



IPTV: Order, Chaos and Anarchy

M

Version: Public – no restrictions

Date of Publication: March 2007

Author: Mark D. Pesce. mark@markpesce.com



Australian Government

**Department of Communications,
Information Technology and the Arts**



Established and supported under the
Australian Government's Cooperative
Research Centres Programme

Disclaimer

This report was commissioned and contains references, comments and projections regarding the topic of IPTV. The recipient acknowledges that these references, comments and projections reflect assumptions by the author concerning the future, which may or may not prove correct.

Smart Internet Technology CRC Pty Ltd and its respective directors and officers expressly disclaim any liability, representations or warranties express or implied contained in this IPTV report or any omissions from it. This disclaimer extends to any other information whether written or not, provided at any time to a partner, researcher, student or any other persons by or on behalf of Smart Internet Technology CRC Pty Ltd.

© Smart Internet Technology CRC Pty Ltd 2007. All Rights Reserved. All trademarks mentioned in this document are the property of their respective owners.

Smart Internet Technology CRC
Bay 8, Suite 9/G12 Australian Technology Park
Eveleigh NSW 1430 Australia
T: 61 2 8374 5080 Fax: 61 2 8374 5090
www.smartinternet.com.au

Contents

Executive Summary:.....	4
I. Introduction: The Many-Body Problem	4
II. Order: All Your Stations Are Belong To Us.....	7
III. Chaos: Steal this Look	10
V. Anarchy II: The Disruptors	16
VI. Anarchy III: Free the Bits!.....	21
VII. Conclusion: Government, Citizens, Consumers and Producers.....	23



Executive Summary:

The future of any commercial IPTV system in Australia is fundamentally hamstrung by a grossly under-resourced national broadband infrastructure. The commercial forces which might generate vast profits from this system are unwilling to underwrite the billions of dollars of investment that could turn their IPTV proposals into reality. Instead, the vacuum created by enormous audience demand for internet-delivered video programming is being filled by audience-driven solutions such as YouTube and BitTorrent. As audiences discover these new channels, the broadcasting incumbents find themselves increasingly marginalized; the audience has seized control of distribution. In this new and anarchic environment, chaos rules. It may already be too late to bring commercial IPTV to Australia.

I. Introduction: The Many-Body Problem

Delivery of audio-visual programming via packet-switched networks, or, as it is more familiarly known, IPTV (from “Internet Protocol TeleVision”), has an enormous and almost unprecedented potential to change the information production and consumption habits of human culture. Just as the World Wide Web changed the dynamics, economics and demographics of print media, IPTV promises to do the same for the moving image. This implies that the huge shifts in power of the last decade, which have raised Google and Yahoo! to the skies while the print media rapidly shrinks into an obsolescent oblivion, will be replayed, with broadcasters and television producers now sitting in the exposed position, threatened from all sides by competition for the attention of the audience.

The world-wide market for film and television production, distribution and broadcasting generates over a hundred billion USD dollars annually in the United States alone [1], a figure which is growing rapidly as developing nations such as India and China industrialize and gain sophisticated (often satellite-based) broadcasting infrastructures. The vast majority of the world’s six billion people can receive some sort of television broadcast. This broadcast infrastructure will not disappear overnight, nor even in the next generation. However, the most advanced nations – in South Korea, Japan, Western Europe, and North America – broadcasting is leaving

the radio spectrum, transitioning to the network-based distribution techniques collectively known as IPTV.

While the definition of IPTV given in the first lines of this work is technically correct, the systems of production, distribution and commerce which underlie IPTV are still nascent. It is not clear what IPTV will look like, from the audience's point of view, so the bulk of this report will cover the three forces shaping the definition of a fully-realized IPTV. Each of the three central sections of this report covers one of these forces in detail.

The first and most obviously visible of these forces are the centralizing commercially-driven forces for IPTV. These, the incumbent broadcasters, together with the telecommunications providers, are pairing to provide high-quality, high-bandwidth digital program streams into the audience's homes, a stream entirely under the broadcaster's control. The audience experience in such an ordered system would closely resemble that delivered by existing cable and broadcast television systems, though the number of channels available to the audience could possibly grow enormously.[2] Features such as video-on-demand (VOD) and digital video recording (DVR) will allow the audience to assert a greater level of control on how, when, and where they watch the programs. Yet these programs will be drawn from the same pool of professional productions broadcast today. The more things change, in this ordered vision of the future, the more they remain the same.

Growing up along side this move toward an ordered future for broadcasting, and mostly in opposition to it, techniques of "hyperdistribution" (which allow any audiovisual content to be shared with anyone, anywhere, at little or now cost) [3] have created a new audience who distribute programming on their own, without the help, or even the legal sanction of the copyright holders. In this chaotic world of peer-to-peer file-sharing, the audience handles all of its own distribution activities. The result has naturally been a rampant disregard for the fundamental protection of copyright: the copyright owner has lost all ability to keep copies of the work from distribution. Nearly everything broadcast (over the airwaves or via cable) anywhere in the world is now available for download via some hyperdistribution mechanism. Formal accountings by the MPAA, an industry trade organization, put the financial losses to

such audience-driven distribution in the billions of dollars every year [4], yet all attempts to quell the chaos – through lawsuits, education, even price-based competition – have failed, and perhaps made the problem worse. This chaos can not be tamed, and it is unclear if it can even be managed.

Finally, drawing from trends in hyperdistribution, while at the same time acknowledging the success of commercial media distribution, a third force, consisting of an odd mix of entrepreneurs and social activists, work to reinvent broadcasting as a true peer-to-peer medium. In this anarchic version of the future, there is no center anywhere. Instead, a planet of creative people are constantly producing and distributing their own works for a global audience. This force freely embraces (and often invents) new techniques for production and distribution, steadily increasing the individual's empowerment. Feature-length films can be produced and distributed completely outside any established systems of film finance or distribution; news programs with decidedly non-mainstream points of view are now reaching global audiences; stars and startups are born. This anarchy is the well into which the commercial forces dip for a touch of rejuvenation; CBS's deal with Google's to distribute full-length television programmes through YouTube is the archetype for the relationship between incumbent and anarchist.[5] Yet the anarchistic trend is constantly overthrowing established models in favor of newer and finer forms; it consumes itself with innovation, and, in the process, destabilizes any process which tends toward order.

These three forces, like chaotic attractors, have the capability to shape some trends to their ends; if any one of them had the market entirely to themselves, they would be able to define the future completely. Instead, we're left with an inherently unpredictable "many-body problem," where three attractors, tugging and pulling against each other, leave the market and the audience in a constant state of flux. No one force has thus far managed to establish any commanding lead over the other two. There is as yet no path dependence [6] model which we can use to predict the shape of the future. What we must do, therefore, is examine each of these forces in some detail, understand their points of leverage, their areas of weakness, and their long-term goals. The future of IPTV is a hybrid mixture drawn from these three forces,

but, because of the tug and pull of each of these forces on one another, its final form remains indistinct.

II. Order: All Your Stations Are Belong To Us

Of all the forces which will shape the future of IPTV, the most significant – economically, technologically, and politically – are the established and incumbent providers of audiovisual programming. In nations such as the United States, which have a long history of CATV, and where it reaches a vast majority of the audience, these corporations have almost complete control over access to the audience. Today’s digital cable systems transmit a synchronous MPEG-2 program stream, multiplexed so that a range of channels can be received simultaneously. In this, digital cable resembles its most potent competitor, satellite-based broadcasting, which transmits a microwave signal encoded with a multiplexed range of MPEG-2 program streams. In both cases a high-speed digital link exists between broadcaster and receiver – a “set-top box” adjacent to the television set which does the de-coding of the digital signal, and modulates it for display on a television set.

For these providers, IPTV is little more than an upgrade to the services already on offer. Instead of a set number of channels delivered over a physical medium, IPTV would offer a nearly infinite range of channels delivered over a physical medium. But, in a true IPTV system, the physical medium is of little account. IPTV replaces the synchronous MPEG-2 program stream with a high-speed *bidirectional* connection using Transmission Control Protocol/Internet Protocol (TCP/IP), the semantic DNA which drives the Internet. The set-top box, no longer the passive receiver and decoder of program streams, becomes an active component, making requests to the “head end” – the network equipment located at the provider’s local transmission facility – for specific program streams. An IPTV set-top box can be thought of as a highly customized web browser, making requests for Internet content which it then displays on the television.

While this sounds like a very straightforward approach, which should be easy and inexpensive to implement, the bandwidth requirements of IPTV require a complete upgrade of the network infrastructure. A single cable with a multiplexed range of

MPEG-2 program streams will suffice for all customers of a digital cable system; an IPTV system requires an individual very-high-speed connection for each customer. As currently conceived, a next-generation IPTV system has to be able to handle three simultaneous television streams, one in high definition (HDTV), two in standard definition (SDTV), plus bandwidth for fixed line telephony (VOIP), plus bandwidth for normal internet access.[7] If all of these services were used simultaneously, the total bandwidth required for an IPTV system, on a per-household basis, comes to something around 20 megabits per second, and this bandwidth must be with a very high quality-of-service, or else television programs will “stutter”, voice calls will drop unexpectedly, and the customer’s experience will rapidly deteriorate. [8] These requirements are so far beyond the capabilities of Australia’s extant broadband networks as to seem almost fantastical.

The average broadband user in Australia today has a connection speed of roughly 256 kilobits per second peak throughput. The average throughput of these systems is anywhere between 30 and 50 kilobits per second – and if every user of the system needed the full bandwidth of their broadband, the number would fall down to about 10 kilobits per second, as users contend for limited bandwidth resources.[9] Internet Service Providers oversell their bandwidth based on usage projections; no customer uses all their bandwidth, all the time. The total bandwidth offered by an ISP is much lower than what would be needed to provide full bandwidth to all users simultaneously. IPTV requires that every user have continuous access to at least 20 megabits per second of bandwidth, a figure a **thousand times greater** than the aggregate peak throughput offered by Australian ISPs. Using the current infrastructure of broadband networks in Australia, there is simply no way to offer an IPTV service. IPTV requires a complete build-out of a very high-speed network infrastructure which can offer high bandwidth and high quality-of-service to all customers simultaneously. The nation’s one extant IPTV service, Canberra’s TransACT, uses fiber to the curb and VDSL to the premises to achieve the throughput needed for IPTV. This required a massive infrastructure investment to serve a community of only a hundred thousand customers. To serve the eighty percent of Australia’s population clustered around its urban centers with high-speed IPTV-ready broadband, an investment of billions and possibly tens of billions of dollars would be

required.[10] This kind of investment can only come from a partnership between industry and government.

Government at all levels – Federal, State and Local – would need to cooperate with the incumbent IPTV carriers in a massive build-out of Australia’s bandwidth. Thus, in this model, commercial interests become irretrievably intertwined with political concerns. Without decisive action by the government – to limit competition, float bonds, grant rights-of-way, etc. – no IPTV project in Australia can ever get off the ground. TransACT is an experiment, and it has achieved its modest success only because of the focused action of the territorial government of Canberra. A deal would need to be struck between the nascent providers of IPTV and the government; this deal would strike down any idea of “net neutrality” in favour of granting an IPTV provider monopoly control over access to this new and very expensive infrastructure. Before any build-out, an IPTV provider must be assured that they will be able to regulate, limit or block any content carried across their infrastructure – so that they can meter and charge for a wide range of audiovisual, telecommunications and internet-based services, thereby ensuring a recovery of their investment.

Thus far the government has been unwilling to stifle competition in consumer broadband; this has meant that the low-end of the market has seen healthy growth (and predatory pricing) over the past several years. The high-end of the broadband market – where IPTV services could be delivered – simply does not exist anywhere in Australia. Several ISPs offer a range of high-speed services, but all have greatly oversold their bandwidth; none could sustain the minimum of 20 megabits per second each IPTV customer requires.

Thus, the commercial forces driving Australia toward adoption of IPTV find themselves in a frustrating situation: no carrier can afford to commit to a network build-out if that infrastructure must be shared with their competitors (as the ACCC now requires), and the present Coalition government seems disinclined to take steps which would limit competition in the telecommunications marketplace.[11] This logjam makes it effectively impossible to envisage a time when Australia has pervasive IPTV, or even a broadband infrastructure capable of supporting it. Thus, French telecommunications giant Alcatel, which bases its Asian operations out of

Shanghai, has broadened its focus to include IPTV markets beyond Australia – Hong Kong, Macau and South Korea – where governments have made strong commitments to provide high-speed broadband access to their citizens.[12]

Despite these seemingly intractable problems, this commercially-driven model for IPTV deployment remains the holy grail for telecommunications providers in Australia. Telstra, as the nation's largest telecommunications company, periodically moots the idea of an Australian IPTV service, but quickly follows that vision with a threat: unless regulatory agencies grant Telstra monopoly control of the IPTV broadband infrastructure, there's no way they could hope to recover their massive investment.[13] Each time this play is performed for the media, Telstra gets to blame the government for its own unwillingness to take a risk, while the government gets to look like the sympathetic protector of consumer's rights. It will likely take an outside threat to provide the clarity of vision both parties need to bring them to the negotiating table.

That threat is already rising, and comes from the two other forces in play: chaos and anarchy. Each of these threaten to destabilize the IPTV marketplace so fundamentally that commercial IPTV interests could simply see the consumer need for a centralized, commercially-driven IPTV system vanish. The audience is already accustomed to using the Internet to access a wide range of audiovisual content; the behaviour of the audience has already changed. With each day that passes, the needs of the audience are diverging from the vision of IPTV offered by the incumbents. Eventually the case for commercial IPTV will make no sense at all. If Australia waits too long to resolve this conflict, commercial IPTV may never be a reality here, overtaken by developments which have nothing to do with commercial interests.

III. Chaos: Steal this Look

From the earliest days of the World Wide Web, audiovisual content has been available online. Progressive Networks (now Real Networks) introduced RealVideo in early 1997, and Apple's QuickTime has been available since 1991. Both formats have been used extensively for "netcasting" – streaming and downloadable

audiovisual content. Netcasting has an inherent drawback: it doesn't scale well. A publisher with popular content will quickly find their servers and bandwidth swamped with requests for the content; users looking for the content will find themselves waiting a long time to download it, and many will abandon the attempt if it seems to be taking too long. Furthermore, because internet traffic is metered, popular content can be very expensive to distribute via netcasting: each download adds to the total cost of distribution.

In 1999, Napster changed distribution forever, introducing the idea of “peer-to-peer” distribution of audiovisual content. While mostly confined to audio recordings – and these, most frequently, in flagrant violation of copyright – Napster cemented the awareness that the Internet could be treated as a whole, an encompassing resource whose integrated components created something far greater than the sum of its parts. Yet Napster, with its centralized database-of-everything, contained the seed of its own failure within its success. Networks which have a single point of failure invite attack. In this case, the record industry attacked with a hail of lawsuits, and Napster, more popular than ever (fourteen million simultaneous users, and over a hundred million registered users), vanished overnight.[14] Yet such was the seduction of peer-to-peer “file sharing” that within a few weeks after the collapse of Napster, another project, Gnutella, arose to take its place. Gnutella implemented a novel approach to file sharing: it distributed its database among all Gnutella peers; requests for files passed from node to node, fanning out across the network of peers until every node, everywhere, had a chance to respond. A network without a centre is both difficult to detect and difficult to destroy, and Gnutella marked the beginning of the Age of Chaos. Pervasive and ever-more-invisible file sharing services created a distribution system for audiovisual materials which exists entirely outside the money economy, and in flagrant violation of copyright.[15]

The *coup de grâce* for commercial distribution came with the release of BitTorrent in 2002. BitTorrent makes it possible to distribute very large files – into the tens of gigabytes – very efficiently, by dividing the file sharing task across arbitrarily large numbers of peers. Each peer exchanges data with a “swarm” of other peers; there is no single point of failure, and the system embodies the idea of the “virtuous cycle”; as more peers join in file sharing, the file transfer process becomes the more efficient for

each peer. BitTorrent very quickly became the preferred technique for the network transfer of any files of significant size; approximately 60% of all traffic on the Internet at any point in time is BitTorrent.[16] BitTorrent has fundamentally changed the economics of network distribution of audiovisual materials: no server, however large, however well-resourced with bandwidth, can compete with a swarm of peers for efficiency. Broadcasting is circumscribed by signal strength and the curvature of the Earth. Netcasting is circumscribed by bandwidth. BitTorrent effectively creates a hyperdimensional infrastructure for data transfer within the Internet, and suffers neither restrictions of distance nor bandwidth.[17]

Users seduced by the universal media library created by Napster and advanced by Gnutella immediately embraced BitTorrent, and specifically used it to share films and television programs – files which are typically a hundred times larger than songs. Throughout 2003 and 2004 a world-wide infrastructure of websites and “trackers” – the entities which BitTorrent peers use to coordinate their file sharing – effectively converted the Internet into the equivalent of a gigantic disk drive. To users it looked like a combination of the world’s largest film repository and a digital video recorder (DVR), where nearly every program broadcast anywhere – over the airwaves, cable, or satellite – became available for instantaneous and efficient download.[18]

Copyright owners effectively lost the ability to control distribution of their copyrighted works. Audience-driven distribution – “hyperdistribution” – has overrun any attempts by copyright holders to restrict, regionalize, or charge for their works.

This, then, represents a second possible future for IPTV, a future which is already a reality for many millions of users. Australians, in particular, have been seduced by this future. At the end of a long distribution chain, and subject to the whims of commercial television programmers, Australians have become the greatest per-capita users of BitTorrent.[19] Australian audiences, fed up with thin stream of programming provided by the incumbent broadcasters, have simply removed them from the distribution pipeline.

This chaotic system of audience-driven hyperdistribution has not yet and may never become the dominant IPTV model in Australia. BitTorrent is still very much an enthusiasts’ technology, although, as will be discussed in the next section, continuous

technical advances make BitTorrent progressively more usable to an ever-greater segment of the population. Furthermore, the uncertain legal status of the hyperdistribution of broadcast television programs has convinced many that BitTorrent isn't worth the legal risk.[20]

However, because BitTorrent takes full advantage of the less-than-ideal broadband infrastructure in Australia, wringing maximum efficiencies from an under-resourced environment, it may represent the most cost-effective approach to IPTV deployment. Nothing need change, technically, for the chaotic model to become firmly entrenched. Such an outcome would be absolutely devastating to the incumbent broadcasters; only live programming – such as sport, news, and “event” programming – can be distributed more efficiently by broadcasting than via audience-driven distribution. Whatever the final IPTV system looks like in Australia, the incumbent broadcasters will need to adapt to a situation where distribution of pre-produced content will be handled more effectively by the audience than by themselves. The broadcasters are no longer competing with each other for the attention of the audience; they are competing with the audience itself.

The tools available to today's audiences to create and distribute IPTV reflect the chaos of this still-evolving environment. A change in distribution technologies, such as the transition from Napster to BitTorrent, can lead to a profound change in audience behavior and expectations. The development of tools for media distribution, undertaken both commercial organizations and loosely-affiliated networks of users, is arguably the most fertile field of development on the internet today. This is the wild card in IPTV, and the anarchic intent of these tools have already radically changed audience expectations.

IV. Anarchy I: The Centre of the World

In February 2005, Chad Hurley and Steve Chen launched an internet video publishing and delivery service which would, over the next eighteen months, completely redefine all audience expectations for IPTV. YouTube, now a division of Internet search colossus Google, is responsible for over half of all the video seen on the Internet [21],

and has become an indispensable resource for the Web's hundreds of millions of users. YouTube has fundamentally changed user behaviours on the Internet for two reasons: it presents an open publishing platform for any audiovisual content; and YouTube's design makes it very easy to share videos with tens or hundreds of people, who can then share the video with tens or hundreds of others, etc. This means that programming can reach a very large audience very quickly, irrespective of the rights of the content creators.

YouTube achieved its first mainstream success when a video clip from NBC's *Saturday Night Live* television programme, titled "Lazy Sunday", made its way onto YouTube [22]. Within a few days millions of people had watched "Lazy Sunday" – viewers who had not tuned into the NBC broadcast. NBC quickly threatened YouTube with legal action in defense of their copyright, and "Lazy Sunday" was removed. But the point had been made, and millions of users began to think of YouTube as a clearinghouse for the world's best audiovisual clips – television, film and other short form productions. YouTube's users began to upload their favorite video clips – from Comedy Central's *The Daily Show with Jon Stewart*, *South Park*, *Family Guy*, FOX's *The Simpsons*, and so forth. Although YouTube would remove clips that they knew violated the terms of use of their site (which prohibit pornographic materials and the posting of materials in violation of copyright) as the number of clips posted on a daily basis headed into the tens of thousands, it became impossible to supervise the audience in any meaningful way.

This functional anarchy defines the essential paradox of YouTube: although it is a centrally administered web site, it is completely driven by its million of users. The "owners" of YouTube are responsible for keeping the site up and running, but they are not responsible for keeping it stocked with fresh content. That responsibility lies with the audience, YouTube's users. That audience does not respect copyrights, or more precisely, does not understand why they should be prohibited from publishing content that they have recorded from a broadcast. The audience wants to publish content, and found the ideal publishing platform in YouTube. This places YouTube at legal loggerheads with the copyright owners; this wasn't an issue when YouTube was a startup, burning through cash to accommodate its outrageous bandwidth needs (with about a hundred million video downloads per day, this figure is estimated to be

terabytes per day). After the acquisition by deep-pocketed Google – which has a market value of almost two hundred billion US dollars – the copyright owners became more active, and more threatening. The purchase agreement with Google included payouts of USD \$50 million to several recording companies, in lieu of lawsuits.[23] Google, hoping to keep their audience free to hyperdistribute materials under copyright, has been negotiating agreements with copyright holders to share the revenues they are earning from YouTube’s users. As these deals cover an ever-larger percentage of the available material, YouTube becomes a legitimate alternative to broadcast television.

Thus, YouTube represents the first audience-driven attempt to create IPTV. While centrally maintained, it is not centrally controlled. YouTube’s users are only limited by the content available to them; there are no gatekeepers, no network programmers or studio executives who keep the channel narrow in order to build mass audiences for programming. YouTube is many-to-many audience-driven hyperdistribution, and because it can be all things to all people, it has engendered enormous user loyalty. Google, as it works to keep its audience loyal and growing, will learn to balance the legal rights of copyright holders against the authentic demands of the audience to have unlimited access to content. The result will be a grassroots IPTV system, which, although entirely centralized, perfectly reflects its audience.

Although much has been made about the use and misuse of content posted to YouTube in violation of copyright, a more fundamental change in user behaviour has also been engendered by YouTube: the rise of audience-created content. YouTube makes it easy to distribute *any* audiovisual material, whether professionally produced or crafted by an amateur. The vast majority of material published on YouTube are such “amateur” productions, and some of these productions – distributed according to a mathematical “power law” – achieve enormous popularity [24]. Australian band Sick Puppies self-published a music video on YouTube in late September 2006, and found themselves on *Oprah* a few weeks later, after their video had been viewed some six million times.[25]

Each user of YouTube has equal access to the entire YouTube audience; the professional quality of a production is not the sole or even strong determinant of

success. Hurley has stated, “YouTube has no gold standard,” [26] meaning that the professional standards of audiovisual production associated with broadcast television and mainstream cinema simply do not confer any inherent advantage on YouTube. YouTube is driven by salience; that is, audiences will view and share a video on YouTube *only if it interests them*. Salience is the anarchic threat to tightly controlled distribution, and it completely empowers the audience to view and share only that content deemed significant. [27]

Thus, although YouTube is becoming the de facto platform for the rebroadcast of television, this will not long remain its essential strength. As YouTube’s users interact with the system, learning how to customize their experience to their own interests, each user will develop a more refined set of tastes – tastes which will, on the whole, lie decidedly outside of the mainstream. There will always be items of immense and widespread popularity – the power law guarantees that – but there is a constantly growing “long tail” [28] of audiovisual content which may only be relevant to hundreds or thousands of users, yet will be so relevant to them that they’ll *always* prefer that content to anything else, however popular, and however well-produced. YouTube has become a meta-polity of micro-polities, each individual satisfying their own needs, each a member of countless communities, each driven entirely by salience. The anarchy is complete; YouTube’s users are wholly empowered, participating in a medium which lies mostly beyond the reach of professional media production.

V. Anarchy II: The Disruptors

Historically, revolutions run away from their vanguards. So much becomes malleable during a time of anarchy that subtle changes can produce grossly disproportionate outcomes, feeding forward into unexpected forms. This, the essential process of disruption, only started with YouTube. Disruptions rarely occur in isolation. One disruption initiates another, in a cascade that resembles a chain reaction.

The IPTV revolution, driven both by technological innovation and fundamental changes in audience behaviour, has created twice the opportunities for disruption. An

IPTV service which satisfies either criterion can potentially become a disruptive influence, extending the tide of anarchy. IPTV offerings which harness both technology *and* audience have an opportunity to establish a new paradigm. YouTube harnessed massively hyperdistributed web-based video with a viral, audience-driven distribution model, and permanently altered the landscape of IPTV. Three other projects, just on the cusp of widespread introduction, could also change the IPTV landscape fundamentally.

The most traditional of these projects is Microsoft's IPTV on Xbox 360. A software upgrade to Microsoft's best-selling current generation gaming console, the service will offer both live (streaming) broadcasts and the store-and-forward capabilities of a DVR.[29] While Microsoft has announced relationships with many mainstream content providers, the most significant feature of IPTV on Xbox 360 is that when it is released to the public in the middle of 2007 (that is, when the software update is automatically set out to Xbox 360 owners) Microsoft will have an IPTV audience of at least ten million viewers. Since most Xbox owners are based in the United States, that will make IPTV on Xbox 360 the largest IPTV deployment in the USA from the day of its introduction.

IPTV on Xbox 360 represents the "Trojan Horse" of IPTV; while sold into the household as a high-performance gaming system, Xbox 360 is actually a general purpose media machine, capable of downloading and displaying video programming, from low-resolution video, *a la* YouTube, all the way to HDTV. In this, Xbox 360 represents the television tuner of the IPTV era; it is not something built into a display, capable only of demodulating radio signals, but rather, an entirely digital device, network-connected and able gather programming from anywhere, delivering it to an array of devices throughout the household. At USD \$499, Xbox Live now becomes a very attractive proposition for IPTV, *because* it is a dual-use device. [30]

Conversely, Apple, Inc. capitalizing on the tremendous success of the iPod, recently announced Apple TV, a device which brings the video capabilities of the iPod to the television set.[31] While internet-connected, Apple TV can only engage in conversation with computers on a local/home network, and thus does not meet the criteria of an IPTV set-top box. Apple TV bridges the gap between the computer and

the television; as this is the last chasm between Internet and audience, Apple TV will extend Apple, Inc.'s, growing influence in IPTV.

For the last year Apple has been delivering full-length television programmes via its iTunes Music Store (iTMS) service. Although these files are large – an hour-long program can be some 200MB of download – Apple has been selling quite a few of them: fifty million so far. This is television broadcasting without radio waves, network distribution without hyperdistribution. The model is centrally authorized, and centrally controlled; this means that Apple acts as gatekeeper and toll-collector, ensuring that producers receive distribution royalties for all programs sold through iTMS. Additionally, the digital files are protected with Apple's FairPlay digital rights management (DRM) system, which prevents these digital copies from proliferating through hyperdistribution to unauthorized viewers.

Apple's iTMS offers producers and distributors just the model they're looking for: revenue production *and* piracy protection. Over the last year, many of the popular programs from the US broadcasters have become available for download through iTMS. But because of international distribution agreements, most of this programming is not available outside the United States. Thus, although iTMS provides a "home market" for IPTV, audience-driven hyperdistribution, through sites such as mininova and eztv, still greatly outweighs the number of legal sales made through iTMS, and will continue to do so until "day and date" international release of television programmes through iTMS becomes a reality. When those international agreements come into effect – which should happen within the next three years, as older distribution agreements expire – iTMS may become the recognized leader in legal IPTV distribution.

Just as Apple has become by far the largest distributor of digital music, it is conceivable that it will also become the largest distributor of IPTV programming. Such a change would be entirely disruptive, because Apple, like IPTV on Xbox Live 360, would rely on an extensive installed base of networks and computers. But Apple's installed base is at least an order of magnitude larger. About a hundred million computers have installed copies of Apple's iTunes application, the core software component for their IPTV distribution network, giving Apple a reach which

far exceeds any other existing IPTV platform. If the IPTV audience drifts in Apple's direction, they could become the global IPTV broadcaster. Already, tens of thousands of video creators use iTunes' "podcasting" features to hyperdistribute their own, "amateur" programming worldwide. iTunes and video podcasting have become linked in the eyes of the audience. As the audience grows, Apple could end up in an unassailably dominant position in IPTV.[32]

Finally, a tiny technology startup could have an enormous influence on the future of IPTV. Janus Friis and Niklas Zennström, creators of the music hyperdistribution software KaZaA, went on, after KaZaA had been sued out of existence by a disrupted recording industry, to disrupt the global voice telecommunications industry with Skype, the world's most popular VOIP software. Skype has been cited as a major factor in plummeting revenues in international voice telephony – it being at least an order of magnitude cheaper to use Skype to place an international phone call than a comparable incumbent carrier.[33] In 2005, at the peak of their success with Skype, Friis and Zennström sold the company to eBay for 2.6 billion US dollars, and retired from view for a year.

Late in 2006 their new venture surfaced, and began a limited beta distribution of a software package known as Joost. It aims to do for video distribution what KaZaA did for music distribution, and what Skype did for VOIP: Joost creates an integrated hyperdistribution platform for video content. Reflecting a new sensitivity to the copyright issues which led to the collapse of KaZaA, Joost has been designed from its outset to promote the hyperdistribution of legally-licensed content, like Apple's iTMS. [34] Unlike iTMS, Joost uses peer-to-peer hyperdistribution techniques to create a high-speed content distribution network on existing internet infrastructure, using existing computers. One only need install the software (which is already available for Microsoft Windows and Apple OSX, just like Skype) to become a peer node in a network which has the potential to encompass of hundreds of millions of computers.

Joost is not fundamentally different, technologically, from the various BitTorrent-based hyperdistribution techniques commonly in use. However, the whole system has a strong and evolving user-centered design sensibility.[35] This marks it as

substantially different from BitTorrent, which requires substantial technological agility from its users. The interface to Joost resembles the interface to a PVR system such as TiVo: programming selections are made from an on-screen display (OSD), and, only a few seconds after a programme selection is made, the video begins.

Although programme selection is extremely limited during Joost's private beta test, Friis and Zennström have announced they intend to close distribution deals with commercial television producers and distributors.[36] Programming distributed through Joost can have commercials embedded inside the programmes, and "header" commercials that can be customized to a particular demographic within a specific market. Joost knows where you are, and who you are, so targeting the appropriate advertisement becomes trivial. Furthermore, only authorized content can be hyperdistributed through Joost: programming is entirely controlled at the "head end," just as with Apple's iTMS, or a more conventional IPTV system. In this sense, it is "BitTorrent, tamed," and will naturally attract the interest of producers and distributors who want a global reach for their video productions, but without the attendant pitfalls of audience-driven hyperdistribution.

When released to the general public, toward the middle of 2007, Joost will succeed or fail on its content offerings; if Friis and Zennström have compelling content, Joost will be widely adopted. But without that content, there's no reason for anyone to use it. This chicken-and-egg scenario could be jump-started if Joost opened itself up to audience-created and audience-distributed content, but these are precisely the features it seeks to thwart. Thus, in an ironic inversion of KaZaA, Friis and Zennström are now wholly dependent on the good graces of a few tightly-controlled media distributors. If, as trends seem to indicate, the audience is inevitably drifting toward audience-creation and audience-distribution, this will have been a fatal mistake. But there still may be a role for mainstream productions in the media ecology of the 21st century. If so, Joost seems poised to disruptively seize the territory from all incumbents: Apple, Microsoft, the telcos and cable companies.

VI. Anarchy III: Free the Bits!

YouTube has created the definitive distribution platform for audience-created video programming. But software is a medium, too, and can be created by the audience, to compete for the attentions of that audience, against the offerings of professional producers. The open-source software movement has grown in lock-step with the development in audience-created media. In the earliest days of the World Wide Web, both open-source software projects and audience productions were modest, and, for the most part, hampered by an amateur's mistakes and production values. Yet both, under the natural selection pressures of the audience – which promotes the useful and interesting, consigning the rest to a swift extinction – have undergone a rapid evolution [37], so that now, fifteen years into the Web, audience-created software and video productions can stand alongside any professional offerings. This constant selection pressure has produced an operating system (Linux), a web browser (Firefox), and a plethora of other software applications (Apache web server, PHP programming language, MySQL relational database, etc.) of sufficiently high quality to be a serious threat to incumbent commercial providers.

In 2006, the Participatory Culture Foundation, established a year earlier in the USA to “enable and support independent, non-corporate creativity and political engagement,” issued a call for open-source programmers to contribute to a media hyperdistribution system known as Democracy. Democracy has two key components: the Democracy Player, a desktop application which allows users to quickly find and download video programming from a wide and growing selection of “feeds” (which are analogous to channels); and Broadcast Machine, which allows users with only modest technical skills to publish their own feeds into the Democracy system. Feeds, once published, are listed within the Democracy channel guide, a searchable index of all content available through Democracy.

The Participatory Culture Foundation explicitly works toward the goal of empowering individuals as broadcasters.[38] When fully realized (Democracy is still in beta testing), the system will allow any individual, anywhere in the world, reach a global audience. Given the increasing concentration of television broadcasting into fewer

and fewer hands, the Foundation seeks to create an alternative, Internet-based infrastructure for the distribution of media considered too controversial or too marginal for mainstream distribution. In a “powershift” [39] archetypical of hyperdistribution, Democracy places all creatives – amateur and professional – on equal footing, with equal access to the audience.

This purest form of anarchy represents the audience’s response to the corporate attempts to implement IPTV systems: incumbent telcos, cable providers, game, computer and software professionals each seek to dominate the market with their own specific solutions, and, in furtherance of their economic interests, each has produced a closed system. Democracy is the precise inversion of these models, their philosophical and technical counterpoint. Democracy encourages contribution and rewards contributors through a social scoring system which allows programmes to be rated and shared virally, much like YouTube. Unlike YouTube, Democracy is thoroughly decentralized; with the exception of the master index of available channels, no media resides on any Democracy server. The media is entirely distributed among Democracy’s users, who share it with one another. Built using BitTorrent, Democracy provides the ease-of-use that most BitTorrent applications lack, together with a search function that makes it easy to find salient programming.

At the present time, Democracy is still more of a geek’s toy than a radical alternative to conventional broadcasting and distribution networks. The software is in general release, but has only recently become stable enough for broad audience adoption.[40] Yet Democracy, like YouTube before it, needs a breakout hit – content available only through Democracy – before it can achieve any mainstream success. Joost seeks to bring professional productions into its system to drive user adoption. Democracy will need to look elsewhere, toward the growing base of audience creatives, for the programming which will make it a must-have desktop application.

If such an event occurs, and Democracy is installed on tens or hundreds of millions of desktops throughout the world, the global television audience will have in their own hands their own broadcasting tool. This would be a fundamentally disruptive event, on a scale far broader than YouTube, for Democracy – decentralised and entirely audience-driven – could not possibly control the content hyperdistributed through it.

In fact, Democracy is designed specifically to prevent that level of control. There is no centre, anywhere, with Democracy, only a global network of creator-contributors and viewers.

It seems reasonable, given the current trends in hyperdistribution, that some system to enable entirely audience-driven hyperdistribution will rise into prominence sometime in the next few years.[41] If not Democracy, something else; the open-source community is both famously creative and fractious. If someone doesn't like Democracy, they could "fork" the source code base (that is, take the existing code and build from it), and create something they do like. That, in turn, could become the wild success that Democracy might or might not achieve. In any case, a force of a pure, philosophical anarchy has entered the IPTV marketplace, and will, sooner or later, utterly redefine it, for one inexorable reason: an audience-driven hyperdistribution system meets the audience's growing demand for salience in an era of infinite choice. It does so in a way that no centrally-controlled system could ever, or would ever hope to.

VII. Conclusion: Government, Citizens, Consumers and Producers

IPTV has already arrived. It has not come in any of its carefully predicted and well-engineered forms. Instead, a melee of conflicting forces have delivered a patchwork of different methodologies. The IPTV audience, caring little for how programming comes to them, caring only for the programming itself, has adopted these methodologies in an ad-hoc manner, using them where useful, abandoning them where useless. Although the forces of order – the incumbent telecommunications and cable industries, together with commercial producers and distributors of television programming – might wish for a well-ordered future where IPTV simply means "more of the same," this is not the reality of the present, and there is little reason to believe it will ever become the reality of the future.

Audiences have embraced the idea and the technologies behind hyperdistribution. Over 50% of Australians have used some form of hyperdistribution (generally, BitTorrent) to evade established distribution channels in the pursuit of programming.

[42] This behavior can not simply be unlearned, nor, given the enormous allure and salience of a nearly-ininitely-large body of programming available through hyperdistribution, can we expect the audience to turn away from it on their own. Even the threat of draconian sanctions upon copyright violators has not slowed the hyperdistribution of recorded music, films and television programs. (As of this writing, no Australian has been successfully prosecuted for the individual act of file-sharing.) Hyperdistribution has become part of the media economy of the 21st century, occupying a mostly-invisible but wholly pervasive niche.

If IPTV in its ordered form is to have any success in Australia, one essential must be addressed: the lack of a broadband infrastructure capable of delivering IPTV content. As noted earlier in this report, modern HDTV IPTV systems require a continuous delivery capacity of roughly 20 megabits per second of broadband per household. Australia's installed broadband networks have approximately one-thousandth this capacity, as broadband has been oversold based on the estimated usage requirements of non-IPTV broadband applications. The infrastructure – wiring, switching, transmission and distribution – will all need to be upgraded, at a very substantial cost. As of this writing, the largest incumbent telecommunications provider in Australia, Telstra, is engaging in a strategic dance with Australia's regulators, promising to deliver an IPTV infrastructure only if they have monopoly control of that infrastructure. As Telstra is the only commercial organization in the nation which has the capital to pay for such an upgrade, and as Australian regulators are unlikely to bless a second Telstra monopoly, movement toward an ordered IPTV system is hopelessly deadlocked. It will take the intervention of outside forces to spur either party into a change of policy.

In the meantime, Australia as a whole falls further behind other OECD nations in the capabilities and services offered by its broadband infrastructure.[43] IPTV is being rolled out in the United States, the UK, and throughout Europe. Asia – in particular Hong Kong, Singapore and South Korea – have poured billions of dollars into broadband infrastructure, declaring it a national priority for competitiveness in the 21st century. Australians as a whole seem unconvinced by the benefits of a very high speed broadband infrastructure – even as they use the existing infrastructure to download more and more content. There is, as yet, little consumer demand for 20

Mbs broadband service, nor, were it available, are there any IPTV services that could leverage it fully. In the absence of this demand, the Telstra broadband stalemate could continue indefinitely. The forces of order have hamstrung themselves, leaving the market open to other influences.

Meanwhile, the Australian audience has embraced hyperdistribution in many forms: BitTorrent continues to increase in popularity, and Australians have embraced YouTube and other video hyperdistribution web sites. The younger generation doesn't see a clear differentiation between content delivered through the television set, via broadcasting, and content delivered to a computer screen via the Internet.[44] As IPTV set-top boxes such as IPTV on Xbox 360 and Apple TV are introduced into the Australian market, this distinction will continue to blur. All content may eventually come to the television set, bypassing the computer entirely, and at that time, most of the audience will forget that a distinction exists between broadcast and hyperdistributed content. The one thing that hyperdistribution can not handle well – live broadcasting – is provided by the incumbent television broadcasters, who will, under the pressure of hyperdistribution, shift more and more of their programming to live broadcasts.[45] If it's live, it will likely be received via broadcast. Anything else will probably arrive via some form of hyperdistribution.

As hyperdistribution-based IPTV grows in importance, the incumbent producers of programming will be faced with an evolutionary choice: adapt or fade into extinction. The existing models of distribution, which ensure that producers are paid for their work by the broadcaster, will need to be fundamentally revised in an age of hyperdistribution. The commercial IPTV hyperdistribution systems from Microsoft, Apple and Joost represent an opportunity for professional producers to leverage revenue from productions, but will require the development of new techniques, strategies and campaigns to maintain their viability in the long term.

Once hyperdistribution begins in earnest (arguably, this is already the case) incumbent media producers will be confronted with a vast and ever-growing library of audience-produced content, which is also demanding the attention of the audience. It is not clear that incumbent professional producers can compete in an entirely open marketplace, for production values do not necessarily (or perhaps, ever) trump

salience.[46] The mass audience in the era of hyperdistribution fractures into micro-audiences, where creative “amateurs” serve communities of tens to thousands of viewers. This can already be seen in YouTube, where the “power law” of statistical distribution applies: while a few YouTube productions have been seen by millions of viewers, many millions of other productions live in the “long tail” of content, having only been seen by, and shared with, small communities of interest. YouTube is the first version of a global hyperdistribution system for video content. As other systems, such as Democracy, rise to compete with it, both audience behaviour and audience tastes are evolving into forms which better fit the era of micro-audiences.

IPTV in 2007 has all the hallmarks of an archetypal “bottom-up” technological emergence, a quality it shares with the World Wide Web. In Australia it is not driven from a centre of control, but rather from the actions of millions of audience members. The audience has asserted control over both their programming choices, and over the creation of the content being distributed. None of this means that the commercial forces which look to order the chaotic and anarchic playground of IPTV today will necessarily fail. But it does mean that their strategies must reflect the ground truths of audience behaviour. To wage war against the audience is to court immediate, spectacular and expensive failure. The future belongs to the audience. Those who can meet the needs of the audience – and they will have needs, for broadband, for programming, for search engines that help them to identify and share salient programming, for tools that allow them to become creators and distributors of their own productions – will do well in the IPTV era. IPTV is a wide-open field, fraught with pitfalls yet laced with opportunity.[47] The most savvy will listen to the audience, align their strategies appropriately, and reap great rewards. The rest will be footnotes in the history of media – a lamentable fate, but an entirely avoidable one. Any strategy – as a nation, as an industry, and as creators – must be informed by what is already happening. The IPTV audience is already telling us what they want. It is up to us to deliver it.

Mark Pesce
November 2006 – February 2007
Sydney

Notes

- [1] http://www.ana.net/news/2006/03_22_06.cfm
- [2] http://www.att.com/Uverse/files/u-verse_FAQs.html
- [3] <http://www.mindjack.com/feature/piracy051305.html>
- [4] <http://torrentfreak.com/movie-piracy-cost-61-billion/>
- [5] http://www.youtube.com/press_room_entry?entry=iXG7e1g-BWI
- [6] W. Brian Arthur, *Increasing Returns and Path Dependence in the Economy*, p. 21
- [7] Conversation with Geof Heydon of Alcatel Australia, 15 November 2006
- [8] *ibid.*
- [9] *ibid.*
- [10] <http://www.theage.com.au/news/business/samuel-throws-broadband-challenge-to-telstra/2006/11/30/1164777700587.html>
- [11] *ibid.*
- [12] *op. cit.*, Geof Heydon.
- [13] <http://www.theage.com.au/news/business/samuel-throws-broadband-challenge-to-telstra/2006/11/30/1164777700587.html>
- [14] Mark Pesce, *Hyperpeople, Part One: The World is My Hard Drive*, p. 25
- [15] *ibid.*, p. 38
- [16] <http://www.pcmag.com/article2/0,1895,2092468,00.asp>
- [17] *op. cit.*, Pesce, *Hyperpeople*, p. 24
- [18] *ibid.*, p. 47
- [19] http://www.zdnet.com.au/news/communications/soa/Impatient_TV_viewers_turn_to_BitTorrent/0,130061791,139186748,00.htm
- [20] *ibid.*
- [21] <http://blog.compete.com/2007/02/02/google-video-youtube-top-video-sites/>
- [22] <http://www.calacanis.com/2006/02/20/youtube-is-not-a-real-business/>
- [23] <http://www.nytimes.com/2006/10/19/technology/19net.html>
- [24] Philip Ball, *Critical Mass: How One Thing Leads to Another*, p. 285
- [25] <http://blog.futurestreetconsulting.com/?p=20>
- [26] *ibid.*
- [27] *ibid.*
- [28] Chris Anderson, *The Long Tail: Why the Future of Business is Selling Less of More*, p. 10.
- [29] <http://www.engadget.com/2007/01/07/iptv-on-xbox-360-is-for-real/>
- [30] http://weblogs.jupiterresearch.com/analysts/gartenberg/archives/2007/01/xbox_gains_iptv.html
- [31] <http://www.apple.com/appletv/>
- [32] http://www.pbs.org/cringely/pulpit/2007/pulpit_20070216_001673.html
- [33] http://www.businessweek.com/technology/content/aug2004/tc20040811_4711_tc024.htm
- [34] http://www.businessweek.com/bwdaily/dnflash/content/jul2006/db20060724_713810.htm
- [35] http://www.appscout.com/2007/01/qa_with_joost_ceo_fredrick_de.php

- [36] http://www.businessweek.com/bwdaily/dnflash/content/jul2006/db20060724_713810.htm
- [37] Eric S. Raymond, *The Cathedral and the Bazaar*, p. 90
- [38] <http://www.getdemocracy.com/about/>
- [39] Alvin Toffler, *Powershift: Knowledge, Wealth and Power at the Edge of the 21st Century*, p. 35
- [40] http://www.boingboing.net/2007/02/13/democracy_player_get.html
- [41] <http://www.disinfo.com/site/displayarticle4565.html>
- [42] <http://australianit.news.com.au/articles/0,7204,20922899%5e16123%5e%5enbv%5e,00.html>
- [43] <http://www.smh.com.au/news/technology/broadband-australia-runs-faster-just-to-stand-still/2006/10/16/1160850869175.html>
- [44] <http://www.technewsworld.com/rsstory/54425.html>
- [45] <http://www.mindjack.com/feature/newlaws052105.html>
- [46] <http://blog.futurestreetconsulting.com/?p=20>
- [47] op. cit., Geof Heydon



Smart Internet Technology CRC | Australian Technology Park Eveleigh NSW 1430 Australia
T: 61 2 8374 5080 | F: 61 2 8374 5090 | E: innovation@smartinternet.com.au | www.smartinternet.com.au
© 2005 Smart Internet Technology CRC Pty Ltd. All rights reserved.

All trademarks mentioned in this document are the property of their respective owners.