

# Digital Television, Personal Video Recorders and Convergence in the Australian Home

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## ABSTRACT

Out of the confusion of delivery technologies for domestic digital video, the function of a Personal Video Recorder (PVR) that has a content management system based on an electronic program guide emerges as a key component of a home entertainment system. Serving as a content manager for video broadcasts for free-to-air and pay-TV, PVRs can automatically record, sort, schedule, store and integrate video material from different sources in a convenient, easy-to-use and timely fashion. Devices with PVR functionality are still not yet in widespread use in Australian homes, but are the increasing subject of pioneering commercial enterprise, innovative experimentation and open-source community development. The concept of a MADE system is introduced as a system with converged functionality for Media, Automation, Data, and Entertainment. This paper describes and compares three systems with PVR functionality and evaluates their current and future roles as a component for MADE systems in Australia: the TiVo appliance, the MythTV open source software for Linux; and a Topfield set top box using IceGuide. The drivers for and threats to the convergence of functionality towards a MADE system are also considered.

## Categories and Subject Descriptors

H 5.1 [Multimedia Information Systems]: Video

## General Terms

Performance, Experimentation

## Keywords

Digital television, Personal Video Recorder, Home Theatre System, Open Source, Copyright, Convergence.

## 1. INTRODUCTION

Digital television in Australia is presently in disarray. From the broadcaster's perspective, it has come to be widely believed that a complex and poorly-conceived series of Australian Government policies enacted as law between 1998 and 2001 has not fostered many new competitive practices nor much by way of technical innovation from the existing free-to-air broadcasters, while simultaneously it has delayed or discouraged innovative new players from entering the market [1,2,3]. Examples include the failure of any of the five domestic free-to-air networks to persist with multichannelling (the practice of using increased digital bandwidth to allow the viewer to select between different camera angles or different commentaries on the same program material) and the lack of interest in "datacasting" either conceptually or as service licenses for which networks would compete at auction [4]. Similarly, an early plan that the analogue broadcast system be discontinued by 2008 has been shelved - or at least postponed - probably in recognition that due the slow uptake of digital receivers by consumers [5], this would effectively eliminate broadcast television for a good many of the voting public.

Despite the promises at the launch of digital television, those consumers who do invest in a digital tuner are afforded only a few extra channels, offering little by way of new services or extra content. Digital television potentially provides increased picture quality, but many consumers do not have the skills to properly set up the combination of a new wide-screen TV and a digital tuner. The continued sales of televisions that do not meet the minimum Australian digital broadcasting standard suggests that a desire for picture quality may be driven more by the marketing claims of "High Definition" and by the availability of cheap TVs with large screens than any significant actual improvement in picture quality<sup>1</sup>. Even true High Definition TVs are often installed with incorrect and mismatched settings between the TV and an external

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<sup>1</sup> Screens with a horizontal resolution of 480 lines (made to meet the minimum USA standards) are regularly sold as "HD ready", even though they do not meet the minimum Australian standard of 576 lines.

digital tuner, resulting in distorted images. This can be seen in most stores selling these products.

Compared to analogue television, digital tuners can also be difficult to set up properly, suffering, for instance from the “digital cliff” effect in which an apparently perfect picture can suddenly degrade into unwatchable chaos if the arriving signal strength is not strong enough to reliably stay above the minimum threshold of sensitivity of the tuner. Another problem is that digital set-top boxes, digital tuners (sometimes referred to as *set top boxes or STBs*), cable modems, DVD players, video game consoles and the like are all essentially independent input devices, and cannot easily be made to interoperate as part of an overall system. Emblematic of this lack of integration is the accumulation of multiple remote controls on the coffee table: one for each box.

The slow take-up of digital TV in Australia thus comes as no surprise. Of course, it has long been possible to purchase or build more or less integrated “Home Theatre” combinations, typically incorporating ever fewer analog and ever more digital television and audio components, from a common manufacturer. If properly configured, these systems can produce high-quality vision from large screens and high-fidelity sound, as well as convenience of using products that act as single-function media device. But it is probably only the lure of large, fashionable 16:9 widescreen TVs at reducing cost that has begun to motivate consumers to trade in their old equipment for new. Even now, many true High Definition Televisions (HDTVs) which have exceptional resolution are only available with analogue tuners, forcing consumers to add an external digital STB with its additional complexity.

To further complicate the matter, a bewildering set of new commercial Internet-related television services are now entering the Australian market. We may distinguish two more concepts here: Internet Protocol Television (IPTV) and Internet Television. IPTV uses the IP network to distribute streaming television content from centralised servers to the consumer’s STB, rather than a PC. This is in essence little different from cable television, since the program content and timing is almost entirely in the hands of the content provider. Although it could theoretically support on-demand video services, there is apparently little interest in doing so at this stage [6].

Internet TV is different in that it genuinely offers on-demand television programs for download to the consumer’s PC as well as enhancements to the existing free-to-air content. In Australia there is some experimentation with video podcasting (or *vodcasting*) of content such as the Australian SBS TV channel’s comedy *Wilfred* on that network’s website, but such services are clearly underdeveloped. At present the range of programs is extremely limited, with little or no programming available from the commercial TV channels.

It is argued here that what is still missing from many of these systems is a comprehensive *content management* function based on an online, *machine-readable* electronic program guide (EPG)<sup>2</sup>.

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<sup>2</sup> Some of the Australian networks have made program guide information for their own channels available as a “datacast”. However, these guides are neither in a common format nor are they machine readable, meaning that they cannot be used for

This provides not merely the capability to time-shift programs - that has been available since the advent of home videocassette recorders in the 1980s - but rather a much greater range of control options over programmatic content, including different playback speeds and viewing styles, search and sorting based on metadata criteria, and a range of disposition or archival options. One might also hope for extra services, such as ease of connection to Internet-distributed services of the kind mentioned above. It is the experience of the authors that the use of machine readable EPG-enabled PVRs to time-shift television programs represents a qualitative difference with respect to recorders without this capability. Being able to build up a backlog of time-shifted, unwatched, high-interest programs fundamentally changes the relationship of the consumer to the medium. The EPG-enabled PVR becomes, in effect, a personalised television channel that always has something interesting to watch, and at a time convenient to the user. The function of a PVR with an EPG provides Really Simple Syndication-style (RSS/pod-casting) functionality for TV programming.

In much the same way that electronics and computers have become integrated into the functionality of cars, so computers are becoming integrated into homes. “Media centres” are the first step in a transition to systems which monitor and control many functions in the home. What we will call a *MADE system* would control and provide Media, Automation, Data and Entertainment. This has started with the management and display of stored digital data such as music and video content, should evolve into management of on-line internet services (including telephony) and may eventually expand in scope to integrate, control and manage the physical environment in the home - air conditioning, water and power management, and security.

A MADE system may be a single centralised set of equipment, but is more likely to be a number of different units scattered about the house, connected with a combination of wireless, wired, and data-over-power networks. The essence of the MADE system is that even though it is a number of distributed units, to the user it “feels” like a single system. This does not mean that all functions are necessarily available in all places in the home. For example, telephony functions may be available in the garage using a traditional telephone handset, but video playback is not available. In this example, the usability of a simple device such as a telephone is extended by the MADE system, so that it is possible to control security (e.g. unlock the front door) by using the telephone handset, or play music from the home-owners MP3 collection through the telephone’s speaker.

MythTV (see Section 3) is an example of this evolution towards a distributed system that presents users with a “single system” interface. Video and music is available throughout the house through multiple MythTV units, while a “single system” view is maintained for scheduling TV recordings. Someone using a MythTV unit in the bedroom can schedule a TV recording which will actually be done using a TV tuner in the MythTV unit in the home theatre room. The recording is then available for viewing on any MythTV unit in the house. Extensions to MythTV’s media centre functions add telephony, home automation, and internet

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automatic control of television systems such as recording a particular program.

services - all clear indications of a design trend toward a single converged interface.

Standalone PVRs may play a part in a converged MADE system, but only if they can be easily integrated into the components providing the other functions. If the ease of integration is stymied by competitive market pressures, legal problems, or simply by poor implementation of technology, then the mass adoption of both standalone PVRs and integrated systems may remain stalled.

In the face of rapid technological development, new products, uncertainty about standards, dramatic shifts in component prices and questions over new laws and practices, there is an understandable “wait and see” attitude among much of the Australian public. As mentioned, the first commercial offerings with desirable features have now appeared on the horizon. However, some enthusiastic hobbyists have already gone ahead and built their own working computer-based digital television systems, often as part of open-source software communities. Rather than try to cover the entire rich spectrum of possibilities, we choose to focus on three representative systems with the crucial common function: a video recorder with a content management function based around an online, machine-readable EPG.

In the following sections, we describe and compare three such systems and evaluate their suitability as Australian domestic entertainment systems and building blocks for a converged MADE system: the TiVo appliance; the open source software for Linux computers, MythTV; and a commercial PVR using the subscription IceGuide EPG. The criteria used to evaluate the systems will include: utility of EPG, ease of installation/maintenance, interface usability, interoperability with the Internet and prospects for future expansion to new services. We conclude with a reflection on the prospects for such systems against the background of the legal and regulatory struggle between open source and closed content.

## 2. TiVo - A PVR APPLIANCE

TiVo is the name of both an incorporated company and their hard-disk based personal video recorder that works by connection to a user’s cable, satellite, or other digital feed to record television programs. It was introduced in the USA in 1999. An evolving series of units in a number of variations have been manufactured by several third-party manufacturers, including Sony, Philips, Pioneer, Toshiba and Thompson.

A TiVo connects via modem on a dialup phone line or broadband Internet connection to a TiVo Inc. server to download electronic program guide information and software updates in a proprietary format provided as a subscription service (in North America, Taiwan and the UK). As well as easily selecting forthcoming programs from the guide, viewers can request a “season pass” to a favourite television program, and the regularly updated guide enables the TiVo to automatically record all new episodes of that program as they appear. Programs can also be recorded based on metadata criteria such as genre or actor, or based on similarity to other programs which the user rates positively by using the green “thumbs up” key on the remote control.

One of the most impressive features of the TiVo is its human interface [7]. The recording unit itself has been simplified into a true consumer appliance: there are no visible switches, buttons or digital displays and operation is controlled entirely by on-screen menus from the remote. These are attractively coloured, and well-laid out with large, clear and jargon-free text labels. Starting up, recording and playing back programs has been made easy and fun.

The product of an intensive 14-week long user-centered process, the device’s distinctive peanut-shaped remote control is a model of good interface design (Fig. 1). It fits comfortably in the hand and features playfully-coloured and pleasant-feeling buttons, the pressing of which evokes amusing sounds from the PVR unit. It has won a design awards from the US Consumer Electronics Association [8]

By use of a sizeable memory buffer between the video input stream and the viewer, live television watching is enhanced by the capability to pause and rewind the buffered stream. Recorded programs can be watched while another is being recorded, and it is possible to begin watching a program before it has finished recording. TiVo users are apparently nearly unanimous in loving these features, with many saying they would now not want to watch television without it. [9]



Figure 1. Peanut-shaped TiVo remote control

Image: Tivo Inc.

TiVo Inc. does not currently sell its PVRs in Australia and does not provide an Internet service that works with Australian network broadcast content, but have recently announced plans to do so in 2008 in a joint venture with the Seven network [10]. However, a vigorous community of enthusiasts have imported a small number of original TiVo Series 1 units from the USA, and have adapted them to PAL television standards, reverse-engineered the TiVo hardware and data protocols of the electronic program guides and set up a free online EPG [11]. This has been possible in no small part to the fact that the TiVo is based on the Linux open source operating system, ensuring that much of the operating information about the TiVo was available in the public domain. The OzTivo community adopts the open source philosophy of the Linux operating system upon which the TiVo is based. Volunteers develop hardware and software that allow Australians to set up a TiVo system; they also maintain the electronic program guide

from readily available public sources of information. Along with other open source initiatives in South Africa, New Zealand and The Netherlands, OzTivo seems unofficially tolerated by TiVo Inc. Whether or not this continues in the future - when there is a commercial TiVo service in Australia - remains to be seen, particularly considering the litigious nature of some media companies.

**Table 1 Evaluation of OzTiVo**

<b>Number and type of tuners, concurrent video streams that can be recorded</b>	TiVo Series 1: one tuner (internal, must be modified) or external Standard Definition signal source (e.g. digital STB). One program can be concurrently recorded. TiVo Series 2 and 3: multiple concurrently recording tuners or signal sources, but not working in Australia (yet).
<b>Electronic Program Guide</b>	Machine-readable. Available from Internet server - data from open source community service. Wide range of viewing, recording, sorting and deleting options are enabled.
<b>Ease of installation/maintenance in Australia</b>	Medium complexity for computer experienced hobbyists. Difficult to impossible for average users. Users need some knowledge of Linux-style software installations and configuration, although OzTivo site provides extensive help documents. Note that in countries where TiVo runs "natively", setup is very simple.
<b>Interface usability</b>	Excellent. Award winning design.
<b>Usability as an integrated media-automation-data-entertainment (MADE) convergence platform</b>	TiVo Series 1- low. Series 1 is a media provider device, and relies on another device which integrates other media and data (e.g. music, photos, phone, data feeds). TiVo Series 2 and 3- medium. Focus on video media, but offers extensions for music, photos, downloadable movies etc.
<b>Future prospects</b>	Electronic Program Guide depends on continued existence and future work of OzTivo community, or use of single Australian commercial EPG provider in future.
<b>Limitations</b>	Present limitations of single tuner in units, limited extra services may be overcome when commercial services commence, early 2008.

In the US, TiVo Inc. is continuing to advance its original service platform with new functions. This means further integration with mobile media devices and PCs, new ways of controlling



**Figure 2. TiVo Series 1 as used in Australia by the OzTivo community. The case is shown open, as required to access the hard disk in order to set up unit for Australian use.**

Image: Kees Cook

programming, and tighter integration with remote scheduling. Some new services now offered include playing of audio throughout the house, display of images of various formats such as digital photographs, PVR-to-PVR transfers of recorded programs, scheduling of recordings using a Web-based client, PVR-to-PC and PC-to-PVR transfers of recorded programs, Internet downloads of media content, and PVR-to-mobile device transfers using a PC as an agent. It is not currently not known whether or how these innovations will be available in the future Australian commercial service.

### 3. MYTHTV - A CONVERGED M.A.D.E SYSTEM

MythTV is free software that runs on most commonly available combinations of Intel Architecture processors and motherboards, using the open source Linux operating system. Like a TiVo, MythTV is designed to be operated with a remote control unit, so it presents a simplified but comprehensive on-screen menu system that is functional, though not as polished as the TiVo interface.

Many functions are incorporated within a single system. These include:

- EPG-based PVR video recording using multiple digital or analogue tuners, or video capture cards hooked up to external video sources such as PayTV STBs;
- DVD player, without region coding restrictions [12], to allow DVDs which have been legally purchased in other countries to be played;
- CD player and CD burning





**Figure 3** Screen shots of MythTV, showing various available functions: menu and PVR function with EPG scheduling weather, music player, and photo viewer.

- MP3 player, with access to a library of music on the local MythTV computer, or other computer on the network with accessible files;
- News feeds;
- Photo and video viewer;
- Telephone (receive calls only);
- Weather information;
- Games (using available game system emulators);
- Security camera recording and viewing.

MythTV was originally written by Isaac Richards in 2002 as a solution to his perceived lack of convergence from existing systems:

*“I figured it'd be fun to try and build a replacement. Yes, I could have just bought a TiVo, but I wanted to have more than just a PVR - I want a web browser built in, a mail client, maybe some games. Basically, I want the mythical convergence box that's been talked about for a few years now.” [13]*

Today, it is one of very few products that deliver on some of the promise of convergence, and gives us a glimpse of what a converged MADE system might look like in the future, without the constraints on users imposed by vendors of proprietary or custom products.

While MythTV is available free of charge, today's reality is that setting up a Linux computer with MythTV is something that is mainly within the reach of computer hobbyists, or others with a skilled person to assist them in choosing their hardware and configuring the software<sup>3</sup>. As Linux distributions continue to improve their ease-of-use and ease-of-installation, MythTV will also improve. MythTV is open source software that can run on any Intel Architecture 32-bit or 64-bit computer (with the exception of Itanium). Some MythTV functions can be accessed using computers running MacOS or Microsoft Windows as an operating system, though only video viewing functions are available in a stable form.

As a general rule, if the network, sound, and video devices in the computer are supported by Linux, then MythTV will also run. Most Linux distributions are suitable (RedHat, SUSE, Debian, and Ubuntu amongst them). An enthusiastic group of users can be found to help out via a mailing list or web forums dedicated to MythTV.



**Figure 3.** Multiple use home computer (covers removed): MythTV system with three digital TV tuners. Computer connects to a home theatre and plasma TV in another room (not shown). Converged functionality also allows system to serve as heater for dog bed (rear of photo).

The system can either be centralised with all functions running on a single server, or the system can be distributed across multiple servers. Possible configurations include:

- A single centralised MythTV computer with TV tuner card/adapters and video capture cards/adapters, and with a video card connected to a TV screen. MythTV functions

<sup>3</sup> The Electronic Frontier Foundation in the USA runs workshops to assist ordinary computer users to set up MythTV computers.

**Table 2 Evaluation of MythTV**

<b>Number and type of tuners, number of concurrent video streams that can be recorded.</b>	Multiple tuner types supported- analogue and digital, also video signals from external signal sources (e.g. cable TV STB). Multiple concurrent recordings possible.
<b>Electronic Program Guide</b>	Machine-readable. Available from internet server- data from open source community service or commercial service. Wide range of viewing, recording, sorting and deleting options are enabled
<b>Ease of installation/maintenance</b>	Medium to high complexity for computer experienced hobbyists. Difficult to impossible for average users. Users need some knowledge of Linux-style software installations and configuration
<b>Interface usability</b>	Very good interface design for TV. Other parts of interface such as music management not always of the same quality and usability.
<b>Usability as an integrated media-automation-data-entertainment (MADE) convergence platform</b>	High- Many functions available as part of standard MythTV software (DVD and CD media player, music, photos, weather, games). Other plugins are also available (e.g. telephony).
<b>Future prospects</b>	EPG depends on continued existence and future work of OzTivo community, or use of single Australian commercial EPG provider. Continued development of MythTV DVD/CD media player is becoming more difficult due to industry moves to lock in DRM and region coding in HDDVD and Blu-ray. Evolution of increased convergence functions is likely to continue, with MythTV as the platform, or as a component of another platform (e.g LinuxMCE).
<b>Limitations</b>	Not a consumer appliance- effort to construct a PC with MythTV is likely to remain as a medium complexity project for hobbyists for at least a number of years.  Future legal and patent issues could restrict the use and development of MythTV and other open-source projects.

- available at this location only. This computer can also act as a normal workstation, as well as a MythTV system.
- A centralised MythTV computer with TV tuner card/adapters and video capture cards/adapters, and other MythTV computers throughout the house. MythTV functions such as program viewing and scheduling of recordings are available throughout the house.
- Decentralised MythTV computers throughout the house, each with its own tuner/capture card and attached to a display or TV in each location. Programs can be scheduled and viewed at all locations.
- Combinations of the above.

Clearly, MythTV is an advanced distributed architecture that is very suitable as the basis for a converged MADE system.

Recently, MythTV has been incorporated as one component of Linux Media Centre Edition (LinuxMCE), which aims to wrap a consistent user interface around MythTV, Xine, Asterisk, and home automation functions (X10 and others) as well as other media devices (e.g. Squeezebox). While it is open source, LinuxMCE is a commercial project, compared to MythTV which is a non-commercial project [14]. Support for MythTV is mostly on a non-commercial basis, though there are a few MythTV system builders who sell and support their products.

The open and cooperative nature of open source software development has spurred innovations that have seen Linux, Apache, and other projects become industry leaders even when pitted against commercially developed projects. MythTV shares the same approach, and may very well share the same success.

#### **4. ICEGUIDE ON A SET TOP BOX**

Consider now a combination of commercially available STB with a built-in PVR - namely, a Topfield Masterpiece standard definition unit - and a subscription EPG available from IceTV- namely IceGuide. Although the Topfield unit has its own recording menu, the subscription service allows access to continuously updated EPG and content management system with its own, arguably better interface. EPG data is downloaded to a PC from IceTV's website using proprietary software supplied as part of the subscription. The data must then be transferred to the Topfield unit via USB or wireless connection each day to stay current. Setting all this up (especially upgrading the STB's firmware) requires rather more technical knowledge than a consumer device should, but less than a TiVo and considerably less than MythTV.

Compared to the TiVo, the user interface is rudimentary, but effective (Fig. 2). The guide screen, available under a single button on the remote, shows programs for all available digital channels for the next seven days. The current program on the selected station is always visible in the top right hand side of the screen. Viewers select a program from the EPG with up and down

keys on their remote, and may mark a program for recording, again with a single button. Like the TiVo, it is possible pause the live television stream, begin playing a program which is still recording. As with later generations of TiVo, it is possible to record two programs at once, even while watching a third program. A wide range of playback options is provided.



Figure 4 IceGuide EPG screen above a Topfield Masterpiece Set Top Box

Image: IceTV Inc.

In Australia, the networks do not feel obliged by their published program schedules. They often re-schedule, delete or substitute programs with less than a day's notice, especially around sporting events. Furthermore, actual programs frequently start and finish later than published times, even when there is no official change to the schedule. This makes recording complete programs difficult, or at least inefficient. The latest version of the IceTV software (like the TiVo and MythTV) includes a provision for *schedule padding* - a fixed earlier time to start and a fixed later time to stop a recording - to try to overcome this. It is not an ideal solution, however, since program delays are variable in practice, and it wastes disk space, thus reducing the number of programs that can be stored - a particular problem when the total recording time is limited, as with the Topfield unit (about 36 hours). IceTV claims that they will improve the update frequency of their EPG data to help overcome this.

The IceGuide currently interoperates with DigiTV, MythTV, SageTV and ShowShifter software, as well as home theatre systems such as Microsoft Windows XP Media Center Edition 2005. IceTV also offers bridging software over the web and to mobile devices called PIMP (Personal Interactive Media Planner), which permits the user to see a seven day TV guide, remotely schedule recordings and notifies the user when a preset favourite programs are due to air. They are also beta-testing a separate social collaborative web service that allows online voting and sharing of favoured programs, called IWatchThis [15].

Table 2 Evaluation of IceGuide on a STB

<b>Number and type of tuners, number of concurrent video streams that can be recorded.</b>	Will record two programs at once, while watching a third
<b>Electronic Program Guide</b>	Compatible PVR uses IceGuide EPG subscription service from IceTV. Updated daily.
<b>Ease of installation/maintenance</b>	Consumer appliance, but some setup required. Firmware upgrades of STB are available, but may be difficult to find or install. Daily transfer of data is slightly awkward.
<b>Interface usability</b>	Simple but effective. A choice of layouts is available. Many functions are available with a single button press.
<b>Internet friendliness</b>	Depends on USB 2.0 or wireless interface for copying recorded programs to PC and updating EPG, software.
<b>Usability as an integrated media-automation-data-entertainment (MADE) convergence platform (see Section 5).</b>	Questionable. Software is not directly under user's control. Expanded services depend on IceTV's interest in new service options. Daily transfer of data could readily be automated.
<b>Future prospects</b>	Completeness of IceGuide EPG data threatened by a legal dispute with a commercial network. Alternative EPGs are not readily available in Australia, so value of this system may be dependent on IceGuide's continued viability.
<b>Limitations</b>	Slow to change channels. Limited disk space for program storage (120GB = 36 hours). Proprietary expansions of function are less likely than for open source projects, due to vendor wanting to sell next improved model.

## 5. THE FUTURE OF PVRs AND INTERNET TELEVISION- LEGALITY, ETHICS, AND PROFITS

The EPG-enabled PVR is the "killer app" for home entertainment systems, but there are reasons to believe that it could be spoiled by moves to lock down programs, guide data and media with overzealous law suits, and Digital Rights Management (DRM) that infringes on fair use rights of consumers and free trade between countries [16].

The evolution of some PVRs is leading toward integrated systems that we have called MADE (Media, Automation, Data, and Entertainment). These PVR devices are starting to integrate other functions - home automation, IP telephony, photo viewing, access to a music library, game playing and data feeds such as weather and traffic are being added to some PVRs original core function of managing video programs [17]. Other devices such as game consoles are approaching the same target from a different direction.

There is always a tension between a single converged platform that provides a single point of control and the promise of simplicity and convenience, and the use of a number of specialised “best of breed” single-function devices which are then somehow integrated. The single converged platform is the MythTV and Microsoft Media Center Edition approach, and can also be seen in “do it all” mobile phones that attempt to be phones, MP3 players, and portable computers. The alternative is the iPod and home theatre approach, which collects multiple components that each do one thing well - with the promise that this excellence outweighs the effort to coordinate and integrate these components.

Serious risks to the continued development and success of MythTV are similar to those faced by the rest of the Linux community:

- Legal actions;
- Adoption of new proprietary media, inaccessible content such as HD-DVD and Blu-ray;
- Domination of the market by a small number of commercial interests.

Legal action may be actual or threatened, directed to the software developers or hosting sites. These legal actions may be related to patents, or circumvention of Digital Rights Management (DRM) “features” such as encryption of program sources, or region coding, or codes transmitted in free-to-air TV signals to restrict the ability of devices to record and store signals. Breaking the locks on media content is often illegal, even though the purpose may be to use that content in a way that is legal and permitted under “fair use” laws. This is true in many countries including Australia, and exposes the user to criminal actions for simply trying to exercise their legal rights. For example, a Norwegian programmer who distributed the codes to unlock DVD encryption was prosecuted, even though his aim was simply to allow DVDs to be played on computers running Linux [18].

According to Panasonic, a major manufacturer of consumer appliances, DRM region coding is about market control to increase profits as well as the prevention of piracy:

*“To maximize their profits, the US movie companies control their release timing, area and means [sic] ... of their titles very carefully worldwide .... Panasonic strongly support this 'region code' concept... We consider the sales of 'code free' DVD players modified by a third party as being a serious problem as it threatens the intellectual property rights of the companies that are providing DVD Entertainment software.” [19]*

This extract shows an industry attitude which confuses the desire for profit with intellectual property rights. Legal action has even been taken by one free-to-air television station against an Australian company selling an EPG service, on the basis that their program guide information is copyrighted [20]. Nor is the law consistent on this point. The Australian Federal government has recognised region-coding DRM as undesirable [21] and recent amendments to copyright laws include exemptions to allow DRM to be bypassed legally where the DRM is specifically for region coding, yet this protection is not extended to other fair use consumer rights such as time-shifting [22].

Currently, the small market for MythTV systems probably helps protect the project. But with increased success comes also comes an increased risk of litigation. Broader patent disputes for open source and Linux such as the JPEG patent, MP3 patent lawsuits might, if successful, have a chilling effect on open source development, including MythTV. New media content formats such as HD-DVD and Blu-ray might also have a negative effect.

In Australia, with the legality of breaking encryption for the purposes of legal fair use access in doubt (due to Federal laws on allowable fair use exemptions being loosely written), and with the introduction of more robust and heavy encryption and DRM in the new media formats, the availability of open-source software that can access this content is delayed. Even once it is available, software that breaks these electronic locks on media content is in an electronic “no man’s land” because of its differing legal status in different countries. (In fact, contradictions are seen even within the legal system of a single country). The required decrypting software cannot be legally distributed in many countries, but must be downloaded and installed by each individual user from a country where it is legal to use such software.

However, the slow uptake of digital television in Australia, as well as the generally low quantity of TV sets that are being purchased might indicate that the public are not as interested in incremental improvements in picture and audio quality as the industry would like to believe. The slow uptake, coupled with the fact that many existing TV and home theatre components force new HD players to play content at a lower quality due to the DRM restrictions, is probably slowing the migration from the existing DVD formats to newer HD formats, and providing a breathing space for open source projects to support the new formats.

Delays and legal difficulties to open source projects present an advantage to commercial interests, because they have early access to the market, and because there are few legal hurdles to be faced in selling or implementing commercial converged systems which can access the new media formats. But these commercially available systems are now being locked down by strict DRM controls, with the result that the user cannot legitimately exercise all of what we consider to be reasonable ethical and legal rights to access content.

Strategically, companies often have an interest in producing a set of products that can only be produced by the company or companies that license that vendor’s products, because this makes it difficult for users to shift to other competing technologies. Companies may actively seek to make it difficult for other competing standards or products to integrate into their systems, by



legal and/or technical measures. Anticompetitive barriers to integration are then encountered to the user who tries to integrate various appliances and systems based on standards from competing manufacturers.

Many integrated home automation systems from companies that focus on the home market alone are expensive and can only be expanded using the same company's products. However, a product like MythTV has the advantages of an open project that can be extended to support almost any aspect of a converged home. Its openness, while a disadvantage in other ways, means that it can adapt to changing requirements and technologies without being constrained by commercial interests and strategies.

## 6. SUMMARY

Video recording within the household remains a key component of the home entertainment system. PVRs with Electronic Program Guides significantly extend the usability of traditional tape-based home video recording systems, and in the opinion of the authors, this winning combination of PVR and EPG will increase the number of PVRs in households across Australia, with a corresponding increase in acceptance of digital TV.

Copyright claims over Electronic Program Guide content have the potential to slow the adoption of digital TV, by slowing the introduction of one of the few functions that is demonstrably desired by consumer. Systems incorporating EPG-enabled PVR functions are also starting to move beyond playing media towards a converged platform that incorporates Media, Automation, Data, and Entertainment (a MADE system).

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Some of the major threats to the future success of computer integration in the home are either legal in support of copyright claims or Digital Rights Management, or the adoption of new technologies with lock-down functions to support DRM. Even free-to-air TV is under the threat of DRM controls (eg the proposed Broadcast Flag in the USA) that restrict the ability of consumers to exercise their fair use rights of time-shifting and content distribution within the home. DRM uses technology and other measures to remove the consumer's fair use intellectual property rights, could even be seen as analogous to the piracy of the intellectual property rights of copyright owners through illegal copying and distribution.

The risk is that by keeping too tight a reign on content and program guide information, governments and the entertainment industry risk alienating consumers and chilling innovation - particularly open source innovation - thereby reducing the attractiveness of new technology and inhibiting the adoption of digital TV, PVRs and converged MADE platforms in the home.

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