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Innovation, convergence and the role of regulation in the Netherlands and beyond

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Abstract in English

In the light of converging services for voice, data, and video, this paper discusses the challenges for telecommunications regulation from a European perspective. The Netherlands, a country with excellent conditions for facilities-based competition, is discussed as a case in point. With dynamic issues at the heart of the debate, the role of regulation and government intervention more generally is to create and possibly to sustain conditions among operators to upgrade their networks and to provide innovative services. A fresh look at current regulation suggests that an overhaul may be needed.

Key words: telecommunications regulation, convergence, network access, IP networks, competition, innovation, NGN networks

JEL code: L96, L5.

Abstract in Dutch

In het licht van convergerende diensten voor spraak, data en beeld bespreekt dit paper de uitdagingen voor telecommunicatieregulering vanuit een Europees perspectief. Nederland, een land met uitstekende condities voor infrastructuurconcurrentie, wordt besproken als een illustratief voorbeeld. Met dynamische ontwikkelingen centraal in het debat verschuift de rol van regulering en overheidsinterventie naar het creëren en mogelijk ondersteunen van de voorwaarden waaronder operators hun netwerken vernieuwen en innovatieve diensten verschaffen. Een nadere kijk op de huidige vorm van regulering laat zien dat een herijking nodig is.

Steekwoorden: telecommunicatieregulering, convergentie, netwerktoegang, IP netwerken, nieuwe generatie netwerken, mededinging, innovatie

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Summary

With the emergence of voice telephony based on the Internet Protocol (VoIP), telecommunications markets are rapidly changing. The application of the Internet Protocol (IP) helps operators to digitize their services in a coordinated fashion, which greatly facilitates the delivery of different services (voice, data, video) over any type of network, e.g. Digital Subscriber Line (DSL), cable, or mobile. This development, known as convergence, may ultimately lead to a decoupling of services and platforms: any service can be offered over any network (unless operators incorporate restrictions into their networks). This is a drastic change for the telecommunications sector: incumbents have to adapt to the new reality, and they are challenged by newcomers from unexpected directions, sometimes with very innovative business models.

Convergence and innovation have strong implications for market structure and competition. As a consequence, these developments must be taken into account by sector-specific regulation and competition policy. This paper explores and discusses the challenges for regulation as imposed by convergence and the emergence of IP-based services, with a focus on innovation and investment incentives. It adopts a European perspective, and discusses the situation in the Netherlands in some more detail. This country can be seen as one of the frontrunners in Europe with regard to the development of competing infrastructures: the presence of competing networks with nationwide coverage brings the option of regulatory withdrawal to the forefront (within the EU). However, some regulatory issues that come to the surface in the Dutch context do not have immediate relevance for those countries in which nationwide network duplication is not an option in the near future. Since it is beyond the scope of this paper to discuss all aspects of regulation and competition policy, to a large extent the focus is on the changing role of access regulation, and how it relates to incentives to innovate and invest.

Our central findings are as follows. First of all, regulatory practice may need a drastic overhaul in order to be able to accept convergence. The current practice, based on fragmented markets definitions, is artificial and not in line with business strategies and consumers' perceptions of electronic services. Voice, internet and TV services are all forms of IP-based communication. Thus, this approach introduces serious risks of reducing welfare. Second, depending on country-specific characteristics, it may no longer be appropriate to see access regulation (and in particular, access regulation of unbundling) as an instrument to promote competition and investments by moving entrants upwards on the "ladder of investments". Rather, in countries with good prospects for facilities-based competition (for instance if there is national coverage of both DSL and a cable networks) dynamic efficiency may be improved substantially by stimulating a race of network investments. This issue may also require an overhaul of regulation, this time because of the need for symmetric (de-)regulation with respect to mandatory access, irrespective of whether networks have SMP. Additional challenges for regulation (and policy) are to consider the option of bill-and-keep for all network

interconnection, to assess the risks of discriminatory practices that may undermine net neutrality of the internet, to reassess the need for universal service obligations, and finally, to upgrade the institutional environment in order to implement a transition from ex ante to ex post intervention (except in specific cases such as simple interconnection pricing rules, as mentioned above).

1 Introduction

With the emergence of voice telephony based on the Internet Protocol (VoIP), telecommunications markets are rapidly changing. The application of the Internet Protocol (IP) helps operators to digitize their services in a coordinated fashion, which greatly facilitates the delivery of different services (voice, data, video) over any type of network, e.g. Digital Subscriber Line (DSL), cable, or mobile. This development, known as convergence, may ultimately lead to a decoupling of services and platforms: any service can be offered over any network (unless operators incorporate restrictions into their networks). This is a drastic change for the telecommunications sector: incumbents have to adapt to the new reality, and they are challenged by newcomers from unexpected directions, sometimes with very innovative business models.

Industry observers tend to agree that in order to survive, incumbent telcos will ultimately have to migrate to IP-based networks. Migration to a single broadband IP network allows incumbents to compete with cable networks by offering broadband “multiplay” services, such as IP TV. Coming from the other direction, cable operators are upgrading their networks to allow media services to run over IP. In addition, fixed wireless technologies (e.g. WiMAX and Wi-Fi) are becoming stronger substitutes to wireline broadband networks. With some qualifications, this also holds for third generation (3G) mobile networks. Thus, one observes an increasing variety of networks that are offering converging applications, sometimes in bundles.

Convergence and innovation have strong implications for market structure and competition. As a consequence, these developments must be taken into account by sector-specific regulation and competition policy. This paper explores and discusses the challenges for regulation as imposed by convergence and the emergence of IP-based services, with a focus on innovation and investment incentives.¹ It adopts a European perspective,² and discusses the situation in the Netherlands in some more detail. This country can be seen as one of the frontrunners in Europe with regard to the development of competing infrastructures: the presence of competing networks with nationwide coverage brings the option of regulatory withdrawal to the forefront (within the EU). However, some regulatory issues that come to the surface in the Dutch context do not have immediate relevance for those countries in which nationwide network duplication is not an option in the near future. Since it is beyond the scope of this paper to discuss all aspects of regulation and competition policy, to a large extent the focus is on the changing role of access regulation, and how it relates to incentives to innovate and invest.

In the electronic communications sector, an important challenge for regulation is to keep up with technological change and innovation. In general, it has to be addressed to what extent the expected benefits of a specific type of regulatory intervention outweigh the costs. Perhaps the

¹ Throughout the paper, it is supposed that maximization of welfare measured as total surplus (the unweighted sum of producer and consumer rents) is the objective of regulation. In reality, some regulators put particular emphasis on consumer surplus. For the discussion here, this distinction has no consequences.

² Because of the institutional situation, parts of the discussion will not apply to the US.

main difficulty is that in highly innovative markets—where the potential dynamic efficiency gains are substantial—it is so hard to foresee how the market will develop, while at the same time, intervening in the market may easily distort or, worse, undermine the potential for innovation. Thus, both the stakes and the risks are high, and hence the importance of assessing the optimal nature of regulatory intervention.

Various other papers and publications explore the future of telecommunications regulation. A recent example is a collection of essays published by Ofcom (2006), providing a broad and comprehensive overview of changes in the telecoms landscape. In that collection, Stelzer (2006) argues that market forces and not regulators should choose winning technologies; Waverman (2006) assesses the changing costs and benefits of *ex ante* regulation versus *ex post* competition policy; Cave (2006a) makes a case for relying more on market-mechanism tools; and Booth (2006) argues that regulators should focus on the competitive process rather than trying to create a hypothetical outcome of perfect competition. Cave et al. (2006) also examine likely technological changes in European telecoms markets over the next decade, and the effects on competition. In the light of these changes, they argue in favour of regulatory disengagement. Finally, while the paper at hand provides regulatory guidelines for making sure that the converged future will not be delayed, a study by Bijlsma and Van Dijk (2007) anticipate such a future and discuss optimal regulation in a situation of a duopoly of triple-play providers. Note that because of the high rate of technological change in telecoms, implicitly this paper also connects to the literature on the relationship between regulation and innovation. There are research avenues on this topic into various applications. See, for instance, Prieger (2002) for an example of empirical work in this field on telecoms, and the references therein.

Concerning methodology, note that this paper does not follow a standard research approach (e.g. based on theoretical or empirical modelling), but builds on insights from existing literature and tries to provide a “well-educated” perspective on the future of telecoms regulation. To a modest extent, this paper affords to be somewhat speculative. As a consequence, the recommendations may not be very specific in certain respects, and sometimes require further research (which will be pointed out). Nevertheless, it is hoped that the paper adds focus to the current policy debate, as well as raises some issues for further research.

This paper is organized as follows. Section 2 provides an overview of recent developments in the Netherlands, a country which can be seen as a frontrunner in Europe, based on the prospects for facilities-based competition, that is, competition between infrastructures. Section 3 discusses the challenges for regulation. Section 4 revisits the situation in the Netherlands by discussing the implications that apply specifically to the Netherlands. Section 5 concludes the paper by recapitulating the main challenges and tradeoffs for regulation.

2 The broadband market in the Netherlands

This section describes recent developments in the Dutch broadband market, in order to have a reference point for later discussion.³

In March 2006, DSL operators (including incumbent KPN) had a market share of about 60%, cable operators around 39%, and Fiber to the Home (FTTH) around 1% for broadband access. Thus, the market was basically divided between DSL, as the dominant network, and cable. These data do not display the small but growing importance of alternative broadband networks, for instance based on mobile standards (Wi-Fi, WiMAX, UMTS). The latter one, the 3G mobile telephony standard in Europe, may not offer the same speed as fixed connections, but one may expect that it will gradually become more important as an additional source of competitive pressure on fixed networks.

The 1% share of FTTH looks insignificant, but it hides the fact that recently, there has been a lot of activity in FTTH rollout. According to a report by Stratix (2007), parties ranging from KPN, cable operators, municipalities, housing corporations, to student dormitory corporations, had an aggregate deployment of about 111,000 FTTH connections at the end of 2006. Based on publicly announced plans by various parties, the expectation is that this number will increase to 377,000 during 2007, and 579,000 during 2009. Underlying this trend are small-scale projects carried out in cooperation with housing corporations as well as city-wide projects coordinated at a larger scale.

In 2001, the market share of cable was 76%, substantially larger than in 2006. It is probably with the help of DSL providers that built their business on regulated local loop unbundling (LLU) that DSL has become so successful. The competitive pressure that former monopolists in Europe experience, stems in large parts from mandatory unbundling at the level of the “main distribution frame” (MDF), enabling competitors to target end-users without the need to invest in their own local loops. Note that the Netherlands is not the only country where local loop unbundling creates competitive pressure both in broadband and voice markets.

Within the DSL segment, KPN had a market share of around 80% in March 2006, which includes the share gained by recent acquisitions of Tiscali and other DSL providers. The most important remaining DSL providers were BBned (owned by Telecom Italia) with a market share of about 8%, Versatel (owned by Tele2) with a market share of 8%, and Wanadoo (owned by Orange) with a market share of 4% (data from 2006). As of the beginning of 2007, these providers have their networks rolled out up to the level of the main distribution frame. For the remaining part, they rely on access to unbundled connections. Note that due to the takeovers by KPN, the competitive pressure from DSL providers without local networks has been reduced substantially.

³ Most of the quantitative data presented in this section is taken from Analysys (2007).

As a part of its “all-IP” strategy, KPN announced (in 2006) to scrap most of its local exchanges containing main distribution frames.⁴ ⁵According to this plan KPN would keep some as “metro core locations”, but would dismantle the main distribution frames at these locations. The link between these metro core locations and street cabinets (currently about 28,000) would be converted into fibre. Upgrading local access connections is important since at present, DSL connections have insufficient capacity to provide media services of similar quality as those provided by cable operators. Migrating the local loop to IP can be done by upgrading access networks to Very High Speed DSL (VDSL), through fibre to the street cabinet, or to FTTH.

KPN’s local loop can be unbundled at another level, besides the level of the main distribution frame. An alternative is access at sub-loop levels (sub-loop unbundling or SLU). Note that if KPN upgrades its network according to current plans, entrants will no longer be able to purchase access at either level. It is not clear, however, whether policy makers should worry about this (this issue will be revisited later). Apart from rolling out connections to end-users themselves, the remaining option would then be to use wholesale broadband access (WBA), a form of service-based entry. Whereas unbundling results in access to the legacy infrastructure of the incumbent, wholesale broadband access will lead to access to the overall network, including the core parts upgraded to IP.

In the light of KPN’s move to all-IP, the Dutch NRA, OPTA, has to decide whether it will allow KPN to redesign its network in such a way that competitors’ investments at local switches (in the main distribution frame) become obsolete, or that unbundling at a lower level will be ruled out. In a 2006 position paper, OPTA indicated that currently granted access can, in principle, not be withdrawn, and that “reasonable” access requests must be granted as well.⁶ Consequently, conditions would be imposed on KPN with regard to its plans to phase out the current type of access (at the MDF). At the beginning of 2007, however, OPTA provisionally concluded that alternative types of access (e.g. through SLU) would most likely not lead to a fully fledged alternative for unbundling at the MDF level.⁷ OPTA argued that a necessary condition for allowing KPN to phase out MDF access is the presence of sufficient possibilities for entry and continuity of service provision by entrants. Subsequently, OPTA obliged KPN to come up with a solution that is acceptable to all involved parties, with respect to the proposed phase-out of access to KPN’s local switches.⁸

⁴ “Dutch Regulator Jumps to Altnets’ Aid”, Telecommunications Online, October 3, 2006 http://www.telecommagazine.com/newsglobe/article.asp?HH_ID=AR_2447.

⁵ BT, in contrast, will not dismantle its local exchanges as part of its upgrade to a NGN (the “21st century network”).

⁶ “KPN’s Next Generation Network: All-IP”, position paper by OPTA, OPTA/BO/2006/202771, 3 October 2006. Available at www.opta.nl.

⁷ “Brief aan marktpartijen inzake vervolg op position paper All-IP”, letter by OPTA, 24 January 2007. Available at www.opta.nl.

⁸ “ALL-IP: agreement between parties”, background document by OPTA, 13 July 2007. Available at www.opta.nl.

Summarizing, at present the two main networks are DSL and cable, while various local initiatives are pushing up the share of FTTH. Thanks to unbundling, the DSL network is currently used by DSL providers without local networks. It depends on KPN's implementation of its all-IP plans and on OPTA's requirements on KPN's new network to what extent these DSL providers can remain active in the market, if they choose to stick to their current business models. In what follows, the regulatory options with regard to mandating access in the light of the planned investments in networks will be discussed.

3 Regulation and market dynamics

This section derives, in broad outlines, the type of regulatory regime that aims at maximizing dynamic efficiency, or total surplus in the long run. To do this, it starts by comparing different regulatory regimes in a hypothetical exercise (section 3.1). Next, several important challenges for policy and regulation of electronic communications markets are discussed, which need to be addressed if policy makers want to create sustainable conditions for competition and maximum consumer benefits in the long run (section 3.2).

Before going into details, it is useful to make explicit why regulation should not primarily aim at creating competition and low retail prices in the short run (an outcome that can easily be obtained). The reason is that the potential welfare gains that result from innovation are likely to be significantly higher, probably of a different order of magnitude, even though typically, they require a longer time horizon. Therefore, to maximize welfare, the policy goal should be to create a sustainable environment in which operators have incentives to innovate and invest in their networks, and where consumers gradually experience the introduction of innovative services and more variety. See Stelzer (2006) for more background and references on the importance of innovation as a driver of welfare.

3.1 Regulatory regimes

Consider a hypothetical exercise in which three regulatory regimes—two of which are hypothetical at present—are compared. In each case, one can think of a situation in which, initially, there are (at least) two networks. Thus, this exercise is tailored to highlight the situation in the Netherlands. Both operators offer triple play bundles. One is a DSL network operated by the former incumbent, who has been forced to provide unbundled local connections to entrants at regulated prices. The other one is, for instance, a cable network, which has not been regulated, except for traditional media regulation, which will be ignored in this discussion. Alternatively, it may be that both networks are subject to regulation, but that because of different “Significant Market Power” (SMP) assessments in the “relevant product and service markets” recommended by the EC,⁹ only the DSL operator has had to provide access at a regulated price. The former incumbent is considering to upgrade its DSL network to an all-IP network. There are several DSL providers without local networks, purchasing unbundled access to the DSL network, who are active in the retail market as well.

The central idea in this exercise is, in a situation with good prospects for facilities-based competition, to consider the whole range of options for access regulation. The regulator now has to decide whether its policy with regard to access regulation needs to be revised in the light of the new market reality.

⁹ Recommendation 2003/311 of 11 February 2003 on relevant product and service markets within the electronic communications sector susceptible to ex ante regulation in accordance with Directive 2002/21 [2003] OJ L 114/45.

Regime I: Continuation. First, suppose that there is no change in regulation while technologies are upgraded. Hence, the DSL network has to (continue to) provide regulated MDF access to entrants, whereas the cable operator does not have to do so. Although the DSL operator may feel that mandated access undermines its business case for upgrading its network to VDSL or FTTH, it actually has no choice if it wants to stay competitive with regard to the cable operator. Nevertheless its incentives to innovate are likely to be harmed, and to a certain extent the network upgrade may be a response to the regulatory reality. Moreover, because of asymmetric regulation, the playing field is unlevelled and both operators' incentives to invest are likely to be distorted even more. The same is true for entrants who currently do not have local networks. Since rolling out a network is not necessary, entrants (continue to) have weak incentives to do so.

Regime II: Broadening of regulation. Second, suppose regulation fastens its grip by mandating access, under the same conditions, to all networks. Note that in case of a strict implementation (by NRA's or the Commission) of the requirement of the European regulatory framework that there must be SMP, this is not straightforward. But for the sake of argument, assume that this is feasible nevertheless. As a result, at least in the short run, consumers get competitive triple play bundles on either network, offered by both networks as well as by entrants without networks. The question is, however, whether the two networks will have sufficient incentives to invest in the longer run. It is possible that their incentives to invest are eroded, since entrants can free ride on the existing local networks.

Regime III: Overhaul of current regulation. Third, consider the other end of the range of regulatory options, by supposing that regulation loosens its grip completely by abandoning access regulation. Now there is unfettered facilities-based competition between networks who, in order to avoid the "commodity trap", will probably aim at building up market power through differentiation.¹⁰ A straightforward way to do so is to strike exclusive deals, or vertically integrate, with content providers. Accordingly, subscribers to the DSL network get content with different characteristics than those subscribing to the cable network.¹¹ Because of symmetric non-regulation, there is a level playing field. The DSL and cable operators, having full discretion over their strategies, try to capture rents from the content layer by leaving network neutrality behind. In order to increase the size of the retail market, or to serve niches beyond

¹⁰ See Crawford (2007) for casual evidence, illustrations, and references that support the move towards product differentiation strategies for networks. In addition, firms may enjoy market power due to the presence of consumer search costs and consumer switching costs. The latter arise e.g. due to long-term contracts or costly number portability. While differentiation typically leads to more market power, the effect of consumer switching costs on competitive pressure is ambiguous (see e.g. Farrell and Klemperer, 2007).

¹¹ One possibility is that the content that is provided is the same on both networks, but that there are differences in delivery speed and priorities. See also the discussion on network neutrality, below. Note that there is a more prominent role for competition policy to avoid anti-competitive exclusive dealing arrangements as part of the networks' differentiation strategy. Oversight by the competition authority can then assure that networks offer fairly homogeneous products.

their immediate reach, they may nevertheless provide access to DSL providers, but access prices will then be based on commercial rather than regulatory considerations. Note that, if current regulation is withdrawn, there may nevertheless be some scope to introduce rules related to non-discrimination, in order to restore network neutrality. Also, having some interconnection rules (terminating access) may be efficient. Section 3.2 will revisit minimal regulations of these types.

To conclude the hypothetical experiment, the obvious question now is which regime is best for welfare in the long run. As discussed briefly above, the conditions to obtain these goals appear to be most prominently present in regime III, although there an emerging uncertainty pertains to the discriminatory strategies of networks. Such strategies, however, will also come to the surface in regimes I and II. In what follows, the insights of this hypothetical experiment will be implicitly used as a working hypothesis, on which policy recommendations will be based. Section 4 will provide further support for this hypothesis, illustrated by the situation in the Netherlands. Underlying this hypothesis is a welfare comparison between facilities-based competition and access-based competition (entrants using the incumbent's local connections rather than building them themselves). In general, one cannot say that one type of competition is socially optimal, as the outcome depends on, among others, the size of scale economies and investment costs.¹² Note that in the Netherlands, where two networks are already present (the investments are sunk), the downside of facilities-based competition stemming from wasteful duplication is largely irrelevant. Therefore, for this particular country, the working hypothesis seems to be on the safe side. Note, however, that for other countries, it may not apply.

3.2 Regulatory challenges

In the light of sustainable, long-term regulatory goals, one may consider several challenges for regulation of the electronic communications sector, primarily from the perspective of access regulation and incentives to invest and innovate. After that the paper will discuss some more general issues.

1. Consistent and neutral regulation of converging services, infrastructures and technologies

Convergence of both services and of infrastructure is, thanks to the increased use of IP, no longer hype.¹³ Voice, content and data are all digitally stored and transported files containing information. Fixed and mobile infrastructures (e.g. DSL, cable, and UMTS) do have their specific characteristics and functionalities, but they are becoming closer substitutes. These developments urgently call for consistent regulation that is, moreover, technologically neutral.

¹² See Bergman (2004) for an elaborate paper on this topic.

¹³ See the survey on telecoms convergence "Your television is ringing" in *The Economist*, 14 October 2006.

The extent to which this is possible, though, will depend on the extent to which regulatory frameworks allow for treating different services and different networks in the same way.

Telecoms regulation has a tradition of heavily relying on detailed market definitions. In the EU, NRAs have little discretion in deviating from the European Commission's "Recommendation on relevant product and service markets",¹⁴ specifying 18 different relevant markets. In the revised framework, this number is reduced to 7, but the underlying philosophy remains unchanged.¹⁵ National circumstances may give rise to the adoption of different market definitions, but the practice is that that happens only under exceptional circumstances.¹⁶ Because of convergence and the adoption of IP, one can less and less distinguish the type of communication service or content that consumers purchase. Moreover, content often makes use of different ways of communication at the same time (e.g. a TV show where viewers can deliver input by making calls or sending short text messages). One can ask why, now that cable and DSL networks compete by offering triple play (voice, internet and TV) or quadruple play (including mobile services) bundles, such a fine-meshed division of the communications market is still appropriate. The distinctions between the networks will be reduced further due to upgrading of the networks. Arguably, these fragmented market definitions should be replaced by a market definition reflecting the business strategies of networks, the way consumers perceive electronic communications and media services, and the fact that the segments distinguished by the Commission's Recommendation are closely linked to one another, for instance because of call traffic across segments.¹⁷ Distinguishing separate segments, and applying regulatory measures in response to assessments of SMP within segments, is highly artificial and, more importantly, introduces serious risks of distorting the decisions to upgrade networks and hence of reducing welfare.

To come back to the starting point, which is convergence, if regulation continues to rely on segmented market definitions, then it will be harder for NRAs to accept convergence as a new reality. Another risk, pointed out by Richards (2006), is that the marketplace evolves so rapidly that market boundary assessments will always lag behind.

¹⁴ Recommendation 2003/311 of 11 February 2003 on relevant product and service markets within the electronic communications sector susceptible to ex ante regulation in accordance with Directive 2002/21 [2003] OJ L 114/45.

¹⁵ Commission Recommendation on relevant product and service markets within the electronic communications sector susceptible to ex ante regulation in accordance with Directive 2002/21/EC of the European Parliament and of the Council on a common regulatory framework for electronic communications networks and services (second edition), Brussels, C(2007) 5406 rev 1.

¹⁶ In the same spirit, the elimination of various markets from the Commission's list implies a substantially higher threshold for regulation of those markets.

¹⁷ Loomis and Swann (2006) make a similar comment based on the competitive situation in the US communications market. See also De Bijl et al. (2005) for a similar point in the context of the interconnection between fixed and mobile networks.

2. New role for access regulation

NRA's have been aiming at increasing consumer welfare by stimulating entry into telecommunications markets. This has been working (with mixed success) for several years now, through mandating access to incumbents' networks. As a result, various types of entrants have become active. Some of them invested very little, and purchased all network capacity on the wholesale market. Others rolled out partial networks and reached end-users by leasing unbundled local loops. This was driven by regulation of call origination charges and rentals for (unbundled) local loops. The underlying idea was that, since rolling out networks is very costly and takes considerable time, by mandating access to existing networks, competition could get off the ground faster. Moreover, these regulatory arrangements were considered to be temporary "stepping stones", helping entrants to build up market share and gradually roll out facilities themselves.

The idea of using access regulation to stimulate network rollout is known as the "ladder of investment".¹⁸ The views on its success are mixed. In a speech, Ms Viviane Reding (member of the European Commission responsible for Information Society and Media), was rather positive and optimistic (Reding, 2006). Some empirical evidence is less positive, however (Hausman and Sidak, 2005; Crandall, 2006). Waverman (2006) cites evidence that the share of cable has suffered because of mandated access to the incumbent's network. It should be noted here that (to some extent) it may not be the underlying idea that is flawed, but that the implementation and credible commitment to the policy by regulators are problematic.¹⁹ Especially the lack of commitment devices for NRAs should be underlined in this respect. Concerning implementation, this type of policy requires considerable fine-tuning by regulators. Even if regulators manage to do this correctly, fast technological developments and changing political realities may pull the intended policy off course.²⁰ Thus it is uncertain whether regulators are able to commit to a certain regulatory policy over a period of several years.

In countries with good prospects for facilities-based competition, mandated network access can easily lead to avoidable distortions of market outcomes.²¹ Typically, there are good prospects for competition between networks if there are nationwide cable networks rolled out alongside the incumbent's network. More generally, in countries where (i) cable operators are getting ready to offer voice and internet, and are becoming triple-play providers, and (ii) additional networks (e.g. based on Wi-Fi, WiMAX, or FTTH) can be used for fast internet

¹⁸ On the relation between access prices and investments, see e.g. De Bijl and Peitz (2002), Cave and Vogelsang (2003) and Valletti (2003b). The central idea of the ladder of investment is that entry may initially be encouraged by low access prices—most likely, entrants will start investing in replicable assets, and while access prices increase over time, move on to less replicable ones (such as local networks). For a recent, much broader survey see Guthrie (2006).

¹⁹ Cave (2006b) sets out a stepwise implementation for regulators.

²⁰ For an interesting example that demonstrates implementation difficulties, see De Bijl and Peitz (2005), discussing OPTA's five-year plan for an increasing local-loop line rental in order to give entrants incentives to move up on the investments ladder, and explaining why it did not work out as intended.

²¹ See also Booth (2006) and Waverman (2006).

access in certain areas, the rationale behind access regulation as a means to stimulate network investments becomes less convincing. This is even more so in the light of the fact that setting the access price correctly is inherently difficult, while setting it at the wrong level may heavily distort investment incentives. Thus, before considering access regulation, the first question to be addressed is how many networks are needed to have effective competition. If a given number of players do not lead to sufficiently effective competition, some form of access regulation might be desirable, provided that less heavy-handed means do not work, and that it does not distort investments in new networks. In addition, if these conditions are satisfied, networks (read: cable and DSL) should, if technically possible, be treated symmetrically, in order to maintain a level playing field.^{22 23}

Regulators should bear in mind that even if there is little scope for facilities-based competition, access regulation is risky. This point seems to be underestimated in practice. For instance, in a recent public discussion document on next generation access networks, Ofcom states that “[...] one key consideration for any next generation access regulatory policy is the correct level in the network to mandate access to promote downstream competition. This will, in part, depend on technology choices made by industry.” (1.15, p. 3). The view expressed in the Ofcom document seems to ignore the endogeneity of technological decisions, that is, that an industry’s technology choices will to a large extent be determined by the regulatory policy. It is because of the risk of lock-in into certain technologies, which can easily be triggered by regulation geared towards specific types of access, that it is wise to be very careful.

While it is not completely certain whether facilities-based competition will be feasible in the long run, regulation can—in a different way—contribute to creating an arena in which firms invest and innovate to create the most attractive network.²⁴ To make such a “race of network investments” happen, access regulation should be used less prominently as an instrument to create competition in the short run. Instead, it can be put on hold and used as a threat that can be applied at some point in case a new network monopoly prevails. Of course, firms should know the regulatory rules of the game in advance, so that there is little risk of regulatory uncertainty or even a regulatory “hold-up”. Hence the regulator must be able to create a credible commitment to stick to (in advance) clearly defined objectives and criteria in the future. Regulation should also take into account the risk that firms will temper the speed of innovation or price less aggressively, as they foresee that winning the race may trigger the regulator to capture the rents from innovation. This can be dealt with by making sure that some monopoly rents are granted.

²² To reduce the intensity of competition, firms may tacitly agree to divide the market geographically, e.g. leading to a FTTH network in one city and a cable network in another one. Therefore, to assess competition, the focus should be on sufficiently narrow geographical markets.

²³ This paper abstracts from the possibility of having competing networks based on the same technology, although this is certainly a possibility in some market segments.

²⁴ See also Stelzer (2006).

3. Network neutrality and non-discrimination

When network operators strike exclusive deals, or vertically integrate, with content providers, non-discrimination may need to be put more prominently on the policy agenda. While there has been a heated policy debate on network neutrality in the US, it seems that Europe is lagging behind.^{25 26} From an economics perspective, a central issue is whether competition between networks can alleviate the harm of discriminatory practices on consumers' choices and innovation.²⁷ If there are several networks and there is sufficient competition between them, discriminatory practices may do relatively little harm, as consumers can switch to other networks if they are not happy with the (limitations in the use of) content provided by their operator. However, it is hard to assess whether there is sufficient competition between networks, especially when they aim at horizontal differentiation through vertical contracting with different suppliers. The larger the number of networks, the less likely it is that such arrangements effectively limit consumers' choices between content packages. The same is true for the potential harm to dynamic efficiency if the possibilities and incentives for decentralized innovation (at the "edges" of networks) are undermined by vertical restrictions and less open networks. It is an open question how many competing networks are needed to repair the harm from exclusive vertical contracting. However, market forces are to be checked by competition authorities, who can restrict or prohibit the use of certain types of vertical restraints. They may also interfere in attempts of vertical integration and even enforce vertical separation.

A broader point is that it is hard to see how networks can add value as gatekeepers in a world where consumers desire plain functionality (voice, e-mail, unlimited access to the internet), reliable connections without binding capacity constraints, and access to whatever they want to see. If this correctly represents what consumers value most, then separate network layers, with competition in each layer and without "smart" gatekeepers, is likely to provide the best environment for innovation that aims at satisfying consumers' needs.²⁸ Nevertheless, in the recent past network operators sometimes tended to vertically integrate (or strike exclusive deals) with content providers,²⁹ sometimes even to the extent of creating "walled gardens" and by blocking certain services provided by independent providers. The underlying business rationale seems to be to control access and content, in order to capture rents. Moreover, this

²⁵ One can loosely characterize network neutrality as the situation in which the internet is operated under non-discrimination: all packets transmitted over the network are treated the same way by the networks, including the traffic originating within the operator's network.

²⁶ A possible reason why there is less debate about network neutrality in the EU may be found in the presence of a regulatory framework for electronic communications, which is absent in the US.

²⁷ See Kocsis and De Bijl (2007) and Van Schewick (2007).

²⁸ Farrell and Katz (2000) analyze when a monopoly network may, by extracting rents in the competitive sector, weaken or even destroy independent innovation. Possibly, such effects remain relevant if there is more than one network.

²⁹ Exclusive deals may, in particular be in the interest of the content owner since it increases the bargaining power of the content owner vis-à-vis the network operator.

may lead to foreclosure and harm competition.³⁰ Hence, in the light of the dual danger of reduced incentives for innovation and reduced competition, NRA's and competition authorities should critically scrutinize vertical ties between networks and content providers.

The issues above have in common that they centre around access regulation and the incentives to invest and innovate. For the sake of completeness, also a couple of more general issues will be discussed, which are less dependent on country-specific characteristics than the previous ones.

4. Interconnection agreements

Some bottlenecks may remain existent even when there is facilities-based competition in local networks. In particular, terminating access may always remain suspect, especially if operators continue to charge for it. The reason is that at the moment when somebody wants to make a call to a specific subscriber, the operator who has access to that subscriber (because of the subscription contract between the customer and the network) has (a certain amount of) market power.³¹ This problem is probably most serious for call termination on mobile networks, where the location of the called person may be unknown at the time of calling, so that alternatives ways of reaching that customer (e.g. through a fixed line) may not be present. Nevertheless, to some extent, this issue is relevant for more types of terminating access, if not because of the exercise of market power, then because of inefficiencies caused by double marginalization (if access prices are set unilaterally) or collusion (if access prices are negotiated among operators).³²

With the migration from circuit-switched telephony to packet-switched IP traffic, wide-scale adoption of bill-and-keep in interconnection agreements may solve inefficiencies caused by mark-ups in call termination prices. It is important to note that bill-and-keep may, in theory, not lead to optimal price levels, which will typically be equal to underlying marginal cost levels. However, especially with the introduction of IP, marginal costs levels are approaching zero. In addition, bill-and-keep substantially reduces regulatory and transaction costs: this type of pricing does neither require cost monitoring by operators (or NRAs) nor adjustments over time.

³⁰ Farrell and Weiser (2003) discuss when a network's decision to vertically integrate make vertical leveraging profitable, even though it is inefficient from a welfare perspective. This may for instance happen when control over applications helps the network operator to engage in price discrimination.

³¹ If network architectures would allow for "call termination bypass", this problem would not occur. See Valletti (2003a) and De Bijl et al. (2005) for a discussion in the context of call termination on mobile networks.

³² A large body of theoretical literature has explored these issues. For a short guide to the literature see Peitz et al. (2004).

It is much simpler to implement than any other pricing rule, also for operators. Thus, the simplicity of bill-and-keep will, most likely, make it the preferred choice in practice from a welfare perspective.³³

5. Universal service

Historically, telecoms has been characterized by a public policy relating to wider social benefits, implemented by imposing universal service obligations (USO) on incumbents. In the light of the widespread adoption of mobile telephony, typically coupled by license requirements related to nationwide coverage, USOs for fixed operators are not cost-effective anymore. As Cave et al. (2006) observe, universal service remains only relevant if policy makers redefine it to include broadband access. Crawford (2007) strongly supports a revision of universal service policy based on the principle that communications regulation should help to encourage diversity and innovation as drivers for economic growth for society. According to Crawford, the role of universal service policy would be to guarantee that everyone in society has high-speed access to the internet, so that the potential to enter into online relationships and communications, and thus the potential to generate innovative ideas, is maximized. To conclude, if an adaptation of USOs in the communications sector is judged to be appropriate, it is important to do this explicitly rather than to automatically extend current policy. Note that typically it is a task of policy makers, and not regulators, to assess the desirability of and design USOs.

6. Upgrading the institutional environment

It is of crucial importance to see the regulatory challenges discussed above in their institutional context. When regulation becomes less specific, the competition authority can take over tasks from the NRA. This would stimulate the transfer from an ex ante regulatory regime to ex post competition policy. Nevertheless, as discussed in relation to interconnection, efficiency in the market can possibly be improved by maintaining some simple, informationally undemanding rules that focus on the structure of specific wholesale charges. To do so would ask for ex ante regulation, but of a different nature than the detailed rules relying on information about underlying cost levels, which is the case for current access regulation?

Another institutional issue is the reduced need to set media regulation apart, in a market composed of converging sectors.³⁴ Now that consumers substitute surfing on the web with watching TV, and that many TV shows can be watched over the internet as well, regulation of

³³ Stennek and Tangeras (2007) make a related point in the setting of mobile telecoms, arguing in favour of regulation that is simple, undemanding as regards information requirements, and yet powerful. They propose simple rules that focus on the structure of prices, not on their level. They refer to this as “structural regulation” that is “both simple to implement and transparent to the industry”. The additional property of bill-and-keep is that also the level is fixed, namely all interconnection charges at zero.

³⁴ Noam (2006) discusses how convergence affects regulation of telecoms, internet and media.

electronic communications and of media should be put in one hand. In the UK, this has happened with the change from Oftel to Ofcom. Other countries have not followed this example yet. In the Netherlands, for instance, it seems that the political climate would make this unlikely.

The next section connects the regulatory challenges laid out above to the situation in the Netherlands, putting the emphasis on regulation with regard to mandating access to local networks.

4 Regulatory challenges: some remarks on the Netherlands

As was seen in section 2, the Netherlands is in a rather special position of having excellent conditions for the viability of competition between infrastructures. There are two nationwide networks, DSL and cable, while FTTH is gathering speed quickly—not to mention the potential of alternatives like Wi-Fi and WiMAX.³⁵ The unknown variable is the prospect for network access based on LLU, SLU or WBA, which will be determined by KPN's implementation of its all-IP plans as well as OPTA's requirements with regard to access to the new network. The central question should not be how to fine-tune or gradually adapt current access regulation. Instead, the issue is how to give the various networks and newcomers stronger incentives to invest in their infrastructures. In other words, given the fortunate conditions that are present, what is needed to trigger a socially beneficial "race of network investments"? The discussion in section 3 suggests that a regime explicitly aiming at regulatory withdrawal (through sunset clauses) would do the best job. This will now be made more specific.

To create a level playing field between the participants of the race, regulation should avoid making a distinction between different infrastructures such as DSL and cable (except if differences in technologies prevent this). In particular, the current number of networks is sufficient to create effective competitive discipline so that network access should not be mandated, or it is insufficient, in which case all players should face similar requirements, of which access regulation would be a last resort. This would imply a departure from the currently applied condition that only players with SMP have to provide access at regulated terms (if lighter forms of intervention for those players are deemed to be ineffective). To make this possible, the European regulatory framework, to the extent that it is not sufficiently flexible, needs to be adapted.³⁶ However, the European Commission seems to be reluctant to impose access regulation with respect to broadband internet access on cable networks infrastructure, as it fears to broaden regulation of cable.³⁷ It would be unfortunate if this implies a continuation of asymmetric regulation which no longer appears to be appropriate.

To make the point above stand up to the scrutiny imposed by real-life details and issues, one still has to assess the effectiveness of facilities-based competition as a function of the number of players. Distaso et al. (2006) shed some light on this, but more research is needed to investigate this issue in more depth. However, the burden of proof should be on the regulator, who should motivate why two nationwide networks, providing a priori fairly homogeneous goods, would compete too little. An additional point to be addressed is the risk that due to regulatory withdrawal, some entrants may leave the market instead of adapting their business models. To prevent bankruptcies that are unnecessarily wasteful (that is, that do not happen as a natural outcome of dynamic competition), caution will be needed.

³⁵ De Bijl and Peitz (2005) elaborate on market conditions in the European broadband market.

³⁶ As pointed out by a referee, the problem may not lie in the regulatory framework, but in the implementation by NRAs or the Commission.

³⁷ See De Streel (2005).

It is useful to comment briefly on how to assess the effectiveness of competition when there are, say, two comparable infrastructures. The received wisdom from oligopoly theory says that a small number of competing firms results in a certain level of market power. An exception is of course price competition among symmetric firms when goods are homogeneous: prices are then driven down to marginal costs. If two network operators with unlimited capacity sell “plain” broadband access at transparent price structures (e.g. flat fees), one would expect that the situation would resemble such price competition. However, if operators implement discrimination and prioritization strategies in order to distinguish their offerings, the situation would be closer to competition between horizontally differentiated networks, allowing firms to charge mark-ups. Thus, such an assessment would boil down to evaluating how homogeneous and “neutral” the networks are.³⁸ Hence in practice, this assessment would require theoretical, empirical as well as technological judgments.

Assuming that a duopoly of fairly homogeneous triple-play providers is characterized by sufficient competition, the implication is not that access regulation should be abandoned completely. The reason is that one cannot exclude the possibility that in the future, only a single network survives because of natural monopoly characteristics in the industry. If that happens, access regulation may be a useful tool to maintain and increase competition at the services level. The participants in the race should, nevertheless, know in advance that access regulation remains a realistic option for the future. To avoid regulatory uncertainty, the conditions and terms should be specified in advance. Otherwise, the prospect of regulatory capture may discourage them to win the race in the first place.

From the perspective of a race of network investments, at least at first glance it is not evident that one would want to constrain the DSL network in upgrading its network by imposing access requirements at specific levels in its network hierarchy. First, the former incumbent is no longer a monopolist, nor is it likely to have SMP in the broader, converged market of triple play offerings. Second, constraining the incumbent is likely to distort innovation decisions by the incumbent, cable operators, and parties active in alternative rollout. However, DSL providers that have invested in equipment installed at MDF locations, come into trouble if access regulation is put on hold. They see their investments stranded. While this is a legitimate reason for concern, the NRA should not automatically give priority to this issue if it comes at the cost of important dynamic inefficiencies in the overall market. Note however, though, that an NRA may not get enough discretion from the European Commission to follow such a hands-off approach.³⁹

³⁸ See Kocsis and De Bijl (2007) and the discussion on network neutrality above. See also OPTA (2006).

³⁹ A related, very interesting case concerns the recent amendments to the German telecommunications law that, if the NRA follows the intent of Parliament, exempts incumbent Deutsche Telekom's VDSL network from current access regulation by granting the operator a “regulatory holiday”. On 26 February 2007, the European Commission announced that it would launch a fast track infringement procedure concerning the amendments in the law. According to the Commission, the new law interferes with the NRA's discretion in defining and analysing markets under EU rules.

The discussion on access regulation in the Netherlands is necessarily brief and requires further analysis, in order to make sure that regulation is optimally adapted to the changing landscape. Nevertheless, it seems that continuing to base regulatory intervention on the legacy framework seriously risks to reduce long-term welfare, by distorting network investments and innovation. The other regulatory challenges, while highly relevant, do not pertain specifically to the Netherlands. As NRAs and policy makers in any country will have to deal with them, this paper does not discuss them in more detail here.

5 Conclusion

A central point in this paper is that in the telecommunications sector, which is characterized by rapid technological change, regulation should avoid interfering with market-driven innovation as much as possible. Several situations were discussed, indicating that the European regulatory framework is not able to optimally address technological change. Note, however, that the framework itself may actually be sufficiently flexible, it is at the level of implementation where problems come to the surface. It is beyond the scope of this paper to address exactly at which level these issues should be addressed.

The central points were as follows. First of all, regulatory practice may need a drastic overhaul in order to be able to accept convergence.⁴⁰ The current practice, based on fragmented markets definitions, is artificial and not in line with business strategies and consumers' perceptions of electronic services. Voice, internet and TV services are all forms of IP-based communication. Thus, this approach introduces serious risks of reducing welfare. Second, depending on country-specific characteristics, it may no longer be appropriate to see access regulation (and in particular, access regulation of unbundling) as an instrument to promote competition and investments by moving entrants upwards on the "ladder of investments". Rather, in countries with good prospects for facilities-based competition (for instance if there is national coverage of both DSL and a cable networks) dynamic efficiency may be improved substantially by stimulating a race of network investments. This issue may also require an overhaul of regulation, this time because of the need for symmetric (de-)regulation with respect to mandatory access, irrespective of whether networks have SMP. Additional challenges for regulation (and policy) are to consider the option of bill-and-keep for all network interconnection, to assess the risks of discriminatory practices that may undermine net neutrality of the internet, to reassess the need for universal service obligations, and finally, to upgrade the institutional environment in order to implement a transition from ex ante to ex post intervention (except in specific cases such as simple interconnection pricing rules, as mentioned above).

This paper discussed regulatory challenges for one particular country, the Netherlands, along broad lines. The conclusions may be different for other countries. In general, more detailed studies, taking into account country-specific characteristics as well as legal and institutional context, would be needed for concrete implementations. Nevertheless, it is hoped that the points in this paper contribute to current policy debates.

⁴⁰ As mentioned in section 3.2, while the update of the European regulatory framework (announced in November 2007) substantially reduces the number of predefined markets, it leaves the underlying philosophy unchanged.

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References

Analysis, 2007, The business case for sub-loop unbundling in the Netherlands. Final Report for OPTA (public version), ref. 264-483, 26 January, <http://opta.nl/download/Analysys+Final+Report%2Epdf>

Bergman, M.A., 2004, Competition in services or infrastructure-based competition? Report commissioned by the Swedish National Post and Telecom Agency, September 16.

Bijlsma, M.J. and M. van Dijk, 2007, Nieuwe generatie netwerken, nieuwe generatie regulering?, CPB Document 145, The Hague: CPB Netherlands Bureau for Economic Policy Analysis.

Booth, P., 2006, Processes and institutions: new perspectives on policymaking and regulatory authorities, in: *Communications: the next decade, a collection of essays prepared for the UK Office of Communications*, pp. 275-285, London: Ofcom.

Bourreau, M. and P. Dogan, 2005, Unbundling the local loop, *European Economic Review*, no. 49, pp. 173-199.

Cave, J., 2006a, Market-based alternatives or complements to regulation in: *Communications: the next decade, a collection of essays prepared for the UK Office of Communications*, pp. 176-194, London: Ofcom.

Cave, M., 2006b, Encouraging infrastructure competition via the ladder of investment, *Telecommunications Policy*, no. 30, pp. 223-237.

Cave, M. and I. Vogelsang, 2003, How access pricing and entry interact, *Telecommunications Policy*, no. 27, pp. 717-727.

Cave, M., L. Prosperetti and C. Doyle, 2006, Where are we going? Technologies, markets and long-range public policy issues in European communications, *Information Economics and Policy*, no. 18, pp. 242-255.

Crandall, R., 2006, "Stepping stones" or "Stumbling blocks"?, Mandatory network sharing in telecom, presentation given at GMU School of Law, September 28.

Crawford, S., 2007, The Internet and the Project of Communications Law, Mimeo, Cardozo School of Law.

- De Bijl, P.W.J., G. Brunekreeft, E.E.C. van Damme, P. Larouche, N. Shelkopyas and V. Sorana, 2005, Interconnected networks, TILEC Discussion Paper 2005-007, Tilburg University.
- De Bijl, P.W.J. and M. Peitz, 2002, *Regulation and entry into telecommunications markets*, Cambridge: Cambridge University Press.
- De Bijl, P.W.J. and M. Peitz, 2005, Local loop unbundling in Europe: Experience, prospects and policy challenges, *Communications and Strategies*, no. 57, pp. 33-57.
- De Streel, A., 2005, A Program for Reforms for the European Regulation of Electronic Communications, Paper presented at the 16th ITS-Europe Regional Conference, Porto, Portugal, September 4-6.
- Distaso, W., P. Lupi and F.M. Manenti, 2006, Platform competition and broadband uptake: Theory and empirical evidence from the European Union, *Information Economics and Policy*, no. 18, pp. 87-106.
- Farrell, J. and M.L. Katz, 2000, Innovation, rent extraction, and integration in systems markets, *Journal of Industrial Economics*, no. 48(4), pp. 413-432.
- Farrell, J. and P. Klemperer, 2007, Coordination and lock-in: Competition with switching costs and network effects, in: Armstrong, M. and R. Porter (eds.), *Handbook of Industrial Organization*, vol. 3, Amsterdam: Elsevier.
- Farrell, J., and P.J. Weiser, 2003, Modularity, vertical integration, and open access policies: Towards a convergence of antitrust and regulation in the internet age, *Harvard Journal of Law & Technology*, no. 17(1), pp. 85-134.
- Guthrie, G., 2006, Regulating infrastructure: The impact on risk and investment, *Journal of Economic Literature*, no. 44(4), pp. 925-972.
- Hausman, J.A. and G. Sidak, 2005, Did mandatory unbundling achieve its purpose? Empirical evidence from five countries, *Journal of Competition Law and Economics*, no. 1(1), pp. 173-245.
- Kocsis, V. and P.W.J. de Bijl, 2007, Network neutrality and the nature of competition between network operators, *Journal of International Economics and Economic Policy*, no. 4, special issue on the Digital Economy and Regulatory Issues, pp. 159-184.

- Loomis, D.G. and C.M. Swann, 2005, Intermodal competition in local telecommunications markets, *Information Economics and Policy*, no. 17, pp. 97–113.
- Noam, E.M., 2006, Why TV regulation will become telecom regulation, in: *Communications: the next decade, A collection of essays prepared for the UK Office of Communications*, pp. 67-72, London, Ofcom.
- Ofcom, 2006, *Communications: the next decade, A collection of essays prepared for the UK Office of Communications*, London.
- OPTA, 2006, Is two enough?, *Economic Policy Note*, no. 6, The Hague.
- Peitz, M., T. Valletti and J. Wright, 2004, Introduction: Special issue on competition in telecommunications, *Information Economics and Policy*, no. 16, pp. 315-321.
- Prieger, J., 2002, Regulation, Innovation, and the Introduction of New Telecommunications Services, *Review of Economics and Statistics*, no. 84, pp. 704-715.
- Reding, V., 2006, From Service Competition to Infrastructure Competition: the Policy Options Now on the Table, Speech delivered at ECTA Conference 2006, Brussels, 16 November, <http://europa.eu/rapid/pressReleasesAction.do?reference=SPEECH/06/697&format=PDF&aged=0&language=EN&guiLanguage=en>
- Richards, P., 2006, The limitations of market-based regulation of the electronic communications sector, *Telecommunications Policy*, no. 30, pp. 201-222.
- Schewick, B. van, 2007, Towards an economic framework for network neutrality regulation, forthcoming in: *Journal of Telecommunications and High Technology Law*.
- Stelzer, I., 2006, Creating an environment for rapid innovation, in: *Communications: the next decade, A collection of essays prepared for the UK Office of Communications*, pp. 143-157 London, Ofcom.
- Stennek, J. and T.P. Tangeras, 2007, Better regulation of mobile telecommunications, *European Policy Analysis*, no. 1, pp. 1-6.
- Stratix, 2007, The Netherlands: FTTH deployment overview Q42006, Report by Stratix Consulting, Hilversum, the Netherlands, January, http://www.stratix.nl/documents/FTTH-B-C_overview_final.pdf

Valletti, T., 2003a, Obligations that can be imposed on operators with significant market power under the new regulatory framework for electronic communications: Access services to public mobile networks, mimeo, Imperial College London.

Valletti, T., 2003b, The theory of access pricing and its linkage with investment incentives, *Telecommunications Policy*, no. 27, pp. 659-675.

Waverman, L., 2006, The challenges of a digital world and the need for a new regulatory paradigm, in: *Communications: the next decade, A collection of essays prepared for the UK Office of Communications*, pp. 158-175, London, Ofcom.