded programmes, segmentation information could be authored manually, or semi-automatically by export from non-linear editing systems. Finally, third parties (including end users) are able in principle to author segmentation information for programmes.

By itself, TV-Anytime segmentation offers lots of opportunities for innovative broadcast services. However, by adding additional functionality as described below, even richer user experiences are possible.

IV. SHARE IT!

The European Union IST 5th Framework project Share it! was established to explore technologies that build on local storage in the home by offering additional functionality such as rights managed peer to peer file sharing. The user is able to pass both home produced and broadcaster sourced content to other users, where they have or are able to obtain permission. Further details of the Share it! system, including a description of discovery, search and transfer of content as well as rights management and security, can be found in [6].

A. Networked Services

Whilst a true peer-to-peer network operates on the principle that equal peers host and serve content to one another, the Share it! protocols support other devices such as servers and storage devices in the network. These networked devices enable a number of additional services to be provided to Share it! peer boxes, including:

- the establishment, management and moderation of broadcaster themed user groups, perhaps built around a particular programme or editorial theme.
- the management of search and location requests for content.
- the provision of high-speed access to pieces of pre-cached programme-related material
- the provision of higher-quality live streams of content to peer devices over fast network connections.

B. Applications

By incorporating TV-Anytime segmentation with the peer-to-peer aspects of the Share it! system, a number of

interesting television-based application possibilities emerge. Users are given access to a rich variety of content from a number of different sources; including off-air, off-disk, from peer boxes, and from other storage devices in the network.

This section describes an application concept being developed around a factual travel programme. The viewer is able to select and watch different segments, and for each segment is offered a number of related pieces of content, which may include text, video, audio or images. A package of this related material can be delivered to the box and sourced from local disk giving seamless and near-instant access. Pointers to more specialist or esoteric content can also be provided, which can be acquired from the network. Additionally, broadcasters often have many hours of archive footage that could be made available by providing pointers to servers hosting the content in the network.

Figure 5 shows a prototype screenshot of the application, offering three pieces of content related to the programme segment.
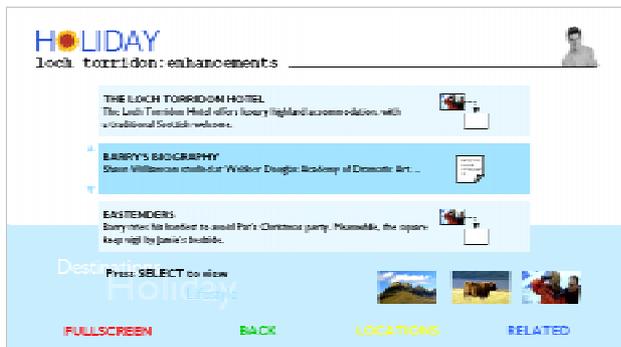

Figure 5: Programme Enhancements

Such services become even more compelling when users are encouraged to contribute their own content to a moderated user group to which the application has access. This home produced content can be offered alongside broadcast content to other peers using the application. Figure 6 illustrates this process.
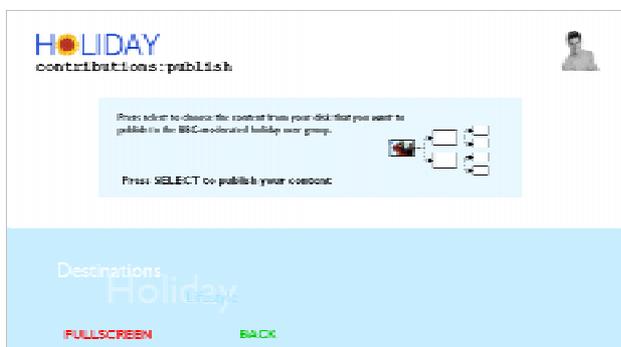

Figure 6: Submitting Content to a User Group

Additional services can be offered to the user through the application, such as searching the user group, networked metadata servers, or the wider peer-to-peer network.

V. CONCLUSION

This paper has introduced new technologies aimed towards the television domain. In particular, the potential impact of TV-Anytime segmentation and the work of the Share it! project on interactive television applications has been discussed.

Such technologies provide opportunities for broadcasters and other parties to create new services that encourage viewer's interest in television programming.

Above all, they offer the viewer easy access to a rich variety of content, that is presented in a user-friendly manner.

REFERENCES

[1] TV-Anytime Forum, http://www.tv-anytime.org
[2] The Share it! project,
    http://www.extra.research.philips.com/euprojects/share_it/
[3] The myV project,
    http://www.extra.research.philips.com/euprojects/mytv/
[4] The Wheel of Fortune, http://www.bbc.co.uk/radio4/wheel/
[5] The TV-Anytime Forum: Metadata Part A, Specification Series: S-3, http://www.tv-anytime.org
[6] J. Walker, O. J. Morris, and B. Marusic, "SHARE IT! - A rights-managed network of peer-to-peer set-top-boxes- System Architecture", IEEE Region 8 EUROCON 2003 conference "submitted for publication"