
We Trip The Light
FANTASTIC

REALIZING IPTV AND MOBILE CONVERGENCE OVER EXISTING IP NETWORKS

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ABSTRACT

Interactivity and the convergence of IPTV and Mobile have been promoted as key to enhanced television services fulfilling their potential.

The combination of IP and MPEG-4 Part 11 provides a means to improve the interactive elements of television from advertisements to personalized services. Expanding digital television to wireless mobile delivery allows providers to offer content in a manner more acceptable to consumers who frequently want more flexibility than offered by traditional television.

MPEG-4 is now fulfilling the promise of significant video quality improvements over MPEG-2, but the advantages of MPEG-4 Part 11 have been largely overlooked. These interactive features provide the key to advancing converged Triple Play systems beyond the limitations of current MPEG-2 multiplexed platforms.

The challenge is to use open standards-based technologies to provide innovative, interactive television services alongside existing voice and data services for both IPTV and Mobile systems.

INTRODUCTION

Television distribution is now fragmented across a number of diverse platforms from mobile to high definition. While similar material is presented on each of these systems subtle differences exist in formatting, content presentation and capabilities of the distribution infrastructure. The bespoke nature of the content presentation for each of these means of delivery introduces additional overhead to broadcasters, Internet service providers, mobile and fixed line telco operators. In the highly competitive market of attracting viewers, technology does have a place in enabling new ways of viewing (mobile and IPTV) and reducing delivery costs through bandwidth reduction or use of more cost effective transmission media. The inertia behind the advances in television distribution is largely the result of developments in two previously separate domains, television broadcasting and computer networking.

Television has traditionally involved the development of specialist systems tuned to deliver real-time content. While overlap between broadcasting and IT networks has existed in the form of enterprise television and video conferencing, the IT based systems have been viewed as inferior. Exploring the reasons behind this perception holds the key to unlocking further growth in television distribution.

If broadcast quality is to be preserved and delivered to the end customer then television is a challenging medium. We have all had experience with soft low resolution pictures skipping and freezing while trying to view video content on mobile or PC platforms. This poor portrayal of the original content has been the result of best case delivery on platforms optimised for low bandwidth delivery of interactive content. To broadcast manufacturers this limitation has preserved markets and margins, stopping significant proportions of broadcast systems being catered for by lower cost IT based infrastructure.

As has happened within the voice industry, video is undergoing a transition where the distinction between broadcast and IT is being continually challenged and in many cases blurred. The drive behind this is the appeal of lower cost systems, based on open standards with the ability to re-use existing infrastructure currently restricted to carrying less demanding content. This paper will discuss the means, IP based networks, and one of the principle standards, MPEG-4, that is defining the operation of video capability in broadcast, mobile and IPTV environments.

IP, the Future Of Broadcast?

Video capability has been instrumental to increasing the appeal of many devices, see Figure 1. Content distribution is expensive and so service providers are keen to identify transmission capability using the most cost effective medium. Catering for multiple platforms to keep distribution costs down and allow existing players to expand into other markets is a common feature in proposed mobile and IPTV systems.

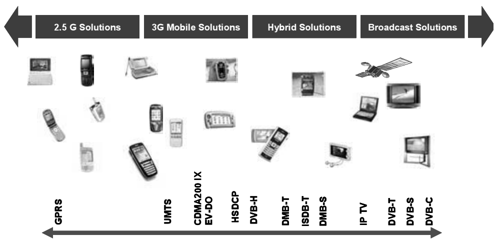


Figure 1 – Video and Network Media

Broadcast television has been a “push” medium with the only support for interactivity being program selection from the channel bouquet and limited additional side bar information services. The inertia behind this approach has resulted in many proposed IPTV solutions using a ”push” architecture with interactive capability grafted onto the original solution. Traits of such solutions are the use of IP carriage of encapsulated MPEG transport streams and heavy use of cached servers to improve channel change performance. Essentially this offers IP carriage, but doesn’t truly implement interactivity in the way Internet, mobile or gaming applications have been developed. What is required is an architecture that allows the variety that consumers have become used to with existing push television systems, along with pull interactivity to facilitate additional revenue and stimulate continued customer loyalty to programs or brands.

The case for moving television distribution to an IP network would be compelling if the medium wasn’t inherently best case delivery with little provision for Quality of Service relevant to time critical television applications. Similar challenges have been overcome in the voice industry, where voice over IP (VoIP) is now delivering the benefits of lower cost IP distribution along with enhanced redundancy and management provision that has evolved within large IT environments. It is clear that the success of VoIP offers a blueprint for video. Yet what are the challenges that must be overcome to prevent the Internet crashing under the new and unique demands of television?

What You Want Isn't Always Good for You, Who Will Get Caught Out With Television?

There are those who think the advances in processors, storage, switches and routers will allow video to seamlessly co-exist on the public Internet along with data and voice. If only it were this simple. ISPs oversell capacity on the Internet in the same way banks assume we all won't want to withdraw our money at the same time. The fact is video is an expensive medium and requires us to draw upon our full bandwidth entitlement from a provider to sustain a high quality viewing experience. ISPs are keen for us to download clips as a pre-cursor to IPTV, but unless they invest heavily in upgrading their networks and changing the charging model they could be introducing a feature that fails to deliver and increases churn.

ISPs are not the only ones who should view the dawn of the new television age with caution. Mobile operators have painfully learnt the limitations of supporting video on 3G networks and now await the allocation of bandwidth capable of supporting a true broadcast infrastructure to handheld devices.

Simply repeating the approach taken by broadcasters is a recipe for disaster for new entrants to the television game. IPTV and mobile services need to play to their strengths, namely concentrating on user choice through good interactivity. To put it another way, track the diverse nature of content consumption and the drift away from linear television, recognising that content snacking is common place and program formats exploiting interactivity will retain audience. The key is to promote the pulling of content using interactivity rather than just mimicking the push capability of television on a different platform. So there we have it, true interactivity, is a key differentiator. What standards support this and what is the implication for middleware, more on this later, lets continue with the ground work.

Program delivery is more challenging in bandwidth constrained applications like mobile and the Internet than in the fat pipe scenario available to satellite, terrestrial and cable operators. While the accountants have done the sums and allocated a per channel budget, the awkward fact remains that comparisons will be made between content offered on different platforms and consumers will decide based on quality, albeit at a level reduced from the broadcast community.

Most of the trials of mobile services have come to the conclusion that video quality isn't a criterion customers will use to access their service. If you can't see the puck in hockey you have a pretty poor user experience. It doesn't even come close to matching the expected television experience.

The tightest cost budget squeeze is being put upon new applications looking to add video to their existing service provision. These applications are typically the most demanding, i.e. operating in the most bit rate constrained environments over the most challenging infrastructure. It's not just video quality at a given bit rate that's important, but also efficient use of the network available.

Usually an answer lies either within the broadcast or IT environment to the challenges presented for IPTV and mobile distribution. Once a provider is beyond outright video quality and into efficient use of the available media they are into un-chartered territory, one-to-many for the Internet. While mechanisms have been developed for this kind of carriage, IP multicasting using class D addressing, this is seldom implemented. IP multicasting needs a routing system that can sustain this type of traffic. Two problems exist, multicasting hasn't achieved widespread implementation and charging for such a method of delivery requires further thought

Why are Open Systems Crucial for Next Generation IPTV and Mobile Deployments?

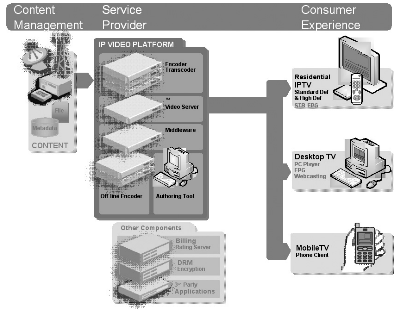


Figure 2 – Beyond Broadcast Television

With so many platforms competing for viewers' eyes, value for money becomes a key factor to success, see Figure 2. There have been numerous movie on demand services promoted where the cost to download significantly outweigh the purchase cost of the movie on DVD. Not only is the download option more expensive than the DVD, it doesn't even allow a consumer own a copy! While catering for spontaneous viewing it is unlikely that such a service will succeed in the same way cost conscious music download services have thrived. The simple fact is that network infrastructure capable of delivering video is expensive and significantly different from the current Internet usage being catered for by ISPs. There also exists a connectivity gap between the PC that downloads and the best display device in the house.

The IT networking market is significantly larger than the television broadcast market. IT infrastructure can already cater for significant proportions of the functionality required for television. The real-time, bandwidth and multicast issues specific to television have solutions underway in the IT domain and providers are eager to identify open standards to operate on such forward thinking platforms. Linking together individual IPTV solutions without becoming locked into a single vendor is the ultimate goal of the systems integrator. This promotes choice, bargaining power and upgradeability. But there's a downside, an operator needs to be a smart to avoid the pitfalls of multi-vendor sourcing!

There are a myriad of technical pitfalls that can inflict themselves on a technically unaware purchaser. This goes partway to understanding the current state of the IPTV market where single sourced and proprietary systems dominate. Sourcing from a large well known name provides protection for the embattled purchaser who is conscious that justifying an unknown solution when it all goes wrong could cost them their jobs!

Part of the solution lies with standards. Both the broadcast and network markets have been underpinned by standards to clarify levels of performance and promote multi-vendor choice. Of course there is always room in the market for the odd proprietary solution addressing a unique industry problem to improve, rationalise or deliver a cost advantage over current industry practice. The problem with IPTV is that standards linking the separate broadcast and network domains have not yet achieved widespread adoption leaving the market open to proprietary, single vendor solutions.

Mobile TV, Many Systems…..a Common Goal?

Most consumers experience with mobile television has been via 3G networks which offer a glimpse into the future of handheld television. Crucially, 3G networks are deployed and do offer true interactivity. The have opened up the market, albeit with a few drawbacks:

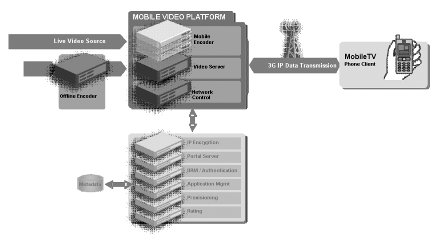


Figure 3 – 3G how it is now!

1. Systems are currently based on one–to–one streaming, although multicast provision is being developed (3gpp MBMS and 3gpp2 BCMCS).
2. The system doesn't scale and has inherent usage limits preventing it from addressing true broadcast applications.

So another solution is required and is being actively promoted in a number of different guises:

1. DVB-H, "handheld" development of DVB-T, IP basic transport & 5Mbits/s channels
2. T-DMB, DMB-S, ISDB-T, OFDM less channels than DVB-H & not IP based
3. MediaFlo, Qualcomm proprietary, OFDM, MPEG-4 & IP (non-real-time content only)
4. DAB/DMB, extension of Digital Audio Broadcasting with enhanced FEC, IP based
5. WiMax, next generation WiFi that promises wider coverage and faster access

Grouping the above systems may seem strange, although all have similar technical underpinnings and in the context of convergence neatly split into two. They can be grouped into those that support IP and those that don't!

A common strategy for dealing with a market in which there is considerable technical uncertainty is to identify a safe demarcation. In both IPTV and mobile IP represents this level, allowing for a change of mobile transmission strategy as well as allowing for infrastructure re-use, or to put it another way, convergence.

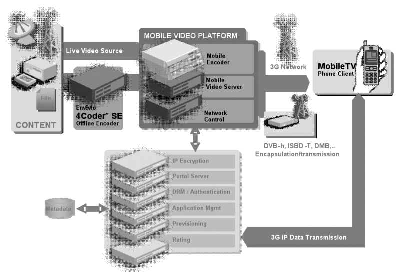


Figure 4 – The Mobile Future

Other characteristics of successor systems to existing 3G networks, is the re-use of 3G infrastructure to cater for the vital interactive capability. Augmenting existing networks with broadcast capability provides a platform on which mobile networks can support television services in such a way that content can be presented in a way that differentiates itself from existing television.

The implementation of interactivity opens up a whole host of issues from browser look and feel to the underlying middleware through which interactive services are accessed.

While some government and regulatory bodies have put in place strict guidelines to protect consumers being bombarded with vendor specific browsers it is at the middleware level where the call for a standards based approach is most clearly required.

Middleware Strategies for Dealing With Interactivity

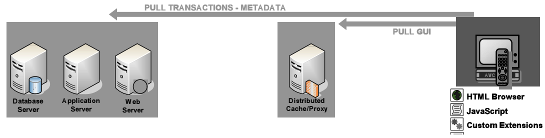
There have been two common classifications of middleware based on thin and thick clients.

Thin client middleware is based around an HTML browser while a thick client is proprietary.

MPEG-4 offers a third option which offers significant advantages to both IPTV and Mobile operators who wish to offer television services.

HTML/Java Script Middleware

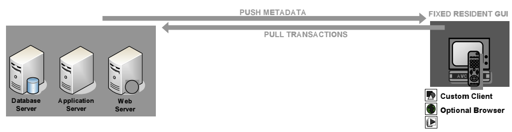
The benefits of this popular approach are flexible GUI development within an open standard, although the use of HTML does require support from customer Java Script.



Within an interactive television environment the browser performance is slow and the pull architecture demands every screen be generated by the application server. This approach has scaling issues and requires significant server deployment to support graphics. The client cannot operate without network access to the application server and the services offered have to be defined by the middleware provider. The HTML is easily hacked and the source can be repurposed on the client. Within this environment there is limited control of the billing and rating. This style of middleware architecture requires a duplex network and so cannot be applied to simplex satellite or terrestrial broadcast infrastructure.

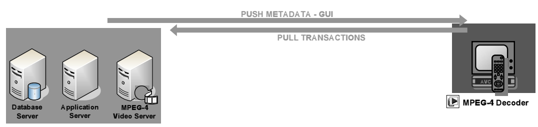
Custom Client Middleware

This approach can offer good client performance as well as push metadata, but it is based on proprietary client architecture. Other drawbacks include a fixed client GUI which is difficult to modify and an application that is tied to a specific STB vendor, making it expensive to migrate to a new STB. The push transport mechanism is proprietary and the range of services is limited to those designed by the middleware vendor. As with the HTML/Java script implementation, the custom client middleware has limited control of billing and rating.



MPEG-4 Middleware

Benefits of this approach are client independence, allowing for easy customization, and application to STB, PC or Mobile devices. Both the metadata and GUI are "push", allowing for operation in simplex satellite and terrestrial applications. Graphics rendering is performed using an engine within MPEG-4. Billing and settlement interfaces are built in along with telco service definition provisioning. The response times for the GUI is comparable to proprietary middleware solution and much faster than HTML / Java solutions



MPEG-4 part 11, sometimes known as BIFs (BInary Format for Scenes) or MPEG-4 Systems, is a standard gaining momentum that is already available within Sigma Designs based set-top boxes as well as the T-DMB mobile specification. It makes use of the object and stream based aspects within MPEG-4 to dynamically control the presentation of hierarchical audio, video and graphical objects**.** As well as being a part of the MPEG-4 specification it is within the ISMA 2.0 standard. For more information on the MPEG-4 part 11standard please see reference 1.

Carriage of Video in an IP Environment

First of all, since bandwidth is scarce, one must choose the most efficient transport for an IP environment. While an MPEG-2 transport using a DVB-ASI as the physical interface may be well suited for a push broadcast environment, the re-use of the MPEG-2 transport it is not optimum for IP carriage.

TCP and UDP are not suitable for real-time applications, because of their non-deterministic delay and poor availability. When the network is busy and there are pressures on bandwidth, no mechanisms exist to deal with the resulting congestion.

To address these short comings and allow multimedia applications to be delivered over packet-switched, multicast networks, the Internet Engineering Task Force (IETF) developed an enhanced Internet service model that includes both best-effort and real-time service. If enough bandwidth is available best effort service is used. When the network is experiencing high utilisation, real-time traffic should be treated differently. To determine the type of service and appropriate quality the following protocols were developed:

- Resource ReSerVation Protocol (RSVP) is a protocol that reserves the resources for real-time applications within the routers on the path.
- Real-time Transport Protocol (RTP) is a layer 4 (Transport) protocol which was developed as a thin protocol to add payload identification, sequencing, time-stamping and delivery monitoring on top of UDP.
- Real-Time Control Protocol (RTCP) is the control protocol that works in conjunction with RTP and helps with audio synchronization and QOS management.
- Real-Time Streaming Protocol (RTSP) is a control protocol that initiates and directs the delivery of streaming multimedia from media servers. Being a control protocol RTSP usually works in conjunction with RTP, but either can be used without the other.

Not all of the above protocols need to be implemented to optimise carriage of real-time data in multicast or unicast environments, for more information on the above protocols see reference 2.

Another IETF development was Multiprotocol Label Switching (MPLS) designed specifically for the routing, forwarding and switching of traffic requiring Quality of Service (QoS) and service quality metrics. MPLS attaches a label to packets so they can be forwarded through an MPLS-enabled network. The path taken depends on the QoS selected for that service and so provides a mechanism to optimise for television services that require a specified bandwidth and end-to-end latency allowing real-time display.

Lastly, television is typically one-to-many, which is multicasting in an IT environment and here lies the biggest challenge. While the terminology for multicasting exists, it is not generally supported on the Internet. Network congestion will be a big problem when large scale viewing of television on the Internet takes place. Mechanisms to control the routing of traffic and keep unnecessary broadcast or replicated unicast traffic to a minimum will be crucial, so supporting multicasting is highly desirable. Upgrading network infrastructure to cater for television will be a key requirement to give IPTV a firm technical footing and allow the commercial battle for viewers to take place.

Conclusion

IPTV and mobile television services require the best solutions from both the broadcast and IT sector to succeed. While much of the infrastructure to enable these services to be delivered has been standardised, i.e. MPEG compression and Internet Protocol, there still exist gaps, which if not filled, will result in proprietary solutions being deployed.

Open standards are the key to the development of IT infrastructure. If future television services are to be successfully introduced into this environment and gain widespread adoption, further work on implementing standards is required. This will preserve vendor choice, upgradeability and flexibility. Middleware can be developed in a manner that is both standards based and sympathetic to the way interactivity currently operates on the Internet. The Internet can be improved to offer network capability supporting both Multicasting and MPLS.

While all the building blocks exist for IPTV and mobile television to compete with linear television, the challenge is implementing the appropriate technology to sustain a profitable service. This will be heavily reliant on the creative side of television producing content that justifies the implementation of this technology. It is important to remember that there have been numerous brilliant technology solutions launched that have been a commercial flop, because they have placed the technology in front of the content. IPTV and mobile services can distinguish themselves, yet will have to play to their strength of interactivity to give content more appeal and engage with an ever more demanding audience.

References

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The diagram shown in Figure 1 was reproduced with the kind permission of Irdeto.