MPRA

Regulatory Approaches to NGNs: An International Comparison

Marcus, J. Scott and Elixmann, Dieter

Communications Strategies

March 2008

Regulatory Approaches to NGNs:
An International Comparison

J. Scott MARCUS & Dieter ELIXMANN
WIK-Consult GmbH, Bad Honnef

Abstract: The emergence of Next Generation Networks (NGNs) raises profound challenges for regulators everywhere. Different regulatory authorities have approached these problems in strikingly different ways, depending in part on the overall regulatory milieu in which they operate, and in part on the nature of the NGN migration envisioned by major market players. Also, the NGN core network raises significantly different issues from those of the NGN access network. The migration to NGN raises many of the same issues that were already on the table as a result of the broader migration to IP-based services, notably in regard to the de-coupling of the service from the underlying network. To these concerns are added profound questions related to the nature of market power. Will NGNs enable new forms of competition? Will competitive bottlenecks remain, especially in the last mile? Will NGN enable new forms of bottlenecks to emerge, especially in the upper layers of the network, perhaps as a result of new IMS capabilities? Regulators in the UK, Netherlands, Germany, Japan and the United States have been forced to deal with these issues due to relatively rapid migration to NGNs proposed by their respective incumbent telecoms operators. Many of the same issues are also visible in the recommendations that the European Commission finalised on 13 November 2007 as part of the ongoing review of the European regulatory framework for electronic communications. In this paper, we compare and contrast the many regulatory proceedings that have been produced by these regulatory authorities.
Key words: Regulation; Next Generation Networks; access network; core network; all-IP; competition; market power; international comparison.

Technological and market forces are driving network operators and electronic communication service providers throughout the world to migrate their networks to new network architectures which are based on the Internet Protocol (IP) [1]. In most of the world, the resultant networks are referred to as "Next Generation Networks" (NGNs). In the United States, people more often speak of convergence rather than of NGN, but the technological and market drivers are essentially the same.

---

[1] IETF, Internet Protocol: Darpa Internet Program Protocol Specification, RFC 791, September 1981.

At an abstract level, one might imagine that a change in underlying technology would have little impact on regulation [2]; however, this evolution to NGN implies substantial changes throughout the entire value chain of electronic communications service provision, and thus implies significant challenges for regulators. Different regulators in different countries are finding somewhat different solutions to these challenges.

NGNs can be viewed as comprising an "NGN access network" and an "NGN core" [3]. The "Internet Protocol" (IP) is central to both.

NGN access in the fixed network is initially broadband access (based on the copper loops between the Main Distribution Frame (MDF) and the end user's home), but is in the process of being enhanced over time in many countries to provide higher speed using fibre-based technology such as "Very High Speed DSL" (VDSL; Fiber–to-the-Cabinet, FTTC) or "Fibre-to-the-Building/Home" (FTTB/H) and possibly also enhanced security and improved ability to distinguish among different "Quality of Service" (QoS) requirements. For cable networks, it is already often the case that the only voice service is IP-based, and the day is rapidly approaching where this will be the case for telephony networks as well. For mobile networks, the migration to IP voice is more complex.

Where the access is evolving to FTTC/VDSL or FTTB/H, traditional remedies become difficult to apply. For VDSL, the natural point of interconnection (PoI) for purposes of network access moves from the MDF to the far more numerous street cabinets; however, access to street cabinets is potentially difficult and costly, calling into question the practicality of Local Loop Unbundling (LLU) as a competitive remedy. For fibre-based deployments to the building, many challenges exist regarding (access to) in-building wiring, and uncertainties as to what might appropriately be done to unbundle "Passive Optical Network" (PON) solutions, again calling into question the practicality of LLU as a procompetitive regulatory remedy [4].

---

[2] Indeed, technological neutrality is ostensibly a core tenet of European regulation.

[3] From a technical perspective, the architecture of an electronic communications network usually also includes a third layer, a so called "backhaul network" located in between the access network (in traditional networks called the local loop) and the core network. The migration to NGN actually affects all three layers: access, backhaul, and core network. This distinction can be ignored for the purposes of this paper.

[4] Bitstream access seems to be far less problematic in connection with VDSL and FTTB/H solutions; also point-to-point fibre introduces fewer problems with unbundling than PON architectures; however, with the migration to NGN, new network locations for bitstream access are likely as well as new "layers" for bitstream access (*e.g.* Ethernet).

In the NGN core, the migration to IP will serve to decouple the application from the (transport and control) network (layer), facilitating triple-play service provision and also enabling third party application service providers to compete with the operator of the physical network in the provision of services. At the NGN core, key regulatory challenges revolve around interconnection rather than access. The two are interrelated, but they are not at all the same. For purposes of this paper, interconnection can be viewed as the ability of one network operator to enable its customers to communicate with the customers of another network operator; access can instead be viewed as the use by one network operator of certain capabilities of another network operator as a component of the former's service, and in support of the former's customers. In other words, with access one operator effectively leases capacity from another.

A range of additional regulatory issues have emerged, many of which are already present as IP becomes an increasingly central component of the architecture of the network: the degree to which access to emergency services should follow traditional models, the degree to which lawful intercept (authorized wiretapping in support of law enforcement and national security) should be supported, data retention issues, and so on.

Different countries have considered these issues, but the pace of regulatory proceedings has been conditioned in each case by developments and market evolution in that country. In the UK, British Telecom (BT) is moving rapidly to replace the PSTN core entirely with an NGN core; however, little change is expected in the near term as regards the access network. In both the Netherlands and in Germany, the incumbents (KPN and DTAG) are moving rapidly to replace all (as in the Netherlands) or substantial parts (as in Germany) of the traditional fixed access network with a FTTC/VDSL-capable network. In France, the incumbent as well as its competitors are moving quickly to deploy FTTB/H in a number of major metropolitan areas. In Japan, FTTB/H deployment has been very successful, with many of the deployments undertaken by third parties other than the incumbents (NTT East and NTT West). In the U.S., incumbent operators AT&T (with FTTC) and Verizon (with FTTB) have made substantial investments in deploying fibre nearer to their respective customers.

The results have also been diverse, reflecting differences in the respective markets, and also in the style and philosophy of the respective regulatory authorities. Within the European Union, these differences are likely to gradually converge over time.

The 2nd Section of this paper considers the various regulatory challenges that NGN raises at an overall, theoretical level. The 3rd Section considers market evolution and regulatory developments in five key arenas: the United Kingdom, the Netherlands, Germany, Japan, and the U.S. The 4th Section seeks to systematically compare the regulatory outcomes. The 2nd Section thus addresses what, in principle, should be done; the 3rd and 4th Sections discuss what has been done, with particular emphasis on access and interconnection. The last Section comprises our conclusions.

■ Regulatory challenges, regulatory goals

This section considers the motivations for regulation of electronic communications, and the degree to which the evolution of the network to an IP-based NGN affects the realization of those objectives. There are a number of specific areas where it is generally accepted that public policy interventions are required to address needs that the market alone would not (HAYEK, 1945). These interventions generally fall in one of three categories:

• Addressing distortions of competition, especially those caused by some form of market power;

• Addressing social needs that the free market might not, typically because the social value exceeds the private value to parties that might otherwise invest;

• Allocating scarce resources that are unique to each country [5].

The migration to NGN implies numerous challenges to traditional regulation in all three of these areas: market power, public goods, and scarce resources.

Market power

As regards market power, one often hears claims that the evolution of the traditional networks to NGN based networks will eliminate the need to consider market power; however, the reality is considerably more complex. There are factors that suggest that market power might decline over time;

---

[5] We have discussed this framework at greater length in several previous papers, including MARCUS & HAUCAP, November 2005.

there are aspects of market power that are unlikely to change much for the foreseeable future; and there are credible risks that new, troublesome forms of market power might emerge. It is impossible to predict at this stage which of these effects will predominate, but it is clearly premature to assume that market power will no longer be a concern.

The ongoing market evolution has the potential to introduce new forms of infrastructure and/or service competition, and thereby to mitigate traditional market power. Unfortunately, some familiar forms of market power are likely to persist well into the future – most notably, access associated with last mile facilities, and with termination of voice telephone calls [6]. Last mile facilities continue to be very expensive (sometimes prohibitively expensive) for new entrants to replicate. Civil engineering costs dominate when it comes to running a new connection to the cabinet, the building or the home, whether fibre or copper. Thus, access to already existing infrastructure (e.g. ducts of the incumbent or other market players; sewage pipes) which avoids digging is crucial.

New technologies are creating new possibilities for last mile competition, but the last mile continues to represent a market segment with high initial cost and low marginal cost, where only a very limited number of telecommunications companies will find it cost-effective to create and maintain network infrastructure.

Another instance where traditional market power is likely to carry forward is the termination monopoly. The termination monopoly is the ability of a network to demand surprisingly high termination fees in order to complete services, especially voice calls, to a device with a telephone number. Some have suggested that the migration to NGN will ameliorate the termination monopoly, due to the inherent routing capabilities of IP [7]; unfortunately, this is a pipe dream. The termination monopoly exists because in general there is only a single service provider that is capable of terminating a voice telephone call to a given telephone number. The migration to NGN will not in and of itself change the termination monopoly at all.

---

[6] See ERG, ERG Consultation Document on Regulatory Principles of NGA, (ERG (07) 16, 2007. See also Ofcom, Regulatory challenges posed by next generation access networks, 23 November 2006.

[7] See Gilbert-Tobin and CRA International, Economic study on IP interworking: White Paper, February 2007.

Public goods: access to emergency services, lawful intercept

Regulation today in most developed countries mandates that certain electronic communications service providers offer a number of capabilities that they would not be motivated to offer on their own initiative. Two notable examples that have featured prominently in the discussion of Voice over IP (VoIP) [8] in most countries are (1) access to emergency services, and (2) the ability to conduct lawful intercept (wiretapping).

Access to emergency services is problematic because VoIP services need not be fixed to a single geographic location – they can easily move around. This nomadicity is somewhat different from mobility; the latter implies the ability for the end user to move (possibly at high speed) while a communications session is in progress, while the former denotes the more limited ability for the end user's location to change between sessions. Nonetheless, nomadicity poses profound challenges as regards access to emergency services, inasmuch as the existing solutions assume that fixed services are truly fixed. Emergency services need to know the caller's location, not only to send emergency response crews to the right address, but also to connect to the responders responsible for the caller's geographic area (the "Public Safety Answering Point", or PSAP) in the first place. Technical solutions are emerging; however, for the foreseeable future, access to emergency services on the part of nomadic VoIP users is likely to be subject to failure modes and inaccuracy.

Lawful intercept represents another problematic case. Traditional solutions in the fixed network once again have tended to rely on the inherent characteristics of the PSTN. In an IP-based network, reliably capturing the right data, without needlessly compromising the privacy of other users, is likely to add expense and complexity.

Scarce resources: numbering

The migration to independent VoIP offerings, rather than the move to NGN generally, has raised concerns in the area of numbering. The use of telephone numbers has been quite contentious in Europe as VoIP has

---

[8] In this paper we use the term VoIP in a very broad sense, i.e. it can be *e.g.* Voice over Broadband (with particular quality features) or Voice over (best effort) Internet. The crucial issue here is that a packet based infrastructure with a specific addressing and routing functionality is involved.

gained in prominence, but scarcely at all in the United States [9] due to differences in retail and wholesale pricing arrangements. In Europe, there has been much debate as to whether VoIP service providers should qualify for geographic numbers, and thus potentially for local calling rates [10]. In many European countries, local calls are priced lower than national calls.

■ Many lands, many proceedings, many results

The emergence of NGN is playing out differently in different countries. In some, it is primarily a migration of the core; in others, primarily a migration of the access network; and in still others, a migration of both core and access. This difference frames the regulatory discussion quite differently. At the same time, the countries that have had to deal with the issue first have regulatory authorities with somewhat different traditions from one another; moreover, the relationship between the national government and the historic incumbent operator is significantly different among these countries.

All of these different circumstances, and probably others as well, have led to a different sequence of regulatory proceedings in different countries, and to different and sometimes conflicting decisions among them.

In this chapter, we consider regulatory proceedings relevant to NGNs in the UK, the Netherlands, Germany, Japan, and the United States in that order. In the interest of brevity, we primarily address access and secondarily interconnection, leaving aside many other fascinating regulatory challenges.

The United Kingdom (UK)

In many respects, regulatory proceedings in the UK were the first to deal with issues of Next Generation Networks. BT's ambitious plans necessitated a comprehensive response on Ofcom's part.

---

[9] The RBOCs raised the issue to the North American Numbering Council (NANC) a few years ago, but it was not felt to be a significant concern.

[10] A number of European countries introduced a specific non-geographic number range for VoIP calls. Consumers appear, however, to have a strong preference for geographic numbers. For more details see ELIXMANN, MARCUS & WERNICK (2008).

In 2004, British Telecom (BT) announced its intent to migrate its entire network to an IP-based Next Generation Network, the 21st Century Network (21CN) [11]. The 21CN is a single IP and DWDM-based network that will carry both voice and data [12]. In most respects, the technology that they intend to use (Dense Wave Division Multiplexing [DWDM], DiffServ, MPLS traffic engineering, and VoIP) is straightforward, mature and unadventurous. At another level, the initiative was rightly seen from the first as breathtaking, primarily for its scope. A rapid roll-out was envisioned for 21CN, coupled with a complete replacement of BT's PSTN operations in the UK. The actual pace of deployment has been notably more mellow, but is nonetheless impressive. BT hopes that this evolution will enable them to (1) transform the customer experience, (2) accelerate time-to-market for new services, and (3) eliminate about a billion British pounds per year in operating expense.

The UK regulatory discussion entails an element that so far is nearly unique in European regulation (although the European Commission has recently proposed to make it a standard regulatory remedy): a set of agreements or undertakings between BT and Ofcom to largely separate BT's wholesale operations from its customer-facing retail operations, and to ensure that BT cannot discriminate against its wholesale customers (who are also its retail competitors) [13]. BT made legally enforceable commitments [14] to provide a range of access services to competitors on a nondiscriminatory equivalence of input basis. Ofcom defines equivalence of input (EoI) as "[…] a requirement for BT to make available the same SMP products and services to others as it makes available to itself, at the same price, and using the same systems and processes". EoI obligations would be applicable "[…] when the cost is proportionate, and in particular [to] all new

---

[11] BT's plans are extensively documented in various public documents, starting with their web site, at http://www.btplc.com/21CN/index.htm.

[12] See:
http://www.btglobalservices.com/business/global/en/business/business_innovations/issue_02/century_network.html.

[13] See: http://www.ofcom.org.uk/media/news/2005/06/nr_20050623
and: http://www.ofcom.org.uk/consult/condocs/telecoms_p2/statement/main.pdf.
See also: Ofcom, 2005a.

[14] BT offered undertakings in lieu of a reference by Ofcom under the Enterprise Act. The undertakings are thus pursuant to competition law, and operate in a parallel and complementary fashion to Ofcom's *ex ante* sector-specific regulation. See:
http://www.ofcom.org.uk/consult/condocs/sec155/sec155.pdf.
BT's commitments appear as Annex A to Ofcom's *Strategic Review*.

wholesale SMP products, processes and systems, and therefore to all new SMP products delivered over 21CN". [15]

BT has not been broken up, but a substantial "Chinese Wall" has been established between BT's Openreach access services division and the rest of BT. Openreach has a separate management team with substantial autonomy, and some 30,000 employees who have their own uniforms and their own branding. Notably, their bonus plans are based on Openreach objectives, and are decoupled from the price of BT group stock. An Equality of Access Board monitors Openreach's compliance with its commitments to provide equality of access [16].

From a public policy perspective, this is a promising but still unproven approach. To the extent that Functional Separation is effective, the provision of wholesale services on a nondiscriminatory basis should be self-enforcing, thus easing the burden on the regulator and also providing BT with greater flexibility to respond to market demands. Many feel that it is a promising way to side-step a range of regulatory issues as the network evolves to an NGN. At the same time, many open questions remain as to how effective these arrangements will prove to be over time; the degree to which information about BT OpenReach's wholesale customers' plans will really be kept confidential from the portions of BT that compete with those wholesale customers; and whether this fairly intensive and intrusive remedy is really warranted.

The UK is unusually liberal in its policies toward geographic telephone numbers. UK numbers are not strongly tied to a particular geographic location, nor for that matter to the UK. This has been a boon to providers of "nomadic" VoIP service – services that can be utilized from a location other than the user's home location. The UK also provides for non-geographic numbers, but in the UK – as elsewhere in Europe – there is negligible demand for non-geographic numbers for standard consumer VoIP services.

Ofcom has conducted a vast number of regulatory consultations that are linked to BT's migration to NGN. Key themes of these consultations have been access and interconnection arrangements; changes in BT's Weighted Average Cost of Capital (WACC); and joint planning between BT and its competitors during the migration. Taken as a whole, the interconnection

---

[15] Ofcom, 2005b (hereinafter Further Consultation), section 1.21.

[16] See: http://www.openreach.co.uk/orpg/aboutus/aregulatedbusiness.do.

discussion in the UK has been surprisingly "retro", largely focussed on narrowband voice interconnection in the context of traditional Calling Party's Network Pays (CPNP) arrangements.
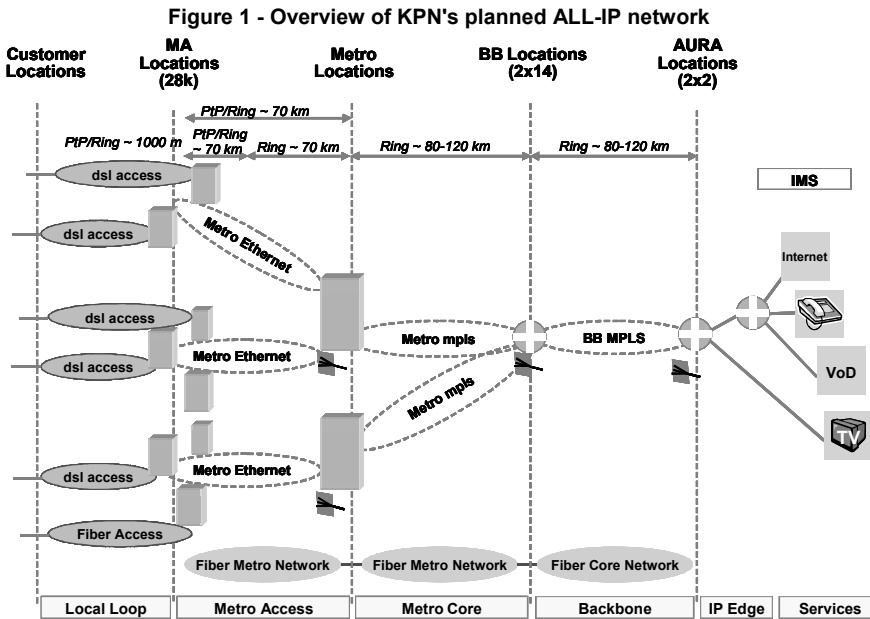
The Netherlands

In the Netherlands, the incumbent (KPN) intends to rapidly phase out existing access arrangements in favour of FTTC/VDSL deployments. The migration is to be funded in large part by revenues generated by selling central offices (Main Distribution Frame locations) that will no longer be needed. Much of the discussion in the Netherlands has centred on this drastic proposed reduction in the number of access locations, and on its implications in terms of stranded investment on the part of alternative operators. KPN's current network infrastructure in the Netherlands consists of about 28,000 street cabinets and about 1,350 Main Distribution Frames (MDFs). Figure 1 provides a high level view of the new All-IP network that KPN is about to introduce in the Netherlands [17]. KPN's All-IP network will consist of five distinct network layers: the access network (local loop), the metro access network, the metro core network, the backbone, and the IP-Edge network.

The original network deployment plan comprises the following features: the existing copper loop between the cabinet and the Main Distribution Frame (MDF) will be replaced or overbuilt by fibre. The number of street cabinets will remain constant at about 28,000, but street cabinets will now contain new devices, NG-DSLAMs, that can provide voice, video and data in an integrated way (thus becoming Multi-Service Access Nodes [MSANs]). The street cabinets will be linked to presumably less than 200 Metro Core Locations (MCLs) placed at former MDF locations. The remaining roughly 1,150 MDF locations will no longer be needed. KPN intends to close down these locations and to sell the real estate in order to fund the transition.

OPTA, the regulator for the Netherlands, initially proposed that KPN (1) issue a reference offer for sub-loop unbundling; (2) that KPN not phase out any location without prior notice to concerned parties, with a reasonable transition period for each location; (3) that KPN must continue to offer access at all locations, but could limit the duration in the case of facilities that were scheduled to be phased out.

---

[17] The following information rests on OPTA (2006).

Figure 1 - Overview of KPN's planned ALL-IP network

Source: OPTA (2006)

A subsequent consultant's study called into question the economic viability of sub-loop unbundling from the street cabinet. Indeed, a competitor would have needed much higher market share than could be realistically expected and/or would have had to be able to increase substantially the Average Revenue Per User (ARPU) due to new services and higher available bandwidths. Consequently, OPTA has essentially abandoned (for the time being) its announced intention to publish policy rules for the phasing out of local loop unbundling from Main Distribution Frames (MDF access) [18].

OPTA then called on KPN to produce a solution that would be acceptable to all of the parties concerned. On July 15, 2007, KPN and its competitors bbned, Orange and Tele2 signed Memoranda of Understanding "on the principles governing the conditions under which they are prepared to cooperate – in due time – in the phasing out of KPN's MDF locations". In these MoUs, KPN agreed to maintain MDF access for competitors at the 138

---

[18] OPTA argues that permitting KPN to withdraw MDF access would only be conceivable if market entry possibilities and the continuity of service provision by alternative operators would be sufficiently guaranteed. However, they came to the conclusion that the alternative solutions to MDF access (proposed at that time) might not be sufficient to enable meaningful competition to KPN.

currently planned Metro Core Locations and at about 35 other MDF locations. The objective had been to reach agreements by December 15, 2007 with the other market participants, and to further elaborate the existing MoUs with bbned, Orange and Tele2; however, this target was not met as of the end of 2007.

On February 6, 2008, KPN announced a revised MDF migration agreement. After a roundtable discussion on February 7, 2008 with OPTA and all market participants involved, it was agreed that the current MDF related services will be maintained until the middle of 2010, that there will be an improved offering regarding large quality wholesale broadband access, and that a substantial share of MDF locations will be available for unbundled access. Moreover, OPTA has asked market participants to also discuss alternatives like Ethernet access on fibre and interconnecting leased lines (*interconnecterende huurlijnen*).

Germany

The German discussion has also centred on the question of access arrangements in a future NGN based on FTTC/VDSL deployment. In Germany, rather short average loop length to the customer (below 400 m) makes VDSL a very workable technical proposition. Interconnection has also featured prominently in the German discussion. These access arrangements enable a drastic reduction in the number of Points of Interconnection (PoIs).

DTAG's current network consists of about 7,900 Main Distribution Frames (MDFs) which are entirely accessible on the basis of fibre, and about 290,000 street cabinets. This corresponds to approximately 40 cabinets per MDF. In Germany, the average number of access lines per cabinet is less than 200. DTAG's biggest competitors currently have access to about 3,000 MDFs, representing a coverage of 70 to 80% of the German population. In 2005, DTAG announced plans to deploy fibre between the MDF and the street cabinet (FTTC), and to install VDSL solutions. Geographically, the company will focus these deployments on densely populated areas. As of January 2007, the network deployment covered 12 metropolitan areas with about 5.9 million potential customers. Based on its original plans, DTAG aims to deploy fibre in Germany's 50 biggest cities by 2008.

DTAG has committed to make these investments only if the German government provides a "regulatory holiday" from the obligations to which

DTAG would otherwise be subject to offer wholesale services to competitors at regulated prices based on these new VDSL capabilities. DTAG has argued that its investment warrants protection from regulation because "new products" like IPTV are offered over VDSL. This lobbying has been successful in Germany [19], but has had no traction with the European Commission. The proposal is dead at the European level [20]. To date, the German regulator (BNetzA) has not imposed unbundling obligations on DTAG VDSL deployments; they did, however, impose the obligation to make ducts available from the central office to the street cabinet.

This is a complicated game, which will likely take two or three years to play out. As we write this paper in the beginning of 2008, there is no effective competitive access to DTAG's VDSL infrastructure; however, German competitors are discussing the conditions under which there might be a viable business case for deploying their own FTTC/VDSL infrastructure. Moreover, at least one carrier (NetCologne, the regional carrier active in Cologne) has initiated a far-reaching FTTB deployment. NetCologne's business case rests on savings in ULL fees that they would otherwise have paid to DTAG for access to the local loop. Their fees will be eliminated once NetCologne's FTTB network is complete.

In regard to the use of telephone numbers by IP-based voice services, Germany has made geographic numbers available, but only where the user has a relationship (for example, a residence or a business) to the geographic area in question. As in the UK, non-geographic numbers are available, but consumer demand is negligible.

**The European Commission's proposals
under the review of the regulatory framework**

The Commission proposed changes to the European regulatory framework on 13 November 2007. These changes touch on a number of NGN issues.

---

[19] A specific clause has been added to the telecommunications law which can be applied to grant a regulatory holiday to DTAG.

[20] The Commission has launched an infringement procedure against Germany the outcome of which is still pending.

In regard to last mile access, the Commission chose to stay the course. They did not propose major changes. The recommendations reemphasize the importance of technological neutrality. In the Explanatory Note to the Commission's revised list of markets where *ex ante* regulation might be appropriate, the Commission notes once again that, while the dial-up Internet access market seems to be distinct from broadband Internet access, they see no basis for treating VDSL or other fibre-based access as a distinct market from other broadband Internet access. They thus reject once again the "regulatory holiday" that the German government has advocated.

There have been calls to implement regulation at European level to prevent network operators from discriminating in favour of affiliated content or affiliated applications, and against other content or applications. The debate over this issue (known as network neutrality) in Europe largely reflects concerns over potential anticompetitive discrimination that have been expressed in the United States in recent years. In our view, network neutrality is unlikely to emerge as such an intense issue in Europe as it has in the U.S, because (1) competition in European broadband markets, which is far more robust than in the U.S., will tend to inhibit anticompetitive acts, and (2) European regulation is better suited to deal with potential problems than U.S. regulation [21]. The European Commission apparently reached similar conclusions, and declined to implement comprehensive network neutrality regulation; instead, they implemented more modest regulatory protections to ensure that consumers must be informed to the extent that network operators disfavour or block access to certain content or applications, and to prevent network operators from erecting barriers to switching providers if consumers are dissatisfied.

The 13 November 2007 proposals would also require providers of VoIP services to conventional national or international phone numbers to provide access to emergency services.

Japan

Japan is by far the country with the highest FTTB/H penetration in the world (more than 10 million at the end of 2007). Some of the recent growth in FTTB/H has come at the expense of DSL, as customers migrate from

---

[21] See MARCUS (January 2008). Also See:
http://www.springerlink.com/content/g37k162urx11/?p=1a363b658dfb4d95accaecba21b38d5f&pi=0.

"traditional" broadband to ultra-high-speed FTTB/H. DSL still is the most important access technology; however, for the largest operator, fibre-optic networks have overtaken ADSL lines as NTT's most popular broadband internet access method. ADSL subscribers fell for the first time since the introduction of ADSL in 2000, down 360,000 in 2006 to 5.32 million. Meanwhile, during the same period, 2.66 million fibre-optic users were added.

In Japan, many players are active in the field of providing FTTB/H access services to end users. It is not only carriers (NTT-East, NTT-West, and KDDI), but also electric power companies, cable television operators, content providers, municipal and regional governments, and ISPs (Yahoo! Broadband being a conspicuous example of this last category). Japan has implemented fairly aggressive unbundling obligations for incumbent fibre; however, there are indications that most actual deployment is being built out by competitors on their own. Part of the dynamic of fibre deployment in Japan might also reflect the fact that aerial deployment is widely used for the fibre link to the end-user's building or home.

The Japanese Ministry of Internal Affairs and Communications (MIC) has initiated several studies relevant to regulatory responses to the emergence of NGN, one dealing with competition rules, and another with technical architecture.

The "Study Group on a Framework for Competition Rules to Address the Transition to IP-Based Networks" developed a framework for an interconnection and tariff policy, and issued its final report in September 2006 (MIC, 2006). They identified the preservation of fair competition as a key goal, particularly as network operators become more vertically integrated. They saw competitive and technological neutrality as vital, and sought to protect the interests of consumers through competition rules that are flexible, transparent and consistent.

They also advocated three key principles that are closely related to calls for wired and wireless network neutrality that have recently been in evidence in the U.S.: (1) IP-based networks should be accessible to users and easy to use, allowing access to content and application layers; (2) IP-based networks should be accessible and available to any terminal that meets the relevant technical standards, and should support end-to-end telecommunications; and (3) Users should be provided with equality of access to telecommunications and platform layers at a reasonable price.

The MIC has also convened a "Study Group on Network Architecture" (MIC, 2006). The group is to evaluate the technical evolution of NGNs, the socioeconomic implications, and the relationships to standards and to the overall research and development process.

The United States

It is rare to hear NGN discussed as such in the United States; however, the evolution of the access network as fibre migrates closer to the end-user is not much different from that in Europe or Japan. Consequently, it raises the same issues. The regulatory response, however, has been completely different. The United States FCC has withdrawn nearly all regulatory obligations on network access as regards not only fibre, but also wired copper broadband Internet access (MARCUS, 2005). A previously effective program of shared access has been withdrawn. The only remaining remedy relevant to broadband access is Local Loop Unbundling (LLU) for copper lines (not for fibre); unfortunately, as European experience has richly demonstrated, that is not enough to maintain a robust ladder of investment.

The FCC has claimed that the wholesale market for DSL and cable modem Internet access services was effective, and would remain so in the absence of regulation (FCC, 2005, especially paragraph 75). The FCC's own data flatly contradict this view, which show third party (CLEC) DSL declining to 3.1% of all DSL lines as of December 2006. The third party access provided by cable operators is negligible.

The U.S. is blessed with extensive cable television infrastructure, and the cable operators were heavily engaged in broadband access before the telephone incumbents; in consequence, the withdrawal of regulation has resulted, not in monopoly, but in a series of non-geographically overlapping duopolies. The results must be viewed as mixed at best. The U.S. has seen strong investment in fibre access by incumbents, and steady improvements in cable plant, but negligible investment (or disinvestment) on the part of competitors. Broadband penetration and the price/performance of offers are reasonable, but probably nowhere near what might have been expected given the ubiquity of cable television and the enormous head start that the U.S. once had.

Numbering has been a fairly minor issue in the United States, largely because termination rates for geographic, non-geographic and mobile numbers are not markedly different from one another. This is largely a result

of efficient U.S. voice telephony interconnection arrangements, which preclude large asymmetries in the wholesale price for terminating a voice telephone call. Geographic numbers are only loosely tied to a geographic area, or for that matter to the United States.

■ Similarities and differences

Both differences and similarities are visible in the regulatory outcomes among the countries that we have reviewed. The differences are conditioned primarily on differences in market evolution. Differences in regulatory style, and in the degree of government ownership of the incumbent, have apparently also played a role. Nonetheless, a number of common threads emerge. It is helpful to begin by reviewing the differences in network evolution, starting with the access network and proceeding to the core network. In each country, issues of access and interconnection have played a key role, but access has been central to the access network, while interconnection has been a concern in the core.

The access network

The access network poses serious challenges to the regulator. Is it more important to stimulate investment, or to ensure competition? Are these goals compatible, or in conflict? Ensuring competition and choice, and avoiding restriction of competition, are largely viewed as demanding aggressive procompetitive regulation; however, it is recognized that this regulation may inhibit investment on the part of incumbents. It is not unusual to hear a European regulator lament that he or she would like to encourage investment, but not at the cost of re-monopolization of the network.

Most European regulators feel (as do the authors of this paper) that a simple withdrawal of regulation is not the most appropriate answer, not only because it risks restricting consumer choice and inhibiting competition, but also because it likely inhibits investments on the part of competitive entrants (which quantitatively are often just as significant as those made by incumbents).

VDSL tends to be the technology of choice in a number of countries, especially where there are short local loops from the street cabinet to the

customer premises. VDSL has been the access technology of choice in Germany and the Netherlands, but not in France or Japan. Japan has emphasized high end FTTB/FTTH solutions. France, largely as a result of rather long loop lengths, has focused on FTTB/FTTH solutions. The UK is effectively in a third category: BT is moving rapidly to modernize its core network, but relatively little is happening in the access network other than ongoing migration to more conventional broadband.

Access issues have been an intense topic of discussion in all of these countries. Deployment of FTTC/VDSL effectively relocates the Point of Interconnection from the Main Distribution Frame to the street cabinet, making unbundled access potentially much more difficult and costly. FTTH involves complex building wiring issues, and difficulties unbundling PON solutions. Unbundled access and shared access (but not necessarily bitstream access) consequently face substantial challenges in a VDSL and/or FTTB/H world.

The regulatory outcomes are as diverse as the inputs.

In the Netherlands, regulation of VDSL is still evolving, but it seems clear that the OPTA will insist that some effective portfolio of access modes (comprising access at the cabinet, access at the MDF, and bitstream access) equivalent to loop unbundling at the MDF will remain in effect.

In Japan, FTTB/H deployments are fully subject to unbundling requirements; however, it is unclear how effective the obligations have been in practice. Unbundling of copper and fibre in the backhaul network was hugely important to ADSL competition; FTTH, however, is often being rolled out by competitors in areas with high teledensity using the competitive operator's own dedicated facilities.

The German government chose in essence to deregulate VDSL facilities in order to encourage investment on the part of DTAG, and are consequently subject to infringement proceedings by the European Commission; the regulator has however attempted to find a more delicate balance, seeking to make access to ducts available to competitors, and thus to provide competitive access to the street cabinet in a different way.

In the UK, there has been much discussion of the role of public policy in promoting enhanced broadband access, but little actual deployment; however, the Ofcom/BT Functional Separation arrangements arguably address the problem in a different way, reducing BT's incentives to

discriminate against competitors. LLU has surged in the UK, perhaps as a result of Functional Separation. There has been much interest in Functional Separation in the past few years, but results to date are still preliminary.

In all of these countries there has been intense discussion of the location and number of Points of Interconnect (PoIs) associated with access, and the rapidity with which current PoIs could be phased out. It is generally recognized that the incumbent should not be obliged to maintain obsolete PoIs any longer than necessary, but that it is nonetheless important that there be appropriate consultation with competitors and that there be appropriate notice periods when PoIs are withdrawn by the incumbent.

Finally, in the U.S., there has been progressive withdrawal of procompetitive regulation, with the subsequent predictable collapse of third party competitors. This has stimulated investment by incumbents, but suppressed investment by competitors. There are few objective sources of analysis for the U.S., but our sense is that the net impact on overall welfare has been negative and substantial. The adverse consequences are mitigated somewhat by strong presence of cable television as a provider of broadband Internet access.

The core network

The NGN core network raises somewhat different challenges. At the top of the regulatory agenda have been issues of interconnection. It is generally accepted that wholesale payments based on Minutes of Use will make less and less sense in the fixed network going forward. They are only weakly correlated to real average incremental cost; the direction of termination or origination was largely irrelevant in the current network, and can be trivially manipulated; and there are measurement challenges and risks of gaming and arbitrage.

Voice services in the fixed network will be subject to intense competition from third party VoIP service providers. It is likely, however, that mobile interconnection arrangements for voice traffic will migrate more slowly to an IP basis than in the fixed network. Mobile operators derive far more wholesale revenue from interconnection than do their fixed counterparts, and also have far more ability to hinder the migration from switched voice to VoIP voice. The authors feel that current interconnection fees are much too high, especially for calls to mobile networks, and that they are inflating retail prices in ways unrelated to cost, and depressing use. The migration to IP has the

potential to force changes to inefficient European arrangements, but fixed and mobile operators appear to be both willing and able to slow the natural network evolution. We see these trends as troubling (MARCUS, ELIXMANN *et al*., 2008).

There has been some tendency in the discussion, and also in the literature, to blur together the discussion of PoIs for access and for interconnection. The number of PoIs needed for IP-based interconnection is probably an order of magnitude less than the number of PoIs needed for access – probably somewhere between three and ten for a European Member State. Again, the incumbent should be able to migrate its PoIs over time, but with reasonable consultation with competitors and with appropriate notice periods.

In an IP-based network, the telephone numbering plan is not a matter of the network, but rather of the applications that run on top of the network. The change in the technical locus of numbering does not eliminate market power concerns; thus numbering will continue to be a critical issue.

Arrangements across Europe are highly diverse. Some Member States permit IP-based telephony service providers to use geographic numbers, some permit them to use non-geographic numbers, and some permit both. Some provide full flexibility in the use of geographic numbers, while others require a link to the area with which the geographic number is associated. This is an area where there are substantial opportunities to increase harmonisation across the European Union [22].

■ **Conclusions**

The deployment of NGN technology is increasingly becoming a market reality throughout the world. Technically, NGNs fundamentally change the architecture and the topology of the current electronic communications networks. They decouple the functionality associated with the transport, control, and provision of applications and services. This decoupling enables

---

[22] Differences of the regulatory environment across Member States do play a crucial role also and in particular for pan-European VoIP business models inasmuch as they represent far reaching economic hurdles, thus, impeding market entry. See ELIXMANN, MARCUS & WERNICK (2008).

a multitude of new business models to evolve that differ with regard to the degree of integration of transport, control, and service provision.

These changes introduce new possibilities for competition that could in time mitigate the need for certain kinds of regulation; at the same time, the migration to NGN raises new regulatory challenges. In the near to intermediate term, we do not expect regulation to wither away. The requirements for regulation due to the migration to NGN are notably different regarding for the NGN access network compared to the NGN core network.

In the access network, a regulatory response to last mile wired market power will continue to be appropriate in most geographic regions of most countries for the foreseeable future; however, the challenges posed to the implementation of loop unbundling by the migration to FTTC/VSDL and by FTTB/FTTH raise serious and as yet unresolved questions as to how this might best be achieved. Experimentation in different countries is likely to shed light as to whether some combination of access to street cabinets (sub-loop unbundling), access to rights of way, access to ducts, and/or access to building wiring might be sufficient to maintain the effectiveness of loop unbundling and shared access (as a ladder-of-investment complement to bitstream access). International comparative assessment in the years to come should also shed light as to the real costs and benefits of the radical deregulation practiced in the U.S.

Many issues impact the core network, but the most notable by far is interconnection. Given that the termination monopoly will persist, we feel once again that some degree of continued regulation will be necessary. The migration to NGN will place enormous strain on existing interconnection arrangements, and will make more obvious the distortions that are already inherent in interconnection arrangements in most countries. Also, existing call termination rates are at inefficiently high levels (MARCUS, ELIXMANN *et al*., 2008).

Migration to NGN will be carried out gradually. For an extended period, which could easily exceed ten years, old circuit switched networks will coexist with new packet-based infrastructures. Thus, a crucial task for regulation is to set appropriate incentives and to avoid distortions during the migration period. Challenges that have already emerged include how long to maintain regulated access to locations that the incumbent would like to phase out, and how to establish an appropriate glide path for price regulation during the migration. Reasonably good solutions have appeared in a number of countries, but issues will surely continue to arise.

References

ELIXMANN Dieter, J. Scott MARCUS & C. WERNICK (2008): *The regulation of VoIP in Europe*, a forthcoming report for the European Commission.

FCC (2005): *In the Matters of Appropriate Framework for Broadband Access to the Internet over Wireline Facilities*, document FCC 05-150, released September 23, especially paragraph 75.

HAYEK F.A. (1945): The *Reader's Digest* condensed version of *The Road to Serfdom*, reprinted by the The Institute of Economic Affairs. The original appeared in *Reader's Digest* in 1945. Available online.

MARCUS J. Scott (2005): "Is the U.S. Dancing to a Different Drummer?", *COMMUNICATIONS & STRATEGIES*, no. 60, 4th quarter 2005. Available at: http://www.idate.fr/fic/revue_telech/132/CS60%20MARCUS.pdf
Also available in *Intermedia* (the journal of the International Institute of Communications), vol. 34, no. 3, July/August 2006.

MARCUS J. Scott, Dieter ELIXMANN *et. al*. (2008): *The Future of IP Interconnection: Technical, Economic, and Public Policy Aspects*, a report for the European Commission, available at:
http://ec.europa.eu/information_society/policy/ecomm/doc/library/ext_studies/future_ip_intercon/ip_intercon_study_final.pdf.

MARCUS J. Scott & Justus HAUCAP (2005): "Why Regulate? Lessons from New Zealand", *IEEE Communications Magazine*, November, available at: http://www.comsoc.org/ci1/Public/2005/nov/ (click on "Regulatory and Policy").

MIC (2006): *Communications News*, Vol. 17, no. 23. See:
http://www.soumu.go.jp/joho_tsusin/eng/newsletter.html.

Ofcom:
- (2005a): Final statements on the Strategic Review of Telecommunications, and undertakings in lieu of a reference under the Enterprise Act 2002 (Strategic Review), 22 September 2005.
- (2005b): *Next Generation Networks: Further Consultation*, 30 June.

OPTA (2006): "KPN's Next Generation Network: All-IP", Position paper, OPTA/BO/2006/202771; October 2 (in Dutch).