

Technical Note
n.6301
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Technical description

B2C advanced DVB-T video recording solution.

Additional “extra content” for the recording packages are provided by the P2P network.

The recordings can be protected with domain licenses such that the locally created cross media content can be used anywhere within a domain, - for example the home.

Description of Content

Recordings of BBC DVB-T broadcasting enriched with extra content coming from the P2P network.

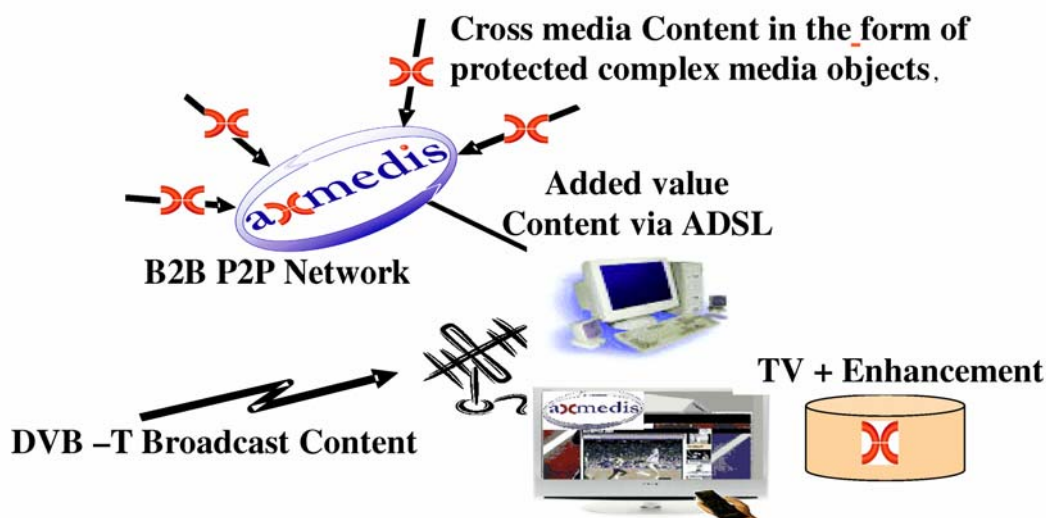
Business Model

Revenue from content distribution to consumers could be earned based on two basic models:

- Consumer pays the distributor for content or for the service;
- Free of charge content.

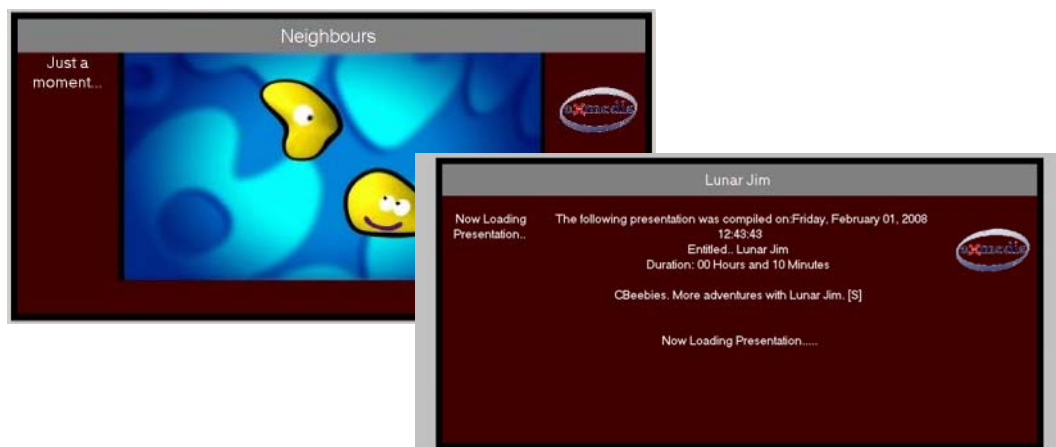
AX4HOME DVB-T Recorder and Broadcast Enhancer

The AX4HOME show case is built around the capture of off-air content selected from an Electronic Program Guide and the subsequent creation of an AXMEDIS object on the client from a number of sources, including: the captured off-air recorded file, a supporting TV-Anytime metadata server and any associated ‘broadcast enhancements’. Enhancements take the form of AXMEDIS objects, distributed over the internet, with extra related content for the user such as trailers, promotions, news flashes, games and so on.



AXMEDIS Tools applied to a home environment scenario. Enhancing Off-air content with internet delivered components creating local complex objects

The resulting AXMEDIS object produced on the final user computer/device is a programme that takes the form of a sequence of presentations of audio and video combined with associated text with some interactivity. This presentation is controlled by the SMIL script embedded within the AXMEDIS object that was generated along with the AXMEDIS object at the time of creation using the AXMEDIS Rule Executor running the AXMEDIS Rule Script described below.



The presentation of the final complex object to the viewer

Beginning with the textual presentation of time of recording, programme title and other details from the TV-Anytime metadata service, the side panels show the AXMEDIS logo and a message that the main presentation is loading. This page is



presented whilst the player loads the video presentations.

The video presentations are in 16:9 format and occupy the central panel, leaving the two side panels for logos and programme summaries. Typically the first presentation would be a seasonal promotion, related to service the main off-air programme was taken from. Then a channel ident can follow, and finally the recorded programme. Other areas include the header banner displaying the name of the recorded programme.

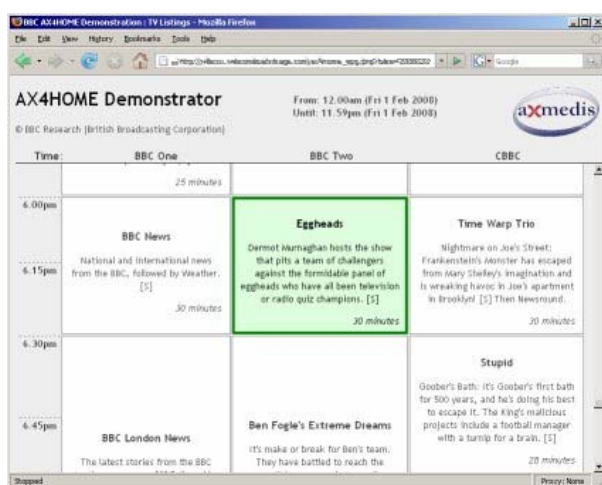
AX4HOME, Broadcast Content Capture and AXMEDIS object

The AX4HOME tool for the final users allows registering DVB-T off-air programmes selected from an EPG and creating AXMEDIS cross media content with additional interactive content inside.

User selection of a programme to be recorded from the broadcast schedules is made through a web browser EPG, hosted by the BBC. The user sees a grid of programmes organized by service and time. Each entry gives the title and duration of the programme. Once selection is made by clicking on the chosen programme square the recorder automatically scheduled to record.

The process of recording capture is initiated through the selection of the programme from a web based Electronic Programme Guide (EPG). A separate executable is registered in the Microsoft Windows Registry as a "protocol handler" for the "crid://" protocol. This provides the bridge, from a user clicking on a programme listing on the Electronic Programme Guide (EPG) web page, to a recording request being scheduled in the Ax4Home Recorder application.

The EPG web page identifies programmes using the TV-Anytime Content Reference ID (CRID). These IDs are mapped to Service IDs and Event IDs that will identify the programme within the DVB-T broadcast stream. The mapping is performed by querying a BBC TV-Anytime metadata server via HTTP.



User selects broadcast content from EPG

The 'now and next' information is data available from the DVB-T broadcast transport stream inserted by the broadcast head-end to provide the end user with running information on the broadcast programmes available. This is carried in the standard DVB Service Information (DVB-SI) format, as 'present-following' data in Event Information Tables (EIT) in the transport stream Programme Status Information (PSI) data.

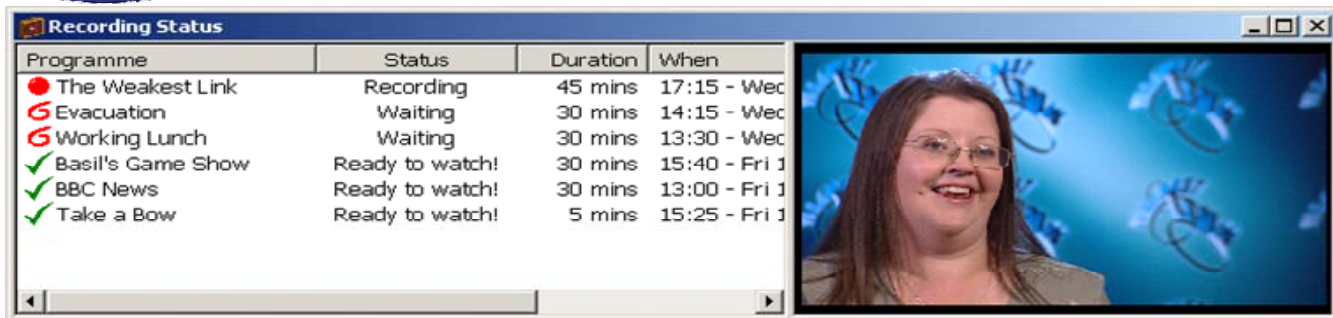
When the "now and next" information changes, this indicates that a programme has started. The recorder determines if it needs to be recorded by matching the DVB Service ID and Event ID of the scheduled requests to the Service ID and Event ID of the newly commenced programme.

The following figure represents the AX4HOME tool. The user interface allows showing the log of recording capture and playback. The recorder automatically instantiates the AXMEDIS Object building process once the programme file has been captured off air by invoking the AXMEDIS Rule Executor and loading the pre-formed script.

The developed tools for the final users brings together the capture of off-air recordings through a consumer PC DVB-T card and the functionality of the AXMEDIS tools that permit scripts to be executed on the home client that create, manipulate and extend an AXMEDIS object to include other features.

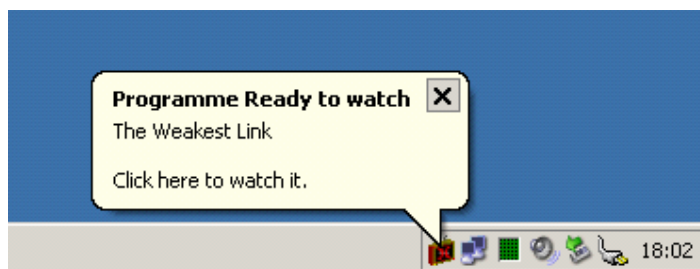


A view of playback and status windows together



The Recorder application presents a list of recordings and their status

General recorder status is also reported to the user through a status information column in the list of scheduled recordings and also by pop up notifications.



Pop-Up Notification of 'Programme ready'

In addition to the listing of AXMEDIS objects, the active component allows automatic loading of the AXMEDIS objects into the ACTIVE X player by double-clicking on the selected item.

Technical Aspects

The AX4HOME client tool includes a DVB-T recording application that has been developed as a background application to run on a Microsoft Windows home PC. It is stimulated for scheduling and recording off-air programmes by the selection of a programme by the home viewer on the EPG. Microsoft DirectShow components are used to control off-air reception, receive, demultiplex and capture the broadcast video. The Microsoft DirectShow components require a Broadcast Driver Architecture (BDA) PC tuning card. In this case we have used a Hauppauge WinTV DVB-T capture device.

The recorder application continuously runs a DirectShow filter-graph containing the Broadcast Driver Architecture components to control the Hauppauge receiver device, receive the MPEG transport stream and demultiplex the audio and video stream. The filter-graph is also used to extract basic "now and next" programme schedule information, allowing the recorder to determine what is currently being broadcast on each channel.

Built using the MFC components and C++, the interface comprises the ACTIVE-X AXMEDIS player in a frame that also encapsulates the live TV preview window, a directory listing of the AXMEDIS Objects available and a general purpose 'status output' text box, to allow monitoring of the recorder activity and status.

To start a recording, the recorder reconfigures the de-multiplexer to de-multiplex the broadcast channel to be recorded. The filter graph also contains a custom component, designed to retrieve the de-multiplexed audio and video stream and save it to disk. When not recording, this component is simply configured to ignore the data. When recording, it is ordered to write it to a file.

When a recording completes, it is added to an internal job queue. A separate parallel thread processes jobs from the queue one at a time. This invokes the AXMEDIS Rule Executor to post-process the video and create the final AXMEDIS object that combines the recorded video and enhancements. The generic rule script designed for this process and described further in the sections below is customised by the recorder application (a simple textual substitution step) for the specific details of the programme to be packaged, such as the location of the source video file and the CRID identifying the programme.



Control of the formulation of the AXMEDIS object is through the AXMEDIS scripting environment. The AXMEDIS scripting rules have been designed to determine the appropriate broadcast enhancements available to the home client at the time of recording and access these to build the AXMEDIS object. In addition, the AXMEDIS rule scripts formulate a SMIL presentation script to bind the resources, both off-air and internet delivered, into a single meaningful presentation to the home viewer. This presentation is incorporated into the AXMEDIS object being created and forms the primary presentation that the home viewer will experience when they play it back.

Functionality Contained in the AXMEDIS Rule Script

The AXMEDIS Rule script that composed the SMIL presentation script is deliberately quite generic: it generates a SMIL script with which the enhancements are displayed first and then the off-air programme. The nature of the enhancements, that might include news, trailers or weather reports, is not determined by the script but instead by the author of the enhancements. The choice of which enhancements to incorporate into the presentation is determined by the AXMEDIS Rule script author. In this case, it depends on a simple algorithm that matches the broadcast service channel (eg, "BBC One") to the latest enhancement in the download directory (eg, "BBCOne_enhancement.axm").

The AXMEDIS Rule Script is executed on the home client by the AXMEDIS Rule Executor to create the AXMEDIS object. It has been designed and tested using the AXMEDIS Rule Editor as the authoring tool.

The script that executes on the home client to create the AXMEDIS object implements the following operations.

1. **Incorporating the off-air recording.** The filename of the off-air recording is inserted into the script 'on the fly' by the recorder application. It also includes the DVB service ID and Event ID, used by the recorder to capture the file from the broadcast, and also the TV-Anytime Content Reference ID (CRID) of the programme. These act as input parameters to the AXMEDIS Rule Executor.
2. **Retrieve TV-Anytime Data.** Using the programme CRID, the AXMEDIS Script queries, via HTTP, a BBC TV-Anytime metadata server to fetch programme information relevant to the programme (such as its title and synopsis). This information is returned as an XML document.
3. **Parsing XML with XML4J.** Using the AXMEDIS Script XML4J functionality, the incoming TV-Anytime metadata is parsed and textual objects formed containing the main items for presentation, including Title, Service name, Synopsis, related media URL and so on.
4. **Building the SMIL.** As the textual objects are created, so the SMIL template is expanded to produce an output SMIL file. This process is extended further as the related enhancement AXMEDIS object is located and opened. The number of objects within the enhancement is not predetermined but discovered during script execution. The corresponding output SMIL entries are authored according to the number of discovered entries in the enhancement. The text displayed during the rendering of the promo videos is currently generic.
5. **Transcoding.** Optionally, the video adapter plug-in, circulated with the tools, can be invoked on the recorded file.
6. **Creating the AXMEDIS object.** The script then assembles the resources into an AXMEDIS object, placing the newly generated SMIL presentation first in the order. The AXMEDIS object can be written out as ".mp21" (MPEG21) or ".axm" (AXMEDIS) format files.
7. **Protecting.** Optionally, the protection algorithm can be invoked on the object. This also creates and issues a user license which is stored remotely (posted) on the AXMEDIS Licence (PMS) server. This licence can be user based or user home domain based.

At the end of execution control is handed back to the AX4HOME application for reporting.

The AXMEDIS Object Model is a solution for modeling distributing content. It has also been designed to be used in conjunction with:

- **AXMEDIS AXCP** to automate your content production, protection and distribution as stated above and in more details into the technical note:
http://www.axmedis.org/documenti/view_documenti.php?doc_id=3624



- **AXMEDIS DRM** which adopts MPEG-21 DRM, including servers and licensing tools and allowing DRM, detection of attacks, black list management, collection of actions logs containing traces about the rights exploitation, tools for administrative management, etc.
http://www.axmedis.org/documenti/view_documenti.php?doc_id=3616
- **AXMEDIS P2P Controlled Network**, for content distribution via P2P. It utilizes BitTorrent Technology with query support and cataloguing servers, for protected or non protected content. It has capabilities of automating content publication, controlling P2P network, and extracting statistical data and reports. The AXMEDIS P2P solution allows to control the network by means of control nodes that can be geographically distributed:
http://www.axmedis.org/documenti/view_documenti.php?doc_id=3612

Benefits of the Recorder Application Using AXMEDIS Support

The home user

This application provides end user (viewer) benefit through the provision of a 'live platform' beyond the simple capture of off-air programmes and offers the possibility of more targeted information based on promotions or information services such as news or weather. This gives the viewer a more complete viewing experience and connection to a reactive service based around chosen scheduled items.

Enhancement services can be high value and personalized to the end user and these can be viewed and transferred to machines around the home.

The Broadcaster

The application offers benefits to the broadcast service provider through the promotion of a rights managed platform that encourages use within the home but discourages redistribution. It allows a closer relationship with a modern audience not prepared to watch a linear broadcast service at broadcast time but who instead prefer to benefit from time shifting selected programmes. It embraces PC culture by utilizing internet and wide band delivery to allow cross media presentations and opens up new possibilities for viewing presentations of stored content.

AXMEDIS Tools for your download

In the following, the links to download the most important AXMEDIS player are reported. It is also possible from the AXMEDIS portal to download additional AXMEDIS tools and content:

- Available PC players are:
 - AXMEDIS stand alone PC player;
http://www.axmedis.org/documenti/view_documenti.php?doc_id=3767
 - AXMEDIS Skin based PC player;
http://www.axmedis.org/documenti/view_documenti.php?doc_id=3716
 - AXMEDIS Active X, for usage into HTML pages and simple VB and/or .NET applications and PC players. .NET Player; http://www.axmedis.org/documenti/view_documenti.php?doc_id=3717
- PDA Windows Mobile 5 and 6 player, supporting: SMIL, HTML, MPEG-4, video, audio, documents, images, etc.; http://www.axmedis.org/documenti/view_documenti.php?doc_id=3842
- Many other tool from:
http://www.axmedis.org/com/index.php?option=com_content&task=view&id=83&Itemid=55

Show case web page:

http://www.axmedis.org/com/index.php?option=com_content&task=view&id=113&Itemid=64&Itemid=45

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