IPTV

Reinventing Television in the Internet Age

When television has fulfilled its destiny, humanity’s sense of physical limitation will be swept away, and boundaries of sight and hearing will be the limits of the Earth itself. With this may come a new horizon, a new philosophy, a new sense of freedom and greatest of all, perhaps a finer and broader understanding between all the peoples in the world. — David Sarnoff

It’s been more than a half-century since television pioneer and RCA chairman David Sarnoff outlined this vision of what television would bring to society. Until the Internet’s development, television was only a broadcast medium without the bidirectional communication needed to fully empower and engage its viewers. Early broadcast networks offered little freedom of choice and control. You could watch, or not, or change the channel, hoping something else more entertaining or higher quality might be on.

Over the past couple of decades, we saw an explosion of cable and broadcast channels offering a much wider selection but still not effectively delivering the “new sense of freedom” or “finer and broader understanding” Sarnoff had promised.

Educators have shown that understanding greatly increases once communication starts flowing both ways, actively engaging students in a subject. The ability to interact, ask questions, explore with others, and pursue your own interests allow learning, retention, and understanding to flourish.

Unfortunately, as Milton Mayer once pointed out, “The marvels of film, radio, and TV are marvels of one-way communications, which is not communication at all” (see www.quotegarden.com/television.html). But until the Internet appeared, we really didn’t have a mass-media network that could support the level of two-way communication required for personalized, interactive experiences on a worldwide basis.

What television and later high-definition television (HDTV) delivered was a powerful visual experience, leveraging the highest bandwidth portal into our brains — our sense of vision. If we say “a picture is worth a thousand words,” then a motion picture must be...
worth a million. People are visual creatures. We experience the world primarily through our eyes. Movies enlighten, motivate, entertain, educate, and communicate far better than any other media. As telepresence developers understand, it’s not what you say but how you say it that’s most important for effective communication — communication that’s remotely delivered primarily by high-quality, low-latency immersive video and associated spatial audio.

Meanwhile, what the Internet has delivered is a flexible platform enabling rapid development and deployment of uncountable services and applications to the public no matter where its users are located. It has democratized the world far better than any nation ever could, and as recent US elections have proven, the Internet has become our virtual Main Street across both US and global societies.

**IPTV Defined**

Through Web technology, the Internet has evolved from a dial-up, command-line childhood into a broadband, visually rich adolescence. However, in many ways it’s still handicapped by its laissez-faire heritage. Video, the most powerful visual multimedia, requires significantly higher bandwidth, quality of service (QoS), reliability, scalability, and security than the Internet’s best-effort legacy might be able to provide. This has led service providers to embark on major investments in new IP networking technologies to better support video while also developing a new form of television called IPTV, which aims to marry the high visual quality and reliability expectations of digital television with the interactivity, flexibility, and rich personalization IP technology enables.

IPTV isn’t just about delivering digital television over Internet technology; it’s about reinventing television to better achieve the goals Sarnoff first articulated decades ago. It’s about developing a new medium that’s greater than the sum of its parts. It’s about creating a video-centric, next-generation Internet accessible on any device, be it mobile phone, computer, or HDTV, at any time and place the consumer chooses. It’s about leveraging the Internet’s power to better navigate the flood of content flowing our way. And it’s about reinventing television advertising from being an unwelcome interruption to being useful, relevant information that can help make our lives more productive and fulfilling.

Some view these lofty goals as making IPTV the next killer application for the Internet. We disagree. IPTV is primarily a platform to better enable future killer applications, including those yet to be invented. It defines how to reliably and securely integrate video — including broadcast television, targeted advertising, and video on demand (VoD) — into flexible applications that can leverage the Internet’s technology and power. It does this while optimizing its user interface for the wide variety of electronic devices consumers want to use.

Video and IPTV have become catalysts for bringing together the requirements, technologies, architectures, services, protocols, organizations, and people to further advance the development of the Internet and the service provider networks that form it. Together, these technologies are helping to drive IPv6 deployment, the scaling of mobile phone networks, consumer electronics integration, and the attention of studio and network executives looking for better direct channels over which to tell their stories.

Telecommunication service providers are finding that video content and mobility are the key services consumers value and are willing to pay for. Being new to video and the multichannel video programming distributor (MVPD) market, they look to use IPTV’s advanced capabilities to differentiate themselves from existing video providers already well established. They also want to integrate their new video capabilities with their existing mobility leadership through technologies such as the 3rd Generation Partnership Program’s IP Multimedia Subsystem (IMS; see www.3gpp.org) and the ITU-T’s Next Generation Network (see www.itu.int/ITU-T/ngn) architectures.

But IPTV isn’t limited only to traditional wireline operator networks. Although they might not use the same term, cable and satellite television networks are rapidly evolving to IP technology as well. Next-generation cable set-top boxes (STBs) have embedded cable modems, enabling greater interactivity, high-bandwidth IP communications, real-time application downloads, and even IP-delivered video simultaneously with direct digital quadrature amplitude modulation (256-QAM) video delivery over cable.
Satellite providers are finding they can enable next-generation functionality as well through hybrid designs that marry a broadband Internet connection with satellite delivery, while they, along with the cable or multiple system operators (MSOs), update their backbone networks to IP technology.

**In this Issue**

All of IPTV’s technologies, capabilities, and environments made selecting only four articles that cover the broad topic of IPTV an almost impossible task. Hopefully, however, these four will give you a sampling of the different areas IPTV addresses and whet your appetite for learning more about IPTV and the capabilities it will deliver in the future.

The first article — “Designing a Reliable IPTV Network” by Robert Doverspike, Guangzhi Li, Kostas N. Oikonomou, K.K. Ramakrishnan, Rakesh K. Sinha, Dongmei Wang, and Chris Chase – describes the challenges inherent in designing an IP transport network, restoration methods, and video packet recovery methods that can achieve the stringent QoS required for IPTV services delivered using IP multicast. It proposes using fast reroute (FRR) in harmony with IP routing and other packet protocols to address these challenges and provides a good overview of how service providers are updating their networks to support next-generation IPTV services.

“Mobile IPTV: Approaches, Challenges, Standards, and QoS Support” by Soohong Park and Seong-Ho Jeong illustrates that IPTV isn’t just about bringing video to STBs or HDTVs. It also leverages the convergence of IP networks to deliver a video-driven quality of experience to all connected devices, including those we have with us at all times. The authors discuss standards development organizations’ efforts to address mobile IPTV requirements and challenges. These include the QoS IPTV requires, for which the authors propose an efficient signaling scheme.

In “Standardization Activities for IPTV Set-Top Box Remote Management,” Jun Shan Wey, Joachim Lüken, and Jürgen Heiles discuss two important areas for IPTV – STBs and their remote management over the network. STBs interfacing to HDTVs are like mobile phones – the front battle lines for IPTV that generate the user experiences so critical for its success. They’ve benefited from continued advancements brought on by Moore’s law, but their sheer numbers make them the most expensive part of any IPTV network. STB costs would balloon out of control if service providers couldn’t manage and support them remotely. This article provides an overview of the various international standards efforts behind effective remote management standards for IPTV’s STBs.

The final article, “Reducing Channel-Change Times with the Real-Time Transport Protocol” by Ali C. Begen, Neil Glazebrook, and William Ver Steeg, highlights a specific IPTV requirement – that of providing a user experience equal to or better than expectations. Consumers have grown up with effectively instantaneous access to analog broadcast television and expect a similar experience with digital television and IPTV. The need for secure delivery of highly compressed digital video streams over an IP network makes delivering rapid random access to an unlimited set of IPTV video streams nontrivial. The authors discuss how to provide rapid and consistent channel-change times using the Real-Time Transport Protocol in an IPTV network.

**IPTV Standards**

Interested further in IPTV? Check out the standards development organizations that have been active in its development. They include the ITU-T IPTV Focus Group (www.itu.int/itu-t/iptv), which led to the IPTV Global Standards Initiative (www.itu.int/itu-t/gsi/iptv); the Alliance for Telecommunications Industry Solutions IPTV Interoperability Forum (ATIS-IIF; www.atis.org/iif); the European Telecommunications Standards Institute Telecom & Internet Converged Services & Protocols for Advanced Network (www.etsi.org/tispan); the MultiService Forum (www.msforum.org); the Digital Video Broadcasting Project (www.dvb.org); the Digital Living Network Alliance (www.dlna.org); and the Broadband Forum (www.broadband-forum.org). In particular, we recommend the ITU-T IPTV Focus Group proceedings freely available for download at www.itu.int/publ/T-PROC-IPTVFG-2008/en.
services via a growing herd of Internet start-ups, including many that studios and broadcast networks support themselves. In addition, the declining cost of HD-quality video cameras, multimedia PCs, and editing software has enabled a whole generation of "pro-sumers" who generate and deliver new or modified creative content through portals such as YouTube.

All these technologies could threaten service-provider-deployed IPTV. If consumers have bandwidth significantly greater than what’s needed for real-time video delivery, many QoS challenges associated with video delivery over the Internet become more manageable. If they have alternative video sources and content available directly on the Internet, those that service providers offer might become less important. On the other hand, using IPTV, service providers can provide a richly personalized entertaining, informational, and interactive television service that’s both easy-to-use and integrated with all the other services they provide. And it can provide these powerful capabilities without the consumer having to deal with all the complexities of the Internet.

As secure and reliable IPTV-based content delivery becomes established, and as broadband bandwidth continues to increase, savings associated with direct delivery over the network will outweigh the costs associated with distributing physical DVD or Blue-Ray media. Thus IPTV will likely emerge as the new preferred channel over which studios distribute their products.

So, we can expect IPTV to start improving how we all enjoy, learn from, and engage with television in the 21st century — and perhaps help achieve that finer and broader understanding between people worldwide that David Sarnoff outlined in his original vision.

Acknowledgments

We thank all the authors who submitted manuscripts for this special issue, the reviewers who helped us select and improve them, the editors and production staff at the IEEE Computer Society who made this issue possible, and all the hardworking people in the industry who are striving to deliver on IPTV’s promise. Unfortunately, space limitations let us publish only four articles out of all the excellent ones submitted.

Greg Thompson is a consultant on video technology and IPTV and founder of Thompson Video Consulting. Until recently, he was a chief video architect at Cisco Systems working on service provider video and co-chairing its effort in IPTV standards development organizations and was CTO at nCUBE, an early leader in the development of video on demand. Thompson has a BS in computer science and electrical engineering from the Massachusetts Institute of Technology. Contact him at gregt@tvideoc.com.

Yih-Farn Robin Chen is a researcher in AT&T Labs Research’s Software Systems Research Department. His research interests include IPTV, mobile computing, peer-to-peer, the World Wide Web, and software engineering. Chen has a PhD in computer science from the University of California, Berkeley. He was general cochair of WWW 2008 and was named an ACM Distinguished Scientist in 2008. Contact him at chen@research.att.com.