HbbTV

— a hybrid broadcast-broadband system for the living room

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HbbTV is a European initiative for providing both broadcast and broadband/web content on a flat-panel screen in the living room. The HbbTV specification introduces only a few new technical components; it is mainly based on existing standards. In this respect, it represents a specific profile of available technologies, rather than a completely new technical development. This approach will be extremely valuable in terms of the development costs and, specifically, for the time-to-market.

HbbTV fully accords with the EBU's requirements for hybrid broadcast/broadband systems.

Today the internet is much more then just a "network". By providing such a huge amount of content of all genres, it has grown into a mass medium of its own. The next step for this medium – convergence with another mass medium, ***television*** – has already started, fostered by the availability of a huge amount of visually-attractive and entertaining content on the web. This web content is optimally suited to be enjoyed in the more relaxing and convenient television environment, rather than on a PC. Actually, a big percentage of the video material now distributed via the internet was originally authored and produced for the TV screen.

Consequently, CE manufactures have begun to offer "hybrid" TV sets and set-top boxes, capable of displaying both TV programmes from a broadcasting network and additional services delivered via an internet connection. However, concepts such as this are anything but new. More then 10 years ago, during the first big internet growth phase, a number of manufacturers tried to sell such hybrid devices, but it has taken until now for internet access to become broadly available in households – so powerful in terms of bandwidth, and so rich in terms of content, that a broad market acceptance can be envisaged.

Almost all TV manufacturers have at least one "hybrid" model in their current offer. To be represented in that market is seen as a "must" in the competitive CE environment. Specifically, services like YouTube along with established news brands and catch-up TV services from the big broadcasters can be found in the manufacturers' offerings. But the concepts behind the devices in the market today unfortunately leave some question marks, in particular:

- Broadcasters are losing their monopoly of the TV screen and have to ask themselves: *what are the threats and opportunities of this development, and how can their needs be met in the future?*

The EBU has studied these issues within their working groups and has formulated the requirements for hybrid systems [1]. The HbbTV system described below fully complies with these EBU requirements.

Conceptual considerations and requirements

The physical resolution of advanced HD screens is ideally suited to display almost all web services. But aiming to offer just "the internet" in its present form, for usage on TV screens, seems not to be the most appropriate approach for several reasons:

- The ratio between viewing distance and screen height is much higher when viewing TV in the living room (lean back), than when viewing such content on a PC (lean forward). Consequently, most websites use fonts and screen layouts which appear too tiny on TV screens.
- Web services are optimized to be navigated using a mouse and keyboard, whereas TV remote controls mostly remain in the same shapes that users are familiar with.
- The colour schema used for TV screen design is usually different from the one used for PCs – a prominent example is black letters on a bright background in the case of PCs, and white letters on a dark background in the case of TVs.
- Commercial reasons prevent CE manufacturers from integrating the full set of processing power, memory and software components needed for rendering the full range of services available on the internet today.

Consequently, random "web surfing" is only possible in a restricted way – if at all – on most of today's hybrid TV sets: re-authoring of the services is required in order to present them properly on a TV screen.

For the broadcast service providers entering the hybrid era, the three main problems with this first generation of hybrid sets are:

1) Each manufacturer uses his own browser profile and his own set of technical features such as streaming protocols or remote-control key sets. This means that the services have to be re-authored for each manufacturer individually, and this requires not only operational effort but also conceptual changes if, for example, graphic options or key sets differ between manufacturers. This kind of technical fragmentation is a considerable obstacle to dynamic development on the content side.
2) The entry portal to internet applications is typically controlled by the manufacturer and no-one but the manufacturer is able to add or replace applications on that portal. Consumers are locked in to a so-called "walled garden".
3) Although using the same screen, both worlds – the broadcasting and the internet one – remain separate. Either there is a hard switching between both modes – when watching TV the connection to the internet is lost and when the browser is active the TV signal is lost – or the TV picture is overlaid by unrelated web content. A combination of service components from both networks is not foreseen, thus losing the potential for true hybrid services.

Therefore, at the beginning of 2009 a number of market partners joined forces within a pan-European project to develop a technical scenario that would address these issues and provide a standardized and functional framework for hybrid television.

The targets for this development have been:

- To provide an open and standardized HTML-based system in order to allow efficient content development by leveraging existing online services, independent from specific manufacturers or platform operators.
- To use existing standardized components as much as possible, in order to gain acceptance and time-to-market benefits.
- To specify only a minimum set of features required for all basic needs, which allows an easy integration in existing hardware platforms and acceptance throughout the entire value chain.
- To allow the combination of all broadcast distribution networks with all internet access technologies.

- To allow the creation of hybrid services using broadcast services and additional resources from the internet at the same time.
- To provide potential for the successor of the teletext system.
- To avoid the "hijacking" of TV signals by unauthorised third-party web services.
- To be applicable to radio services also.

With a system like this, "red button" services linked to TV programmes can be implemented. This can be used to provide teletext services that are graphically much more appropriate to the HD era. Additional services like news tickers can be provided in a much more functional and flexible way. Also, HTML overlays are possible on full-screen TV pictures as well as the integration of a scaled TV image into a full-screen application.

Technical concept of HbbTV

An overview of the technical concept of the HbbTV specification is shown in *Fig. 1*. The specification introduces only a few new technical components, being mainly based on existing standards. In this respect it represents more a specific profile of available technologies than a completely new technical development. This approach is extremely valuable in terms of the development costs and, specifically, for the time-to-market.

In detail, HbbTV is based on the following three standards: CE-HTML, the Open IPTV Forum's browser profile, and DVB's signalling and transport.

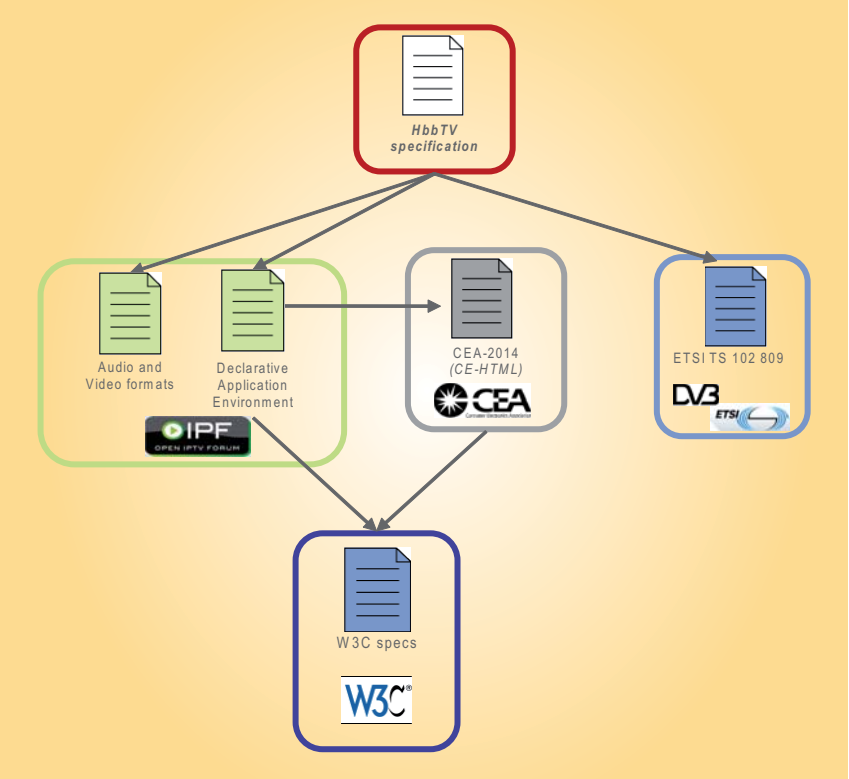

Figure 1
Technical concept of the HbbTV specification

CE-HTML

CE-HTML [2] defines the core browser functionality for HbbTV. CE-HTML is based on common W3C web standards and it specifies an HTML profile for CE devices. It uses XHTML 1.0, DOM 2, CSS TV profile 1.0 as well as ECMAScript-262 ("JavaScript") and is optimized for rendering HTML/JavaScript web pages on CE devices, specifically on TV screens.

As the `XMLhttpRequest` object is supported, application developers are able to design HTML applications which are very similar to up-to-date web 2.0 services. Compatibility in this respect also allows us to apply to HbbTV in a seamless way ... our existing know-how, technology and experiences relating to standard web development. So the effort needed for TV integration can be kept to a minimum (optimization for the different viewing situations).

CE-HTML also contains elements such as the definition of key codes for common TV remote controls.

Open IPTV Forum browser profile

Unfortunately, CE-HTML does not convey any interfaces to the "DVB world". These are provided by the browser specification of the Open IPTV Forum [3] which was published in January 2009. This specification has been developed for DVB-based IPTV systems, but the APIs it provides can also be applied to any hybrid DVB systems. These APIs convey functions to combine the TV picture with HTML pages, to tune to other DVB television or radio services, to add events to the timer list, and to read DVB metadata and other DVB-related things.

Selected components from CE-HTML and the Open IPTV browser define the main functions of the HbbTV browser component.

DVB signalling and transport

Beyond the browser functionality, more DVB-related integration capability is required. This is granted by including reference to the DVB standard "*Signalling and carriage of interactive applications and services in hybrid broadcast/broadband environments*" which was completed by DVB in March 2009 and has just been published by ETSI [4] in February 2010. As the title suggests, this DVB standard defines the signalling of applications which shall be run in the context of specific TV or radio services in the corresponding DVB multiplexes. In a very similar way to the MHP standard, this is done via an Application Information Table (AIT) of the relevant DVB service and indicated by its Programme Map Table (PMT).

The AIT carries the signalling of all applications which are supposed to run in the context of this programme. Other applications are allowed to tune to this programme but they are stopped unless they are referenced in its AIT. Thus it can be avoided, for example, that TV programmes are hijacked by third-party applications carrying advertising or other overlays – thus misusing both the business model of the broadcaster and the confidence of the viewer in the integrity of what is seen on the screen.

One of the applications signalled in the AIT can be marked as "autostart", which means that this application is automatically launched after tuning to the corresponding service. In order not to annoy the viewer with undesired overlays and to allow a uniform experience for the application start, it has been agreed as a guideline that the application should draw a small icon including a red button upon start-up which then disappears after a few seconds. The application is then active from a technical perspective but it does not draw anything on the screen until the user presses the red button.

Abbreviations

AIT	Application Information Table
API	Application Programming Interface
CE	Consumer Electronics
CSS	Cascading Style Sheets
DOM	Document Object Model
DSM-CC	Digital Storage Media – Command and Control
DVB	Digital Video Broadcasting http://www.dvb.org/
ECMA	European Computer Manufacturers Association
EPG	Electronic Programme Guide
ETSI	European Telecommunication Standards Institute http://pda.etsi.org/pda/queryform.asp
HBB	Hybrid Broadband/Broadcast
MHEG	Multimedia and Hypermedia information coding Expert Group http://www.impala.org/
HTML	HyperText Markup Language
IBC	International Broadcasting Convention http://www.ibc.org/
IFA	*Internationale Funkausstellung* (Berlin consumer electronics exhibition)
IPTV	Internet Protocol Televison
IRT	*Institut für Rundfunktechnik GmbH* (German broadcast technology research centre) http://www.irt.de/
MHP	(DVB) Multimedia Home Platform
MPEG	Moving Picture Experts Group http://www.chiariglione.org/mpeg/
PMT	(MPEG) Programme Map Table
W3C	World Wide Web Consortium http://www.w3.org/
XHTML	eXtensible HyperText Markup Language
XML	eXtensible Markup Language

Another signalling option for the AIT is designed to support the establishment of HbbTV as a successor to the teletext standard. An application can be signalled as "digital teletext application" which allows the CE manufacturer to start this specific HTML application when the familiar teletext key is pressed on the remote control.

But HbbTV does of course not only support applications which are tied to a broadcast service ("broadcast-related applications") but also applications with no relation to any broadcast service ("broadcast-independent applications"). Such broadcast-independent applications can be electronic programme guides (EPGs) or "TV editions" of existing web services such as flickr, YouTube and very many more that may be provided by the big brands as well as on a regional level or even by individuals.

HbbTV does not define detailed access mechanisms for broadcast-independent applications. It is left to the CE manufacturers to implement flexible portals allowing the end user to find and access all the services he or she could be interested in. HbbTV portals and search functions for interesting HbbTV applications could also be provided by third-party operators. It is left to the retail market to find access strategies that best serve the end customers' needs. In vertically-integrated market segments with subsidised devices, more closed portal services may be provided.

Fig. 2 shows an example of what the "lifecycle" of broadcast-related and broadcast-independent applications can look like. This example, which also includes the teletext option, shows how applications can be started from broadcasting services and how the navigation between various applications could look like.

ETSI TS 102 809 [4] specifies the carriage of HbbTV applications via the DVB broadcast channel. This option is specifically interesting for HbbTV devices which are not connected to the internet. In the market, this may be the case for a considerable number of devices, as some manufacturers plan to integrate HbbTV as a standard feature like teletext today. So this feature may be found in devices which are not explicitly bought for hybrid use. Similar to MHP, the DSM-CC object carousel is used to transmit the applications. Certainly the whole amount of data which can be distributed via the broadcast channel is rather limited compared to the internet capabilities, but may be sufficient for

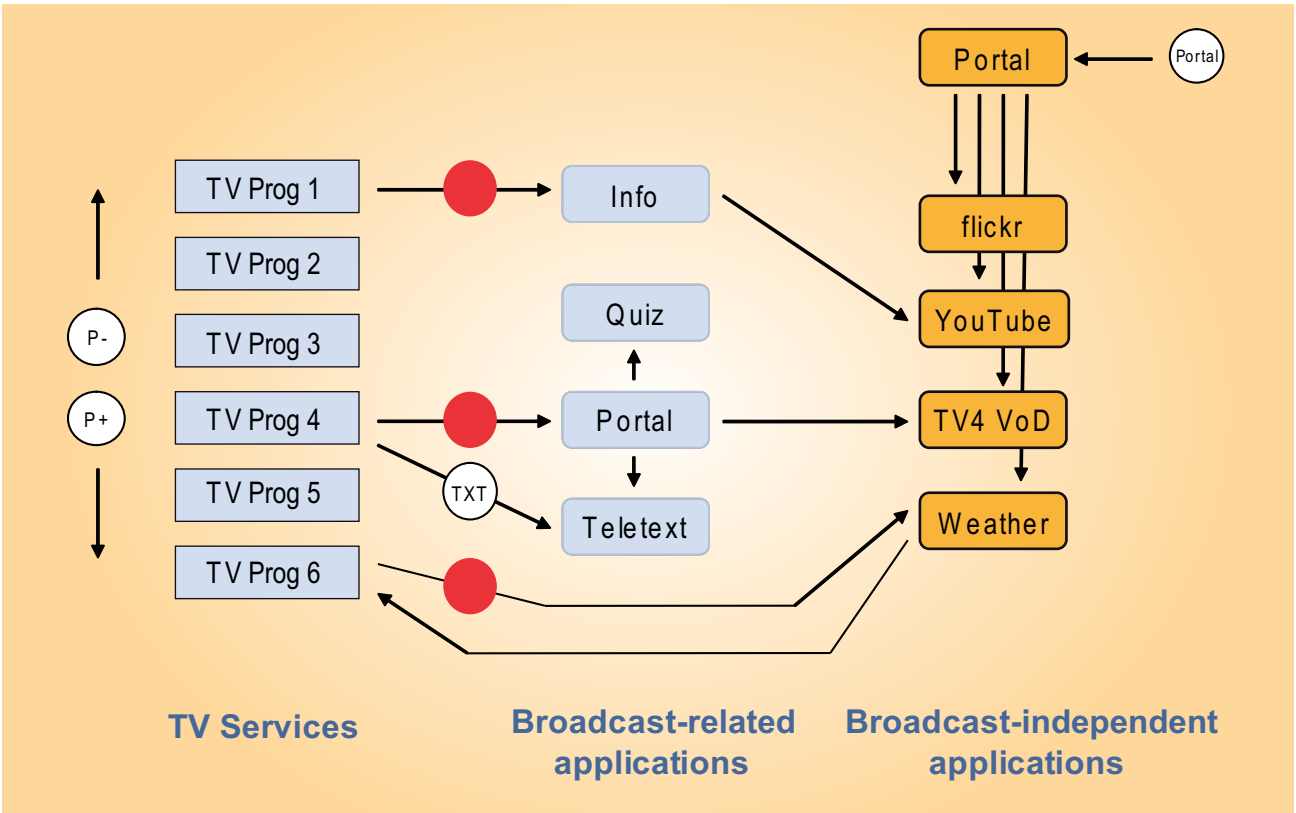

Figure 2
"Lifecycle" of broadcast-related and broadcast-independent applications

relatively lightweight information applications such as graphically- and functionally-advanced teletext services.

As a part of the DSM-CC system, “stream events” are available in HbbTV which consist of small data packets that can be transmitted synchronously with the programme signal. They allow time-accurate data – such as questions or answers for an interactive quiz show – to be conveyed.

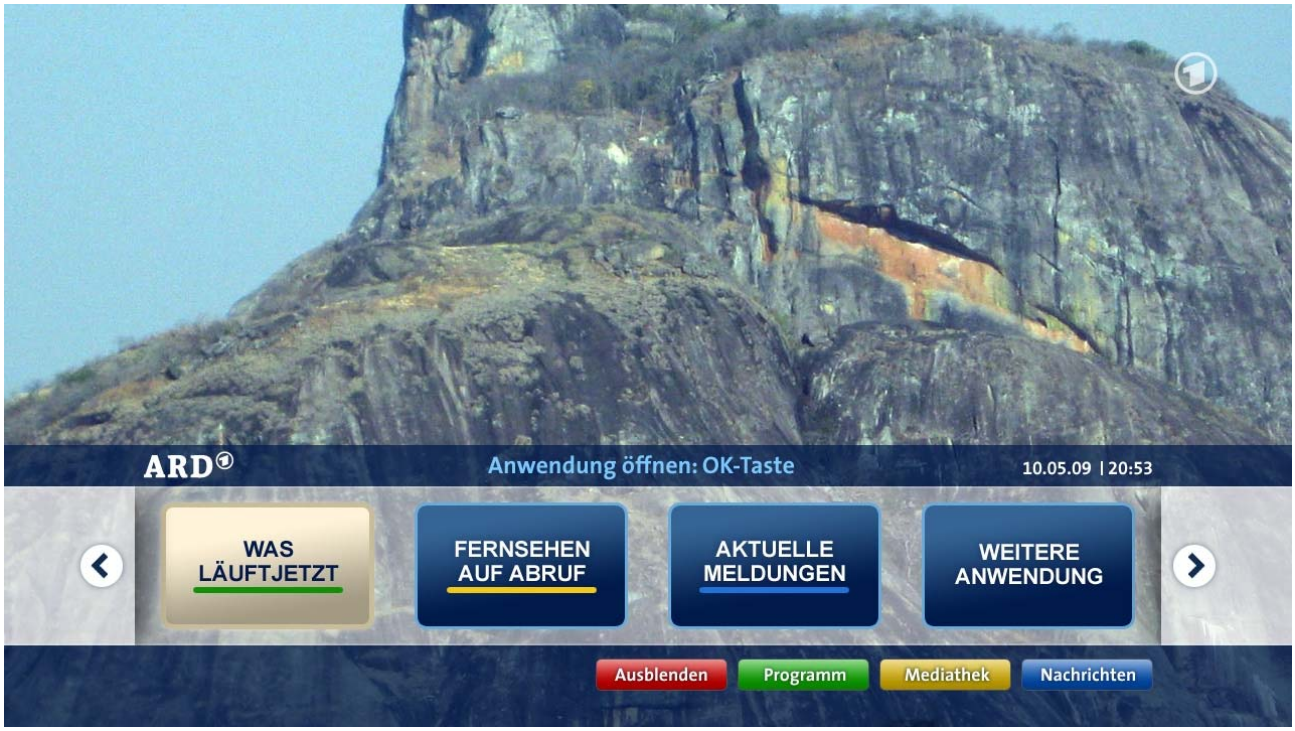

Figure 3
ARD “launcher application” as on overlay on the TV picture – used for launching EPG, Teletext, catch-up TV and other applications

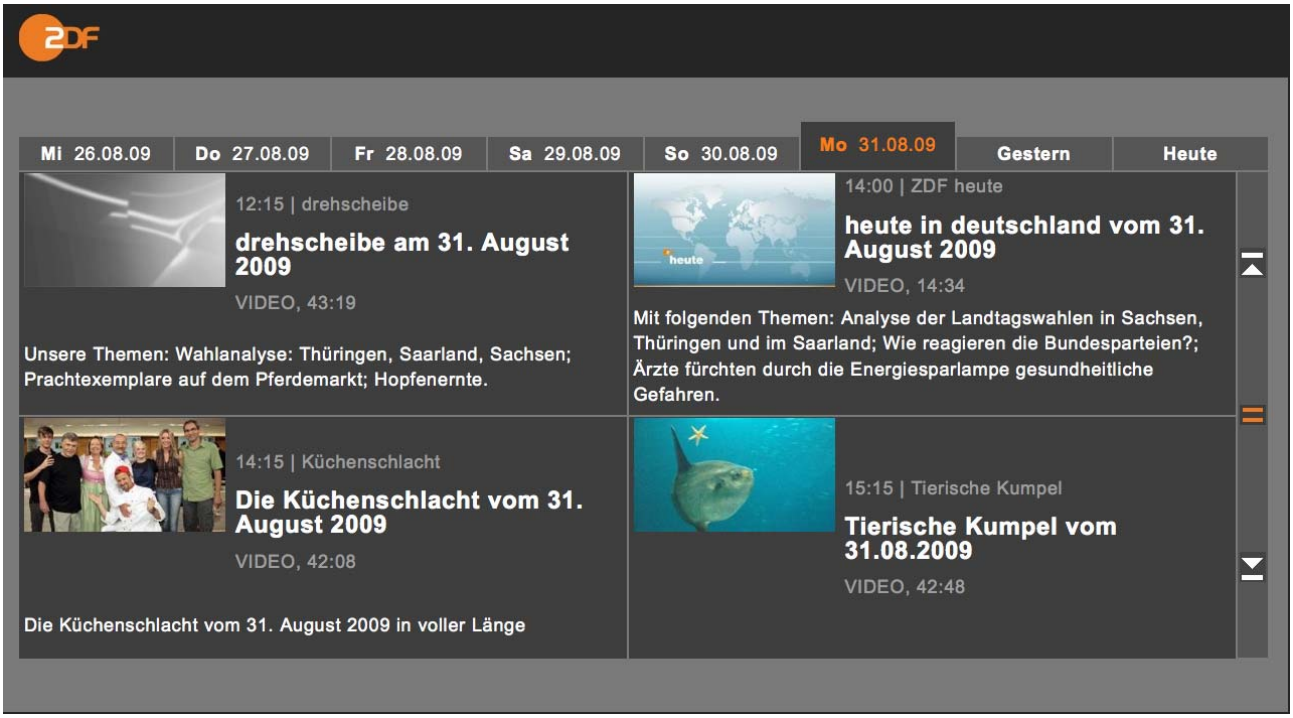

Figure 4
ZDF Mediathek – the ZDF catch-up TV service that is very popular with PC users, and is now also available on the TV screen

The timing precision of an internet connection would be more limited for this purpose and, in addition, it would put very high performance requirements on the web servers to serve potentially millions of real-time connections at the same time. Using the broadcast channel is far more efficient for applications like this.

As a whole, the overall technical concept of HbbTV represents a pragmatic compromise which provides a flexible and universal infrastructure for a variety of broadcast-related and independent

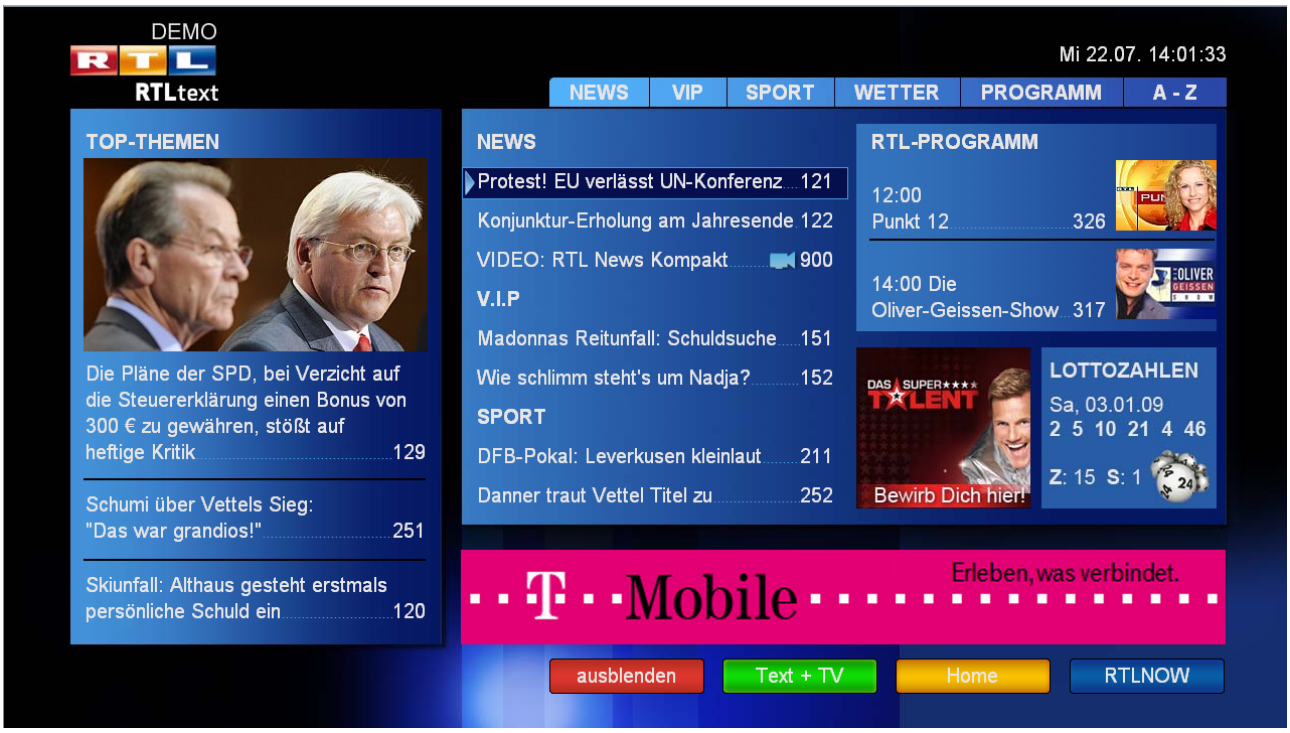

Figure 5
Demo of RTLtext which contains Teletext messages, accessible via page numbers, along with slideshows, videos and interactive advertising

Figure 6
Demo of the Sat1 portal which has no explicit Teletext reference, but includes a news area, EPG, video section and other content

services, but allows relatively fast integration in CE hardware which is less powerful than standard multimedia PCs.

The HbbTV system is designed as a fully-interactive system on its own. But middleware vendors can decide to integrate HbbTV into their own products which may provide more functionality such as scanning routines, PVR management, EPGs and others. Depending on the individual requirements of specific markets, HbbTV could also be combined with other middleware systems such as MHP or MHEG.

Developing and testing HbbTV

HbbTV's unique proposition in the market offers easy application development and porting, as it is based on the common Internet technology set which is used by Internet services. Know-how related to HTML and JavaScript is widely and readily available and can easily be employed for the development of HbbTV applications. Thus, existing online services can readily be adapted to the TV screen and service providers can more or less instantaneously provide services also for the TV screen. This allows the leveraging of synergy and effectiveness at the levels of conceptual design and application development as well as during integration and operation.

Technically, data delivery to PC and TV screens, in an individually optimized way, uses existing XML data feeds and web servers. With HbbTV, it is now possible to seamlessly mesh together linear and non-linear service elements, even communication, thereby unleashing the development of completely new hybrid services. HbbTV supports the integration of both worlds via simple API extensions as described above.

Obviously, the development of HbbTV applications does not require specific tools for all the standard application functionality. For testing the more TV-related features, specifically-modified PC browsers are under development.

Tests will allow us to identify potential interoperability problems. Early testing can accelerate both the application and device development. Due to the limited hardware resources of CE devices, checking the application performance on a variety of consumer hardware is advisable as well.

During the first implementation phase of the HbbTV standard, the IRT organized an HbbTV interoperability workshop in November 2009. Representatives from over twenty different companies from across the value chain – including broadcasters, software providers and CE device manufacturers – attended the three-day event to evaluate current HbbTV applications and implementations. This workshop received a strong response from many market participants, indicating the momentum that has been experienced since HbbTV was formally announced in August 2009. Live satellite feeds containing HbbTV signalling plus test feeds, generated by the IRT, provided the framework for ten companies to host their applications. Over ten manufacturers and software vendors performed interoperability testing against 17 different applications and over a dozen specifically-written feature test cases. A further seven test cases focused on application lifecycles issues.

Klaus Merkel graduated in 1992 as an electrical engineer at the Technical University in Munich, Germany. At that time he had already started working at the *Institut für Rundfunktechnik* (IRT) in Munich which is the central research and development institute of the public broadcasters in Germany, Austria and Switzerland. During his first years at the IRT, he developed studio hardware equipment relating to digital component technologies that use a screen aspect ratio of 16:9.

Since 1995, Mr Merkel has been engaged in the establishment of DVB-based digital platforms for broadcast TV distribution and interactive services. During the last few years, broadcast distribution via IPTV networks has become an important additional aspect for his work. Currently, the integration of broadcast and broadband services into a true hybrid system is his main task – in this area the IRT is contributing to the development of the HbbTV specification and is working on testing and integration of the system.

More interoperability workshops are planned for the months to come in order to give further support to those involved in getting HbbTV products and services to market.

Compliance of all components to the specification will be crucial for a broad market success of the whole system. To allow a more standardized testing of HbbTV implementations, a working group is currently developing a test suite which conveys a large set of test applications. This will help manufacturers to verify the compliance of their products and give confidence that a sufficient interoperability level can be achieved.

Actual market status of the HbbTV development

The HbbTV specification was developed in 2009, based on a broad discussion process among all interested market players. It was submitted to ETSI at the end of November 2009 and will be published by ETSI as TS 102 796. During the specification phase, the HbbTV project has gained significant support from many market partners acting at a national, European and worldwide level. They include big brands in iDTVs, set-top boxes and network operators as well as a variety of middleware suppliers and other technology partners. A list of industry partners supporting HbbTV can be found at **www.hbbtv.org**.

HbbTV has been designed as a standard for pan-European adoption and many countries in Europe are considering to do so. France is one of the key countries supporting HbbTV: a broad launch is planned there at the end of 2010. However, the country which is currently the most advanced in market introduction is Germany. The major German public and commercial broadcasting groups – ARD, ZDF, RTL and Pro7Sat1 which together have a market share of around 90% of the whole German TV market – have announced that they will support HbbTV. All of them have developed applications which are partly showcases and partly ready for regular operation. Some 20 applications have been developed by them and were demonstrated publicly at IFA, IBC and other events in 2009.

The first HbbTV-compatible set-top-box was launched in the German market in December 2009. More decoder products have been announced by a number of manufacturers for the coming months. It is believed that IFA 2010 will become a major milestone in terms of public awareness and market acceptance of HbbTV in Germany.

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