Networked Digital Video Recorders and Social Networks

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Abstract—Digital video recorders (DVR) are getting connected to the Internet. There are several ways to engineer networked DVRs. Consumers can store the recordings at home or to remote cloud storage service. The recorder software can be implemented to respond to consumers’ or rights owners’ needs. The most common DVRs have been home based recorders that respect at least some of the rights owners’ interests. However, the cloud model is developing traction as broadband becomes more common. The new technology changes markets and courts have to define the limits of place- and time shifting. Networked DVRs open a door for social enrichment by viewer communities, but also threaten the whole business model of advertisement-based television. Networked DVRs can potentially change the centrally controlled broadcast economics of television into decentralized Internet economics.

Keywords: TV, Social Factors, Technological Innovation

I. INTRODUCTION

The television experience is far from optimal. Television is quite poor at providing what consumers ultimately want—the right programs at right time to right devices. Viewers have to schedule their lives or video recorders to TV programming, there are geographical restrictions limiting where the programming is available, television is very much created to be consumed only with a television receiver at home, it lacks interaction with broadcasters, and commercial breaks interrupt viewing with irrelevant ads. If TV were to be invented today, and a start-up company were to present the idea of broadcasting linear programming through signals distributed to geographically limited areas, they might have a hard time finding venture capital.

For a long time, innovations happened at the broadcasters’ and cable operators’ end. The mechanics of having intelligence only at the broadcaster’s and at the cable network operator’s side is very different when compared to the end-to-end-architecture of the Internet where both ends are intelligent.

The TV experience has evolved as the consumer electronics industry has tried to overcome the shortcomings of broadcast television. One of the first innovations to bring intelligence to the viewers’ end was the invention of time shifting with the video cassette recorder (VCR). The VCR gave consumers the control to decide when to view broadcasted programs. It also enabled social sharing of recorded tapes with friends and family and with other television fans through video tape clubs.

The shift of control made copyright owners nervous. Briefly after the introduction of the VCR, television and film studios sued Sony, the manufacturer of the first VCR devices, for copyright infringement. However, the US Supreme Court ruled, in a decision known as “Sony Betamax,” that consumers have a right to time shift copies of TV programs [1]. The decision created room for further innovations to improve the TV experience.

Innovations cycle of television has been static compared to the speed of Internet innovations. What if there was more networked intelligence at the receiving end of the broadcast? Would it be possible to treat television as an extension of the Internet? Networked recorders could be used as a target for personalized asynchronous distribution of programs [2]. The idea for networked recorders to act as a television hub and personal media server is intriguing.

Internet accessible media is the key for Internet economics. The disrupting of the economics of broadcast requires that TV broadcasts can be recorded and those recording can be access trough Internet. Modern digital video recorder (DVR) can record hundreds of hours of digital television. As storage media grows and becomes less expensive, it is will become possible to record thousands of hours of television on a regular home
DVR. By connecting the DVR to the Internet, the recorded library could be accessed anywhere via the Internet.

There are several ways to engineer Networked Digital Video Recorders (NDVR). We are used of having DVRs at the users’ end, next to the television. But because, by definition, NDVRs are networked, they don’t have to be next to television sets. This enables a cloud recording approach. Secondly, the system may have central control, where the service provider or device manufacturer designs the features and limitations of networked recorders; an alternative would allow owners to manage the recorders, their features and the content they store. In the second part of this paper, I will examine the advantages and disadvantages of the different implementations.

Connected recorders mean connected viewers. Connecting viewers enables large-scale online collaboration, which has proven to be an effective way to innovate. The NDVR holds the promise of fixing the TV experience, but it also poses a threat to current business models. The third part of this paper examines how social networks affect television in general. I investigate how TV viewers can benefit from social networks and why social enrichment of television has failed thus far. In the fourth part of the paper, I examine the potential of combining social networking with NDVRs. The fifth part discusses the findings.

II. TAXONOMY OF NETWORKED DIGITAL VIDEO RECORDERS

Digital home recorders like TiVo have replaced VHS recorders as the most common video recording technology. When TiVo was introduced in 1999, ReplayTV immediately appeared as a competitor. Both offered similar products. In a move to gain market share, ReplayTV started to advertise its AutoSkip feature as a way to skip commercials. ReplayTV users could also connect to their friends’ ReplayTV devices and share their recordings. TV networks feared that those features would risk premium channel profits and pull the plug of “the lifeblood of most television channels” – advertising [3]. In 2001, 28 movie studios and TV networks sued ReplayTV for copyright infringement. After two years of expensive litigation, the company behind ReplayTV had become bankrupt even before the court reached a decision.

While it is still unclear whether the features were illegal, the case sent a chilling message to the consumer electronics industry: introduction of features that increase consumer control will lead to expensive litigation.

TiVo kept the lesson in mind. Just because TiVo runs Linux and has a network connection doesn’t mean that TiVo is open. Hacking a TiVo to run user-developed software is nearly impossible, and accessing TiVo recordings is restricted to TiVo software and hardware. TiVo, is by design, a walled garden.

There are several network add-ons for non-networked home DVRs. For example Slingbox and Popcorn Hour devices can be used for place shifting recordings and live broadcasts. The goal of the devices is to increase consumer control of recorded and broadcasted media. While the device manufacturers play it safe by separating the recording and network features, the disadvantage of the approach is that it clutters living rooms with several set top boxes that may have problems interoperating.

One alternative for using a dedicated DVR is to use personal computer with special hardware and software to record programs. The problem with PC-based DVRs is that they require technical knowledge, a PC-television connection and the computer must be on when the recorded programs are broadcasted. PC-DVRs can typically receive and record just one or two programs at the time and the uplink capability of home broadband packages tends to be limited. This means that the PC can record one channel at a time; accessing those recording outside of the home network can be slow. Because of this, do-it-yourself video recorders are marginal compared to dedicated solutions.

The advantage of using a PC as a DVR is the separation of hardware from software. Myth Television and Microsoft Media Center are among the most used recording and media management software. While Microsoft may be hesitant to introduce industry-disrupting features, there is nothing holding back the open source community that develops MythTV. MythTV is an example of a home-based and consumer-controlled network recorder.

While the TiVo and MythTV approaches rely on storing programs locally at consumers’ homes, the programs can also be stored remotely. Remote cloud storage offers several advantages compared to local network storage. However, remote NDVR solutions have faced copyright problems.

In 2006, American cable operator Cablevision was preparing to run a remote storage pilot program with thousand of its cable subscribers. During the pilot program, individual customers would be able to use a central DVR to record 80 hours of programming. The system would have recorded programs that subscribers chose with their remote control and home set top boxes. The recorded programs were to be stored on the cable provider’s storage system, and subscribers would be able to access their personal copies only with their home set top boxes. Cablevision notified TV networks, but did not seek a license from them.

As with the advent of VCRs, the invention of a new product for manipulating copyrighted materials created dispute. A legion of TV networks quickly filed copyright infringement suit [4]. While the district court held that Cablevision was indeed infringing on their rights, the Second Circuit court reversed the decision. It held that Cablevision was not directly infringing copyrights with its remote video recorder because the recording was done by consumers who had to push a “REC button,” and the system made separate copies for each consumer. Cablevision was not making the recorded copies available to the public, as only the client who had made the copy could access it.

The Second Circuit’s decision is rather limited. Plaintiffs did no sue for indirect infringement and, in turn, Cablevision promised not to use the fair use defense. The court expressly avoided addressing “whether such network operator would be able to escape any other form of copyright liability.” One potential reason why the parties decided to limit the scope of
the trial was that they did not want to open the gate for other services that could benefit from the decision.

The benefits of the remote nature of the system are clear. It is more cost-efficient to implement a cloud storage system and add resources to the cloud than to provide individual recorders with expensive storage media that might go unused. In a cloud model, Cablevision could capture the value of unused resources and sell more storage space for heavy users.

While Cablevision’s service survived the trial, cable providers have to respect the contractual limitations of innovation. That is to say, if cable providers disrespect the needs of networks, the networks will refuse to distribute their shows. This is why Cablevision’s remote recorder’s features will have strong industry control.

While the networks may place restrictions for Cablevision’s innovation, having limited services may help Cablevision to create lock-in. Because access to remote recordings is limited to Cablevision’s set top box, customers who want to keep viewing their recorded programs have to continue to subscribe to the service.

The fourth category is remotely stored network recorders that are hosted by a third party service provider. The roots of user-controlled remote recorders can be traced to the tech savvy Slingbox-user communities. On Slingbox forums, Slingbox users are offering hosting services for other users. The storage provider charges rent for providing access to a television signal and a network connection to Slingbox owners who store their Web-connected receivers at the storage provider’s house. People value the access to TV that would not otherwise be accessible because of geographical restrictions.

While Slingbox hosting is small scale and without commercial relevance, there are some service providers who are creating commercial services that hosts NDVR devices. One of these services is Tvkaista. Tvkaista is a Finnish service that sells hardware that is needed for recording and storing television programs. It also provides hardware hosting that includes electricity, network connection, and access to must-carry TV channels. Users can install software on their NDVRs that makes the recording privately accessible on several platforms, including via iPhone. The service can provide a quality of service that home networks with limited upload speeds have a hard time providing.

Tvkaista has received its share of legal threats. The TV networks and rights owners teamed up to publicly object to the Tvkaista model. However, after reviewing the architecture of the service and copyright laws, the alliance did not pursue litigation that might not have led to the outcome they wanted.

The third party providers rely on free-to-air channels for access to signals. This limits the channels that are available for the independent remote NDVR providers. However, it is likely that if the business model for remote recorders is a success, the premium channels might consider using the recorders as a platform for distributing their content.

III. SOCIAL TELEVISION

For a long time TV’s social enrichment involved gathering around a TV set to enjoy programs together. Today, there are several types of personal displays and the television experience is no longer the shared social experience it used to be. However, the common screen and simultaneous viewing are not the only ways to bring social value to TV.

The idea of bringing value through technology that enables social interaction is not a new one. However, implementing social interaction through TV has had its technical challenges. The most obvious one is that the TV screen lacks intelligence for social interaction. Taking advantage of social network features requires that either the television set, the set top box, or, for example, the cable provider’s head end is connected to the Internet and that the device accepts connections to social networks. The device is the gateway for the social services. This why it also matters who controls the gateway. Industry gatekeepers are more likely to slow down the innovation and keep disruptive services out of the devices.

It is not enough to add means for interaction. The interactions must be enjoyable and value creating. Interrupting live television by adding social features on the same or separate screens may not be desirable. Adding services to live broadcasts decreases the viewing area and creates distractions that may reduce the viewer’s immersion in and enjoyment of a program. Another big challenge for interaction is the design of the interaction method. Television is traditionally used with a remote control. Using a keyboard changes the passive lean-back experience into an active lean-forward experience.

There are great expectations for combining TV with social networks to provide a way to socially enrich the television experience. Making a service "social" means providing a way for a user to engage with a product or service as part of a group, rather than as an individual [5]. In a social service a group a produces value to the service or product that the original value chain is either unable or unwilling to provide. The members of a social network create the value typically by aggregating or peer-producing meaningful information and opinions from several sources.

For example a TV network may be unwilling to provide trustworthy discovery information because its business model relies on consumers’ lack of information. Even if the network has the information, it will never say that “tonight’s episode is not worth watching.” That is because networks rely on high viewer numbers which directly affect its advertisement sales. In fact, the networks will advertise the show in order to encourage people to watch it.

However, viewers value the information that enables them to steer clear of programs that are a waste of time. If they have

| TABLE 1. TAXONOMY OF NETWORKED DIGITAL VIDEO RECORDERS |

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<tr>
<th>Industry Control</th>
<th>TiVo</th>
<th>Myth TV</th>
<th>Consumer Control</th>
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<tbody>
<tr>
<td>Cablevision’s remote DVR</td>
<td>TVKaista</td>
<td>Cloud</td>
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NOT FOR DISTRIBUTION
wasted their time watching a show, they can use social networks to help other people to avoid the same mistake. At first, it might seem that the bigger networks increase the value of such signals as more peers obtain the value of the information. However, with social networks, it sometimes is the opposite case. The value of signaling is derived only from the increase of social standing with close peers. Thus, signaling even in a small network has a payoff.

On the other hand, TV networks may not be able to provide the same value that social network can. TV networks have little knowledge of the individual tastes of their viewers. Social networks that collect previous viewing habits and peer-ratings of programs can provide more accurate recommendations in terms of which programs and channels provide the most value in return for viewers’ attention.

IV. SOCIAL VIDEO RECORDERS

While live TV might not be the best suited medium for social networks, it makes sense to include social functions in NDVRs. The multi-screen approach of the NDVR means that some of the screens will have user interfaces that enable easy typing. Thus, the interaction issue can be solved without a forced marriage of keyboard and TV screen.

The technical reasons are not the only advantages of NDVRs. NDVRs change the mode of communication from synchronous to asynchronous. Audiences no longer view TV programs simultaneously. The fact that social communication does not have to happen in real time is a big advantage. On the other hand, time shifting can also reduce the feeling of shared social experience, as it lacks the possibility of instant and direct communication during the watching of programs.

The social enhancement of the TV experience can be accomplished on several levels. Social interactions can occur either before, during, or after broadcasts. Social enrichment changes the TV experience by automating discovery, making remixes readily available, and by adding new meaning and links to programs.

Social interaction before a show can involve recommendations and other discussions. By combing social networks with NDVRs, it is possible to automate the process of combining peer recommendations and the selection of recorded programming. In an experiment conducted at MIT, researchers connected Facebook recommendations with NDVRs that recorded programs automatically based on Facebook friends’ recommendations [6]. By obtaining information regarding friends’ preferences, users can record programs that are likely to receive the attention of their social network. This approach makes programming a NDVR automatic and social. There are plenty of other rich sources for content-related metadata and various types of social metadata at openly accessible network services, such as IMDB.

While social interaction may be less prominent during a show, there are still possible ways to use and create meaningful additions that change the watching experience of social networking. For example, adding peer voting, opinion polling, or prediction games of future outcomes in the show may enhance the social experience of TV. However, one of the most interesting and, at the same time, controversial features of NDVRs is the ability to monitor how people view programs.

NDVRs could automate the task of ad skipping by monitoring and creating database of the times when users start and stop fast forwarding programs. If several people skip the same part of a program, it is likely that there is an advertisement or some other uninteresting content at that segment. This information could then be used by later viewers to automatically ignore the advertisements.

Many television channels are based on advertiser incomes. Having features that automatically eliminate ads would mean that networks would have to find alternative income sources. The other option would be to introduce technology that would disable ad skipping. Networks and rights owners tried to introduce a rights management system called broadcast flag that were to control consumers’ recording. However, the plans to include the technology in all new digital television receivers sold in the US by 2005 never materialized.

It is likely that, in the future, we will have ad-free premium television and free television that is ad-funded. However, unlike today, the content on those channels could be the same. Television will still be distributed through broadcasts, but it will be recorded, and those who can afford, would be able to carve out the advertisements. However, those who do not mind watching the ads would be able to obtain free television that is either in real time or recorded, but they would not be able to skip the commercials. Their commercials would not be the shotgun spam of today, but personalized to their needs and interests. NDVRs can offer more reliable data than traditional Nielsen methods in terms of what shows are being watched and when. This data, combined with data from social networks and previous buying habits, could lead to ads that are up-to-date and relevant to the receiver.

Tagging could be used for other than ad-skipping functions. As users add machine-readable data to programs, they become searchable and remixable. Blankinship et al. described the phenomenon as follows: “The cable television adage, ‘a thousand channels and nothing on’ might soon be remedied when television fans edit together the next thousand channels” [7]. Social networks could be used to filter the best of television into user-created remixes. By having data on which parts of the show other viewers found interesting, viewers could just skip to the best parts of the shows. This could enable time saving features such as watching one-hour shows in just ten minutes.

After a show interactions typically involve ratings and discussions in reference to the program. Just as the recordings of interesting shows can be automated, the discovery of programs that are worth watching can be automated by using peer ratings of shows. This can be done by feeding rating data into an NDVR. The NDVR can be programmed to keep only episodes of 3 stars or better and delete the recordings in a week if ratings drop below a certain threshold [8]. Poor quality episodes could end up with very limited viewership, as early viewers quickly downgrade them to the point that nobody watches those programs.
NDVRs also enable peer connections between recorders. Suddenly, networked recorders make video sharing clubs simple. If one user has missed the opportunity to record a program, she or he can ask for a copy that some other user has recorded. Transferring the recorded show between recorders takes little effort. The next level would be to cluster recorders in order to create mega-recorders. While the idea sounds tempting, copyright law places restrictions on the architecture of such shared resources.

The NDVR services all rely on the private copying and fair use exception. This means that the private person has to be the one who initiates the recording and each user has to have his or her own private copies. However, European copyright law allows club sharing, as long as it is done among a limited number of friends and relatives and the copies are not publicly performed. For example, in Scandinavian countries, the copyright act enables the making of a few private copies that can be shared with friends and family members.

V. DISCUSSION

When television viewers and their recorders are connected to the Internet and, thus, to other viewers, we can expect collective intelligence to gather and edge innovation to occur [9]. Peer groups using social networking tools can create new value. The current value proposition of ad-supported TV might not work as social networks help to shift value from producers and distributors to consumers. The value proposition where viewers receive programming in exchange for their attention for commercial messages doesn’t make sense if the attention can easily be focused away from the ads.

The Internet is full of services that enable mash-ups, and remixes. Many of the most successful services have open interfaces that enable these interconnections. However, those services typically have terms of use that govern the use of content that is derived from the service. TV, on the other hand, has no terms of use - at least other than copyright laws. This means that if networks want to fight NDVRs and social networks, they have to file copyright claims against consumer electronic manufacturers or even consumers. Recording industry has shown that going after consumers and limiting technology and services does not serve business. Social networks provide new opportunities for advertisers to interact with TV audience in more meaningful way. However the change from broadcast to Internet economics is a major one and the industry is likely to fight it vigorously.

The application interface to connect TV to the Internet is not that complicated. Connection requires only hardware for receiving the radio signal and for storing it. After the broadcasts are in digital storage, the economics of broadcasting turn into the very different economics of the Internet. The central control turns into decentralized innovation. The phenomenon is not unique. Just recently, Google moved the economics of book printing into the Internet age with its Google Books project. However, the difference is that, with personal video recorders, the content stays closer to its consumers.

The delivery method to consumers’ devices affects the magnitude of control that consumers have. The control ranges from one time viewing of DRM-protected streamed videos to the sharing and collaboration of online community videos. The independent services may provide more control for consumers and act as key parts when consumers begin to create and use services that refine and enhance their recorded content. However, the services that have permission from the rights owners can provide premium content that may help to compete with the independent networked recorder services.

Creating personal duplicates, just because copyright law requires private copies, is an inefficient way to store programs. The hardware and storage space requirements mean that centralized services have a technical advantage for now. However, when storage media becomes less expensive, there is no reason why every consumers could not have a year’s programs from twenty to fifty channels stored on their hard drives. In the meantime, peer-to-peer technology enables users to cluster their recorders and share their resources to create super recorders. They may even help to reduce the duplication problem, which makes personal video recording inefficient.

In the long run, NDVRs are likely to be a passing phase in the development of a celestial library of television programs much like the one that music has experienced. When consumers have a library of every television program ever broadcasted with reasonable terms, there will be no reason to store personal television recordings. We are slowly getting there, but meanwhile, NDVRs and social networks will help consumers to obtain more value from television.

REFERENCES