The role of IPTV in education

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Abstract

Internet Protocol TV (IPTV) is best known as a platform for the provision of entertainment services, such as movies-on-demand, and which provides sizeable revenue streams for telecommunications and Internet service providers in various markets across the globe. Less appreciated are the intriguing possibilities IPTV offers in the education domain where operators are also in competition. They, too, are constantly seeking innovative services and delivery mechanisms for their ?customers?, who increasingly demand their education via non-traditional modes of delivery to fit in with changing lifestyles and expectations. This article will outline the basics of IPTV technology and provide examples of its being used in a variety of situations across the educational spectrum, including tertiary education, continuing professional development (CPD), and personally tailored education services in the home for the wider community.

Introduction

Internet Protocol Television (IPTV) utilises broadband data networks to deliver live and pre-recorded channels as well as video-on-demand (VoD) to consumers. Although the term ?IPTV? is often loosely used to describe unmanaged, or ?over-the-top? best-effort Internet video services, it really means a fully managed, broadcast quality data service that offers high definition (HD) as well as potential to deliver 3D, excellent Quality of Experience (QoE) and the highest levels of reliability (Arberg et al. 2007 [9]). In short, the service is fully managed from playout to set-top box by the IPTV service provider. The IP protocol is used to convey the audio and video streams as well as the necessary management and control overheads. To achieve all of this, consumers must be subscribers to the service, which also requires them to log-in, and authenticate in some manner. This also provides secure payment mechanisms for those situations requiring it. IPTV has traditionally been used successfully in the entertainment sphere to deliver sports, movies, drama and a host of other consumer channels to millions of customers in many instances across the globe across the USA, Europe and Asia (Zhu et al. 2009 [10]).

More recently, IPTV?s potential in education is starting to be explored (Pohradsky et al. 2010 [11]) with particular interest in China (Zhu et al. 2008 [12]). Students of all ages and types increasingly expect to have access to more flexible alternatives to campus-centric models of learning. Often they want to fit their learning around other commitments, such as jobs and family, and access educational services in multiple ways. This is one of the major drivers for the current interest in using IPTV to provide the necessary 24/7 access via multiple screened devices such as tablets and smart-phones as well as domestic TV?s. The result is ?blended learning?: a model where students receive their education in a mix of face-to-face and online, or ?eLearning?, experiences.

IPTV?s ability to provide such services in a variety of situations across the educational spectrum, from school age children, through higher education to continuing professional development (CPD), as well as for the general population, will be described in this article. Firstly, some details about generic IPTV services and technology will be provided as background information.

[13]

Figure 1 - Multi-screen IPTV is a commercial reality today, available across multiple devices (source: Ericsson)

Generic IPTV features

Users in the home or hotel room, for example, require a set top box (STB), which is connected to a video service provider directly or via the Internet with a broadband connection. This provides the link to the IPTV service provider. The STB is also connected to their domestic TV and decrypts the incoming data to provide the TV with a standard video and audio signal. The STB can be seen as the middleman in IPTV transactions: it takes the user commands and interacts with the IPTV management and control layer to provide the requested channel and any associated user functions (Chae 2007 [14]). Access to IPTV channels and services normally involves some form of login and authentication. This can mean simply entering a four digit pin number via the STB?s remote control, or selecting a user from a list and then entering a password via a remote control which can have a mini-keyboard built in. In any open setting such as domestic lounge or hotel room authentication allows for some form of secure pay-per-view mechanism if required: the IPTV management system knows who is logged in, and this person can authorise payment for particular movies, for example, via their account.

A typical IPTV platform provides two standard services. One is so-called ?linear TV?, which is rather like traditional broadcast TV in that, via the STB remote, users can select from a number of channels that are delivered according to a published schedule. These can be live events such as sports as well as pre-recorded material. The second service, video-on-demand (VoD), presents the user with a list, or a more user-friendly series of ?thumbnail? images, of videos that can be selected and viewed at any time as shown in figure 2. The user then has full control of ?trick-features? such as pause, channel record, fast forward, rewind etc, from their STB remote control, just like having a DVD player or personal video recorder attached to the TV. This is where the critical issue of latency, or system delay, has most impact: if the user feels that the IPTV system is slow to respond to their commands then this quickly degrades the quality of experience.

STB functionality can be built into the TV set or have its function mimicked by a ?Smart TV? (basically a TV with a built in microprocessor and browser). Other platforms can be used with software clients that replace the STB entirely such as PC?s, smart-phones, and tablets.

[15]

Figure 2 - Educational VoD on IPTV.

IPTV hardware

An IPTV service requires some basic elements in terms of hardware.

- A server architecture that takes into account the locations and spread of its users so that it can efficiently host and deliver a wide range of video content with low latency and low cost.
- Encoding platforms that take various video and audio feeds from a range of sources, live or recorded, and compress them into MPEG2 or MPEG4 data streams. These data formats are then ingested by the video server and allow the delivery of much smaller amounts of data compared with the originals, but still maintain the high quality necessary for a HD video.
- A high-speed, reliable broadband network that offers quality of service (QoS) differentiation so that the IP (TV) packets can be delivered to end users with priority over other broadband traffic on the same connection, such as Internet best-effort traffic (Arberg et al. 2007 [9]). Uni-cast and multi-cast capability must also be supported by the network. For example, when a user makes a request for a particular VoD item the video server will return it in a uni-cast stream. This means the data stream is directed on a one-to-one basis from the server to each STB. Alternatively, live channels can be ?broadcast? to multiple simultaneous viewers analogously to terrestrial broadcast TV. This involves the use of multi-cast data which is an efficient way of distributing video through a network: additional data streams are only created where required, rather than sending multiple copies entirely from end to end (NBNCo 2012 [16]).

IPTV middleware

IP Multimedia Subsytem (IMS) is a standardised architecture for providing IP-enabled services, and is designed to have the flexibility to deliver new types of combined telecommunications and Internet services into the future (Mas 2008 [17]). It allows users to access all of their multimedia and voice services from any platform, fixed or wireless.

IPTV ?middleware? refers to the software that provides communication and delivery of data and connects the separate parts of the IPTV ecosystem. It can be integrated with IMS to enable the service provider to give their IPTV customers an interactive, customised, or even mobile experience (Nguyen 2010 [18]). For example, IPTV can be delivered to multiple screens, not just large screen TV?s, so that users can watch and have control over video streams on mobile devices such as tablets and smart-phones. Messaging, social media and other telecommunications services can also be integrated with the IPTV service to add to the user experience (Beck 2007 [19]).

IPTV in education

Now that the IPTV basics are covered, we take a look at the possibilities IPTV has in education.

Tertiary education

IPTV has been used in educational institutions on many campuses worldwide, but often with entertainment rather than education in mind: to rebroadcast terrestrial TV channels and VoD into student residences, for example (Klick 2012 [20]). Other institutions have used IPTV in some form to deliver live or recorded lectures, sometimes along with the entertainment channels, but still falling short of offering the innovation in services, interactivity, or delivery of content to multiple devices that the platform is capable of.

In one example of what is possible, The University of Melbourne recently investigated the potential of IPTV for truly innovative educational services in a pilot lab-based proof-of-concept (PoC) called ?Uni TV? (IBES 2012 [21]). This PoC proved that the IPTV platform was well suited to the provision of educational services. This ranged from more traditional online lectures, tutorials and fact-based programming, to more forward-looking implementations for eLearning such as lectures filmed in 3D at the University (IBES 2011 [22]). Figure 3 shows a 3D chemistry lecture using physical models to explain the molecular dynamics of CO_2.

[23]

Figure 3 - 3D chemistry lecture with IPTV STB and active glasses.

3D is also becoming more prevalent in the education domain thanks to the development of various training simulators, particularly in medical faculties, which was also demonstrated as part of the ?Uni TV? PoC. The details of this are described in the section on continuing professional development later in the article.

The cost of 3D technology, such as domestic TV screens and high-definition (HD) camcorders, has fallen dramatically in the past twelve to eighteen months thanks to its wide uptake and ongoing development by the entertainment industry (Deal News 2011 [24]). This means that 3D can now be used for practical, cost-effective educational purposes in many scenarios, and IPTV can extend 3D?s reach out of the laboratory, clinic, and class-room and into the homes of users via broadband data networks. For a considerable period of time, the usage of 3D has been recommended to facilitate learning in situations that would be impractical in the real world, to transfer knowledge through the contextualisation of learning, to enhance intrinsic motivation and to create spatial representations of complex concepts (Chitaro 2007 [25]). IPTV?s ability to store, to provide easy repeated access, and to display 3D HD reliably at broadcast quality makes it an excellent choice for these situations.

The IPTV platform chosen has also shown its ability to stream video material to iPhones, Android phones, laptops, PC?s, and tablets with the addition of encoders that can serve the material in the appropriate format for each device. It can also take into account the bandwidth of the network connection and scale the resolution appropriately, which may change in real-time, particularly with wireless connections.

The successful PoC has more recently led to ?Uni TV? being rolled out by The Melbourne Dental School (MDS). At the time of publishing the IPTV platform is in the installation and commissioning phase and is due to go live for staff and students early in 2013. The roll-out consists of delivering IPTV to various sites across Victoria via both the National Broadband Network (NBN) and Australia?s Academic and Research Network (AARNet) infrastructure, including local and remote campus locations in Melbourne and Shepparton, as well as home use in the first wave NBN build area of Brunswick.

The MDS is an interesting test case for IPTV?s real-world efficacy in an educational setting, because it has so many video-content creation avenues. As well as lecture and tutorial capture cameras, the School?s pre-clinical and clinical areas between them have a range of specialist cameras and simulation tools as part of their daily teaching and patient treatment activities. There are microscope cameras which can be monocular (2D) or stereo (3D) according to the type of beam-splitters used; podium cameras which look down on the clinical-tutors? hands as they demonstrate complex procedures; wide angle cameras that capture dentist-patient interactions; 3D haptics simulation work-stations; intra-oral dental cameras which can be used for tele-dentistry with the confined elderly, and remote patients.

MDS has identified scenarios where IPTV could have major impact on both future learning and business opportunities for the school, and these are to be the subject of IPTV trials in the coming year. These opportunities range from improving outcomes for existing undergraduates, providing services to staff and students on remote campuses, and improved continuing professional development (see below).

Primary and secondary education

Kindergarten to year 12, or K-12, school-age children are well placed to benefit from innovations in educational IPTV, particularly for those subjects often identified with serious teacher shortages in many areas across Australia (MCEECDYA 2005 [26]). These usually occur in outer metro, rural, and remote areas and highlight the importance of the National Broadband Network in delivering services to these regions. However, particular subjects also suffer from shortages in metro areas: mathematics, the sciences, as well as music and arts training fall into this category.

Educational IPTV offers an opportunity to get high quality teaching into class-rooms that have no local specialist teacher. Master-classes in music tuition could also be delivered. Depending upon requirements and circumstances, the IPTV experience can be facilitated by the simultaneous use of video-conferencing, via either a second screen or a ?picture-in-picture? approach that allows a central tutor to appear alongside video material. This can provide for live one-to-many and many-to-many ?Q&A? sessions for a number of students spread across various locations.

Continuing professional development

Part of the ?Uni TV? rollout described above is aimed at improving pathways to continuing professional development (CPD) for existing dental practitioners. Provision of educational services locally via IPTV can save lengthy and costly travel to city locations for training which, in turn, improves the range of locally provided dental expertise in outer metro and rural communities. Such cases make it is easier to understand how educational IPTV can provide spin-off benefits to the wider community as CPD training can occur in many areas inside and outside the health domain.

Although CPD is usually based around traditional lecture and tutorial style courses, it is possible for sources other than cameras to provide content for these specialised IPTV channels: ?haptics? simulators are increasingly common and provide a virtual environment where realistic touch feedback is provided to the user via a number of motors that resist the operator?s movements whenever a virtual obstacle is encountered (Minogue 2006 [27]). This is combined with a 3D (anatomical) display which provides for a more immersive environment. For example, the user picks up a pen-like control held in a motorised cradle. The simulation can show a virtual drill or scalpel, or similar hand-held tool, and reposition it according to the hand movements of the user. If the virtual drill contacts virtual bone in the 3D simulation, the hand-piece no longer moves forward, giving the user the feeling that they really are cutting into bone with the genuine article. If the drill touches virtual flesh, slightly less resistance is felt and even virtual blood can be spilled, giving the user a literally ?hands-on? training experience without risk to real patients (Hutchins et al. 2005 [28]).

Such haptics tools have direct applications in CPD environments: in the ?Uni TV? PoC a live IP video stream from a haptics cochlear implant surgical 3D simulator was captured by the IPTV platform, and then made available as a live surgical training IPTV video channel (IBES 2011 [22]). The Melbourne Dental School is also planning to use such haptics trainers for the practice of various types of clinical procedures.

The IPTV system is able to automatically record such inputs so that they then become available as VoD material for subsequent view by (CPD) students unable to attend the live demonstration, or for those who were present but also wish to go over the material at a time and place of their choosing. This is the so-called ?time- and place-shifting? model: students increasingly expect to have access to such flexible online, or ?eLearning?, alternatives.

Public education

IPTV obviously has potential in delivering education services of a more general nature to the public, but there is also ample scope for it to be used in targeted ways for particular applications in the community. For example, there are large numbers of the population in lower socio-economic categories, such as migrants (English as second language), indigenous, and the aged. These segments of the population tend to have difficulties with personal computers and Internet tools: they are less likely to have adequate finances or the required skills to use the technology. This means that their access to vital information is often compromised, which negatively impacts on their financial and health literacy for example (Schillinger 2002 [29]).

(IP) TV offers the above-described groups the potential to reach what is, for them, otherwise inaccessible information via a more familiar and friendly interface. Making information accessible via a remote control and TV makes it much more likely to get through to the target group. Equally importantly, the provision of a relatively inexpensive STB means existing TV?s in the home can be used without incurring high levels of additional expense. IPTV can easily be provided at alternative venues such as libraries, health centres, and other public places to improve access even further.

IPTV integration example

The IPTV integration example below describes one approach to improve health literacy. An existing web-based system called SeeCare is used to provide online access to personalised health information to older people and to people with chronic conditions such as diabetes and cancer. It also provides personalised information to the carers in their support networks. The personalisation is achieved from the details entered both by their health professional and by the patient themselves: the patient can set the necessary permissions for family members or friends to access information about their condition. Figure 4 shows how this service is integrated with IPTV to provide personalised video content. The IPTV middleware seeks only the relevant health information from the SeeCare server to enable it to select the appropriate material for view by the currently logged in viewer. It then provides a list of content based on these parameters to ensure the patient or carer receives exactly the right material based on their current status.

[30]

Figure 4 - Integration with a health literacy platform to deliver personalised video content

The system still maintains patient privacy via the authentication mechanisms between the viewer and IPTV platform, as well as between the IPTV platform and SeeCare server.

The integrated SeeCareIPTV system thus provides people in need of care and support, and their carers, with a personalised health literacy TV channel using familiar technology, the television, in a familiar setting, the home.

The same approach can be used for future services that will cater for other areas of interest via the additional of IPTV channels integrated with the relevant IP-enabled platforms.

Conclusion

IPTV can have genuine pedagogical impact in education, not only for tertiary level students seeking alternatives to campus-centric learning models, but also for many in the wider community. These include those undertaking continuing professional development courses to maintain and improve their skills, and ?K-12? school students who often lack access to teachers in certain subjects. The general public can also benefit from educational IPTV and, in particular, those in lower socio-economic groups, who lack the requisite skills and access to personal computers and web-based tools. This group could use their home (IP) TV as an educational resource for improved lifestyle choices and to strengthen the quality of their support networks.

IPTV?s ability to be integrated with other IP-enabled services will be a major driver of its use into the future.

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