

IST-1999-11702:

myTV

*personalised services
for
digital television*

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myTV Consortium Members:

P01	Philips Electronics Netherlands	Philips NL	NL
A01a	Philips Italy	Philips It	IT
A01b	Philips United Kingdom	Philips UK	UK
A01c	Radiotelevisione Italiana	RAI	IT
P02	British Broadcasting Corporation	BBC	UK
P03	Nokia Corporation	Nokia	Fin
A03a	Nokia Home Communications	NHC	S
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Project overview

myTV is a European project focussing on future digital Television. The project consortium consisted of Philips, Nokia, BBC, NOB (Dutch Broadcasting Services Corporation), the University of Ljubljana, and NDS as an assistant contractor. myTV is funded by the European Commission under the IST program. The project started January 2000 and finished in December 2001.

The project goal was to apply solutions of information and communication technology to digital television broadcasting. By integrating extensive use of local storage with internet connectivity new opportunities for digital television are created. In the project we decided to put a major emphasis on open standards and interoperability, since we believe that only in this way new digital services can be implemented.

Early in the project it was decided that the focus would be on a set top box implementation that combines TV-Anytime, MHP, local storage and Internet. This combination leads to the following observations:

- Local storage in a set top box or personal video recorder can drastically change the way people watch television. The pause functionality offered by the possibility of simultaneous playback and recording using a hard disk frees customers from exact broadcast schedules.
- TV-Anytime takes this principle a step further and investigates how by means of local storage TV programmes can be consumed at any time.
- MHP provides a standard platform for set top boxes that allows applications to be downloaded onto a set top box and executed allowing for interactive digital TV.
- The internet connection provides an alternative source for obtaining TV-Anytime based meta-data. Additionally the internet connection can be used to provide remote access to the set top box allowing users to program their personal video recorder from anywhere in the world.

The combination of TV-Anytime, MHP, local storage and Internet allows us to create a versatile digital television platform based on open standards that is interoperable in two ways. First, a myTV device can run multiple services and second, a service can run on myTV devices of different manufacturers. The interoperability was demonstrated by developing two platforms. Each platform has its own resident navigator providing a user interface to the TV-Anytime based personal video recorder functionality, but both platforms can execute the same MHP applications. In total 3 MHP applications were developed, (BBC Navigator, Segmented latest news, RAI segmented regional News). The developed platforms and applications allowed us to validate our ideas before proposing solutions to the TV-Anytime forum.

In the next sections we will describe the project's results. Starting with our contributions to TV-Anytime and MHP. Next the two myTV box implementations, remote access to the box, and the meta data services are described in section 4,5 and 6. Thereafter, each application is discussed in section 7. Followed by dissemination, exploitation and conclusions.

1. myTV in the IST programme

Within the framework of the IST programme, the myTV project fits well in Key Action IV, "Essential Technologies and Infrastructures". Here, convergence of broadcast and Internet technologies is essential to the information society. The interoperability issue and the goal of personalised consumer services and products facilitating access to content form the strongest correspondence between the programme and the project objectives. The provision of intuitive means of interaction with systems, the application of mass storage, and means for content and information management are also significant points of agreement.

Within Key Action IV, the myTV project fits in well with action line IV.6.1 "Adaptable multi-sensory interface". Some of the matching characteristics include:

- Interoperability issues for high quality services over Internet and broadcast networks.
- The creation of open standards for protocols and tools supporting such services.
- Contribution to protocols and open standards, including TV-Anytime, API's, STB and DVB MHP initiatives.
- The integration of Internet and broadcast components, local storage and networking.
- Distributed and interactive access to personalised adaptable TV. Providing consumers with options to create their own personalised services, such as personal virtual TV channels etc.

2. MHP

MHP, the multimedia home platform, is a new standard for interactive digital television (see www.mhp.org). It allows downloading of applications to a set top box via a DVB stream. Using MHP broadcasters can develop applications and send it along with a TV-programme. In the myTV project we focussed at extending MHP to include API's that can deal with storage. By adding new storage APIs broadcasters can make use of the local storage capacity through MHP applications. These extensions to MHP are currently being discussed in the MHP 2.0 standard. The definition of these functions has a major impact on what is possible with a box. The answer to the questions; Who owns the storage? Can broadcasters record programmes for the user? Is the user still in control? depend on the definition of these functions.

Next to extending MHP with storage, additional work was done to implement API's that support TV-Anytime functionality. These API's were completely written in Java which had the added benefit that it was easy to demonstrate and test TV-Anytime functionality on multiple platforms. The TV-Anytime API's developed within the project are quite extensive. The most important ones are (this list is by no means complete, but it does illustrate the major building blocks):

- Database API
For storing and accessing TV-Anytime metadata.
- Content Resolution
For resolving Content Reference ID's to a time and location.
- Recording Scheduler

- For managing recording, deletion requests.
- Remote programming
For programming the myTV box from a remote location through the Internet or a Wap phone.

Together with the already available MHP software stack, the API's developed within the project provide a ready to use platform for TV-Anytime based MHP applications running on a settop box equipped with storage.

3. TV-Anytime

TV-Anytime is a forum that develops open specifications designed to allow Consumer Electronics Manufacturers, Content Creators, Telcos, Broadcasters and Service Providers to exploit high volume digital storage in consumer platforms (see www.tv-anytime.org). The TV Anytime forum has developed four key specifications, which cover content referencing and location resolution, metadata, rights management and protection, and an overall systems specification which addresses the integration aspects.

Metadata is the term used to describe information about TV programmes, which can be human readable (title, genre, etc.) and/or machine-readable (audio type, aspect ratio, etc.). The primary use of TV Anytime metadata is to attract users to content and to provide users with enhanced information on that content. In this context "content" can refer to an individual TV programme, or to a large group of programmes that are in some way related. Each of these entities is assigned a content reference identifier (CRID). By delivering metadata in a standard format the user is able to discover new content in easy, and potentially novel, ways.

Using the CRID it is possible for a PDR to flexibly capture the content by means of the location resolution process. This process allows a PDR to capture a programme or its repeats, regardless of which channel it is broadcast on and even when its broadcast schedule changes.

During the lifetime of the myTV project, it has strived to provide significant contributions to the TV-Anytime forum. Its aim has been to enable the creation of an open standard that allows many new features for consumers, creates new value chains for the 'players' in the broadcast TV market, and is implementable without undue costs.

At the time of writing, the myTV project has submitted more than 20 proposals to TV-Anytime. This includes proposals for meta-data definitions, transmission of meta-data and CRIDs over DVB and over IP, programme segmentation data, and CRID resolution mechanisms.

4. The two myTV boxes

The myTV-box implementation is based on TV-Anytime delivery architecture. This TV-Anytime delivery chain starts at the broadcaster, and ends in the myTV-box. One of the primary aims of the myTV-box design is to provide true interoperability, both across different TV-Anytime service providers and across different box manufacturers. During the project, two distinct but interoperable myTV-boxes were designed and developed both by Nokia and Philips.

The requirements of the myTV-box can be summarized as follows:

- The myTV box must be capable of receiving DVB streams.
- Decompressing MPEG-2 compliant audio and video streams must be possible in real-time.
- It must be possible to mix computer generated graphics with decoded MPEG-2 video streams to create overlays.
- Must contain local storage, to store recorded TV-programmes and other types of data.
- The myTV box must have an Internet connection to enable third-party service provision of TV-Anytime services.

4.1. Nokia's myTV box implementation

Nokia's myTV-box hardware implementation is based on Nokia Media Terminal architecture. The Media Terminal is implemented using an open architecture, so it is well suited also for the myTV-implementation. The Media Terminal has all the needed hardware devices and features, that the myTV-implementation requires, like local storage, network interfaces, MHP-support and so on.



Figure 1: Nokia Media Terminal

Nokia's myTV-box software implementation is based on the software architecture of the Media Terminal, which is called OST (Open Standards Terminal). The goal of OST is to provide an architecture that supports different flavors of applications: the applications that are written directly for this platform, those written for the Linux community, the Mozilla browser and browser-based applications, and applications needed for the support of the system. Applications written directly for this OST include Nokia-supplied and other vendor-supplied applications, including the DVB viewer apps, record capabilities, and the navigation application. One application framework is MHP. The myTV-API is built partly on MHP and partly directly on the system software, because the current version of MHP doesn't support the local storage system.

4.2. Philips' myTV box implementation

The Philips' myTV box is based on an existing hardware design developed by Philips Research Redhill. This design was originally developed as a prototype platform for demonstrating MHP functionality. The implementation of the design is such that it resembles as much as possible a commercial low cost, small size set-top box with a Philips TriMedia processor as its core.

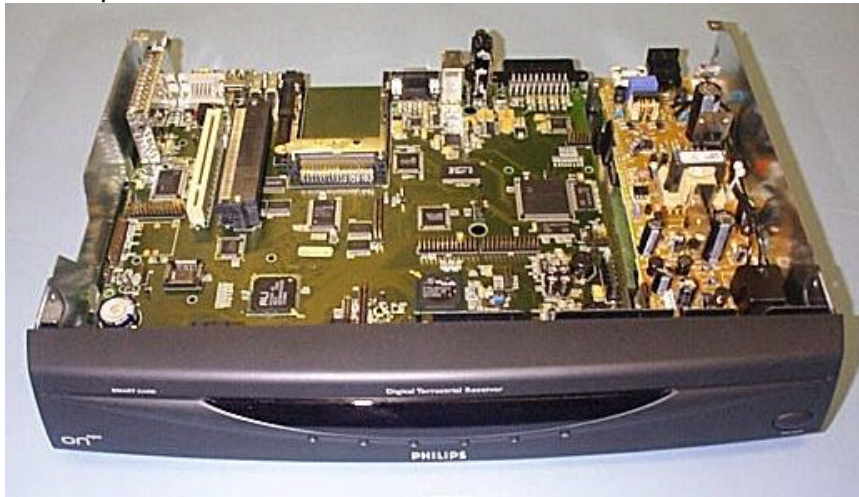


Figure 2: Philips' personal video recorder prototype

The software stack used within the project consists of an MHP stack with additional API's for storage. Storage API's were added to the MHP stack to allow downloadable MHP applications to access local storage. This allows downloadable applications to record the latest news, for example. The work done within the project on adding storage to MHP can be used as input for the MHP 2.0 specification.

5. Remote access to the box

With the assumption that the myTV box is connected to the Internet it becomes possible to access the myTV box at home from anywhere in the world. To programme the myTV box two different applications were considered. First, *direct connection to the STB* and second, *connection via a 3rd party server*. In the first case the user accesses the myTV box and has full access, i.e. the user can perform most options that are normally available remotely as well. In the second case the user visits a service that connects to the myTV box. An example is a fanclub website where by clicking on an image of a movie, a recording suggestion is sent to the myTV box at home.

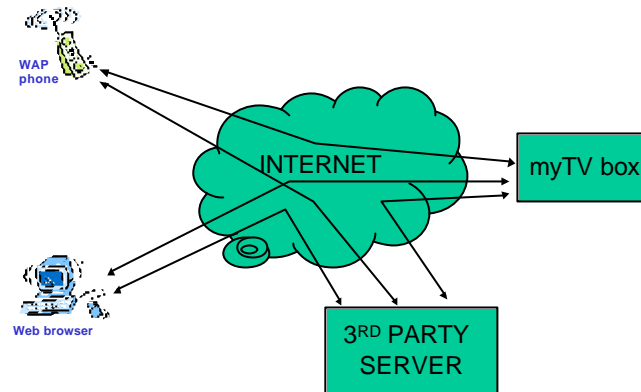


Figure 3: Connections to the myTV box

For remote programming any webbrowser can be used. The user makes a connection to the box by entering the box URL in the web or wap client. Thus, providing a username and password for security reasons, he has full access to the box as he would have been at home. He can manage the recorded contents, the contents that are marked for recording and add new contents to the list of marked for recording.

The myTV-box provides HTML output that will be displayed by the browser (see picture below). Additionally a WAP phone can be used for remote programming. When a connection is made by a WAP phone the myTV box responds with WML output. During the design of this user interface we had to take into account that only very little information can be displayed on a phone's screen and also deep nesting of menu's is not preferred.

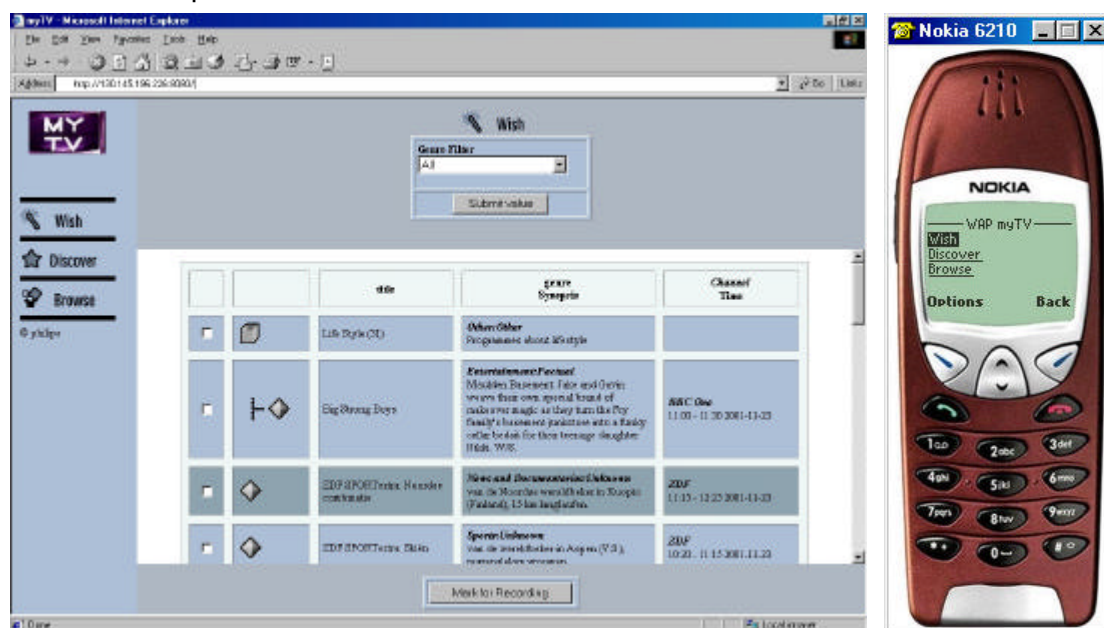


Figure 4: Left: Remote programming using a web browser,
Right: Interface on a WAP mobile phone

In the project a 3rd party EPG service was developed from where recording suggestions (in the form of CRIDs) can be easily sent to the myTV recorder at home. (see figure 5 below)



Figure 5: 3rd party web interface

For direct access to the box no standardization is required. Each box manufacturer can provide software with each device that can be used to contact it. On the Philips box a small HTTP server was implemented. Using that approach any web browser can be used to control the box. When the box has a permanent connection to the Internet near real-time interaction is possible from a remote location. In the case of a WAP phone the box needs to respond with WML. Therefore, the HTTP server needs to distinguish between the two kinds of requests, WEB and WAP, and generate the appropriate response.

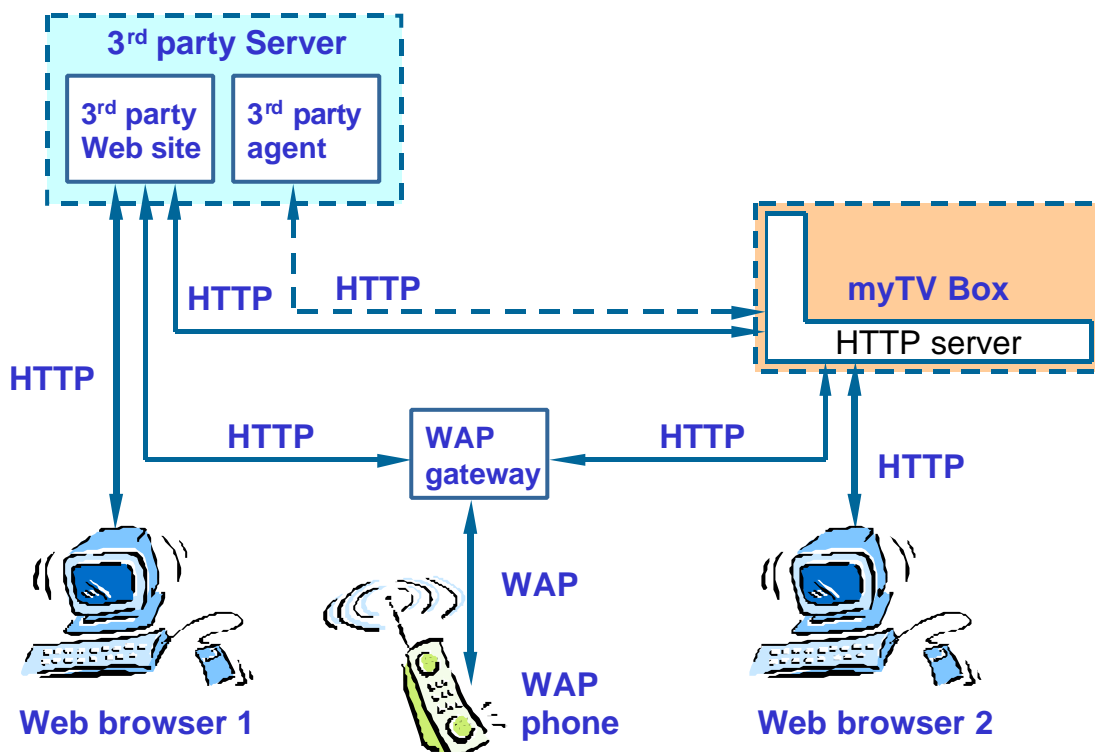


Figure 6: Options for myTV box connections

In the second case, 3rd party requests, standardisation is important. The implementation of 3rd-party websites should not differ per box manufacturer. We again propose an HTTP based solution to solve this problem. In the myTV project requests from a 3rd party server should be interoperable between the Philips and the Nokia box, therefore they were defined within the project.

This "TVA-compliant" service provides the user with the ability to find information about TV programmes on a 3rd party *web* or *wap* site. When the user finds an interesting programme while searching or browsing on a 3rd party web/wap site, a "mark for recording" request together with a CRID is sent to the myTV box. In order to avoid misuse of this feature the myTV box asks for authentication (HTTP basic authentication) before proceeding with the recording.

It is also possible for a 3rd party agent to send a "suggest for recording" request together with a CRID to the box. This can be done automatically by a 3rd party server (e.g. one suggestion a day chosen by the server's agent based on a user profile) Depending on the box implementation this suggestion can be automatically recorded or it waits for the user to confirm it (to avoid misuse).

Definition of the requests

The myTV project proposes to embed the 3rd party request into a URL. This URL consists of an IP address and a port number followed by a path. The pathname is defined as 3p to indicate 3rd party requests. The next part is the method which can be either "mark_for_recording" or "suggest_for_recording" followed by any number of CRIDs. More precisely the syntax is defined as:

http://< <i>IP-address</i> > : < <i>port</i> > / < <i>path</i> > ?Method=< <i>method</i> > [&Crid=< <i>crid</i> >] ^[1,2,...]	
Location string	Query string

Examples of requests are:

http://130.145.195.198:8080/3p?Method=mark_for_recording&Crid=crid://bbc.co.uk/24354

http://130.145.195.198:8080/3p?Method=suggest_for_recording&Crid=crid://bbc.co.uk/2435664&Crid=crid://nob.nl/2435445

6. Transmission of Meta-data

Most functions of the myTV personal video recorder rely on the availability of meta-data for TV-programmes. This meta-data consists of CRIDs (Content reference IDs) and programme descriptions (e.g. title, summary, actors, etc.). When the myTV box has obtained a CRID it needs to find the corresponding broadcast time, date and channel of the program. This process is called resolving a CRID.

To transmit data to a myTV box the broadcast channel, the Internet or a combination of both can be used.

For the DVB broadcast channel the myTV project proposed new tables that can carry references to resolution information and meta-data. The meta-data itself we propose to transmit using a DVB DSMCC object carousel. A specification for handling the

data via DVB was created and used in a multi-channel multiplex created for testing the boxes. The specifications of carriage of this data have been submitted to TV-Anytime, and will be used in submissions to DVB.

For delivery of data via the Internet our proposal is based on widely used standards in the Internet such as IP, HTTP and XML. The Internet Protocol represents the best point-to-point transport mechanism for meta-data delivery to myTV client devices. With respect to application level requirements, it has been decided to adopt simple, standardised protocols that are sufficiently lightweight to place on a PDR. The HTTP protocol is therefore proposed as a meta-data delivery protocol. We also propose to use a standard dynamic HTTP server technology (CGI, Java Servlets, ASP, various server programming interfaces, etc.) to interface with the metabase situated on a meta-data web server.

The definition of TV-programme descriptions is based on XML. XML has the advantage of being human readable, flexible in structure, support for multiple character sets and has several available lightweight parsers. We propose an XML format that can be easily adapted to DVB SI, so that maximum similarity can be maintained between the head end and client systems responsible for handling the data on both DVB and IP networks. The myTV meta-data XML format was developed and specified at an early stage to permit development of the services. This data format is very similar to that being developed within TV-Anytime, sharing almost the same attributes and data model.

Three IP-based programme meta-data servers have been developed. These meta-data services support retrieving meta-data for a CRID, resolving a CRID, asking for a schedule of a service and describing the services that are provided. Thus an application can dynamically access remote databases to find out information about programmes. The meta-data servers developed by the BBC and NOB provide up-to-date information of tv and radio services. The XML structure of the data that is returned by the services allows broadcasters to decide how rich their meta-data will be. A third service was developed by the University of Ljubljana. This service is aggregating the data from NOB and the BBC and adds additional information about football and movies (obtained from UEFA web service and the Internet movie database). This shows that third-party services are enabled by the TV-Anytime open standard.

7. Applications and demonstrators

In the previous sections we discussed the requirements of the myTV boxes, the mechanisms to obtain meta-data, remote access to the myTV box, and our input to standardisation in TV-Anytime and MHP. In the following sections we will describe the applications that were developed on the myTV boxes from a user perspective.

The applications that have been developed in the myTV project consist of resident navigators for each myTV box and a number of downloadable MHP applications. The two resident navigators are developed by the box manufacturers and are capable of using all of the features of the box. With a resident navigator we mean the user interface that is present on the settop box when you buy it. The resident navigators for the Philips and the Nokia myTV box are completely different in design, but obviously use exactly the same data made available by the service providers, thus showing many-to-one interoperability.

The downloadable applications have been developed to demonstrate interoperability using open specifications, and the possibilities created by having rich metadata and local storage. They are written in Java for the MHP platform with extensions to allow access to the storage and metadata. The BBC downloadable navigator provides an alternative navigation tool to the resident navigators. This uses the same data but presents a totally different interface to the user than the resident navigator.

The NOB Latest News application has been developed to show what the combination of local storage and personalisation can achieve. The user is able to create a profile defining his preferences as to which parts of news programmes he would like to see and in which order.

Both of these applications are working on a prototype myTV box. A simple test application has also been developed to demonstrate the features of TV-Anytime that runs on both boxes.

7.1. Philips Resident Navigator

The work on the Philips Resident Navigator was aimed at creating a MHP user-interface to demonstrate the power of the TV-Anytime functionality developed within myTV. TV-Anytime opens up a whole new TV-viewing experience to viewers.

Main features that are supported by the Philips resident navigator are:

- virtual channel created by scheduling content that was recorded automatically by an agent into a full evening programme.
- Trailer recording allowing users to select a programme for recording while watching a trailer of the programme.
- Using hierarchically nested CRIDs, broadcasters can group arbitrary sets of programmes. Group recording gives users the possibility to select an entire group of programmes for recording at once.
- Browsing the hard disk, searching for something nice to watch.
- Users can query a meta-data service to search for an interesting TV-programme.

Since personal video recorders offer a large amount of new features it is important that the main access point, the resident navigator is easy to use. So the resident navigator was developed with usability as the main focus.

To make the resident navigator easy to use a strategy was adopted that organises UI functions into four layers. The organisation of content and functionality between these layers is such that it allows for passive and active viewing. The four layers are:

- Watch layer
The watch layer is a virtual channel automatically constructed for the user by an agent running on the PVR. The programmes in the virtual channel are selected by the agent based on a viewing profile of the user.
- Browse layer
The browse layer displays a table of recorded programmes. Programmes are represented graphically by cubes and are sorted by genre and broadcaster. The viewer can browse through the cubes as if browsing through a library of books.
- Discover layer
The functionality provided by the discover layer is very similar to the browse layer. With one mayor difference that in the discover layer the viewer can “discover” programmes that will be recorded soon (as opposed to recorded programmes in the browse layer). It is called discover layer because the programs in this layer will be recorded at some point in time. However, due to the CRID based mechanism the actual broadcast times need not to be known yet.
- Wish layer
In the wish layer viewers can make a wish to record programmes by specifying a title, actor, genre etc. The system uses the remote metadata services provided by the BBC, NOB and UOL to search for programmes that match the viewer’s wishes.

In figure 7 a picture of the main view of the navigator is depicted. At the top of the main view is the watch layer. Viewers will typically learn to use the system through interaction with this layer. Once a viewer has become familiar with the concept he will start using the others layers (see figure 8). By using the other layers the viewer can exert more direct influence on the choice of programmes recorded.



Figure 7: Navigator main view



Figure 8: Browse layer view

In a layer, every functionality, simple or advanced, can be executed in 2 steps. First the viewer selects an item with the highlight, then he selects one of the actions shown at the bottom of the screen. These actions are directly mapped to keys on the purpose designed remote control. For instance programme information can be displayed by using the information key.

An additional feature made possible by implementing TV-Anytime is trailer recording. Trailer recording has been implemented so that the viewer can record the programme advertised in the trailer by pressing one button on the remote control (at that moment the system stores the CRID that was inserted in the video stream by the broadcaster). In the navigator the trailer recording option is available when the user-interface is hidden from view and the viewer is watching live TV. To indicate that the

viewer can record the advertised programme a small unobtrusive bar is displayed in the top of the screen with the title of the programme.

7.2. Nokia's Resident Navigator

Nokia's Resident navigator is an extension of the Navi Bars concept used for the product version of the Media Terminal. Internet, broadcast TV and local archives constitute the world of infotainment for the home. Navi Bars supports navigation through this world and enables displaying of selected infotainment. The most important task for the Nokia Navi Bars is to be a Service Navigator: a 'desktop for the home' supporting the selection and structuring of stored and/or linked events, services, documents and other infotainment objects. Viewing of broadcast streaming DVB video, and supporting the selection of different viewing options is one of the services that can be reached from Navi Bars. Another is playing and navigating in recorded DVB streams. The Nokia Navi Bars is a navigation menu system, consisting of one vertical and one horizontal bar, which allows viewers to easily navigate between internet, TV and digital content through their TV.



Figure 9: Navi Bars

Nokia's work in myTV has been to investigate and add the concept of personalization to Navi Bars. This has mainly been done by providing the functionality for user profiling, advanced search of programmes and assistance in recording of programmes.

Together with other resident software, such as installation/configuration services, Navi Bars will be realized on top of the *TV-Anytime* module, using both *TV-Anytime*

based API's and MHP API's. The *TV-Anytime* module will handle the communication between the different services.

The development of Navi Bars done in the myTV project has been achieved by adding the following functionality.

- User profile management

This service manages user profiles related to content. It creates and updates user profiles from user input, user profile templates and observed viewer behavior. The user profiles are based on free keyword lists. User profiles are selected in the Service Navigator and could be managed as any other object in the navigator. The user profiles are updated when the user searches for, views or records content.

- Advanced programme search

The advanced programme search finds interesting events to be recorded or viewed using available metadata and the user profile. It has the same function as the EPG in the set-top boxes of today, but is more like a search engine that searches for attractive infotainment and presents the viewer with a set of options for viewing and/or recording. It has a user model based on the user profile or a user selected programme and matches this model against descriptions of the programmes to derive suggestions for viewing or recordings. The finder also finds programmes by matching metadata and user-inputted keywords or other forms of descriptions, such as title, language, time, etc., considering the user model when necessary.

- Recording Agent

This service detects and solves recording conflicts, for example if a requested recording cannot be executed due to tuning resource or disc space limitations. In that case the service will try to solve the conflict itself or ask the viewer for guidance. It has a user model based on the user profile and user ratings of recordings and works in the background, continuously detecting and solving recording conflicts. When a conflict cannot be solved it informs the viewer using a messaging system in the resident navigator. It then asks the viewer to solve the conflict himself, proposing different available alternatives.

Together these three services provide a possibility to personalization by providing suggestions of programmes to view and record and also by providing personalized TV-channels of selected events for the evening. The Nokia Navi Bars allows the user for personalization by providing possibilities to save links to TV-channels, web pages and also to other applications. In addition the Navi Bars also provides a history list of services visited.

The focus of the work in the myTV project has been to investigate how to increase the personalization of Nokia Navi Bars by adding the services above. In practice this means that we allow adding the following functionality for the user:

- A personal on-TV guide for each person in the family
- A personal TV-channel, i.e. suggestions for the evening for each person.
- A personal list of recommended recordings for each person.

- Possibility to create and affect the personal profile
- Advanced search for programmes

7.3. The Segmented Latest News application

NOB (Dutch Broadcasting Services Corporation) created the Segmented Latest News application to show how local storage enables different ways of using recorded content, even at the 'within programme level'. It also shows how broadcasters can offer their viewers extra context and information around already broadcasted material. NOB chose to develop an application around the news, because it is a well-known and popular programme and because it seemed relatively cost-efficient to facilitate such an application coming from traditional broadcasting operation.



Figure 10 Main screen of the news application

Key design-goals were to have a demonstrator that clearly demonstrates the concepts of profiling, random-access and personalisation and to have an application that is easy to use for average viewers. These goals led to a user-interface with a minimal number of options and keys being used in a consistent way. Also much attention was paid to having an attractive television-compatible appearance, because branding is assumed

to be one of the key issues for broadcasters providing new applications.

The application starts with the assumption that a number of newsprogrammes have been recorded. The main screen (figure 10) of the application first of all resembles the styling of the newsprogramme* and provides the viewer with three options: to choose/edit a profile, to select individual items for viewing or to watch a personal version of the news. Editing the profile is a task typically performed only a small number of times. Usually the viewer would choose to watch an item directly or to view the personal news.



Figure 11 Items overview screen

The items-overview screen (figure 11) shows how the items are presented and how the viewer can select different items (the blue rectangle). The icons to the right reveal the item-type ('genre') the item belongs to. The button-bar at the bottom of the screen

shows the viewer which coloured keys on the remote control can be used in this context.

When the viewer presses the blue button, more detailed information on the selected item is shown. This information is taken directly from the newsroom computer system and thus can be made available in a very cost-effective way. When the viewer wants to watch the item, he/she presses the yellow button and the item is played.



Figure 12 Item details provided for each item

The information that provides the starting and ending points of the items within the programme is made available through an XML-file provided with each programme. The XML is based on the TV-Anytime segmentation specification (contained in the metadata specification, SP003) and can be seen as a simple predecessor of it. The programmes themselves are recorded from the DVB-stream supplied to the settop-box. For the demonstrations pre-recorded content consisting of five different Dutch newsbroadcasts were used.

* Actually the same art-director that created the styling of the most popular Dutch newsprogramme also designed the user-interface for this application, thus the styling of all screens is very authentic.

7.4. BBC Downloadable Navigator

The BBC Downloadable Navigator application is aimed at providing an alternative view of programme data and the content available to the user. It allows the user to navigate around both content stored on the disk and content available via broadcast. It is used within the myTV project to test the TV-Anytime APIs and explore issues of access to the disk and other services.

A downloadable navigator cannot hope to implement all of the features of a resident navigator. However, a downloadable application does allow specific services to be implemented well, and can overcome some of the gateway issues of navigation services supplied by a single service provider or box manufacturer. A downloadable application that provides a fundamental feature such as navigation is more similar to application software for personal computers than straightforward service-based interactive applications. The user interface of a PVR, and the functionality it provides, may become more important than the technical features of a particular PVR.

The downloadable navigator the BBC has developed is intended to provide straightforward access to content of interest to the user and explore different navigation features. The main features of the user interface are the virtual channel, the extensive use of programme groups and the exposure of personalisation information to the user. The virtual channel ("myChannel") is intended to be a combination of live, time-shifted, and recorded material which suits the user's interests. The virtual channel exists as a distinct entity – the user can effectively "tune" to their own personalised channel and just watch it.

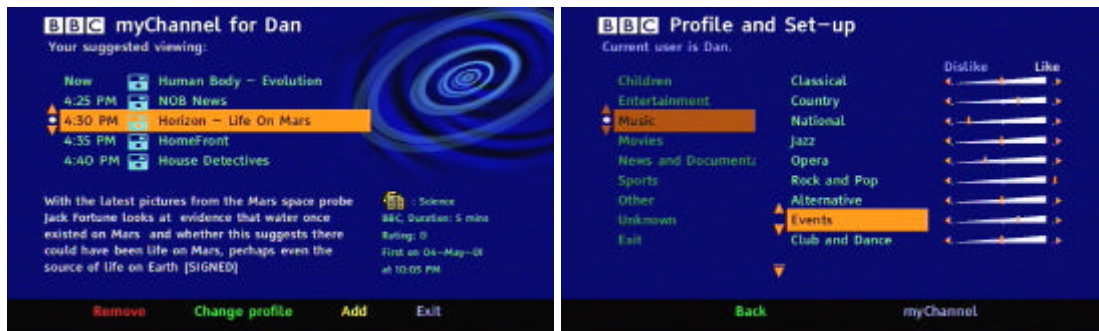


Figure 13 BBC Virtual channel and profile editing/viewing

The screenshot on the left shows the virtual channel screen; this is the main screen seen by the user. The virtual channel contains the programmes that are thought to be of most interest of the user at that particular time of day. The programmes are listed in successive time-order, similar to the running order for a conventional channel. The icons next to each programme indicate whether the programme is live, time-shifted or to be played back from disk. Also shown is a screen where the user can configure their preferences and find out what the personalisation agent thinks what the users preferences are. This is aimed to overcome the fear that the user does not know “what the box is doing”.

7.5. RAI segmented Regional News application

The downloadable MHP application developed by RAI, named TG3-R Interactive and consisting of 20 regional news programmes, is based on video content recorded locally from the TG3-R Carousel broadcast service. The programmes are organised in carousels, cyclically offering news programmes relevant to groups of adjacent Regions. The transmission system automatically inserts the required information (DVB Event Information Tables) in the digital transport stream to automatically operate a Personal Video Recorder (PVR) and can be easily updated to new standards. This pilot service is now under test on the DVB-T site in Turin. The user interface of the application allows selection of a regional news programme and of a single piece of news, enabled by downloading the required textual metadata from a remote server via network connection.

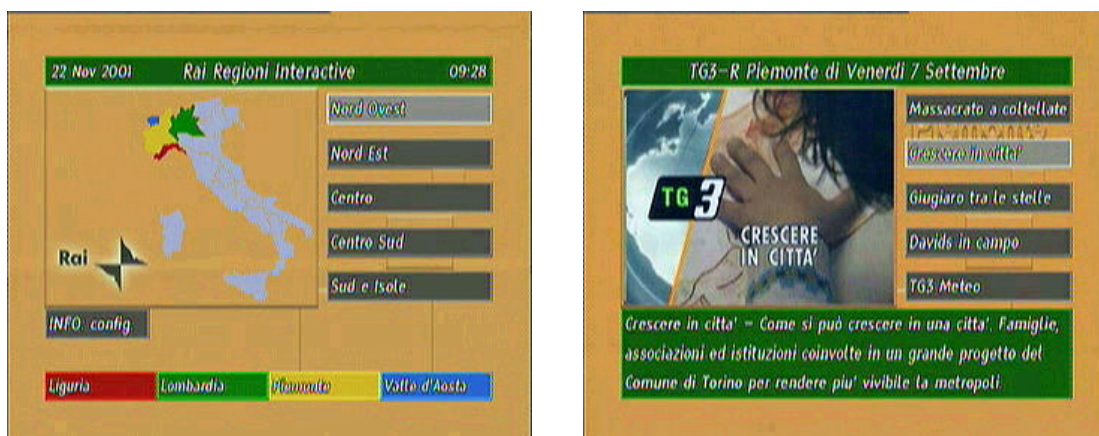


Figure 14: RAI interactive navigator

8. Dissemination and exploitation

The main focus of the myTV project was on standardisation, we believe that only open standards can provide new opportunities for future enhanced television on a large scale. Through open standards the chicken and egg problem of introducing new functionality can be made less severe, though not completely solved. With this we mean the fact that broadcasters see no need to transmit meta-data if there are no devices that make use of it while at the same time CE-manufacturers are reluctant to implement products that require meta-data that is not yet available. By promoting the results of TV-Anytime and demonstrating the interesting options that are provided the project wants to contribute to easier market introduction of new devices and services for digital television.

For this reason we demonstrated our results at the IFA 2001 (Internationale Func Austelling in Berlin) and IBC 2001 (International Broadcasting Convention). The demonstration at IFA was actually in hotel Berlin, not at the IFA premises. On invitation only, visitors could see the booth of Philips semiconductors showing a future home built using new multimedia processors. We demonstrated the Philips myTV recorder with its resident navigator. During the demonstrations the metadata services from NOB, BBC and the University of Ljubljana were accessed via the Internet. Additionally remote programming was shown using a WEB browser and a WAP phone simulator.



Figure 15: Left: Demo setup in Hotel Berlin, Right: Demo setup at IBC in Amsterdam

At the IBC together with 6 other European projects (NexTV, MEGA, OCCAMM, OPENISE, SAMBITS, SonG) a large professionally designed booth was organised. At the IBC the Nokia and Philips box with their resident navigators were demonstrated. An additional small MHP application was developed that demonstrates the access of the TV-Anytime services from both the Nokia and the Philips box showing the interoperability of the TV-Anytime APIs. Three small PCs were used to show the three different TV-Anytime IP-services (BBC, NOB, University of Ljubljana). Additionally two downloadable MHP applications, the NOB segmented latest news application and the BBC downloadable navigator, were demonstrated. Remote programming was demonstrated using an Internet browser and a real WAP telephone. Another part of the myTV project, the RAI downloadable navigator was shown at the RAI booth.

Other dissemination includes giving numerous demos. This includes promoting the results of the project also in each company internally by each partner. Articles on myTV have appeared in the press and on TV (Dutch programme "Jan Douwe op Zoek", a popular science program).

9. Conclusions

The myTV project strongly believes that open standards are very important for the creation of new opportunities for digital television. The MHP standard allows broadcasters to send applications along with the video broadcast to the settop box. Users obtain applications that provide additional information, easy navigation, games etc. In myTV we investigated how MHP can be extended to include storage APIs. This allows MHP applications to make use of the storage in the set top box. This way applications can record programmes and control playback of a recorded programme. Automatic latest news and access to the individual items was implemented to demonstrate these concepts. Our results showing the use of storage by MHP applications, will be used as input to the standardisation of MHP 2.0.

The TV-Anytime Forum is defining a standard which allows Consumer Electronics Manufacturers, Content Creators, Telcos, Broadcasters and Service Providers to exploit high volume digital storage in consumer platforms. In myTV we actively participated in the TV-Anytime forum since we believe that an open standard for TV related meta-data and Content reference identifiers is the only way to put new products in the market. Without an open standard broadcasters are not willing to provide meta-data in a digital format since they would need to supply different formats to devices of different manufacturers. Set top box manufacturers can not easily create new services when the required meta-data is not available. In the myTV project we showed that especially the CRID based two step approach of location content creates many opportunities that are interesting to broadcasters, ce-manufacturers and service providers. For users they finally make it easy to record programmes, making it possible "to watch what you want when you want".

Assuming that "the personal digital recorder of the future" has a connection to the Internet creates many opportunities for new services. We showed that any 3rd party service can provide TV-Anytime data and CRID resolution services. This option can facilitate the introduction of TV-Anytime based personal video recorders in the market. Another type of service is a service that provides recommendations for recording programs based on user profiles. This makes it easy for users to subscribe to a services that provides a list of the best movies broadcast this week or to select a program for recording from an actor's web page. An additional advantage for users is the possibility to program the myTV recorder from anywhere in the world via the Internet.

In myTV we showed that the combination of TV-Anytime, MHP, Internet and local storage can provide very interesting new possibilities for all parties involved. Introducing new products, services and applications is greatly facilitated by the use of open standards. By implementing and demonstrating our ideas we were able to validate our input to standardisation and show users a glimpse of the possibilities. The audience at the IBC, consisting of people from the broadcast world as well as consumers, reacted enthusiastically at the possibilities offered by the combination of TV-Anytime, MHP, Internet and local storage. Features like trailer recording, group recording, remote programming etc. were immediately understood and appreciated.

10. Appendix: Contributions to Standards Bodies & Published Papers

Contributions to the TV-Anytime Forum

Date	Title of contribution
Jan00	AN032 Suggestions for further requirements on content referencing.
Mar00	AN070 Suggestions for further requirements on metadata.
Mar00	AN076 myTV proposal on TV-Anytime data for content referencing.
May00	AN098 Addition to myTV proposal AN076 on Resolving Resolution Authorities
May00	AN110 Segment identification
Sep00	AN166 myTV proposal on content referencing over IP
Sep00	AN169: Scenario 1 for TVA
Sep00	AN170: Scenario 2 for TVA
Nov00	AN192: myTV proposal for Content Referencing over IP
Nov00	AN195: A Schema for TV-Anytime: Segmentation Metadata
Nov00	AN196: myTV proposal on basic metadata
Nov00	AN200: Discussion Of Uses of Content Referencing with the Proposed Metadata Structure
Nov00	AN202: Data model for Content Referencing Locator Environment
Jan 01	AN195r1: A Schema for TV-Anytime Segmentation Metadata
Jan 01	AN215: A system's view on metadata
Jan 01	AN223: Comments on TV049r3 (TVA Metadata Specification)
Jan 01	AN225: MPEG7 & myTV Segmentation Proposal a Comparison
Mar 01	AN234: Comments on metadata specification SP003 v 1.0
Mar 01	AN236: Proposal for a Metadata Locator Record
Mar 01	AN237: Extensibility of metadata in TV Anytime
Mar 01	AN238: myTV Proposal on Access to Remote Metadata Servers
Mar 01	AN249: Content Referencing: Frequently Asked Questions
Mar 01	AN250: Proposal for MPEG-2 Carriage of Content Referencing Information
June 01	AN277: Extensibility of metadata – Response to CfC TV 081
June 01	AN278: Some considerations on grouping
June 01	AN285: Searching and filtering of metadata – Response to CfC TV 081
Aug 01	AN308: A system's view on the carriage of TV-Anytime data
Dec 01	AN343: Location identification: Response to CfC TV095
Dec 01	AN335: myTV Proposal on Access to TV Anytime IP Servers

Published Conference Papers

Author	Title of Paper	Name of Journal, Conference, etc.	vol/no/page of Journal	Location	Date
Tol	TV Anytime: Store it on myTV	ICCE 2000		Los Angeles, USA	Jun 2000
Tigchelaar	myTV in the living room	Digital Workflow		Hilversum, The Netherlands	Jun 2000
Persoon	How storage at home will change how we watch TV	EUSIPCO	Proceedings	Tampere, Finland	Sep 2000
Leban	DVB/Internet Interoperability and New Possibilities in Distance Learning	ISTAS 2000	<i>Proc. ISTAS 2000</i>	Rome, Italy	Sep 2000
Ashley	Introduction to Content Referencing	IBC		Amsterdam, The Netherlands	Sep 2000
Leban	TV Anytime and Distance Learning	ERK 2000	<i>Proc. ERK 2000</i>	Portorož, Slovenia	Sep 2000
Mulder	Metadata	EBU website		www.ebu.ch	Oct 2000
McParland Morris,Leban,Hickman, Ashley, Haataja, De Jong	myTV: A Practical Implementation of TV-Anytime on DVB and the Internet	International Broadcasting Convention 2001	Conference Publication, Volume 1, pp. 116-125.	Amsterdam, Netherlands	13-18 Sep 01
Tol,Parnali,De Jong, Millar, McParland, Stromback, Visintin, Newton	A myTV View on TV-Anytime Metadata Attractors and Segmentation	International Broadcasting Convention 2001	Conference Publication, Volume 1, pp. 126-135.	Amsterdam, Netherlands	13-18 Sep 01
Matevz Pogacnik, Jurij F. Tasic	Interactive and personalized television of the future	FIRST COST #276 WORKSHOP on Information and Knowledge Management for Integrated Media Communication;	Proceedings FIRST COST #276 WORKSHOP	Madrid, Spain	Nov 01
<i>Non english papers</i>					

Marijan Leban	Importance of Internet for interactive television	ERK 2001, Electrotechnical and Computer Science Conference	Proceedings ERK 2001, Volume A, (in Slovene) ISBN 961-6062-21-2, pp. 155-158.	Portorož, Slovenia	24-26 Sep 01
Matevz Pogacnik, Jurij F. Tasic	System for personalised search of TV programs	ERK 2001, Electrotechnical and Computer Science Conference	Proceedings ERK 2001, Volume A, (in Slovene) ISBN 961-6062-21-2, pp. 123-126.	Portorož, Slovenia	24-26 Sep 2001
Marko Tkalcic, Jurij F. Tasic	Implementation of a 3rd-party server for a TV Anytime system	ERK 2001, Electrotechnical and Computer Science Conference, Portorož	Proceedings ERK 2001, Volume A, (in Slovene) ISBN 961-6062-21-2, pp. 151-154.	Slovenia	24-26 Sep 01
Hans Steeman	MHP, het Multimedia Home platform (language Dutch)	Video & Audio report	Aug/Sep2001, pp.1-5		Aug/sep01
Rob Linders	Interactieve TV in ontwikkeling (language Dutch)	Video & Audio report	Video & Audio report		Nov 01

Information and contacts can be found at:
<http://www.extra.research.philips.com/euprojects/mytv/>