Evolving the TV experience: Anytime, anywhere, any device

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Broad deployment of broadband access infrastructure and pressure on telecommunications operators to exploit new business potential are driving up interest in IPTV. However, in order to meet the ambitious expectations, IPTV must quickly evolve into a personalized, interactive application that is well integrated with communication services and has inherent support for portable and mobile devices.

The requirements for personalized, interactive IPTV are best addressed by a solution based on IMS. Because IMS already provides an open, IP-based framework for voice and multimedia communication services across fixed and mobile devices, only minor extensions are necessary for integrating media services.

The authors describe Ericsson's approach toward a personalized, interactive IPTV solution based on IMS. They also discuss standardization activities and highlight areas where more work is needed.

Personalized, interactive IPTV – meeting future needs

The transition from analog to digital TV standards is in full swing around the world. Efficient video compression and broad deployment of broadband access allow telecommunications operators to complement IP telephony and internet services with IPTV offerings. However, the anticipated consumer, operator, and service-provider demand will require features that go beyond what IPTV is able to deliver today. Consumers, for example, increasingly want personalized media services, anytime, anywhere, and on any device. Operators want to seamlessly combine TV with internet and communication services. And content providers are looking for new revenue opportunities from interactive services. They also want to mine the consumer feedback loop enabled by IP-based content distribution.

Personalization and interactivity

Consumers want greater control over TV services and delivered content. Personalization will enable them to customize TV and video-on-demand (VoD) packages according to individual preferences and to exert greater control over channel content as well as when children, for example, may access it.

Personalized user interfaces will present customized channel selections, much in the same way as bookmarks in a web browser, and pre-scan electronic programming guides (EPG) for content that matches user interests. These capabilities improve usability by reducing the time a user must spend zapping through channel lists.

The increasing popularity of SMS-based voting and chat services in TV programs points to strong business opportunities in the area of interactive services. Enabled by the bidirectional nature of the transport system, interactivity will give content providers simple interfaces that allow users to vote, shop, access background information, and publish content to a program.

Personalization and interactivity will enable TV service providers to increase the appeal of advertisements, and permit users to dynamically select camera angles from a pool of cameras at a sporting event or reality game show.

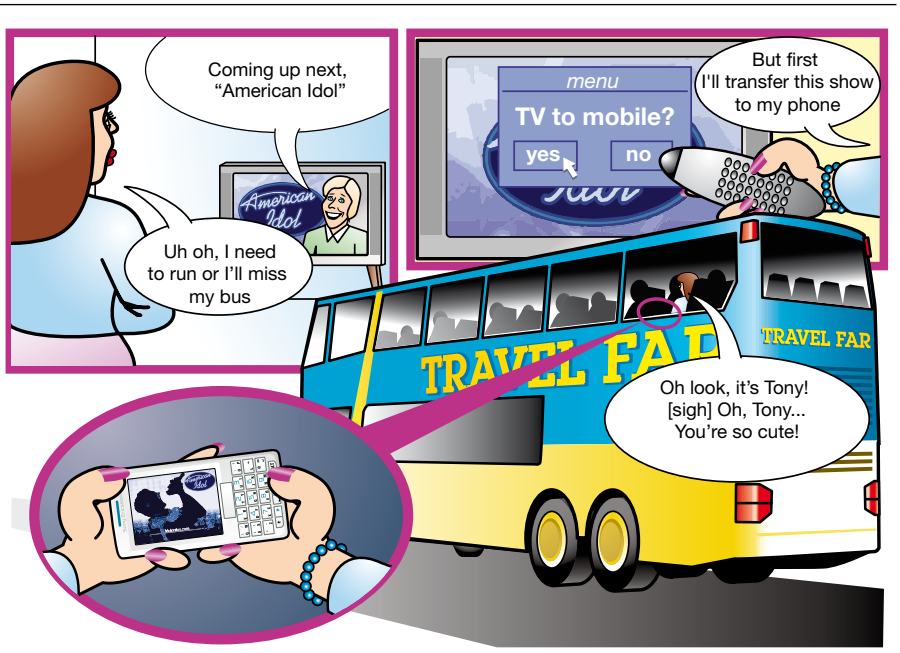
Clearly, the role of mobile devices will become increasingly more prominent in a world of personalized, interactive IPTV. Numerous cellular network operators have already launched mobile TV services, and the deployment of mobile broadband access (HSPA) as well as the introduction of mobile broadcast technology (MBMS) will supply the capacity that is required for excellent-quality delivery of mobile TV services over cellular networks.[1-2]

Apart from consuming TV content, users will be able to use their mobile devices in many different ways, for instance, to control their IPTV services when they are on the move or for sharing personal content in a TV program.

The use of a common control framework for fixed and mobile devices opens the door to many new possibilities, including session portability between fixed and mobile devices. This means that if a user, "Maria", begins watching a TV program at home but must step out, she can either transfer the TV session to, or reconnect to the service from, a mobile phone once she is, say, seated on a bus (Figure 1).

But this is only the beginning. The seamless integration of TV, communication, and

Figure 1
Maria transfers the TV program she is watching at home to her mobile phone.



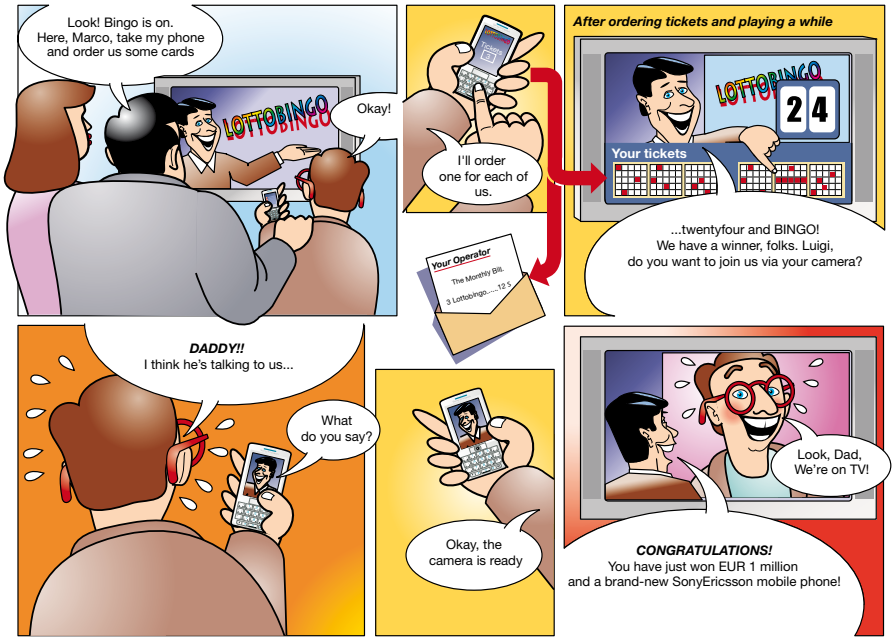


Figure 2
IMS-based IPTV solutions enable service blending and fixed-mobile convergence.

internet services facilitates the combination of services and fixed-mobile convergence, which will enable even more exciting scenarios.[3]

In Figure 2, for example, we see how Maria's family has gathered to watch and participate in a popular, interactive game show: "Bingo." Maria's son (Marco) uses his father's (Luigi) phone to buy some bingo cards. The price of the cards is charged to Luigi's monthly bill. As the show progresses and numbers are drawn, the cards are updated in real time. Today is Marco's lucky day – he drew the winning card! A request pops up on their mobile phone, asking if they want to establish a live video call. Marco accepts and jumps for joy at seeing himself on TV.

This multi-user multimedia experience also introduces new kinds of social interaction. Later in the evening, for example, Luigi settles down in front of the TV to watch Formula 1 racing. To make the most of the experience, he logs in with his personal profile. As the race gets underway, a small window opens on Luigi's screen, displaying the position of all the cars via a graphical representation of the racetrack. At the same time, a presence module indicates that Luigi's friends, Mauro and Andrea, are online. Luigi opens a voice session with his friends to comment on the race. A moment later, in a daring move, Fernando Alonso overtakes Kimi Raikkonen, triggering a chorus of cheers in the voice channel. Mauro's profile includes a pay-per-view perspective from Alonso's cockpit, which for a small additional charge, he can share with his friends. Luigi and Andrea are quick to accept his invitation to incorporate this picture-in-picture (PIP) feature.

Home networking

Strategy Analytics states "the most significant home technology trend of the next five years will be the ability of fixed and portable devices to exchange media with each other over a multimedia home network." [4]

Sony's LocationFree concept, which is one example of this trend, aims at making content from different sources (for example, live TV channels, DVD, and DVR) available on different devices (large-screen TVs, PCs, laptops, portable players, and so forth) and at different locations.[5]

Forums such as the Digital Living Network Alliance (DLNA, Box A) are working on guidelines and specifications to guarantee interoperability between consumer devices from different vendors in a networked home environment.[6]

IMS-based personalized, interactive IPTV

Personalization, interactivity, combined services, and fixed-mobile convergence can be achieved in several ways, but to succeed in stimulating new services and in guaranteeing interoperability between technologies, the industry must agree on one approach that is based on open standards and interfaces. The most promising approach is to use an IMS framework[7-8]:

- IMS-enabled IPTV uses the session initiation protocol (SIP), which provides a unified control scheme that can be used to control all types of media sessions as well as application services. It thus supports combined services and interactivity by joining different communications paradigms into a complete multimedia user experience.
- From the outset, IMS was designed to provide a personal communication infrastructure with group communication, thus transforming the TV experience from a personal, private domain to a socially interactive experience. Communication and TV services can share IMS enablers, such as presence, instant messaging, and profile management. In particular, presence and profile management will form the basis of new personalized IPTV experiences.

BOX A, DLNA

The Digital Network Living Alliance is an industry forum founded in 2003 by leading manufacturers of consumer electronics, mobile phones and personal computers. As of September 2006 it had more than 250 member companies. DLNA compliance is quickly becoming one of the most important features for home and mobile-networked appliances.

The vision calls for a seamless environment that enables users to share digital media within the home and while they are on the move. Examples of digital media are personal content, packaged media, and broadcast content.

DLNA has published home device design guidelines based on
- prevailing networking standards, such as UPnP, HTTP, IP and IEEE 802.x; and
- dominating content formats, such as JPEG, MPEG2 and LPCM.

A variety of DLNA-certified products have already been launched. DLNA is now working on Phase-2 guidelines which put greater focus on IPTV and use cases beyond the home.

- The ability of IMS to deliver combined services enables the seamless integration of TV, communication, and internet services. This will create a more convenient and attractive experience.
- IMS-based IPTV also inherits all the capabilities of IMS for service roaming, thus linking the IPTV experience to a user profile, not a device as with traditional set-top boxes. The IPTV experience can then be delivered to any device in any network in the IMS domain. The access-agnostic nature of the IMS control layer is an important prerequisite for fixed-mobile convergence.
- IMS is an open standard supported by all major telecommunications operators.

Figure 3 gives a high-level view of an IMS-based personalized IPTV architecture. The architecture consists of a client environment, IMS application servers, IMS common system, and transport layer. The service delivery platform (SDP) offers a standardized set of support functions that can be shared among various service components.

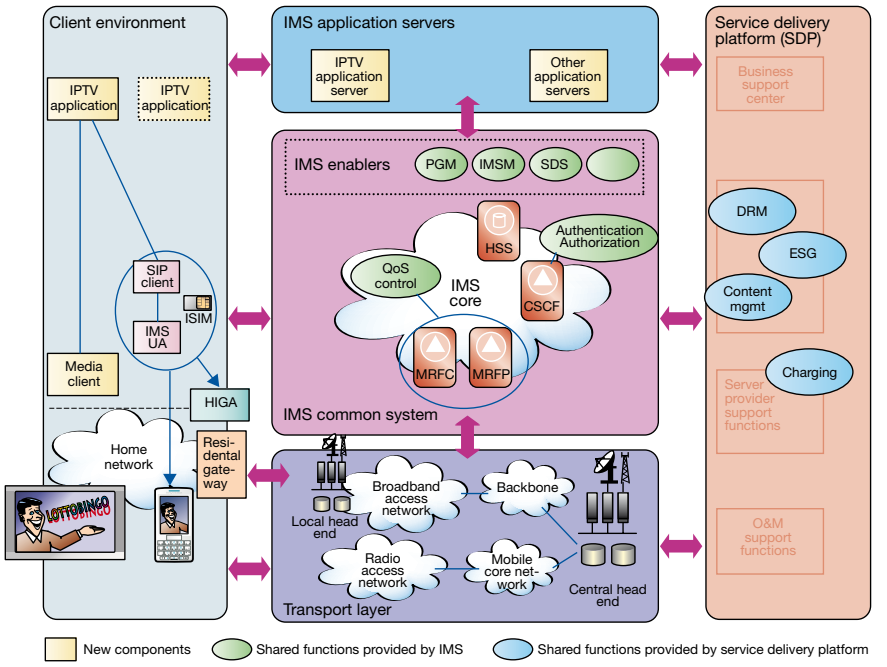


Figure 3.
IMS-based IPTV architecture for combined services and fixed-mobile convergence.

Client environment

The main functional blocks in the client environment of the consumer premises network are the IPTV application, other applications (for instance, for combinational IMS services), media client, SIP client, and IMS user agent (IMS UA).

The IPTV application is responsible for all interaction between IPTV services and users on their end devices, for instance, a set-top box, TV, PC, or mobile phone. The end device also hosts the media client, which receives and decodes the video and audio streams that make up the digital TV signals.

Each IMS application, such as IPTV, voice, instant messaging, or video conferencing, contains a SIP user agent (SIP UA) that terminates SIP services in the client environment. Depending on the application, consumer devices will be required to support specific hardware, such as a camera or microphone.

SIP user agents communicate through a common SIP client that provides the control interface to the IMS core with help of the IMS user agent. The latter registers users or devices with the IMS core using secure IMS SIM (ISIM) authentication. IMS user agents and SIP clients can be implemented in end devices or in a residential gateway in the form of a home IMS gateway (HIGA).

Ericsson introduced HIGA to enable interworking between IMS and non-IMS consumer devices (Box B, Figure 4).[9]

At GlobalComm 2006, Ericsson and Sony jointly demonstrated the consumer benefits of DLNA/IMS interworking. The demonstration showed how users can wirelessly view digital photos stored in mobile phones on a TV, use a home gateway for instant messaging between mobile phones outside the home and a TV, and access content stored on a home PC via a mobile phone. The combination of technologies based on IMS and DLNA standards will enable users to access digital media anywhere and any time.

IMS application servers

The IPTV application server (IPTV AS), which is the central control point of the IPTV service, manages all IPTV-specific functions not provided through IMS interfaces. It interfaces with the IMS core and functions provided by the service delivery platform. It also has access to common IMS enablers provided by the IMS common system.

IMS common system

The IMS common system consists of the IMS core and IMS enablers.[10-11]

The most relevant enablers for personalized TV services are presence and group management (PGM), and IMS messaging (IMSM). Presence and group management enables applications to consider presence information and group membership, for instance, by drawing on a user's buddy list when personalizing a service – as was done, for instance, for Luigi, Mauro and Andrea.

The IMS core provides a control layer that controls services provided over fixed and mobile access networks.

The home subscriber server (HSS) provides a master database for user data and service profiles in IMS. It contains subscription-related information that network entities need in order to handle calls/sessions, and provides support for user security, authorization, mobility management, roaming, and so on. The HSS is enhanced for the IPTV service to hold IPTV-specific information – personalized channels, parental control, advertisement preferences, and so on. Additional

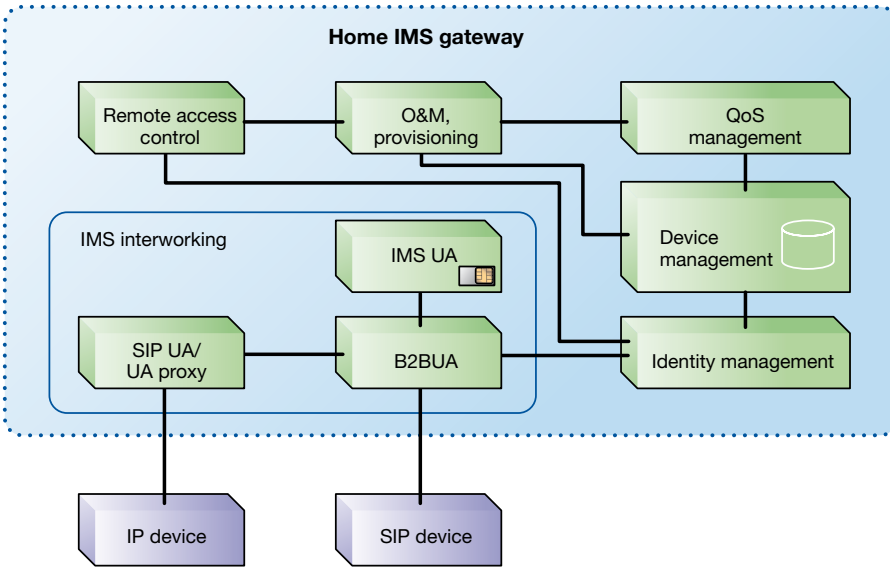


Figure 4
The home IMS gateway (HIGA, see also BOX B).

complexity is contained in extra databases that the HSS can control if necessary.

The call/session control function (CSCF), which is the central control point in IMS, provides SIP routing services and enforces authentication and authorization (AA). The IMS security functions can be reused for generating keys required by digital rights management (DRM) and for protecting service access.

Quality of service (QoS) is controlled through a media resource function controller (MRFC) and media resource function proxy (MRFP).

Transport layer

The transport layer supports fixed and mobile access networks by distributing media streams, injected at headends, to various end devices. A headend consists of streaming servers (for live and on-demand content) and servers for network-based personal video recording (nPVR). Apart from a central headend, the transport network may contain local headends within the fixed-access network. Local headends distribute load and can be used to inject regional content – that is, content which is only offered in a particular area. The interface between the IMS core and transport layer is primarily used for managing QoS over the various access networks.

The article *VDSL2: Next important broadband technology* gave an overview of fixed-access network technologies and pointed out that widespread acceptance of Ethernet in the aggregation network makes for more efficient delivery of IP services over fixed broadband networks than over legacy ATM access networks.[13] And now, with the release of the TR-101 specification from DSL Forum, Ethernet technology has been standardized to support adequate QoS and traffic separation.[14] The TR-101 specification introduces a dual-edge-node architecture that makes it feasible to dedicate one edge node for IPTV, further optimizing delivery over fixed access.

Service delivery platform

The service delivery platform provides a variety of support functions that can be shared among different types of services. The functions, provided through software components (called "enablers"), can be roughly divided into the following support functions: business, content, service provider, and operations and maintenance (O&M).

Specific to IPTV are content-related support functions such as DRM and electronic service guides (ESG). DRM is used to protect premium content. ESGs provide information about available services and contain an electronic program guide that enables viewers to navigate, discover, and select programs and content by time, title, channel, and genre.

The charging function in the service delivery platform supports charging models for online and offline charging.

Standardization

The DVB Forum has finalized a set of specifications for early deployment of DVB services over bidirectional IP networks.[15] Phase 1, which is limited to MPEG-2 DVB services encoded with MPEG-2 technology and encapsulated in an MPEG-2 transport stream (TS), covers live media broadcast services (in the style of TV or radio), media broadcast with trick modes, and video on demand (VoD). The DVB Forum also has a working group that addresses the distribution of broadcast and broadband IPTV services in the home, DVB-HN. The DVB-HN specifications will be based on DLNA guide-

BOX B, HIGA

The home IMS gateway (HIGA) is a logical function with an attached ISIM card that can be deployed in a residential gateway or other networked devices inside the home. HIGA contains a back-to-back user agent (B2BUA) and a SIP user agent (SIP UA), which allow devices in the home network to interact and interwork with the IMS core.

SIP devices that contain a SIP UA can register with HIGA. For IP devices, such as a DLNA-compatible set-top box, the SIP UA inside HIGA functions as a proxy, initiating registration. The B2BUA then translates SIP registration messages into IMS registration messages and sends them to the IMS core.

The IMS user agent supports the B2BUA with secure ISIM-based authentication.

After registration, the IMS interworking function of HIGA negotiates session parameters based on
- the capabilities of home devices (relevant data is retrieved from the device management database); and
- user preferences (managed by the identity management function).

Therefore, without any direct user interaction, a media stream (for instance, a video conference call or a video-on-demand movie) can be set up and fed to desired home devices.

lines. Accordingly, a liaison has been set up between DVB and DLNA.

To highlight the need for international specifications, ITU-T has also recently formed a focus group for IPTV.

ETSI TISPAN is currently working on a set of requirements and an architecture that address the integration of IPTV services into next-generation networks using the capabilities of IMS. ATIS IIF (IPTV Interoperability Forum, an American organization for communications standards), has created a set of IPTV requirements that it has communicated to ETSI TISPAN.

The main focus of these standardization activities is on IPTV as a stand-alone service. To date, issues such as interworking among interconnected home devices, interfaces to IMS for combined services, and fixed-mobile convergence have not been addressed. Therefore, going forward, the work must, among others, also involve

- DLNA and Home Gateway Initiative (HGI), to address home networking scenarios[16]; and
- 3GPP, TISPAN, and OMA, for harmonization with mobile TV services.

Conclusion

IPTV, as it exists today, must quickly evolve into a personalized, interactive service that is well integrated with communication services and has inherent support for portable and mobile devices.

The most promising approach is to build on IMS, which already provides an open framework for voice and multimedia communication services across fixed and mobile devices. Therefore, only minor extensions are needed to accommodate the integration of media services.

Ericsson's IPTV target architecture, which is based on open standards and interfaces, is divided into a client environment, IMS application servers, IMS common system, transport layer, and service delivery platform.

Standardization organizations are developing specifications for the deployment of DVB services over bidirectional IP networks and the distribution of broadcast and broadband TV services in the home. To date, however, the main focus of standardization has been on IPTV as a stand-alone service. Therefore, going forward, the work must also include harmonization of the work carried out by 3GPP, TISPAN, OMA, DLNA and HGI.

TERMS AND ABBREVIATIONS

3GPP	Third Generation Partnership Program
AA	Authentication and authorization
ATIS IIF	Alliance for Telecommunications Industry Solutions IPTV Interoperability Forum
B2BUA	Back-to-back user agent
BCAST	Mobile Broadcast Services (subordinate working group in OMA)
CSCF	Call/session control function
DLNA	Digital Living Network Alliance
DRM	Digital rights management
DSL	Digital subscriber line
DVB	Digital video broadcasting
DVD	Digital versatile disc
DVR	Digital video recorder
EPG	Electronic program guide
ESG	Electronic service guide
ETSI	European Telecommunications Standards Institute
HGI	Home Gateway Initiative
HIGA	Home IMS gateway
HSPA	High-speed packet access
HSS	Home subscriber server
IETF	Internet Engineering Task Force
IMS	IP Multimedia Subsystem
IMSM	IMS messaging
IMS UA	IMS user agent
IPsec	Internet protocol security
IPTV	Internet protocol television
ISIM	IMS subscriber identity module
ITU	International Telecommunications Union
LPCM	Linear pulse-code modulation
MRFC	Media resource function control
MRFP	Media resource function proxy
nPVR	Network personal video recorder
OMA	Open Mobile Alliance
PGM	Presence and group management
QoS	Quality of service
RADIUS	Remote authentication dial-in user service
RGW	Residential gateway
SDP	Service delivery platform
SDP	Session description protocol
SDS	Service development studio
SIP	Session initiation protocol
SMS	Short message system
STB	Set-top box
TCP	Transport control protocol
TISPAN	Telecoms & Internet converged Services & Protocols for Advanced Networks
TLS	Transport layer security
UPnP	Universal plug-and-play
VoD	Video on demand

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