Coping with TiVo: Opportunities of the Networked Digital Video Recorder[1,2]

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Abstract

Despite the progressive switch to digital TV, there has not been any significant change to the value chain of the TV industry. At the same time, the introduction of novel information and communication technologies, such as the digital video recorder (DVR) and efficient Peer-to-Peer (P2P) content distribution, have been regarded as a threat to the established broadcast business players. Previous research has described these threats and has suggested competitive strategies, but it has not investigated the opportunities. This work aims to identify a framework of new business models that take advantage of the networked DVR. For this purpose, we examined the TV literature from diverse academic disciplines, such as mass communication, computer engineering and advertising research. We have also collaborated with network and multimedia engineers, with broadcasters, and we examined novel interactive television (ITV) prototypes. The findings suggest that the networked DVR could be exploited to provide personalized channels and that the dynamic advertising insertion could be introduced as an effective advertising format. In the light of these findings, the TV industry should consider the pro-active adoption and facilitation of the networked DVR infrastructure.

Keywords: Business Model, TiVo, Digital Interactive TV, Content Management

1 Introduction

During the last two decades many research projects, market trials and commercial products developed digital TV (DTV) and promised interactive TV (ITV). Nevertheless, the majority of the TV audience is still not receiving the benefits of easy access to diverse and personalized TV content (Atkin 2003; Carey 1997; Hart 2004; Theodoropoulou 2002). In particular, the broadcast mentality has implicitly imposed an artificial association between content distribution and content packaging. As a result, currently content has to be distributed and consumed through unidirectional and inflexible TV channels. However, the traditional TV value chain is being disrupted by novel information and communication technologies—a change that could be beneficial for viewers and as well as the commercial TV stakeholders.

The most important technological changes are in the areas of content distribution, packaging and advertising. In the past, TV viewers had become accustomed to the inflexibility of the broadcast schedule and to the burden of irrelevant advertising (Dawson 1996). Lately however, technological innovation in the form of digital video recorder (DVR)[1] devices, such as TiVo (http://www.tivo.com), has allowed unsophisticated viewers to time-shift TV programs and to fast-

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[2] This is a machine-readable rendering of a working paper draft that led to a publication. The publication should always be cited in preference to this draft using the reference in the previous footnote. This material is presented to ensure timely dissemination of scholarly and technical work.

forward through the advertising break with a minimal effort. The widespread use of the DVR might mean the end of the traditional advertising break (Rose 2003). In addition, despite the increased production of audiovisual material, the pipes that feed content to TV viewers have been governed by the economics of broadcast (in the form of terrestrial TV), or inflexible channel bouquets (in the form of multichannel cable and satellite). Both put the highest priority to the content with the widest spatiotemporal appeal, as demonstrated by geographic region licensing and prime time airing. In parallel, novel internet peer-to-peer (P2P) content distribution technologies, such as BitTorrent, have allowed viewers to share TV content that has not yet been aired in a geographic area efficiently, and, more often than not, illegally. This reality poses a new threat to traditional broadcast distribution.

Some of the above threats have been addressed by previous research, which has also proposed feasible paths of action. The majority of the consumer behavior research in ITV has investigated adoption of new TV technology (Choi et al. 2003). The business model implications of the DVR have been treated at the strategic and industry structure levels (Wirtz and Schwarz 2001), in which they identified the threat of the DVR for the traditional business model. Additional business model research has investigated digital TV advertising (Pramataris et al. 2001) and digital pay TV (Kaitatzi-Whitlock 1999), but has neglected to examine the networked DVR as a node in the content delivery chain and as a personalized TV channel provider.

Our work complements previous research by looking at the new TV information and communication technologies as opportunities for new business models. We therefore explore the business model opportunities offered by the networked DVR, which we regard as a node in a converged (internet and broadcast) TV value chain. In particular, we suggest that the networked DVR can play two roles that have been traditionally assumed by the TV channel operator: 1) the syndication of content from hybrid networks, such as broadcast channels and the internet; and 2) the packaging of content together with advertisements (ads) to match a particular household's preferences. Overall, we suggest that the exploitation of efficient internet video distribution and the local storage of content for personalizing TV channels and ads is a major opportunity for the TV industry.

2 Disruption of the Established TV Business Model

I have never seen a bad television program, because I refuse to. God gave me a mind, and a wrist that turns things off.
Jack Paar

Let us briefly highlight research findings that are relevant to the traditional TV distribution, packaging and advertising. Through this literature review we can re-assess the significance of the threats to the established business model and set the background for identifying the opportunities of the networked DVR for new business models.

2.1 Content Distribution

TV content distribution has been performed mainly in real-time over broadcast communication channels (cable, terrestrial, and satellite), which, from a technical viewpoint, have some particular advantages and disadvantages. The major advantage of broadcast delivery is the achievement of a wide population reach with a zero marginal cost for each additional viewer. On the other hand, the investment for infrastructure, the scarcity of the available spectrum, and the cost of airtime during prime time makes the distribution of content unprofitable, unless there is a critical mass of viewers for that content. TV practitioners are referring to this phenomenon as the economics of broadcast.

The economics of broadcast affect firstly the free-to-air terrestrial TV, which is supported by advertising. Multichannel pay-TV operators broadcast content over cable, or satellite links. They are not so much depended on advertising revenues, because they receive a monthly subscription fee for each set-top box (STB) installation. Still, content distribution through multichannel TV offers an inflexible bouquet of channels and content delivered through a fixed broadcast schedule. In the 90s, there have been many efforts for developing video-on-demand over the internet, but the telecommunication infrastructure and the software architectures of the past did not scale very well for large audiences that demand real-time concurrent access (Lobbecke and Falkenberg 2002). The broadcast model limitations and the limitations of the deployed internet technology have been

disrupted with the adoption of broadband internet and the development of CCnovel P2P content distribution systems (Androutsellis-Theotokis and Spinellis 2004).

Apart from the technological limitations of distribution, another problem of the current TV value chain is its hierarchical structure. Such a structure is not efficient for managing low-demand content. In particular, the hierarchical structure of the TV value chain makes the trading of the rights and the adaptation of the content to small markets unprofitable, because it consumes significant resources that are better spent on more popular TV programmes. The consequence of the hierarchical content distribution value chain and of the broadcast technology is that the majority of the available TV content remains unused, because there is not sufficient local demand or bandwidth to put it on all potential broadcast schedules. Besides distribution, the online TV sharing community is adding value to the video files by providing adaptation of the content, such as English subtitles for Japanese anime. Thus, the file sharing networks could be exploited to add value to TV content, through user participation, without additional localization costs to copyright owners.

Since the economics of broadcast TV are disrupted by the introduction of the networked DVR, which allows the asynchronous distribution of content from broadcast and from internet sources, it makes sense to re-examine the rationality that has kept the TV archives and the diversity of the available TV content locked within spatial and temporal borders.

2.2 The Television Channel

Our familiar television channel provides easy access to audiovisual content across user groups of different cultural and educational backgrounds. Different TV channels build their brands by providing competing assortments, or themed TV content. The introduction of the DVR breaks down the notion of the TV channel and the notion of appointment TV viewing by allowing the manual, or automatic storage of content from different TV channels on a hard disk drive (HDD). For example, TiVo users have access to the stored content through the menu selection ‘now playing on TiVo’, which becomes the main TV channel for them, by providing a personalized schedule and assortment of content. In brief, previous research suggests that the disruption regarding TV channel behavior will be more qualitative (how the TV channel is going to be packaged), rather than quantitative (how many TV channels will be available).

Mass communication research has proposed the notion of the channel repertoire, and this can be distinguished into two types: 1) the mindful channel repertoire (MCR), which is the number of channels that viewers freely recall watching, and 2) the total channel repertoire (TCR), which is the number of channels that viewers remember watching if aided recall is used (Ferguson and Perse 1993). In brief, previous research findings indicate that TV channels breed familiarity and viewers are loyal to a small set of channels that fit in their MCR (Lee and Lee 1995). It is usually assumed that the introduction of new communications technology results in increased interactivity and choice, but there is evidence that this opportunity had not materialized in the case of the TV channel repertoire. Ferguson (1992) found that the impact of the video-cassette recorder (VCR) and the remote control on the channel repertoire did not substantially increase the number of channels that viewers watch. Moreover, he found that the channel repertoire did not change significantly even in cable homes, in which there are seven times as many channels available as those that can be viewed on public TV broadcasts.

Recent research by Ferguson and Perse (2004) pointed out that, eventually, the most popular function of the VCR turned out to be not the advertised ability to time-shift TV channels, but the watching of rented movies. By making an analogy to the history of the VCR, the DVR could be employed to enhance access to TV content.

To summarize, previous research has suggested that the channel repertoire is not changing in terms of quantity (viewers watch the same number of channels regardless of the number of available options, such as those offered by multichannel TV), but recent research suggests that new technology has an impact on TV watching in terms of quality (viewers consume content from alternative distribution channels, such as video-rentals and internet downloads). Although, time shifting is a worthwhile function of the DVR and a possible threat to the notion of the TV channel, there might be many opportunities for enhancing TV channels, such as dynamic virtual channels at each user terminal—the concept we discuss in Section 3.

2.3 Television Advertising

Skipping advertising breaks became possible for the first time with the VCR. But, an analog VCR is not as disturbing to TV advertising as it is its successor, the DVR. TV broadcasters are reluctant to adopt a STB technology that neglects advertising, because some contemporary DVRs offer an advanced skip functionality (e.g. a 30 second skip button) that makes it easy to ignore Ads —one of their main revenue sources. Nevertheless, usage patterns of Ad skipping have not been researched extensively and there might be additional opportunities for advertising by exploiting the storage capacities of DVRs.

Previous research has addressed the issues of skipping advertising messages with a VCR and found that repeated watching of zipped commercials had a positive effect on the recall and the recognition of Ads, when compared to viewing the same advertising message just once (Martin et al. 2002). Indeed, recent market research has revealed that viewers replay interesting commercials.[2] On the other hand, Ferguson and Perse (2004) surveyed a large number of TiVo users and found that the skipping of advertising is one of TiVo's most popular functions. As a measure to address this emerging behavior, Wirtz and Schwarz (2001) have proposed advertising through product placement in TV content, which is a technique that is gaining advertising market share (Economist, 2005). Nevertheless, product placement is just a defensive move in the face of a possible threat, but as a strategy, it fails to consider the potential of novel advertising formats.

Given the DVR's negative effects on the revenues obtained through the established TV advertising model (Barwise 2004), it is worthwhile to investigate opportunities for new advertising formats. For example, TiVo is offering a special area (named 'TiVo Showcase'), where advertisers may store their advertisements for users to watch on-demand. Moreover, Bell and Gemmell (2002) have suggested the development of dynamic and personalized advertising schemes for supporting the distribution of digital media.

3 A Framework for New Business Models

Imagine what it would be like if TV actually were good. It would be the end of everything we know.
—Marvin Minksy

The characteristics of the DVR as an enabler of new business models for broadcasting are revealed through the study of a few experimental ITV applications. Then, we can combine the core elements of these applications into an integrated framework that exposes the opportunities for new business models with the networked DVR.

3.1 Content Distribution through User Terminals

The open-source programming code community has developed numerous P2P protocols and programs that allow their users to share video content and large files efficiently over (relatively) low-bandwidth asymmetrical connections, such as ADSL lines. For examples, many use the BitTorrent (http://bittorrent.com) and the RSS (Really Simply Syndication) technologies to distribute large files, such as movies and TV shows.

The BitTorrent protocol[3] splits a large file into many pieces that can be downloaded in an out-of-order fashion from many nodes of the network, without imposing significant bottleneck effects to the backbone infrastructure or to the source of the file. Actually, the BitTorrent protocol becomes more efficient, as more nodes are added, which resolves the main issue with the centralized video servers that have been employed for video on-demand in the past. Furthermore, BitTorrent is designed to enforce altruism among the users nodes: every BitTorrent client downloads approximately as much as it uploads.

The RSS mechanism employs a summary file that users with an RSS reader can periodically pull from web sites in order to be alerted when a page has been updated. In our domain, the RSS technology is often employed to notify users when a BitTorrent file becomes available on the network. In brief, one could think of the RSS as a TV channel schedule and the BitTorrent as a distribution channel. BitTorrent and RSS have been very popular for sharing TV shows that take a long time to be released, or are never released to other countries—these include Japanese anime and new US TV series. For example, a network traffic analysis[4] revealed that 30% of all Internet traffic by the end of 2004 was due to BitTorrent. At the time of this writing, one BitTorrent web site[5] had an index of 5875 files for TV series, while the most popular series ('The Lost',

'Desperate Housewives') accounted for several hundreds of thousands of completed downloads (2.149.264, 523.190 respectively)[6].

The combination of RSS, BitTorrent and a digital video player in an integrated user client, such as the DTV system,[7] creates a complete alternative to the broadcast TV content distribution and play out system. Users can subscribe to TV channels by selecting an RSS feed, new content is downloaded automatically and efficiently through the BitTorrent, and material is stored and played on a home media station computer. Since there is no requirement for real-time viewing, the distribution bandwidth may be much larger or much smaller than the bit-rate of the media content. For example, BBC, in the UK, decided to provide access to last week's broadcasts through the interactive Media Player (iMP) application, which is based on BitTorrent network technology[9].

In theory, the integration of novel internet technology, in the form of RSS and BitTorrent, with a DVR would allow the development of a consumer-level networked DVR. Such a device could expose users to all available TV content, regardless of time and broadcast footprints. Thus, the content that does not find its way to viewers through the traditional TV channels could be downloaded through bandwidth efficient P2P networks, such as BitTorrent. In practice, content owners and broadcasters have been very sceptical about the traditional DVR. For example, TiVo and ReplayTV have been legally forced to eliminate the thirty-second ad-skip button of their STBs. We can thus easily see that the traditional media industry players might be even more sceptical in the face of the emerging networked DVR.

Many forms of online sharing of copyrighted material are obviously illegal. Nevertheless, their sharing allows people who would not have any chance to obtain particular TV shows to download and watch them.[10] The discussion regarding the nature of copyright online, which started with the music industry, has been affecting the movie and the TV industries as well. Just like the MP3 and Napster is (slowly) changing the music industry, the networked DVR may force TV content producers (particularly niche ones) to devise more flexible methods for trading their rights in a complex ecosystem of content producers, viewers and distributors. One such suggested copyright system is the creative commons format (Lesigg 2004).

Irrespective of the regulatory framework, the availability of the network DVR could be economically beneficial for broadcasters and content owners. For example, online music and video-rental stores have been found to make a significant share of their revenue from the cumulative sales of a very large number of low demand items (Anderson 2004). This finding has been defined as the 'Longtail' of sales, because there is demand (sales) for so many low-demand items that the 'tail' is more important than the large sales of just a few popular items. The Longtail mentality could potentially disrupt in a positive way the established broadcast economics, if content provides embrace alternative distribution channels and exploit copyrighted content that is remaining unused in TV archives. Content owners, such as the BBC,[11] have realized the potential of the internet for the distribution of archival material.

On-demand distribution of niche and archived content could be also financially rewarding, if coupled with novel advertising systems and formats, which is the subject of the Section 3.3.

3.2 Personalized Channel Packaging

Once stored on a DVR and indexed with related data, the TV content is set free from the constraints imposed by the medium of broadcast, and can therefore be accessed and manipulated in countless different ways. Therefore, a new business model for TV should aim to seamlessly integrate the digital broadcast transmissions, persistent local storage and internet resources, in order to facilitate the augmentation of the TV as a medium of entertainment and passive discovery.

On the reception side, the organization of media content into a small number of locally assembled and personalized TV channels simplifies the choice from a vast array of available broadcasts, stored content and internet resources. In this way, the presentation of media programming from virtual channels[12] gives more control to the user, who can actively shape the flow of the TV content. Furthermore, if we accept that the behavior of the TV audience will not change significantly (Lee and Lee 1995), then the synthesis of the virtual TV channels is an opportunity for extending the management of the TV value chain to viewers' homes. Overall, the networked DVR as a channel aggregator and content packager model (Figure 2) shifts the decision-making about TV programming from the broadcast station to the DVR.

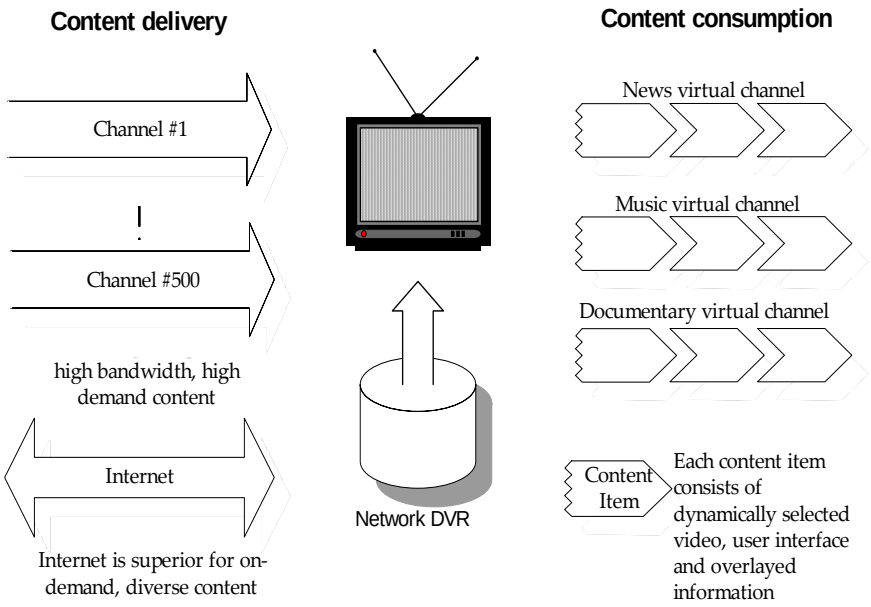

Figure 1 The network DVR as a virtual channel provider

Under this scheme (see figure 1), established or new content producers provide the content. Existing players or a new market intermediary may provide the interfaces for managing the channels on the viewer side. Moreover, a novel advertising format that integrate with the emerging video skipping behaviour, such as dynamic advertisement insertion and personalization, could be employed in place of the fixed ad break.

The main proposition put forward in the present section is that neither the vision of five hundred channels, nor the vision of a single personalized channel is suitable for giving consumer access to the digital STB. Instead, it is proposed that a small number of dynamic virtual channels may offer enough choices to cater for serendipity in media experiences, while simplifying the access to vast and diversified sources of television content.

3.3 Dynamic Advertisement Insertion

Currently, the duration and format of the typical advertising break are dictated respectively by the economics and the technology of the broadcast medium. Air-time duration determines the pricing, while the passive video format only allows the inclusion of a reference for the collection of further information through a different media channel, such as the web or the phone. Both barriers are now falling, and TV advertising can increasingly employ interactive and alternative duration formats.

Dynamic advertisement insertion has been delivered to viewers by the XTV platform.[13] The XTV platform allows the broadcaster to make a deal with the advertisers regarding ad skipping on DVR devices. Advertisers have the option to block skipping of certain ads and the option to purchase ad 'air-time', in order to display a short ad, when the user fast-forwards through recorded video content. The system was developed by NDS as a remedy to the introduction of DVR devices. Since NDS belongs to Rupert Murdoch's News Corporation, the XTV service protects the interests of the parent company: allowing subscribers of the XTV platform service (e.g. BSkyB plus) to buy a stand-alone DVR would have allowed them to skip advertising, which supports a major part of the cost of the TV content. In order to test viewer acceptance, we have developed an interactive music TV application, which inserts a short ad, when the user selects to fast-forward to the next music video-clip (Chorianopoulos and Spinellis 2004). We found that viewers are positive towards the trade-off of viewing a dynamically inserted ad when skipping content they don't like.

The dynamic advertisement insertion may be employed as a way to slow the navigation of the user through the finite number of video clips stored locally. In addition, the video-skipping feature has the benefit of revealing whether the viewer is actually paying any attention to television programming. Thus, the video-skipping feature provides the TV advertising researchers with an objective behavioral metric, which is directly linked to the viewer's attention to the TV. Furthermore, previous research addressing the personalization of TV advertising (Lekakos and

Giaglis 2004; Spangler et al. 2003) demonstrates how advertisers can target their message with increased precision. In this way, the dynamic advertisement insertion and the scheduled ad break may be personalized for each user or household. In summary, the local storage of the DVR can be exploited for more types of advertising and for more parameters for targeted advertising.

4 Implications for Existing and New Market Players

So long as there's a jingle in your head, television isn't free.
— Jason Love

We proposed to regard the network DVR as a node in the TV value chain that plays two roles, which were traditionally assumed by the TV channel operator: 1) the aggregation of content from hybrid networks, such as broadcast channels and the internet; and 2) the packaging of content together with advertising to match the household preferences.

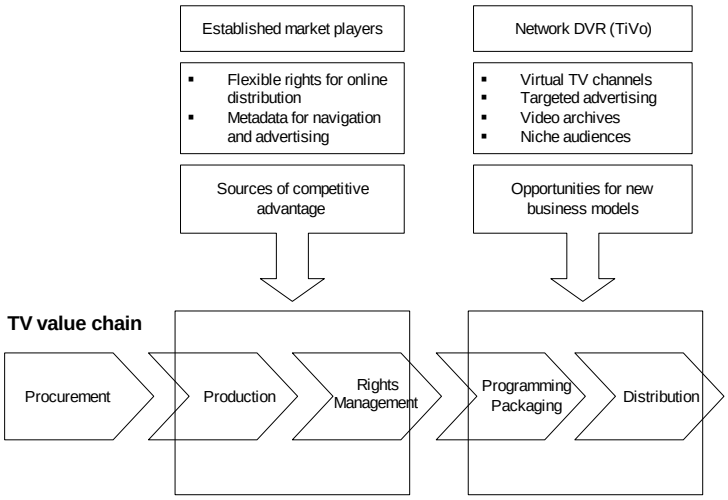

Figure 2 The network DVR should be considered as an opportunity for new business models in two nodes (programming and packaging, distribution) in the TV value chain —Adapted from Wirtz and Schwarz (2001)

Let us now examine how the established TV players may fortify their position by leveraging their sources of competitive advantage and by exploiting the opportunities of the DVR (figure 2).

4.1 ITV System Development and Content Production

In ITV conferences and project meetings with TV executives, there are two anecdotes that recur every time there is a discussion about ITV content and viewer behavior. The first anecdote about ITV reflects an apparent pessimism of the TV industry executives regarding the viability of ITV. The saying is: 'there's no new killer application for ITV. The killer application of ITV is TV!', meaning that interactivity is a nice-to-have, but not a must-have enhancement of the traditional passive TV content. There is also academic research that confirms the above opinion: viewers simply want more TV from ITV (Theodoropoulou 2002). Thus, ITV is currently perceived as a decorative element that does not provide any actual improvement of the existing TV content. Nevertheless, it could be argued that there exists a killer application for ITV, beyond TV the content itself, and that is the ability to break-up the dependency on the content on the broadcast schedule. The networked DVR we presented can act as both a content distribution node and as a virtual channel provider.

A second anecdote about ITV concerns the production, development and adoption of interactive content. It goes like this: 'Consumers don't buy a digital STB because there's not enough compelling content and producers don't create interactive content, because there are not enough viewers with a digital STB! It's a chicken and egg problem!' Instead of producing novel interactive content for ITV, we suggest that TV producers should develop applications for DVRs that exploit the wealth of digital broadcasts, local storage and internet resources for enhancing their traditional linear TV programs. Viewers have already started adopting advanced digital STBs, such as the DVR, DVD-Rs with a HDD and video-game consoles with a HDD. In addition,

there are already open standards for DTV application development, such as the Multimedia Home Platform (MHP). TV producers may only need to develop a single digital STB application and insert the appropriate metadata to their content.

4.2 Broadcasting

The DVR model has implications for the programming of the schedules for TV channels. Firstly, the broadcasters may offer an interactive channel, in addition to their linear one. Then, the dynamic generation of TV channels from each STB raises the question: 'Who controls a personalized channel? Is it the broadcaster or the user?' Here are some possible answers.

Existing broadcasters that operate a TV channel will find in the DVR the opportunity to diversify their fixed TV schedule. For example, a music TV channel such as MTV may offer a virtual MTV channel (iMTV) that provides an interactive music TV experience including features such as video-clip skipping and artist information on demand. The broadcast MTV channel could be used to promote the iMTV brand and avoid channel switching. During the broadcast of the popular 'Top 20' it may display an overlay suggesting to viewers to switch to iMTV (which is a virtual TV channel) that plays the 'myTop 20'. Switching from the broadcast to the virtual channel would be for the MTV network a preferable outcome to one where a viewer does not like the currently playing video-clip and switches to a competing channel. After all, the main objective of the broadcasters is to keep viewers tuned into their channels, and because the one-size-fits-all fixed schedule of the current TV business model does not correspond to the fragmented preferences of the contemporary TV audience, allowing the viewer to 'change channel', but still, remain within the same 'parent brand', appears like a sweet-spot for broadcasters.

The most controversial implication of the DVR regards the entity that controls the dynamic generation of TV channels at each home. On the one hand, the DVR implementation may be offered as open-source software for PCs, such as MythTV,[14] and thus, the functionality will be under the control of the viewer or some third-party personalization software. For example, the viewer will be able to browse music video content stored on the HDD freely, without any advertisement insertion. Nevertheless, indexing of the content will be restricted to the extent that the TV content can be automatically segmented and indexed with free resources from the internet. On the other hand, a broadcaster may offer the DVR as part of a subscription service, such as the UK's BSkyB Sky+ service. In this case, the broadcaster may assume the complete control of what is stored on the HDD and how it is played from the DVR. Nevertheless, it would be beneficial for the broadcaster to allow increased control to the viewer, although the transfer of control might be reflected as a higher price on the subscription fee. For example, viewers may be allowed to skip advertising breaks, but they will have to pay a higher fee for this privilege. Between the two extreme possibilities of control, there is a wide spectrum of control schemes that balance between the needs of the viewer and the broadcaster.

4.3 Advertising

The introduction of the DVR has freed the TV channel from the linearity of the fixed broadcast schedule. The same properties that apply to TV content, apply to advertising too. Thus, an advertising video clip need not be part of an advertising break and need not be presented at the same time to all viewers. For most countries, there is a regulatory framework for TV advertising that dictates how often and how many advertisements may be shown during a broadcast schedule. The extension of the TV experience beyond the fixed broadcast schedule is likely to create new regulations for the delivery of advertising messages. For example, if a virtual TV channel is left to play without viewer intervention, it should conform to the existing legislation that applies to TV advertising. Furthermore, if the viewer is allowed to manipulate the flow of the virtual TV channel, then, revenues will have to be supported by a subscription fee or by a novel advertising scheme, such as the dynamic advertisement insertion, which is described next.

After the advertising video-clip is released from the ties of the ad break and the broadcast schedule, creative advertisers will have the opportunity to experiment with new formats. The traditional advertising video-clip may be augmented with additional on-demand information and may expand its duration beyond the typical thirty seconds. For example, video-clip skipping by the viewer may insert a short advertising teaser that links to a short-movie advertisement and to an interactive product demonstration. The characteristic that makes the dynamic advertisement insertion such a powerful format is the certainty that the viewer will watch it, since the viewer has

implicitly triggered it, in order to get to the next video clip. As a consequence, for each advertisement there may be accurate statistics regarding the number of STBs in which it has been displayed (reach) and the frequency with which potential consumers viewed it. Viewers may even be allowed to tag adverts and propagate their opinions to their friends through RSS feeds.

4.4 New Market Entrants

In the recent past, the DTV systems created the opportunity for a new player in the media industry. TV channel aggregators (e.g. BSkyB) provide TV viewers with a coherent collection of TV content and services that gratifies a wide gamut of preferences, such as music, sports, movies and news. In the same way, the DVR creates opportunities for a new business role. The *DVR content aggregator* is a new mediating role in the TV industry that combines the available broadcast transmission with audiovisual elements from other sources, such as the internet and computer generated graphics, to provide personalized TV channels. For example, there are multiple music TV channels available on a digital satellite system and each of them may be themed. If the music video-clips are broadcast without any fixed overlay (channel logo), then there is no barrier to create a music TV channel for each household. By reversing the promotion scheme used internally by a music TV channel to promote its interactive spin-off, the virtual TV channels may promote their ancestors by displaying overlays suggesting to viewers that 'more music like this may be enjoyed on that channel.'

The synthesis of a TV channel from content available on potentially competitive TV channels may seem contradictory, but the role of the TV channel aggregator has always been to re-package the available content and to market it to new audiences that are not reached by the existing market offerings. The balance of power between the established broadcasters and the new channel aggregators is reflected in the struggle between the information technology (IT) and the traditional TV players. TV players have the experience of the TV formats, ownership of rights to content and the knowledge of the TV audience, but IT players are developing and deploying the tools that will shape the new TV experience. Unless the TV players employ the networked DVR to leverage their unique competitive advantages, the viewers will pull the DVR from the new emerging market entrants, such as TiVo and ReplayTV.

5 Re-defining Interactive Television

> *The marvels of film, radio, and television are marvels of one-way communication, which is not communication at all.*
> —Milton Mayer

TV content delivered through the digital STB's software provides new opportunities of control, with associated advantages and problems. On the one hand, being able to control the TV experience at viewers' households has considerable ethical implications. Computer programs in digital STBs may store and analyze a wide variety of interactions for every household. Then, the interactions may be connected to personality characteristics, which is a major privacy issue. For example, the interactive music TV usage may reveal a great deal about musical tastes, which could be associated with personality traits and psychological state. On the other hand, the availability of detailed user models allows content to be individually personalized, thus improving a medium that has been criticized as mass and passive. Therefore, the balance between privacy and personalization features will be a major research and practice issue as ITV becomes more widespread.

The dynamic ad insertion and the personalized TV channels entail two seemingly antithetical suggestions for the future of the TV industry. On the one hand, TV content should be annotated, linked with external resources and indexed at the video-clip level, which suggests more freedom for viewers to manipulate the flow of the TV channel. On the other hand, the need to protect copyright might force the broadcasters to devise new forms of intrusive advertising, such as the dynamic advertisement insertion, which are strongly coupled with the TV content at the software level, meaning that viewers have less freedom over what to watch. It is argued that the DVR operators should balance the two extremes, in order to devise service offerings that viewers will be willing to pay for. For example, a subscription scheme may offer total freedom for recording and skipping of TV content in exchange of a high fee. At the other end, free TV may be offered with support from intrusive advertising similar to the contemporary free web sites. In between the two extremes, lies a multitude of possibilities for the broadcasters and viewers to select. Overall, the

main threat that the TV industry is now facing comes from not recognizing the opportunities offered by the networked DVR.

The present research opens up more new research questions than the old ones it has addressed, both for business models and for related disciplines. In the context of related disciplines, further research should consider the obstacles that the networked DVR is facing, such as technical standards, consumer adoption, regulatory framework, and digital rights management (Rosenblat et al. 2001). For example, the lack of commonly agreed technical standards, or the existence a single popular platform prevents the wide adoption of advanced STBs, because application developers have to develop and support multiple code-bases. The regulatory framework is also an obstacle, because outdated laws and rules, such as those controlling the number and the size of the time slots for ads, govern the broadcast and advertising industries. Since the networked DVR disrupts the established process of TV advertising, there is a need to re-examine the respective regulatory framework, as well. In the context of business models, further research should consider the multiple aspects of the commercialization of a new technology by existing, or new market entrants. In particular, there is a need for detailed quantitative business model analysis regarding established broadcast players. The latter have become more vulnerable to new market entrants, because new information and communication technologies, such as the networked DVR, have shifted the control of the TV content's distribution and presentation from the single broadcast point to multiple user nodes.

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[1] We use the acronym DVR (digital video recorder) to refer to devices such as TiVo, which uses an internal Hard Disk Drive (HDD) to record audiovisual content and to store executable, just like a personal computer. There are many other names that are used in the literature to refer to the same category of devices. To name a few: PVR (personal video recorder), DPTR (digital personal television receiver), HMS (home media server).
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[3] BitTorrent Economics: Hhttp://bittorrent.com/bittorrentecon.pdfH Accessed on 31/10/2004
[4] Hhttp://www.cachelogic.com/research/2005_slide06.phpH Accessed on 29/11/2005
[5] Hhttp://www.mybittorrent.com/bittorrent/television/H Accessed on 29/11/2005
[6] Hhttp://thepiratebay.org/brwsearch.php?b=1&c=205H, Accessed on 29/11/2005
[7] The DTV system is an open source project for Linux, Mac, Windows, developed by the Participatory Culture Foundation: http://participatoryculture.org
[8] A hidden satellite channel has been used to download and store on a DVR advertisements, in order to provide targeted ad breaks in place of the schedules ad breaks (Bozios et al. 2001)
[9] BBC moves ahead with TV downloads Hhttp://news.bbc.co.uk/1/hi/entertainment/tv_and_radio/4552635.stmH Accessed on 25/9/2005
[10] Must-download TV Hhttp://www.salon.com/tech/feature/2004/08/11/must_download_tv/H Accessed on 2/11/2004
[11] BBC launches online clips archive: Hhttp://news.bbc.co.uk/1/hi/entertainment/tv_and_radio/3525455.stmH Accessed on 3/11/2004
[12] The term virtual channel was first suggested by Whittingham (2000)
[13] Murdoch's Must-See TV: Hhttp://www.wired.com/wired/archive/8.09/mustread.html?pg=7H Accessed on 2/11/2004
[14] MythTV is a popular open-source DVR project based on the Linux OS