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Innovation at the Edge: Social TV and Beyond

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The premise of the Value Chain Dynamics Working Group's research is the movement of communication service functions outside the exclusive control of the network core. Traditionally, communication services were provided by network operators as a vertically integrated set of functions. Today, more and more of these functions have moved outside the core while new ones have emerged. Our research takes this fundamental change in the architecture of the communications infrastructure as its starting point. Through our case studies, we seek to map out emerging value chains and examine the opportunities for creating and capturing value.

Introduction

In the last few years, we have seen the rise of new systems for delivering video content to consumers, including digital, IP, and wireless networks. These systems constitute modifications or alternatives to the traditional analog platforms of OTA, cable, and satellite. An important part of these technological developments is the increasingly wider array of end user devices that connect to these platforms—and each other—including STBs, DVRs, PCs, digital recorders, and portable media like cell phones and PDAs.

The "edge" occupied by these end user devices comprises a very dynamic part of the value chain for all new TV systems. Devices integrate multiple content and value-added services—both authorized and unauthorized—and their respective value chains into the TV ecosystem, expanding its boundaries and creating new opportunities for both network operators and non-network players to create and capture value while dramatically changing the TV experience for consumers.

In this paper we will look at edge-based trends driving "social TV," including the personalization of devices, the integration of social networks with the video value chain, and P2P networking among STBs, and the impact these trends are having on the user experience and the TV industry. The focus will be on social TV services offered by cable and telco IPTV operators.

Social TV is viewed as an emerging category of interactive video services that in our analysis are currently considered to be secondary—ancillary—functions, while the acquisition, packaging, and provisioning of content is considered primary. Social TV applications are geared primarily at real-time interactivity with peer groups (shared viewing) and peer

recommendations (what are my friends watching right now? what are their "favorites"?). They are driven by the recent rise of social networks, and based on the seemingly paradoxical trend of individualized viewing on personal devices like PCs and PDAs, or simply one's "own" TV, and the customization of the user experience with "widgets."

A brief background on innovation at the edge

Recording

The first TV add-on was the VCR, introduced in the late 1970s. It enabled little more than recording TV content onto tape cassettes for what is now commonly known as time-shifted viewing, as well as ad-skipping and library-building. The entertainment industry attempted to stop its distribution in a case that made it to the Supreme Court, where it was declared that time-shifting was a legitimate use and therefore the device could be legally sold. Ironically, few people could figure out how to set the clock or program the VCR, so its primary function went largely unused. Instead, the VCR ended up becoming more important as a new content channel to the TV and spawned the retail video cassette industry, becoming a crucial source of revenue for the entertainment industry.

Although a rather primitive playback technology by today's standards, the VCR is significant because it enabled the first important non-broadcast function to the TV. (The other non-broadcast function available at the time was very rudimentary video gaming like Pong introduced in the early 70s. While gaming has not figured prominently in the TV ecosystem until recently, the gaming console is now positioned to compete with both the PC and the STB to become the media hub in the home. In this sense, the seeds of today's disruptions were present in this first wave of disruption, 3 decades ago.) By the late 1990s, DVD players and the DVD format began replacing the VCR and tape cassettes, with most retail outlets having completed the transition (only to face a new HD format, the Blu-ray Disc…).

The DVR was introduced at around the same time, enabling digital recording of TV signals directly to a hard drive. As a digital technology, recording, and therefore ad-skipping and library-building, became much more convenient and more than doubled the instances of time-shifted and ad-skipped viewing among DVR owners compared to VCR owners.

By the late 1990s and early 2000s the digital cable and satellite network operators began adding recording functions to their STBs, taking away market share from third-party DVR services, currently dominated by TiVo. TiVo's strategic response has been to work with operators to provide the UI on their own boxes, since TiVo's UI has thus far provided a superior user experience than the operators'.

At the same time, the network-based DVR, or network DVR (nDVR) has emerged as a centralized solution to recording by storing recorded content remotely, i.e., on a DVR that is owned by the MSO and part of the network core, rather than locally, on a home DVR (think of voice mail versus an answering machine). For MSOs, the nDVR eliminates the cost of

supplying and installing STBs for each customer (cable operators reportedly spend around 10 percent of capital investment on DVR boxes[1]).

The nDVR was initially blocked in the mid-2000s when the US entertainment industry sued Cablevision following its trial in 2006, accusing the system of violating broadcast and copyright laws. The courts ruled against Cablevision in March 2007, but in August 2008, the ruling was overturned, claiming that with regards to copyright law, remote storage is no different than local storage. This ruling is an important driver of the trend towards centralized recording.

Software has also been developed to enable PCs (equipped with tuners) to function as a DVR, including Linux-based SageTV and MythTV, and Windows Media Center and MediaRoom (for IPTV). In effect, the recording *function* has become less tied to a stand alone device, which has become commoditized, and increasingly integrated in other points in the value chain including the network-based DVR or the PC. In the section, P2P-based community TV, we will discuss the various forces that are driving DVR functionality in one direction or another

Transferring and redistribution

In addition to recording, the DVR, when connected to home networks, serves as an "outbound" channel for other device value chains by enabling the *transfer* of recorded programs (as well as other personal data like family photos or home videos) to new viewing devices including the PC and portable media players via USB or other connection standards using the Digital Life Network Alliance (DLNA) protocols. Transferring recorded TV content by cracking DRM systems is illegal, but services like TiVo's TiVoToGo offer a legitimate way to transfer recorded programs to the PC and certain PDAs.[2]

In this way, the DVR ultimately serves as a (re)distribution channel to the Internet for TV content. Recorded and subsequently edited (sliced and diced) TV programs are an important—albeit often unauthorized—source of user-generated content for online video services like YouTube, representing both a threat (piracy) and opportunity (promotion) for traditional content providers.

Other technologies redirect TV programming to the Internet using a different model, namely the Slingbox, which essentially *rebroadcasts* a cable signal over the Internet so that a subscriber can access their content remotely via the Web, a process referred to as place-shifting. The subscribed-to package remains "intact" but is redelivered over the Internet, as opposed to the user editing and redistributing recorded content.

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[1] http://www.reuters.com/article/marketsNews/idINN0448712120080804?rpc=44&sp=true

[2] The TiVoToGo service was offered on the TiVo Series2, however the TiVo Series 3 HD does not include this feature. http://reviews.cnet.com/digital-video-recorders-dvrs/tivo-series3-hd-dvr/4505-6474_7-32065631.html

Inbound channels

Just as the VCR created a new retail channel to the TV, thereby giving it it's first non-broadcast function, the DVR and other set-top-boxes, increasingly connected to the Internet, have also come to serve as an "inbound channel" for online services. TiVo for example, can be programmed remotely through Yahoo! TV, integrating Yahoo's Web program listing value chain into the conventional subscription/broadcasting chain. But a more salient feature is its ability to connect to select Web content (or over-the-top) services like YouTube, the NBA, and Brightcove affiliates, which can then be watched on TV. More recently, TiVo has integrated Web-based media services like Amazon Unbox, Music Choice Videos and even Rhapsody's music service.[3] Tivo's Web video services are one solution to bridging the gap between online content and the TV.

Several single-purpose (i.e., without recording or other features) Internet-to-TV devices have also appeared on the market, most of them proprietary boxes that deliver a Web-based video service providers' content to the TV. The AppleTV for example streams iTunes content from the PC to the TV and in 2007 announced direct-to-Internet streaming access (i.e., not downloaded to an iTunes client first) to the iTunes Store, as well as YouTube and potentially other Web content. Other boxes of this type include the Roku for streaming Netflix's "Watch Now" service from the PC to the TV, and the Vudu, which connects the TV set to an online catalog of movies and TV shows.

In addition to stand-alone boxes like the DVR and AppleTV etc., the PC-based media hub is another model for bringing online video to the TV, streaming video content acquired from Web video services from the PC to the TV, and increasingly via mobile devices.

Interactive applications

In the new world of video, it's what you're able to do with content once you get it that's important. The trends discussed so far describe the ability to move operators' content around in both time and space, while bringing over-the-top content to the TV. But given the evolution from one-way, analog services to two-way digital and IPTV delivery platforms, the real fun starts with applications that enable interactivity. Initially, interactivity has enabled navigation (the electronic program guide, or EPG) and video on demand (VOD). Early scenarios for interacting with content itself were largely focused on ecommerce, e.g., clicking to buy products associated with a program, or pizza-and-a-movie type offerings. With the rising importance of "social media," the most recent category of services to receive attention are those that enable a shared TV experience. The rest of this paper explores the integration of Web-based social networks like Facebook and MySpace into the TV ecosystem to enable social TV, and its logical evolution towards a P2P-based community distribution system we call "community TV."

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[3] http://www.usatoday.com/tech/products/services/2006-06-06-tivo-web-video_x.htm. About 400,000 out of 4.4 million subscribers are connected via the Internet (about .01%).

The return of social TV

While the social aspect of TV is not new in and of itself, the term, social TV, has emerged fairly recently to describe a new breed of video services that integrate other communication services like voice, chat, context awareness, and peer ratings to support a shared TV experience with one's peer groups. Social TV stems from two trends intrinsically linked to the TV experience: social interaction and personalization.

Social interaction

The first trend, social interaction, involves the re-discovery of TV as a shared activity. Back in the 1950s, when television came of age, watching TV was typically a communal activity, involving family and friends gathered in the living room around the TV, choosing what to watch—*content discovery* (or imposing programming choices, as was often the case!)—and sharing reactions to the same program and exchanging comments—*the shared viewing experience*. In the 2000s, TVs are less of a luxury item and it has become common for the typical home to have more than one TV, where individuals or smaller groups watch their preferred programs separately. In 2006, Nielsen Media Research reported that only 19% of American homes have one TV and the typical home now has more TVs than people—2.73 TVs and 2.55 people.[4] In effect, we have seen the growth of "anti-social TV" watching, where the social aspect of exchanging comments and making program recommendations is delayed—or asynchronous—occurring the next day around the water cooler and in other social contexts.

But the shared TV experience is now returning, in a new form. The typical family room of the 1950s is being replaced by online virtual communities accessed through personal devices. These communities extend far beyond the home to span entire neighborhoods, cities, countries, and hemispheres. And like the traditional living room, these communities are increasingly organized around video, connecting families, friends, and some strangers alike in a shared video space defined by interactions, common interest, or location.

As an aside, it's interesting to note here that Robert Putnam in his book, *Bowling Alone*, considers the family-room TV experience itself to be an instance of the "individualization" of news and entertainment since it allows people to watch it in the privacy of their own homes—and is therefore, in fact, *anti*-social. For Putnam, the "social" is a function of consuming and engaging in entertainment activities in *public* spaces, e.g., the baseball park, the dance hall, the movie theater, etc., and thus the living room experience (the "electronic hearth") contributes to the decline of social and community involvement by disconnecting people from the outside world. This perspective actually illuminates the increasing granularity of media space as a result of the personalization of devices (discussed below)—moving from the shared TV, to the personal TV (in one's own bedroom or study for example) to the PC, and finally to the cell phone and PDAs like the video iPod. In this sense, the new social TV experience is arguably more conducive to Putnam's idea of social

[4] http://www.usatoday.com/life/television/news/2006-09-21-homes-tv_x.htm

engagement and is, ironically, enabled by the individualization of technology—when combined with sociable media.

The social TV the experience has thus originated online. Many emerging online video services like Joost and Hulu integrate social networking features like program ratings, "favorites" lists, discussion forums, and multi-user chat sessions directly into their offerings.

Meanwhile, Web-based social networks like Facebook and MySpace have begun embedding video applications into their sites, thereby becoming video distribution platforms in their own right, where viewing is, by definition, a social experience. In addition to getting movie and TV recommendations from their peers, subscribers to these social networks can now stream selected content on a personal page for a shared viewing experience with visitors and "friends." In this way, video-oriented social networks essentially become "virtual operators," servicing the user and their group of friends. Like any other traditional MSO, the virtual operator effectively programs the customer's service (chooses and rates their content) but based on peer recommendation lists and ratings, not generic population statistics. While enhancing the user experience by making it more relevant, this also creates tremendous opportunity for targeted advertisement, and the ad industry is taking note. Already one can see a huge difference in the advertisements for a given show when viewed on prime time TV versus video on demand versus online. Social networks would take targeting to a new level. (It's useful to note here that there has also been a rise in social features in gaming, where users can connect to friends or meet new people using various applications. These developments in gaming will influence user expectations vis-a-vis the TV experience, especially as gaming becomes more integrated with TV viewing.)

In the world of cable and IPTV services, the return to social TV began in the early 2000s, with STB-to-STB communications provided by a few operators. Today, social TV offerings are on many operators' roadmaps. IPTV middleware like MediaRoom[5] as well as next generation versions of OCAP (recently branded as True2way) middleware for digital cable, are readily offering shared viewing applications. These systems use Instant Messaging-like capabilities with buddy lists, etc. that overlay the watched content, text bubbles, or even avatars to convey the friend's messages, enabling friends watching the same program in separate homes to exchange comments about the show they were watching

But operators are also starting to incorporate aspects of Web-based social networking directly into their offerings via the STB. Sites like Facebook and MySpace have been complementing operator services with features like movie recommendations for the last few years, but in a loosely-coupled way. Consumers discover content through their online communities, and then turn on the TV and interface with the EPG (electronic program guide). Although the process can be more synchronous than the water cooler scenario, it is a technically separate process.

Recent work with social networking extensions to TV UIs including TiVo show that various social features can now be technically integrated with the actual TV viewing experience,

[5] http://www.lostremote.com/index.php?tag=iptv

similar to online video services described above. Facebook TV is one such application being developed at the MIT Media Lab.[6] Facebook TV essentially enables the DVR to communicate with Facebook so that users can see what their friends are watching and their ratings. The social network look and feel is incorporated into the TV UI with some minor changes, e.g., a menu item (e.g., my friends' favorites) and/or a real-time chat application for shared viewing.

The social network becomes a "virtual operator" as described above—in effect, performing a more personalized or customized version of the programming function, based on the viewing habits of the user's peer group. For example, the "favorites" list on the TV UI can be influenced by what a subscriber's friends in their social network are watching.[7] The list of one friend's favorites can also be used to determine what to record on another friend's DVR.[3] As in the online examples above, this creates the opportunity for more targeted advertising. While some critics are skeptical, claiming that too much of the information about users is fake or out of date, and also that connections to social groups can be meaningless because they are so remote (many degrees of separation) or no longer relevant,[8] they social network for a typical user is still considered valuable by advertisers.

The Facebook TV prototype so far has shown that commercial operators see value in the opportunity to build a new type of UI—the social network UI—over and above the services they already offer. This raises more general questions regarding the value of social networks beyond target audiences for advertisers. As David Reed notes, "From a business point of view, almost all of the value (economic utility) of our communications arises out of the shared context that we have created, so as part of understanding what the communications business is about, we should be studying the value that is created through the elements of context, rather than the speeds and technologies of the particular pipe."[9]

Personalization

The other trend driving social TV is the *personalization* of video services—the delivery of customized services to personal—rather than shared—devices, including PCs, cell phones and PDAs (as well as TVs). Often referred to as three-screen TV, this approach addresses new user behaviors emerging primarily from younger generations that grew up on iPods and YouTube and have grown accustomed to watching video on devices that are far more personal (and smaller) than the TV set.

The personalized TV experience aims to deliver "my" content to "my" device of choice, when and where "I" want it. Personalization creates a more individualized experience, but because today's personal devices are networked, that experience can be shared among other individuals. In other words, the global virtual community is comprised of groups of

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[6] Marian Baca & Henry Holtzman, "Television meets Facebook," EuroITV 2008, June 2-4 2008.

[7] Damien Alliez, Adapt TV paradigms to UGC by importing social networks, EuroITV2008, June 2-4 2008.

[8] "Word of Mouse: Will Facebook and other social-networking sites transform advertising?", *The Economist*, November 8, 2007. http://www.economist.com/business/displaystory.cfm?story_id=10102992

[9] http://cfp.mit.edu/cfp-pi/?p=7

individuals each interacting with each other via their own devices. In this sense, personalization can be viewed as the precondition or the foundation of social TV.

Furthermore, by making a user's social group one of their identity features (in addition to other elements like location and presence), a user's personal content can then also easily include that of their family or a select group of their friends, i.e., their social network. In other words, "my" content can also mean "our" content.

Personalization is also driving the inclusion of Web 2.0 services in general to IPTV and online video: users download widgets providing anything from weather forecasts and traffic reports to health care information to two-way video conferencing, or ratings and real-time commentary on programs, to complement and customize their TV experience.

The availability of Web 2.0 applications and widgets across all viewing devices—the rendering ecosystem—stimulates the cross-development of applications that will encourage a more novel approach video consumption. This new approach centers on the user's *intention* regarding the video experience and, in addition to more traditional considerations like content choice (what do I want to watch?) and device (on my TV or my iPod?) will include such factors as real-life events (it's my mother's birthday), geolocation (where am I relative to my friends?), social connections (who is in my peer group), and emotional state for example (I want to be alone).

The MIT Media Lab calls this the "canvas-based approach," suggesting that applications enable the user to approach their video experience like a blank canvas and ask, "what do I want to *do*, based on my circumstances—where I am, my mood, who I'm connected to, and what is going on around me," and then invoke the various components, i.e., device, network, peer group, and content. Note that in the canvas-based approach, and in video services today in general, content choices go beyond traditional entertainment video to include music, personal photos, video greeting cards, and other video-based services, all of which converge within a broader media experience. For example, one user may want to listen to music off the STB using the home theater surround sound system, or perhaps watch a movie on-demand. Another user might be interested in using their smart phone to share photos among friends, or watch a movie online.

Towards true community TV

At this point, most social TV applications offered by cable and IPTV operators still follow the traditional head-end/STB mechanisms of TV delivery. However, once TV becomes truly social—a shared experience among peers—the next logical step is to consider user-controlled peer-to-peer (P2P) *delivery networks* for operator-controlled content. This community-focused approach harnesses the combination of the now almost ubiquitous home LAN; end user technologies (like the whole-home DVR) for content distribution to local communities and the collective knowledge of these communities for programming and content discovery; and the ever-growing number of power users—those who tend to use the more advanced features of technology.

Several trends are overlapping to support this vision of community TV. First of all, as discussed above, the combination of social networking and personalization is driving a shift in the distribution of the TV experience away from the living-room TV in a single household to multiple homes as well as multiple devices. More specifically, social networks are driving the transition from the *whole-home* DVR—a centralized hub serving a single household (an approach supporting the traditional living room scenario)—to the *community* DVR. The community DVR is essentially an edge-based version of the core-based network DVR, where one household's DVR serves a community of users who are defined by their membership to a social network. This trend will eventually progress towards true "community TV," where members of a social network will connect to each other's DVRs via peer-to-peer networking, depending on what content is stored on each member's DVR.

Secondly, although consumers are concerned with the security of locally-stored—un-backed up—data on their DVRs, concerns about the reliability of the operator-controlled network DVR are equally important. As one analyst puts it: "We're…looking at a living-room analog to cloud computing. What if the cloud goes offline? What service expectations should consumers have? Should there be TV SLAs?[10] Combined with network upgrades, operators are facing extra costs with the network DVR.

A tremendous opportunity therefore exists for a shift from distribution based on a core network infrastructure and a single content source to community-based distribution. This change can happen, and is happening, at many levels including the physical layer, where autonomous systems manage the organization of the network; the architecture level, where users are both content sources and/or consumers; and the management level, where power users are responsible for guaranteeing connectivity and the legality of the experience.

In order for this P2P network to be functional, intelligence must be added to otherwise dumb devices; adding "self" capabilities like self-configuration, self-detection and self-management. As the work on the CFP Viral Communications Working Group's P2P platform[11] is demonstrating, P2P-based community TV will encourage the move away from the monster media hubs of the early 2000s—where a single device is overloaded with features—towards a peer network of collaborating devices that share functions based on service and user profiles. For example, the DVR with large enough disk space could become the designated community storage device while an attached PC can provide the transcoding to allow image rendering (viewing) on a handset. The community can also extend beyond a geographical area with one member in Massachusetts, for example, watching content subscribed to by a friend in France via a super peer in Boston—the global STB-based "Slingbox."

This peer-based TV network reduces the need for large operator-controlled server farms and also reduces the need to expand uplink capacity, resulting in lower CAPEX and OPEX. Some studies have shown that relying on a wireless peer-to-peer network and a few hybrid

[10] http://www.techlore.com/blog/entry/23528/A-Cablevision-Win-for-Network-DVR-AKA-Cloud-TV/

[11] http://media.mit.edu/research/1045

peers connected to the traditional IPTV network could provide service to a community, even on slower DSL connections. In this scenario there are fewer users connected to the infrastructure but each of them would pay extra for premium service.

Business and technical challenges

The business and technical challenges of social and community TV should not be overlooked. One of the key issues is the diversity in how members of a social network receive their television programming and what content they have access to, which can easily fragment a social network. Without a common experience available to everyone in the group—access to the same content, regardless of provider, platform, or viewing device—the value of the social connections is diminished and consequently so is the likelihood of social TV adoption on a large scale.

There are several types of boundaries that lead to fragmentation. The first boundary we examine results from a diversity of connectivity platforms and operators. Certain members of a social network may receive service from a cable operator, others from a telco, and yet others from satellite, and some over-the-air or over-the-top. (In some cases, they may receive service from two or more platforms.) And within each of these platform options, there are multiple providers and multiple content bundles, even in geographically-bounded social networks. Given today's walled-garden architectures, if members of a social network do not all share system operators, that network will be fragmented because not everyone in the social network will have access to the exact same pool of content.

We are seeing some changes that might reduce fragmentation at the content level. For starters, content providers are increasingly distributing their content across multiple providers and platforms, including through their own direct online sites (e.g., NBC.com), especially in the case of the more popular shows, where advertising gains can be high. This increases the likelihood that all members will have access to the same content, at least for "short-tail" programming.

Another scenario that involves crossing platform boundaries is the "three-screen" television model. The personalization trend discussed earlier in the paper emphasizes the increasing demand for delivery of video content to more personal devices including PCs, cell phones and PDAs as well as the TV, in a seamless fashion. In this way, interoperability among networks, devices, and applications at the individual user level is a precondition for the success of social TV.

Network operators in particular have increasing incentives to extend their reach beyond the TV—or to at least not lose eyeballs when a customer is away from home and can't access their STB. The Slingbox described above provides a third-party solution for redistributing content over the public Internet to the PC, but it is in the operators' interest to provide this service themselves—in effect becoming over-the-top providers. For example, an American cable subscriber in Paris may be able to access their content online by logging onto their provider's site (assuming that the program is not available in Paris) using the local network.

It remains to be seen if networks will block access to other MSO's content if this model takes off.

More generally, three-screen TV will depend on personalized access, or what the CFP calls personalized broadband. The CFP paper, "A Vision for Personal Broadband," outlines the scenarios and business models associated with personalized access in more detail, where users seamlessly connect to the network that best suits their needs at a given moment.

In terms of devices and applications, platforms have traditionally been developed in technical silos and poorly orchestrated, with little or no common interfaces. Efforts are well underway within and outside the traditional TV community to build common middleware—the set of functionalities that enable the acquisition of content, its conditioning and formatting, its delivery to and rendering on the user end device—to reduce the number of software platforms while encouraging diversity in the device ecosystem as well as stimulating innovation by third party application developers.

This middleware can support interfaces beyond the operator-provided content itself to include portals, provide conditional access and authentication across content types and have unfettered access to the Internet. Middleware can also control and define the built-in or operator provider functionality of the rendering device (i.e., the "screen"), and can determine the state of the STB via APIs to the provisioning system.

Middleware is driving the development of social TV through SDKs (software development kits) and open APIs that personalize the TV experience by supporting multiple devices as well as third-party applications. Efforts like the cable MSO's OCAP (OpenCable Application Platform, recently rebranded as tru2way) and the telcos' Open IPTV Forum, for example, are opening the STB to 3rd party developers who provide the social functions/applications, the same way Google's Android open platform seeks to open up the cell phone to all networks and application developers. Thus one could imagine a world where the operators continue their role as mass content providers via the centralized approach but collaborate with innovative 3rd parties to provide the social functionality in a community-centric, decentralized fashion.

Over and above the issues related to interoperability among members of a social network, there are several forces that work against the decentralized, P2P-based community-TV model in particular. For starters, the operators fear that this model would erode their market share since fewer subscribers (the super peers) would need to buy their services to serve the same number of users. But as mentioned above, the users would be paying a premium. The bigger challenge here might be designing community-based billing models that would attract the mass-market user.

Furthermore, in certain markets the negative association of P2P with piracy and security (viruses) is driving the trend towards centralized operator-controlled services in general, since they are considered less vulnerable to DRM hacking and more secure than decentralized models. The average user trusts their cable provider and will have little problem downloading content from them, however, they may be less trusting of a member

of their social network. Ultimately, the operators remain the authentication and provisioning authority. This feeds into the view that a centralized model is more reliable especially as more content is loaded onto DVRs, with no back up possible. (Although, as mentioned above, there is the opposing view that if the network goes down, users have no access to their content).

Lastly, operators also have the advantage of offering QoS connections, compared to the public Internet's "best-effort" network. However, QoS is promoted to discourage the substitution of their "walled gardens" of on demand content with over-the-top services like iTunes and YouTube. For on-demand content, a guaranteed connection may offer no better quality than a progressive download or buffered streaming service delivered over the public Internet and therefore only offers an advantage in the case of a live or scheduled broadcast.

Summary and conclusions

This paper has explored innovation at the edges of the new TV ecosystem, with a focus on the trends associated with social TV including social networking, personalization, and P2P networking.

It is still in its early stages, but this new frontier of TV is evolving at a very rapid pace. YouTube and Facebook are just a few years old, yet who can remember the world without them? The next innovation could be just around the corner with more online video migrating to mobile platforms, new Web appliances like Chumby delivering online content, and the blurring of boundaries between devices as well as innovations spawning from open hardware and SDKs like iPhone or Android.

The value chain implications are numerous and include fascinating challenges:

- Connecting multiple end user devices to new delivery platforms and open SDKs
- The integration of multiple value chains into the TV ecosystem and the convergence of voice, music, video, and data experiences
- The emergence of new functional components and their (re)distribution across devices and platforms
- Renewed opportunities for network operators and non-network players to create and capture value
- The intensification of the core vs. edge tension and of the incumbents vs. new players and the creation of a more dynamic marketplace.

In particular will be watching the evolution of the living room from the traditional "screen" to a more connected and shared space with family, friends, and communities. One interesting aspect of the evolution of social TV will be to see what the future of the STB holds. Will the STB be completely replaced by the PC—a fate predicted for quite a long time now, or will it become a central element of the connected ecosystem, providing storage, DRM and power to drive large screen TVs? Will it be rendered obsolete by Web devices or will it itself become a Web device?

The impact of the renewed interest in TV as a social phenomenon is barely being felt at this time, but as this paper demonstrates this impact could change not only how TV is delivered and consumed but how a whole industry could be reinvented. Recent work using game theory shows that while new entrants into the video market, including social networks and online video services, offer innovative, socially-oriented features, they will not necessarily destroy the traditional video business but will instead cause a shift in the focus of an offering from its physical and technological features (e.g., MPEG 2 vs MPEG 4, DSL vs WiFi) to the service that is provided and the overall experience. Furthermore, the traditional operator model will not be threatened if their services can compete with features like user-generated video (YouTube), anytime viewing, and more personalized advertising, widgets, etc. Work is under way in the Value Chain Dynamics Working Group to evaluate these different challenges using system dynamics and game theory as it applies to the impact of new entrants in the operator-based TV realm.[12]

Acknowledgements

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[12] Chintan Vaishnav, (2008). "Does Technology Disruption Always Mean Industry Disruption?." International Conference of System Dynamics, Athens, Greece.