Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development

18-Dec-2012

English - Or. English

DIRECTORATE FOR SCIENCE, TECHNOLOGY AND INDUSTRY
COMMITTEE FOR INFORMATION, COMPUTER AND COMMUNICATIONS POLICY

DSTI/ICCP/CISP(2011)9/FINAL
Unclassified

Working Party on Communication Infrastructures and Services Policy

THE DEVELOPMENT AND DIFFUSION OF DIGITAL CONTENT

JT03332791

English - Or. English

FOREWORD

The Working Party on Communication Infrastructures and Services Policy (CISP) discussed this paper in December 2011. It agreed to recommend the paper for declassification to the Committee for Information, Computer and Communications Policy (ICCP). The ICCP Committee agreed to its declassification in March 2012.

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It is published under the responsibility of the Secretary-General of the OECD.

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MAIN POINTS

Digital content distribution has reached an inflection point. Streaming video now represents the largest component of Internet traffic.[1] Viewers are watching a growing share of video via Internet-based distribution systems to both television sets and new endpoints such as computers and mobile devices. A substantial share of that video content is user-generated, user-selected, or otherwise outside the traditional model of professionally-produced linear programming.

A prior OECD report highlighted the convergence of telecommunications and broadcasting into a multiplatform audiovisual environment.[2] Recent developments have deepened that convergence. New digital content distribution services are having appreciable impacts on established media industries and network service providers in many OECD countries. An analysis of recent developments and trends is therefore timely.

New entrants and services are competing with the linear broadcast paradigm and the bundling arrangements driving revenues in many content industries. Some substitution is occurring, but the main trend is toward diversification, especially as new digital media devices proliferate. The competitive landscape in media, already complex, will become even more multifaceted. Public policy frameworks in the media and telecommunications sector must be reviewed in light of these developments.

Growth in digital content distribution, especially video, will be a major consideration for both wired and wireless communications networks in the coming years. The impacts on network performance and investment in each market will depend on specific usage patterns, technical choices, and business decisions. The robustness of the Internet and associated digital networks will become an increasingly significant consideration as greater percentages of content and user activity flow over them.

Policy-makers must be careful not to impose unnecessary obligations on innovative new services, but they also must remove competitive obstacles and the friction of outmoded regulatory distinctions. Convergence should be taken as the rule, rather than the exception. Careful application of best practices can address most policy concerns, especially with the recognition that technology offers new solutions even as it poses new challenges.

POLICY IMPLICATIONS

The transformation of digital content creation and distribution has already begun, and cannot be halted. However, the speed and shape of this revolution in different parts of the world remains to be determined. Regulation and business strategies will shape the new market equilibria. This section provides general guidelines for thinking about future policies. Timing will be important as well: even the proper approach can be implemented too early or too late in fast-changing markets.

Internet as the primary distribution channel

The most salient aspect of the growth in digital content markets in recent years is the increasing centrality of the Internet to digital media. Everything is becoming connected. Online platforms will not be just a new way to deliver programming, but the primary means of doing so. Service providers may make this choice to achieve technical efficiencies or business synergies, even when delivering a product that strongly resembles traditional offerings. Thus, for example, IPTV services may not appear that different from existing pay television offerings, but behind the scenes they represent a significant technological shift. Other offerings such as OTT video, on the other hand, use the Internet to change not only the distribution platform, but the service offering as well.

Just as the Internet is becoming the common platform for the world's data and telecommunication traffic, so too will it become the common platform for video and other digital content forms. At the same time, traditional content distribution platforms will continue to exist and will remain important for a long time. However, from a public policy perspective, Internet protocol platforms should be acknowledged as evolving into primary forms of digital content distribution, not just peripheral new entrants.

The Internet is a global network that fosters localised communities. Because the Internet does not orient itself around national boundaries, regulations designed on that basis become more difficult to maintain. As discussed above, existing rules for media and content encourage localism. As with other Internet policy debates, regulators will need to consider how to promote legitimate national values while respecting the global nature of the Internet environment. At the same time, the Internet allows communities to find shared interests even when separated by distance or other factors. New digital content distribution services can benefit these virtual communities, such as expatriates and distributed ethnic, religious, or linguistic groups. Usage patterns for new video models such as OTT distribution may differ from conventional broadcasting, which may remain popular even as the underlying technology infrastructure evolves.

Elimination of legacy distinctions

In a similar vein, many traditional distinctions between networks and services may no longer be meaningful in a world of digital convergence. Some "level playing field" obligations on new entrants may in fact operate to protect legacy industries against competition, even when it would be beneficial for users and overall market performance. Others may hold back incumbents from themselves entering into new digital markets.

As a general matter, the scope of media regulation will expand to cover new digital distribution providers, but at the same time, some industry-specific regulatory obligations may no longer be necessary. Media policy and other legal requirements protect important civic values that do not disappear as technology evolves. If Internet-based content distribution services reach a similar spot to traditional platforms, they should not be exempt from reasonable, limited and proportionate public policy obligations purely because they use different technologies. For example, the European Audiovisual Media Services

Directive attempts to achieve this goal through its technology-neutral categories of line and non-linear video. On the other hand, technology may mitigate constraints, such as the scarcity of distribution channels, underlying certain traditional requirements. Policy-makers should actively seek to revise rules that are based on historical conditions that no longer hold in order to adapt them and apply them to the whole media ecosystem. In most cases, industry specific regulation will fall into this category.

Infrastructure as a content issue

Media and telecommunications policy have traditionally been separate. Even when regulatory agencies combine authority over both industries, legal requirements have traditionally reflected a sharp division between infrastructure and content regulation. Telecommunications focused more on competition and universal access, while media policy emphasized promotion of societal values around content. Convergence and the global shift toward market-based regulatory regimes have already broken down this divide to some extent. Digital content markets will further bridge the gap. Even five years ago it was clear that "the two policy domains of telecommunication and broadcast need to converge"[3]. The details of that convergence now need to be considered.

Topics such as network management and broadband capacity are increasingly central to digital content distribution markets. Video is the single greatest demand driver for network infrastructure investment, and the quality of broadband connectivity is a critical foundation for new online video services. Different applications such as streaming movies and real-time video calling place different demands on networks. The rise of cloud computing will also have major impacts as well. Choices at the network layer may influence not only the shape of application and content markets, but the dynamics of policy debates around privacy, security, intellectual property, and more. This is especially true for wireless systems. Network infrastructure considerations therefore must be viewed as important considerations in discussions about digital content policies.

Careful application of proven policy tools

Digital content markets are not the first example of the Internet's intrusion into established industries. While some issues are new, policy-makers have been confronting similar challenges for a number of years. Approaches that have been successful in other areas include:

- Competition policy techniques such as the Significant Market Power regime for telecommunications regulation in Europe and the United States antitrust jurisprudence are sophisticated, well-developed tools for reviewing business conduct in an era of convergence. The downside is that such mechanisms are backward-looking and relatively slow.

- Balancing rights and responsibilities has proven successful in areas such as online intellectual property protection, where intermediaries have defined obligations to avail themselves of legal protection. Nonetheless the implementation of these obligations and IP protection still remain an issue of concern.

- Targeted interventions can be used when market failures exist. For example, to ensure availability of certain forms of content, the best approach may be localised subsidies, educational efforts, or infrastructure policies.

- Co-regulation is widely used in Europe to foster collaborative industry responses by Internet service providers. Similar techniques may prove effective with online video providers.

Technology as both the problem and the solution

When policy and infrastructure challenges are well-defined, technology can sometimes offer novel solutions. YouTube's work with content creators to develop digital watermarking techniques to identify and remove infringing content automatically is a good example. YouTube provides marketing and other benefits to its content providers and users. Digital watermarking on YouTube is by no means a complete solution to online copyright infringement, which is still a matter for discussion and some litigation procedures, but it shows the potential for collaborative technology responses alongside legal enforcement. Google is now engaging in a similar discussion with network operators, especially in Europe, about mechanisms to reduce traffic load from YouTube videos. Google's knowledge about content and users, combined with operators' information about the infrastructure, can be combined to build efficient caching and traffic shaping mechanisms that benefit both parties.

Policy-makers need to build the technical expertise to assess such options. In addition, they should examine opportunities to separate technical considerations from regulation. In some cases, industry collaborative bodies could be established to address technical disputes and develop new solutions. Existing technical standards bodies may also play a role. It bears emphasising that digital content distribution markets are new and are still evolving quickly. The scope of technical possibility may be broader than it appears.

THE DIGITAL MEDIA LANDSCAPE

Digital content distribution is developing against the backdrop of complex, well-developed global markets for video and other content. Even in analogue form, content assets pass through sophisticated distribution chains designed to maximise revenues across multiple audience windows. Against this backdrop, digital media adds new players and changes the environment for the existing ones. This section identifies the main roles in distribution of content, the economic relationships among them, and the regulatory environment in which they operate.

Brief tour of the industry ecosystem

Broadly speaking, there are five basic roles in the digital content distribution process:

- **Content producers** develop original material for distribution across digital, analogue, or physical media channels.

- **Distributors** license content and store, aggregate, package, or manipulate it for availability to end-users.[4]

- **Networks** provide the communications links to carry content between producers, distributors, and end-users. A producer or a distributor may also own a network, but the functions of moving bits and selling content are conceptually distinct.

- **Hardware vendors** manufacture end-user devices to display, store, and manage content. The hardware involved may be a general-purpose platform such as a personal computer or smartphone, or it may be a specialised device such as a television, digital video recorder, or mobile phone with media capabilities.

- **Supporting services** such as advertising, programme guides, search, analytics, and tools facilitate revenue-generating business opportunities around digital content. Because so much digital content is monetised through advertising and subscription, these ancillary functions are often central for revenue flows.

Companies engage in both competition and co-operation inside and across these categories. Technical standards and industry co-ordination around matters such as intellectual property or protection of children may require a concerted effort of major players. And some companies such as Sony or Comcast occupy more than one role.

The distribution chain from producers to consumers can be juxtaposed against the picture of layers that engineers use to describe data networks. Layered models such as the widely-referenced OSI stack place physical network infrastructure on the bottom and content on the top, with various intermediary software layers that encapsulate lower strata. Policy-makers can use layers to escape from the network-based silos of traditional regulatory regimes.[5] A layered approach, however, cannot address all the policy considerations around digital content distribution. Services and business arrangements can cross layers, and significant regulatory concerns may emerge within layers.

Media economics

The business and legal environment for digital content reflects the relationships among the five provider categories. Even before the Internet, these relationships could be complex and multi-faceted. For example, major commercial content creators employ "release windows" to license the same content to a variety of distributors. In the late 1980s, for example, a Hollywood movie might have six sequential distribution windows for nine different distribution environments.[6]

For all the complexity, there are only two significant sources of revenue for digital content: users and advertisers. Users may pay *à la carte* for programmes, they may pay a recurring fee to access a bundle of content, or they may pay a license fee for their hardware. In some cases, such as commercial broadcast television, they may pay nothing, because advertisers provide the revenue. Advertisers pay the other providers for the privilege of reaching users. Every provider tries to maximise its financial position by capturing the biggest possible share of these revenue flows, net of what they in turn must pay to others.

Commercial media industries can be thought of as two-sided markets with distributors in the middle, flanked by content producers and end-users. Revenues can flow in both directions through any links in the chain. A few examples are illustrative. Television broadcast networks pay studios and other content creators to produce programming, which they monetise by selling advertisements. Public broadcasters receive additional funds from taxation, donations, and government subsidies. Newspapers similarly sell papers to customers and those customers to advertisers. In a pay-TV system, distributors also receive subscription revenues directly from viewers, but they must pay monthly carriage fees to popular channels. Google applied a two-sided approach to search engines, realising that advertisers would pay "per click" fees for ads alongside search results, if Google could aggregate a large enough audience of searchers and match their queries with those ads.

The complexity of licensing arrangements reflects the underlying nature of the products as information goods. Information is infinitely and very cheaply replicable, especially in the current converged digital environment. Versioning and bundling are well-known economic strategies for such an environment.[7] Moreover, intellectual property rights (IPR) and legal responsibility reflect the flows of money and information. The discussion in this paper focuses primarily on video, but the same basic concepts apply to all content forms. As one example, ebooks through devices such as Amazon.com's Kindle and Apple's iPad require negotiations between content creators, distributors, and other services providers to create a seamless distribution chain.

Certain content forms such as movies and professionally-produced television series involve large up-front costs for the talent and production. These economics have traditionally rewarded scale and consolidation, as well as complicated arrangements among those financing production. Online distribution channels and the dramatic reduction in the cost of professional production equipment open up opportunities for lower cost (if somewhat lower quality) content offerings. YouTube grew rapidly despite originally limiting videos to standard-definition resolution and ten minutes in length and limited investment in original production. If online platforms are to attract movies and high-quality television series as their primary distribution vehicles, they will need either substantial up-front acquisition budgets or the prospect of large back-end revenue sharing from advertising or subscriptions.

Many of the leaders in the nascent digital content distribution market are established players in the traditional media industry. For example, the BBC operates the iPlayer site for online video in the United Kingdom. The YouView initiative in the United Kingdom is a partnership of the major broadcasters and broadband providers BT and TalkTalk. The Hulu online distribution site for United States television programming is a joint venture among Comcast, News Corp., Disney, and a private equity firm. Existing players control content for which the Internet is a new distribution channel. Online offerings may provide them with new revenue streams and place them in a better competitive position. At the same time, the

Internet helps new entrants such as Netflix and YouTube to gain significant footholds, where in the past they would have had to negotiate access to incumbents' distribution channels. These providers are free from legacy business obligations and often from legacy regulation, allowing them to develop new business opportunities the incumbents cannot easily initiate or replicate. At some point, though, regulatory distinctions between traditional and new players must be evaluated to eliminate artificial distortions.

The ultimate balance of power among traditional and new media is impossible to predict, and will vary from country to country. Independent producers of the most popular content could dramatically tilt the balance if they shifted away from incumbents. Whether regulation hampers new entrants or is used to open existing markets to greater competition will be an important variable. The speed at which advertising, the core business driver of many media markets, flows to new services will also be quite significant. Online services outside of transactional e-commerce did not reach their business potential until search engines perfected direct-response advertising and other companies did the same for display ads.

Regulatory context

Media industries are subject to several forms of special regulation. Some of these regulatory regimes are based on economic rationales, while others seek to advance societal values. Some operate through administrative regulation, others through judicial action. Every network (broadcast, telephone, cable TV, satellite) traditionally had its own industry structure, history, and regulatory environment. The major concerns these rules are designed to address include:

- *Competition.* Media industries are subject to sectoral rules such as cross-ownership limits and general competition policy regimes to prevent excessive consolidation or exercise of market power. Economies of scale and the scarcity of distribution channels historically prompted these concerns.

- *Democratic discourse and cultural diversity*. Content that informs the citizenry promotes democratic values, and some countries see viable local content industries as important elements of their cultural identity. This aim may be advanced through public funding, minimum local content requirements, and taxation policies, among other means.

- *Consumer protection.* Content distribution creates many potential dangers, including misleading business practices, lack of disclosure, and improper marketing to children, which governments seek to address through regulation.

- *Privacy*. The online environment raises a host of challenging privacy considerations, few of which were significant for traditional one-to-many broadcast media.

- *Media-specific obligations.* Certain media forms have obligations tied to their physical properties. Broadcasting, for example, uses wireless spectrum that is widely considered a public asset subject to channel scarcity that necessitated special government involvement.

- *Intellectual property.* Intellectual property (IP) regimes reflect a government-defined balance between incentives for creators and access to content by users. In the digital environment, concerns about both unauthorized use of content and chilling effects of excessive restraints are magnified. IP frameworks need flexibility to adapt to new technologies and to maintain incentives for innovation.

As digital content and digital distribution systems converge, overlapping regulatory regimes are coming into conflict. Moreover, although there has been significant regional and international harmonization of media regulation, the ease with which information can flow across boundaries online creates difficulties where national regimes differ. Traditional mechanisms that were effective when

regulating a limited number of regulated broadcasters may no longer be so across a diverse universe of digital content players.

MAJOR TRENDS

This section identifies the main ways that digital content is evolving away from traditional programming models and formats. It focuses on changes in user behaviour and experience; the following section delves into the economic impacts on distribution markets.

Digital content distribution has grown rapidly in recent years. Most viewers throughout the OECD still spend most of their time watching traditional television programming delivered to a television set. Viewership rates for traditional television services are even up in some countries.[8] At the same time, new services such as streaming distribution of movies over the Internet have gained substantial subscriber bases in some countries. The proliferation of new digital devices and the evolution of wired and wireless broadband connectivity are laying the groundwork for future expansion of digital content distribution. Adoption patterns will, of course, vary by demographics and geography. While it is important not to overstate the current situation, it is equally important to identify the major trends that are likely to come to fruition in the coming years.

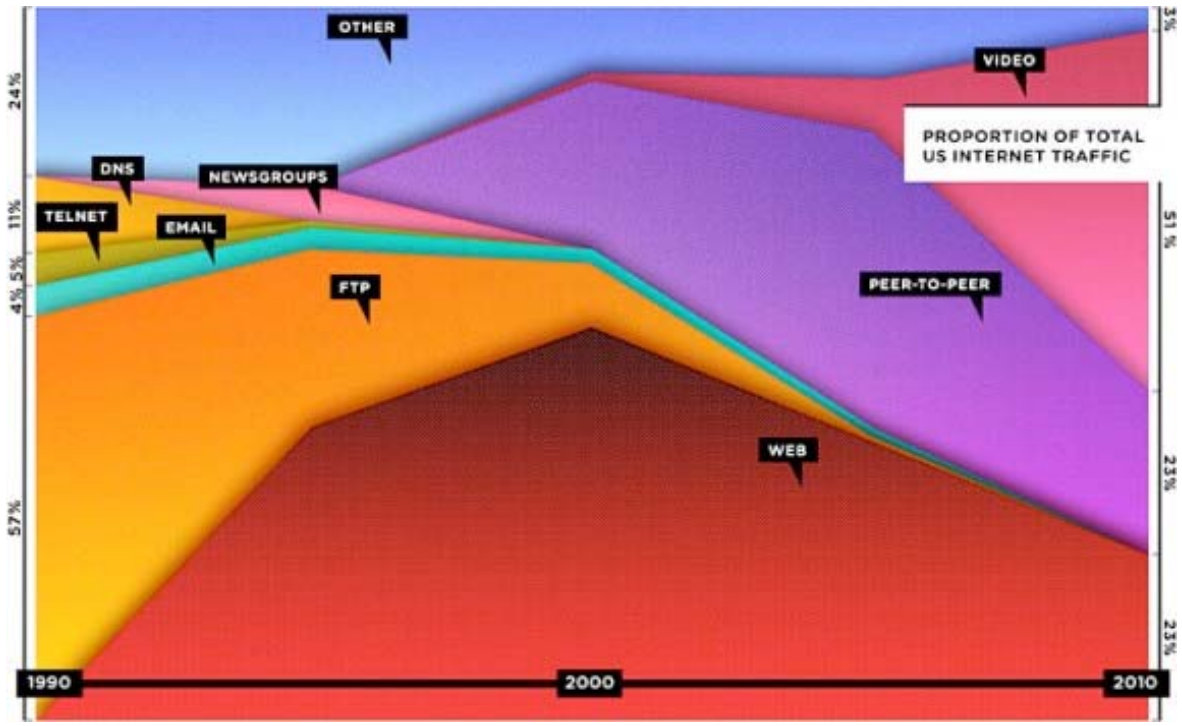
Growth of online video

The biggest digital content distribution shift for network infrastructure is the massive growth of video traffic over the Internet.[9] Internet video is not new. Dial-up modems were too slow for a high-quality video experience, but even so, a number of online video start-ups were launched during the dotcom boom of the late 1990s. At that stage, however, the online video experience was far inferior to traditional media, and revenues were very limited.

With the rise of broadband throughout the world, online video usage steadily grew. First, the BitTorrent file-sharing protocol and similar peer-to-peer (P2P) services became widely used for distribution of movies and television programmes.[10] Much of the P2P video activity involves unauthorised copying of commercial programming. However, there are counter-examples such as the original implementation of the iPlayer for distribution of BBC content in the United Kingdom and services such as PPLive for authorised redistribution of local television stations in China. The volume of P2P video traffic remains substantial, but it has been widely reported to have been surpassed by video streaming services in recent years.

Prior to approximately 2005, commercial online video distribution was relatively insignificant because of limited broadband adoption, major content owners were reluctant to license their content, and non-commercial content was difficult to upload and scattered across many sites. As one example, Netflix always intended to be an online video distribution company, but chose to focus on physical distribution of DVDs for several years from its launch in 1999 until conditions enabled it to switch to streaming. The emergence in 2005 of user-generated video hosting sites, most notably YouTube, and Apple's addition of licensed video content to its iPod devices and iTunes online store represented a turning point.[11] Since then, video volumes have scaled rapidly as costs have fallen.[12]

Figure 1: Distribution of US Internet traffic by year



Source: Wired

A chart that appeared in a provocative August 2010 *Wired* magazine cover article, "The Web is Dead. Long Live the Internet," illustrates the dramatic rise of online video (Figure 1).[13] According to comScore, the average United States online video viewer watched 908 minutes per month (30 mins/day) at the end of the 2010.[14] Each video file uses far more bandwidth than text, images, or audio, so video usage has a disproportionate impact on data traffic flows.

Online video growth is a global phenomenon. The data in the *Wired* chart are from the United States, but while adoption patterns differ, the broad pattern is consistent throughout the OECD. Moreover, a great deal of online video activity involves cross-border viewership. A study of YouTube viewership across the European Union found that in 17 of 22 countries analysed, a majority of views were from outside the country of origin. The highest percentage of domestic viewership was in Poland, but even there, cross-border viewership amount to 36% of the total. Cross-border viewership represented 55% in France, 71% in Spain, 80% in Sweden and 93% in Ireland. This represents a significant shift. A few countries such as the United States and United Kingdom have substantial media export businesses, but the bulk of non-Internet video and other content production is targeted at national or local audiences. Some of the cross-border activity on YouTube may be attributed to expatriate or linguistic communities. Much of it, however, reflects the ecumenical appeal of short-form video content.

Until recently, virtually all Internet video traffic was distributed over wired networks or through WiFi hotspots serving personal computers. Now mobile devices are viable video clients as well. Mobile television services were the first to gain traction, primarily in Asia, and the growth of smartphones in 2007 has produced rapid growth in mobile video elsewhere. Tablets, such as the iPad, offer an ideal viewing environment for high-quality video, and are therefore likely to push mobile Internet video adoption still further.

There are three major forms of online video: commercial, user-generated, and two-way. Each involves different policy, infrastructure, and business issues. Other distinctions could be made, such as

between short-form and long-form content. Focusing on the economic arrangements among content creators and distributors highlights the considerations likely to drive the evolution of industry structures. Content forms will certainly evolve, once freed from the rigid format requirements of linear television. Dividing lines between categories will blur, something already occurring with episodic web shows and television series that are downloadable in entire season packages.

Commercial video

Commercial video services deliver the same class of professionally-created programming as traditional over-the-air and pay television services, only they do so using the Internet as a distribution mechanism. The first successful commercial video offering, Apple's iTunes store, downloads entire files onto the user's device. Most other services, however, employ streaming technology to make programming viewable almost immediately.[15] Over the top (OTT) services such as Netflix, LoveFilm, Hulu, Voddler, and PPLive use the Internet to deliver individual programmes directly to users. Set-top boxes such as Slingbox, Roku, and Boxee can be used to move the OTT experience closer to that of television. Internet protocol television (IPTV) services use managed IP networks to deliver television channels to televisions in the home or mobile devices outside it. They are often sold in bundles with broadband access and other services.[16] Leading IPTV services include Orange TV, Free, and SFR Neufbox (France); Bouygues BBox; Deutsche Telekom Entertain (Germany); AT&T UVerse (United States); and PCCW (Hong Kong). IPTV systems use private IP networks and multicasting to provide high-quality video, in contrast to OTT services which generally utilise the "best effort" Internet.

Both categories of commercial online video have seen substantial growth in recent years. A 2011 Yahoo! survey of web video viewers found a trend away from short clips toward full-length programmes and viewing during traditional television prime-time hours.[17] A quarter of American consumers reported that they subscribed to an OTT service, in a September 2011 survey by Credit Suisse.[18] The most dramatic example may be the Netflix OTT offering for movies and selected television shows, which rapidly increased in popularity when the company offered streaming delivery at a fixed monthly fee. As of 2011, over twenty million customers subscribe to the Netflix service in Canada and the United States.[19] Netflix is reportedly in negotiations to launch its service in Europe in 2012, beginning with Spain and the United Kingdom, and Australia shortly thereafter.[20] And standalone video sites are not the only competitors in the market. Amazon.com offers streaming access to approximately 8 000 videos for subscribers to its USD 79 annual Prime service, which provides free shipping on purchases through the site.

The success of European streaming music services such as Spotify and Deezer, and the substantial adoption levels of broadband in Europe today, suggest that Netflix and similar services will take root outside North America once licensing arrangements can be struck. Several OTT services are operating in Europe including LoveFilm (a subsidiary of Amazon.com), Headweb, and Voddler. Voddler, for example, offers movies and TV shows to customers in Sweden, Norway, Finland and Denmark, and launched in Spain in March 2012. Voddler employs a hybrid P2P architecture and offers a combination of free advertising-supported content and paid rentals through its proprietary client software. Spain may be a particularly appealing market for streaming services, as content owners have been hesitant to license downloads there due to concerns about intellectual property protection.

IPTV services are often part of "triple play" offerings incorporating broadband Internet access and telephony. Globally, there were approximately 46 million IPTV subscribers in 2010, expected to grow to 131 million by the end of 2015.[21] Overall, Diffusion Group estimates that over-the-top digital video available to 488 million households worldwide by 2016, and roughly 250 million will subscribe to those services.[22]

Mobile television is an additional new form of linear video distribution to mobile devices. It uses separate terrestrial or satellite spectrum, and is therefore distinguished from mobile video delivered over data networks along with other forms of traffic. Mobile television has seen substantial uptake in some countries, notably Japan and South Korea. In Korea, where Digital Multimedia Broadcasting (DMB) service launched in 2005, there are now six terrestrial operators in Seoul and 13 elsewhere, along with a satellite-based provider. The terrestrial systems use the television model of free advertising-supported service, while the satellite system has a monthly subscription fee. Cumulative sales of DMB devices in Korea exceeded 40 million as of 2010, with approximately 70% to mobile phones and 20% to in-car navigation systems.[23]

The business prospects for mobile television are uncertain. There are several trials and a few commercial services in Europe and elsewhere using the Digital Video Broadcasting – Handheld (DVB-H) standard, but adoption has been relatively limited. In the United States, Qualcomm invested hundreds of millions of dollars to deploy its MediaFlo platform on dedicated spectrum, but shut it down in 2010 amid weak sales.[24] Even where there is significant usage, mobile television has yet to demonstrate a sustainable business model. The DMB competitors in Korea, for example, are generally unprofitable and are seeing declining advertising revenues.[25] Competition from mobile video services delivered over data networks is rising, as 4G cellular and WiFi systems provide greater capacity for video.

An alternate means of delivering mobile television is to stream content over the Internet from a user's home connection. The German company Elgato, for example, markets a device called Tivizen that enables users to watch live television on their smartphones or tablets, free of subscription, from over-the-air digital television.[26] Slingbox offers a similar product in the United States that does the same for pay television content delivered over cable and satellite. In this model, the mobile service is ancillary to the home connection. The user generally pays a one-time fee for the device, avoiding the complexities of subscription or advertising models.

User-generated content

As significant as the rise of commercial video distribution through the Internet has been, the growth of user-generated content (UGC) has been even more transformative in many ways. A distinctive feature of the Internet compared to other mass media is that it is a two-way network. UGC online video is an extension of the many millions of websites, blogs, reviews, discussions, and other user-created content online. However, because of the storage requirements for video and the difficulty of effectively searching video distributed across the Internet, aggregation and hosting sites play a more important role for UGC video than other content forms.

The largest UGC player is YouTube. As of May 2011, YouTube users were uploading 48 hours of video every minute.[27] On the downstream side, YouTube played over 700 billion videos in 2010. Although based in the United States, 70% of YouTube traffic comes from users in other countries, and as noted earlier, a substantial portion of YouTube viewership is cross-border. Beyond YouTube, there are many other large aggregators hosting online video, including Blip.tv and Vimeo in the United States, DailyMotion in France, and Tudou in China. Social networking services such as Facebook also host massive quantities of video. Facebook has recently experimented with streaming of Hollywood movies and live baseball games, and will surely expand these efforts. And it is increasingly possible to enjoy online video without any of these intermediaries. The rise of "cloud computing" data centres makes it easy and affordable for individuals to distribute private video content such as home movies, and the plummeting price of storage for home servers makes it possible to store substantial quantities of video in the home.

The lines between user-generated and commercial content are not always sharp. The costs of creating high-quality video content have plummeted as fast as the costs of distributing it, leading to the

emergence of "prosumers" – halfway between professionals and consumers. There are also many small-scale commercial video writers, actors, and producers able to reach audiences online even though they could never have imagined gaining carriage on the limited channels of broadcast and pay television platforms. As a result, some entirely web-based shows involve commercial production values and attract substantial audiences and advertising revenues. Going the other direction, YouTube now offers large amounts of licensed commercial content, with over 7 000 hours of full-length movies and television shows as of mid-2011, live streaming of some sporting events (*e.g.* Indian cricket matches) and a vast number of music videos and trailers. It is reportedly planning substantial expansion in original programming.[28]

Two-way video

The nascent online video environment is not limited to one-way distribution. Interactive video services over the Internet such as video calling and videoconferencing are also growing rapidly. Two-way communication is not "content distribution" or media in the conventional sense, but it uses many of the same technologies and distribution channels. As University of Minnesota scholar Andrew Odlyzko has documented, users have historically been willing to pay more interactive person-to-person communication than for packaged broadcast offerings, contrary to the mantra that "content is king"[29]. Even with a focus on digital content assets, therefore, the development of two-way video communication bears watching.

Video communication is appearing in many contexts. Most of the leading instant messaging clients such as Tencent's QQ, Microsoft's Windows Live Messenger, and Yahoo! Mesenger now include either video chat or recorded video messages. Skype, best known for its VOIP service, has reported that video calls now represent half of its traffic, with Skype users averaging 300 million minutes of video calling per month as of mid-2011.[30] Internet-based video communication is now being integrated with other services. For example, in July 2011, Skype announced integration with Facebook to offer video chat to Facebook's 750 million users. Similarly, Apple integrates its Facetime video calling technology with the iPhone and iPad. At the high end of the market, companies such as Cisco sell telepresence services to enterprises for high-fidelity videoconferencing over managed IP links, potentially reducing the need for travel to meetings.

Two-way video creates fundamentally different challenges for network infrastructure than commercial or user-generated content. A video call is symmetric, requiring as much upstream capacity as downstream. As a real-time service, it also requires low latency and cannot be cached. Thus, even though users may spend more time watching high definition movies over their Internet connections, widespread adoption of video calling may add more traffic to networks. For consumer services, however, there is some room to trade off quality and reliability for functionality and price, as was the case with mobile phone services. Skype in particular has demonstrated that users will adopt "good enough" video calling. If video becomes more of a core component of person-to-person communication, though, a series of questions around reliability, interoperability, and regulatory obligations will quickly come to the forefront. New entrants in OTT and two-way video are often not subject to obligations such as lawful intercept, data retention, and privacy rules that apply to incumbent operators.

Microsoft's May 2011 acquisition of Skype could lead to significant new developments around two-way video. Skype has 170 million active monthly users and well over half a billion user accounts, with approximately 30 million concurrent users online at peak times. With Skype, the TellMe enterprise voice technology platform, the Xbox, the Kinect motion sensing controller, Xbox Live and Windows Live Messenger, Microsoft owns a number of significant components for real-time audio and video communication. Exactly how it bundles these offerings remains to be seen, and Microsoft has had limited success in the past in its media endeavours. Nonetheless, the combination is bound to produce new experimentation at the intersection of content and two-way video.

Changing user experiences

The move from traditional media and content markets to digital distribution could result in significant changes in the nature of service offerings. Some Internet-based services such as IPTV closely track analogue equivalents. Others, however, resemble their predecessors only vaguely. It would be premature to claim that established business models and interfaces are no longer viable. However, it would be equally short-sighted to ignore the likelihood that new distribution models will change not only what users experience, but how they experience it.

Before the Internet, content discovery was largely controlled by distributors, because of the inherent scarcity of distribution. There were only a limited number of television channels, bookstore shelf spaces, and movie theatre screens. Those who owned or subsidised them had a disproportionate impact on what users knew about, could access, and experienced. Today, by contrast, there are billions of conversations going on constantly on Facebook, Twitter, blogs, microblogs, apps, and other social media environments. And those conversations can hyperlink directly into YouTube, Amazon.com, iTunes, or other media sources.

Compared to traditional technologies that supply pre-defined content to a group of consumers (*e.g.* radio and television), the Internet gives users more opportunity and a greater ability to select content that is relevant to them when they want to consume it. Traditional video programming services organise content by time, date, and location. The channel grid has been the primary interface for television for decades. The growth of online video will put pressure on this model. However, it will not necessarily eliminate it in the foreseeable future. While OTT video services replace the channel grid with *à la carte* offerings, IPTV services generally mimic the experience of conventional television. Electronic programme guides and digital video recorders also provide some facility for viewers to enjoy an on-demand experience when subscribing to a linear television service. This reflects the usual historical pattern in which new media forms both co-opt and diverge from existing ones.

There are several reasons why the linear experience of the channel grid will not disappear. Some content such as news and live sports are very time-sensitive, and television series are designed for watching in a sequence. Networks and channels still have some brand value, and the packaging of content into channels and timeslots supports established business arrangements. Studios were willing to license movies to Netflix and TV shows to Hulu because they saw revenues from those services as additive to their existing distribution mechanisms. However, licensing deals have been harder to strike outside North America, and many content producers are already calling for higher fees as OTT video usage takes off. Thus, while Hulu, Amazon, and Netflix have been successful offering on-demand streamed OTT video content in North America, IPTV has been the primary commercial offering in most countries so far.

Even when programming appears in traditional formats, ubiquitous broadband and mobile connectivity is changing the user experience. Social media has extended the traditional patterns of "water cooler" conversations. Many reality television programmes now incorporate live voting via SMS, a phenomenon that first gained notoriety with the British hit *Big Brother* a decade ago. Viewers can now interact with each other through real-time messaging and after-the-fact sharing or commentary. A huge percentage of the chatter on popular social networks such as Facebook involves sharing and interaction around media. Celebrities such as Justin Bieber and Susan Boyle owe their success to the Internet. Major media companies now operate sophisticated online and social media operations, using online platforms to enhance engagement with their programming.

Programmes are also sprouting all manner of social media appendages to extend out and connect with their fan communities. Al Jazeera's show "The Stream", for example, integrates social media into all aspects of the programme, from news-gathering to audience interaction.[31] The rapid growth of e-readers such as the Kindle and tablet computers such as the iPad is further transforming one-way media into

interactive experiences. These changes not only allow for social interactions such as comments, referrals, and links, they facilitate the radical personalisation of the media experience, event for mass-market content.

Device proliferation

For decades all video programming terminated on one kind of screen: the television set. The growth of personal computers with broadband Internet connections since the millennium created a second mass-market screen in the form of the personal computer. Over the past five years, the number of screens has exploded, beginning with portable computers and then the so-called "third screen" of smart mobile phones. This trend will continue, because users today want to interact with digital content on multiple devices. One research group estimated that in 2016, a total of 1.8 billion in-home video devices will be sold, including tablet computers, and 70% of those devices will connect to the Internet.[32]

Televisions themselves are changing. Virtually the entire market has shifted to flat panel displays, which can be deployed in new locations both inside and outside the home. More recently, manufacturers began to build Internet capabilities directly into television sets. One study found that 20 percent of television sets shipped in 2010 had Internet connections, a number that would grow to 123 million units shipped in 2014.[33] Some sets have built-in connections to popular applications such as Facebook and YouTube, or integrate a full-blown online navigation service such as Google's GoogleTV. This partly reflects the commoditisation of the television business, as vendors look for ways to push prices and margins up. It also reflects the growth of broadband connections, social media services, and apps that are synergistic with linear television offerings. This differentiates the current crop of enhanced television sets from the first wave in the 1990s, such as WebTV, which essentially used the television as a low-resolution PC monitor.

The second change in the home is the rise of set-top boxes and other ancillary devices that connect and transform a television's functionality. Pay television set-top boxes have evolved into full-fledged computers, incorporating digital video recorder (DVR) functionality and other features, although operators do not necessarily make their full capabilities available to subscribers. For example, Iliad's Freebox Revolution set-top includes broadand Internet access, an electronic programme guide, phone service, a cordless phone base station, WiFi, games, a Blu-Ray disc player, a delivery platform for third-party software or content, 250 GB of network attached storage, and the ability to stream content to mobile devices. It bears noting that if Google's proposed USD 12.5 billion acquisition of Motorola Mobility is successful, Google will become one of the leading vendors in this space, which could expand its Google TV efforts. A growing percentage of new Blu-ray players have Internet connectivity, although the growth of online video may auger the slow death of the DVD. Standalone DVRs such as Tivo remain in the market, but have largely given way to bundled set tops from pay television operators. The most popular standalone set-top devices are actually videogame consoles. The Playstation 3, Xbox 360, and Wii have collectively sold nearly 200 million units worldwide.[34] All of the current-generation consoles have Internet connectivity and the ability to provide non-gaming video services such as Netflix streaming. In fact, Microsoft recently revealed that 40% of all Xbox activity is non-gaming, and the average Xbox now streams 30 hours of video a month.[35]

A new category of set-top boxes is being designed specifically to facilitate OTT services. Roku, Apple TV, and Boxee deliver OTT video content from a broadband connection to television sets, separate from any pay television service. Slingbox allows customers to watch the pay TV programming they subscribe to at home on a computer or mobile device anywhere they have an Internet connection. The YouView platform in the United Kingdom is developing a set-top box that will offer live IPTV as well as OTT offerings such as "catch up" viewing of recent shows, on-demand premium content, and an open platform for independent content producers. After delays, launch is currently planned for early 2012, around the same time Google TV is expected to launch in the United Kingdom.

Even more dramatic than the transformation of video hardware in the home is the rise of mobile video-capable devices. Led by Apple's iPad, tablet computers are ramping up quickly, with estimated sales of over 50 million units in 2011 and close to 100 million in 2012.[36] Tablets are ideal devices for digital media, with screen sizes big enough for a TV-like experience but portability close to that of a mobile phone. A 2011 study by WiFi technology vendor Meraki found the iPad used approximately four times the bandwidth on WiFi networks as mobile smartphones, suggesting that video was a significantly larger share of the activity.[37] Dedicated media players also have a place in the market. However, they may well lose out to tablets and smartphones, which incorporate their capabilities. Already, the functionality of dedicated music players such as the iPod or Zune is available embedded in smartphones. Cisco's decision to shut down the Flip digital video camera business only two years after acquiring it for USD 590 million may have been influenced by similar factors.

The profusion of digital devices creates major headaches around compatibility. Much of the developed world has already raced past the model of one computer per household or even per person. The same user may own a Zune portable music player, a PlayStation 3 game console, a pay televison subscription through a set-top box, and a video-capable smartphone, in addition to one or more personal computers. Walled gardens in which content is tied to a single device or vendor create significant friction. On the other hand, content producers appropriately worry about the costs of supporting multiple formats and the risks of allowing content onto devices without sufficient digital rights management protections. Even with standards, storing content in the cloud and accessing it as needed may be more efficient that synchronising files across devices. A coalition of over 70 major media companies known as the Digital Entertainment Content Ecosystem began in late 2011 the roll out of a technology called UltraViolet to facilitate cloud-based distribution of media across any authorised device.

IMPACTS ON TRADITIONAL DISTRIBUTION MARKETS

The technological and behavioural changes described in the previous section are putting pressure on established business models. There is great variation in the business arrangements of national media industries, so the business effects of digital content distribution will vary as well. This report highlights four broad trends that appear to be widespread and have the potential to cause substantial revenue shifts: cord cutting, unbundling, the "tug of war" for the customer, and the transformation of advertising.

Cord cutting

Digital content distribution calls into question the role of distributors such as broadcasters, pay television, and broadband access providers. If customers can access the programming they desire directly through the Internet, those customers may decline to subscribe to pay television services, a process known as cord-cutting.[38] The prospect of cord-cutting creates significant financial risk for pay television operators, because those businesses tend to have high fixed costs of infrastructure deployment and content acquisition. This evolution leads in turn to risks for the financing of creation, which in some markets largely relies on pay TV operators. As the environment changes and business models adapt, distributors of content are being asked to contribute to the costs of its production. A recent Nielsen survey found that the more time viewers watched web video, the less traditional television they watched.[39] A Credit Suisse analysis in September 2011 concluded that a fifth of pay-TV subscribers in the United States may cancel their service in the next few years, due in part to OTT alternatives.[40]

The significance of cord-cutting depends on national market structures. It is likely to be a more important phenomenon in the United States, where 90% of households subscribe to pay television and cable operators are among the largest broadband access providers. Even in the United States, the scope of cord-cutting in practice is debatable. Pay television services in the United States experienced their first-ever overall decline in subscribership in 2010, but macroeconomic and industry factors are likely to be more responsible than OTT competitors.[41] Industry observers now speak about variations such as "cord shaving" (choosing a less-expensive pay television package and supplementing it with OTT offerings) and "never cords" (young people who become accustomed to OTT offerings and never subscribe to pay television packages, similar to those who never purchase a landline telephone subscription).

A further development which may influence "cord cutting or shaving" is the growth of "free" over-the-air digital television services provided by traditional public and private broadcasters (*i.e.* channels financed by advertising or public funding from licenses or general public expenditure). Whereas there was a relatively limited number of analogue stations in the past, in recent years, there has been a proliferation of multi-channel offerings from free-to-air broadcasters. In Australia, New Zealand and the United Kingdom, for example, services branded as "FreeView" are now available with extensive geographical coverage and typically with 16 to 50 channels.[42] This model of terrestrial free-to-air and pay television, long used by Canal+ in France, with analogue and now digital broadcasting, adds considerable choice to consumers. And it should be noted that a factor in the decision to subscribe to pay-TV services, at least for some users, is the availability of pirated content online.

Apart from multi-channel offerings from free-to-air public and private broadcasters, these services are evolving with local characteristics. In the United Kingdom, consumers of FreeView have the option to purchase subscription services from pay television providers, with the use of a set-top box.[43] Significantly, this includes some of the most popular live sporting programmes that are often listed by consumers as a reason not to cord cut. This follows Ofcom decisions that required Sky Sports and BskyB to offer popular sports channels and movies to third parties, although BskyB is appealing the decision.[44]

Video service providers, including BT, Virgin Media, and Top Up TV are expanding their range of bundled and *à la carte* services.

The growth of Internet video distribution is not necessarily mutually exclusive with pay TV subscriptions. Today, owners of popular content such as sports or movies receive monthly per-subscriber fees from pay TV operators, even for those subscribers who do not watch their content. In the United States, customers often subscribe to over-the-top services as such as Netflix and Hulu Plus in addition to their pay TV service, because they perceive those services offering a different value proposition. To a point, therefore, the new service does not cannibalise the old one, much as the introduction of videotapes and DVDs did not destroy theatrical releases of films, and in fact contributed to Hollywood revenues. Customer spending, however, is not infinitely elastic. As Internet video services offer more of the content that users consider essential, revenue flows may become more zero-sum or even declining.[45] Content owners must consider the relative benefits of revenues from traditional distributors and new over-the-top players, or from customers directly.

The tipping point for cord cutting is likely to occur when Internet distribution offers a sufficient volume of high-demand content that is not available from traditional pay television operators. Netflix recently announced it would spend USD 100 million for exclusive distribution rights to *House of Cards*, a highly anticipated new television series.[46] This single deal will not transform the industry, but it could be a harbinger of things to come. If OTT providers are able to obtain exclusive rights over a significant quantity of popular programming, it could produce a fragmented market.

Unbundling

The phenomenon of unbundling is related to cord-cutting, but is even broader. As users can access the specific programming they desire, their reliance on intermediaries such as pay television providers will diminish. These intermediaries serve many functions, but in terms of user experience, perhaps the most significant is the combination of content into packaged bundles with associated fees. Cable TV operators in the United States have steadily increased the number of channels in the "expanded basic" tier that most subscribers purchase. This gives users more content, but it also allows the operators to charge higher monthly fees, even if few users watch many of the channels. The differentiation between channels that users "get for free" as part of a bundle and those on higher-priced tiers determines business models. It also defines the media experience as aggregated packages of content.

Unbundling also changes user behaviour. When content or other products are available on an individual basis, without the shelf-space limitations of physical distribution channels, marketplaces can tap into the power of what *Wired* editor Chris Anderson labelled the long tail.[47] Demand for content, as with many phenomena, follows the exponential curve known as a power law. The very few most popular items sell vastly more than those in the next tier. At the opposite end, there are a huge number of items selling in very small amounts. With physical limitations on inventories, these items in the long tail would simply not be sold by mass-market distributors. In digital form, however, it is cheap to make them available to their niche markets. The revelation is that there are so many items in the long tail that, in aggregate, they generate sales comparable to the more popular end of the curve. An unbundled media environment therefore creates new business opportunities for both aggregators and small content providers. At the same time, though, some channels benefit from the guaranteed distribution that bundling provides, and could suffer if forced to go it alone.

Unbundling also affects operator business models. In the United States, at least, pay television operators staunchly resisted pressure to offer *à la carte* channels, giving users the ability to purchase only those offerings they choose. Former Federal Communications Commission (FCC) Chairman Kevin Martin aggressively pushed for *à la carte* without success. The net impact of this change on consumer bills was hotly debated. However, with the rise of over-the-top Internet video distribution, this structure may become more prominent through market forces. The Internet is a force toward disaggregation and atomisation in many markets. In digital media, the opportunity for users to purchase programming directly, without going through distributors, makes it easier to imagine an *à la carte* environment taking hold.[48] United States pay television operators are responding to the threat of unbundling with an initiative called television Everywhere. Through licensing arrangements and authentication services, TV Everywhere allows users to watch pay television content over the Internet or on mobile devices, so long as they have a subscription to that content with a pay television provider. It therefore gives users some of the flexibility of OTT offerings without disturbing existing subscriptions.

There are other reasons to question how far unbundling will go. Users value simplicity. An environment in which thousands of content sources compete for attention and revenues is not necessarily appealing. Users also appreciate getting access to a large amount of programming "for free" as part of a bundle, even in scenarios where they would pay less through an *à la carte* model. And depending on pricing and channel selection, users might even pay more. As a result, content that is unbundled through regulation or market forces may subsequently be re-bundled by another provider. This was the experience

in the United Kingdom, where BT incorporated sports programming offered on a wholesale basis by Sky under Ofcom mandates. It bears noting that distributors are not the only ones who see value in bundling. Owners of popular content often push distributors to bundle in their other properties as a condition. For example, Disney required pay television operators to run its Disney Channel in expanded basic and also to include ESPN 2, ESPNews and ESPN Classic in order to show the immensely popular ESPN sports channel. Even if Disney could deliver ESPN directly on an unbundled basis, it might well decide it generates higher revenues from pay television subscribers and advertisers under the existing model.

Another driver for unbundling is the rise of the app store model. Software applications were traditionally sold on physical CDs or pre-installed on computers. Apple pioneered a new model with its second-generation iPhone in 2008. The Apple App Store allowed thousands of independent developers to create and sell iPhone applications through a simple interface that handle reviews, payment, and installation. Instead of seeking limited shelf-space at software retailers or marketing through their own websites, developers merely had to submit their apps to Apple. On the other hand, Apple zealously controls access to the App Store, and takes a significant commission on all sales. The same model applies to music and video content delivered to iPods and Macintosh computers, and now to those media as well as books and apps for the iPad. All the other major mobile platform vendors, including Google's Android, Blackberry, Microsoft, and Nokia, have their own app stores. Amazon.com has even launched an independent app store for Android content.

The app store model is the fulfilment of the unbundling vision, with both content and applications available for individual purchase rather than through program aggregators. At the same time, app stores are themselves aggregators, with power to control who gets in, what they can charge, and what users see.

Tug of war to control the experience

As the video distribution ecosystem is disrupted, all players are engaged in a tug of war to control the user experience and to extract the bulk of the economic value. Each actor has its own perspective. To a broadband access provider such as Comcast or Deutsche Telekom, a set-top box is commodity hardware that should not interfere with the business relationships between producers, distributors, and viewers. To a hardware vendor such as Apple, the device is the nexus between producers and consumers, with the network operators as commodity pipes. To Disney, valuable content such as ESPN is the lever that moves the system. To Facebook, users and their online interactions are the centre. Editors of content continue to play a very significant role. As a result, conflicts are emerging at several points in the system.

The competitive space is expanding as well. In a digital world, all content is just a string of bits. The same infrastructure that offers virtually any form of online transactions can be employed to deliver digital content. This makes it possible for companies that are not primarily in the media business to integrate digital content distribution into their offerings. Amazon.com's launch of free video streaming for customers of its Amazon Prime service and Facebook's recent forays into streaming movies are illustrative. Many companies that would not traditionally be considered part of the media industry are therefore becoming serious competitors in the digital content distribution world.

The result will be a complicated environment. Broadband access providers own the digital pipe out of users' homes, and many of them also control telephone, cable, and content assets. As more digital content moves through computer-like devices, hardware providers also have the potential to serve as control points, a model Apple has demonstrated with its iTunes/iPhone/iPad/AppStore ecosystem. If the broadband provider controls the "last mile," the device vendor potentially controls the "last foot." Companies such as Google (with its Android mobile phone operating system and Google TV) are taking a similar approach. Aggregators of huge numbers of users or transactions, such as Google again, Facebook, and Amazon.com, may also view themselves as the centrepiece of the user experience, with the devices and pipes as merely means to reach them. And some content providers own properties that are virtually

essential to large populations, particularly sports and hit movies or television shows. All of these providers will have to work together for users to receive a smooth experience, rather than an "arms race".

So far only Apple has had significant success building a fully-integrated proprietary environment that ties together computers, consumer electronics, mobile devices, and content distribution. While the iPhone is the leading smartphone in much of the world, however, more Android devices are sold in aggregate, and most personal computers still run Windows. Moreover, there are significant pieces such as the broadband access network and the wireless service contract that Apple does not control.

Viewers, of course, do not wish to be "owned". In a multi-platform digital environment, they are likely to have relationships with several distributors at the same time. A critical aspect of the business battle will involve control over user data. It raises the question of who has access to demographics and viewing histories to provide targeted advertisements, which command a higher price - assuming such targeting is permitted under data privacy regimes. In other words, which providers will be able to craft a personalised experience for the user, and tie that experience in with other offerings?

Media companies have always combined creation and aggregation of content. The Internet, however, greatly increases the potential of aggregation as a business opportunity. Lower barriers to entry mean there is much more content available, and the Internet's openness means much of that content is accessible for re-use. A company such as Huffington Post could build a successful media business around a small amount of original reporting mixed with free content from a network of blogger correspondents and material repurposed from elsewhere online. In 2011, AOL purchased Huffington Post for USD 315 million, making it the centrepiece of its content offerings.

At some point, however, aggregation alone is insufficient. Aggregators often depend on material from established publishers such as newspapers as the backbone of their offerings. As those newspapers find their businesses undermined, it is not clear the aggregators can or will invest in the capabilities to offer the same depth of coverage. Aggregation also serves the positive role of filtering the overwhelming mass of information, but in so doing aggregators may limit or distort their users' perspectives. A number of authors have warned that personalised online aggregation runs the risk of reinforcing users' pre-existing biases, rather than exposing them to the breadth of opinions necessary for an informed citizenry.

The question is whether new intermediaries will change the nature of aggregation for online video and other forms of digital content. Before Google, it was far from obvious that the dominant intermediary for the web would be a search engine. One aspect of online video that may give power to new intermediaries is the need to link together so many devices and formats. Video services platforms such as Brightcove manage the encoding and distribution of video, along with tracking and advertising which are important for monetisation. Online video distributors integrate similar features, but some companies may prefer to deal with a pure technology provider. Similar developments are occurring in the ebook market.

Transformation of advertising

Advertising plays a central role in many digital content markets. Broadcast television, for example, is essentially a multi-billion dollar advertising market. It is free to the viewer only because its real funding comes from advertisers. This model is common online as well. The true customers for search engines, for example, are not the searchers but the advertisers competing for their clicks.

Advertising was historically a blunt instrument, especially when associated with mass market content. The unit of advertising was the programme or show. Ratings services provided broad demographics of a show's viewers, but the advertiser had no way of knowing who was actually watching their ads or what they did in response. Viewers who do not fit a show's primary demographic will therefore

see commercials they are less likely to respond to. Those viewers who do respond positively to commercials on television have no easy way to act on those responses, and the advertisers have no good way to track who do act on them. Finally, traditional advertising has no context for a user's prior history; it operates on a snapshot basis only.

Online distribution promises to change all these aspects of advertising, and more. Most significantly, because each user has a direct, interactive relationship with a content distributor or other intermediary, advertisements can be tailored to the individual user level and every interaction can be tracked. Users who want more information or purchasing opportunities can now do so directly through the advertisements. And the forms of advertising are significantly more varied than the old precisely defined commercial blocks.

The most significant shift is the potential for radical personalisation and closed-loop targeting of the advertising process. A famous aphorism is that advertisers know that half their spending is wasted; they just do not know which half. It is remarkable in a way that advertisers spend hundreds of billions of dollars worldwide promoting products with only the vaguest assurance those ads are reaching their target customers and no hard data at all on the response. With digital distribution, the user is connected to the same network as the advertiser, allowing real-time tracking and rich profiling of each user and each transaction. Behavioural targeting systems track user actions across multiple sites. Mobile devices can track the user's physical location as well, opening the possibility for further personalised location-based advertising.

There are significant levels of concern about these new hyper-personalized advertising models. The European Union and the United States Federal Trade Commission have expressed concerns about the privacy impacts of data collection and use in behavioural targeting. Some rules will probably be imposed in much of the world, but the move toward personalised advertising is unlikely to stop. Websites already make extensive use of cookies and other personalisation techniques, which have become embedded into the fabric of online commerce. To the extent hyper-targeted advertising techniques increase revenues, there will be tremendous pressure to allow them, with reasonable limits and disclosure requirements.

The question remains how much the advertising-based business models around digital media will change. When advertising does not generate sufficient revenues to compensate content providers, distributors must turn to subscriptions or other models. Hulu, for example, initially used a pure advertising-based model for over the top distribution of television shows, but put its premium content on a monthly-subscription tier after pressure from its content partners. The other issue is how the many intermediaries in the advertising process, such as agencies and corporate media buyers, will be affected in the move towards digital hyper-targeted advertising. Some brands may seek to disintermediate their agencies, or to bring content to their own sites, for example, in order to promote their brands more efficiently.

INFRASTRUCTURE CONSIDERATIONS

The tidal wave of online video and other forms of digital content distribution will have significant impacts on physical networks. This section examines general issues around managing the capacity demands of digital video, and then looks at robustness and particular considerations for wireless distribution.

Network capacity

Video demands on infrastructure

Increasing volumes of digital content, particularly video, will invariably place demands on network infrastructure. A single television show amounts to several hundred megabytes. As a result, in North America, Netflix is said to already represent more than a fifth of all Internet traffic. Network equipment vendor Sandvine estimates that by the end of 2011, real-time entertainment as a whole will represent as much as 60% of network capacity.[49] Even in Europe and Latin America, where online video distribution services are less prominent, real-time entertainment represents approximately 30% of network capacity in mid-2011, according to Sandvine. Cisco estimates that by 2015, video will be approximately 90% of global consumer traffic.[50] These estimates suggest that questions about Internet infrastructure investment in the coming years will to a great extent revolve around online video. The specific infrastructure and policy implications will depend on more granular factors such as the ratio of on-net to off-net traffic and streaming to downloading. Reliable and detailed cross-network data are not publicly available.

Online video usage patterns are stratified. Some users consume more than others, and some content is more popular than other content. Pricing policies, usage terms, and availability of content all influence the degree of stratification. Concentrations of high-volume traffic can create bottlenecks where network costs and performance reflect the management of peak loads. Client devices are also a factor. Different browsers and mobile phones vary in how frequently they poll the network for new data, and how efficiently they do so. The software and hardware vendors involved do necessarily have incentives to limit demands on networks, especially when the alternative appears to offer a superior customer experience.

High variability in consumption patterns by itself does not itself determine the effects on network infrastructure. The effects of video traffic depend heavily on architectural choices for both the content distribution and the networks. For example, a centralised hosting service such as YouTube is very different from a P2P system such as Skype, which in turn is different from a one-to-many broadcast architecture.[51] One of the factors for the early growth of P2P for music (Napster and Kazaa) as well as video (BitTorrent) was the mitigation of network demand. P2P essentially distributes the load of bandwidth, processing, and storage for digital content from central hosting sites to individual PCs.

Over the past several years, the environment for online video has changed. Internet capacity, both within core networks and in the last mile, has increased to the point where high-quality video does not automatically choke the system. ISPs have deployed IPTV services that segregate video onto managed IP networks rather than the best-efforts Internet. At the same time, the distribution paths within the Internet have come to resemble the distributed architecture of P2P. The proliferation of distributed data centres, content delivery networks (CDNs) and similar overlay networks means that popular content is cached close to end users, rather than redundantly distributed across the network. Improvements in codecs and PC CPUs also make it easier to create a smooth streaming experience through buffering. Finally large content

providers began peering directly with one another, rather than routing traffic through multiple "Tier 1" backbone networks.[52]

Another variable concerns whether content is distributed through downloading or streaming. In each case, the entire file is sent across the network. With downloading, however, the file is not available for viewing until received in its entirety, because it will be played locally by the user. The speed of the connection will affect the delay before playback can begin, but variability in network performance doesn't matter. With streaming, however, consistent network performance is highly important. Because a user watches a streaming file as it is downloaded, latency and jitter can degrade the viewing experience. Buffering mitigates this problem. For streaming, overall throughput is less important, because users see no benefit beyond a threshold performance level.

Finally, backbone networks play an important role. Backbones provide high-capacity links between the Internet service providers that reach end-users. Some backbones are owned by incumbent telecommunication providers, but others are independent wholesale operators. When backbones interconnect, they use either peering (settlement-free interconnection) or one provider charges the other for termination of traffic (transit). These arrangements are usually privately negotiated agreements, leaving the parties leeway to negotiate any flow of funds. If video causes a spike in traffic across an interconnection point, it can call into question the assumptions underlying a peering or transit agreement.

In some cases, parties can work together voluntarily to avoid conflicts and reduce network strain. Although capacity demands may be an externality to providers other than the network operator, no one wants a poor user experience for their customers thanks to overloaded networks. YouTube is reportedly in discussions with major operators globally on technical co-operation mechanisms to reduce the load that video traffic places on networks.[53] If such discussions came to fruition, any agreement could mitigate demands that YouTube and other online content providers pay supplemental fees to network operators, a prospect that may raise competition and non-discrimination concerns.

Games

Another category of digital content that could increase demand for network capacity is games. As noted earlier, there are approximately 200 million current-generation game consoles in use, and hundreds of millions of other users play videogames on their PCs or mobile devices. Worldwide, videogames are more than a USD 50 billion industry, growing faster than movies or television. Though usage patterns vary, games are a global phenomenon. Although some games are still based on a single-player experience, online games are skyrocketing in popularity. Massively multiplayer online games (MMOGs) such as World of Warcraft and Lineage create vast worlds for tens of millions of players, and social games such as Cityville are a significant component of usage on social networks such as Facebook.

From an infrastructure perspective, the key questions about online games are the richness of the user experience and the extent of processing in the network compared to the user device. Games that offer a two-dimensional or low-resolution environment do not require as much network capacity as those that provide a more cinematic three-dimensional experience. While games with limited graphics have the largest overall user-bases, several immersive MMOGs have subscriber counts in the millions or even tens of millions. Competition and the shift away from retail software distribution in the games industry will likely create pressure for more photorealistic games, potentially incorporating video streaming in addition to computer-generated graphics.

The biggest question for online games and their effect on networks is whether centralised streaming will replace local processing. High-resolution games today typically do the "heavy lifting" on

the local PC, console, or mobile device, only sending relatively small update instructions in real-time across the network. The alternate approach of rendering the games in networked data centres and streaming down the actual content has only recently become technically feasible for high-resolution real-time games. OnLive now offers subscription access to PC and console games across the network. If this approach catches on, it could dramatically increase the network load from games.

Metrics and transparency

Understanding the impact of digital content distribution on networks will require good data. The advertised or even measured broadband access speed to an end-user may not accurately reflect the end-to-end performance of an online video service. Parameters other than bandwidth, such as latency and jitter, may contribute significantly to the user experience. The data sets available today on broadband network performance are therefore not likely to be useful for developing complex indicators for user experience when accessing digitally distributed content. Some data may become available through private action. Netflix has begun to post performance indices for the major Internet service providers that deliver its content. Akamai, though not indicating actual networks, publishes a quarterly report which includes data gathered across its global server network on average and maximum connection speeds. Collective or governmental action may be necessary, however, to develop more comprehensive data to inform regulation and policy making. Any such policies should be targeted and take due account of any costs imposed on firms.

Robustness

Capacity is not the only dimension of network infrastructure. Network robustness, in particular reliability and security, is also an important consideration for content distribution services. The Internet was designed to interconnect research and educational data networks. Its architecture does not ensure end-to-end reliability or security, because those functions are the responsibility of applications and devices at the edges of the network. The Internet approach fosters tremendous innovation and growth, but it creates difficulties for mass-market commercial services that require high availability. Moreover, with vast amount of data and money flowing across digital networks, bad actors with financial or other motivations will seek to exploit vulnerabilities in Internet-based services.

Online video distribution services generally require huge data centres, which can become major points of failure. Companies such as Amazon.com, Google, and Apple are investing heavily in data centres that provide massive storage capacity for cloud computing offerings, including online video and other forms of digital content. Thousands of companies, large and small, now run on top of Amazon Web Services, which benefits from scale economies and the ability to aggregate demand. Although Amazon's systems are highly redundant and reliable, failures do occur, effectively knocking those services off the Internet for a period of time. Digital content services dependent on cloud infrastructure may not enjoy the same level of reliability as traditional broadcast or pay television systems. Peer-to-peer distribution mitigates this risk, but creates other reliability challenges because individual nodes can so easily fail or go off the network. Failures that delay users' ability to watch movies may not be of great policy concern, but as digital distribution platforms are used for news, live sports, and other content of public consequence such as health and home care, reliability may need greater scrutiny.

There are many means to make digital content distribution more reliable. For non-real-time content, buffering and storage on local devices, and techniques such as background downloading during non-peak time periods, can mask variability or failures in the network. Redundancy of data centers and network paths is another step that can improve robustness. Services such as Netflix employ content delivery networks (CDNs), which cache content close to users and use algorithms to redirect requests to these local nodes. And just as the state of the art in telecommunications and broadcast engineering evolved over decades, cloud computing will become more reliable in the years to come.

Security may be a more enduring concern. In April 2011, Sony announced that its PlayStation Network had been hacked. Personal and financial information about millions of users was potentially compromised, and Sony was forced to shut down its profitable online console gaming network for an extended period. The PlayStation Network hack will not be the last of its kind. There are simply too many ways that vulnerabilities in large networked systems can be exploited. Digital content providers such as Apple and Amazon hold hundreds of millions of credit card numbers, in addition to the rich troves of passwords, private information, and other data. These providers and their partners have incentives to prevent security breaches, but they lack the deep security expertise of banks and similar industries that have deployed secure networked systems.

A final dimension of robustness concerns the Internet's underlying technical protocols. In particular, the proliferation of networked devices threatens to overwhelm the addressing structure incorporated into the Internet Protocol (IP). Adoption of the next-generation IPv6 protocol is therefore important to facilitate continued robust Internet growth. While strides have been made recently as the existing IPv4 address space nears exhaustion, IPv6 adoption remains incomplete. Policy-makers should recognise the importance of these technical developments to the smooth functioning of the Internet and the markets that depend on it.

Wireless networks

The issues with network capacity are even more significant on wireless networks. In general, wireless systems offer less capacity than their wired equivalents, and their connections are both less reliable and more dependent on local conditions such as topography and distance to towers. Many physical factors can make it difficult for a wireless device to distinguish the desired signal, including the presence of other devices nearby. For a service like streaming video that requires a large amount of consistently available capacity, wireless is a particularly challenging environment. According to mobile network management vendor Byte Mobile, video represents 40-60% of traffic on mobile networks worldwide as of mid-2011, even though less than 10% of subscribers view videos during an average day.[54] Other reports claim even higher percentages.

Nonetheless, wireless video is growing fast. The convenience of accessing video content anywhere, especially with tablet-sized devices, is a powerful incentive. Video is already the biggest share of mobile data traffic, even though only a small percentage of mobile users watch it.[55] As those percentages increases, the strain on networks will increase. Mobile broadcasting of traditional linear television in countries such as Korea and Japan generally uses a terrestrial or satellite broadcast architecture, so it does not create special demands on two-way wireless data networks. However, when digital content is distributed to mobile devices on an *à la carte* or other over-the-top basis, this is not the case.

Some mobile operators are imposing a variety of policies which they say are in response to growing mobile data usage. These include caps and pricing tiers for data services, restrictions on tethering PCs to mobile phones, and prohibitions on use of applications such as Skype over 3G wireless connections.[56] Although not directly tied to video content, these terms are likely to have the greatest impact on mobile video services because they consume greater amounts of bandwidth. Application providers and civil society groups have begun to question whether such policies are truly necessary to address capacity limitations. Usage caps and other restrictions, if sufficiently strict, could prevent certain mobile video services from gaining a foothold. They could also be used anti-competitively if an operators' own services or partners receive preferential treatment.

There are several technical options to address wireless capacity limitations. The transition to digital television in most of the world frees up frequencies that could be reallocated to wireless broadband. In the United States, the FCC and President Obama have proposed an "incentive auction" by which

broadcasters can voluntarily give up their licenses for re-auctioning in return for a portion of the proceeds. Offloading traffic from cellular networks to WiFi or other unlicensed systems may also significantly alleviate congestion. Most current smartphones offer WiFi connectivity. Network operators, initially hostile to WiFi, are now recognising it as a means to improve performance of their own networks without necessarily reducing revenues.

WiFi hotspots are moving toward ubiquity in urban centres in the developed world. The CEO of China Mobile, the world's biggest mobile phone operator, stated recently that cellular networks would never be able to keep up with mobile demand, so WiFi should become the default connection for wireless data services.[57] The municipal government of Seoul, South Korea, plans to install 10 000 hotspots in the city by 2015.[58] In the United States, WiFi equipment provider Meraki found that non-PC devices such as the iPhone, iPad, and Android phones represented over half the connections to its WiFi access points in 2011, up from one-third in 2010.[59] Globally, Cisco estimates that by 2015, Wi-Fi and and mobile devices will account for a majority (54%) of IP traffic.[60]

Other technologies such as the use of broadcast "white spaces" on an unlicensed basis may also be called into play to reduce wireless data network congestion. White spaces are un-used frequencies that were set aside to prevent interference between local over-the-air television stations, or where stations do not actually broadcast over the air. The shift to digital television has also created white spaces in some countries. With today's technology, devices can query geolocation databases and sense the local spectral environment, allowing them to operate in the white spaces without creating interference. The United States authorised white spaces devices on an unlicensed basis in September 2010, following a multi-year proceeding, although some issues remain unresolved. In the United Kingdom, Ofcom is exploring authorising similar license exempt services beginning in 2013.[61]

The IEEE and other standards groups are developing standards for white spaces devices, and companies such as Microsoft have demonstrated proprietary systems as well. The market for white spaces devices is uncertain due to both technical and regulatory concerns. However, one possibility is that these systems will be employed or used more extensively in rural areas, where there are fewer television broadcast stations and other broadband connectivity options are less economical. Because they operate at low frequencies, white spaces may also be appropriate for additional channels for wireless data, long-range WiFi-like services, or machine-to-machine communications.

Finally, digital content services can be integrated with wireless hardware to facilitate efficient delivery. Apple reportedly worked to minimise the volume of background data requests from the iPhone, recognising that it could overwhelm wireless networks.[62] Systems such as RIM's Blackberry network that route mobile web page requests through proxy servers can compress the content actually sent over the air. Special-purpose devices such as the Amazon Kindle e-book reader incorporate capacity-saving techniques such as background downloading during periods of light network usage. Integration of video content delivery with hardware, however, can have both positive and negative consequences. Tighter integration could produce more efficient network utilisation, but it could also limit the opportunities for third parties to leverage open platforms as they do on the Internet.

REGULATORY QUESTIONS

Digital content raises a large number of public policy issues in several different legal domains. This section attempts to identify significant areas where existing national and international regulatory arrangements may need to be re-examined. Many of these are addressed in some form in other OECD projects. In general, this section notes tension points and provides examples of debates which have taken place, rather than recommending particular courses of action.

Competition/non-discrimination

Network neutrality

Broadband and wireless access providers have the potential to act as gatekeepers for digital content distribution. Network neutrality refers to rules mandating that these providers do not unreasonably block, degrade, or impose tolls on unaffiliated providers of applications, services and content. Supporters of network neutrality say it is a means to facilitate innovation at the edges of the network, and to assure the free flow of information among individuals. However, the topic is quite controversial.

Network neutrality has garnered the most attention in the United States, but the debate is expanding globally. After significant controversy, the United States Federal Communications Commission adopted network neutrality rules in December 2010, but only for wireline networks. Those rules are currently being challenged in court. Japan promulgated principles for network neutrality in 2007 and for traffic shaping in 2008, although those recommendations do not have the force of law. Similarly, Neelie Kroes, European Commissioner for the Digital Agenda, has made statements opposing broadband discrimination, but encouraging innovative business models between content providers and network operators. She indicated that the European Commission is studying market practices in this area. Chile adopted mandatory network neutrality obligations in 2010, and in May 2011, the Netherlands adopted legislation barring mobile network operators from discriminating against applications such as Skype.[63] Ofcom published a guidance document in November 2011.

There is not a universal definition of network neutrality. Blocking content or applications purely for anti-competitive reasons clearly qualifies, but is the rare case. More difficult to evaluate are steps that allegedly degrade the experience, where there are potentially legitimate rationales involved. Traffic management has beneficial uses. It can be employed to enhance the efficiency of network utilisation, and to enhance reliability for critical services. Most network neutrality regimes allow for "reasonable" network management and limit protections to lawful content, as well as distinguishing between best-efforts Internet services subject to non-discrimination obligations and "specialised" or "managed" services that are exempt.

Still, many scenarios pose difficult questions. If network operators provide a "fast lane" for private services such as IPTV, does that constitute discrimination against OTT video offerings? Should they distinguish between legal and illegal content or services to protect legitimate interests of creators? And what if the dispute concerns not discriminatory practices but monetary charges, which are equally applied but tied to categories of traffic? At the same time as network operators are seeking supplemental fees for distributing online content, so are some content providers. For example, Disney in the United States charges broadband access providers to make its ESPN3 sports video content available on the web to their subscribers.

Given the business and infrastructure dynamics described in this paper, network neutrality is likely to remain a high-profile topic for the foreseeable future. Every company is looking to shape the distribution chain for its own advantage. Virtually all of them face potential cannibalisation of traditional revenue streams as digital content grows in significance. At the same time, infrastructure demands of video and other digital content forms create legitimate traffic management considerations. Case-by-case analysis of allegedly discriminatory practices may be inevitable, regardless of whether countries have ostensibly mandatory network neutrality regimes.

Competition policy

The changing structure of media industries raises a variety of antitrust or competition policy questions. As convergence dissolves lines between media and communications industries, competition authorities will be called upon to review mergers and acquisitions that require a determination of industry boundaries and concentration levels. As an illustration, American regulators in 2011 approved Comcast's acquisition of a majority stake in NBC Universal, but sued to block AT&T's acquisition of T-Mobile, based partly on concerns about innovation around wireless data platforms. In other cases, the competition question will concern unilateral or multilateral actions that limit market access. For example, British competition authorities in 2009 blocked Project Kangaroo, a joint venture of the BBC, ITV, and Channel 4 to create a content aggregator service, because they felt it was a threat to competition in the developing VoD market.[64] In the United States, public interest groups have questioned whether TV Everywhere creates impermissible barriers for independent over-the-top video providers. The FCC is also considering adopting new rules, termed Allvid, mandating open access standards for video set-top boxes, to address a similar concern.

At a broad level, the rapid convergence of media, technology, and infrastructure markets could subject market leaders in every category to scrutiny. The United States Federal Trade Commission is currently investigating Google's business practices. The inquiry is not specific to digital content, but any action is likely to have significant implications for Google's activities in this area. Exclusive deals and differential pricing are staple business arrangements in traditional media, but often raise red flags in information technology or Internet markets. There are also likely to be more cross-industry acquisitions, like Google's purchase of Motorola or Microsoft's purchase of Skype. Competition authorities will face challenges in assessing the relevant markets because so much is in flux.

Program access

New digital distribution platforms need access to quality programming. The long tail of demand for content means that a small number of "hits" are extremely popular relative to everything else. Incumbent distributors hold rights to the vast majority of those hits, such as successful television series and major sporting events. For complementary services that offer niche programming or new categories such as user-generated content, this may not be a significant concern. For services that seek to replace established broadcast or pay television offerings, inability to offer popular programming may be a huge obstacle. For that reason, some regulatory regimes include programme access or must-carry requirements designed to ensure non-discriminatory availability of programming to non-broadcast distributors.

Programme access and must carry requirements becomes more important when media, broadcasting and telecommunications companies engage in vertical integration. With more network operators acquiring broadcasting entities and other content producers, the concern increases that vertically-integrated entities will engage in anticompetitive practices toward competitors with no broadcasting assets.

Programme access and must carry rules may also need to be revised with the emergence of new digital content services. These rules are often specific to cable television and direct broadcast satellite, and therefore may not cover Internet-based competitors. In South Korea, the major terrestrial broadcasting

companies refused to license programming to TU, the satellite digital mobile broadcast (S-DMB) operator. This has significantly impeded the success of TU's service. Under the Korean regulatory regime, S-DMB does not enjoy the same must carry rights as terrestrial services. Such distinctions illustrate the problems when functionally similar services are treated differently because of legacy regulatory silos.

In the United States, broadcasters are entitled to forego must-carry and seek compensation from pay television operators for carriage of their content through "retransmission consent" negotiations. These are often high-stakes, contentious battles, because both sides need to reach a deal. The pay television operators must offer certain popular channels such as sports networks, and those networks need distribution from the cable and satellite systems that reach 90% of all households. In several negotiations, one side or the other has temporarily cut off channels, creating customer ire and drawing the attention of regulators. These disputes are starting to spill over into online video. In fall 2010, Fox pulled its programming from Hulu customers in New York as part of a retransmission dispute with Cablevision, a local cable television operator.[65] Similar controversies are likely as OTT platforms become more important content distribution mechanisms.

Wireless carterfone

As more digital content is delivered to mobile phones, tablets, and specialised wireless devices, the openness of those devices will be a subject of contention. In the United States, public interest advocates and companies such as Skype and Google pushed at the beginning of 2007 for "wireless Carterfone" rules, analogous to the rules requiring open standards for devices connected to the telephone network. Verizon agreed to a limited form of these rules for the wireless spectrum licensed it purchased in 2008. The FCC's network neutrality rules expressly did not extend to wireless networks, but the agency left open the possibility of taking further action as the industry evolved. The growth of the smartphone market and of mobile voice and video applications may bring wireless Cartefone back into the spotlight. The Dutch network neutrality legislation focuses specifically on mobile applications.

With mobile devices moving toward the app store model, the question of openness will extend to the device and operating system vendors as well. Companies such as Apple and Google are not subject to traditional telecommunications regulation, but given their dominance of smartphone devices, their decisions to exclude or mandate pricing structures for digital content will be subject to scrutiny.[66] Apple has refused to approve some apps and required others to limit features. Critics see potentially anti-competitive motives, while Apple and its handset partners claim they are acting to protect network performance. Content producers have also chafed at Apple's revenue-sharing terms for subscriptions and other digital content monetisation techniques. Google has been less restrictive with its Android Marketplace. However, it is currently subject to antitrust scrutiny in the United States, and its purchase of Motorola could raise concerns about favouritism on the Android platform.

Backbone and peering regulation

Internet backbone networks carry data traffic between end-user Internet service providers (ISPs). The interconnection arrangements between these providers are largely governed by private agreements. Voluntary interconnection has traditionally been part of the Internet model for network infrastructure. Moreover, most backbone markets are either relatively competitive or dominated by a single national operator that is already regulated. Regulators have generally not felt it necessary to impose special obligations for Internet backbone interconnection, except in merger cases.

The rise of digital content distribution will bring backbone practices into the regulatory foreground. Whether a relationship is considered peering (settlement-free) or transit (one party pays the other for transport) has major economic consequences. For example, in late 2010, Level 3, the largest United States backbone provider, accused Comcast of unreasonably imposing a recurring monthly fee on traffic it

delivered to the broadband provider.[67] Under the parties' prior contract, Comcast actually paid Level 3 for transit. However, after Level 3 became the primary delivery network for Netflix, it began sending substantially more downstream traffic to Comcast customers than it was receiving. Comcast claimed the fee was necessary to recover its additional costs to handle the new traffic, whereas Level 3 saw an anti-competitive move to disadvantage a competitor to Comcast's cable television service. The FCC declined to become involved, stating that this was a commercial dispute rather than a network neutrality issue. A similar battle may be brewing in Europe, where several major carriers are seeking supplemental payments from Internet-based content providers.[68]

Such conflicts may be viewed as network neutrality controversies, but they are really disputes over payment levels for traffic exchange. As more video traffic flows through private peering links among large content providers and broadband access providers, the backbone market becomes less of a neutral competitive environment at the core of the Internet. Wholesale relationships within the Internet tend to be opaque. Greater transparency about interconnection terms, network management practices, and traffic flows would allow for a more thoughtful review of the need for government action.

Media policy

Broadcast regulation

Broadcasting is subject to a large number of regulatory obligations that may not apply to interactive media. As the Internet becomes a platform for broadcast-like digital content, regulators are beginning to consider whether and how to impose these rules. Some of the major elements of broadcast regulation may include:

- Advertising restrictions governing how much advertising is permitted, how products can be promoted, which products may be advertised on television, limits on subliminal or surreptitious advertising, and terms for political advertisements.

- Hate speech and other unsuitable contact that may be directly prohibited or otherwise limited on broadcast systems.

- Protection of children through limits on violent or inappropriate programming, restrictions on advertising, and mechanisms to limit children's access to adult content.

- Promotion of local content through subsidies, requirements that a certain percentage of programming to be locally produced, or that local communities be involved in broadcasters' management or programming decisions.

- Disability access measures such as subtitles, closed captioning, or audio descriptions.

- Educational programming mandates that require a certain amount of educational content be provided.

- Diversity requirements that seek to achieve a diversity of viewpoints through direct content mandates, ownership requirements, or license renewal processes.

- News reporting rules that ensure broadcasters access to report on high public interest events.

- Emergency broadcast network rules to make the broadcast channels available to public safety authorities during emergencies or natural disasters.

In 2007, the European Union adopted a comprehensive framework, the Audiovisual Media Services Directive, to address both traditional and Internet-based media.[69] It revised the Television Without Frontiers directive, which was adopted before the emergence of the Internet as a video distribution channel. The core of the directive is a distinction between "linear" and "non-linear" services. Linear services are analogous to traditional television, and include IPTV offerings that employ Internet technology to deliver a conventional channel grid experience. Non-linear services include OTT offerings and other video programming delivered on demand to the user. Under the directive, non-linear services are subject to substantially fewer obligations. This distinction is sensible, but as the boundaries between OTT

and IPTV services blur and non-traditional forms of online video attract larger audiences, further refinements will likely be needed.

Public media

Public funding of at least some media outlets is common throughout the OECD. Although there has been a general move toward privatisation, at least one major national television and radio station receives public funding in most countries. The scarcity of channels, combined with the important public interest and democratic values that mass media affects, support the need for outlets representing more than private commercial interests. In the European Union, the rules for financing public broadcasters have been updated in order to take into account the dynamics of the digital transition.

As media industries converge and content migrates to Internet distribution, the rationales and mechanisms of public media are called into question. Instead of an environment where most countries had at most a handful of television networks, people now have access to a multitude of information and media sources. Bloggers and others can exploit social media to highlight local issues in a way that used to require dedicated news organisations. Even without the scarcity constraint, however, there is reason to believe purely private networks will have neither the motivation nor the wherewithal to offer the full range of high-quality news and information. A recent FCC report warned that the Internet, by undermining traditional newspaper and television advertising, was indirectly undermining local and investigative journalism, which traditionally depended on those revenue sources.[70]

A separate question is whether traditional funding mechanisms for public media can endure. Where public broadcasters are funded through annual license fees on television sets, the move to watching video programming on a computer or mobile device could undermine subsidy flows. Germany is moving to a per-household fee as a result. Similarly, if viewers move from broadcast or pay television systems with well-defined channels and timeslots to on-demand programming, mandates requiring a certain fraction of capacity for public, educational, and government (PEG) access may create difficulties. And finally, political support for public media may erode in an environment where so much diverse content is available, even though civic values may not be promoted in the same way.

It bears noting that many public broadcasters have been among the more aggressive incumbent media companies in exploring digital distribution. For example, the BBC developed the iPlayer for online video distribution, and some German public broadcasters offer live feeds through their websites. A commitment to the public interest and funding sources not reliant on advertising may explain this phenomenon. Going forward, policy-makers should consider how public broadcasters might be sources of innovation in the emerging digital distribution world. In addition to experimentation with content, public broadcasters often have significant spectrum holdings that could be utilised in creative ways.

Finally, it is noteworthy that some countries are using public funding raised for broadcasting to influence the development of broadband infrastructure in areas that may not have otherwise received higher speed access.[71] In the United Kingdom, for example, money raised by the BBC licence fee is being used to expand services in some rural areas. The government wishes all households to have access to a minimum speed of 2Mbps. Apart from better services for general Internet applications, it notes that this speed would enable users to watch television catch-up services, such as the BBC's iPlayer

Copyright

The tensions between digital distribution and copyright protection have been evident for some time. On one side, content creators and their allies argue for new, stronger mechanisms to combat infringement, arguing that protection of their rights online will also foster the growth of innovative content distribution services. On the other side, certain technology companies and their allies respond that new

freedoms to create, remix, and redistribute content online actually promote new forms of creativity, and that responses to digital piracy produce more harms than benefits. As stated in the OECD Communiqué on Principles for Internet Policy Making, "*effective protection of intellectual property rights plays a vital role in spurring innovation and furthers the development of the Internet Economy*".[72]

Many legal regimes provide mechanisms for content owners to address infringing content that is distributed online. Such mechanisms should remain flexible as technology and methods of infringement evolve. A common legal process is notice and takedown, which means that intermediaries have incentives to co-operate with content owners' take down notices to avoid liability. However, there are not usually direct obligations, for instance, intermediaries do not have a general obligation to monitor all material. This approach recognises the unique aspects of digital content distribution, especially with user-generated content. However, it is not universally incorporated into national legal regimes.

At the same time, providers are applying technical mechanisms to combat infringement. As noted previously, YouTube is working with most major content producers to apply digital watermarking technology to flag and remove infringing copies of commercial content. Apple's recently introduced iTunes Match, under which iTunes users who pay USD 25 per year can authorise up to 5 000 songs that were obtained outside of iTunes. This money will be split with record companies, providing a pathway for them to monetise content acquired through unauthorised downloads. What these steps illustrate is that content creators and online intermediaries often have a shared interest in facilitating legal distribution. Effective legal enforcement is an important tool to combat infringement, but attractive legal content options, technical mechanisms, and education should also play a role.

Commercial content producers will not make their materials available for digital distribution without sufficient assurances about copyright protections. Countries have taken various steps to address this problem. In France, for example, the Hadopi law created a graduated response programme for infringement and also raised user awareness of copyright. As shown in Figure 1, primarily licensed streaming video has replaced largely unauthorised P2P file transfers as the largest component of online video worldwide is a positive development. However, significant distribution of infringing material still occurs. Another consideration is that not all content producers seek to monetize their content, and even some commercial content, such as music videos, generates revenue only indirectly.

Not all copyright disputes involve users seeking to access content without authorization. And as new services combine storage, streaming, and device-shifting in creative ways, significant uncertainty remains about the implications. For example, in Australia, Telstra paid AUD 153 million for five-year exclusive online streaming of rebroadcasting of football matches. Its competitor Optus is offering customers access to that same content on their mobile devices with only a short delay, as little as two minutes. Optus uses a home server to store and retransmit the free over-the-air broadcasts of the programming. The Australian Federal Court ruled that Optus is not in violation of copyright, because its service merely allows its customers to time-shift their television content.[73] However, the decision has been appealed and the outcome remains uncertain. In the United States, Cablevision was initially held to violate copyright law by offering digital video recording functionality from its cable network head-ends, instead of a home set-top box. The decision was reversed on appeal in 2009.

Intermediary liability and responsibilities

Digital content distribution calls into question the appropriate treatment of intermediaries such as content aggregators, payment providers, search engines, and advertising networks. These intermediaries differ from traditional broadcasters who exercise direct editorial control over all programming. There are significant questions about the appropriate legal obligations for digital intermediaries, involving intellectual property protection, privacy, protection of minors, and other important public policy consideration. This issue is the subject of a concurrent OECD project, which is seeking to "obtain a

comprehensive view of Internet intermediaries, their economic and social function, development and prospects, benefits and costs, and responsibilities".[74]

Privacy

Interactive media forms allow for far greater access to information about users than one-way broadcasting. Because viewers are connected to the same network as content distributors, their actions can be tracked in real-time. Providers can potentially monitor extremely granular information about user behaviour before and during the viewing experience. The growing significance of user data creates both benefits and dangers. When content distribution is monetised through advertising, this tracking data may be used to target advertisements to specific users. Mobile devices capable of delivering video mean that location data can be tracked as well. The potential for aggregating user profiles across sites and with other data sources further raises privacy concerns. User-generated content and two-way communications add further privacy considerations.

Online privacy raises a complex, evolving set of issues. The OECD has done extensive work in this area, to which the reader is referred for further discussion.[75]

Standards fragmentation

Standards are the common technical formats for digital hardware, applications, and content. Governments today often leave standards-setting to the private sector, but in important cases they have imposed national or even international standards. For example, Europe established a common GSM standard for cellular telephony, and the United States decided not to follow the Japanese analogue Hi-Vision HDTV standard in favour of the digital ATSC. In addition, governmental and quasi-governmental bodies are sometimes involved to resolve standards conflicts, or to prevent companies from utilising standards anti-competitively.

Internet technologies are generally built on open standards. Organisations such as the Internet Engineering Task Force (IETF) and World Wide Web Consortium (W3C) have a commitment to open membership, processes, and distribution that differs from many traditional industry or governmental standards bodies. As the Internet grew, the two standards worlds converged to an extent. Just what is "open" is not always obvious. Standards may benefit particular companies or industry groups because they incorporate certain technologies, lock in certain forms of market power, or optimise for certain benefits, even if adoption is voluntary. Disputes about standards are thus rarely purely technical disagreements. There is also a subtle balance between the benefits of uniformity and those of flexibility and evolution, which may call for greater fragmentation.

For digital media, there are at least two prominent standards battles ongoing today. One concerns the technology for rich Internet applications, pitting Adobe's Flash against the W3C's HTML5. Flash was the primary format for most early online video activity. Adobe licensed Flash widely and it provided sufficient capabilities for video services such as YouTube. Recently, however, Flash has been attacked as being proprietary and offering poor performance. The W3C's HTML5 format has emerged as a non-proprietary alternative. Apple refused to include Flash on its iPhone and iPad devices, driving many sites, including YouTube, to shift to HTML5 for their mobile offerings. Even Adobe now supports HTML5, making it likely to emerge as the winning format. Developers appreciate the flexibility of HTML5, and the fact that it is not controlled by a single vendor. For the time being, however, users may find some videos incompatible with their devices.

The other significant battle concerns encoding technology for online videos. The most widely used standard is H.264, developed under the auspices of the International Telecommunication Union. H.264 is considered an open standard, but is subject to licensing royalties for the patents that various

companies contributed to the standard. Google introduced a competing format, WebM, which it touts as an open source, royalty-free alternative. In early 2011, Google announced that its Chrome web browser would no longer support H.264. Given Google's control of YouTube, the Android operating system for smartphones, and the Chrome browser, this decision could produce significant fragmentation if other platforms remain committed to H.264.

So far, the digital content market has been able to resolve standards battles without government intervention. As online video becomes a more significant phenomenon, the pressure may increase to avoid excessive fragmentation.

User protection

There are several additional forms of communications and media regulation designed in some way to protect end users. These include:

- Free expression. Governments have varying forms of protection for free speech and expression. In a one-way television world, the speaker is the corporate content producer and the individual is merely the audience. Today, by contrast, a substantial percentage of digital content is created by users. Governmental limits on online content distribution therefore may restrict freedom of expression.

- User choice. Competition law may restrict business models that do not provide sufficient choice to users. Sometimes similar rules operate through communications regulation. One example are *à la carte* restrictions that limit the ability of pay television providers to bundle channels. There is a complicated balance between the user benefits of choice and flexibility, on the one hand, and the potential simplicity and efficiency of bundles, on the other.

- Transparency obligations. There may be value in ensuring that users have clear and understandable information about how providers are managing networks, using their data, and otherwise providing service. Transparency rules may be considered an element of a comprehensive package of user empowerment or protective regulation, or as a substitute to express regulatory mandates. The FCC, for example, imposed a transparency mandate as a component of its Open Internet rules. The European Commission imposed transparency and privacy obligations in its Telecom Package.

ENDNOTES

[1] "Real-Time Entertainment (comprised mostly of streaming video and audio) is the largest traffic category on every network we examined. Furthermore, with the sole exception of North America's fixed access networks (where Netflix is dominant), YouTube is the largest single source of Real-Time Entertainment traffic." Sandvine, GLOBAL INTERNET PHENOMENA REPORT, 1H 2012, 24 May 2012.

[2] OECD (2007), Policy Considerations for Audio-Visual Content Distribution in a Multiplatform Environment, DSTI/ICCP/TISP(2006)3/FINAL, 12 January 2007; OECD Policy Guidelines for Digital Content, 17 June 2008.

[3] OECD, Policy Considerations for Audio-Visual Content Distribution in a Multi-Platform Environment, p. 13.

[4] This paper generally employs the term "users" rather than "consumers" or "audience" to reflect the increase in interactivity compared to traditional one-way media.

[5] Werbach, K. *A Layered Model for Internet Policy*, 1 JOURNAL ON TELECOMMUNICATIONS AND HIGH-TECH LAW 37 (2002).

[6] *A Survey of the Entertainment Industry*, THE ECONOMIST (Special Report), 23 December 1989, p. 5.

[7] *See generally* SHAPIRO, C. & VARIAN, H. (1998), INFORMATION RULES: A STRATEGIC GUIDE TO THE NETWORK ECONOMY (1998).

[8] "The average UK viewer watched 18 hours and nine minutes of commercial linear TV a week (two hours, 35 minutes a day) during the first six months of 2011, according to Barb figures published last week. That is an increase of 48 minutes a week (seven minutes a day) on the same period in 2010." James Robinson, *"Google Needs Television Industry" will be Message at Edinburgh*, THE GUARDIAN, 21 August 2011, *at* *www.guardian.co.uk/media/2011/aug/21/google-needs-television-industry-edinburgh*.

[9] I use the term "Internet" here to refer to any public or private IP network.

[10] Werbach, K. (2009) *The Implications of Video P2P on Network Usage*, in PEER TO PEER VIDEO AS A MASS MEDIUM (Columbia Institute for Tele-Information 2009).

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