

DIGITAL CONVERGENCE AND BEYOND

INNOVATION, INVESTMENT AND
COMPETITION IN COMMUNICATION
POLICY AND REGULATION FOR THE
21ST CENTURY

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MEETING ON THE
DIGITAL ECONOMY

BACKGROUND REPORT



FOREWORD

This report was prepared as part of the documentation for Panel 2.1 of the OECD Ministerial Meeting on the Digital Economy, “Improving Networks and Services Through Convergence”. It provides a discussion of convergence over broadband networks as well as its policy implications.

The report was prepared by a group of experts, including from Canada, Italy, Korea, the United Kingdom, the United States and Mexico’s Instituto Federal de Telecomunicaciones, as well as delegates from the Working Party on Communication Infrastructure and Services Policy (CISP). We would like to thank, in particular, the lead author, Kiran Duwadi, as well as (in alphabetical order), Young-gyun Jeon, Nae-Chan Lee, Paolo Lupi, Jonathan Levy, and Maria Luce Mariniello. Verena Weber of the OECD Secretariat coordinated and contributed to the report. Additional OECD staff contributors include Frédéric Bourassa, Agustín Díaz-Pinés, Hajime Oiso, and Lorraine Porciuncula.

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EXECUTIVE SUMMARY

The digital convergence anticipated during the 2008 Seoul Ministerial has become a reality. Historically, communication services were delivered via single-purpose dedicated networks (e.g. telephone, television). Communication operators across OECD countries have invested large sums to upgrade their networks to broadband Internet networks capable of supporting multiple platforms, services, and market participants. This transition is also facilitated by the commitment made by most OECD countries under their respective national broadband plans to encourage deployment and use of broadband. Many OECD countries have now moved to a state of affairs where most networks are converged. This process has been facilitated by the Internet Protocol (IP) in which “bits” are the building blocks for transmission of all content and service—all “applications.” This process of convergence is steadily deepening as technology evolves and as more and more activity shifts online.

The Internet is composed of a multitude of broadband Internet networks owned by different entities. These networks are capable of enabling new services and applications across an entire economy and embody pervasiveness, technological dynamism, and general productivity gains. Broadband Internet networks, therefore, can be regarded as *general-purpose networks (GPN)* that enable the deployment of platforms that offer a broad range of services, traffic types, applications, content, and devices.

Although the effects of digital convergence go beyond communication networks and services, the primary purpose of this report is to examine the effects of *network convergence* and its policy implications. In accordance with the 2008 Seoul Declaration on the Future of the Internet Economy and the related Policy Guidance on Convergence and Next Generation Networks, digital convergence in this report refers to “the shift towards IP-based networks, the diffusion of high-speed broadband access, and the availability of multi-media communication and computing devices.”

The modular architecture of broadband GPNs enables innovation “at the edges” without affecting the system’s overall (core) functionality or performance. For instance, GPN modules (such as network connections, transport, and service applications, including video services, and content) enable entities to innovate and introduce new products and services. On occasion, innovations at the edges have turned into “disruptive innovations” such as VoIP services. Broadband GPNs thus help create value by facilitating interactions among different market actors such as transport, application, and other service providers.

This converging environment changes the dynamics and relationships between competition, innovation and investment. Although the nexus between innovation and competition is complex, evidence suggests that innovation and investment both at the network core and edge have led to a change in the nature of competition and market structure. In particular, technological, service, and business innovations both at the core and at the edge of the network are significantly affecting competitors, investors, and consumers. This report identifies the opportunities and challenges arising from these changes and suggests policies to meet them.

Policy recommendations to address opportunities and challenges

In a constantly changing world of communications, policy makers and regulators are confronted with familiar challenges as well as new ones. The familiar challenges include the promotion of competition, investment, innovation, and consumer choice while meeting a number of social objectives such as universal service, emergency services, privacy and security. However, in a world where innovation at the core and at the edge of the network is more prominent and often disruptive and where services and applications are decoupled from the network new policy conundrums may emerge.

Meeting the growing demand for high quality connectivity. With increasing dependency on communications, connectivity becomes essential for economic and social development, and there is consensus that future demand for data will grow substantially. While demand is likely to grow across all segments of society, this is particularly pressing for individuals living in less densely populated areas, vulnerable consumers and small and medium-sized enterprises. As a result, the need for universal availability of communication services has come to the fore as well as a variety of approaches employed to ensure consumer demand can be met, either through commercial provision or, where this is not possible, through public intervention.

Competition policy to promote demand driven investment and innovation. Innovation, investment, and competition in mobile, video and traditional fixed voice marketplaces also means that markets in a GPN world change faster than in the past and so does the potential locus of innovation in the value chain. Considering there is greater potential for innovation today than in the past, policymakers need to be careful to err on the side of caution, giving greater consideration to dynamic efficiency to encourage investment and not focus excessively on static efficiency. The relative weighing will need to take the local context into account. Regulation needs to be applied carefully, mindful of unintended consequences and in a targeted fashion, with a focus on identifying and reducing rather than increasing regulatory barriers to entry where possible. This will include considering investment and innovation when deciding where in the value chain to intervene to promote competition. Policies to promote competition, innovation and investment may include: Identifying and removing or lowering barriers to entry to the market; evaluating existing public interest criteria to see whether the objectives are still relevant; and examining the continued relevance of regulatory tools to achieve these objectives.

Meeting the challenges of the trend toward consolidation in a manner that continues to protect competition and consumers. The continuing trend toward sector consolidation is likely to cause regulatory challenges in particular where it reduces the degree of competition in the market potentially leading to calls for greater regulation, for example in oligopolistic markets. Part of the response to this challenge will come in a careful review of mergers. Other policy responses may include protecting consumer choice through net neutrality rules (such as those recently promulgated in Chile, the Netherlands and the United States), or fostering competition and consumer choice through mandated network access, for example, in Europe, or measures to facilitate consumer switching. Which approach is most appropriate in a given market will depend on the specific circumstances in that market.

Symmetric sectoral regulation may need to be reviewed in light of evolving technological and market trends, while ensuring consumers and citizens remain protected. The high degree of innovation implies that many service providers are not regulated the way traditional telecommunication providers might be. This means there is likely to be a need for a review of symmetric regulation - that is, regulation applied to all providers of the same type of communications service. This may include examination of rules governing sectoral consumer protection, emergency calls, interconnection, number portability, privacy, security and media content, as well as providing national regulators powers to gather information from all relevant undertakings of the Internet value chain. In some cases, rules may need to be reconsidered, as they may no longer be necessary given changed market conditions; there may be more efficient ways of delivering the intended public policy objectives given the legitimate needs of consumers and citizens. Such reviews should also assess whether to consider extending existing rules to new parties, while being mindful of the inherent trade-offs between protecting consumers and citizens on the one hand, and the potential for damage to competition and innovation on the other. In this respect, market analyses play a crucial role in ensuring a better understanding of competition and innovation dynamics before any regulatory intervention, and, therefore, to this end, whether extended powers of information gathering are needed to sufficiently understand market dynamics is an important consideration to address the new challenges. Finally, public interest goals that remain valid should continue to be fulfilled.

INTRODUCTION

The digital convergence anticipated during the 2008 Seoul Ministerial is now a reality. Traditional telecommunication and cable operators and new network entrants have invested large sums of capital to establish or upgrade infrastructures to broadband Internet networks capable of supporting multiple platforms, services, and market participants. The transition to broadband Internet networks is also facilitated by the commitment made by almost all OECD countries under their respective national broadband plans to encourage further deployment and use of broadband.

Many OECD countries have now moved beyond convergence to a system of networks transmitting information using the Internet Protocol (IP), in which “bits” are the building blocks for the transmission of all content and services - all “applications.” A majority of information and communication technologies (ICTs), including computers, other end-user devices and the Internet, are generally considered to be a General Purpose Technology (GPT) capable of fundamentally changing how and where economic activity is organised.¹ The Internet is composed of a multitude of broadband Internet networks owned by different entities. A broadband Internet network is capable of enabling new services and applications across an entire economy and embodies pervasiveness, technological dynamism, and general productivity gains associated with a GPT. A broadband Internet network, therefore, is a general-purpose network (GPN) that enables deployment of a broad range of services, traffic types, applications, content, and devices.

Before the advent of the Internet as a GPT, most media and telecommunication services were provided via end-to-end delivery networks initially developed for a single purpose. In many cases, in order to provide service to end-users, an entity needed to have a commercial relationship with the network provider. The widespread use of the Internet and Internet Protocol-based technologies capable of delivering multiple services and applications has transformed single purpose networks into a General Purpose Network (GPN). In the GPN world, there is a kind of uncoupling, with independent application providers functioning at the “edge” of the network and end-users (generally) acquiring equipment to attach to the GPN in order to receive services. These can be services that are provided by the owner of the distribution infrastructure to which the end-user subscribes, or they can be services accessed by the end-user and supplied by application providers with no direct relationship with the distributor.² This process of convergence is steadily deepening as technology evolves and an increasing number of activities shift online.

These new, innovative (and sometimes disruptive) distribution technologies and service offerings present challenges for policymakers and regulators. It is not so much that the public policy or regulatory goals have changed, rather, there may be changes happening in terms of the entities that might be the subject of regulation and in the ability of regulators to impose and enforce regulations, as well as opportunities for lightening the burden of legacy regulatory requirements. In this environment, it makes sense to take an inventory of the changes in market structure and their implications for public policy and regulation.

In most OECD countries, for instance, policymakers and regulators have focused increasingly on innovation, whether technical or business, to foster deployment and use of broadband GPN networks. They believe that an enabling environment generally leads to a virtuous circle in which innovation in services at the edge of the GPN (i.e., applications) leads to increased demand for broadband services and networks, which in turn leads to increased investment and innovation in network infrastructure and capacity, which then stimulates further innovation at the application level. Regulators in the European Union and its Member States have been sensitive to the risk that regulation of network access can cause a reduction in incentives to invest. In doing so, they have considered the benefits of lower prices to consumers in the

short term against the benefits of greater investment and innovation in the longer term, in other words, recognising that there can be a trade-off between static and dynamic efficiency.

Competition in broadband markets should be evaluated with respect to its implications or effects on innovation at all levels of GPNs. This might require the consideration of a sort of “hierarchy of policy objectives” to be pursued by regulators, in addition to pursuing the idea of dynamic efficiency in competition policies. Whether focusing on innovation or directly on competition, it is important to evaluate the effects of public and regulatory policies on market players participating across layers of a GPN including the transport, application and service layers.

Traditional *ex ante* horizontal regulatory policies are meant to affect relationships between market players in the same industry or service. The obligations imposed under horizontal regulations including unbundling, interconnection, number portability, and rights of way are designed to have a procompetitive effect on market entry. Vertical regulation, on the other hand, affects relationships between independent market players at different stages of production or distribution within an industry or service. Proponents of vertical regulation claim that it fosters innovation that generally leads to service-based competition.

While still relevant, these traditional regulatory tools must be evaluated in terms of their effects on the market participants in a GPN. For example, not all market players participate in the transport, service and application layers of a GPN. Those who do may have a strong market position in one layer but not in others. Some market players may offer complementary services at different layers and have interdependent relationships with others. Even players with market power may see greater threats from a wider range of market participants than in traditional telecommunication networks.

However, interdependencies between market players across GPN layers, and network effects associated with such interdependencies are becoming important in shaping markets and market power. Network effects have both stabilising and destabilising effects on markets and market power. More specifically, positive network effects as a result of an early success may lead to future success and market domination. These are disruptive and destabilising effects on markets and are, thus, potentially a source of regulatory concern.

In addition, in many countries, telecommunication operators and service providers at the edge of a network most likely will be serving similar end-users. The de-coupling of services from networks in a GPN world may potentially pose challenges to policymakers in terms of whether to reduce the regulatory rules applying to the “legacy” services provided by communication operators or to extend the regulatory obligations to new service providers using a GPN, as the case may be.

Despite changing market structures and the greater scope for disruptive business models and innovative technologies, the common policy goals, including competition, investment, and innovation remain valid. The policy and regulatory framework fit for the GPN world should not only tackle how best to achieve these objectives, but also fulfil public policy objectives created in the traditional telephony environment, which still have a strong resonance today, such as in the areas of consumer protection, media content, privacy, public safety, universal service and provision of emergency services.

Furthermore, with increasing dependency on GPNs for the provision of a variety of services and applications, connectivity to such networks has become essential for economic and social development. As a result, policies to promote universal availability of GPNs, especially in traditionally underserved and unserved areas, have gained additional importance.

There is a greater potential for innovation in today’s GPN world than in the past. The challenge for policy makers and regulators will be to identify where in the value chain to intervene in order to promote

competition. This report attempts to identify policies and regulations that will complement market mechanisms to optimise incentives for all market players to innovate, compete, and invest along the entire GPN value chain, in order to benefit individuals, communities and business users.

The continuing trend toward sector consolidation is likely to cause regulatory challenges, in particular where it reduces the degree of competition in the market. This report attempts to identify policies that promote competition while protecting consumers. Further, the report also addresses the relevancy of traditional regulatory models in a GPN world and whether regulators and policymakers have adequate tools and mandates to meet the challenge. More specifically, this report examines the need for a review of symmetric regulation - that is, regulation applied to all providers of the same type of communications service.

In accordance with the 2008 Seoul Declaration on the Future of the Internet Economy and the related Policy Guidance on Convergence and Next Generation Networks, (OECD,2008) digital convergence in this report refers to “the shift towards IP-based networks, the diffusion of high-speed broadband access, and the availability of multi-media communication and computing devices.”Although the effects of digital convergence go beyond communication networks and services, adequate treatment of other aspects of the new digital economy, including digital services, platforms, and converging communications networks (as opposed to the public Internet), would require a separate study beyond the scope of this report.

This report is divided into three sections. The first (“background”) section describes broadband as a general-purpose network and its modular architecture capable of supporting multisided platforms that promote innovation. This section also describes relationships between competition and innovation and any potential policy trade-offs between innovation and competition. The second section of the report describes competition, innovation, and investment within and on the GPNs with respect to applications, distribution, and customer equipment. This section also identifies potential vertical and horizontal market issues. The final section uses the description of market developments to date to identify the policy challenges mentioned above and outlines some initial recommendations to meet such policy challenges.

BACKGROUND

Broadband as General Purpose Network

One of the major consequences of widespread use of broadband Internet networks is the transformation of *special purpose service delivery* networks e.g., telecommunication, and cable television to *general-purpose networks* capable of supporting multiple applications and services including transmission and connectivity (Bauer, 2010, 2014). General-purpose networks (GPNs) like the General Purpose Technologies (GPTs) are considered vital to the functioning of a large segment of existing or potential products and production systems (Bresnahan and Trajtenberg, 1995) (Box 1).³

Many applications across sectors use GPNs, and, therefore, generally benefit from architecture that enables decentralised end-user customisation. A modular architecture incorporates such flexible functionality where internal structure is designed independently, but, when combined, functions as an integrated whole (Baldwin and Clark, 2000). Modularity in this sense also suggests “organising complements (products that work with one another) to interoperate through public, non-discriminatory, well understood interfaces” (Farrell and Weiser, 2003).

Box 1. General purpose network

The 2008 OECD Report on "Broadband and the Economy" describes broadband as a general-purpose technology enabler. The report anticipated that broadband would replicate and surpass the hugely positive and transformative effects of other “enablers” including electricity, railways, and steam technology. In this report, a broadband network is defined as a General Purpose Network (GPN), which, using multiple distribution technologies, enables deployment of IP-based services, applications and content in various devices. Like other enablers, GPNs include three distinct characteristics: pervasive, technologically dynamic, and conducive to innovation leading to general productivity gain.

For example, “broadband can be used as a key input in nearly all industries. Second, broadband has the potential for technological dynamism through the development of new technologies, as well as improvements to the capacity and speed of broadband systems. For example, the average global broadband (wireline and wireless) speed in mid-2011 was 2.6 Mbit/s, with the top 20 countries having average speeds of over 7.6 Mbit/s, which allows services and applications requiring higher bandwidth, such as streaming video, to develop and become accessible to users. Third, broadband has the potential to enable and engender new organisational methods that result in more general increases in productivity.”

Sources: OECD, Broadband and the Economy; World Bank, “Why Broadband “available at <http://broadbandtoolkit.org/1.3>.

A modular architecture does not necessarily lead to a modular business relationship. The traditional “public switched” telephone networks despite their modular architecture (e.g. equipment including phones and transmission services), largely remained a vertically-integrated industry. Broadband Internet networks consisting of network connections, transport, and service applications modules, have hastened disintegration of both horizontal and vertical business relationships. The vertically integrated “all-in-one” business practices of the telephone operators who provided connectivity, transport, and services are

uncoupled in broadband GPNs, where services are provided separately from the connectivity and transport-related functions of a network.

The emergence of broadband GPNs has given rise to new business models that value “permission-less innovation” and innovations that are independent of the network. The strong complementarity between network, applications, and new devices has also led to the creation of a new value chain or “platformisation” strategy where market players operating in different layers of GPNs rely on their specific assets (for example, content, networks, and search engines) to reach different groups of customers and enter different markets.

The transformation from special purpose service delivery networks to broadband GPNs has supposedly affected the realm of business ethos as well (Feasey, 2015). Whereas traditional telephone operators emphasise reliability and predictability, companies providing services and applications using broadband GPNs tend to be more innovative and opportunistic. Changes in business ethos and business models are accompanied by changes in revenues and profits. Some argue that the broadband GPNs have facilitated a net transfer of revenues from network operators to service and edge providers and consumers, leaving fewer resources for investment and innovation in network infrastructures. Admittedly, this has undoubtedly created demand for broadband access alongside changes in the size and shares of revenues and also provided additional competition as well as a range of innovative services for users.

Modularity and innovation

A modular architecture, by encouraging decentralisation and a method of upgrading or remixing new configurations without affecting a system’s overall (core) functionality or performance, enables innovation “at the edges.” Broadband GPN modules (such as network connections, transport, and service applications, including VoIP and video services, and content) enable entities to innovate and introduce new products and services. On occasion, innovation at the edge has turned into “disruptive innovation,” where introduction of new applications and services takes market share from (and may eventually displace) well-entrenched market players. One such example is the Over the Top (OTT)(OECD, 2014a) provision of voice, video, and data services over fixed and mobile networks. OTT providers have become a competitor to incumbent operators. However, most, if not all OTTs are provided over incumbent operators’ networks, meaning that OTTs are therefore reliant on them to some degree.

Advances and innovation in unlicensed wireless spectrum are also considered by some as disruptive to the prevailing technological and market structure. Other technologies including mobile Internet, cloud technology, and the Internet of Things (IoT) are often identified as having the potential to “disrupt the status quo, alter the way people live and work, rearrange value pools and lead to entirely new products and services” (McKinsey Global Institute, 2013).

Innovation, however, is not tied exclusively to providers operating at the edge of networks. Innovation in the broadband Internet network infrastructure is also possible. For example, wireless operators, by introducing 3G and most recently 4G LTE, have proven that they are capable of broadband infrastructure innovation. Some are of the view that the propensity to innovate depends on where the regulatory obligations fall. They contend that vertical obligations, including network neutrality rules, promote innovation and investment by the edge providers at the potential expense of rewarding investment and innovation in network infrastructure. Others contend that vertical obligations such as network neutrality rules can facilitate innovation and investment at the core and the edge of a network.

Although modularity promotes innovation and competition, it has its own set of issues. A modular relationship may increase the cost of coordination between entities that provide different functions of an end-to-end service. Some contend that modularity introduces a “free rider” dynamic, as services can be

offered with the ownership of little or no network infrastructure.⁴ In a GPN world, others see all entities as autonomous and bringing their own contribution to value chains, with many larger OTTs and Content Delivery Networks (CDNs) investing in their own private infrastructure for content distribution. The disintegration is often between the service and the local access network that reaches end-users.

Multi-sided platforms

Increasingly, complementary technical and industry modules are assembled to create a platform used to support a value chain.⁵ For example, broadband GPNs, by providing connectivity and lowering transaction costs, help create value-creating interactions between transport, application, and other service providers. Therefore, a multi-sided platform (MSP) capable of supporting different types of services, applications and market players has a wider reach, as well as greater interdependencies among the market players, than the traditional service specific platform supported by traditional telecommunication networks.

MSPs are normally efficient, acting as intermediaries between the two or more distinct sets of customers, where transactions costs or asymmetries of information are such that the parties could not negotiate their way to an equally efficient outcome without the platform. While it is possible that competitive concerns are reduced if consumers on both sides “multi-home”, i.e. use more than one platform, this may also reduce the efficiency benefits the platform brings. Regulators tend to have few instruments at their disposal to address competition challenges resulting from indirect network effects. Indirect network effects are at work where the popularity of a product, a service or a platform rises exponentially with the number of its users, or its contributors. This can, in some cases, lead to some products or services becoming a strong force in the market and remaining so for quite a long time, in particular once a critical mass has been achieved (also referred to as ‘tipping’). However, often the advantage of such a platform or service may be short-lived if it is “leap-frogged” by another.

MSPs can also be subject to various types of market failure, including externalities and coordination problems. Moreover, the presence of network effects can magnify the “first-mover” advantage and potentially lead to a “winner takes all” outcome which, in the long run, could inhibit both competition and impede further innovation.

While competition challenges have often been dealt with in *ex-post* competition cases under antitrust rules, (Evans, D 2011) S in regulated markets, these concerns are becoming more frequent. In many instances, the analyses do not take into account the multi-sidedness of the markets⁶, and treat them as a one-sided supply chain. In principle, network effects should be an important component of any analysis where a provider sells bundled services and where the components of the bundle are highly complementary, that is, where a significant proportion of consumers will only buy one part service if it is bundled with another. This may, for example, be the case with certain types of content, or any other service that drives take-up of a particular network technology.

Regulatory tools including regulating entry, regulating price schedules, setting quality and service standards, and imposing non-discriminatory trade practices, may not be sufficient to influence all issues associated with a MSP. Boudreau and Hagiu (2011), after examining several case studies, contend that more research is needed to understand the economics of non-price mechanism used by MSPs. They further contend that “the sheer number of and complexity of instruments being used by platform owners (including investments, technology rules, information dissemination, contracting choices and pricing) is also clearly an empirical phenomenon deserving closer attention and clearer explanation” (Boudreau and Hagiu, 2011).

Competition and innovation

Competition and innovation share a complex relationship. While both competition and innovation benefit society and economic welfare, more competition leads to better allocation of resources, greater consumer choices and welfare in the short run - this is termed “static efficiency”. Competition also encourages firms to innovate, whereby firms race to invest to benefit from a temporary competitive advantage thereafter – usually termed “dynamic efficiency”. However, there is often a trade-off between static and dynamic efficiency, because in the longer term, lack of competition or the threat thereof can diminish a firm’s incentive to invest.

Early economic literature on the relationship between innovation and competition shows a nexus between market structure and innovation, where greater market power leads to larger “rents” available for innovation and research and development. This view, advocated almost seventy years ago by Joseph Schumpeter, suggests that a less competitive but dynamic market (one that is conducive to innovation and long-run economic growth) could be more beneficial to society than a competitive market that strives for short-run efficiency gains. Some, citing industries with significant sunk costs, have argued that oligopoly rather than perfect competition is most conducive to innovation and investment (Bauer, 2010, 2014). A competing view on competition and innovation put forward by Kenneth Arrow suggests that market power would lower the incentive to innovate and invest. A monopolist, therefore, is less likely to innovate because any addition of new products or services may not significantly increase its current market share. In a competitive market, however, firms may gain market share by introducing new products and services.

John Sutton (1998), citing manufacturing industries with high levels of market concentration, is one expert who contends that oligopoly, rather than perfect competition, is most conducive to innovation and investment. According to Sutton, under certain circumstances, in industries with high endogenous sunk costs (e.g. optional fixed investments in quality, advertising, and cost-reducing plant that allow the firm to raise its price or lower its variable costs), market expansion will lead to a reduction in the number of firms. Unlike the linear relationship between innovation and competition implied in the work of Schumpeter and Arrow, the explanation of the effects of market structure on innovation reveal a non-linear relationship between market concentration and innovation where: Once market size reaches a critical value, and if the endogenous sunk costs are high, innovation and investment will increase with an increase in market size and market concentration (Shiman, 2008; Sutton, 1998).

More recent empirical studies examining the relationship between competition and innovation also show a non-linear relationship in the form of an inverted U-shape. Aghion et al. (2005) have shown that firms that are competing side-by-side in this type of economic ecosystem will have more incentive to innovate to “escape the competition.” In contrast, competition may reduce the incentive to innovate in a situation where firms are laggards.

The above discussions present conflicting views of innovation and competition. Jonathan Baker (2007) synthesised these views into four principles that may be useful to policymakers. First, according to Baker, competition among firms seeking to develop similar or new products or processes encourages innovation. Second, competition among rivals producing an existing product encourages firms to lower costs, improve quality, or develop better products. Third, firms that expect to face more product market competition after innovation have less incentive to pursue innovation. Finally, a firm will have an added incentive to innovate if, in doing so, it can discourage potential rivals from investing in research and development.

While the first two principles lead to situations where competition promotes innovation, the latter two principles convey a different story. The third and the fourth principles lead to either less innovation in

situations with increased post-innovation product market competition or increased post-innovation market concentration because of pre-emptive actions taken by the incumbent firms.

Notwithstanding the complex relationship between competition and innovation, a generally held view is that “competition does not just lead firms to produce more and charge less; it encourages them to innovate as well.” However, any policy giving prominence to innovation may involve a policy trade-off between short-term static efficiency and long-term dynamic efficiency. This is a tension that has long been recognised in regulatory economics. For instance, the recitals to the European Union Access Directive (2002) outline this trade-off in the following terms:

“Mandating access to network infrastructure can be justified as a means of increasing competition but national regulatory authorities need to balance the rights of an infrastructure owner to exploit its own infrastructure for its own benefits and the rights of other service providers to access facilities that are essential for the provision of competing services. ... The imposition by national regulatory authorities of mandated access that increases competition in the short-term should not reduce incentives for competitors to invest in alternative facilities that will secure more competition in the long-term.”

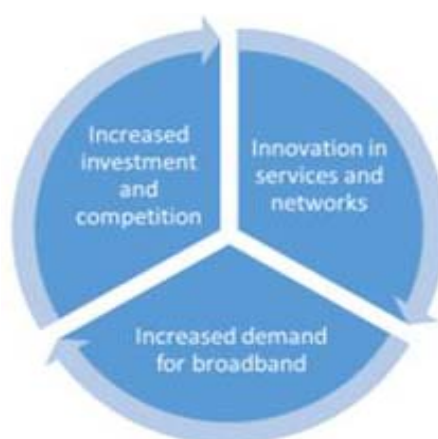
The nexus between competition and innovation and investment is a complex one. Even when innovation affects competition, it is not always clear how best to promote innovation without favouring a particular market participant. Similarly, policies promoting competition should be evaluated with respect to the evolving market and technology scenarios and their effect on innovation. A possible solution would be to evaluate each case on its own merit to determine whether any regulatory action is needed to balance conflicting objectives.

VIRTUOUS CIRCLE: INNOVATION, COMPETITION, AND INVESTMENT WITHIN AND ON THE NETWORKS

Broadband GPNs are vital to the functioning of a large segment of existing or potential products and production systems and are a proven catalyst of economic growth.⁷ To facilitate further deployment of broadband GPNs and sustained economic growth, the European Commission, in its “Digital Agenda” framework (2010), proposes to speed-up economic recovery and to lay the foundations of a sustainable digital future by removing current obstacles to maximising the potential of information and communications technologies and by ensuring long-term investment in the sector. More specifically, the Digital Agenda for Europe (2010) proposes, “Europe needs to ... create a virtuous cycle in which ICT stimulates the EU economy. This can happen when attractive services are made available in a borderless on-line environment and their availability and use creates demand for faster Internet. This demand for faster Internet, in turn, creates investment opportunities in faster networks. When put in place and widely used, the faster networks open the way for even more innovative services.”

In its 2015 Open Internet Order, the United States’ Federal Communications Commission (FCC) also reaffirmed policies promoting the virtuous circle “in which innovations at the edges of the network enhance consumer demand, leading to expanded investments in broadband infrastructure that, in turn, spark new innovations at the edge.” Policies promoting the virtuous circle are said to be behind the increased investment by broadband providers in the amount of USD 212 billion between 2011 and 2013, more than any three-year period since 2003 (FCC, 2015b). Others contend that innovation and investment evolve around the interaction between the network core and edge applications. In this formulation, the causality in the virtuous circle, unlike the one shown in Figure 1, rotates both clockwise and counter-clockwise, i.e. investment in broadband GPNs lead to increased applications and vice versa. (Bauer J and Guenter K, 2015) and Ilsa Godlovitch, Iris Henseler-Unger, and Dieter Elixmann 2015)

Figure 1. Illustration of the virtuous circle



Policy initiatives are underway in OECD countries to promote the “virtuous circle” (Figure 1). For example, in Mexico, the recent constitutional reform promoting the construction of new infrastructure, intended to promote widespread broadband services by a public-private wholesale access carrier as part of

the 700 MHz band, aims to increase competition and expand broadband access. The reform also promotes competition by issuing “convergent licenses” to provide all services.⁸ For example, the *Instituto Federal de Telecomunicaciones* (IFT), responsible for telecommunication regulation in Mexico, carried out an auction for 80 MHz of the AWS spectrum for the provision of mobile wireless access on February 2016⁹ and has announced that it will undertake an auction of 2.5 GHz in late 2016/early 2017.¹⁰

Initiatives abound in countries such as Japan and Korea. Building on their existing scope of fibre deployment, they are moving forward with the next generation of wireless networks. This was undertaken in association with the upcoming Summer and Winter Olympics in both countries, but in the longer term, the enhancement of GPNs will be vital to their respective digital economies. In association with these initiatives, Korea has made spectrum available for the introduction of a fourth mobile network operator, while Japan has introduced a number of measures to increase competition and empower consumers, including by examining how to make it easier for mobile virtual network operators to compete in that market. (Gabriel C, 2015) Meanwhile, countries such as Australia and New Zealand continue their roll-out of broadband Internet networks using a mix of all technologies including fixed, wireless and satellites to ensure GPNs are deployed as widely as is practically possible.¹¹ In both countries, the aim is to leverage the substantial public investment in broadband GPNs to attract private investment, further competitive choice for consumers and to encourage innovation in areas such as the “Internet of Things” in all geographical areas (e.g. the potential to use satellites as backhaul for terrestrial wide-area wireless networks, thus enabling large numbers of sensors to transmit data via low-power in rural and remote areas). Moreover, in its recent review of wholesale wireline regulation, the Canadian Radio-television and Telecommunications Commission (CRTC) mandated access to fibre to the home facilities. This determination will ensure that Canadians have more choice for high-speed Internet services and are able to leverage the benefits of broadband for home or business. The regulator recently stated that this “increased choice is expected to drive competition, resulting in further investment in high-quality telecommunications networks, innovative service offerings, and reasonable prices for consumers.”¹²

In a recent article, Tennenhouse and Gillette (2014) contend that although liberalisation and competition policies were instrumental in increasing the deployment and use of broadband GPN around the world, significant gaps in coverage provided by broadband GPNs still persist. They propose a reevaluation of existing public policies to emphasise an “innovation first” approach to encourage innovation within and on the network to reap the full economic and societal benefits of the broadband GPN. More specifically, Tennenhouse and Gillette contend that, traditionally, policy makers and regulators in developed economies pursued a “coverage-primary” approach that was supplanted by a “competition-primary” approach towards the end of the 20th century. While the competition-primary approach supposedly led to expansion in coverage and productivity improvements within the network, the approach also facilitated innovation on the network, from data modem, Internet access, cordless phones to, more recently, smartphone applications and cloud-based services. Elevating innovation to a priority in its own right purports to create value through gains in production efficiency within the network and by fostering the creation of new firms, activities, and services at the network edge. Tennenhouse and Gillette also envision a virtuous circle where innovation and introduction of new techniques and products stimulate competition, investment, and market entry that may help to address the lack of broadband in unserved and underserved areas. They contend that innovative uses of new technologies. These include multi-standard network equipment based on software-defined radio to provide broadband Internet access in rural Vermont State in the United States, and the use of television ‘white spaces’ (unused portions of the television spectrum) to increase availability of broadband Internet in previously unserved and underserved areas, most notably in a number of remote areas in Africa.

Evidence shows that service and application level innovations are taking place at the edge of the network, carried out mostly by new entrants to ecosystems, thus leading to competition and additional choices for consumers (Teece, 2012). For example, as recently as 2008, smartphone device-maker Apple

introduced the “App Store” (Application Store) in its device. This business model innovation has given birth to the mobile “app economy”, which was said to be USD 87 billion in 2014 and projected to grow to USD 150 billion by 2017 (Bernard and Godfrey, 2014).¹³ More recently the mobile app industry has spawned a “sharing economy” that allows individuals to share anything from rooms to equipment for a fee. The home and room rental site “Airbnb”, for example, which provides matching services to hosts and guests, is expected to generate USD 850 million in revenue in 2015. (Winkler, R and Douglas MacMillan, 2015).

While the app economy may compete with “traditional” network investors to some extent, it is likely that it displaces more revenues from traditional off-line intermediaries. These include travel agents and hotels (in the case of Airbnb), payment systems (banks and payment networks), and taxis and taxi-firms (Uber, Lyft). Technological innovation may also upend the market structure and its participants. Following the launch of cellular technology in the 1990s, today, many households in OECD countries do not have traditional fixed-line connections and rely solely on the use of mobile phones to communicate. For traditional services such as telephony, many developing countries have moved directly to supporting mobile networks, thus achieving high penetration rates that had not proven possible for fixed networks. Nonetheless, broadband fixed-lines continue to be the standard for new services in households, even when consumers also use wireless devices. Also, backhaul remains a challenge, especially in areas that did not inherit extensive telecommunication networks. Today, the use of Wi-Fi technology by new entrants to provide broadband and applications is considered a source of disruption affecting incumbent broadband providers, as well as an essential tool for those providers to meet increased demand for Internet services.

The above discussion indicates that innovation and investment, both at the network core and edge, would lead to a change in the nature of competition and market structure. Below are examples of investment, innovation, and competition within and on the edge of GPNs. The discussion is organised along technological, service, and business model innovations within the network that primarily improve network efficiencies, and innovation at the GPNs edge. These innovations are associated with new product, applications and services, including the OTT services that are provided by entities other than the network owners.

Innovation within the network core

Technological innovation

Mobile Network Operators (MNOs) continue to introduce new technologies to provide broadband services. New technologies include both advanced transmission standards and new mobile devices, all enabled by the allocation of additional spectrum for mobile broadband usage. The latest technology in widespread use, 4th Generation Long Term Evolution (4G LTE), under certain conditions, (such as the level of concurrent usage), is able to deliver mobile broadband data, voice, and video at a speed similar or faster than some fixed broadband services. The introduction of LTE has also accelerated the transition from a legacy network to an IP-based network. In OECD countries, major carriers have rolled-out 4G LTE technologies primarily to compete in the mobile marketplace. They are also adopting LTE technology to reduce cost through more efficient use of spectrum (Paolini, 2012). As of January 2014, 98.5% of the population in the United States was covered by a 4G LTE network, and Japan, Korea, Norway and Sweden have also been early adopters. In Europe, the United Kingdom has the largest share of 4G LTE subscribers. Regulators in Denmark, Slovenia and the United States have also identified 4G LTE as a means of improving broadband coverage in rural, unserved and under-served areas. Carriers in a number of OECD countries have announced plans to trial the next generation of wireless technology (i.e. “5G”, though this is a technology that is not uniformly conceptualised at this stage).

In the United States, the FCC's "spectrum frontiers" proceeding holds the potential to unlock vast millimetre-wave bands for mobile use, particularly for use by 5G mobile services. Previously, bands above 24 GHz were believed to be infeasible for mobile use due to their straight line propagation and atmospheric absorption characteristics. However, as technologies continue to evolve, innovators are working to tap into the potential of using millimetre-wave bands for mobile services, and the promise of high capacity data transfers from these millimetre-wave bands could be a useful supplement to the mobile services offered in lower bands. The respective FCC Notice of Proposed Rulemaking (NPRM) also proposes a variety of licensing mechanisms with the goal of developing flexible rules that will accommodate a wide variety of current and future technologies.

In addition, in 2015, the FCC established a three-tiered spectrum authorisation framework to facilitate a variety of small cell and other broadband uses of the 3.5 GHz band on a shared basis with incumbent federal and non-federal users of the band. The three tiers of users, in order of priority, are: Incumbent Access, Priority Access, and General Authorised Access ("GAA"). Incumbent Access users will be protected from harmful interference from Priority Access and GAA users. Priority Access licensees will receive protection from interference from GAA users. Access and operations will be coordinated by a dynamic spectrum access system ("SAS"), conceptually similar to – but more technologically advanced than – the databases used to manage Television White Spaces devices.

The most far-reaching innovation in the mobile industry is taking place in mobile handheld devices. In some OECD countries, the increasing provision of mobile and fixed services using converged cellular/Wi-Fi or cellular/Bluetooth dual-mode handsets has unleashed competition between MNOs and mobile device makers. Almost all incumbent mobile operators in OECD countries are offering inclusive Wi-Fi access services to their customer base. For example, AT&T has a Wi-Fi offering in the United States, as does Telstra in Australia, as well as every MNO in Japan. Part of the rationale for this shift into Wi-Fi may well be the protection of market share even at the risk of a certain erosion of revenue. However, it is also aimed at moderating congestion in places of intense use, such as city centres, by offloading data to Wi-Fi hotspots.

Over the past few years, mobile operators such as Iliad Free in France, TeliaSonera in Sweden, Swisscom in Switzerland and NTT Docomo in Japan have begun to offer Extensible Authentication Protocol (EAP-SIM), as a way of automatically identifying their subscribers to seamlessly connect to Wi-Fi networks managed by the operator. In particular, Iliad's Free Mobile service provides access to the Wi-Fi enabled by the operator's more than four million fixed broadband set-top-boxes, thus serving as a gateway for Wi-Fi offloading. Free Mobile's subscribers connect automatically to the community Wi-Fi network using a dedicated, personal IP address. The SIM card takes care of authentication, so users do not need to enter an identifier to connect to the community network, making it seamless from their perspective.

In North America, several cable broadband Internet networks have also placed an emphasis on Wi-Fi rather than building their own mobile networks. In 2011, Shaw Communications decided not to use spectrum it had purchased, instead leveraging its fixed cable network to offer Wi-Fi to its subscribers. Shaw's Wi-Fi network has been expanded to over 70,000 sites across Western Canada (Trichur, 2014). Similar to the Free Mobile example, after an initial authentication, customer devices connect automatically to Wi-Fi hotspots. Apart from apps provided by the company for access to cable television, call forwarding and voice mail, Shaw subscribers can, of course, access the Internet using data included in their capped bundle.

In the United States, Comcast's Xfinity service is a further example of cable companies competing with mobile operators via Wi-Fi hotspots, enabling its users to consume data without concern for data caps. Comcast's smartphone app also allows them to check their Comcast email, send and receive text messages, make and receive voice calls (forwarded from the home phone) and voicemail all in one place. They can

also make unlimited voice calls using dedicated numbers if included in their cable package and can send and receive free unlimited text messages with no text plan required. In addition, users can send and receive free unlimited text messages to the United States, Canada, Mexico, and over 40 other countries using their home phone number, with no text plan required. The United Kingdom has seen, and continues to see, investment in Wi-Fi hotspot availability from major communication providers with strong competition existing between BT and Sky (“TheCloud”) and the United Kingdom’s cable operator (Virgin Media).

MVNOs are often seen as a source of disruption and innovation in the mobile space. In assessing the wireless market in Canada, the CRTC noted that the presence of smaller wireless carriers, including new entrants, has contributed to the overall competitiveness of the retail wireless market. In addition, the CRTC found that MVNOs can play a role in increasing consumer choice and value in the retail market. The regulator took action to reduce certain barriers faced by MVNOs, including prohibiting restrictive provisions in wholesale roaming arrangements, and allowing full MVNOs to acquire mobile network codes. These actions will further the development of a competitive market for wholesale network access, and accelerate offerings of innovative wireless services.

One of the implications of the increasing use of Wi-Fi technology is that some mobile devices will no longer be tied to a mobile network operator, so that the device is able to react opportunistically to use the “best” network, regardless of the use of the cellular network or Wi-Fi to connect to a fixed network. From the device perspective, the cellular network is just one possible supplier of transmission services, and other options, including Wi-Fi, Bluetooth and USB ports could also be used. The device is thus able to make “independent” choices based on its own preferences. As a consequence, operators gradually have lost influence over terminals and significant control over these devices has been taken by two main operating systems.

Once the device itself is able to connect to other access networks, mobile data network operators may find it more challenging to maintain a price premium for their mobile broadband service, though pure “mobility,” as compared to “portability,” may continue to be tied to mobile network operators. Nonetheless, this is one reason the margins for mobile network operators are under constant competitive pressure.

Several technical solutions are already available to support the trend of employing Wi-Fi networks to compete with or complement mobile cellular networks. Carrier hand-off, VPN or multipath TCP approaches can be used to achieve seamless hand-over between Wi-Fi hotspots, from cellular to Wi-Fi or *vice versa* without this being perceived. This has significant implications for providing calls in various FMC – Wi-Fi scenarios, and, therefore, raises both business models and regulatory considerations in areas such as the provision of emergency calls.

As Wi-Fi is usually first deployed in dense areas and coverage distances are relatively short, the implications for competition may vary depending on the region or areas. Coverage data collection by regulators, including broadband maps can help track Wi-Fi deployments.

In April 2015, Google unveiled its *Fi* service that allows Google’s Nexus phones to switch automatically among mobile networks and local area Wi-Fi networks depending on relative signal strength of mobile and Wi-Fi networks (Metz, 2015). Google’s Nexus phones are now equipped with wireless radios that can work with both GSM and GSMA mobile standards, and Google expects to have *Fi* services available on a broader range of devices in a short span of time. With the offering of *Fi* service, Google essentially became the first operating system provider to become a MVNO, which is consistent with the steps taken by others in the value chain to challenge MNOs.¹⁴ Google states that users can seamlessly move and hand over their call from Wi-Fi to the cellular network with continuity, which was previously only possible between MNO’s cells.¹⁵ Re-programmable and virtual SIMs launched by Apple, Huawei and

Xiaomi for some devices are also examples of partially replacing the role of MNOs, in response to customer demand for more flexible and competitive international mobile roaming offers. They demonstrate how convergence between different players is occurring as entities reach into the traditional roles played by other parts of the value chain.

Software defined networks (SDNs) are another example of innovation within the network. Current generation communications networks comprise a number of different equipment types, each offering specific functionality and capacity. This is a consequence of different parts of the network facing different traffic demands in terms of the physical interfaces and protocols that are used and the volume of traffic that is handled. However, the deployment of separate equipment to support each function can lead to over-provision, sterilisation or inflexibility in the face of changing bandwidth demands, and, therefore, can result in relatively inefficient network use. The underlying protocols and functionality required of these network elements are converging towards IP packet transmission and routing. This raises the opportunity to rationalise the number and type of elements deployed in practice.

SDNs have been proposed as an enabler for such network rationalisation. In this new architecture, generic servers replace dedicated network elements. In so doing, less physical equipment is required, but these can be upgraded more easily as they use common off-the-shelf components. Furthermore, additional functionality can be introduced via software updates as opposed to physical change-outs. This should result in a lower-cost, more flexible network infrastructure.

SDNs could facilitate the introduction or growth of network technologies such as CDNs (Content Delivery Networks), C-RANs (Cloud-Radio Access Networks), Cloud PVRs, Filtering and APIs (Application Programming Interfaces). In turn, these facilitate the provision of newer and better on-line services. However, they could also raise a number of important policy issues including access to dark fibre, traffic management and thus future implications for policies related to network neutrality, filtering, and effects on API development.

Service innovation

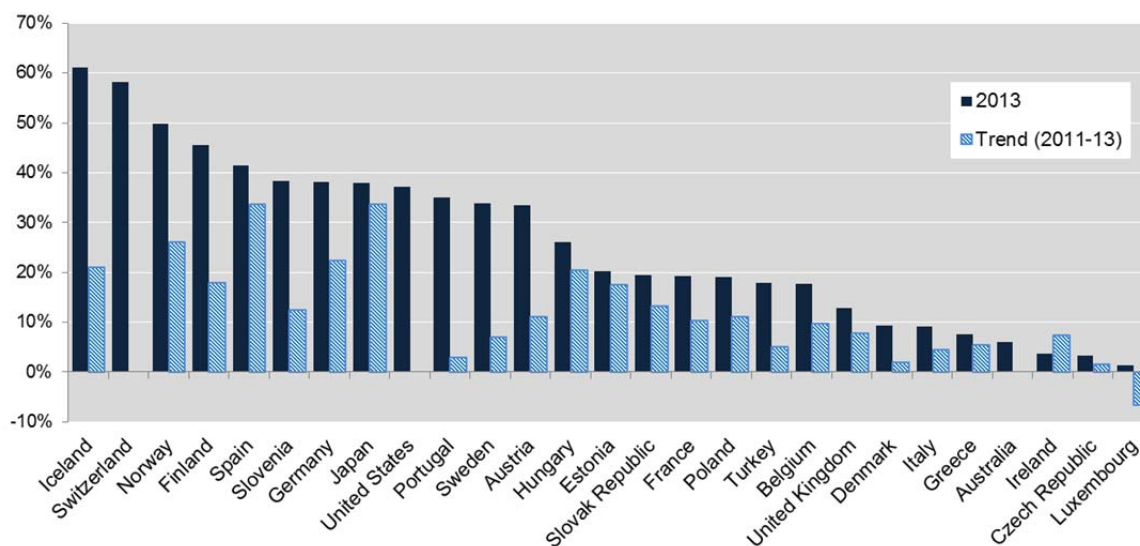
This section discusses how innovation within the networks has led to the convergence of traditionally stand-alone services, most notably fixed-to-mobile substitution.

Innovation on and additional investment in IP-based mobile networks are increasingly blurring the line between fixed and mobile services. More specifically, the transition from voice toward data-centric mobile networks and services is driving fixed-to-mobile convergence where increasingly service bundles, devices (e.g. smart phones used for both fixed and mobile access) and applications (e.g. network-agnostic VoIP and video streaming) are used to access services, and content. Innovation is expected to surge as seamless transfers between fixed and mobile networks, devices and services become available. Although fixed-to-mobile convergence (FMC) has the potential of redefining markets for fixed and mobile services, the evidence so far suggests that substitution between fixed and mobile services is asymmetric with consumers substituting fixed with mobile but not *vice versa*. In addition, differences in preferences and usage pattern and characteristics of fixed and mobile services have led many regulators to refrain including these services in the same retail markets (BEREC, 2012). Nevertheless, the effect of FMC is now witnessed along different parts of the mobile value chain including manufacturers, operating systems, network providers, advertising intermediaries and OTTs.

Dual fixed and mobile access to the Internet is gaining popularity among consumers. Statistics from national surveys show that a growing number of households in the OECD arena are using both fixed and mobile connections to access the Internet. In 2013, above 50% of households in Iceland and Switzerland and above 40% of households in Norway, Finland and Spain (Figure 2) had dual access to the Internet.

None of this is surprising given the complementary nature of fixed and mobile broadband. According to Cisco's 2016 VNI report, "46 percent of total mobile data traffic was offloaded onto the fixed network through Wi-Fi femtocell in 2014." On the supply side, 45.2% (47 among 104 surveyed) of fixed network operators in the OECD arena have some integrated offers that include mobile connections in addition to fixed, and 58.6% (61) of those fixed operators have also some mobile operations either in the form of MNO or MVNO (OECD, 2015).

Figure 2. Percentage of Internet connected households having dual access



Note: Mobile and fixed broadband.

Source: OECD (2015), OECD Digital Economy Outlook 2015, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/9789264232440-en>.

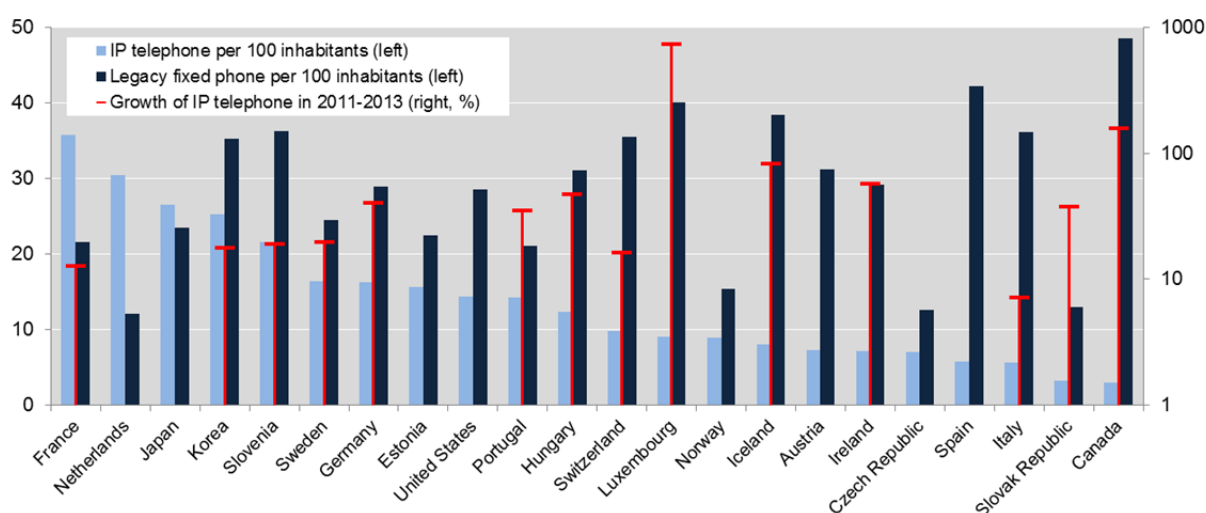
In some cases, households use mobile-only connections to access the Internet. In Australia, Austria, Finland, and Italy, mobile-only households represent more than 25% of all households connected to the Internet. Evidence from countries with less competitive fixed-line markets indicates substantial quality differences with respect to the stability of connection or severe limitations on data consumption compared to the fixed networks. In addition, in some countries (such as in Australia, where there are regions with low population densities), fixed wireless services are provided by mobile networks and utilised by consumers in the absence of fixed broadband access but at substantially high rates. Despite efforts by fixed operators to provide faster download speeds, a growing number of users, such as those with limited incomes, are likely to favour mobile-only options if they have ready access to Wi-Fi at work or school. Given that fixed broadband subscribership is generally not decreasing, this suggests that mobile-only households may be getting their first broadband connection rather than performing "cord-cutting".

It should be noted that, until the late 1990s, regulation of telecommunication networks was largely voice-centric. In addition to regulatory provisions for the development of competition, operators facing liberalisation, as well as operators with a strong market position in voice telephony markets were subject to a number of obligations aimed at extending telephone service coverage and adoption (i.e. universal service obligations or network extension plans), access to emergency calls, transparency obligations in voice service contracts and number portability requirements.

Traditional fixed-line telephony has been declining in the OECD area, largely due to the rise of mobile service (fixed-mobile substitution) and to the increased use of managed IP-based voice telephony. A number of popular applications, including Skype, Viber, WhatsApp or Apple's FaceTime are also fuelling the growth of non-managed OTT voice service.

In the OECD area, the number of fixed telephone access subscriptions declined 4.24% per year between 2003 and 2013 (OECD, 2015). Managed IP-services provided by operators have also been increasing as measured against total population, although data are not yet available for all OECD countries (Figure 3).

Figure 3. Penetration of IP telephony (excluding softphone) and legacy fixed phone



Source: OECD (2015), OECD Digital Economy Outlook 2015, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/9789264232440-en>

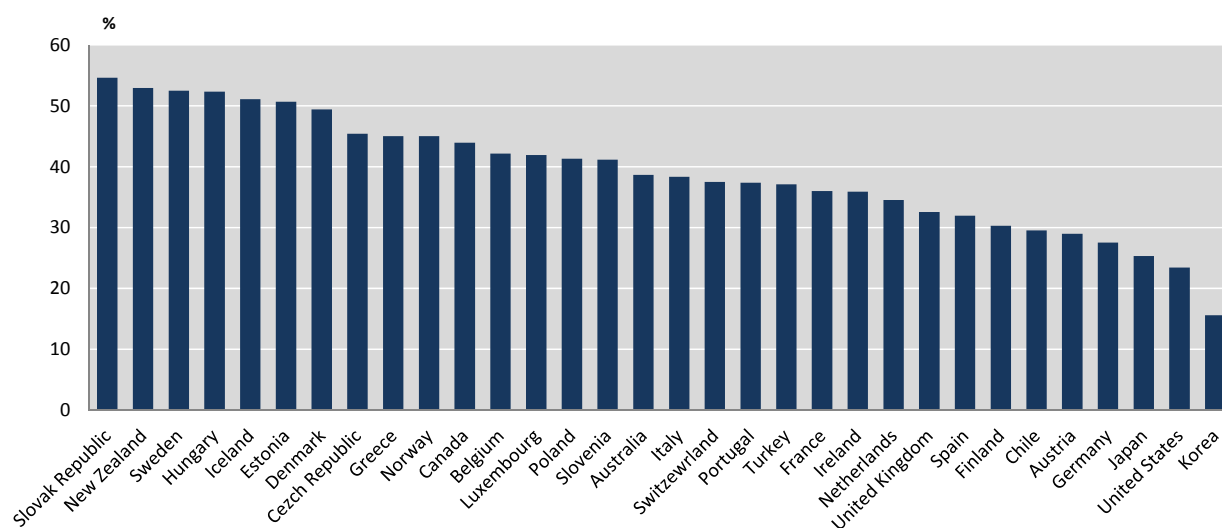
In addition to Figure 3, which does not cover over-the-top VoIP services, national consumer surveys show that voice or video calling services over the Internet, excluding managed IP-telephony, have been adopted by over 30% of consumers in most countries and more than 50% in the Slovak Republic, New Zealand, Sweden, Hungary and Iceland (Figure 4). Generally, IP telephony and Internet voice service will gain more leverage among consumers where there is a substantial price difference. If voice services are included in unlimited tariff plans or bundles have large included allocations, there is little incentive to use an OTT service unless it has some additional advantage.

Communication network operators have widely regarded VoIP services provided by third parties as a threat to their revenues from legacy voice services. In response, some of them have excluded, restricted or price-discriminated the use of VoIP services, absent explicit network neutrality rules. In 2011, the European Union's BEREC conducted a survey of operators on traffic management practices, including restriction of VoIP services, and some level of VoIP restriction was reported by 41 out of 115 mobile operators, though not all users were affected or only at certain times, in some cases. Over the years, mobile operators around the world have employed a variety of measures to restrict and/or charge for access to OTT VoIP services.¹⁶

None of the efforts to block the service have been successful in discouraging VoIP use, according to available data (for example, Skype's international traffic was estimated to grow by 36% in 2013). KakaoTalk has widely been accepted among consumers in Korea, and its number of registered users

surpassed the Korean population by the end of 2012. Other OTT messaging applications equipped with voice talking features, such as WhatsApp, Facebook Messenger, Viber and LINE, have also achieved tremendous success at least on a global level. On the other hand, operators that have restructured tariffs, for example by including unlimited voice and text for particular locations or destinations, have reduced much of the incentive to use VoIP services.

Figure 4. Take-up of Internet voice services, 2014



Note: Proportion of Internet users who have used the Internet in the last three months for telephoning/video calling (via webcam) over the Internet for private purpose (managed VoIP, i.e. telephone devices directly connected to the router, are not included) in 2014. Unless otherwise stated, Internet users are aged 16-74. For Japan, data refer to individuals aged 15-69. Unless otherwise stated, a recall period of three months is used for Internet users. For Australia, Canada, Chile, Japan, Korea, Mexico and New Zealand, the recall period is 12 months. For Switzerland, the recall period is six months. For the United States, no time period is specified. For the countries in the European Statistical System, Chile, Korea and Mexico, data refer to 2014. For Israel and Japan, data refer to 2013. For Australia, data refer to the fiscal year 2012/13, ending 30 June. For Canada and New Zealand, data refer to 2012. For Korea, data just refer to telephoning. Therefore, the figure is underestimated.

Source: OECD ICT database; Eurostat, Information Society Statistics, October 2015. Further information on on-line activities in OECD. (2015), *OECD Science, Technology and Industry Scoreboard 2015: Innovation for growth and society*, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/sti_scoreboard-2015-en.

In some cases, operators have lifted restrictions. In 2014, T-Mobile in Germany removed restrictions on VoIP and eliminated the surcharge. NTT Docomo no longer warns its customers on VoIP restrictions for LTE service or 3G services. Moreover, it is increasingly collaborating with LINE, the most popular messaging and voice application in Japan with 180 million worldwide monthly active users, by introducing a function for smartphone users to directly access LINE from the dial screen so that the user can easily choose between legacy voice and LINE to initiate a call. For its part, KDDI, the second largest mobile operator in Japan, released a mobile application that enables Skype communications. Some of the major European operators, Orange, Vodafone, Telefonica, Deutsche Telekom and Telecom Italia have jointly developed an Internet messaging service called Joyn that can be pre-installed in handsets but is also available on app stores. In April 2014, the (then stand-alone) German operator E-Plus began to offer a SIM card with zero-rated Whatsapp traffic, which did not count against the data cap. Telecommunication operators are, therefore, including VoIP applications, as opposed to restricting them, in order to increase the attractiveness of their own services in the face of competition from OTTs.

Operators in non-OECD countries have also imposed restrictions on VoIP services, in some cases backed by regulators. In the United Arab Emirates, the country's telecommunication regulatory authority (TRA) has issued a statement warning that OTT VoIP (Skype, Viber or others) providers are not yet

licensed to operate in that country, and thus can be blocked. In other countries, such as the People's Republic of China or India, some restrictions on VoIP have been imposed on some VoIP providers with reference to national security requirements.

New messaging and voice services are proliferating and clearly benefiting consumers in the OECD area. This understanding is increasingly shared by network operators that are now examining ways to take advantage of VoIP technology, including the provision of HD voice on wireline and VoLTE networks. Most likely, business models and charging schemes will adapt to remove incentives based on price, with competition being more oriented towards convenience and innovation.

Business model innovation

Recent OECD work has underscored the increasing importance of bundles of communication services (OECD, 2015). The joint provision of multiple communication services, such as voice, broadband Internet access and television/video services, is an example of bundling, either “pure bundling”, “tying” -when these services can only be purchased jointly - or “mixed bundling” when they are also available on a stand-alone basis. The ubiquitous use of IP technologies has provided the technological basis for bundling communication services which. This, from the operator's perspective, represents a rational economic behaviour given the presence of joint costs which, using bundling, can be spread across different services. From the customer's perspective, unified billing and, in most cases, a substantial discount over the price of the sum of standalone services, generally makes bundles of services attractive.¹⁷

Nevertheless, the competition implications of bundles are not without challenges. These can be summarised in three respects: *i*) bundling renders market analysis and definition more complex, *ii*) there is a risk that, if bundling becomes predominant, some providers may be forced out of the market, as they may not be able to provide one or more elements of the bundles economically (e.g. mobile services) and, *iii*) the inclusion of non-traditional telecommunication services, such as television, may require institutional changes that not all countries may be ready or willing to undertake.

If these challenges are duly addressed to mitigate their possible negative influence on competition, consumers and businesses can greatly benefit from bundling. Moreover, bundling provides an opportunity for telecommunication operators to test new, innovative services, such as home monitoring services (e.g. security and heating) and various over-the-top services, in a way that they would not otherwise do if they had to launch these services separately. Moreover, bundling of communication services is not new and has been present since the early 2000s, driven by cable television providers. Given technological developments in cable networks, these operators were able to provide bi-directional services, especially voice telephony and broadband Internet access.

Bundling of fixed and mobile services, from the customers' perspective, is a relatively new development. While communication providers could have arguably provided converged fixed and mobile services since the inception of mobile technologies, they have only reluctantly done so, mostly driven by the need to manage bandwidth utilisation and competitive pressure. The existing record suggests that only when operators with both fixed and mobile operations have started to face competitive pressure, have they responded with converged fixed/mobile bundles. Such was the case in France, Spain and the United Kingdom. In Korea - where 83.5% of all households have subscriptions to bundled offers - bundles containing fixed and mobile services account for 43% of the total number of subscriptions to bundles.¹⁸ The growth of offers bundling fixed and mobile services was fuelled by a series of mergers and acquisitions between fixed and mobile communication operators during 2008-2010.

In contrast to the above-mentioned examples, many operators still provide fundamentally separate fixed and mobile services, such as in Canada, Mexico or the United States, despite having both fixed and

mobile networks, although this is changing in some countries, such as Japan. The challenge for regulators when analysing the emergence of converged fixed mobile bundles is whether sufficient and sustainable levels of competition will be possible if these bundles become predominant.

Undoubtedly, one of the more challenging issues is whether bundles have become a market from the competition perspective, and, if so, whether the focus should be on the bundle or on the individual standalone services. Recent work has already addressed this issue and offered the following conclusions: First, regulators should provide themselves with enhanced tools to delineate markets from the demand perspective, in particular through the SSNIP (Small but Significant and Non-transitory Increase in Price) test. For example, Pereira, Ribeiro and Varela (2013) reported that 3-play bundles (fixed voice, broadband and television) should be an independent relevant market, using standard SSNIP tests applied to consumer billing data obtained from Portuguese operators. Second, as pointed out by BEREC's analysis (2010), bundles may play a relevant role in retail markets but not in wholesale markets, which are often the focus of ex-ante regulation. Dominance in either wholesale input of mobile or fixed networks undermines competition in bundling, and, thus, needs to be evaluated carefully for a possible regulatory intervention. In Colombia, the regulator (CRC) analysed bundling in the fixed market and declared the currently-offered bundles as relevant markets. It found the market was in a developing stage and concluded that there was no market failure at that stage. The CRC proposed some measures to enhance transparency rules for consumers in relation to these bundles.

A related issue is whether fixed and mobile broadband services are complements or substitutes and also whether they should be included in the same market, such as in Finland (voice, only one-way substitution) and in Colombia (voice, only one-way substitution). At the moment, the CRC is analysing whether mobile services (voice and Internet) are substitutes per se, or if they are part of the same market, constituted as a bundle. The CRC has recently concluded that mobile and fixed broadband services are considered separate markets, given the characteristics of the service such as speed (downstream and upstream) and capacity, and given that mobile broadband services are not comparable with fixed broadband services (from a technical point of view) due to the characteristics of the available mobile network in Colombia.

In Austria, fixed and mobile are seen as substitutes in residential markets but not in business markets. In Mexico, fixed and mobile services are seen as complements. In the majority of European Union Member States, fixed and mobile are seen as complements. In any case, such assessments need to be undertaken on a case-by-case basis using a fair amount of empirical evidence about demand-side substitution patterns.

In addition to bundling, "platformisation" is among the new trends among market players operating in different layers of a GPN (Box 2).

Box 2. Platformisation

In the last decade, scholars and regulators have observed a common “platformisation” trend among market players operating at different layers of the Internet value chain and with different strategic assets (media contents, networks, search engines, etc.). Platformisation can be defined as a market strategy by which players operating at different layers of the Internet value chain rely on their specific assets to reach different groups of customers and enter different markets. The multi-sidedness of a platform (MSP) enables companies for example, using broadband GPNs, to not only offer services they previously could not because they were coupled with network services, but also to enter different yet related markets offering complementary service bundles to end users on a single platform. For example, traditional fixed and mobile telephony providers today provide not only data services, but often associated service portals allowing access to, for example, payment systems. This is similar to platformisation at the network edge, where some content providers may need consumers, advertisers and content providers on board to be successful in the market. An important consequence of platformisation is that market players in MSPs could be exposed to disruptive competition originating from outside of what may appear as “their” market.

Market participants in a multi-sided platform model have a fundamentally different business model than for example traditional telecommunication operators. Unlike the telecommunication operators, market participants using MSPs typically do not charge end-users for service because they seek fees from other groups of customers. Competition in MSPs is different than in telecom markets. MSPs participants often compete for the entire market or service category reflecting the “winner-takes-all” strategy.

Competition in MSPs may often be “for a market” where participants compete to create a new standard or platform that often involves introduction of displacing technologies or strategies, resulting in them gaining a strong market position for some time thereafter. This is in contrast to competition “in a market” where incumbents and entrants compete. MSP participants competing with incumbents in ‘traditional’ markets can win market shares by decomposing markets into highly customised niches so that the incumbents cannot compete on scale alone. Hence, there are some Internet-based markets or sectors dominated on a global scale by a single company competing with other Internet companies at different levels of the Internet value chain. By contrast, in the “traditional telecom markets” competition usually occurs “in the market”.

Economists observe that in a broadband GPN companies with distinct core businesses operate in the Internet value chain with overlapping activities, especially when they use a MSP model. As a result, they are competitors for the supply of a number of services but their core activity is distinct. For example, Google has its core business in search engines, Apple in smartphones, Microsoft in operating system and software. The same companies may offer complementary services, which partly overlap (email, instant messaging, and social media contents). Not all activities offered by these MSPs have a two-sided nature but many external effects could be present. The challenge in antitrust analysis is how to approach multidimensional competition in assessing market power, as these platforms are singular entities (companies) rather than several insulated production functions.

Staying in business and expanding new business opportunities for platforms stem from their ability to render interactions among group members more efficiently than they would be through direct bilateral relationships. For instance, access to GPNs offer services to consumers on one side of the market and to content and application providers on the other side. Similarly content and application providers offer their services to consumers on one side of the market and advertisers on another side. By (inter alia) reducing transaction costs, multi sided platforms can contribute to price efficiency by facilitating internalisation and costs allocation across the different sides of the market.

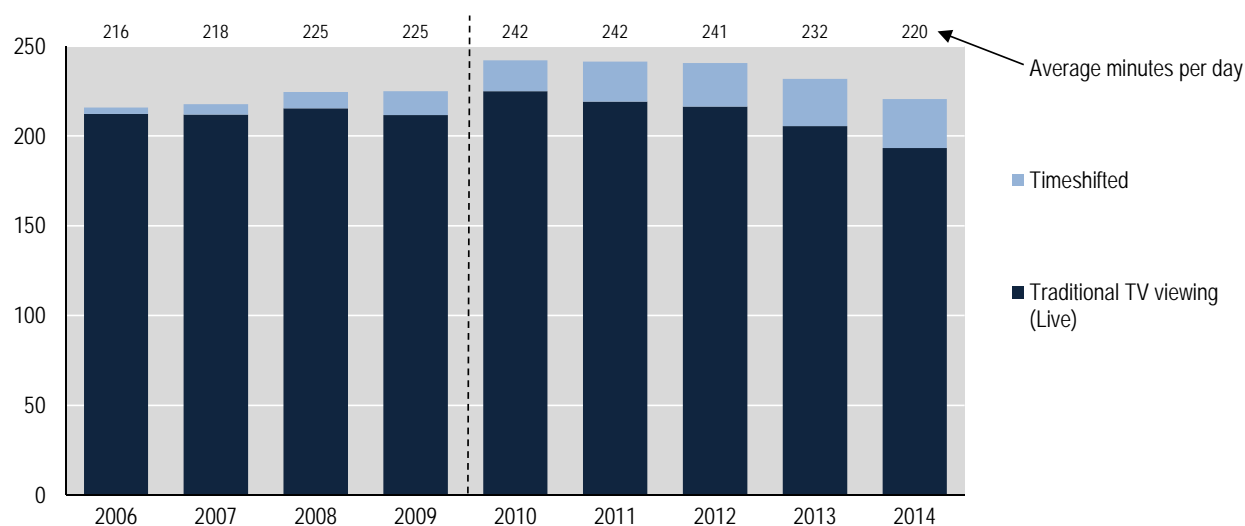
Because GPN owners and access providers can internalise cross-group externalities by managing the interaction between OTTs and users, regulators, in order to better understand the inner workings of these interactions should closely monitor the evolution of markets and gather evidence of commercial practices in a multi-sided scenario. In this respect, regulators will have to address new challenges in assessing the competitive dynamics and the relationships between firms operating at different levels of the value chain. In market analyses, the one-side logic might prove to be inadequate as some broadband providers, and namely access providers may have incentives to play the role of platform intermediaries. In this respect, traditional ways of analysing costs, prices and defining competitive benchmarks might require some methodological adaptation. In fact, where complementarities between two sides of a platform are particularly strong, neither prices below cost nor very high prices on one side may be indications, *prima facie* of anti-competitive behaviour. Rather, they could be a means to internalise externalities among the various sides. Regulators may need a clearer conceptual framework on, for instance, how to apply an SSNIP test to a multi-sided market, considering that it may be beneficial to the end user if the hypothetical monopolist were to provide services for free on one side of the platform and where the costs are borne by the other side. Furthermore, given cross-group externalities, the issue of whether one should consider profits on one or on both sides of the market arises.

Innovation at the network edge

The modular architecture of broadband GNPs has enabled new market (non-network owners) players to carry out “permission-less innovation” to provide voice, video, and applications. This also created a new value chain including manufacturers, operating systems, network providers, advertising intermediaries and OTTs. Below is a brief discussion of such innovations and their effects.

Considering the enormous influence of television in society in terms of mass media appeal, public opinion and freedom of speech, and as a platform for advertising, policies surrounding broadcasting have been at the forefront of evolving media policy. Traditional television viewing remains popular, although there is evidence of a slight decrease in recent years. According to Nielsen’s Total Audience Report, an average adult in the United States spent four hours and fifty-one minutes per day watching live television and 33 minutes watching time-shifted television (Nielsen, 2015). In the United Kingdom, the average consumer (aged 4 and above) watched 220 minutes of broadcast television on a television set per day, 11 minutes less than in 2013. This decrease of 4.9% year on year represents the second consecutive year of decline. (Ofcom, 2014 and Figure 5).

Figure 5. Average minutes of viewing per day, total TV: by activity



Note: New BARB panel introduced 1 Jan 2010. As a result pre- and post-panel change data must be treated with caution (see dotted line).

Source: Ofcom (2015a), *The Communications Market Report*, Ofcom, London and BARB, individuals 4+, network, total TV - Average minutes of viewing/day.

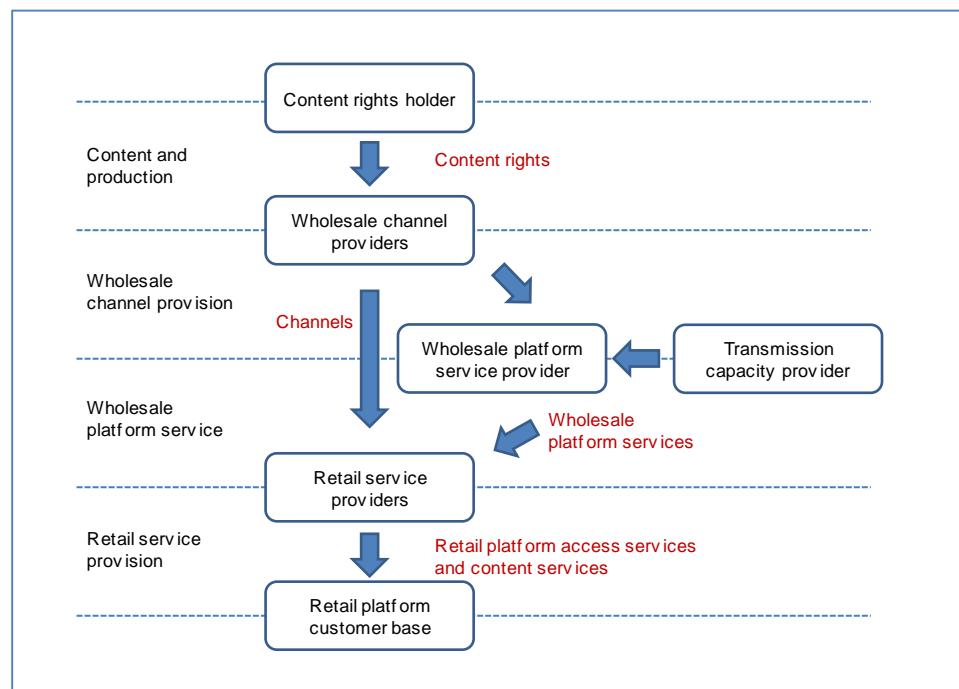
The once vertically-integrated broadcast, cable, and direct-to-home satellite industry has gone through revolutionary changes where content, content distribution, and content navigational devices can be and increasingly are offered and sold separately in many countries. At the same time, in some countries, a contrary business model is emerging which involves increasingly large bundles (linear and VOD; triple-play and quad-play), explained by the need for network operators to monetise their network investment, in particular where there is a degree of facilities based competition.

Recent developments in video delivery technologies are increasingly blurring the lines between traditional (scheduled or linear) television feeds and other types of video content. Catch-up television,

video-on-demand and the simultaneous release of several episodes (such as by HBO, Netflix or other video-on-demand providers) are challenging traditional legacy television regulation. Consumers no longer need to wait until a specific time of day or week to watch an episode of a television programme or series and can watch several episodes in a row. Moreover, connected devices (including televisions) make it possible to stream video content virtually anywhere and anytime via smartphones, tablets or laptops (OECD, 2014). Technological developments such as digital video recorders (DVR), cloud-based television and the aggregation of traditional broadcasting feeds for Internet streaming (e.g. Magine, Sling TV) also have potential implications for market structure and consumer welfare.

The value chain for content and pay television in the United Kingdom can be shown here (Figure 6). It also includes the supply of transmission capacity as a service separate from content and pay television. Transmission capacity would include the facilities of BT (the incumbent) and Virgin Media (covering almost half of United Kingdom premises with its cable footprint) and, for video distribution, the satellite platform of Sky and the terrestrial digital television platform. In the United Kingdom, most of the large television platform providers are also large scale ISPs, accessing the incumbent's fixed wholesale lines (copper unbundling or active fibre access). BT and Virgin Media provide content via their own network infrastructure while others, such as TalkTalk and Sky use BT's local loop or fibre access network to offer a variety of content via their platform. Wholesale channel providers supply channels directly to retail service providers and/or to intermediaries (wholesale platform service providers, which in turn market the platform service, a package of channels and related functionality, to retailers). Ofcom notes that the broader market structure for content has been changing. New OTT providers have emerged, such as Netflix and Amazon, who also produce content, aggregate it, and retail it directly or indirectly (in some cases promoted by an ISP as part of their platform) to consumers as the case may be.

Figure 6. The content and pay TV value chain



Source: Ofcom (2005b), *Strategic Review of Digital Communications 2015*, Ofcom, London.

Emergence of on-line video distributors

According to the United States' FCC (2015a:3), an On-line Video Distributor (OVD) is an “entity that offers video content by means of the Internet or other Internet Protocol (IP)-based transmission path provided by a person or entity”. It is not clear whether OVDs will function as full substitutes for traditional pay-television services, and, if so, when and under what circumstances for which type of users. OVDs are generally more accepted by users already adapted to watching television on any device, such as a laptop, smartphone or tablet, and by those who are already active Internet users. Some contend that OVDs, at least those providing video-on-demand services, will neither replace linear traditional television channels, as the service they provide is fundamentally different (linear versus non-linear), nor will they offer content that will be sufficiently attractive to a majority of end users. This may not hold true in the long run as consumers become more accustomed to watching television anytime, anywhere, including serial watching of several episodes in a row (what some term “binge viewing”). However, some television content, such as news or live sports, may never be replaced by non-linear content, but most television channels may face competition from OVDs.

In 2011, the FCC recognised the importance of OVDs as a potential competitive force in video markets in the United States, and it included specific conditions related to OVDs in the Commission's authorisation of the merger of Comcast and NBC Universal. The FCC acknowledged that consumers were increasingly demanding on-line video content, and that agreements restricting on-line distribution of video content could potentially harm competition. As a condition merger approval, the FCC required the merging entity to make its video content available to OVDs on the same terms and conditions that would be available to multi-channel video programming distributors (MVPDs), which are traditional cable and satellite providers. At that time, the FCC recognised that OVDs did not fully replace traditional pay-television providers, but may do so in the future, and, in any event, they provide some competition to traditional providers. In its 16th Video Competition Report, released in April 2015, the FCC noted that there are different views as to whether consumers are replacing traditional pay-television services with OVD services. Some indicate that the increasing presence of OVDs may lead to increased substitution in the long-term, but the current degree of full substitution is relatively minor (only 1% of households subscribed to an OVD exclusively, according to Nielsen). In December 2014, the FCC proposed to interpret the definition of MVPD in a way that would broaden its scope to apply it to all entities, including OVDs that offer multiple linear streams of programming for purchase.

Similarly, in Canada, as part of the ‘Let's Talk TV’¹⁹ process, the CRTC recognised that significant change is necessary in a world where broadband networks are enabling viewers to bypass the traditional content curators, the broadcasting networks, and where content is available on digital platforms. This ground-breaking set of decisions includes a reduction in broadcast quotas for Canadian programmes, but at the same time ensures that Canadian television services reinvest a portion of their revenues into the creation of content made by Canadians. The CRTC also recognised that viewers want around the clock, on-demand access on several platforms. In light of this, the CRTC created a new hybrid video-on-demand (VOD) service category and exempted these services from the requirement to hold a broadcasting license. This forward-looking approach will remove barriers for Canadian companies to compete on an equal footing in the OVD marketplace.

In the United States, OVDs can potentially disrupt pay-television markets and impose significant competitive pressure on existing providers. In particular, OVDs unaffiliated with an established communication or content provider are likely to have stronger incentives to disrupt market dynamics. A selection of some of the largest OVDs, most of which are jointly owned by content companies, is shown here (Table 1).

In the United Kingdom, on-line TV revenue has increased rapidly in the past five years, growing by 38% in 2014 to USD 1 103m (GBP 793m), with income from on-line TV subscriptions increasing by 53% to USD 441m (GBP 317m), driven by the increasing popularity of services such as Netflix and Amazon Prime Instant Video. However, on-line TV revenue still represents a small proportion of total TV revenues. The subscription model now represents the principal contributor to overall on-line television revenues, accounting for 40% of the total. The free-to-view (FTV) business model represents the second largest segment, contributing USD 334m (GBP 240m) in 2014 (Figure 7).

Table 1. Examples of leading on-line video distributors

OVD	Business model	No. subscriptions/ viewers	Countries	Source
Netflix	Subscription, VoD	47 million (streaming, US), 34.5 m (streaming, non-US)	190 countries	Netflix (Shareholder statement, 2016 ²⁰)
Hulu	Advertising and subscription-based "plus" version	9 million paid-subscribers	Japan, United States	Hulu ²¹ (2016)
YouTube	Mainly advertising, some paid channels In October 2015 YouTube launched a subscription service (YouTube Red) in the US for \$9.99/m	162.2 million (US), 1 billion worldwide	Global	Comscore (2014), Forbes (2013)
Amazon	Downloads, streaming, VoD, subscription	45 million (US) unique viewers, 2013), 10 million subscribers (2013, Prime Service)	AT, DE, JP, UK, US	FCC/SNL Kagan (for 2013)
Apple	Downloads, VoD		+120 countries	
Daily-motion	Mainly advertising, some paid channels	20 million viewers (France) per month	35 countries	Daily-motion (2016) ²²
Wuaki.tv	VoD, subscription	2 million users	FR, IT, DE, ES, UK, +10 countries planned	Tech.Eu ²³

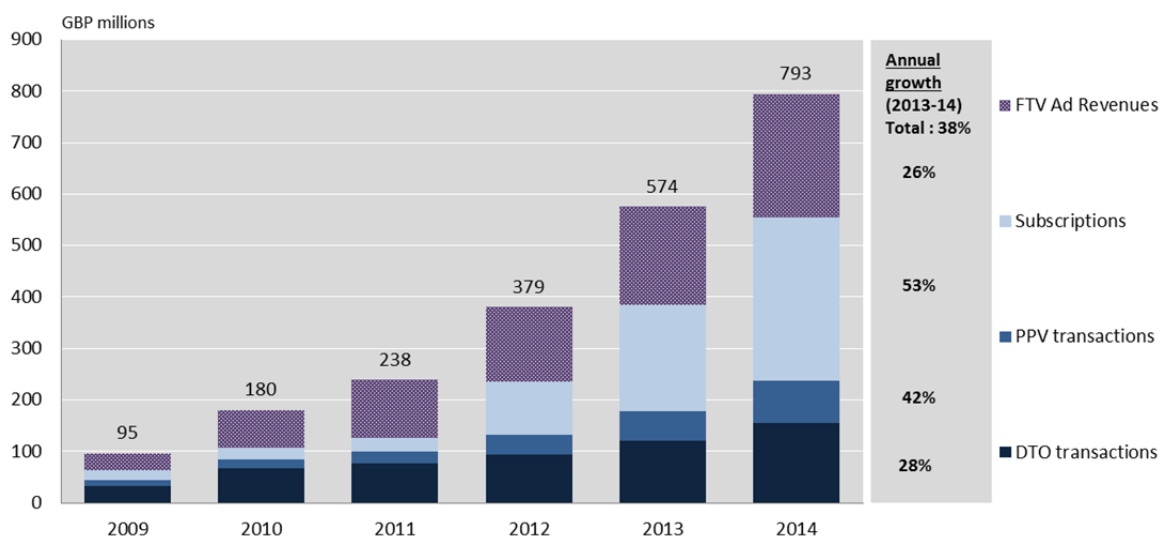
Source: <http://variety.com/2014/digital/news/youtube-u-s-video-ad-revenue-will-top-1-billion-in-2014-report-1201303523/>, <https://support.apple.com/en-us/HT204411>, Netflix, Hulu, Daily-motion, Tech EU.

In the third quarter of 2015, the total number of visitors of selected on-line television and film streaming sites in the United Kingdom was 5.1 million (Netflix), 1.4 million (Amazon/LoveFilm) and approximately 600 000 for NOW TV, Sky's OTT service (BARB Establishment Survey, 2015).

These figures may seem relatively low, but the audience and influence of on-line video providers is growing markedly in most OECD countries. According to Screen Australia, the Federal Government's primary agency for supporting Australian screen production, close to 50% of Internet-connected Australians currently watch some type of professionally-produced film or television content on-line. In France, the estimated revenue of the VoD pay-television market was USD 272 million (EUR 240 million) in 2013, of which only USD 31.8 million (EUR 28 million) were subscription-based. Likewise, according

to the French Audiovisual Council (*Conseil Supérieur Audiovisuel*), YouTube counted 23.4 million unique video viewers in France in June 2014, Facebook had 14.3 million, Dailymotion, 7.25 million, and MyTF1, website of the largest television broadcaster, 6.48 million.

Figure 7. On-line TV revenues in the United Kingdom



Source: Ofcom Communications Market Report 2015, Ofcom, London.

Despite the increasing importance of OVDs in some OECD countries, traditional MVPDs have in some cases exercised or tried to exercise control over how the end user can access MVPD services via the set-top box. For example, even now, cable operators in the United States essentially require subscribers to accept a particular user interface even if the subscriber utilises a commercially available set-top box (which not too many subscribers currently do).

Competitive response (Video)

Some traditional communication providers have recently engaged in strategic partnerships with Over-the-Top Providers (OTTs). Their partnerships include a wide variety of services, including video and on-line music services, such as Deezer or Spotify, which may give rise to significant changes in competition dynamics. For example, in early 2014, Virgin Media, the largest cable operator in the United Kingdom, was among the first to actively advertise Netflix by providing the service on a discount for six months to new subscribers. In Mexico, there are two main OTT providers: Netflix and Claro Video, and Televisa is currently launching an OTT service. Some cable operators like Totalplay offer Netflix with the pay TV service. Others have followed suit, in some cases using OTT video services to complement their own video offerings, such as Vodafone in New Zealand. In the United States, AT&T is partnering with Hulu to offer a Hulu streaming service to AT&T customers.

In France, as part of the CanalPlus/TPS merger proceeding, the French Competition Authority set out various conditions specific to the merger, including the separation of VoD and linear television rights and the possibility to re-sell these rights, in order to facilitate the development of competitive VoD offers and to lift some of the restrictions imposed by right-holders. These conditions highlight that coupling linear and non-linear rights and concluding exclusive distribution agreements may certainly reduce competition. Other players are also responding to on-line video competition with innovative approaches both from the technological and business perspective. HBO, a popular movie and series channel owned by Time Warner,

has started to be available outside the traditional cable bundle (first in the Nordic countries and later in countries such as the United States and Colombia), including in partnership with non-traditional video distributors, such as Apple²⁴. Other business models, taking advantage of the reach of the Internet and the power of social networks for commercial purposes, may well be envisaged, for example, the direct on-line diffusion of live sports or music shows. OVDs are also competing through original programming and attractive discovery tools that allow users to navigate large libraries of content, including increased reliance on recommendations via social networks. Traditional broadcasters are being pressured to respond to such enhanced features.

In short, video and television markets seem to be undergoing a positive wave of innovation and competition, where innovative services and features and affordable prices are being offered by new players and the larger incumbent pay-television providers are making changes to their commercial offers. While the effects of “cord-cutting” may seem limited, existing evidence suggests that some broadcasters are already responding by improving their commercial offers.

Both fixed and mobile broadband service providers may have incentives to favour certain content, including commonly-owned content, with respect to data charges, and this may result in potentially anti-competitive consequences. In some countries providers impose monthly data caps on subscribers; these tend to be evident most frequently for mobile subscribers. The term “zero rating” refers to the practice of not counting content from particular edge providers against the data cap. The United States’ FCC’s “Open Internet Order” does not prohibit zero rating or data caps but provides for case by case review of these practices. In Canada, the CRTC found that some wireless carriers had conferred an undue advantage on their own services by exempting their mobile TV services from data charges. The CRTC’s regulatory framework supports new and innovative services that allow Canadians to watch both Canadian-made and foreign-produced content. However, the regulator has stated that mobile service providers cannot offer such services in a manner that gives them an unfair advantage and puts others at an unfair disadvantage in the marketplace. This decision clearly favours an open and non-discriminatory marketplace for mobile TV services, enabling innovation and choice for Canadians.

In some jurisdictions, whether the television/video service is considered as “managed” or “Over-the-Top” may result in different regulatory treatment.²⁵ In addition, most traditional television “free-to-air” broadcasters have created websites where live or catch-up television programmes can be watched over the Internet. This report does not intend to draw a clear distinction between these different technological solutions and regulatory treatments, but rather underlines the importance of having independent television/video service providers over the Internet. These services may be perceived as complements or substitutes to existing television services, hence their effect on competition may vary significantly.

Indeed, this complexity relates not only to the technical characteristics of video and television services, but, more importantly, to the different business models that have emerged. In order to provide an overview of existing business models, which are partly a result of the functional improvements outlined above, both subscription-based and advertising-based business models can be identified. In addition to others, Slingbox, AppleTV and Chromecast earn a large part of their revenues through the sale of the device (Table 2).

Table 2. Different business models for the provision of on-line video services

Subscription (VoD)	Subscription (linear)	Advertising (VoD and linear)	Electronic sell-through and rental (PPV)	Device-based
Netflix (VoD), Youtube (paid channels)	Aereo (aggregation), Magine (aggregation)	Hulu (VoD), Youtube (UGC, free channels)	Vudu, Apple's iTunes, Amazon.com, Microsoft Xbox Live Marketplace,	Chromecast, AppleTV,

It is also important to understand that content navigation technologies are subject to large changes and constitute a field of substantial innovation (e.g. content navigation through gesture and speech), and any less-than-careful regulation could inadvertently hinder innovation by freezing legacy navigation techniques.

Other applications and services

The integration of different parts of a value chain, including manufacturers, operating systems, network providers, advertising intermediaries and OTTs is also likely to intensify. Within this new market, players are expected to be brought into areas of co-operation with other formerly-distinctive parts of the ICT economy. For example, the potential incorporation of bitcoin functionality into SIM cards could involve traditional communication value chain players, as well as banks and any other actor involved in financial payments or money transfers (Weru Maina, 2015; Fargo, 2015; Casey, 2015; Kaminska, 2015). Such developments could provide competitive margins on services such as M-Pesa, first developed in Kenya, as well as potentially increasing revenue streams through new business models as proposed by companies such as “21 Inc” (Srinivasan, 2015).

POLICY CHALLENGES AND RECOMMENDATIONS

In a constantly-changing GPN world, policy makers and regulators are confronted with familiar challenges as well as new ones. The familiar ones will remain in a GPN world. These include the promotion of competition, innovation and consumer choice while meeting a number of social objectives including universal service, emergency services, privacy and security. Some new relevant factors are:

1. innovation at the core and at the edge of the network is more prominent and often disruptive
2. services and applications tend to be technically decoupled from the network, and
3. market players often participate in more than one side of the market

The following section identifies these challenges and suggests policies to address them.

Meeting the growing demand for high quality connectivity. With increasing dependency on communications, connectivity becomes essential for economic and social development. Although predictions do vary, there is consensus that future demand for data will grow substantially. This is particularly pressing for individuals in less densely-populated areas, vulnerable consumers and businesses. As a result, demand for the universal availability of communication services around the world has grown and a variety of approaches have been employed to ensure consumer demand can be met, either through commercial provision, or, where this is not possible, through public intervention.

Competition policy to promote demand driven investment and innovation. Innovation, investment, and competition in mobile, video and traditional voice marketplaces also mean that markets in a GPN world change faster than in the past, and so does the potential locus of innovation in the value chain. At the same time, given the increased potential for innovation today, so too could be a higher cost of regulatory error. Therefore, policymakers may wish to err more on the side of caution when regulating. They should place greater weight on dynamic efficiency and investments and not focus excessively on shorter term static efficiency. The relative weight for intervention will need to take the local context into account.

Regulation needs to be applied carefully, mindful of unintended consequences and in a targeted fashion. Regulatory barriers to entry should be reduced where possible. The implications of regulation on innovation and investment will need to be considered when deciding where in the value chain to intervene in order to promote competition. This could, for example, entail liberalising licensing laws subject to certain public policy objectives being met, facilitating the use of rights of way, or reducing the complexity of local planning rules.

Meeting the challenges of the trend toward consolidation in a way that continues to protect competition, and consumers. The continuing trend toward sector consolidation is likely to cause regulatory challenges, in particular where it reduces the degree of competition in the market. Competition law will, of course, provide a brake on consolidation, at least as far as mergers are concerned. However, the trend could also lead to calls for greater regulation, for example, in oligopolistic markets. It may also require protection of consumer choice through network neutrality rules, such as in the United States, and facilitating choice through mandated network access as in Europe, or other similar measures to facilitate

consumer switching. Which measure is most appropriate in a given market will depend on the specific circumstances in that market.

Symmetric sectoral regulation may need to be reviewed in light of evolving technological and market trends, while ensuring consumers and citizens remain protected. A high degree of innovation implies that many service providers are not regulated in the same way as traditional telecommunication providers might be. This means there is likely to be a need for a review of symmetric regulation - that is, regulation applied to all providers of the same type of communications service. This may include examination of regulatory issues such as sectoral consumer protection rules, emergency calls, interconnection, number portability, privacy, as well as security and information gathering. In some cases, rules may need to be reconsidered entirely, as they may no longer be necessary given changed market conditions, or there may be more efficient ways of delivering the intended public policy objectives reflecting legitimate needs of consumers and citizens. Such reviews will also need to consider extending existing rules to new parties, while being mindful of the inherent trade-offs between protecting consumers and citizens on the one hand, and the potential for damage to competition and innovation on the other. In this respect, market analyses play a crucial role in ensuring a better understanding of competition and innovation dynamics before any regulatory intervention, and, therefore, to this end, extended powers of information gathering are essential to address the new challenges.

The following subsection provides a more detailed discussion of these challenges and some related recommendations.

Meeting the growing demand for high quality connectivity

There are different approaches to ensuring that future demand for connectivity is being met, and various models have been applied in different jurisdictions. As a general matter, the demand for connectivity is rising in all geographical areas, in those where commercial incentives are likely to bring investment in capacity expansion and in those where some degree of government intervention may be necessary. As wireless connectivity will continue to be an important component of the GPN, government authorities will be called upon to make additional radio frequency spectrum available over time. Moreover, in addition to investment in new physical infrastructure, whether wireline or wireless, future investment in new technologies that improve transmission efficiency will also be important.

All countries face a reality: commercial provision of connectivity is not profitable in all geographical areas, and, therefore, public intervention, usually involving some form of public subsidy or funding may at times be required to achieve it. Where competition policy is mindful of the effects of regulation on investment incentives, it can help minimise the need for public funds to support wide availability. Finally, many European countries also use spectrum auctions with rural coverage obligations (e.g. France, Germany, Spain, Sweden, United Kingdom) to ensure that coverage is extended in rural and remote underserved areas.

Nevertheless, public intervention is typically required to achieve wide-spread availability. Although increased innovation and competition within and on networks has led to increased investments in network infrastructure (for example, the expansion of Google Fibre network and the subsequent announcement by the incumbent network to increase investment on high-speed networks in those areas), a handful of OECD countries, including Australia, Luxembourg, and New Zealand (and other countries outside the OECD area, including Brazil, Colombia, Peru, Singapore and South Africa), have directly invested in broadband Internet networks. In the European Union, member states are pursuing market-led approaches to investment. In these countries, competition policy that is sensitive to the need for investment and innovation can also help underpin and deliver public policy goals. Nevertheless, in hard-to-reach areas, high-speed network investment is mainly funded through public subsidies. For example, in the United

Kingdom, the incumbent initially planned to make high-speed broadband available to two-thirds of the country. Public funding was made available to eventually increase nationwide coverage to 95%, and subsequently the government announced the introduction of a universal broadband service of at least 10 Mbit/s for 100% of premises.

At the same time, technological innovation supported by regulation can help achieve the goal of promoting universal coverage traditionally met under a national universal service policy. For example, in the United States, particularly in rural and remote parts of California and Colorado, otherwise unused parts of the spectrum dedicated to television transmission (“television white spaces”) are used to deliver wireless broadband. In the United Kingdom, Ofcom has also introduced an application and service-neutral framework for the opportunistic use of television ‘white spaces’, where one of the likely “use cases” is wireless broadband. In addition, innovation within wireless networks, especially the rollout of LTE, has significantly increased mobile broadband coverage in the United States.

Competition policy to promote demand driven investment and innovation

Sustained economic growth and increased consumer choice can be achieved by policies promoting competition, innovation and investment. These policies include: identifying and removing or lowering barriers to entry to the market; evaluating existing public interest values to see whether they are still feasible in the new environment; and examining the relevancy of regulatory tools and non-regulatory policies.

Promoting competition at the network infrastructure level will likely call for different policies in the wireline and wireless sectors. On the wireline side, cost considerations might limit the scope for facilities-based competition, although such competition is present in some countries or regions within countries. However, some countries have either permitted voluntary sharing or resorted to mandatory sharing of infrastructure (see Figure 8). On the wireless side, although some jurisdictions have imposed MVNO requirements as a merger condition, it does appear that the scope for facilities-based competition is greater. Many countries are able to support four or more independent wireless operators. The next subsection addresses the need to evaluate consolidation proposals carefully.

Lowering barriers to entry in the provision of fixed and mobile connectivity can be achieved in a variety of ways, including removing or simplifying licensing rules where possible, reducing the cost of rolling out high-speed broadband by reducing the complexity and cost of obtaining rights of way, or compliance with planning rules. Equally, it can be achieved through increased sharing of passive infrastructure such as ducts, poles and masts, including by public utilities such as railways and waterways amongst others.

Generally, regulated industries such as telecommunication services and media are subject to licensing procedures, territorial restrictions, safety standards, and other legal requirements that may unnecessarily deter or delay entry and thwart innovation. Some of the licensing regimes implemented to discourage the so-called “cream skimming” by operators or to limit loss of service due to sudden departure of an operator were worthwhile policies for a static era. Today, some legal and licensing requirements inspired by such regulatory concerns may negatively impact device makers, operating systems, application developers and the rest of the value chain.

A more flexible licensing regime adopted by regulators, such as the United States’ FCC, that does not mandate any particular technology or network standard for commercial mobile wireless licensees, has resulted in rapid roll-out of new technology by the network operators. The FCC has publicly attributed the rapid deployment of 4G LTE in the United States to the technology-neutral licensing regime implemented many years ago.

The unpredictable locus of likely innovation makes the promotion of both innovation and competition a challenging endeavour. Regulators may need to develop new tools: Depending on the circumstances where there is insufficient competition (thus negatively affecting the potential for innovation and potentially harming consumers through higher prices), regulation may need to be applied. Where this is considered, it needs to be undertaken with caution in order to avoid any negative effects on efficient incentives to invest. Nevertheless, where regulation is needed to protect competition and consumers, traditional models of regulation are likely to remain relevant.

To the extent that facilities providers have market power, they may have the ability and incentive to restrict access of certain edge or application providers to their customers. This has the potential to limit innovation at the edge of the GPN. Internet Service Providers (ISPs) can create barriers to entry by controlling access to the network; in 2009, the Canadian CRTC established a cutting-edge framework that sets out how ISPs can manage traffic on their networks. This framework is guided by four key principles: transparency, innovation, clarity and competitive neutrality. This flexible approach recognises that there are legitimate reasons for network management, while encouraging the ability of edge providers to innovate and offer new services.

As set out in the “background” section of this report, competition increases incentives to innovate and invest and also incentivises lowering production cost and consumer prices. Competition among firms seeking to develop a similar or new product or process encourages innovation, and competition among rivals producing an existing product encourages firms to lower costs, improve quality, or develop better products. Thus, it is important to consider policies that can encourage innovation and reduce barriers to entry at the edge of the network, whether by content/application providers or by providers of consumer equipment. For example, an increased number of different types of mobile devices to access mobile networks pioneered by device manufacturers led network operators not only to provide dual-purpose handsets to subscribers but to further invest in network infrastructure to improve connectivity. This is because once a device has been adopted by a significant number of end users, network operators may no longer be able to afford to maintain a standard that could exclude them from the market. As noted above, this is often referred to as a market ‘tipping’.

Various developments with respect to encouraging entry and reducing barriers at the application level are also relevant for examination. In the European Union, the legislation for audio-visual services (electronically-provided designated television and video services) facilitated cross-border entry by introducing the principle of “country of origin” (Recital 33 and Article 2 of the AVMS Directive). As a result, audio-visual service providers in the European Union only need to comply with the rules of one Member State (the “country of origin”) to provide audio-visual services to any Member State in the European Union. Moreover, the European Union AVMS Directive provides a broad set of minimum standards including editorial standards and obligations in relation to European production, which are intended to provide a minimum level of protection for European Union audiences and help to reduce the risks of jurisdictional shopping although national laws may go beyond the AVMS minimum standards.

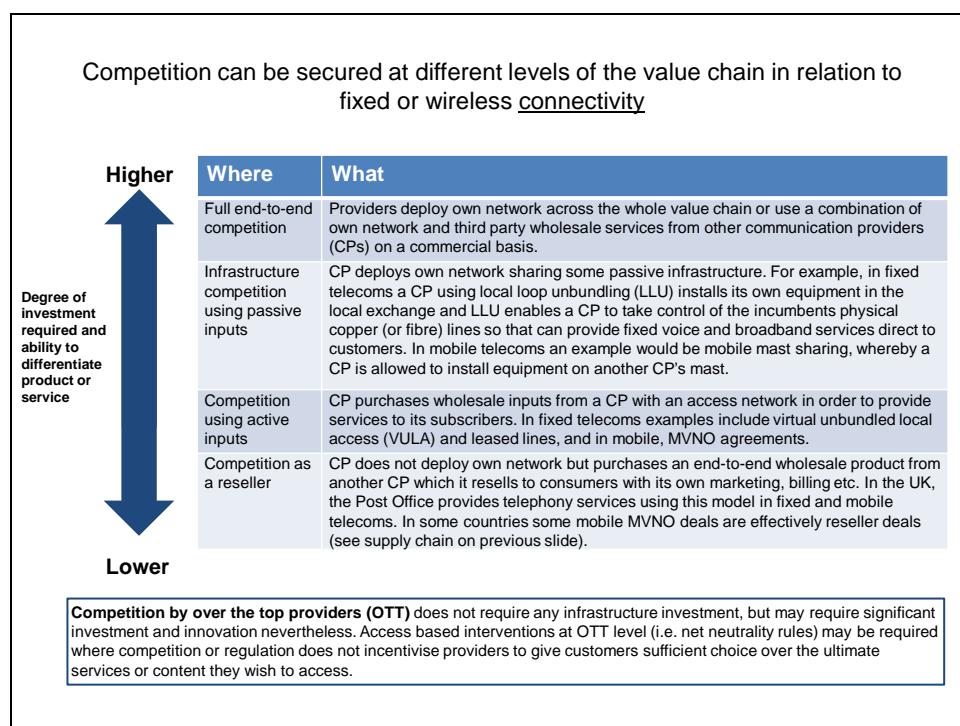
Additionally, the emergence of on-line video distributors (OVDs) is increasingly viewed as competition to the MVPDs. Moreover, some OVDs have invested in network infrastructure to improve quality of service to win new customers as a result of having to compete with MVPDs. Some MVPDs are also trying to move into the OVD “space” by offering non-linear and on-demand programming. Elsewhere, the advent of VoIP providers has placed downward pressure on the price of some types of telephone calls. Consequently, incumbents have embraced new technologies and business models in order to be more competitive. Nevertheless, there are areas where there may be risks to competition. For example, the experiences of some VoIP providers may point to anti-competitive behaviour practiced by incumbent operators in some countries, potentially leading to less innovation, reduced investment and less consumer choice.

Similarly, the bundling of services allows market players to innovate and offer new offerings and services benefiting the consumers. This is particularly relevant to consumers where the two elements of the bundle are strongly complementary. However, when complementarity is strong, bundling may also be a way to thwart market entry and discourage potential innovation and investment by competitors, as outlined earlier. A firm will have an added incentive to innovate if, in doing so, it can discourage potential rivals from investing in their own research and development. This could potentially have negative effects on competition and consumer choice. For example, a strong pay-television provider may use the attractiveness of its content to improve its broadband market share, in turn giving it a competitive edge when buying content. Where such a player is already strong in both markets, it may eventually become dominant in both. In addition, in some countries, there is cross-ownership of the largest communication and the largest pay-television provider, such as in Australia (where Foxtel, the largest pay-television provider, is jointly owned by Telstra and News Corporation), or in Spain (after the recently approved acquisition of Digital Plus/DTS by Telefónica).

Additionally, the United States' FCC is also reviewing its MVPD definition. The proposed definition of a MVPD would include providers that make multiple linear streams of video programming available for purchase, regardless of the technology used to distribute the programming. In particular, it no longer requires an MVPD to have control over the transmission path, and so this would therefore apply to on-line video providers. The new definition maintains the requirement of offering linear video programming to qualify as an MVPD, and, hence, it does not apply to video-on-demand (i.e. non-linear) video providers. This proposal could be justified on the grounds that it reduces barriers to entry into provision of multichannel video. However, it could also be construed as reducing barriers to entry into provision of wireline broadband service, to the extent that, in the absence of OTT, entrants might have felt it necessary to provide both multichannel video and broadband with attendant higher costs than providing broadband on a stand-alone basis.

However, network effects are becoming more important in shaping markets. They can have both stabilising and de-stabilising effects on markets and market power; that is, network effects can be a source of disruption as much as potentially a source of regulatory concern. Therefore, network effects need to be evaluated in the right context and according to the type of concerns.

In the vertical supply chain which best characterises more traditional markets (where network effects are not a predominant cause of market power), there are different potential areas where regulatory intervention may be best applied, depending on the circumstances (Figure 8).

Figure 8. Overview of potential competition interventions

Source: Ofcom (2016), Ofcom, London.

Regulatory remedies requiring cost-based access to the access network should only be applied where there are compelling reasons, for example, where lack of access could restrict the building of new network infrastructure. These remedies are used, for example, in the European Union. Access-based intervention at the retail level to ensure open access by OTT providers to end users' devices may be used to address either competition concerns or to secure the free flow of information over the Internet.

However, regulation has become more complex due to the greater prevalence of indirect network effects in all markets, including services at the network edge. With regard to potential competition policy intervention in markets where network effects are important in determining competitive outcomes, regulatory failure is a greater risk due to the more unstable and intrinsically dynamic nature of these markets. Therefore, intervention will need to be cautious and its necessity determined on a case-by-case basis.

Strong complementarity characterises many multi-sided platforms supported by GPNs. These generally include markets with multiple products where different sets of market participants interact with each other. The multi-sided nature of the platform means it cannot set prices in one arena without affecting demand and supply in other sides of the market. While market power on one side of the market may, in some circumstances, help achieve or maintain market power in another, this is not necessarily the case.

Market power issues raised by multi-sided platforms are not necessarily congruent with significant market power designations in one-sided markets. Hence, the current regulatory framework in most OECD countries may not address the relevant problems comprehensively and adequately. Rather, platforms may require adjustments to traditional market analysis to examine whether, when and why regulatory intervention may be needed and whether competition law alone could address potential consumer harm

arising from market power. In this regard, any revisions to a regulator's toolbox may need to include re-thinking of current theories and assumptions for analysing market power in multi-sided markets.

Nevertheless, communications infrastructure can still be subject to high barriers to entry, a legacy of state-sanctioned monopoly, and certain features akin to natural monopoly such as particular assets may not be practical or economical to duplicate by entrants. As noted in the OECD's 2013 "Broadband Networks and Open Access" report, measures to address these types of issues have been widely adopted to varying degrees across the OECD and are expected to have continued relevance in the future. The extent to which these issues are present certainly varies depending on the local context in OECD countries.

Meeting the challenges of the trend toward consolidation in a way that continues to protect competition, and consumers

In recent years, there has been a wave of mergers and acquisitions among European operators, some involving consolidation within the mobile sector and some combining fixed and mobile operators, but all driven by the increasing convergence of services and the recurring case made by some players for the importance of scale. Examples of mobile mergers include Three's purchase of O2 in Ireland and Orange in Austria, its proposed acquisition of O2 in the United Kingdom, as well as O2's acquisition of E-Plus in Germany. All three mergers have reduced the number of mobile wholesale network operators in these markets from four to three.

The OECD, in its 2014 "Wireless Market Structures and Network Sharing" report, which examines recent experiences in a number of OECD countries, found that having more than three national Mobile Network Operators (MNOs) often leads to innovative product and service offers that challenge existing market wisdom and practices, and the presence of more than three national providers is a driver for the entire market to become more competitive. The 2014 OECD report also suggested network sharing could be considered as an alternative to the concentration that would result from a complete merger (Box 3).

In addition, there have also been mergers between fixed and mobile operators, driven by the increasing convergence of services. Examples include Vodafone's purchase of cable operator Ono in Spain, and Liberty Global's acquisition of Base, a Belgian mobile operator. These types of mergers are less likely to cause concerns with regard to potential lessening of competition. Currently, fixed and mobile are not yet considered as sufficiently close substitutes but are more complementary in nature in many countries (e.g. Wi-Fi use lightens demands on spectrum).

Box 3. Mobile market entry, exit, convergence and the role of MVNOs

There have been a number of recent mobile mergers in the OECD area, with reductions of MNOs cleared in Australia, Austria, Germany and Ireland (all 4 to 3), but there has also been entry of new players in France, Luxembourg and the Netherlands (all 3 to 4). In some countries authorities are considering further requests by industry for consolidation (e.g. Israel from 5 to 4 and the United Kingdom from 4 to 3) or industry has decided not to proceed while the matter was under consideration by authorities (Denmark and the United States). Meanwhile Korea and Singapore have made spectrum available for new entrants, which could lift their number of MNOs from 3 to 4 in both countries. Where there have been mergers the remedies imposed often use MVNO access obligations to endeavour to compensate for the contraction in end-to-end competition.

There are a number of different potential commercial arguments made for the focus on mobile mergers, including scale benefits (mainly in terms of capacity available to support consumers), efficiencies and synergies (via cost savings), new revenue opportunities (including fixed mobile convergence), lower competitive tension, leading to what some analysts have referred to as the opportunity for “market repair” in terms of introducing higher prices and claims that a country or region is falling behind peers.

Some have suggested that investment would increase if levels of competition were lower. For example, HSBC suggest that a four-to-three mobile merger will increase profit margins, and this will boost investment by MNOs to the long-run benefit of consumers.

However, other studies have suggested that concentration reduces investment, and that there is a complex relationship between competition and investment. A report by the Centre on Regulation in Europe found that “...an increase in market concentration in the mobile industry generates a true economic trade-off. While a merger will increase prices, according to our analysis investment per operator will also go up.” In practice, it appears that market structure and competitive intensity combine with many other factors in influencing levels of investment. Indeed, a recent study by Wik (2015), a consultancy company specialising in telecommunication regulation concluded when addressing these questions:

“On the basis of our analysis including econometric assessments, we have found no linkage between consolidation or higher concentration in mobile markets and an increase in investment. Investment tends to follow long-term investment cycles which appear to be largely unrelated to developments in market structure in the countries assessed.”

A factor that can influence the level of investment in different countries is their respective use of network sharing. The potential savings from network sharing may represent a significant proportion of the savings that are used to justify a full merger. Where there is significant competition among MNOs, the benefits of these savings are potentially more likely to be passed on to consumers. While Mobile Virtual Network Operators (MVNOs) can also bring benefits to consumers, end-to-end competition is generally preferable because consumers are likely to get better services at lower prices and more innovative services if there is competition at the network level that determines many of the parameters of quality, and there is competition between these networks to supply MVNOs. While MVNOs may enhance retail competition, where the wholesale prices they pay provide the incentives for them to do so, their contribution is limited compared to MNOs. MNOs keep control of their network investment decisions and can significantly differentiate the service quality offered to their customers driving innovation and long-term competition, whereas MVNOs often target consumers that their host MNO may not serve as effectively.

Sources : OECD (2014b), “Wireless Market Structures and Network Sharing”, *OECD Digital Economy Papers*, No. 243, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/5jxt46dzl9r2-en>; Wik (2015), “Competition and investment: An analysis of the drivers of investment and consumer welfare in mobile telecommunications”, Wik, Bad Honnef, <http://www.wik.org/index.php?id=70>.

However, consumers could suffer if bundling results in reduced levels of retail competition. This concern can arise for two reasons. First, this is because a lack of competition in any of the individual services can affect the entire bundle, and, second, because retail bundling can make it more complex for consumers to switch providers.

Symmetric sectoral regulation may need to be reviewed in light of evolving technological and market trends, while ensuring consumers and citizens remain protected

Traditional policy goals that are separate from economic efficiency, such as sectoral consumer protection rules, access to emergency communications, number portability, privacy, security, and media policy goals (such as maintaining plurality in news coverage and provision of domestic content), continue to be important. However, the separation of applications and distribution calls into question traditional methods of pursuing these goals. It will be necessary to decide how to advance these goals, that is, on which entities in the value chain should regulatory requirements fall; given the different methods used to provide similar media and communications services, is symmetric regulation appropriate; if it is not, how should regulators approach the different providers; and, finally, are there goals that are harder to achieve in a GPN world and for which traditional techniques may be less effective (*e.g.* enforcing domestic content regulations, given the global scope and mature of GPNs).

To be specific, services offered by communication operators and by providers of digital services such as OTTs are increasingly overlapping. Operators are moving to new network architectures, based on network functions virtualisation, and they are gravitating from the provision of simple connectivity to a whole new range of higher-value services. Some OTTs are already providing services, such as VoIP or messaging, that constitute substitutes to telecommunication services. These considerations lead to different views as to whether regulation of existing network providers needs to be reduced or if existing regulations should be extended to new service providers.

Consumer reliance on OTT services will require a review of sectoral consumer protection regulation. Traditional communications providers are subject to regulation designed to empower consumers to participate effectively in the market and to protect them from harm. Examples include protection measures to promote public safety, fair and reasonable contract terms, and the protection of vulnerable consumers. Today, consumers who substitute traditional digital communications services with OTT alternatives may unknowingly lose some of this protection. This could lead to consumer harm, particularly if consumers are not aware of the level of protection offered by the services they use. Similar concerns may arise with respect to the ability of consumers with hearing impairments to access content provided by on-line video distributors not subject to any closed-captioning obligations.

As these services evolve and usage increases, regulators will need to consider the extent to which consumer protection regulation should extend to OTT providers, in some cases, or whether there is a case for deregulation in others, to ensure desirable outcomes in terms of consumer protection. In order to make such an assessment, it is important to determine whether the original rationale for intervention remains intact, and whether the obligations considered are proportionate to the costs, including the potential cost in terms of any loss in innovation.

In addition, the extent to which OTT services replicate the essential characteristics of traditional services and the effects of this on consumer expectations may be a relevant consideration. For example, consumers may expect the same level of protection from OTT communications services as they receive for traditional telecommunications services. This becomes more significant where devices seamlessly select alternative services, potentially switching between traditional and OTT communications services, without the consumer being aware which is being chosen at any one time.

Finally, separating applications from distribution also raises important questions of where and how to impose any service or content-related regulatory requirements that a country might have. These issues arise in the context of emergency communications (*e.g.*, “E-911” or “E-311”), domestic content, advertising, and protection of children, among others. Historically, enforcement generally requires a local licensee or other local presence in order for sanctions to be credibly threatened or imposed. With services/applications

hosted outside the country, it is not clear whether it is desirable or practical to impose any these requirements in a new and evolving converged digital environment, but rather to look for other ways to achieve these important policy objectives.

With respect to media content regulations, such as those requiring exhibition of domestic content and encouraging plurality in news, it is fair to say that while the goals have not changed, the regulation to achieve them may need to adapt to a new ecosystem where media content is increasingly consumed on-line, which in turn facilitates consumption of material hosted outside of the relevant national jurisdiction.

Due to innovation in the video-delivery technologies, content-navigation technologies, and general business models, a majority of OECD countries have adopted different licensing regimes. In particular, in many OECD countries, audio-visual services provided over the Internet will not be subject to the same set of rules for traditional broadcasters, as the nature of these services is inherently different and falls under different regulatory provisions. For example, over-the-top video services in Mexico are not considered a substitute for pay television, because services provided by Netflix, for example, are a catalogue of audio-visual content that has been provided previously on other platforms (via cinema, movie rentals, pay television or television broadcast). According to the Mexican National Household Income and Expenditure Survey of 2014, 46.8% of households with pay television service do not yet have access to Internet services.

The European Union's Audio-visual and Media Services (AVMS) Directive regulates television broadcasts and on-demand audio-visual media services²⁶ for which providers have editorial responsibility. The AVMS Directive includes a set of criteria to establish whether a given service falls under the scope of the Directive: i) it is under the editorial responsibility by the media service provider, ii) the principal purpose is the provision of programmes, iii) provided to the general public, iv) in order to inform, entertain or educate, v) service normally provided for remuneration and (in the case of on-demand service providers) the form and content of the programmes is comparable to broadcast television programmes. This list is non-exhaustive. It should be noted, though, that these criteria are technology-neutral, as they refer to the characteristics of the service provided, as opposed to the underlying technology. Furthermore, in July 2015, the European Commission (EC) published a public consultation on the review of the AVMS Directive that sought the views of all interested parties on Europe's audio-visual media landscape. The EC has published the results of its consultation, and it is expected to issue legislative proposals for a revision of the Directive in summer 2016.

The challenges and the policies crafted to address these challenges, as described above, do not represent the entire scope of issues related to network convergence. Certainly, the effects of digital convergence go beyond communication networks and services. Possible policy responses to address emerging issues related to digital services and platforms, for example, as well as those specific to converging communications networks (as opposed to the public Internet), are beyond the scope of this report. However, future work in this area is welcome, as these evolving policy questions and policymakers' response to them will be particularly relevant and stimulating for the international ICT community for some time to come.

NOTES

¹ A few technological improvements fundamentally change how and where economic activity is organised. These are so-called general purpose technologies (GPTs). Historical examples of GPTs include printing with moveable type, electricity and the dynamo, the internal combustion engine, steam engines and railways.

² Increasing use of the content delivery networks (CDNs) often owned by the edge providers to reach end users, however, point to a growing relationship between the edge providers and the intermediate distribution platform owners.

³ GPTs generally have three characteristics, pervasiveness, improvement, and innovation spawning (Jovanovic and Rousseau, 2005).

⁴ It is important to note that over the top providers (OTTs) pay transit fees or peer from their networks with infrastructure owners and end-user subscribers pay for service providers for the bandwidth.

⁵ According to Baldwin and Woodard platforms represent a set of common components or modules that are shared across complex products or systems of production. A multisided platform is defined as “an organization that creates value primarily by enabling direct interactions between two (or more) distinct types of affiliated customers” (Hagiu and Wright, 2011). For example, Internet access providers may be considered as a MSP because they have direct association (interconnection) with complementors (e.g. Wikipedia) that enable users to create value (Claffy, K. C. and D. Clark, (2014).

⁶ See also the OECD Competition Policy Roundtable for a general discussion of two-sided markets <http://www.oecd.org/daf/competition/44445730.pdf>.

⁷ According to European Commission a 10% increase in broadband penetration causes GDP to increase by 1-1.5%. See Digital Agenda for Europe available at <https://ec.europa.eu/digital-agenda/en/broadband-strategy-policy>. See also, Council of Economic Advisors Issue Brief, March 2016 available at https://www.whitehouse.gov/sites/default/files/page/files/20160308_broadband_cea_issue_brief.pdf

⁸ The granting of such convergent licenses to provide all services is subject to the fulfilment of certain requirements, which differ across operators.

⁹ In September 2015, IFT proposed auction rules and procedures for the 2015-2016 award of AWS spectrum in Mexico. The bidding stage of the auction ended on February 18th this year, where Telcel (America Movil) submitted bids worth 2.1 billion Mexican Pesos for 2x10 MHz of AWS-1 spectrum and 2x20 MHz of AWS-3 spectrum (1755-1780/2155-2180 MHz), and AT&T bid 1.03 billion Mexican Pesos for 2x10 MHz of AWS-1 spectrum, which in total will give it 2x25 MHz across the AWS band. <http://www.totaltele.com/view.aspx?ID=492816>

¹⁰ <http://eleconomista.com.mx/industrias/2016/02/01/licitacion-banda-25-ghz-sera-hasta-finales-ano>.

¹¹ For example, in Australia’s case, refer to the most recent Regional Telecommunications Independent Review Committee (RTIRC) in 2015: <http://www.rtirc.gov.au/issues-paper/>

¹² Canadian Radio-television and Telecommunications Commission, Telecom Regulatory Policy CRTC 2015-326 <http://www.crtc.gc.ca/eng/archive/2015/2015-326.htm>

¹³ See also Gartner, Newsroom, available at <http://www.gartner.com/newsroom/id/2654115>.

¹⁴ <https://fi.google.com/about/experience/>

15 <https://fi.google.com/about/experience/>

16 In 2009, for example, T-Mobile in Germany required its customers to sign up for an USD 11.50 per month option (EUR 10) to be able to use OTT voice services. TeliaSonera (Yoigo) in Spain introduced a similar surcharge (USD 7) per month in 2012, while in Sweden, the same company increased mobile broadband prices regardless of VoIP use. In Japan, the largest mobile operator NTT Docomo, warned that VoIP may be unavailable on its 3G network, while in Mexico, the fixed-line incumbent blocked OTT VoIP in 2005.

17 There are bundling practices associated with digital services platforms other than broadband GPN. For example, Apple bundling its own applications with the iPhone, and Android users required to have Google identity.

18 Data from December 2014.

19 <http://www.crtc.gc.ca/eng/talktv-parlonstele.htm>

20 http://files.shareholder.com/downloads/NFLX/1921341065x0x886428/5FB5A3DF-F23A-4BB1-AC37-583BAEF2A1EE/Q116LettertoShareholders_W_TABLES_.pdf

21 <http://www.hulu.com/press/about>

22 [http://press.dailymotion.com/fr/apropos/.](http://press.dailymotion.com/fr/apropos/)

23 [http://tech.eu/features/4395/wuaki-tv-rakuten-profile/.](http://tech.eu/features/4395/wuaki-tv-rakuten-profile/)

24 In April 2015, HBO's "Now" service launched across Apple TV and iOS.

25 As the OECD (2014a) noted (box 1, page 28): "Some commentators have made a distinction between managed and over-the-top connected television services and this wording has featured in some regulatory decisions. The term "managed" refers to a service offered by the broadband network operator. This network operator manages the service by providing dedicated bandwidth for the service and creating a special QoS class, by using multicast or by having the facilities closer to the end-user. Over-the-top (OTT) connected television is perceived as being unmanaged, because the network operator does not provide facilities to the OTT service provider to improve or guarantee the quality of experience. OTT is felt to provide inferior performance and service quality and, therefore, is not regarded by some as "true television". Some regulators use this distinction to differentiate in the regulatory treatment of services. At the same time, some network and OTT providers use the distinction to support their views on which treatments that should be applied to services.

A key question that can be asked, in relation to any distinction, is whether it makes a difference for consumers or if they expect the Internet access service they pay for to be able to deliver a quality acceptable for their requirements relative to a video service bundled with that subscription. OTTs such as the Swedish Public broadcaster, Netflix, Lovefilm and others have found the use of an unmanaged Internet sufficient for their customers. That being said, it should be underscored that the vast majority of linear television is still handled by broadcasting technologies such as DTT, satellite and cable). Even when broadband ISPs have tried to make managed services commercially available, they have found few distribution networks willing to make use of these services. A further factor that blurs such distinctions, including between OTTs, is that some of the OTTs have more far reaching distribution networks as well as making differing levels of uses of CDNs."

26 In the Directive, the term "on-demand audiovisual media service" is defined as follows: 'on-demand audiovisual media service' (i.e. a non-linear audiovisual media service) means an audiovisual media service provided by a media service provider for the viewing of programmes at the moment chosen by the user and at his individual request on the basis of a catalogue of programmes selected by the media service provider (<http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010L0013&from=EN>);

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