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Information and communication technologies in Germany : Is there a remaining role for sector-specific regulation?

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Information and communication technologies in Germany: Is there a remaining role for sector-specific regulation?

by Günter Knieps

**Discussion Paper
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Abstract:

In order to analyze the remaining role for sector-specific regulation the focus of this paper is on those elements of the Internet periphery and Internet service provision, which are strongly based on telecommunications, in particular Internet access and Internet backbone. Section 2 deals with the role of telecommunications for the Internet, differentiating between local network access and long distance network capacity. In section 3 the new regulatory arrangements for communications services within Europe, with particular emphasis on Germany, are explained. In order to analyze the future role of sector-specific regulation from a normative point of view, in section 4 the network economic concept of a disaggregated regulatory approach is provided. Section 5 deals with phasing-out potentials for sector-specific regulation due to increasing competition within the local loop. In section 6 the role of technology-neutral regulation is considered, which implies that in an environment of competing network infrastructures sector-specific regulation should not be extended, but removed. Finally, section 7 explains the role of competition in the markets for backbone interconnectivity.

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1. Introduction

The role of government interventions and regulations has strongly different traditions in the media, IT and telecommunication sectors. The media industry is traditionally attributed a function as the bearer of social, cultural and ethical values within our society. Whereas private communication has traditionally been unregulated, broadcast content has traditionally been regulated to some extent (public broadcast). The computer / IT industry developed in an unregulated manner, under the application of the general competition law. Although the telecommunications sector is fully liberalized in Germany – as well as in all other European countries – there still exist a complex set of sector-specific regulation.

These different approaches of government interventions may be challenged by the convergence of the telecommunications, media and IT sectors. On the one hand convergence may outpace existing sector-specific regimes. On the other hand sector-specific regulation may even be extended in the future to include markets at present not regulated, e.g. mobile telephony and new markets, e.g. Internet services. The question arises how to achieve the proper role of government intervention in a comprehensive institutional framework, leaving markets as much freedom as possible.

There are many highly relevant questions related to the Internet, which are not the subject of this paper; for example: will there still be a role for content regulation in the future, given the enormous scope of content production and distribution in the converging markets? (cf. Mestmäcker, 2001). Is there still a serious applications barrier to entry problem in the microprocessor market, given the enormous potential for middleware threats due to innovations on the browser market (cf. Economides, 2000; Fisher, 2000; Sidak, 2001)? What are the potentials and limits of self-regulation in the organisation of access to Internet Protocol (IP) number assignments and domain name systems? (cf. Kesan, Shah, 2001; Hillebrand, Büllingen, 2001). How is Internet safety (cf. Müller, Rannenberg, 1999) and the enforcement of property rights within the Internet to be guaranteed? (cf. Möschel, 1999; Engel, 1999).

In order to analyze the remaining role for sector-specific regulation the focus of this paper is on those elements of the Internet periphery and Internet service provision which are strongly based on telecommunications, in particular Internet access and Internet backbone. Access to the Internet requires a connection between the Internet user and the interface to the Internet service provider (ISP). Several access technologies exist: copper, fibre optics, two-way cable TV infrastructure (CATV network), power line communication and radio in the loop. One may differentiate between narrowband and broadband Internet access.

In the past the local loops of the established telecommunications carriers have been considered as areas with network-specific market power with a consequent need for sector-specific regulation. Gradual phasing out of this sector-specific regulation is under debate, due to increasing access alternatives.

Transit and peering arrangements among Internet backbone providers (IBPs) are not subject to sector-specific regulation. The agreements that cover interconnection between IBPs are characterized by private negotiations and are subject to non-disclosure rules. From the economic theory of regulation it follows that there is indeed no need for sector-specific regulation due to the absence of network-specific market power. The input market of communications bandwidth is competitive and each IBP can develop its own logistic concept to optimize its own backbone and set of transit and peering arrangements.

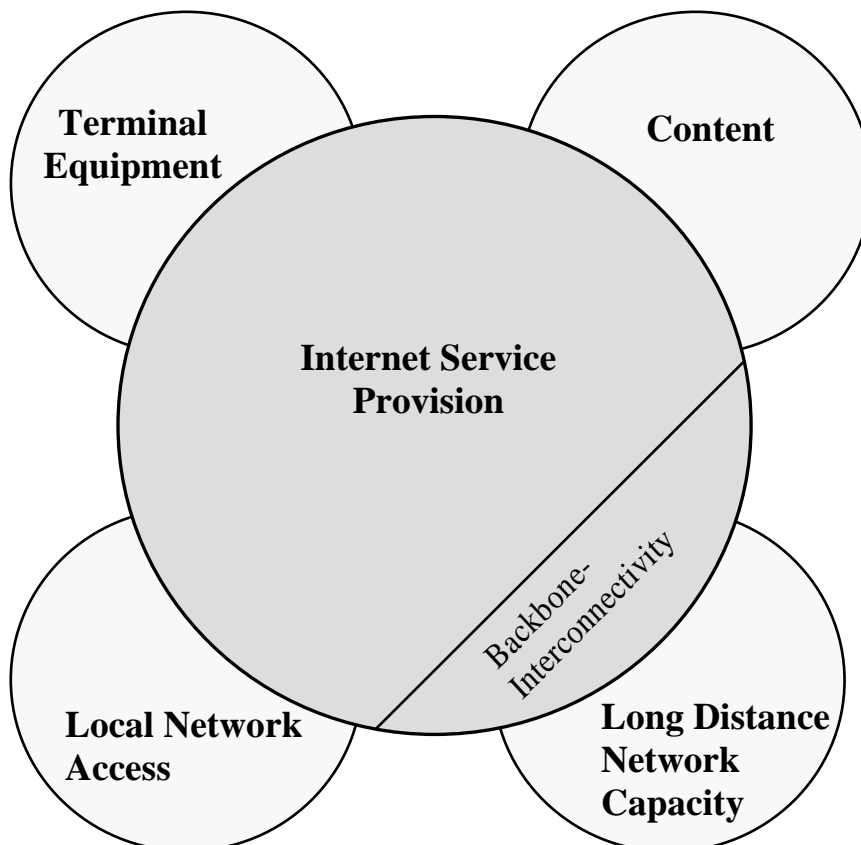
The paper is organized as follows: section 2 deals with the role of telecommunications for the Internet, differentiating between local network access and long distance network capacity. In section 3 the new regulatory arrangements for communications services within Europe, with particular emphasis on Germany, are explained. In order to analyze the future role of sector-specific regulation from a normative point of view, in section 4 the network economic concept of a disaggregated regulatory approach is provided. Section 5 deals with phasing-out potentials for sector-specific regulation due to increasing competition within the local loop. In section 6 the role of technology-neutral regulation is considered, which implies that in an environment of competing network infrastructures sec-

tor-specific regulation should not be extended, but removed. Finally, section 7 explains the role of competition in the markets for backbone interconnectivity.

2. The role of telecommunications for the Internet

Internet service provision requires several complementary elements belonging to the Internet periphery, which are viable on their own, even in the absence of the Internet. In contrast to the elements of the Internet periphery, the elements of Internet service provision are an inalienable part of the Internet and would not exist without the Internet (see Knieps, 2003, p. 219, fig. 1). Internet service providers (ISP) offer their customers a spectrum of different services (cf. Elixmann, Metzler, 2001, pp. 14 ff.), which are classified according to O'Donnell (O'Donnell, 2000, pp. 13 ff.) as fundamental networking and internetworking, application services and customer relations.

Fig. 1: Internet Periphery versus Internet Service Provision



Terminal equipment (PCs, cellular phones) can be used either without or with access to the Internet, although obviously the use of the Internet is not possible without any terminal equipment. *Content* (including broadband) may be provided via the Internet (e. g. video on demand, customized music and video libraries), but there are also other distribution channels available (e. g. cinemas, traditional video libraries, traditional broadcasting). Internet service provision would be possible even without any content provision, by specialising on interactive services (e. g. e-mail). Access to the Internet requires a connection between the Internet user and the interface to the Internet service provider (ISP). Several access technologies exist: copper, fibre optics, two-way cable TV infrastructure (CATV network), power line communication and radio in the loop. One may differentiate between narrowband and broadband Internet access. In order to provide Internet services, capacity of long distance telecommunications networks (bandwidth) is required. Although in the meantime investments in long distance telecommunications infrastructure are strongly motivated by Internet demand, telecommunication transmission capacity has many alternative purposes.

3. New regulatory arrangements for communication services

The basic goal of the 1999 Review of the European Commission (European Commission, 1998) was to consider to what extent phasing out of sector-specific market power regulation should take place. The key objectives stated at the beginning of the reviewing process were the maximization of the application of the general European competition law, the minimization of sector-specific regulation, a rigorous phasing-out of unnecessary regulation and the introduction of “sunset clauses” (European Commission, 1998, p. 3).

On 12 July 2000 the European Commission presented its “1999 Review Package”, with five proposals for Directives of the European Parliament and the Council and one proposal for a Regulation. In the meantime these proposals

have been enacted: an ONP Framework Directive,¹ an Access and Interconnection Directive,² a Licensing Directive,³ a Universal Service Directive,⁴ a Personal Data/Protection of Privacy Directive,⁵ which came into effect in July 2003. A Proposal for the regulation of unbundled access to the local loop has been passed by the European Parliament and the Council and was enacted in January 2001.⁶

The legal instrument of a regulation has not been used before in European telecommunications policy. In contrast to a directive (“Richtlinie”), a regulation (“Verordnung”) is the most powerful legislative tool made available by the EC Treaty. It shall be binding in its entirety and directly applicable in all Member States. This means that regulations automatically become part of each Member State’s legal system without the need for any intervention by national governments or national legislators. Unlike directives, which require national implementation measures,⁷ regulations become law in all Member States as soon as they are enacted.

¹ Directive 2002/21/EC of the European Parliament and of the Council of 7 March 2002 on a common regulatory framework for electronic communications networks and services (Framework Directive), OJ L108/33, 24. 4. 2002.

² Directive 2002/19/EC of the European Parliament and of the Council on access to, and interconnection of, electronic communications networks and associated facilities (Access Directive), OJ L108/7, 24.4. 2002.

³ Directive 2002/20/EC of the European Parliament and of the Council of 7 March 2002 on the authorisation of electronic communications networks and services (Authorisation Directive), OJ L108/21, 24.4.2002.

⁴ Directive 2002/22/EC of the European Parliament and of the Council of 7 March 2002 on universal service and users’ rights relating to electronic communications networks and services (Universal Service Directive), OJ L108/51, 24.4.2002.

⁵ Directive 2002/58/EC of the European Parliament and of the Council of 12 July 2002 concerning the processing of personal data and the protection of privacy in the electronic communications sector (Directive on privacy and electronic communications), OJ L 201/37, 31.7.2002.

⁶ Regulation (EC) No 2887/2000 of the European Parliament and of the Council of 18 December 2000 on unbundled access to the local loop, OJ L336/4, 30.12.2000.

⁷ This does not rule out the fact that directives may have direct effect in Member States, provided that the provisions of the directive are sufficiently precise and unconditional.

The incumbent operator with significant market power is obliged to provide full unbundled access, as well as shared access to the copper local loop under transparent, fair, and non-discriminatory conditions. The implementation of price regulation is left to the national regulatory authorities. As long as the level of competition for local access is insufficient to prevent excessive pricing, national regulatory authorities are required to ensure that the principle of cost orientation is applied.

Both the Framework Directive and the Access Directive provide no clear-cut definition of future sector-specific regulation. The Framework Directive provides a new interpretation of the criterion of “considerable market power”, moving in the direction of establishing the criterion of dominance on a given market as a prerequisite for sector-specific market power regulation. It gives the commission discretionary power to identify a variety of markets for which the introduction of sector-specific regulatory measures should at least be considered. The Access Directive already indicates that sector-specific regulation may be extended to competitive markets (e.g. mobile telephony) as well as newly developing innovative markets (e.g. the Internet). This would be a definite step backwards from the Access Notice of August 1998, which extended the role of competition policy, pointing out the importance of ensuring non-discriminatory access to essential facilities.

The question arises whether phasing-out of sector-specific regulation can be expected. The incumbent operator with significant market power is obliged to provide full unbundled access, as well as shared access to the copper local loop under transparent, fair, and non-discriminatory conditions (EU-regulation on unbundling). Both the Framework Directive and the Access Directive leave the planned extent of the future sector-specific market power regulation in long-distance networks in the dark. Sector-specific regulation of bit-stream access may be introduced by national regulatory commissions, based on the EU Framework Directive.

Since 1998 a new telecommunications law has allowed global market entry. Taking into consideration the EU review process, in Germany national communications law had been under revision and was enacted in June 2004.⁸

4. The disaggregated regulatory approach

Criteria like relative market share, financial strength, access to input and service markets etc. can only serve as a starting point for evaluating the existence of market power; but the development of an ex ante regulatory criterion creates a need for a more clear-cut definition of market power. This is even more important, because “criteria for conjecturing a dominant position” (“Vermutungskriterien”) on the basis of market shares can lead to economically unjustified criteria for government intervention in network industries. From a competition economics point of view, the use of ex ante sector-specific regulatory intervention constitutes massive interference with the market process and therefore always requires a particularly well-founded justification based on modern network economics.⁹

It is important to identify the regulatory basis by means of Stigler’s concept of entry barriers, focussing on the long-run cost-asymmetries between incumbent and potential entrants (Stigler, 1968, p. 67):

⁸ Telekommunikationsgesetz (TKG) vom 22. Juni 2004, Bundesgesetzblatt Jahrgang 2004, Teil I, Nr. 29, ausgegeben zu Bonn am 25. Juni 2004, pp. 1190-1243.

⁹ The traditional methods and approaches in general competition law, both with respect to merger control and the control of abusive practices, are fundamentally different from those of sector-specific regulatory economics. Any mingling of these two different approaches cannot but be misleading. The paper examines the question of a sector-specific need for regulation and therefore does not comment on merger cases. Market shares and turnover are easily measurable and are therefore usually taken up as criteria in competition law. However, they must not in any way be confused with a sound economic analysis of the effectiveness of active and potential competition. When examining a merger case, the competition authorities use a large number of criteria to which they attach, by their own discretion, a varying degree of significance on a case-by-case basis. For the general control of abusive practices, too, competition law envisages a correction of market processes on a case-by-case basis.

“A barrier to entry may be defined as a cost of producing (at some or every rate of output) which must be borne by a firm which seeks to enter an industry but is not borne by firms already in the industry”.

The sector-specific characteristics of network structures (economies of bundling) are not a sufficient reason to conclude that market power does exist. It is necessary to differentiate between those areas in which active and potential competition can work and other areas, so-called monopolistic bottleneck areas, where a natural monopoly situation (due to economies of bundling) in combination with irreversible costs exists. It can be demonstrated that the regulation of network-specific market power is only justified in monopolistic bottleneck areas. In all other cases, the existence of active and potential competition will lead to efficient market results as in the other sectors of an economy. The pressure of potential competition can be sufficient to discipline the behaviour of the active supplier, even if he is the owner of a natural monopoly. Such networks are called “contestable” (e.g. Baumol, Panzar, Willig, 1982).

An essential condition for the functioning of potential competition in order to discipline a firm (natural monopoly) already providing network services is that the incumbent firm does not have asymmetric cost advantages in comparison with potential entrants. In contrast, if sunk costs are relevant, consumers, who would intrinsically be willing to switch immediately to less costly firms, cannot do so. Sunk costs are no longer decision relevant for the incumbent monopoly, whereas the potential entrant is confronted with the decision whether or not to build network infrastructure and thus spend the irreversible costs. The incumbent firm therefore has lower decision relevant costs than potential entrants. This creates scope for strategic behaviour of the incumbent firm, so that monopoly profits (or inefficient production) will not necessarily result in market entry (e.g. Knieps, Vogelsang, 1982).

Therefore we can conclude that sector-specific ex ante regulatory intervention in order to discipline market power can only be justified in monopolistic bottleneck areas, i.e. where a natural monopoly in combination with irreversible costs is relevant (e.g. Knieps, 1997a, 1997b). The basic concept of the disaggregated

identification of network-specific market power can be illustrated by the following table:

Table 1: The localization of monopolistic bottleneck facilities

Network area	With sunk costs	Without sunk costs
Natural monopoly (bundling advantages)	(1) Monopolistic bottlenecks	(2) Potential competition (contestable networks)
No natural monopoly (bundling advantages exhausted)	(3) Competition among active providers	(4) Competition among active providers

The network economic concept of monopolistic bottlenecks suggests a connection with the essential facilities doctrine resulting from US antitrust law, which is now also being used increasingly in European competition law (e.g. Knieps, 2000, p. 104).¹⁰ In accordance with this doctrine, a facility can only be regarded as essential if the following two conditions are fulfilled: (1) market entry to the complementary market is not actually possible without access to this facility, and (2) providers on the complementary market cannot, using reasonable effort, duplicate the facility; substitutes do not exist either (e.g. Areeda, Hoverkamp).¹¹

The application of the essential facilities doctrine means that a traditional instrument of competition law can be used as a regulatory instrument. A facility is regarded as essential when it fulfils the criteria for classification as a monopolis-

¹⁰ This means that access to ports, airports or railway networks can neither be refused, nor granted under conditions that penalize competitors, without factual justification.

¹¹ The fact that use of this facility is essential for competition on the complementary market is also occasionally expressed as a third criterion, as it reduces prices or increases the volumes offered. This third criterion, however, only describes the effects of access.

tic bottleneck facility in the context of the disaggregated regulatory approach. The starting point for this approach is to differentiate between those network areas in which functional (active and potential) competition is possible, and those network areas in which stable network-specific market power can be localized.

The disaggregated regulatory approach involves applying the essential facilities doctrine not only on a case-by-case basis, but to a category of cases, namely to monopolistic bottleneck facilities. The non-discriminatory conditions of access to the essential facilities must be set out in more detail as part of the disaggregated regulatory approach. In doing so, the application of the essential facilities doctrine must be seen in a dynamic context. The aim must therefore also be to design the conditions of access so as not to hinder infrastructure competition, but instead create an incentive for research and development, innovations and investments at facility level. This is the only way to establish a balanced relationship between services and infrastructure competition.

5. Localization of monopolistic bottlenecks within telecommunications networks

5.1 Competitive long distance networks

Although the markets for long distance telecommunications services are still frequently characterized by economies of scale as well as bundling advantages, there is nevertheless competition. Inefficient suppliers are replaced by less expensive ones because there is free market entry. Even when the incumbent's market share is high, inefficient production or services not geared to market requirements will soon lead to a considerable loss in market shares, because customers are not tied to a specific supplier and can react without delay to price cuts on the market. Excessive prices and inadequate network quality would result in switching to alternative suppliers, which would appear on the market immediately, due to the possibility of free market entry. Thus there remains no

regulatory need for disciplining the market power of alternative network providers.

Since overall free entry became possible, the performance of the German long distance telecommunications market has improved strongly: this includes a large number of service providers, providing an increasing scope of services, entry of several network carriers, strongly decreasing prices for long distance calls etc. (cf. Gabelmann, Gross, 2003, p. 113; Stumpf, Schwarz-Schilling, 1999; Knieps, 2004, p. 10).

The market for long distance transmission capacity is competitive (cf. Laffont, Tirole, 2000, p. 98). There have been a large number of newcomers building transnational network infrastructure as input for Internet backbone capacity (cf. Elixmann, 2000, p. 7). Another possibility is to lease transmission capacity from several alternative providers of network infrastructure. In Germany a larger number of carriers possess their own fibre-optic networks (Immenga, Kirchner, Knieps, Kruse, 2001, table 1, p. 14). The telecommunications transport capacity is readily available today from a variety of providers (Kende, 2000, p. 25).

5.2 The remaining regulatory problem in the local loop

It is traditionally assumed that local networks constitute monopolistic bottlenecks, for which neither active nor potential substitutes are available. The EU-regulation on unbundled access to the local loop proceeded from this assumption and concludes that there is a remaining need for regulation of the incumbent operator's local access network

Table 2:**Local telecommunications networks as monopolistic bottleneck facilities**

	Natural monopoly (Economies of bundling)	Irreversible costs
Terminal equipment	–	–
Telecommunications services (including voice telephone services)	X	–
Satellite/mobile networks	X	–
Long-distance cable-based networks	–	X
Local cable-based networks	X	X

To the extent and as long as local networks constitute monopolistic bottlenecks, ex ante regulation seems justified. Non-discriminatory access to essential facilities has to be guaranteed (e.g. Knieps, 1997a, p. 328). Since unregulated tariffs would allow excessive profits to the owners of monopolistic bottlenecks, the instrument of price-cap regulation should be introduced (e.g. Beesley, Littlechild, 1989). Its major purpose is to regulate the level of prices, taking into account the inflation rate (consumer price index) minus a percentage for expected productivity increase. It seems important to restrict such price-cap regulation to those areas of telecommunications networks where market power due to monopolistic bottlenecks is a regulatory problem. In all other subparts of telecommunications networks price-setting should be left to the competitive market forces.

Concentrating on the regulation of the “last mile” does indeed constitute the one remaining task of a tailored sector-specific market power regulation. Non-discriminatory access to this bottleneck facility must be guaranteed for all competitors. The EU Regulation on unbundled access to the local loop contains an

obligation for full unbundling as well as line-sharing. In order to guarantee competition on long distance telecommunications markets global access to local networks seems already sufficient (Engel, Knieps, 1998). In any case, one variant of non-discriminatory access to the local loop should be considered sufficient to overcome the monopolistic bottleneck problem.

5.3 Increasing competition within the local loop

However, it is important to view the application of the essential facilities doctrine in a dynamic context. Therefore, one objective in the formulation of access conditions must be not to impede infrastructure competition, i.e. not to destroy incentives for either research and development activities or innovations and investments on the facilities level. This is the only way to reach a balance between service and infrastructure competition. Local network competition started with business customers in urban centres. There the preferred access technology is optical fibre (cf. Diestelkamp, 1999, p. 94). However, after the granting of licences for point-to-multipoint microwave systems, the wireless local loop has also gained increasing importance (Regulierungsbehörde für Post und Telekommunikation, 1999, p. 24). Consequently, ever since the comprehensive opening of the telecommunications market, the pressure of innovation has increased in local networks, too. This has lead to considerable technological variety (e.g. optical fibre, wireless networks, CATV networks, satellite technology) and a consequent increase in varieties of network access. As a consequence, broadband technologies no longer have the characteristics of a national monopoly. In addition, effective platform competition becomes relevant, where alternative providers have complete control of all aspects of their networks and the subsequent services. Because of these rapid developments the local loop facilities in bigger cities and agglomerations in Germany are increasingly loosing their character of monopolistic bottlenecks.

Only recently the gradual phasing out of access networks as monopolistic bottlenecks was considered a futuristic dream, however, the building of parallel networks in Germany is now in full swing. Local network competition started

with business customers in urban centres. There the preferred access technology is optical fibre. After the auctioning of licences for point-to-multipoint microwave systems, the wireless local loop has also gained increased importance (Regulierungsbehörde für Post und Telekommunikation, 1999, p. 24). Consequently, ever since the comprehensive opening of the telecommunications market, the pressure of innovation has increased in local networks too. This has led to considerable variety in technological platforms, e.g., optical fibre, wireless networks, CATV networks, satellite technology, and an increase in product variety. Because of these rapid developments the local loop facilities in bigger cities and agglomerations in Germany are increasingly losing their character of monopolistic bottlenecks. Although it is not possible at this point to predict exactly how long it will take for the monopolistic bottlenecks in the local loop to disappear completely, there cannot be any doubt that the regulation of monopolistic bottlenecks has to be viewed in a dynamic context, so that the potential for phasing out sector-specific regulation in telecommunications can be fully exhausted. This means especially that the essential facilities doctrine should not be extended to facilities that have yet to be built, as this would lead to a distortion of incentives preventing the necessary investments in the first place.

6. Broadband versus narrowband access to the Internet:

Is there a remaining role for sector-specific regulation?

Access to the Internet requires a connection between the Internet user and the interface to the Internet. Public switched access to the Internet primarily requires access to a local telecommunications network. In addition, a (long-distance) link between the originating (local) network and the Internet service provision is required.¹²

Several access technologies exist: copper, fibre optics, two-way cable TV infrastructure (CATV network), power line communication and radio in the loop.

¹² Oftel (2001), p. 41 differentiates between “wholesale call origination” and “wholesale Internet call termination market”.

One may differentiate between narrowband and broadband Internet access. Narrowband Internet access takes place on two-pairs copper cables via analogue modem and ISDN (integrated services digital network). Broadband Internet access can be provided either by upgrading two-pair copper cables by means of xDSL (digital subscriber line) technologies – the most popular one being ADSL (asymmetric DSL) technology –, CATV based broadband Internet access, as well as broadband wireless technology (e. g. UMTS). Convergence and platform independence, however, does not mean that these broadband access technologies have the same cost-characteristics, and they also have different access quality attributes (e. g. mobility, reliability, start-up speed etc.).

There are particularly strong quality differences between low-speed access (narrowband) and high-speed access (broadband). For example, transmission of 100 text pages takes 120 sec. via modem, 25 sec. via ISDN and 0,4 sec. via ADSL; 5 colour photos take 22 min. via modem, 5 min. via ISDN and 4-5 sec. via ADSL; a 30 minute video takes 38,8 hours via modem, 8,7 hours via ISDN and 8 min. via ADSL (cf. Fesenmeier, 2001, p. 17). This already indicates that narrowband Internet access does not provide an economically sensible way to consume data-intensive Internet services like streaming video and interactive entertainment. On the other hand, dial-up (analogue modem) access is sufficient for managing an e-mail account and surfing the Internet for a few hours a week.

To the extent that the local loops of the established carriers are still monopolistic bottlenecks, there is a consequent need for sector-specific regulation (price cap, accounting separation, discriminatory free entry). Alternative providers of broadband access (e. g. CATV networks) are not yet able to discipline the market power of the established provider of the local loop. Line sharing obligations, focussing on the stimulation of broadband access are, however, superfluous from the perspective of this low-speed access market.

But line sharing regulation seems also not justified from the perspective of broadband Internet access. From the dynamic perspective of convergence, the separation of the Internet into a large narrowband part on one hand, and a rather marginal broadband part on the other seems artificial. For the development of

the innovation potential for data intensive Internet services broadband access is indispensable. Whereas the local loop of copper pairs can provide, via xDSL, one broadband access possibility, there also exist economically feasible access alternatives. In particular, mobile Internet access based on GPRS (General Packet Radio System Standard) as well as UMTS demonstrates the large innovation potential and evolution of mobile technologies for the Internet (e. g. Büllingen, Stamm, 2001; Büllingen, Wörter, 2000).

Looking ahead the Europe 2005 Action Plan promotes a multi-platform approach to broadband development, driven by strong competition between networks and services. In the meantime, the focus of the EU commission shifts to considering the importance of technology-neutral regulation avoiding favouring one technology over another. Technology-neutral regulation is considered to allow provision of new services to lead to competition between different network-access methods (facility based competition). As an important conclusion, the Commission states “When there is effective facilities-based competition, the new framework will require ex-ante regulatory obligations to be lifted” (Commission of the European Communities, 2003, p. 6).

Effective facilities-based competition shall include high-speed access. From the perspective of high-speed broadband access, the local loops of the established telecommunication carriers therefore lose the characteristics of a monopolistic bottleneck. Alternative broadband access technologies (cable modem, UMTS, mobile access etc.) create economically sensible alternatives to xDSL. Due to the increasing role of product differentiation, based on the different network characteristics of these access technologies, the long run convergence towards a single globally dominating access technology seems unrealistic. As a consequence, sector-specific regulation of broadband access – in particular line sharing obligations – seems superfluous.

The aim of technology-neutral regulation is also stated in the new telecommunications law of Germany (§ 1 TKG). This implies that in an environment of competing network infrastructures ex-ante regulation should not be extended but removed. Alternative competing broad-band access technologies should not be

regulated. Moreover, the traditional regulation of narrow-band access should not be continued for historical reasons, but abolished as soon as narrow-band access loses its bottleneck characteristics. Only then will the adequate incentives for investments in new network infrastructures be provided and an unbiased infrastructure and service competition be guaranteed.

7. Backbone interconnectivity: is there a remaining role for sector-specific regulation?

7.1 Competitive markets for communications bandwidth

Access to the IP-based backbone network is impossible without access to telecommunications transport capacity, delivered e. g. by high-speed fibre optic networks, coaxial cables and satellite. The performance-price ratio for leading-edge optical communications technology has been improving rapidly. Developments in optical technology unquestionably have made massive increases in bandwidth possible. New transmission technologies work most effectively over new fibre strands that have enhanced optical properties. Growth of bandwidth in use for Internet traffic has been dramatic since 1995. However, expectations of a bandwidth revolution similar to Moore's Law on the performance-price ratio for computers have not yet been fulfilled. Cost and benefits of additional investment into bandwidth have to be counterbalanced. This also includes exploiting the benefits of substitution among bandwidth, storage and CPU cycles (cf. Galbi, 2000).

Communications bandwidth is readily available today from a variety of providers. IBPs own or lease communications bandwidth that is connected by routers which the backbones use to deliver traffic to and from their customers. The underlying network logistics is the TCP/IP protocol. Whereas the IP (Internet protocol) is responsible for shifting the data packets from router to router, the TCP (transfer control protocol) is responsible for the reliability of transmission, including error correction. IBPs are also responsible for quality of service and network management, including the capacity control of the backbone network. An

additional dimension of Internet backbone services is the organization of interconnectivity with other IBPs by means of peering and transit arrangements.

7.2 Unregulated interconnectivity: transit and peering

Each IBP forms its own network that enables all end users and content providers connected to it to communicate with each other. End users, however, often want to be able to communicate with a wide variety of end users and content providers, regardless of the IBPs involved. In order to provide end users with such universal connectivity, IBPs must interconnect with one another to exchange traffic destined for each other's end users. It is this interconnection that makes the Internet the "network of networks".

One may differentiate between peering and transit arrangements. Peering partners exchange traffic on a settlement-free basis (bill and keep type), that is, each peer terminates without charge the traffic originating with other peers. In contrast, with transit arrangements one IBP pays another IBP to deliver traffic between its customers and the customers of other IBPs (e. g. KENDE, 2000, p. 5). Peering used to occur in the U.S. at public peering points, NAPs (network access points)¹³, where different backbones could exchange traffic. As the result of the increased congestion at the NAPs, IBPs turned to bilateral peering arrangements (private peering). Because each bilateral peering arrangement only allows backbones to exchange traffic destined for each other's customers, backbones need a significant number of peering arrangements in order to gain access to the full Internet. The alternative to peering is a transit arrangement between IBPs in which one IBP pays another IBP to deliver traffic between its customers and the customers of other backbones. Many IBPs have adopted a hybrid approach to interconnection, peering with a number of backbones and paying for transit from one or more IBPs in order to have access to the backbone of the transit supplier as well as the peering partners of the transit supplier.

¹³ In 1993, the U.S. National Science Foundation, NSF, designed a system of geographically dispersed NAPs (Kende, 2000, p. 5).

Transit and peering arrangements among IBPs are not subject to sector-specific regulation, neither by the Federal Communications Commission, nor by the regulatory agencies in Europe. The agreements that cover interconnection between IBPs are characterized by private negotiations and are subject to non-disclosure rules. From the economic theory of regulation it follows that there is indeed no need for ex ante regulation due to the absence of network-specific market power. The input market of communications bandwidth is competitive and each IBP can develop its own logistic concept to optimize its own backbone and set of transit and peering arrangements.¹⁴

¹⁴ Of course, general competition law also applies to transit and peering arrangements. However, antitrust proceedings are geared towards dealing with concrete conflicts case by case and not towards designing a new ex ante regulatory policy.

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