GSR discussion paper

Why Competition Matters and How to Foster It in the Dynamic ICT Sector

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Why Competition Matters and How to Foster It in the Dynamic ICT Sector

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1 INTRODUCTION

Over the last three decades, laws and regulations designed to introduce and promote competition have been a crucial catalyst in the booming global information and communications technology (ICT) sector. At the early stages of competition, government authorities are generally faced with issues related to licensing, interconnection, and access. As competition increases and markets mature, government authorities must monitor these issues, but may also face concerns related to consolidation and horizontal and vertical integration, as well as consumer issues regarding lock-in, transparency, and quality of service.

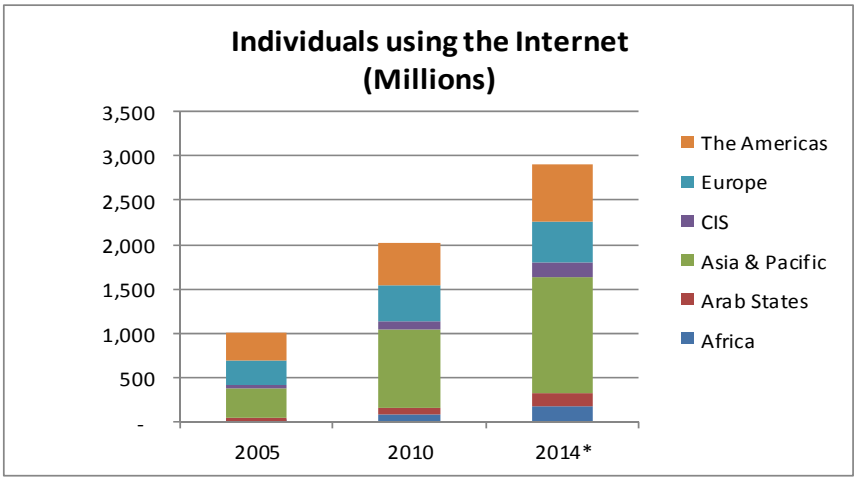
Today's emerging broadband-centric environment is presenting lawmakers and ICT regulators with a new set of challenges. They must address traditional competition issues, but often with new twists resulting from new players, greater consolidation, and integration among telecommunication service providers, content providers, and manufacturers. The rise of Internet protocol (IP) based networks and the separation of services from the underlying physical infrastructure has unleashed a variety of innovative applications and services and new business models that challenge old revenue streams and legacy regulatory regimes. In this new environment, regulators must find ways to adapt their rules to ensure fair competition, drive investment and innovation and protect consumers.

These issues are only likely to increase over time, as more services and economic and social activity move online. This trend is illustrated in the growth of data traffic over the last decade. Between 2002 and 2012, global Internet traffic increased 120 times, now amounting to 12,000 gigabytes (GB) of information being transmitted per second.[1] Today, a fifth of Internet traffic is cross-border.[2] By 2017, estimates are that global Internet traffic will reach 35,000 GB per second, nearly a 350 fold increase from 2002, reaching three times more traffic than in 2012. Today, 40 per cent of the global population is using the Internet and notably the most significant growth is in emerging markets such as Africa and Arab States -- growth between the years 2005 and 2014 was 934 per cent and 480 per cent, respectively. (See Figure 1).

[1] Cisco VNI, "The Zettabyte Era – Trends and Analysis," May 2013, *available at* http://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/VNI_Hyperconnectivity_WP.html

[2] Global flows in a digital age: How trade, finance, people, and data connect the world economy, McKinsey Global Institute, April 2014.

Figure 1: Individuals Using the Internet



Source: ITU World Telecommunication/ICT Indicators database.

This paper examines the increasing complexity of devising an effective, yet flexible, framework to promote effective competition and consumer choice in the rapidly changing ICT sector. Section 2 addresses the impact of competition and the benefits that can ensue in a competitive ICT environment. Section 3 addresses the emerging competitive landscape; Section 4 identifies the key existing and emerging competition issues and how regulators are seeking to address them. Section 5 presents the overall conclusions of this paper.

2 WHY COMPETITION MATTERS

Competition is a key element in realizing the benefits that advanced networks and services can bring. Monopoly markets, even those with strong regulatory oversight, are often characterized by high prices, poor quality of service and limited innovation. Providers in such a situation are often slow to develop new services in response to evolving consumer demand. By contrast, more competitive markets force more attention to be paid to consumer needs, driving prices down and service quality and innovation up.

Reflecting an increasing realization of the benefits of competition, the global ICT sector has overwhelmingly moved from one based on monopolies towards fully competitive markets for a variety of services and across technologies. The existence of multiple players in a market, rather than one sole provider, has been shown to benefit consumers as companies compete for customers by lowering prices, improving service quality, and introducing new technologies and services. Importantly, effective competition reduces the need for *ex ante* regulatory interventions at each level of the service supply chain, including the international gateway, national and regional backbone networks, and the local access market.

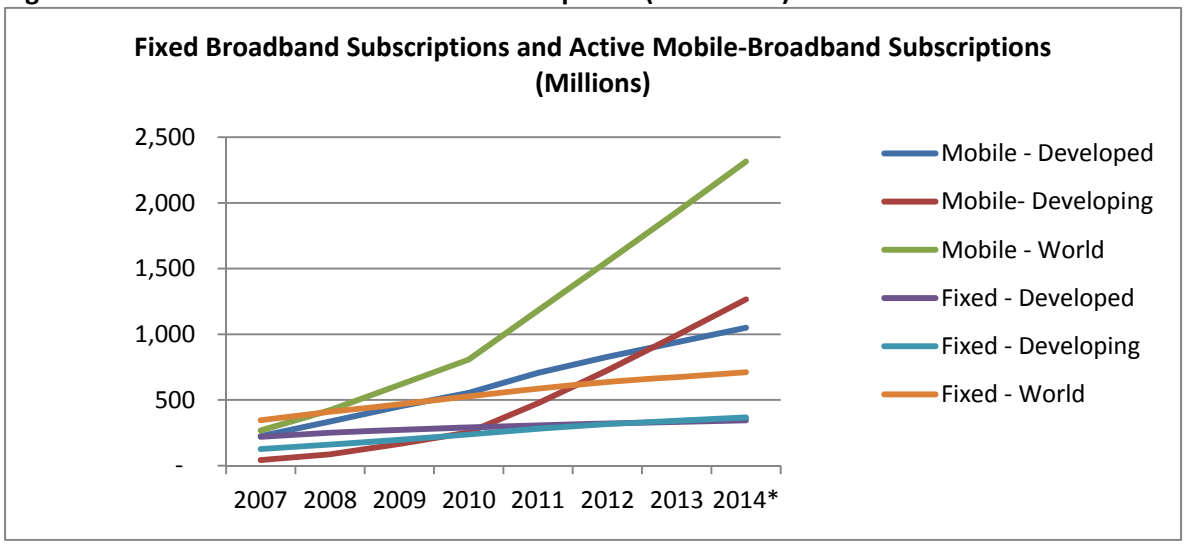
On the technology side, having multiple competitors increases the supply of network infrastructure, giving consumers more choice and making services more affordable. For example, based on ITU statistics, between 2004 and 2013, the percentage of countries worldwide with partial or full competition in the international gateway market increased from 55 per cent to 84 per cent.[3] Likewise,

[3] ITU World Telecommunication/ICT indicators database, www.itu.int/icteye.

the percentage of countries with partial or full competition in the DSL market rose from 59 per cent to 82 per cent between 2004 and 2013.[4] In addition, new business models, new players, and new services are creating an unprecedented amount of choice for consumers. In a competitive environment, consumers are able to choose not only amongst network service providers for fixed line and mobile telephony and broadband services, but also among an emerging array of new providers that offer "over the top" (OTT) services.

Competition is also key to ensuring widespread access to and adoption of ICT services, particularly broadband services. As reported by the UN Broadband Commission, a study of 165 countries between 2001 and 2012 revealed that countries with competitive markets had average broadband penetration levels 1.4 per cent higher for fixed line broadband and up to 26.5 per cent higher for mobile broadband than those countries without competitive markets.[5] The correlation between liberalization and penetration is particularly notable in the mobile market. The precipitous rise in the number of mobile connections between 2005 and 2013 tracks the increase in fully competitive mobile markets.

Figure 2: Fixed and Mobile Broadband Subscriptions (2007-2014)



Source: ITU World Telecommunication/ICT Indicators database.

The mobile services market in Costa Rica, for example, illustrates how competition helps the ICT sector grow. In 2011, two new mobile operators, as well as two mobile virtual network operators (MVNOs), entered the market to compete with the monopoly incumbent provider. Since then, penetration and traffic have steadily increased, while prices have decreased (see Box 1).

Box 1: Effects of liberalization and introduction of competition: Case of mobile services in Costa Rica

Recent market liberalization in Costa Rica's mobile market highlights the benefits of competition for consumers. In 2011, the Costa Rican government introduced competition into its mobile market with the assignment of two mobile network operator licenses (Telefonica Moviles and America Movil) and two mobile virtual network operator licenses (Tuyo Movil and Fullmovil). These operators launched

[4] ITU World Telecommunication/ICT indicators database, www.itu.int/icteye.

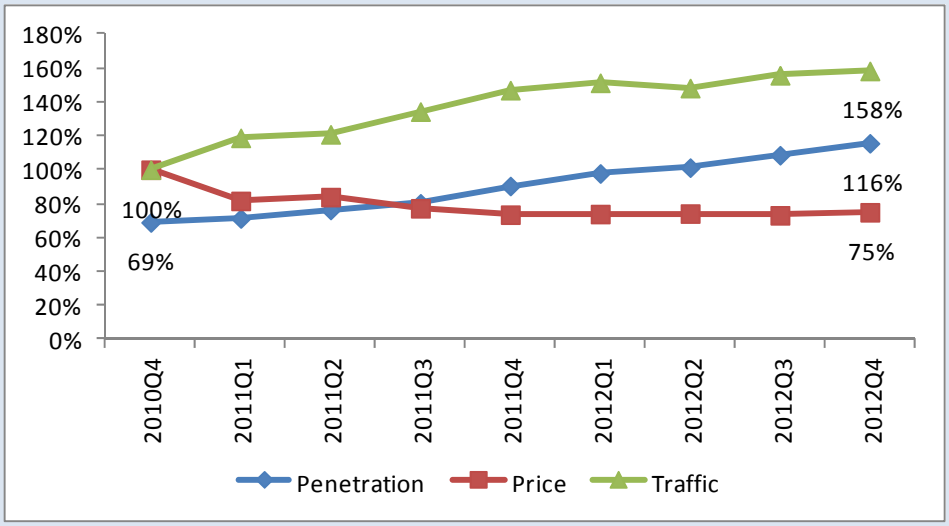
[5] UN Broadband Commission for Digital Development, "The State of Broadband 2013: Universalizing broadband," p. 78, September 2013, http://www.broadbandcommission.org/Documents/bb-annualreport2013.pdf.

service between the third and fourth quarters of 2011 to compete with state-owned incumbent, Instituto Costarricense de Electricidad (ICE).

The introduction of competition was triggered by Costa Rica's commitments under the Dominican Republic-Central American Free Trade Agreement (CAFTA-DR) with the United States that required mobile market liberalization and led to the passing of the General Telecommunications Law (Law 8642 of 30 June 2008). At that the time the law was passed, mobile penetration in Costa Rica was around 43 subscriptions per 100 inhabitants, the lowest in Central America.

In fact, the impact of competition in Costa Rica was felt even before the actual entry of competitors into the market. In preparation for the new competitors, ICE made a significant push to increase service take up and reduce prices—and these gains for consumers have been maintained or increased following entry. As shown in Figure , key market metrics have changed significantly between the fourth quarter of 2010 (nine months before entry occurred) and the fourth quarter of 2012 (one year after entry). In that period, mobile service penetration increased from 69 per cent to 116 per cent, prices per minute dropped by about 25 per cent and, as would be expected, usage increased by about 58 per cent. These figures highlight how the threat of imminent competition, as well as actual competition in the market, leads to clear benefits for consumers in the form of increased choice, lower prices, and higher take-up and consumption.

Figure 3: Key Mobile Market Metrics for Costa Rica



Note: Penetration represents the number of subscriptions per 100 inhabitants. Prices are based on the average revenue per minute of mobile voice traffic. Traffic represents total mobile traffic reported by operators.

Source: Authors based on SUTEL statistical data report.

Today, two-thirds of the world's population has a mobile phone, with global mobile data traffic increasing 81 per cent in 2013.[6] What is particularly notable is that the growth in mobile broadband subscriptions is greater in developing countries than in developed countries; the growth between 2007 and 2014 was almost 2850 per cent – almost eight times the average rate of growth for developed

[6] Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2013-2018, February 5, 2014.

countries. The beneficiaries of this dynamic marketplace are generally the consumers who are offered better and more alternatives in terms of their offerings.

3 A CHANGING COMPETITIVE LANDSCAPE

The competitive landscape in the ICT sector has changed dramatically, particularly in the last several years. New technical capabilities made possible by IP-based broadband networks have given rise to new entrants competing in traditional markets with new business models and completely different cost structures than traditional providers. New technologies and upgraded networks have also enabled the introduction of a wide variety of new services and applications. Competition from these new entrants, models and services are forcing traditional service provider to adapt, and adapt quickly. This section discusses the changes that are taking place in the ICT sector and how these changes are impacting the competitive environment.

3.1.1 What's happening?

3.1.2 Convergence creates new competitors and regulatory complexity

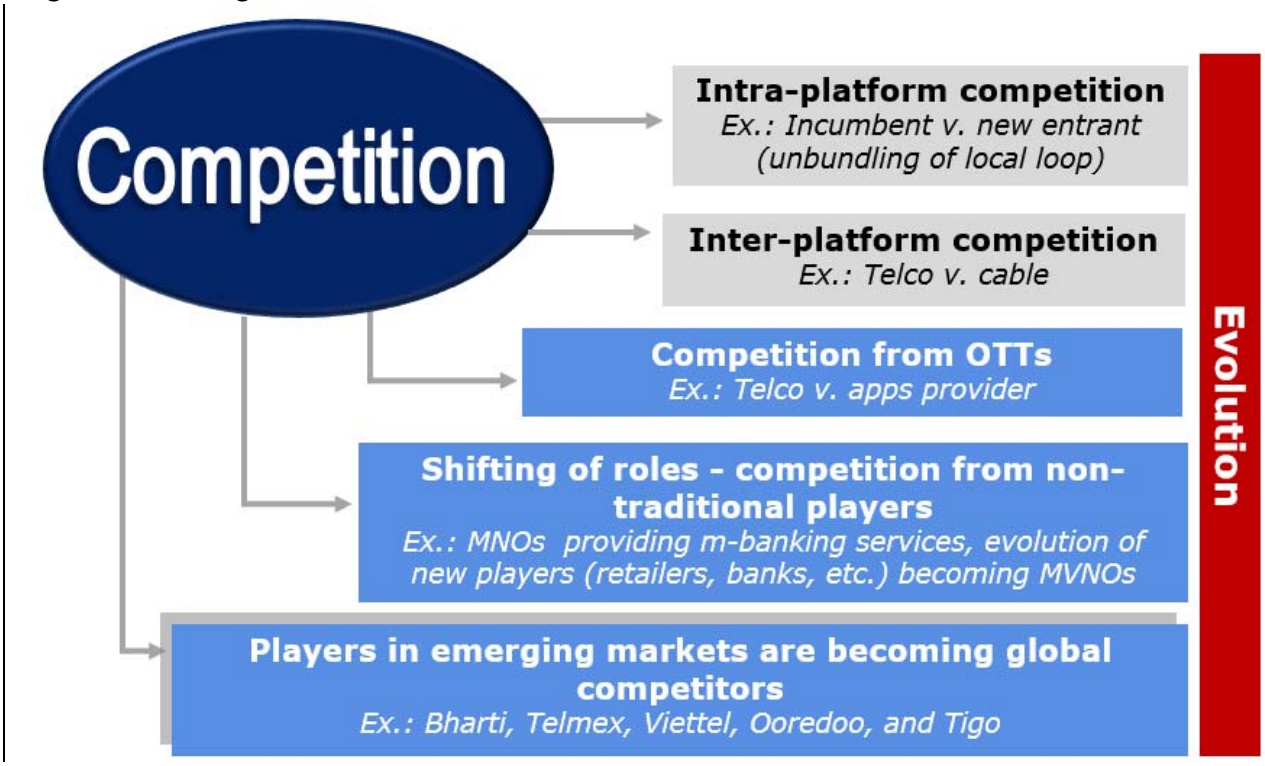
IP-enabled broadband networks allow ubiquitous access to all types of content. Users expect to be able to access any service and application from any device and from any location—whether high-quality voice and video telephony; business projects and documents; live, streaming and downloaded video (whether a two-minute YouTube video, television programming or a feature length film); music and games; email, text messaging and social media; and a myriad of mobile applications. The introduction of cloud-based services increases the importance of access as users can begin a project or program on one device and finish it on another in a different location. From the consumer's perspective, this seamless and ubiquitous access highlights the importance of content while de-emphasizing the delivery mechanisms. Users are not necessarily concerned about the underlying network technologies used to deliver their content, as long as their networks are secure and fast.

Although a converged broadband environment has undoubtedly expanded the user's experience, the provider side has become more complex. For over a decade now, traditional telecommunications service providers that were previously in different markets now compete with one another. For example, bundled "triple play" packages mean that traditional telephony operators have expanded into pay TV services by offering Internet protocol television (IPTV), while cable TV operators have expanded into telephony services by offering voice over Internet protocol (VoIP) services, and both offer high-speed Internet access. Similarly "quadruple play" packages (fixed line telephony, pay TV and Internet, plus mobile services) offered by a single company add even greater complexity to the field of competition.

In addition to the changes taking place amongst the traditional telecommunications companies, those same companies are now facing competition from new providers in downstream markets. In the past, traditional companies provided services that were intimately tied to their infrastructure—broadcasters supplied radio and television programming; telephone networks provided voice communications (and some data) and cable television provided video programming. In today's world, with broadband rapidly becoming the norm, all voice, data and video services can be provided over a single converged network. As a result, content and applications have been separated from the underlying transmission. More importantly, this has led to a boom in new content and application providers that do not own the access

networks, but that compete with operators' traditional services, such as OTT voice (Skype) and video (Netflix) services. Network operators are also now expanding into content markets in order to generate new sources of revenue and try to prevent from becoming mere conduits (or "dumb pipes") through which other firms' content passes. Figure 3 shows how the competitive landscape is changing and becoming more international in scope.

Figure 3: Challenges to Traditional Service Providers



Source: TMG

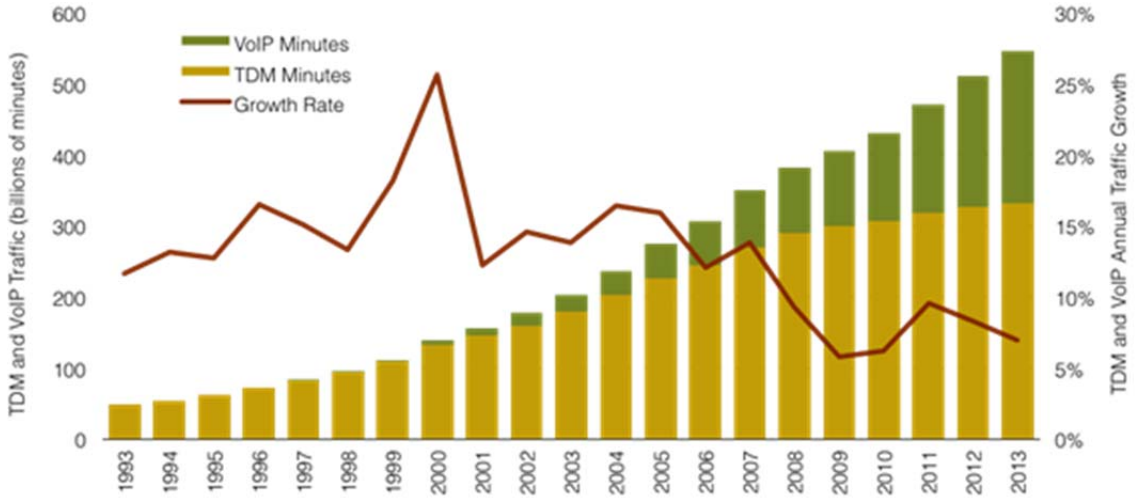
One example of this trend is VoIP. Rising from a simple program to provide voice communications between personal computers using a data connection, VoIP has become a multi-billion dollar business, with Skype alone earning nearly USD 2 billion in 2013 alone.[7] More importantly, VoIP has been taking an increasing share of global voice traffic (see Figure 4). TeleGeography estimates that Skype's on-net international (Skype-to-Skype) traffic grew 36 per cent in 2013, to 214 billion minutes.[8] While the volume of international telephone traffic still remains far larger than international Skype traffic, Skype's traffic is growing much more rapidly. Skype added approximately 54 billion minutes of international traffic in 2013, 50 per cent more than the combined volume growth of every carrier in the world,

[7] Dina Bass, "Microsoft Skype Unit Approaching $2 Billion in Annual Sales," Bloomberg News, 19 February 2013, http://www.bloomberg.com/news/2013-02-19/microsoft-s-skype-unit-approaching-2-billion-in-annual-revenue.html.

[8] Telegeography Report on International Voice, (January 2014) http://www.telegeography.com/page_attachments/products/website/research-services/telegeography-report-database/0004/6341/TG_executive_summary.pdf

combined.[9] Currently, 39 per cent of international calls are completed via Skype. Figure 4 shows how VoIP growth is continuing to accelerate, even as traditional voice calling is slowing.

Figure 4: **International Call Volumes and Growth Rates, 1993-2013**



Source: Telegeography Report, 2013.

Clearly the success of VoIP has undercut traditional models of voice telephony carriage. How have operators responded? In many cases, operators initially resisted allowing VoIP applications as they correctly perceived it as a threat to their traditional revenue stream. This resistance was often then reflected in laws and regulations that limited VoIP, as governments sought to protect their monopolies (especially if state-owned) and their own tax revenues. Many of these restrictions remain in place today. Over time, however, VoIP has slowly entered the mainstream, particularly in the mobile segment of the market, as carriers themselves began to offer their own interconnected VoIP services to compete with VoIP applications like Skype or Viber. Although VoIP is allowed in a large majority of countries, it remains illegal in nearly 30 countries.[10]

In the video services market, a broad range of services has sprung up, ranging from user-generated content sites like YouTube to sites offering high-definition movies and television shows, like Netflix, Lovefilm in the United Kingdom (now Amazon Prime), and Hulu. The rise of Netflix has been particularly strong. Between 1999, when it began its video streaming operations, and April 2014, Netflix has acquired almost 50 million global subscribers, and a 32.3 per cent video streaming market share in the United States.[11] Netflix currently operates in over 40 countries[12].

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[9] Telegeography Report and Database on International Voice, (January 2014) http://www.telegeography.com/research-services/telegeography-report-database/

[10] ITU, "World Telecommunication/ICT indicators and World Telecommunication/ICT Regulatory databases," 2013, www.itu.int/icteye.

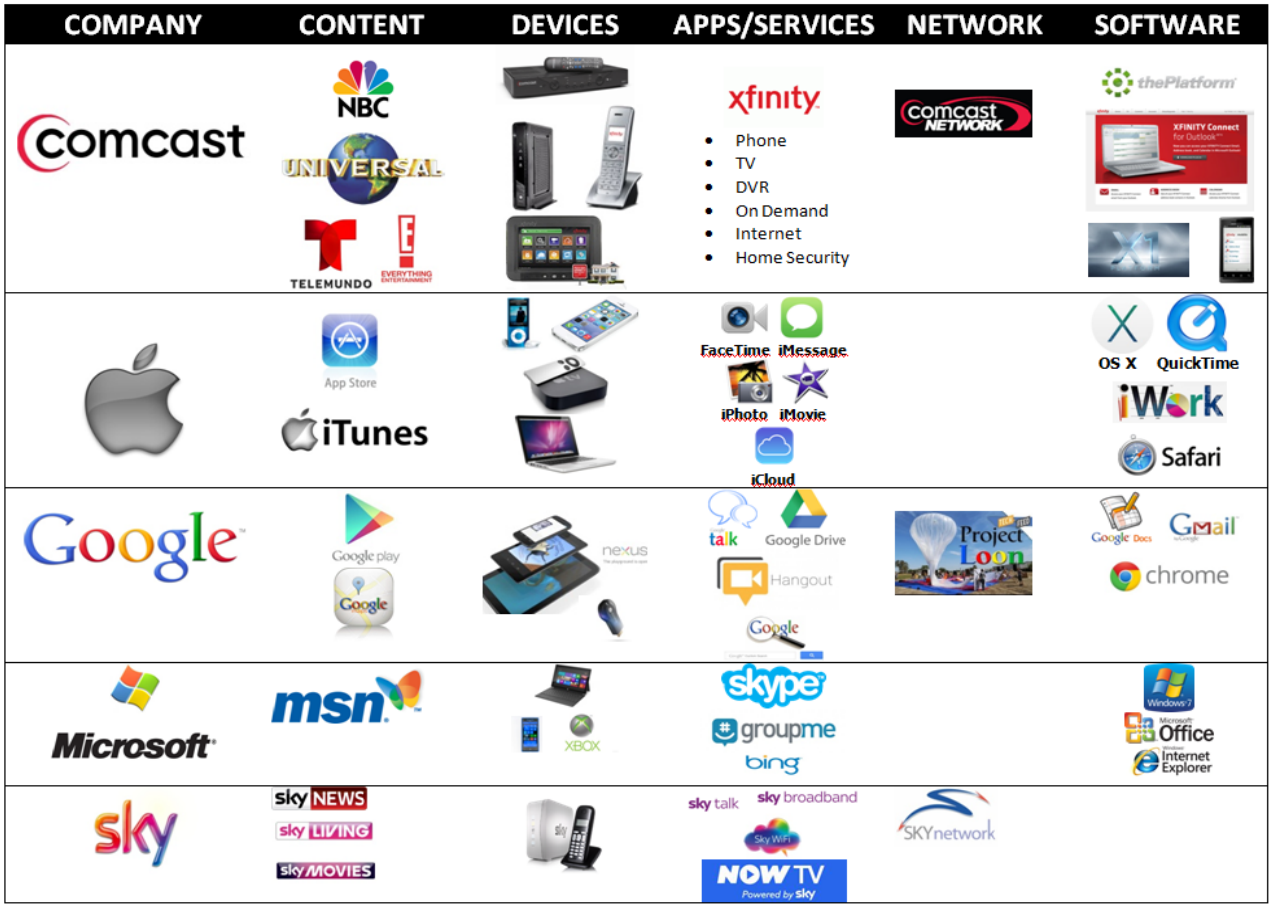
[11] Reuters, "Netflix price hikes seen boosting global expansion," April 22, 2014, available at: http://www.reuters.com/article/2014/04/22/us-netflix-results-idUSBREA3K14N20140422

[12] Netflix to launch in six more European countries this year, May 21, 2014, available at: http://www.reuters.com/article/2014/05/21/us-netflix-europe-idUSBREA4K03D20140521

Existing video content programmers or developers have responded, in many cases, by starting their own video streaming services. Hulu, for example, is owned by Comcast, Disney, and Fox, and makes content available in the United States and Japan from NBC, Fox, ABC, TBS, WWE, among others. In the United Kingdom, NowTV was launched by Sky in July 2012 and now offers a stand-alone streaming box or applications that enable content to be viewed on an iPad, iPhone, Android devices, personal computers, Roku, Smart TVs from LG, PS3, and Xbox 360. The rapid proliferation of video services shows that companies see great potential in video services going forward, and competition between traditional, OTT and hybrid providers is likely to be intense.

More broadly, the last few years have also seen a rise in acquisitions and consolidation as companies expand their business lines to include network, hardware, software, services, online content (e.g., music, books, movies, etc.) apps, retail stores, etc. to create a complete ecosystem. Companies have generally done this through a hybrid approach of internally expanding their business and/or by acquiring other companies that can provide them with additional businesses and/or assets to enhance their participation in the market. Google for example has the Google Play Store, the Android operating system, Project Loon, fiber network, and Google Hangout, among others. Apple has created a similar ecosystem with devices (iPads, iPhones, computers) and software (IOS), iTunes, and FaceTime. Others have acquired their new business via acquisitions such as Microsoft's purchase of Skype and Facebook's purchase of WhatsApp. Likewise, many of the new players in the market are prompting the traditional players to rethink their business strategies, and become more innovative in their plans, products, and services. As a result, more traditional players are pursuing acquisitions to horizontally or vertically integrate their business, such as Comcast's acquisition of NBC Universal and its proposed acquisition of Time Warner, as well as AT&T's recent announcement that it is purchasing DirecTV (see Figure 5).

Figure 5: Companies Developing Technology Ecosystem - "Covering All the Bases"



Source: TMG

As companies address the current landscape where data and communications flows are experiencing tremendous growth, they are also expanding their businesses internationally. Netflix started out as a domestic business in the United States; by 2013 (only three years after starting its international expansion), almost one quarter of its streaming customers resided outside of the United States, and the company just announced plans to expand to six European countries by the end of 2014. Approximately 66 per cent of Apple's revenues in the second quarter of 2014 and 40 per cent of Amazon's revenues in the first quarter of 2014 came from sales outside the United States.[13] In addition, companies that were local or regional players are expanding internationally as well. The telecommunications operations of Telmex, based in Mexico, were limited to the Americas, but has recently begun to make acquisitions in Europe. Similarly, Bharti of India purchased Zain's operations in Africa and now operates in eight countries in the region. Viettel of Vietnam has expanded its operations into Africa and the Americas. H3G, a new entrant in Europe, has acquired various companies in Austria and Ireland.

[13] Apple, "Apple Reports Second Quarter Results," Press Release, 23 April 2014, https://www.apple.com/pr/library/2014/04/23Apple-Reports-Second-Quarter-Results.html; Steve Lohr, "Amazon's Revenue Grew 23 Percent in First Quarter, Nearing $20 Billion," 24 April 2014, http://www.nytimes.com/2014/04/25/technology/amazon-quarterly-earnings.html.

3.1.3 Content delivery

As the Internet has continued to evolve, the delivery of content to end users has grown more complex. The key driver behind these changes in recent years has been the growth of video traffic and, most recently, the increasing shift from recorded or on-demand video to live streaming. For example, video streaming will account for an estimated 69 per cent of all consumers Internet traffic by 2017, up from 57 per cent in 2012.[14] The direct impact is a change in Internet traffic flows leading to an asymmetric in-bound to out-bound traffic mix as a consequence of increased traffic from content delivery networks (CDNs) to service provider networks that connect end users.

To accommodate for exponential traffic growth and consumer demand, new arrangements to exchange traffic and payments and increased instances of vertical integration have emerged within the Internet supply-chain. This includes, in particular, the growth and evolution of CDNs, the deployment of national Internet Exchange Point (IXPs) and the adoption of paid-peering arrangements for exchange of traffic.

Box 2: The increased relevance of CDNs for Internet traffic exchange

CDNs comprise a network of servers deployed across multiple networks in several data centers that enable fast and high-quality delivery of content to end users. Caching content close to the edge of the network via a CDN is especially attractive to OTT providers that offer video streaming as their content is latency-sensitive and uses large amounts of bandwidth. CDNs have increasingly become key players within the distribution of Internet traffic. It is estimated that 65 per cent of all Internet video traffic will cross CDNs in 2017, up from 53 per cent in 2012.[15]

There is already a significant number of CDNs around the world.[16] Originally, pure-play CDNs, like Akamai and Limelight, invested in caching technologies to host content closer to the end users. As video began to be embedded in web sites, CDNs began to distribute pre-recorded or on-demand content and subsequently to stream live content. However, other actors within the Internet ecosystem have been vertically integrating into the CDN market. This includes Internet backbone providers, such as Level 3, content providers (CPs), such as Netflix or Google, and Internet service providers (ISPs), like Telefonica (Spain), Comcast (U.S.), Korea Telecom, Telecom Italia, and SFR (France), to name a few.

The goal of this strategy is to essentially cut out the middle man –the pure-play CDN. A pure-play CDN operator gets paid by the CP for delivering its content to the CP's audience of end users. The CDN in turn must pay ISPs, carriers, and network operators for hosting its servers in their data centers. By vertically integrating into the CDN market, CPs are able to save the costs of paying for transit traffic over Internet backbones.

The latest step in this continual evolution is the push to create CDN federations mainly to expand the geographic footprint of its individual members. These can be characterized as a multi-tier integration

[14] *See* Cisco Visual Networking Index: Forecast and Methodology, 2012–2017, *available at* http://www.cisco.com/c/en/us/solutions/collateral/service-provider/ip-ngn-ip-next-generation-network/white_paper_c11-481360.pdf.

[15] *Id*.

[16] A list of selected active CDNs can be found at www.cdn-advisor.com.

between CDNs, which involve agreements similar to peering at an IP-layer, allowing interconnection, and integration between CDNs and the ability to exchange traffic between them and deliver service to an end user. While still incipient, CDN federations initially covered operator-owned CDNs only, but pilots for incorporating pure-play CDNs into federations are ongoing.[17]

An issue for many countries, particularly where there is low Internet penetration, is a lack of IXPs. This results in bottlenecks in which small ISPs do not exchange enough traffic to engage in settlement-free peering and therefore must either aggregate their traffic with other ISPs or pay for interconnection (i.e., paid peering). Additionally, countries without their own IXPs must transit all Internet traffic through another country (called tromboning), which affords large backbone providers more bargaining power and reduces quality of service since traffic must travel longer distances before reaching the end user.

The early Internet ecosystem—before the rise of IXPs—was strongly hierarchical with backbone providers at the top and able to dictate terms. IXPs, however, have flattened the hierarchy by enabling ISPs to peer directly to one another through secondary peering arrangements. IXPs themselves have developed due to increases in Internet demand and new players, such as CDNs, which have created a market to deliver content closer to the edge of the network.

As IP transit is substituted for settlement-free peering at the local level, these developments have had a significant impact on increased traffic flows as well as cost savings relating to the exchange of Internet traffic in many developing countries. For instance, a Google cache deployed in Kenya boosted traffic over the Kenyan IXP (KIXP) from 100-150 Mbit/s to around 1 000 Mbit/s. By peering locally, the Kenyan ISPs did not have to buy transit for this traffic, which then ranged from USD 150 to USD 600 per Mbit/s/month.[18]

Section 4.6 addresses Internet interconnection issues in more detail.

3.2 Why are these changes important?

The importance of such changes is that they are also reshaping the regulatory and competitive landscape. Legacy regulations that applied just to monopoly telephony providers make little sense in an environment where companies can provide a wider range of services than before and compete with each other. So, for example, should a traditional telephone company that now provides IPTV services still be regulated as a telephony provider, a cable company, a broadcaster, or something new entirely? Similarly, new entrants to this converged ICT market often have no physical networks and operate with business models that are nothing like traditional telecommunications companies. What regulations should apply to them? In this situation, regulators face a complex task to ensure that all competitors are treated fairly and competition can flourish, while also seeking to ensure that market-led rapid innovation continues and government regulations do not provide disincentives for new entrants or entrepreneurs.

[17] *See* Francois Le Faucheur, CDN Federation: Lessons from Phase 3 of the CDN Federation Pilot Cisco, Content Delivery Summit, NYC, May 20, 2013, available at http://conferences.infotoday.com/documents/172/2013CDNSummit-B102C.pdf

[18] OECD Communications Outlook 2013, p. 143.

The consequences of these changes are largely positive, but also quite disruptive. For example, this active marketplace with new business models, new players, and new services is creating an unprecedented amount of choice for consumers, who can now use services from a variety of providers. For policymakers and regulators, however, the result of all these changes is an ICT sector that is evolving rapidly and becoming increasingly complex. This, in turn, means that competition regulation must evolve to reflect the new players and new ways of providing services; old regulatory constructs and competition policies may no longer make sense or serve the purposes for which they were originally developed.

4 REGULATORY RESPONSES TO CHANGING COMPETITIVE CONDITIONS

As policymakers and regulators confront this rapidly changing environment, a range of issues must be addressed to ensure that competition can continue to flourish in all the different segments of the ICT sector and throughout the broadband value chain. Although the benefits of competition are widely recognized, the dynamic nature of the industry itself poses several challenges to identifying whether and what types of regulation are needed in order to effectively promote competition. First, as the various markets continue to develop and mature, the regulatory framework must be flexible enough to accommodate the changes, and specific regulatory obligations and requirements must be updated to reflect new market conditions. Incumbents, for example, may lose their large market shares to new entrants, so there is no longer a clear dominant operator. This, in turn, can lead to removal or easing of *ex ante* regulation in favor of *ex post* competition rules.

Second, technological and service convergence has blurred the lines between traditional products and services, making it more challenging for regulators to delineate between relevant markets. For example, in many countries regulators are debating whether fixed line broadband and mobile broadband are distinct markets or whether there is sufficient fixed line to mobile demand-side substitution to conclude that a single broadband access market exists.

Third, as noted in Section 3, the emergence of new actors and business models in the broadband value chain, such as OTT (e.g., VoIP) applications, cloud computing and CDN providers, raises questions of how to apply existing competition rules in an objective, non-discriminatory way. In many jurisdictions, the services provided by these new players may not be included in market analyses and may not be subject to existing ICT regulation, despite the fact that they provide similar services. The challenge is how to support these new players and innovation—and the positive impacts they are having on consumer choice, services and prices—as well as facilitate the roll-out of new businesses that are driving big data and the Internet of Things.

Finally, the new markets and competitors arising in a converged broadband environment also create new opportunities for operators to cut costs and improve efficiencies wherever possible through horizontal and vertical integration, a trend that can negatively impact consumers' ability to realize the full benefits of a competitive marketplace and that may unfairly disadvantage their (new and old) competitors. In particular, policymakers and regulators are increasingly taking a closer look at vertical integration issues. In addition, market shifts in Internet interconnection are also highlighting potential new issues.

The following sections discuss some of the key ways in which policymakers and regulators seek to promote competition in the context of these complex challenges.

4.1 Licensing reforms

In the past, many countries did not have competitive telecommunications markets due to restrictions resulting in a single, monopoly operator. The simple solution that most countries have adopted is to liberalize their markets and open the provision of ICT services to multiple providers. Regulators have introduced various licensing-based measures to facilitate competition. These have included eliminating exclusivity and allowing for any number of entrants who satisfy the licensing criteria (with the exclusion of scarce resources, such as spectrum). In addition, the process to obtain licenses has become much more streamlined in terms of the application process (i.e., the information to be provided and the requirements that must be met) as well as the timeframe to obtain a license.

Today, many jurisdictions are looking into the prospect of fostering competition and innovation by allowing the use of new services through liberalized licensing measures, or by not requiring any type of license. For example, unlicensed[19] (also called license-exempt) spectrum rules have enabled the boom in Wi-Fi, Bluetooth and other devices that are now integrated into the broadband ecosystem.

One example of how licensing can influence competition is seen in the varying policy and regulatory responses to VoIP. Competition in the voice telephony market has changed dramatically over the years due to the introduction of VoIP. Policymakers and regulators, however, have sometimes struggled with how to oversee the new entrant/technology; ranging from outright bans to policies that subject VoIP providers to the same regulatory requirements imposed on traditional telephony providers. Over 80 per cent of countries responding to the 2013 ITU Regulatory Survey indicated that VoIP is legal, a percentage that has remained largely unchanged for the last several years. However, a minority of countries either prohibit or strictly regulate the provision and use of peer-to-peer (P2P) VoIP and other OTT applications—often to protect incumbent revenues. This is particularly the case with P2P Skype, which has substantially cut into profits of incumbent's operators.[20]

Some countries have officially banned P2P Skype, Viber (an encrypted app that allows callers to make calls and send texts to other Viber users) and other OTT applications on the basis, at least in part, that they deprive licensed operators of their voice and text message revenues.[21] Most countries that limit P2P Skype and other OTT applications, however, do so by classifying such applications as telecommunications services subject to onerous licensing obligations or limiting the number of licenses available to just the incumbents. In these scenarios, only licensed operators (and typically just the incumbents) are permitted to offer any type of telecommunications service, including P2P Skype, which means that Skype and other OTT applications are available only if the operators permit them. This enables the incumbents to decide whether or not to allow competition from OTT applications and inhibits consumer choice since they are unable to access certain apps and services that are available in other countries. Consumer pressure, however, can encourage operators to unblock apps. For example,

[19] For which radiocommunication devices are exempted from individual licensing, as they have been already authorised in a general manner to operate under a specific regulatory framework (also named *Generic Use Licensing*, or similar; i.e. Wi-Fi devices).

[20] Global flows in a digital age: How trade, finance, people, and data connect the world economy, McKinsey Global Institute, April 2014.

[21] MTIT, "Ministry News," June 27, 2012, http://www.mtit.gov.ps/index.php?option=com_content&view=article&id=784%3A2012-06-27-09-32-07&catid=1%3A2011-03-30-09-48-14&Itemid=25.

Escalate and du In the UAE blocked Skype's website and use of the app to make P2P VoIP calls and calls that connected to the public switched telephone network (PSTN) until April 2013 when both operators lifted the ban and enabled customers to use the application.[22] Although neither operator expressly stated its reasons for unblocking the app, du implied that it was due to customer pressure.[23]

4.2 Access obligations

Building communications networks requires significant sunk cost, especially if nationwide coverage is required as part of the license terms. In an attempt to facilitate competition for new and smaller players, certain countries have imposed access obligations on dominant or SMP operators that require them to allow their competitors to use their network elements at cost-based rates and on non-discriminatory terms. While the effects of these policies are controversial, access obligations are generally intended to facilitate competition by removing high barriers to entry associated with new entrants building out their own network infrastructure. Recently, in a new approach, governments themselves are creating shared, open access networks that provide wholesale services to retail providers. Such networks are being created in response to the same cost/efficiency issues addressed above, as well as a desire to speed up the deployment of broadband services.

4.2.1 Opening wireline network access

Wholesale obligations may require incumbents to lease out just passive infrastructure, such as masts, ducts or poles, to smaller competitors or require full unbundling of the local loop for telephony and bitstream access for broadband services.[24] At the same time, because *ex ante* wholesale access obligations involve a greater degree of regulatory intervention than interconnection obligations and regulated termination rates, they potentially create even greater market distortions.[25] As such, mandated unbundling obligations, if adopted, should be carefully tailored to each country's unique situation. In addition, regulators should review wholesale access regulations on a regular basis and eliminate any *ex ante* obligations if they are no longer necessary to facilitate effective competition. According to the ITU's annual telecommunication regulatory survey in 2013, 50 per cent of the 181 countries responding to the survey reported that they require full unbundling of copper local loops and 36 per cent reported wholesale bitstream access obligations are in place.[26]

Many regulators view these obligations as a means to enhance competition, given that fixed line broadband, in particular, requires substantial investments, which may be economically burdensome or inefficient for new entrants to replicate, especially in rural areas. While the expectation is that regular market reviews will demonstrate at some point that competition is sufficient to no longer warrant mandated access obligations, nearly all countries that have imposed LLU or bitstream access obligations have opted to maintain them, at least for some markets. As outlined in Box 4, Canada is one of the few countries currently revisiting its wholesale access regulations and considering the removal of certain obligations.

[25] ITU, "Telecommunications Regulation Handbook: Tenth Anniversary Edition," 2011, http://www.itu.int/dms_pub/itu-d/opb/reg/D-REG-TRH.01-2011-PDF-E.pdf.

[26] International Telecommunication Union, "World Telecommunication/ICT indicators database," www.itu.int/icteye.

Box 3. Canada's ongoing reviews of mandatory unbundling for broadband access services

In *Telecom Decision CRTC 2008-17*, the Canadian Radio-Television and Telecommunications Commission (CRTC) articulated new rules for the regulation and pricing of wholesale telecommunications services provided by incumbent carriers. Under these rules, large operators must provide unbundling of broadband network infrastructure as well as traditional network elements.

In 2010, the CRTC reiterated that large incumbent local exchange carriers (ILECs) and cable companies must make wholesale broadband available to competitors at speeds matching their own service offerings to facilitate competition in the retail Internet services market. However, in seeking to ensure that large operators would be incentivized to continue investing in network build-out and offering innovative services, the CRTC permitted such operators to charge competitors 10 per cent more than for unbundling of copper loops. In October 2013, the CRTC initiated a consultation process to once again review its rules relating to whether mandated wholesale unbundling remains appropriate, with particular focus on broadband. The CRTC noted that the broadband market had changed significantly over the last several years and the current ongoing proceeding is intended to provide an overall view of the wholesale broadband market. More specifically, the CRTC stated that it is considering whether changes should be made to relevant product and geographic markets, and whether new wholesale services should be included under mandatory unbundling rules and/or whether it should forebear on such obligations for any existing services. The consultation closed in December, and the CRTC has announced plans to hold a public hearing to further discuss the matter on October 27, 2014.

Sources: http://www.crtc.gc.ca/eng/archive/2008/dt2008-17.htm; http://crtc.gc.ca/eng/archive/2013/2013-551.htm; http://crtc.gc.ca/eng/archive/2010/2010-632.htm.

Other countries are forging ahead with unbundling and other *ex ante* obligations as part of a long-term regulatory strategy. For example, Brazil recently established a National Wholesale Trading System, which is a virtual platform for trading regulated wholesale products between operators.

Box 4: Brazil's National Wholesale Trading System

The Brazilian National Wholesale Trading System (*Sistema Nacional de Ofertas ao Atacado - SNOA*) is a virtual platform for trading of wholesale products between telecommunications operators.

SNOA is expected to be "a one stop shop" for the wholesale telecommunications market in Brazil, as it will compile all information necessary for a buyer when acquiring wholesale telecommunications products, such as towers, switching centers; Internet Exchange Points (IXP); and points of interconnection, among others. The virtual platform will also serve as a management system because it will provide performance indicators by each provider with significant market power (SMP), enabling Anatel to track the traffic transactions and requests, helping the regulator to assure that the market will operate in a fair and transparent competitive fashion. Ultimately, SNOA will provide transparency regarding the treatment of wholesale transactions, reducing asymmetric information and transaction costs, and above all, reducing disputes among all players. SNOA's system is managed by a Wholesale Board comprised of SMP and non-SMP operators. It is funded by the SMP operators and has a budget of USD 10 million for five years.

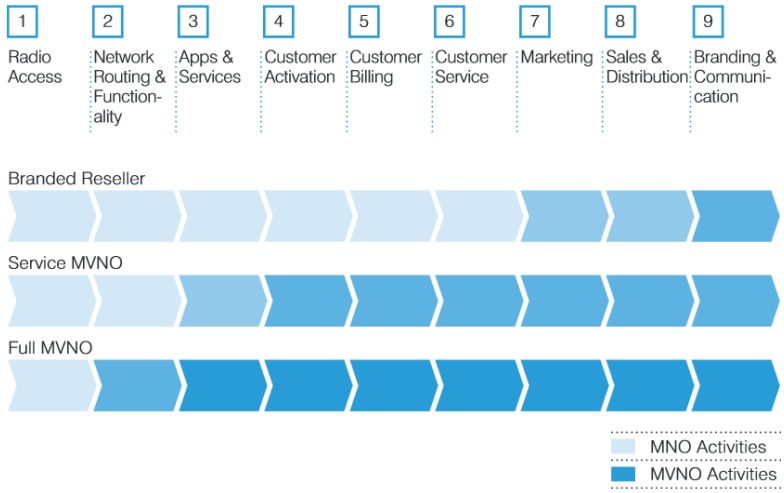
Sources: See Silva, Abraão, "The Brazilian National Wholesale Trading System (SNOA)," Anatel Presentation, Mar. 2014, Costa Rica, available at http://www.itu.int/en/ITU-D/Regulatory Market/Documents/CostaRica/Presentations/Session%207_Abraao_Anatel%20%282%29.pdf

4.2.2 Mobile Virtual Network Operators

A similar approach to opening access to new market entrants has also been instituted by many regulators in the wireless market. Beginning in the late 1990s, mobile virtual network operators (MVNOs) began to enter the mobile market in countries around the world. MVNOs offer mobile services to customers by reselling wholesale capacity purchased from Mobile Network Operators (MNOs) that own infrastructure. In this way, MVNOs avoid the costs of obtaining, owning and operating their own facilities-based mobile networks, and instead focus on providing services and marketing those services. MVNOs pay the host MNO for using its infrastructure to facilitate coverage to their customers, or in some cases are wholly owned subsidiaries of MNOs.

The entry of MVNOs into a market was seen by policymakers and regulators as a means to enhance competition with the established MNOs, providing subscribers with more – and hopefully more innovative – options when selecting mobile carriers. There have been a wide range of MVNO strategies, informed by a combination of regulation, MVNO investment, and target markets. Depending on the applicable regulations and the agreements negotiated with MNOs, MVNOs can determine which elements of service provision they will control directly as opposed to those that will be the responsibility of the MNO, as illustrated in Figure 7.

Figure 6: MVNO/MNO activity split



Source: Booz & Co.

MVNOs often target specific markets in an effort to succeed by catering to a niche that is perceived as underserved by existing service providers or, in some cases, to leverage brand affinity. For example, MVNOs targeting ethnic groups remain an attractive strategy for investors, though such services have enjoyed varying levels of success. Movida, a U.S. MVNO, launched in 2005 targeting the Hispanic market ceased operations in 2008, while KPN-owned Ay Yildiz, which targets the Turkish community in markets including Belgium, Germany, and the Netherlands, still operates in Germany while having ceased operations in Belgium and the Netherlands. Tesco Mobile, an MVNO established by UK grocer/retailer Tesco in the United Kingdom in 2003 has enjoyed success and expanded to four additional European markets. Other niches targeted by MVNOs have included the youth market and discount/low-cost services, as well as a first wave of MVNOs supporting M2M services.

Although MVNOs indisputably changed the competitive landscape simply by virtue of the entrance of new services and brands into the market, their effect on prices and service adoption have been unclear, as there has been relatively little in-depth analysis on the subject. Two economic analyses found that the entry of an MVNO into a market did not, in and of itself, have a significant impact on competition, and that MNO incentives to court MVNOs would depend on the likelihood of such MVNOs competing with the host MNO, as well as the potential for revenue generation.[27] These economic analyses were based on pure economic models, but noted that regulatory intervention could be employed to make market entry conditions for MVNOs more favorable. One of the reasons cited for the failure of MVNOs was over-segmentation of the market, with operators focusing too narrowly on a particular niche and being unable to build a profitable business without a broader customer base.

In recent years, there has been something of a resurgence in MVNO interest among service providers focused on new niches, as well as new attempts to cater to previously targeted niches. While there is no single shift that is responsible for such a development, we can broadly point to changing user needs and an overall increase in the availability of mobile data connectivity as key enabling changes in the market. In such cases, the market has identified a gap that can be filled – profitably, it is presumed – by MVNOs. In another case, European regulators focus on reducing roaming fees has created an opening for MVNO services.

In particular, the growing interest in M2M services and the "Internet of Things" (IoT), combined with expanding 3G and 4G data service offerings from MNOs have spurred new interest in MVNOs offering data connectivity for such services. For example, despite the existence of an established group of M2M-focused MVNOs – as well as increasing interest in M2M services by MNOs themselves – a new pan-European MVNO, CoSwitched, has stated its belief that the European market needs a simple, affordable, regional M2M MVNO.[28]

In Europe, recent changes to regulations setting upper limits on wholesale and retail data roaming services have the potential to drive the creation of MVNOs focused on providing data services to customers roaming outside their home markets. The European regulations set enough of a margin between the maximum wholesale and retail data rates that there is a legitimate opportunity for new entrants to provide such roaming services and generate a profit. Roaming-only MVNOs will be able to enter the European market in July 2014, and MNOs and MVNOs will be required to provide their subscribers with the capacity to be served by alternative roaming providers when they travel outside their home market.

Other new permutations of the MVNO model continue to arise. In Kenya, the regulator awarded three MVNO licenses in April 2014, two of which went to firms with a clear interest in mobile payments, which are a key driver of Kenya's mobile market. One analyst suggested that the entry of MVNOs in the Kenyan market allows for mutually beneficial arrangement in which the MNO derives revenue from excess

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[27] Philip Kalmus and Lars Wiethus, "On the Competitive Effects of Mobile Virtual Network Operators (Preliminary)," (September 2006), http://www.webmeets.com/files/papers/EARIE/2007/401/Kalmus_Wiethaus_2006.pdf and Ralf Dewenter and Justus Haucap, "Incentives to license mobile virtual network operators (MVNOs)," (2006), http://userpage.fu-berlin.de/~jmueller/its/conf/amsterdam06/downloads/papers/dewenter_haucap_workingpaper.pdf.

[28] European Communications, "Start-up IoT MVNO aims to disrupt M2M market with value connectivity offer," (March 20, 2014), http://www.eurocomms.com/industry-news/49-online-press/9708-start-up-iot-mvno-aims-to-disrupt-m2m-market-with-value-connectivity-offer.

network capacity and the MVNO obtains the network infrastructure it needs to launch a profitable service.[29] In April 2014, messaging provider WhatsApp began offering a SIM card through German operator E-plus, providing unlimited access to the WhatsApp service without counting against the subscriber's data allowance. Facebook-owned WhatsApp refers to the partnership with E-Plus as an MVNO, although the SIM is marketed with the names of both the messaging provider and the carrier.[30] In May 2014, an analyst suggested that music streaming firm Pandora consider launching an MVNO in the United States in a bid to improve its revenue stream, which is currently driven primarily by advertising.[31]

4.2.3 Wholesale, open access models

In their strategies to deploy widespread, affordable access to broadband as quickly as possible, some countries are moving beyond implementing unbundling/bitstream access obligations at the wholesale level by creating a wholesale broadband access network. These wholesale, open access models seek to ensure deployment of the domestic backbone and metropolitan connections and promote retail competition at the local connection level.

The plan to establish a partially or fully state-owned, wholesale-only, fiber-based broadband network operator that sells capacity to an array of retailers was initially adopted in Australia in 2011 and has gained some traction in other countries, particularly in Brazil, Kenya, Oman, and South Africa.[32] Singapore and Peru have adopted similar models, but instead of a state-owned wholesale provider, the entities deploying the broadband backbone are private operators, with financing coming from a mix of private and public funds.[33]

The basic premise of these wholesale open access models is that a governmental entity builds out broadband infrastructure nationwide, then leases access to retailers on a transparent, non-discriminatory, and wholesale-only basis. In turn, retailers sell high-speed Internet access to end users. The idea behind such an approach is that the state removes bottlenecks, while ensuring that retailers can access facilities at wholesale rates so they may deliver broadband services to consumers, businesses, and institutions.

More recently, there are also examples of the open access model being pursued for mobile services. For example, Mexico and Kenya are both pursuing the open access model for the 700 MHz band. The regulator in Mexico, IFT, is examining a number of different options for the creation of an independent

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[29] HumanIPO, "Kenyan MVNOs boost competition, spectrum efficiency – analyst," (May 20, 2014), http://www.humanipo.com/news/44147/kenyan-mvnos-boost-competition-spectrum-efficiency-analyst/.

[30] TechCrunch, "WhatsApp Becomes An MVNO, Sells €10 SIM In Germany With Free WhatsApp Use Included," (April 7, 2014), http://techcrunch.com/2014/04/07/whatsapp-launches-a-e10-sim-with-e-plus-in-germany-with-free-whatsapp-usage-included/.

[31] Generator Research, "Pandora should consider becoming a virtual mobile network operator," (May 21, 2014), http://www.generatorresearch.com/tekcarta/analysis-insight/pandora-should-consider-becoming-a-virtual-mobile-network-operator/?lid=01a259167aa210514a155837a.

[32] Australia Department of Communications, "National Broadband Network," http://www.communications.gov.au/broadband/national_broadband_network.

[33] Infocomm Development Authority, "Singapore's Next Generation Nationwide Broadband Network," 2010, http://www.ida.gov.sg/~/media/Files/Infocomm%20Landscape/Infrastructure/Wired/IDA_INFOKIT.pdf

operator that would use the 700 MHz band to provide wholesale broadband services in the country. The new operator could offer services using 700 MHz, as well as the dark fiber belonging to state-owned power company Comision Federal de Electricidad. In Kenya, the Ministry intends to roll-out a wireless broadband network through a public-private partnership (PPP) whereby the PPP company will offer services to service providers on a wholesale basis only and will not be permitted to offer services to end users.[34] Unlike with the Mexico model, Kenya has listed a number of spectrum bands that may be included under this PPP model.

Increasing competition and universal access are the drivers behind pursuing these models, both on the fixed line and mobile sides. The government authorities view this as a mechanism to increase coverage and quality of service, as well as to allow fair competition in the provision of services and provide affordable data services to consumers. However, there are potentially large drawbacks. First, these initiatives are subject to intense political pressure and governmental budgets, making it a challenge to implement plans and maintain financing over the years it takes to fully realize the plans. For example, a change in Australia's government last year prompted a significant scale-back of the country's NBN project. Rather than provide fiber-to-the-premises (FTTP) directly to 93 per cent of homes, schools and businesses, the government announced in November 2013 that FTTP would be provided only to about 25 per cent of buildings with the remaining getting fiber-to-the-node (FTTN) with last mile connectivity via DSL.[35] Additionally, these initiatives drive out private investment and can reintroduce the same issues with liberalization and privatization as addressed over the last few decades in the traditional telephony market. Finally, these models represent a relatively novel approach for broadband, with many complex aspects and only limited case studies from the ICT sector on which to rely.

4.3 Network and spectrum sharing: cooperation and competition in broadband

With the liberalization of former monopoly-based markets, significant issues have arisen over the need for new providers to build out their own physical networks. In the past, many countries, particularly those with dominant ex-monopoly providers, have turned to access obligations (see section 4.2) to make it easier for new players to enter a market by using the incumbents' existing network. Today, as they seek to extend networks to areas that are unserved or underserved, policymaker and regulators are considering regulatory approaches that allow, encourage, or even require competing companies to share the basic infrastructure that provides the services, rather than forcing them to compete on a facilities basis.

In urban areas, multiple networks may be easily supported because of the large subscriber base from which to generate revenue and recover upfront investments, but in low-density population areas, having multiple capital-intensive networks may not make economic sense, since the return on investment may not cover the cost of building and operating the network. As a result, network operators are adopting new network infrastructure and spectrum sharing models in order to share the substantial costs of network deployment and maintenance while meeting obligations to roll out broadband services. Many countries have prohibited such sharing arrangements in the past due to

[34] Consultation on Wireless Broadband Spectrum Policy Guidelines, Ministry of Information, Communications and Technology, Republic of Kenya, http://www.information.go.ke/wp-content/uploads/2014/03/DraftSpectructionPolicy.pdf

[35] Rodney Tucker, "he Rise and Fall of Australia's $44 Billion Broadband Project," IEEE, 26 November 2013, http://spectrum.ieee.org/telecom/internet/the-rise-and-fall-of-australias-44-billion-broadband-project.

concerns about anti-competitive behaviour, such as collusion, as well as believing that true competition required operators to build out their own infrastructure and engage in facilities-based competition.

With respect to the competitive aspects of infrastructure and spectrum sharing, discussed in more detail in Sections 4.3.1 and 4.3.2, regulators must consider whether the particular sharing being proposed would (or does) negatively impact competition in the relevant wholesale and retail markets.[36] According to a report by the Body of European Regulators of Electronic Communications (BEREC)/Radio Spectrum Policy Group (RSPG), considerations could include whether sharing agreements are unilateral, bilateral, or multilateral; the geographic scope of the agreement; the impact on the competitive situation in the relevant market(s); who retains control of radio planning; exclusivity clauses; and whether the independence of a network operator is prejudiced.

In general, potential sharing agreements must be considered in light of their compatibility with applicable competition or other relevant law. In Europe, for example, infrastructure sharing agreements are evaluated with an eye to their compatibility with the Treaty on the Functioning of the European Union, both related to concerns over the immediate effects on competition in upstream and downstream markets, as well as to the possibilities of collusion or exchange of confidential information.[37] In addition, reviews of sharing arrangements must also balance anti-competitive concerns with any positive impacts on competition, such as increased incentives for network deployment, enhanced competition in services or lower cost structures and prices.

4.3.1 Infrastructure sharing

There are many different forms of infrastructure sharing, with some types more likely to implicate competition issues than others. Passive infrastructure sharing, such as sharing of ducts, poles, masts, or towers, does not require operators to coordinate operations and is generally viewed as posing little threat to competition. Since active infrastructure sharing requires operators to more closely coordinate, there is greater opportunity for competition issues, such as collusion, to arise.

There are many benefits to infrastructure sharing as examined in the 2008 edition of ITU's Trends in Telecommunication Reform[38] and in the 2008 GSR best practice guidelines adopted by world community of regulators focusing on innovative infrastructure sharing and open access strategies[39]. A 2012 study by the GSM Association (GSMA) came to the same conclusions.[40] Existing operators in mature markets can use infrastructure sharing to reduce operational expense (OPEX) and increase capacity to under-served areas while existing operators in nascent markets can save on capital expenditures (CAPEX) and OPEX and more easily expand coverage to previously unserved areas by sharing infrastructure. The study also

[36] BEREC/RSPG, "Joint BEREC/RSPG Report on Infrastructure and spectrum sharing in mobile/wireless networks," 16 June 2011, p. 13, http://rspg-spectrum.eu/_documents/documents/meeting/rspg25/rspg11-374_final_joint_rspg_berec_report.pdf.

[37] BEREC/RSPG, "Joint BEREC/RSPG Report on Infrastructure and spectrum sharing in mobile/wireless networks," 16 June 2011, p. 14, http://rspg-spectrum.eu/_documents/documents/meeting/rspg25/rspg11-374_final_joint_rspg_berec_report.pdf.

[38] http://www.itu.int/pub/D-REG-TTR.10-2008

[39] https://www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR08/PDF/GSRguidelines08_E.pdf

[40] GSMA, "Mobile Infrastructure Sharing," Public Policy Report, 2012, http://www.gsma.com/publicpolicy/wp-content/uploads/2012/09/Mobile-Infrastructure-sharing.pdf.

found that infrastructure sharing can promote competition by lowering barriers to entry for new entrants, especially regarding mobile networks where national roaming is in place for a limited fixed timeframe while the entrant deploys its own network.

Since the benefits of infrastructure sharing tend to outweigh potential threats to competition in rural or underserved areas, regulators generally approve—and even encourage—infrastructure sharing agreements. For example, 106 countries responding to the ITU's ICT Eye annual survey in 2013 reported that regulators require operators to engage in passive infrastructure sharing for fixed line and mobile networks, up from 62 countries in 2008.[41] Regulators have more recently begun permitting mobile operators to share both passive and active infrastructure. According to the ITU's ICT Eye data, in 2008 124 countries reported that they permitted mobile infrastructure sharing, including active sharing through MVNOs. By 2013, 151 countries stated that such sharing is permitted.[42]

In the mobile market, most active infrastructure sharing takes place at the access network level, which includes sharing passive infrastructure, and increasingly active elements.[43] MVNOs typically share the access network equipment and passive infrastructure. Sharing the core network is the most integrated type of sharing, which involves passive infrastructure, backhaul equipment and the core transmission ring, switching center, billing platform and value-added systems (VAS). Due to the need to coordinate closely, and the increased likelihood of collusion, sharing of the core network and spectrum resources requires the most regulatory scrutiny.

Although regulators have been more hesitant to allow or encourage any type of active infrastructure sharing for mobile networks, they are finding that the benefits gained from faster deployments and lower costs outweigh the risks of potential collusion or other anti-competitive harms. For example, the four main mobile operators in the United Kingdom—Three, Everything Everywhere (EE), O2 and Vodafone—have all entered into some type of network sharing agreement for 3G networks since 2007, including for passive and active elements. Ofcom noted in 2009 that active sharing, such as radio access network (RAN) sharing, may raise competition concerns for a number of reasons. Most notably, Ofcom expressed concern over potential collusion due to the information exchanges necessary to coordinate sharing and an overall reduction in the intensity of competition between the sharing operators.[44] However, in 2011, Ofcom recognized the value of RAN sharing, noting that it reviews all sharing agreements on a case-by-case basis under EU competition law.[45] The success of the agreements, through cost-savings to the operators and faster, more affordable delivery of services to end users, is demonstrated through the operators' continued use of sharing agreements. In February 2014, for example, EE and Three announced a new network sharing agreement for their LTE networks, with the

[41] ITU, "ICT Eye: Infrastructure Sharing," 2013, http://www.itu.int/net4/itu-d/icteye/Topics.aspx?TopicID=15.

[42] ITU, "ICT Eye: Infrastructure Sharing," 2013, http://www.itu.int/net4/itu-d/icteye/Topics.aspx?TopicID=15.

[43] GSMA, "Mobile Infrastructure Sharing," Public Policy Report, 2012, http://www.gsma.com/publicpolicy/wp-content/uploads/2012/09/Mobile-Infrastructure-sharing.pdf.

[44] Ofcom, "Mobile Evolution, Ofcom's mobile sector assessment," Statement, 17 December 2009, ¶ 3.15, http://stakeholders.ofcom.org.uk/binaries/consultations/msa/statement/MSA_statement.pdf.

[45] Ofcom, "Consultation on assessment of future mobile competition and proposals for the award of 800MHz and 2.6GHz spectrum and related issues, Annex 6: Competition Assessment," 7 October 2011, ¶ 5.45, http://stakeholders.ofcom.org.uk/binaries/consultations/combined-award/annexes/Annex_6.pdf.

operators investing a total of GBP 1 billion (~USD 1.7 billion).[46] In the near term, the operators plan to share just passive infrastructure, particularly masts and backhaul transmission costs, which does not require Ofcom's approval. However, there may be active sharing in the future, which would require Ofcom approval. In 2013, the operators considered active sharing of their LTE networks in the 800 MHz band, but decided to scrap the plan in favor of their own rural deployments.[47] As their LTE networks grow, they may seek to restart negotiations in order to cover remaining under-served areas and/or share operational costs.

Another factor that should be considered by authorities weighing infrastructure sharing agreements is the balance between short-term and long-term effects. For example, imposing regulatory mandates for shared access to an incumbent's assets and facilities may increase competition in the short term, but increased obligations on operators may also decrease incentives for network deployment, thus having a negative impact on competition in the longer term. Conversely, regulations forcing a company to build its own infrastructure across an entire country may improve facilities-based competition in the short term, but if the network is not economically sustainable, the company could be forced out of business, thus reducing competition in the longer term.

4.3.2 Spectrum sharing

The skyrocketing demand for spectrum in order to keep pace with new bandwidth-hungry broadband-enabled applications and services has spurred policymakers and operators to better utilize existing spectrum allocations, as well as reallocate additional spectrum to mobile broadband use. Spectrum scarcity has driven new ideas for efficiently using existing resources, including through spectrum sharing. According to the ITU, of the 77 countries that responded to the ICT-Eye annual survey in 2013, 64 per cent replied that spectrum sharing is permitted.[48]

Spectrum sharing takes active infrastructure sharing a step further by combining sharing at the access network layer with sharing of dedicated frequencies. It can be defined as the simultaneous usage of a specific radio frequency band in a specific geographical area by a number of independent entities, leveraged through mechanisms other than traditional multiple- and random-access techniques.[49] In general, this means that end users of any participating operator can use their operator's services across any spectrum used in the shared network. Spectrum sharing can also allow for the more efficient use of spectrum resources and possible exploitation of under-used spectrum.

There are multiple approaches to spectrum sharing, including approaches where operators could share RANs with dedicated frequencies, with physical sharing of the node (hardware) but with the software components managed separately. Or, where multiple operators hold licenses for the same spectrum

[46] Ken Weiland, "EE, 3 take passive route to 4G network-sharing," Mobile World Live,3 February 2014, http://www.mobileworldlive.com/ee-three-take-passive-route-4g-network-sharing.

[47] Graeme Neill, "EE ditches Three talks over 4G spectrum, Mobile Today UK," 14 June 2013, http://www.mobiletoday.co.uk/news/industry/25654/EE_ditches_Three_talks_over_4G_spectrum_share.aspx.

[48] ITU, ICT-Eye, http://www.itu.int/net4/itu-d/icteye/.

[49] BEREC/RSPG, "Joint BEREC/RSPG Report on Infrastructure and spectrum sharing in mobile/wireless networks," 16 June 2011, p. 14, http://rspg-spectrum.eu/_documents/documents/meeting/rspg25/rspg11-374_final_joint_rspg_berec_report.pdf.

bands, RAN sharing can take place within the shared spectrum band, though this is technically and operationally more complex.

However, because spectrum sharing requires cooperation between companies that otherwise compete, some regulators have been wary of such agreements. For example, India's Department of Telecommunications (DOT) did not permit spectrum sharing under its licensing conditions and the guidelines on infrastructure sharing issued in 2007 (which considered spectrum sharing as a type of active infrastructure) opted to prohibit spectrum sharing between competing mobile service providers.[50] The Telecommunications Regulatory Authority of India (TRAI) sought to reverse this policy in May 2010 by issuing a series of recommendations to the DOT proposing to permit spectrum sharing in India.[51] The DOT's draft spectrum sharing guidelines circulated in late 2013, for example, indicated that such sharing could only take place in circles (geographic licensing areas) where the two operators wishing to share spectrum already hold licenses.[52]

In contrast, Sweden's ICT regulator, the Post and Telecom Agency (PTS) and the Swedish Competition Authority (Konkurrensverket) have supported mobile sharing of both spectrum and infrastructure. Sweden's ICT law specifically permits the PTS to impose spectrum sharing conditions on operators, which the regulator implemented in the 3G auction in 2000.[53] In that case, spectrum sharing has been considered a success. In 2009, mobile operators Telenor and Tele2 created a joint venture, called Net4Mobility. Through Net4Mobility, the operators now share spectrum in the 800 MHz, 900 MHz, 1800 MHz, and 2600 MHz bands. The benefits of the joint venture appear so far to have outweighed competition concerns. In particular, after a 2009 review of Net4Mobility, Sweden's competition authority determined that it did not raise competitive concerns and that the joint venture would provide for faster and less costly deployment of 4G networks in the country.[54] The competition authority's conclusions have since been confirmed—through the use of shared networks and spectrum, Tele2 announced in 2013 that its multi-band 4G LTE mobile broadband network covered 99 per cent of population.[55]

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[50] Telecommunications Regulatory Authority of India, "Recommendations on Infrastructure Sharing," 11 April 2007, http://www.trai.gov.in/trai/upload/PressReleases/447/recom11apr07.pdf.

[51] Telecommunications Regulatory Authority of India, "Recommendations on Spectrum Management and Licensing Framework," 11 May 2010, http://www.trai.gov.in/WriteReadData/Recommendation/Documents/FINALRECOMENDATIONS.pdf; Telecommunications Regulatory Authority of India, "Recommendations on Telecommunications Infrastructure Policy," 12 April 2011, http://www.trai.gov.in/WriteReadData/Recommendation/Documents/Rec_Infrastructurel.pdf; Telecommunications Regulatory Authority of India, "Recommendations on Spectrum Management and Licensing Framework- Response of the Authority on DoT reference no. 20-281/2010-AS-I(VoL)(Pt.)," 10 October 2011, http://www.trai.gov.in/WriteReadData/Recommendation/Documents/Final2011.pdf.

[52] The Telegraph, "Spectrum sharing spoiler," 22 December 2014, http://www.telegraphindia.com/1131223/jsp/business/story_17710584.jsp.

[53] See Chapter 3, Section 11, paragraph 5 of Sweden's Electronic Communications Act.

[54] KKV, Dnr 364/2009, 9 August 2010, http://www.kkv.se/upload/Filer/Konkurrens/2010/Beslut/beslut_374_2009.pdf.

[55] TeleGeography, "Tele2 Sweden reaches 99% 4G coverage?," 19 March 2013, http://www.telegeography.com/products/commsupdate/articles/2013/03/19/tele2-sweden-reaches-99-4g-coverage/.

4.4 Potential competition concerns raised by vertical integration

As technological and service convergence continues and OTT providers compete with traditional players, particularly in video services, access to content may be an area of competitive concern on the supply-side of the broadband market. So far, regulation in this area has been fairly limited due to the large and ever-expanding number of content providers and the relatively low barriers to entry into the content market. But, as horizontal and vertical integration increases, it may be possible for dominant network operators vertically integrated with large content providers to engage in a refusal to deal or other anti-competitive behaviours to prevent OTT providers from accessing key content, such as television programming or important sporting events. These are part of the concerns being expressed in relation to the Comcast and Time Warner merger currently being reviewed by government authorities in the United States (see Box 5). Such issues have often been addressed in a merger review context with the parties agreeing to certain concessions in order to address or alleviate competition concerns raised by the government authorities.

Box 5: Proposed Comcast/Time Warner Merger

In February 2014, Comcast Corp. and Time Warner Cable (TWC) agreed to a merger in which Comcast, a global and media technology company that is the largest U.S. video and broadband provider, would purchase TWC, the second largest cable company in the country, in a transaction valued at USD 45 billion. The resulting entity would reportedly control 30 per cent of the U.S. cable television market (including 19 of the 20 largest markets), more than 40 per cent of the broadband access market, as well as a large portfolio of cable and broadcast television networks. In April 2014, Comcast announced a divestiture plan in conjunction with Charter Communications to transfer approximately 1.4 million of TWC's current subscribers to Charter, thereby reducing the combined Comcast/TWC's managed subscriber base below 30 per cent of the nation's total cable television subscribers. In past mergers, Comcast has kept its share of the cable market below 30 per cent in an effort to avoid regulatory opposition.

Opposition to the merger, which has come from civil society, competitors, and legislators, has centered on the significant market power that the new Comcast would have over pay television and broadband service. Critics of the transaction are wary of allowing one company to control nearly a third of cable television subscriptions and more than 40 per cent of residential broadband subscriptions, as well as a reduction in the overall number of market players. Some worry that Comcast would not face robust sufficient competition to prevent it from taking actions viewed as unfriendly to consumers, such as drastic speed or bandwidth caps on broadband service, or higher prices or limited programming choices among pay television services. Echoing concerns that were raised in the 2009 acquisition of content provider NBC Universal by Comcast, some critics also have expressed concerns that Comcast will discriminate against other operators offering subscription TV services, such as Verizon, AT&T, and DirecTV, by withholding or charging excessive prices for NBC Universal's programming content.

Sources: Comcast, Reuters, Time, Washington Post

4.5 Net Neutrality

The Internet generally operates on a "best effort" basis in which all traffic is treated equally, except where data traffic is managed to ensure that congestion is minimized and all traffic reaches its final destination as quickly as possible. Consumers and entrepreneurs, however, have long been concerned

that ISPs block traffic (or particular websites) or discriminate against particular types of traffic in an effort to protect their own services (e.g., a mobile provider blocking VoIP applications to ensure that voice traffic stays on its network). As a result, there have been calls for regulators to enact regulations that would prevent such anti-competitive behaviours.

4.5.1 What is net neutrality?

As outlined in the ITU's *Trends in Telecommunication Reform 2013*, net neutrality broadly refers to the principle that all Internet traffic should be treated equally.[56] Net neutrality regulation generally requires an operator, regardless of market power, to treat all Internet traffic equally and to allow users to access and use the Internet content of their choice. This principle requires operators to not discriminate against any particular type of traffic, but also requires them to deliver service on a "best efforts" basis. Other principles of net neutrality relate to operator disclosure and transparency in implementing data caps or how they use temporary traffic management practices to relieve network congestion or protect network security.

Canada and Chile were among the first countries in the world to enact broad net neutrality legislation, in 2009 and 2010, respectively. More recently, the issue has been heating up, especially in Europe, Latin America and increasingly in the Asia-Pacific region. (See Box 6 for an overview of net neutrality rules in Europe and the Americas.) Net neutrality can be a political issue because blocking certain types of content may be viewed as implicating rights relating to freedom of expression and access to information.

In the limited countries where a full set of net neutrality laws and regulations have been proposed or enacted, the following rules tend to apply:

- **No blocking or degrading traffic:** As part of the non-discrimination principle, net neutrality rules prohibit operators from blocking access to certain applications and services. Most rules have an exception for reasonable network management practices whereby operators may prioritize or slow down traffic temporarily during times of network congestion or for network security. However, some countries, such as Chile, prohibit operators from singling out any particular application to prioritize or slow down.

- **No paid prioritization:** Based on the idea that traffic should be treated in a non-discriminatory basis, net neutrality rules tend to prohibit paid prioritization, which allows operators to charge consumers for Internet connectivity and charge OTT providers to reach consumers. Start-up companies, consumer groups, and small businesses are concerned that this will create a two-tiered Internet. They fear that these "pay-for-priority arrangements" will only be able to be paid by the larger companies and smaller businesses will be discriminated against both technically and financially by Internet service providers.

- **Disclosure and transparency:** The least contentious of the net neutrality rules—and the most common—relate to disclosure and transparency. Such rules require operators to clearly state what their network management practices are and may also require identifying the actual speeds and service quality levels that subscribers can expect. A number of countries have

[56] ITU, "Trends in Telecommunication Reform 2013," April 2013, http://www.itu.int/pub/D-REG-TTR.14-2013.

adopted such regulations, rather than enacting more onerous net neutrality requirements. In part this is because known instances of outright blocking/degradation of services have been relatively rare, and regulators have been concerned of over-regulating a problem that might not exist and that may have unforeseen impacts on network reliability and security. Disclosure and transparency requirements are thus often seen as a first or interim step, with further regulation to be applied only if necessary.

- **Tiered data plans:** Net neutrality rules generally permit, and even encourage, operators to offer tiered data plans with data caps. This means that subscribers could choose in advance how much data they want to purchase, with multiple price/cap levels available. There may also be rules requiring operators to notify a subscriber who is about to reach his data limit and/or allow him to upgrade to a higher tier.

Box 6. Recent changes in net neutrality

Brazil

Brazil's net neutrality bill, called Marco Civil or Internet Civil Framework, was signed into law in April 2014. Among other principles related to the use and provision of Internet services, the law also establishes the principle of net neutrality and requires ISPs to abide by non-discrimination principles of no blocking or degrading traffic, unless necessary for technical reasons or emergency situations. There are also disclosure and transparency obligations. The law calls for a Presidential Decree to further regulate the net neutrality principle and traffic management practices.

Canada

The CRTC issued net neutrality rules in 2009 that prohibit blocking or degrading of content except in certain circumstances, such as traffic management during congested period. The rules also require disclosure of any network management practices. In January 2012, the CRTC notified fixed line operator Rogers that there was evidence of violation of net neutrality rules through deliberate throttling of some applications, particularly online video games. In response, Rogers stated that it would stop throttling traffic by the end of 2012. In June 2013, the CRTC accepted this response and closed the investigation.[1]

Europe

In April 2014, the European Parliament voted overwhelmingly in favor of stringent net neutrality regulations requiring all broadband providers (both fixed line and mobile) to treat all Internet traffic equally. To become EU-wide law, the Council of Ministers must vote in favor of the bill in October of this year. The basic principles of Europe's net neutrality bill are:

- No blocking or degrading traffic, even if an application competes with an operator's services. This would ban the current practice by several mobile operators throughout Europe who currently block or charge for Skype.
- No prioritization of traffic. Thus, an OTT provider would be prohibited from paying an operator to deliver its traffic faster than other traffic.
- Tiered data plans and data caps are allowed, but must be clearly disclosed to consumers.
- Traffic management is allowed, but only on a temporary basis, such as to ease network congestion during peak-use times.

[1] CRTC, CRTC investigation prompts Rogers to stop slowing down Internet traffic, Press Release, June 28, 2012 at http://www.crtc.gc.ca/eng/com100/2012/r120628.htm.

United States
In 2010, the U.S. Federal Communications Commission ("FCC") adopted net neutrality regulation based on principles of non-discrimination (i.e., no blocking or degrading) and no prioritization, except where necessary for reasonable network management practices, such as to resolve network congestion during peak-use periods. However, Verizon filed a claim against the FCC on grounds that the rules were not founded on a sound legal basis. In February 2014, a U.S. court rejected the FCC's attempt to ensure net neutrality, finding that although the FCC holds authority to impose net neutrality rules, the regulator must provide a different legal justification on which the rules would be based.

In May 2014, the FCC opened a consultation that proposes amended rules that outlines unacceptable practices for broadband providers, and provides for case-by-case enforcement when content providers or users complain of unfair discrimination. Transparency rules would require ISPs to file publicly available reports with information on the actual Internet speeds they deliver, instances of network congestion, actual instances when they block content or any paid prioritization agreements. Supporters of net neutrality are dismayed that the rules permit paid prioritization, claiming that this will create a two-tiered Internet in which large, established content companies get better access to consumers, while smaller competitors would be disadvantaged. They also claim that consumers will likely suffer due to more limited choice in services.

Sources:
The Internet Civil Framework is established through Law 12965 of April 23, 2014, that implements principles, guarantees, and rights on the use of Internet in Brazil, available at http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2014/lei/l12965.htm
http://www.fcc.gov/document/statement-fcc-chairman-tom-wheeler-fccs-open-internet-rules;
http://gigaom.com/2014/04/03/european-parliament-passes-strong-net-neutrality-law-along-with-major-roaming-reforms/

4.5.2 Sponsored data plans: neutral or not?

Whether supportive or opposed to net neutrality regulation, the principles at a high level – no blocking, no discrimination and no prioritization – seem straightforward. However, the issue of net neutrality sometimes becomes murkier when looking at these principles in the context of some of the new business models that are emerging. For example, to stimulate consumer demand for their services, a relatively new commercial practice has developed in the retail mobile broadband market, called sponsored data programs. Under these programs, among other variants, content providers pay mobile operators to deliver their content without such use counting towards the subscriber's data plan. In some cases, the subscriber may not need a data plan at all in order to access the sponsored content. Other alternatives include operators themselves sponsoring access to third party content, or even their own content, with such usage not counting towards subscriber's data caps.

Sponsored data programs represent a new revenue source for operators and can benefit consumers as well. In April 2014, a U.S. consumer survey found that 71 per cent of men and 62 per cent of women surveyed were more willing to increase their data usage if their data plans included sponsored data programs.[57] These subscribers identified several types of content that they most likely would use if

[57] Citrix, "Mobile Data Users Fear Exceeding Their Quota, Open to Sponsored Data Plans," 16 April 2014, http://www.citrix.com/news/announcements/apr-2014/citrix--mobile-data-users-fear-exceeding-their-quota--open-to-sp.html.

offered through a sponsored data program, including mobile banking, educational videos, viewing advertisements, and holding a teleconference. Such programs have been introduced around the world. For example, Facebook Zero, started in 2010 and available in numerous countries in Asia, the Americas, Europe, Middle East, and Africa[58] enables smartphone users to connect to a text-only version of Facebook's mobile site without incurring data charges. In 2012, Wikipedia began sponsoring access to its site also through their Wikipedia Zero program, allowing users in India, Jordan, Malaysia, Pakistan, Saudi Arabia, Sri Lanka and Thailand to access Wikipedia's content without it counting towards the users' data plans.

Some argue that sponsored mobile data programs fall outside net neutrality rules because, provided the sponsored traffic is not prioritized, there is no discrimination, blocking, or prioritization of sponsored content vis-à-vis non-sponsored content. However, some net neutrality advocates assert that such programs are within the realm of net neutrality because, under certain scenario, content providers may be paying operators for access to customers. They claim that this practice could have a negative impact on content providers by increasing their costs overall. These costs may be passed on to consumers or may diminish investments in new content. Additionally, opponents to sponsored data programs argue that large content providers with deep pockets can pay for sponsored data and may potentially squeeze out smaller content developers and start-ups that cannot afford sponsored content.

Regardless of whether net neutrality rules apply to sponsored data programs, other competition issues could arise if an operator is sponsoring its own content in direct competition with other OTT apps. One such case is pending before the Canadian Radio-television and Telecommunications Commission (CRTC). Although the CRTC's investigation into the matter is ongoing, the case demonstrates challenges associated with balancing the benefits of new business models and consumer choice along with ensuring that these practices do not allow dominant operators to leverage market power and stifle competition.

Box 7. Sponsored data program and competition in Canada

In November 2013, a Canadian citizen filed a complaint with the CRTC over the practice of mobile operator, Bell Mobility, offering a sponsored mobile TV service.[59] For CAD 5 per month, Bell Mobility subscribers can watch 10 hours of video (equivalent to about 5 GB of data) from over 40 Bell-owned or licensed TV channels without it counting towards the subscribers' data plan.[60] These same TV channels are available via other OTT applications; however, viewing video through these other applications would count against the subscribers' monthly data caps. To get the equivalent amount of video that the Mobile TV sponsored program provides, a subscriber would need to purchase a CAD 40 per month plan for tablets or a CAD 105 per month plan for smartphones, resulting in a markup of non-sponsored content of several hundred per cent. The complaint alleges that Bell Mobility is leveraging its large market share and vertical integration in the video programming market to give itself undue preference.

[58] The countries include Australia, Bangladesh, Cameroon, Canada, El Salvador, France, Guinea, Indonesia, Malaysia, New Zealand, Philippines, Qatar, Suriname, Trinidad and Tobago, Pakistan and the United Kingdom,

[59] CRTC, "Application requesting fair treatment of Internet services by Bell Mobility," Part 1 Proceeding, 22 November 2013, https://services.crtc.gc.ca/pub/instances-proceedings/Default-Defaut.aspx?Lang=eng&YA=2013&S=C&PA=t&PT=pt1&PST=a.

[60] Kazi Stastna, "Bell's discounting of mobile TV against the rules, complaint claims," CBC News, 16 December 2013, http://www.cbc.ca/m/touch/news/story/1.2445059.

Sources: CRTC and CBC News.

4.5.3 Quality of service monitoring

The level of regulatory intervention with respect to quality of service is often dependent on the degree of competitiveness in the market. Regulators typically take a hands-off approach in monitoring quality of service and reporting requirements if a market is highly competitive. In markets where competition proves not to be effective, and poor quality of service becomes an issue, regulators have intervened. Historically, quality of service requirements have been applied to voice services, but most recently regulators have been incorporating net neutrality principles into minimum quality of service requirements for data services. These requirements can vary from high-level transparency guidelines on how the information on traffic management techniques is disclosed to end-users, to requiring actual indicators for data network performance for fixed and mobile broadband providers.

In 2011, the U.K. regulator, Ofcom, issued a statement recognizing the risk of network operators entering into discriminatory blocking and unreasonable network management practices. Ofcom noted that if complaints were received, the regulator would consider using its authority to insure "best-effort" access to the Internet by imposing a minimum quality of service on all providers. However, Ofcom also stated its belief that there was sufficient competition in the U.K. market to discourage discriminatory blocking and prioritization of data traffic. Nonetheless, Ofcom also noted that effective competition requires that sufficient information be available to users, and that it would be monitoring market practices in that regard.[61]

The French regulator ARCEP also issued network neutrality principles in 2010. Among those principles, ARCEP noted that it was necessary to promote transparency to users, monitor data traffic management practices, and conduct regular evaluations of quality of services. [62] In 2012, ARCEP issued a statement to the French Parliament noting that there was a decrease on all discriminatory management practices particularly because of the increased competition in the market. [63]

Some countries have imposed very detailed and specific market regulations regarding quality of service, even though the market is regarded as competitive, but not efficiently competitive.[64] The Chilean Senate is currently discussing a bill that would oblige both fixed and mobile operators to assure a minimum Internet speed to users. According to the bill, ISPs must guarantee 70 per cent of advertised speed for national connections and 50 per cent in the case of international connections. In the case of mobile connectivity, providers must guarantee 60 per cent of domestic and 40 per cent of international advertised speed.[65]

[62] OECD, Communications Outlook 2013, at 48.

[63] OECD, Communications Outlook 2013, at 48.

[64] Brazil has four major mobile operators and each having approximately 25 percent market share by subscribers.

[65] "Proyecto que garantiza velocidade minima de acesso a Internet es aprobado en general en el Senado" http://www.subtel.gob.cl/noticias/138-neutralidad-red/5298-proyecto-que-garantiza-velocidad-minima-de-acceso-a-internet-es-aprobado-en-general-en-el-senado

In 2011, the Brazilian regulator Anatel approved two regulations establishing targets for network management and transparency requirements for both mobile and fixed broadband providers.[66] Both regulations establish minimum indicators for data network performance for mobile and fixed broadband providers, as well as minimum rates of complaints and customer service. Some of the requirements applied to mobile data providers in Brazil include the following:[67]

- Connection attempts of data services during periods of high mobile data traffic should be connected in at least 98 per cent of cases
- During each period of high mobile data traffic, the rate at which an operator's data services network is down must be less than 5 per cent per month
- During each period of high mobile data traffic, the operator must ensure that the instant transmission rate of data services, whether downloading or uploading, in 95 per cent of cases each month is 40% of the maximum rate contracted by the user
- The operator must ensure that the average transmission rate during high mobile data traffic, whether downloading or uploading, of data services must be at least 80% of the maximum transmission rate contracted by the user
- Data services may not make voice communications unfeasible.

Regulators in other countries have also raised concerns over the quality of mobile telecommunication services provided in their respective countries. In response, policymakers are considering a variety of remedies, such as fines, the cancellation of mobile operator licenses or the suspension of new customer acquisitions unless certain quality of service standards are met (see Box 8) .[68]

Box 8: Brazil Bans Mobile Operators from Selling Mobile Connections Due to Poor Quality of Service

Under Brazilian rules, companies that do not meet the quality of service target indicators will be subject to fines and sanctions. Based on the increasing number of user complaints for poor service quality,[69] on July 23, 2012, Anatel issued a series of preliminary decisions temporarily banning thee of the four mobile operators (Tim Cellular S/A/, Group Claro, and Group Oi) from selling and activating new mobile connections in certain states.[70] These operators were singled out because they had the highest index of user complaints due to poor network performance in each of the 26 states and the Federal District, from the period of January to June 2012.[71]

[66] Quality of Service for the Provision of Mobile Service Regulation is established through Resolution 575/2011 (Regulamento de Gestão de Qualidade de Prestação do Serviço Móvel Pessoal-RGQ-SMP) *available* at http://legislacao.anatel.gov.br/resolucoes/26-2011/68-resolucao-575 and the Quality of Service for the Provision of Multimedia Communication Services is established through Resolution 574/2011 *available at* http://legislacao.anatel.gov.br/resolucoes/26-2011/57-resolucao-574.

[67] Based on Anatel's Resolution 575/2011 and Anatel's Press Release announcing the ban on sale of mobile subscriptions on July 23, 2012.

[68] http://www.oafrica.com/mobile/quality-of-service-stressed-in-a-growing-number-of-african-nations/

[69] *See* Anatel's Press Release announcing the ban on sale of mobile subscriptions on July 23, 2012.

[70] *See* Decision No. 4783, applicable to Tim; Decision No 4787 applicable to Claro; and Decision No. 4789 applicable to Oi, that were issued July 18, 2012.

[71] The index of complaints from January-June 2012 was measured with the following formula: Index of complaint = number of complaints/ total number of subscribers in the state in June-2012. Results are available here.

Although operators resumed their operations on an average of a month after Anatel's sale ban, Anatel continues to monitor their quality of service indicators and have recently noted to the press that operators have not achieved their target obligations of quality and that the regulator is preparing a new package of quality of service obligations to apply on mobile providers, particularly with regard to data service.[72]

4.6 Internet Interconnection

As noted in section 3.1.3, the Internet interconnection market is becoming increasingly complex. From a policy perspective, the key question is whether these developments may lead to market failure and the ability for certain players within the value chain to exercise market power.[73] To date, Internet interconnection has remained largely unregulated, as privately negotiated agreements have resulted in efficient outcomes. The use of peering and transit arrangements has been effective in controlling any potential exercise of market power, especially considering the continued reductions in IP transit costs over the last several years.[74] If a larger network refuses to peer, the argument goes, the smaller network can still reach its users via transit.[75] However, not all Internet traffic is equal. This is especially the case for highly latency-sensitive traffic, such as video streaming. In such cases, it could be argued that despite low prices, IP transit may not be a good work around for cases where an ISP refuses to peer.

As expected, there are proponents on both sides of the issue. Very public disputes between content providers and CDNs, on one side, and large ISPs, on the other, have led the former to call for regulatory action in the Internet interconnection market (Box 9). They argue that large ISPs have market power in terminating traffic, as their subscribers are locked-in, and are exercising it by demanding payments from CPs and CDNs. Large ISPs, on the other hand, argue that paid-peering arrangements with CDNs have been the norm and that just because new players, such as backbone providers and CPs, are becoming CDNs does not justify any changes in the Internet interconnection framework.[76] As such, ISPs argue that

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[72] "Anatel não está satisfeita com qalidade dos serviços movies e prepara novas exigências," Teletime, May 20, 2014 http://www.teletime.com.br/20/05/2014/anatel-nao-esta-satisfeita-com-qualidade-dos-servicos-moveis-e-prepara-novas-exigencias/tt/378160/news.aspx

[73] Some commentators argue that, considering the success of unregulated Internet interconnection arrangements to date, private agreements should continue to be applied and that "[a] very high threshold of market failure should be established to justify intervention in the Internet market." *See* OECD, Internet Traffic Exchange Market Developments and Policy Challenges, 31 January 2013, *available at* http://search.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DSTI/ICCP/CISP%282011%292/FINAL&docLanguage=En.

[74] *See* William B. Norton, Internet Transit Pricing – Historical and Projected, DrPeering.net, 2011, at http://drpeering.net/white-papers/Internet-Transit-Pricing-Historical-And-Projected.php.

[75] The European Commission has supported the view that peering and transit are demand-side substitutes and should be included within the same broader relevant market. *See* Commission Decision of 3 March 2010 pursuant to Article 7(4) of Directive 2002/21/EC (Withdrawal of notified draft measures). Case PL/2009/1019: The wholesale national market for IP traffic exchange (IP transit). Case PL/2009/1020, at paragraph 36, *available at* http://circa.europa.eu/Public/irc/infso/ecctf/library?l=/poland/registered_notifications/pl20091019-1020/act_part1_v4pdf/_EN_1.0_&a=d

[76] *See*, for example, Jennifer Khoury, Comcast Response to Netflix's Opposition to Time Warner Cable Transaction, Comcast Voices, 21 April 2014, *available at* http://corporate.comcast.com/comcast-voices/comcast-response-to-netflixs-opposition-to-time-warner-cable-transaction. *See also*, Letter from Ian Dillner, Vice President, Federal

they should be compensated for the use of their networks, especially considering the significant demands placed on them by the increased volume of traffic being exchanged.[77]

Box 9: Evolving landscape of traffic exchange between content providers, CDNs and large ISP – the case of the U.S. (2011-2014)

The Level 3-Comcast interconnection dispute that took place in the United States exemplifies the types of disputes that may arise due to shifts within the Internet ecosystem and changing roles of existing players. As a major U.S. backbone provider, Level 3 engages in settlement-free peering with Comcast, the country's largest ISP. In 2010, Level 3 entered into an agreement with Netflix, a subscription-based OTT content provider that allows users to stream TV shows and movies over their Internet connection.[78] Netflix requires high-quality and dedicated connectivity to end users to deliver its services. To drive revenues, Level 3 agreed to deliver Netflix's video content for a fee, thereby acting as a CDN. Since Netflix represents 30 per cent of peak U.S. broadband traffic, the deal meant that Level 3 began sending huge amounts of traffic for Comcast to terminate—much more than Comcast sent to Level 3. Comcast eventually issued an ultimatum: Level 3 had to pay Comcast to deliver Netflix's video content like any other CDN or else Comcast would not deliver the additional traffic. Level 3 took the issue to the FCC, but did not file a formal complaint and the parties eventually resolved the dispute in 2013 through negotiations. Although terms of the deal were not disclosed, it is understood that the parties reached an agreement to share the costs of increased traffic.

On February 24, 2014 Netflix signed a deal with Comcast which allowed Netflix's CDN (Open Connect)[79] to directly interconnect with Comcast's servers and cache its video content closer to Comcast's subscribers. By doing this, Netflix cut out the wholesalers that previously transited its traffic to Comcast. Prior to reaching this agreement, Netflix had reported that delivery speed of its content to Comcast subscribers had declined by more than 25 per cent, resulting in frequent interruptions and delays of its service.[80] Comcast denied that it was slowing Netflix's traffic and instead blamed intermediate CDNs for poor traffic management.[81]

Despite reaching agreements with Comcast, Level 3 and Netflix have claimed that Comcast and other

Regulatory Affairs, Verizon, to Marlene Dortch, Secretary, FCC, Preserving the Open Internet, GN Docket No. 09-191, 13 January 2011, *available at* http://apps.fcc.gov/ecfs/document/view?id=7021025758.

[77] In 2012, the association of European Telecommunications Network Operators (ETNO) – whose members include Orange, Deutsche Telekom, Telefónica and Telecom Italia – proposed to amend Article 3 of the International Telecommunications Regulations with language that would results in OTT providers paying for the termination of traffic. ETNO argued that this charging mechanism for interconnection would be consistent with the principle "sending party network pays" used in some telecommunication services for the Internet, and would ensure the sustainability of the Internet ecosystem and allow all stakeholders to invest and innovate. *See* OECD Communications Outlook 2013, p. 49.

[78] Drew Fitzgerald, "Level 3, Comcast Reach Accord on Internet Traffic Costs," Wall Street Journal, 16 July 2013, http://online.wsj.com/news/articles/SB10001424127887323394504578609963298727892.

[79] Netflix deployed its Open Connect CDN and migrated most of its traffic to this platform. *See* http://conferences.infotoday.com/documents/197/2014CDNSummit-Netflix.pdf.

[80] Edward Wyatt and Noam Cohen, Comcast and Netflix Reach Deal on Service, The New York Times, 23 February 23, 2014.

[81] *Id.*

ISPs are using their position in the Internet ecosystem to create a bottleneck and charging interconnection fees for CDNs and content providers to reach end users.[82] In March 2014, Level 3 proposed a new rule to the FCC that would require ISPs to provide CDNs interconnect on "commercially reasonable terms, without the payment of an access charge."[83]

Source: Authors

While the issue is still unsettled, some regulatory authorities and analysts agree that greater transparency in the Internet interconnection market is needed. For example, calls for transparency have been made recently in order to ensure that better information is available about traffic patterns, the costs of increased usage and the terms, conditions, and norms that are emerging as Internet interconnection markets continue to evolve. Increased transparency may face certain challenges, however, since the great majority of peering agreements are not written contracts. Despite this, some regulatory authorities have begun to take steps in order to obtain information relating to Internet interconnection relationships.

For example, in 2012 the French regulator, ARCEP, imposed a requirement on ISPs to provide information on a biannual basis on the technical and pricing terms governing data conveyance and interconnection.[84] After a two year review, ARCEP found there was no need to impose specific *ex ante* regulatory obligations in the Internet interconnection market (e.g., obligation to provide interconnection, rate regulation, etc.).[85] Instead, ARCEP continued its light-handed regulatory approach of collecting information from market participants which allows the regulator to monitor Internet interconnection markets more closely.

In any case, close review of traffic flows, and the terms, conditions and commercial practices is advisable prior to any policy decision in this area. Further transparency in this market will be essential to monitor the continued development of interconnection and allow evidence-based decision making going forward in order to assess whether there is significant market failure that warrants intervention by regulatory authorities.

4.7 Mechanisms to enhance and protect consumer choice

[82] Stacey Higginbotham, "Here is Level 3's plan to make interconnection fees a network neutrality issue," Gigaom, 21 March 2014, https://gigaom.com/2014/03/21/here-is-level-3s-plan-to-make-interconnection-fees-a-network-neutrality-issue/. *See* also, Reed Hastings, Internet Tolls And The Case For Strong Net Neutrality, Netflix Blog, 20 March 2014, *available at* http://blog.netflix.com/2014/03/internet-tolls-and-case-for-strong-net.html.

[83] Stacey Higginbotham, "Here is Level 3's plan to make interconnection fees a network neutrality issue," Gigaom, 21 March 2014, https://gigaom.com/2014/03/21/here-is-level-3s-plan-to-make-interconnection-fees-a-network-neutrality-issue/.

[84] David Clark, *et al.,* Interconnection in the Internet: the policy challenge, The 39th Research Conference on Communication, Information and Internet Policy, George Mason University, 9 August 2011, *available at* http://groups.csail.mit.edu/ana/Publications/Interconnection_in_the_Internet_the_policy_challenge_tprc-2011.pdf.

[85] A survey of 142,000 peering agreements published in 2013 found that 99.5% of interconnection agreements are concluded without a writ en contract. This is, however, suggestive of generally accepted standard terms and conditions for these types of agreements. *See* OECD, Internet Traffic Exchange Market Developments and Policy Challenges.

A framework focused on enhancing competition is essential to the development of a thriving ICT sector, but should also be complemented by measures that help ensure consumers make informed decisions and reap maximum quality for price from the variety of service providers. Service providers have an obvious incentive to keep their customers and can use several strategies to stop them from leaving. Some of these are good for competition; lowering prices, for example or offering new attractive services.

However, other practices may be seen as denying customers the ability to switch providers, essentially locking them to their existing provider in such a way that it is impossible or extremely difficult (or costly) for competitors to actually gain their business. In some cases, activities that prevent subscribers from switching providers may be anti-competitive, such as collusion between competitors to maintain certain market shares or carve out geographic territories in which they will not compete with each other. However, it is often the case that the same activity may be either a sign of a competitive market that benefits consumers through greater choice in service offerings or an anti-competitive practice if a provider is exploiting its market dominance to artificially limit competition and market access, raise prices or reduce output.[86] In more mature competitive markets, these issues are increasingly confronting regulators seeking to maximize the benefits of competition.

4.7.1 Contractual obligations

In order to take advantage of a competitive environment, consumers must be able to effectively choose amongst service providers. While disclosure and transparency on prices and service quality are important to ensure consumers can make informed decisions prior to signing on with a service provider, it is also important for consumers to be able to switch from one provider to another. Customer lock-in can become both a competition and a consumer protection issue.

For example, long-term customer contracts lock customers in for one or two years, and it can be difficult for customers to break the contract without paying high early termination fees (ETFs). Notably, the 2009 amendments to the EU Universal Service Directive require EU Member States to ensure that customer contracts cannot exceed 24 months and that operators also offer contracts with a maximum duration of 12 months.[87] However, the benefit to these long-term contracts is that customers often receive heavily discounted rates and/or a subsidized handset for mobile services. In such instances, customers opt to be locked into a certain provider in order to take advantage of such cost-savings. These practices also give operators another means by which to compete and diversify their service offerings.

Despite the benefits, regulators may occasionally become concerned with ETFs, especially if such fees are not clearly disclosed to consumers or seem excessive. In April 2012, for example, Israel's Ministry of Communications banned all ETFs for mobile services and backdated the ban for any customer with 100 or fewer mobile subscriptions (i.e., non-enterprise customers) who signed a mobile contract after

[86] Organisation for Economic Co-operation and Development, "Anticompetitive Practices," http://stats.oecd.org/glossary/detail.asp?ID=3145.

[87] EU, "DIRECTIVE 2009/136/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 November 2009 amending Directive 2002/22/EC on universal service and users' rights relating to electronic communications networks and services, Directive 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications sector and Regulation (EC) No 2006/2004 on cooperation between national authorities responsible for the enforcement of consumer protection laws," 2009, http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32009L0136&from=EN.

November 1, 2011.[88] For customers who signed a contract before that date, an 8 per cent fee based on the customer's monthly bill multiplied by the number of months remaining on the contract applies. The ban on ETFs does not include recovering remaining payments for subsidized handsets; mobile customers breaking their contracts can still be charged for the balance of any handset subsidy.

4.7.2 Number portability

Another measure that regulators adopt to facilitate consumer choice is number portability, which allows customers to keep the same telephone number when they switch carriers. Because people and businesses become closely associated with their phone numbers, having to change that number as a result of switching carriers is often seen as a burden that will keep subscribers from moving to a new carrier. In such cases, even if a competitor provides a better and/or less expensive service, subscribers will not switch because they will lose their long-held existing number. Such a barrier can undermine the development of a truly competitive network. Number portability rules also generally include measures to streamline the porting process, and further encourage consumers to take advantage of competition. Although policymakers often require fixed line operators to port numbers, mobile number portability is more common, both as a regulatory obligation and consumer practice, which may be due to greater levels of competition (and therefore choice) in the mobile market generally. For example, since Mexico first introduced fixed line and mobile number portability in 2008, over 14 million numbers have been ported, nearly 90 per cent of which was subscribers moving between mobile operators.[89]

According to ITU data, the implementation of mobile number portability is on the rise with a sharp uptick over the last several years. In 2008, 46 per cent of the countries responding to the annual Telecommunication Regulatory survey reported that mobile number portability rules had been adopted—by 2013, this figure reached more than 90 per cent of surveyed countries.[90] For fixed line portability, the percentage has remained more or less constant since 2008, with approximately 44 per cent of countries reporting that they require fixed line number portability.

Number portability rules typically outline the steps consumers must take, and the process that operators must follow, a timeframe in which operators must complete the process, and may also include limits on the amount that operators may charge consumers to port a number. Bahrain's Telecommunications Regulatory Authority (TRA), for example, requires no customer involvement beyond the initial application for service with the new provider and it is incumbent on the two providers to port the number.[91] Mexico's telecommunications regulator, IFT, has also sought to simplify and bring transparency to the number portability process, including new rules issued in May 2014 requiring mobile operators to send customers a standardized text message with instructions and a code to switch. The European Union has also adopted measures, set forth in the Universal Service Directive amended in

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[88] Cellular News, "Israel Bans Early Termination Fees," 3 April 2012, http://www.cellular-news.com/story/Regulatory/53786.php.

[89] TeleGeography, "Ifetel Standardises Number Portability Process," 9 May 2014, http://www.telegeography.com/products/commsupdate/articles/2014/05/09/ifetel-standardises-number-portability-process/?utm_source=CommsUpdate&utm_campaign=48a3913c1f-CommsUpdate+09+May+2014&utm_medium=email&utm_term=0_0688983330-48a3913c1f-8837629.

[90] ITU, ICT-Eye, http://www.itu.int/net4/itu-d/icteye/.

[91] TRA, "Important Information on Number Portability," 19 May 2012, http://www.tra.org.bh/en/press-releases/important-information-on-number-portability.html.

2009, to speed up the porting process by requiring operators to port both fixed line and mobile numbers within one working day.[92] However, this ambitious deadline is proving difficult to meet—only operators in Ireland port both fixed line and mobile numbers within one working day while operators in all other EU Member States take at least two working days and up to two weeks to port a number.[93]

4.7.3 Interoperability

Interoperability refers to the ability of one device to communicate and exchange information with another device, with both devices able to understand and use the information. Interoperability in a broadband environment is important for ensuring that software and equipment from different operators, manufacturers and vendors work together seamlessly to deliver broadband services and applications to consumers. A lack of interoperable products can impede the ability for customers to switch providers (particularly if the products are costly) and reduce consumer choice even if there are otherwise a variety of services and devices available in the market. To facilitate choice and ease of access, many view common, open standards as key to ensuring interoperability. However, there are multiple benefits to proprietary standards. Manufacturers, software developers, and operators may create or license proprietary systems to maintain greater control over the quality and security of the products, which also benefits consumers, particularly if they are seeking a customized, secure product...

As defined by the ITU-T, open standards "are standards made available to the general public and are developed (or approved) and maintained via a collaborative and consensus driven process… open standards facilitate interoperability and data exchange among different products or services and are intended for widespread adoption."[94] (See Box 10) for other elements of open standards.) Standard-setting organizations provide rules governing consensus-based decision-making processes and the development of open standard specifications, including the ITU, International Organization for Standardization (ISO), International Electro technical Commission (IEC), Institute of Electrical and Electronics Engineers (IEEE) and European Telecommunications Standards Institute (ETSI).[95] When software, content and devices are based on open standards, any telecommunications service provider or end user can select those products that suit their needs and—importantly—use the same devices or software with a different provider without losing functionality of their data or needing to go through lengthy processes to retrieve their data.[96]

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[92] EU, "DIRECTIVE 2009/136/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 November 2009 amending Directive 2002/22/EC on universal service and users' rights relating to electronic communications networks and services, Directive 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications sector and Regulation (EC) No 2006/2004 on cooperation between national authorities responsible for the enforcement of consumer protection laws," 2009, http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32009L0136&from=EN.

[93] CEPT, "Number Portability Implementation in Europe," 14 March 2014, http://www.cept.org/files/5466/documents/Number%20Portability%20Impementation%20in%20Europe%20-%20based%20on%20a%20survey%20of%20CEPT%20member%20countries%20-%20March%202014.pdf.

[94] ITU-T, "Definition of Open Standards," 2005, http://www.itu.int/en/ITU-T/ipr/Pages/open.aspx.

[95] Rudi Bekkers, "The Role of Standards in a Digital Economy," GSR-13: Discussion Paper, 2013, http://www.itu.int/en/ITU-D/Conferences/GSR/Documents/Role%20of%20Standards%20in%20a%20Digital%20Economy.pdf.

[96] ECIS, "Interoperability and Open Standards," http://www.ecis.eu/open-standards/.

Box 10. Elements of open standards

- **Collaborative process** – voluntary and market driven development (or approval) following a transparent consensus driven process that is reasonably open to all interested parties.
- **Reasonably balanced** – ensures that the process is not dominated by any one interest group.
- **Due process** - includes consideration of and response to comments by interested parties.
- **Intellectual property rights (IPRs)** – IPRs essential to implement the standard to be licensed to all applicants on a worldwide, non-discriminatory basis, either (1) for free and under other reasonable terms and conditions or (2) on reasonable terms and conditions (which may include monetary compensation). Negotiations are left to the parties concerned and are performed outside the SDO.
- **Quality and level of detail** – sufficient to permit the development of a variety of competing implementations of interoperable products or services. Standardized interfaces are not hidden, or controlled other than by the SDO promulgating the standard.
- **Publicly available** – easily available for implementation and use, at a reasonable price. Publication of the text of a standard by others is permitted only with the prior approval of the SDO.
- **On-going support** – maintained and supported over a long period of time.

Source: ITU-T, "Definition of Open Standards," 2005, http://www.itu.int/en/ITU-T/ipr/Pages/open.aspx.

In contrast, providers of devices and software based on proprietary systems develop their standards without outside input and often do not license or make their standards public. In addition, they typically restrict which vendors can use their standard, charge higher licensing fees than products based on open standards and retain control over the specifications. Nonetheless, proprietary systems must still maintain some degree of interoperability in order to provide connectivity and value to the consumer. For example, Microsoft Word is proprietary software, but may be used with a variety of devices and operating systems, and can be used by different, but compatible, such as Adobe Acrobat or LibreOffice. Nonetheless, proprietary systems are more likely to result in consumer lock-in whereby data portability is hindered.

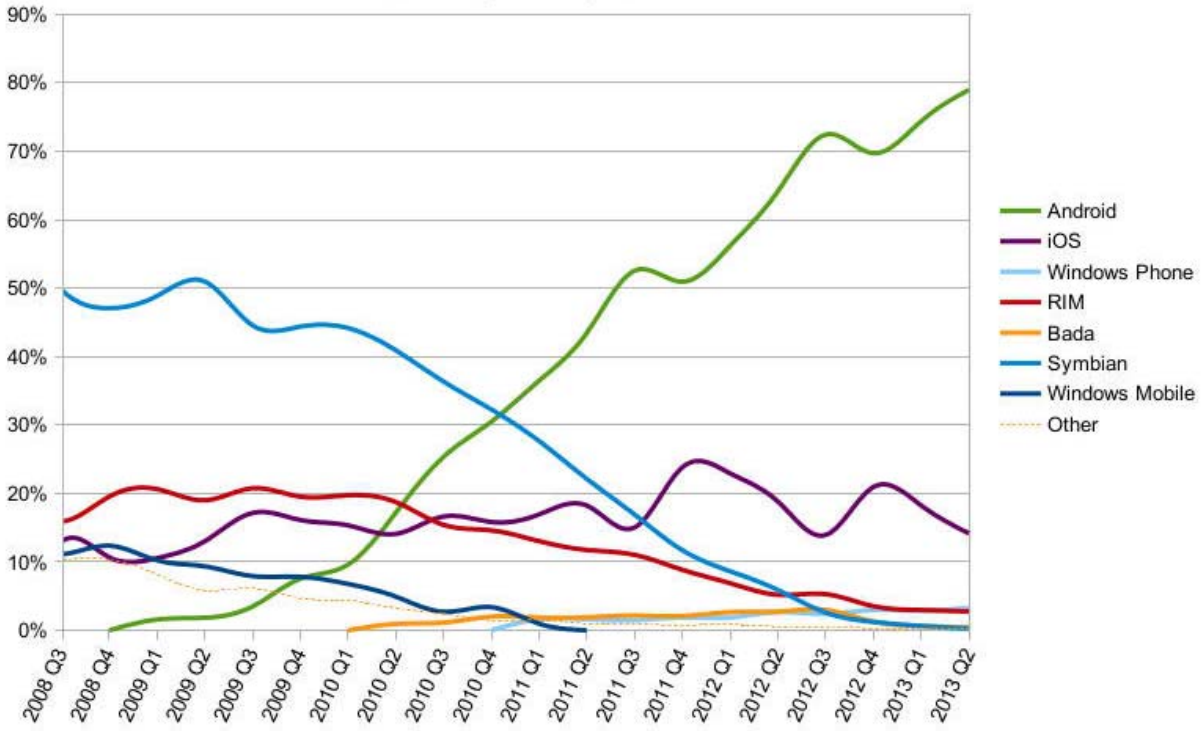
Proprietary systems may be more common when certain technologies are nascent and as expertise in the new technologies develop, sharing of standards also develops. Additionally, because proprietary standards yield higher licensing fees (and therefore revenues), a company may adopt proprietary standards if it believes its product is strong enough to succeed in the market.[97] For example, Apple first released its iPhone (based on a proprietary system) in 2007 with Google introducing its open standard Android operating system over a year later.

While Apple has maintained tight control over its devices, iOS operating system, software and app development, Google sought to build on its share of the app market by allowing any device maker to use its Android operating system through a much more open platform for app development. The tactic has paid off for Google. In terms of the number of devices sold globally using the companies' respective operating systems, Android has far outpaced iOS. As shown in Figure 7, Android went from zero market

[97] Rudi Bekkers, "The Role of Standards in a Digital Economy," GSR-13: Discussion Paper, 2013, http://www.itu.int/en/ITU-D/Conferences/GSR/Documents/Role%20of%20Standards%20in%20a%20Digital%20Economy.pdf.

share at the end of 2008 to nearly 80 per cent market share by the middle of 2013.[98] In contrast, the iOS operating system has hovered from 10 to 25 per cent during the same period, with about 15 per cent market share worldwide by the middle of 2013. Notably, however, as Android-based devices and apps have gained market share, Google has more recently "closed" many of its Google-developed applications, including the company's search, maps, calendar, music, and messaging apps.[99]

Figure 7. Smartphone market share worldwide (2008-2013)



Source: ARS Technica, Google's iron grip on Android: Controlling open source by any means necessary, 20 October 2013.

While both proprietary and open source systems provide consumers a wider variety of choice, there are instances in which proprietary models can negatively impact consumers and limit competition. Cloud-based services represent an area in which interoperability among platforms and data portability are often an issue because different cloud service vendors often use different combinations of operating systems and databases with their own processes, security mechanisms, and storage, licensing and networking models.[100] This means that even if there are certain common elements between two cloud providers, it is highly unlikely that all elements will be the same. Thus, customers are often not able to easily migrate from one provider to another and continue to use the same applications and software.

[98] Ron Amadeo, "Google's iron grip on Android: Controlling open source by any means necessary," ARS Technica, 20 October 2013, http://arstechnica.com/gadgets/2013/10/googles-iron-grip-on-android-controlling-open-source-by-any-means-necessary/.

[99] Ron Amadeo, "Google's iron grip on Android: Controlling open source by any means necessary," ARS Technica, 20 October 2013, http://arstechnica.com/gadgets/2013/10/googles-iron-grip-on-android-controlling-open-source-by-any-means-necessary/.

[100] Bill Claybrook, "Cloud interoperability: Problems and best practices," 1 June 2011, Computer World, https://www.computerworld.com/s/article/9217158/Cloud_interoperability_Problems_and_best_practices.

Instead, migration from one cloud provider can require separating all data and processes from their original ecosystem and re-engineering them for the new cloud service. To resolve these issues, developers are working on a cloud standard using an open standards approach that would better enable enterprise customers to move large amounts of data from one provider to another.[101] As cloud services develop, open standards to support interoperability are likely to develop as well.

For example, the European Union is working towards facilitating interoperability and the portability of data from one cloud provider to another. In 2012, the European Commission drafted model contract terms and conditions for businesses in Europe to use—on a voluntary basis—for contracts and service level agreements with cloud computing providers.[102] To provide guidance on the model contract, the European Parliament submitted recommendations to the Commission seeking inclusion of language in the model contract to promote competition among cloud providers.[103] The recommendations include adopting standards and specifications that allow for easy and complete data and service portability; ensuring a high degree of interoperability between cloud services in order to promote competition among cloud providers; and ensuring that consumer devices do not restrict users to any specific cloud service provider.

Another issue that arises with interoperability relates to customer equipment. Service providers may sell customer equipment that is technically incompatible with their competitors; such that the equipment will not work if the end user tries to switch carriers. Thus, if a user wants to switch, he or she will have to buy new equipment and incur a potentially significant expense (in the case of a business switching, all devices would have to be replaced), which can obviously reduce the incentive to switch. For example, the U.S. FCC issued an order in 2013 to amend spectrum licenses in the 700 MHz band to ensure interoperability and the ability for users to roam on competing providers' networks.[104] The issue arose in 2008 after the close of the 700 MHz auction in which device makers began manufacturing LTE devices that filtered out all frequencies other than those specifically assigned to the large mobile operators, AT&T and Verizon. Rather than enable use for the entire 700 MHz band, devices with these "narrow" filters function only on certain frequency blocks. This placed smaller regional and rural mobile operators at a severe competitive disadvantage because AT&T and Verizon subscribers using these devices could not roam onto the smaller operators' networks. This also limited consumer choice by rendering their devices useless except in those areas where their carrier had deployed LTE networks. In order to switch from one provider to another, consumers needed to purchase a new device even if operators were using the same technology. To remedy the problem, the FCC amended the 700 MHz licenses to ensure that devices using this band do not contain narrow filters, but allow for use on the entire band.

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[101] Bill Claybrook, "Cloud interoperability: Problems and best practices," 1 June 2011, Computer World, https://www.computerworld.com/s/article/9217158/Cloud_interoperability_Problems_and_best_practices

[102] European Commission, "European Cloud Computing Strategy," September 2012, http://ec.europa.eu/digital-agenda/en/european-cloud-computing-strategy.

[103] European Parliament, "European Parliament resolution of 10 December 2013 on unleashing the potential of cloud computing in Europe (2013/2063(INI))," 10 December 2013, http://www.europarl.europa.eu/sides/getDoc.do?type=TA&reference=P7-TA-2013-0535&format=XML&language=EN.

[104] Federal Communications Commission, "In the Matter of Promoting Interoperability in the 700 MHz band," 29 October 2013, http://www.fcc.gov/document/700-mhz-interoperability.

5 CONCLUSION

Policymakers and regulators are facing an increasingly complex ICT regulatory environment due to the convergence of services, the entry of new players with new business models and cost structures, and rapidly increasing flows of data throughout the world. As a result, the competitive landscape is significantly different than it was only a few years ago, and this change seems poised to accelerate as technology advances and consumer demands change. Competition issues have become more complex as market definitions have become less distinct and companies compete in various links in the broadband value chain. New business models are being devised and discarded at an amazing speed. In an effort to address the changes in the ICT market, policymakers and regulators are engaged in a variety of efforts to ensure that competition and innovation can continue to flourish. In some cases, these efforts are aimed at opening the market to new competition or restraining the power of a still-dominant incumbent operator (i.e., licensing reforms, access obligations, vertical integration, net neutrality, and consumer protections). In others, regulators seek to fine tune measures to promote competition to ensure that networks can be expanded and continue to grow as consumers demand and markets dictate faster, ubiquitous, more reliable and more secure services. As the markets and technologies continue to evolve, policymakers and regulators should monitor developments and carefully consider whether these regulatory tools will be necessary to harness the benefits of competition for meeting their social and economic goals.