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Competition in Telecommunications and the Internet Services: A Dynamic Perspective*

by

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Critical comments to the author are welcome!

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Competition in Telecommunications and the Internet Services: A Dynamic Perspective

***Abstract:** 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, fiber optics, two-way cable TV infrastructure (CATV network), powerline communication and radio in the loop. One may differentiate between narrowband and broadband Internet access.*

From a rather short run perspective the local loops of the established carriers are still – at least to some extent – monopolistic bottlenecks, with a consequent need for sector specific regulations (price cap, accounting separation, discriminatory free entry). However, neither from the (short run) perspective of narrowband Internet access nor from the (longer run) perspective of broadband Internet access does the recent introduction of line sharing regulation by the FCC as well as the European Parliament seem to be justified.

Transit and peering arrangements among Internet backbone providers (IBPs) are not subject to sector-specific regulations. 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.

1. The Internet as prime driver of convergence of the telecommunications, media and information technology (IT) sectors

Convergence of the telecommunications, media and information technology sectors has been increasing in recent years with the emergence of the Internet and with the increasing capability of existing networks to carry both telecommunications and broadcasting services. Developments in digital technologies and software are creating large innovative technological potential for the production, distribution and consumption of information services. Convergence, characterised as the ability of different network platforms to carry essentially

similar kinds of services, may have different faces: telecommunications operators may offer audio-visual programming over their network, broadcasters may provide data services over their networks, cable operators may provide a range of telecommunication services (cf. EUROPEAN COMMISSION, 1997, p. 1). Up to the present time the most relevant evolution and adaptation of such platform independence is that of the transmission control protocol / Internet protocol (TCP / IP). TCP / IP allows information packets to be transported across different networks, despite differences in bandwidth, delay, and error properties associated with different transport media (e.g. fiber, radio, satellite) (cf. FRISHMANN, 2001, p. 4).

The Internet as the prime driver of convergence is displacing traditional isolated computer networks, it is providing an alternative means of offering telecommunication services (e. g. Internet telephony), and, moreover, the Internet is also becoming a significant platform for broadcasting services. In addition, technological convergence makes possible innovative services which combine product characteristics from the traditionally distinct branches of telecommunications, IT and the media, thereby enlarging the scope of voice, data, multimedia and audio-visual services.

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. In contrast, the telecommunications sector had for many years been organised as a legal monopoly.

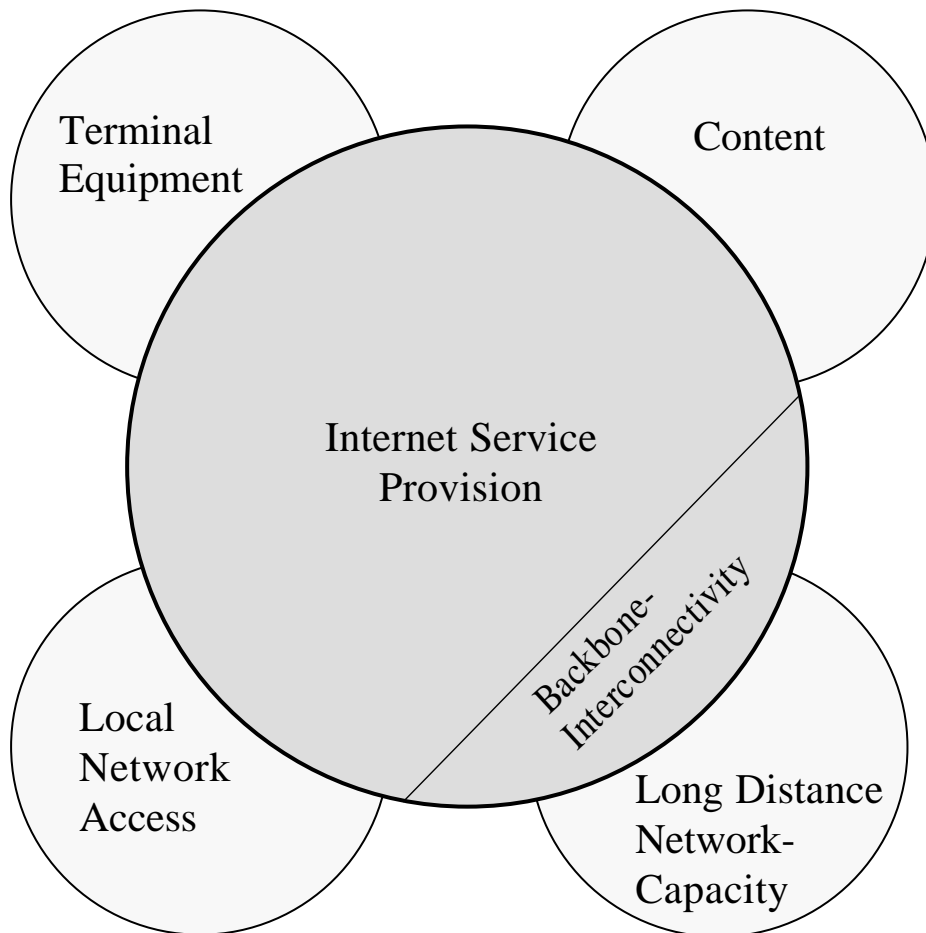
In the meantime the recent process of gradually opening the telecommunications markets to competition has been coming to an end. Since 1998 in most countries of the world market entry has been allowed to all parts of the telecommunication networks, including both cable-based infrastructure and telephone services. Nevertheless, sector specific regulations still play an important role. In many

countries the telecommunications sector is still a heavy-handedly regulated sector. Remaining sector specific regulations concern not only technical regulations (e.g. allocation of radio frequencies) or politically desired universal services objectives, but there also exists a complex set of ex ante regulations of end user tariffs, interconnection and access charges in long distance as well as local networks (cf. KNEIPS, 1999, 2001). 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 not yet regulated, e.g. mobile telephony and new markets, e.g. Internet services (cf. UNGERER, 2000, pp. 227). The question arises how to achieve the proper role of government intervention in a comprehensive institutional framework, leaving markets as much freedom as possible.

2. Internet periphery versus Internet service provision

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 fig. 1).

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 may take place via local telecommunications networks, cable networks or wireless local loop. 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.

Internet service providers (ISP) offer their customers a spectrum of different services (cf. ELIXMANN, METZLER, 2001, p. 14 ff.), which are classified according to O'Donnell (O'DONNELL, 2000, p. 13 ff.) as fundamental networking and internetworking, application services and customer relations. Examples of fundamental networking and internetworking are IP number assignments, directory services, in particular domain name service (DNS), outgoing/incoming packet routing and connectivity (among different ISP), quality of service and network management. Via their servers ISP offer different kinds of application services to their customers. Examples for application services are file transfer (FTP), e-mail, web-browsing, newsgroups and chat-rooms, IP-telephony, IP-fax and video on demand. By means of client-server architecture and different client-programs, a large number of value added services such as incoming and outgoing mail services, mail list services, online banking, portals and web hosting are realised. The borderlines between content provision and service provision are obviously blurring. Customers relations may be divided into technical support, billing and accounting, and security and confidentiality.

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 (section 3) and Internet backbone (section 4). Fundamental networking and internetworking may be divided into Internet-governance (IP number assignments and domain name service), and Internet backbone services; the latter is considered in section 4.2. There are many other highly relevant questions related to the Internet, which are not the subject of this paper; for example: is there still a future role for content regulation, 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 for self-regulation in the organisation of access to 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).

3. Access to the Internet

Access to the Internet requires a connection between the Internet user and the interface to the Internet (ISP point of presence/POP). 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 ISP is required.¹

Several access technologies exist: copper, fiber optics, two-way cable TV infrastructure (CATV network), powerline communication and radio in the loop. One may differentiate between narrowband and broadband Internet access. Narrowband Internet access takes place on two-pairs copper cables via analog 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 entertain-

¹ OFTEL (2001), p. 41 differentiates between “wholesale call origination” and “wholesale Internet call termination market”.

ment. On the other hand, dial-up (analog modem) access is sufficient for managing an e-mail account and surfing the Internet for a few hours a week. At the moment narrowband internet access still plays the dominant role. According to Oftel:

„The importance of dial-up Internet is crucial. Analysts and market research widely predict that dial-up access will remain the dominant method of connecting to the Internet among residential consumers and small businesses for the foreseeable future. Broadband access will be attractive for some users and some applications.“ (OFTEL, 2001, p.11)

From this rather short run perspective the local loops of the established carriers are still – at least to some extent – monopolistic bottlenecks, with a consequent need for sector specific regulations (price cap, accounting separation, discriminatory free entry).² 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 regulations seem also not justified from the perspective of broadband Internet access. From the longer run dynamic perspective of convergence, the separation of the Internet into a large narrowband part on one hand,

² Even from the traditional perspective of narrowband access there does exist a potential for phasing out sector-specific regulation in local telecommunications networks due to the gradual disappearance of monopolistic bottlenecks (cf. KNIIEPS, 1997, pp. 331). It is traditionally assumed that local networks, in contrast to long-distance networks, constitute monopolistic bottlenecks, for which neither active nor potential substitutes are available. 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. However, it is important to view the application of the essential facilities doctrine in a dynamic context. Therefore, an objective in the formulation of access conditions must be to not impede infrastructure competition, i. e., to not destroy incentives for either research and development activities, or innovation and investment. In this way a balance between service and infrastructure competition is reached. Competitive conditions cannot be expected to change simultaneously in all local loops. Therefore it is necessary to examine at regular intervals which subclasses of local loops still constitute monopolistic bottlenecks and in which subclasses of local loops there is already workable active and/or potential competition, e. g., because of wireless local loop facilities.

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 (see fig. 2). In particular, mobile Internet access based on GPRS (General Packet Radio System Standard) as well as UMTS demonstrate the large innovation potential and evolution of mobile technologies for the Internet (e. g. BÜLLINGEN, STAMM, 2001, BÜLLINGEN, WÖRTER, 2000).

Figure 2: Narrowband and broadband Access

<p>Low-speed Access or narrowband:</p>	<ul style="list-style-type: none"> • Dial-up modem (up to 56 Kbit/s over analogue connection) • ISDN • Internet on the TV • GSM dial-up (e. g. using WAP) and GPRS mobile access (the latter not available yet) • Leased lines (up to 128 Kbit/s)
<p>High-speed Access or higher bandwidth: (“broadband” by some definitions)</p>	<ul style="list-style-type: none"> • Leased lines (over 128 Kbit/s) • Satellite (upstream usually on lower-speed dial-up) • xDSL • Cable modem • Broadband fixed wireless access • UMTS mobile access (not available yet)

Source: OFTEL, 2001, p. 56

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 importance 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.

Neither from the (short run) perspective of narrowband Internet access nor from the (longer run) perspective of broadband Internet access does the recent introduction of line sharing regulation by the FCC as well as the European Parliament therefore seem justified. The provision of xDSL-based service by a competitive local exchange carrier (LEC) and voiceband service by an incumbent LEC on the same loop is called “line sharing” by the FCC. The FCC decision to unbundle the high frequency portion of the loop was issued in December 1999.³ The regulation of the European Parliament and the Council of December 5, 2000 on unbundled access to the local loop⁴ also entails line sharing:

“‘shared access to the local loop’ means the provision of access to the non-voice frequency spectrum of a copper line over which the basic telephone service is being provided to the end-user by the incumbent operator allowing a new entrant to deploy technologies – such as asymmetrical digital subscriber line (ADSL) systems – to provide the end-user with additional services such as high-speed internet access”.

The question whether broadband Internet access and narrowband Internet access belong into one large Internet access market was controversial in recent antitrust cases dealing with AT&T-Media One and AOL-Time Warner mergers. Here the controversy was not whether the traditional local loop of telecommunications carriers would constitute a monopolistic bottleneck, but whether DSL or satellite-based Internet service will be able to offer close substitutes for cable-based Internet services in the short run (within a two years time horizon). The propo-

³ FEDERAL COMMUNICATIONS COMMISSION, In the Matters of Deployment of Wireline Services Offering Advanced Telecommunications Capability (CC Docket No. 98-147) and Implementation of the Local Competition Provisions of the Telecommunications Act of 1996 (CC Docket No. 96-98); Third Report and Order in CC Docket No. 98-147; Fourth Report and Order in CC Docket No. 96-98, Washington D.C. December 9, 1999.

⁴ Regulation on unbundled access to the local loop (EUROPEAN PARLIAMENT AND COUNCIL 2000/0185 (COD), 5. Dec. 2000).

nents of the one large Internet access market approach argued that “residential broadband cable modem internet access” is not a relevant market because of the intense deployment of DSL by both incumbent and competitive local exchange carriers (LEC’s), and additional competition from providers employing other technologies and networks (such as satellite and fixed wireless) (ORDOVER, WILLIG, 1999, pp.7). Since the existing digital loop carrier (DLC)⁵ cannot support DSL service without additional investment – the carrier must install digital subscriber line access multiplier (DSLAM) termination at the DLC – it has been argued by the opponents of the one large Internet access market approach that this additional investment may impede DSL’s ability to compete with cable-based broadband Internet access within a two years time horizon (HAUSMAN, SIDAK, SINGER, 2001, p. 150). Due to the economically feasible alternatives of access to the Internet this controversy did, however, not come to the conclusion that residential broadband cable modem Internet access creates a bottleneck monopoly that is an essential facility in the relevant market of Internet access.

4. Internet backbones

In the following we shall differentiate between Internet service providers (ISPs), Internet backbone providers (IBPs) and suppliers of long distance network-capacity (communications bandwidth). IBPs may be vertically integrated into the market for telecommunications inputs that underlie the services that backbones provide on one hand and with ISPs on the other hand. IBPs may be differentiated by the reach of their networks. There are regional and national backbones which may number from one to many in any given country. At the top level or tier 1 level of IP-connectivity only a limited number of companies (such as MCI/WorldCom, Sprint, AT&T and GTE) are operating (cf. EUROPEAN COMMISSION, 2000, p. 5).

⁵ As early as the 1970s, local exchange carriers in US began using a new type of loop, a digital loop carrier (DLC).

4.1 Long distance network-capacity (communications bandwidth)

Access to the IP-based backbone network is impossible without access to telecommunications transport capacity, delivered e. g. by high-speed fiber 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 fiber 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).

The market for long distance transmission capacity is competitive (cf. LAF-FONT, 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 fiber-optic networks (IM-MENGA, 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).

4.2 Internet backbone services

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.

4.3 Organization of 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 which IBPs are 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 rule), that is, each peer terminates without charge the traffic originating with other peers. In contrast, with transit arrangements one IBP pays another IBP to transmit 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)⁶, 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.

⁶ In 1993, the U.S. National Science Foundation, NSF, designed a system of geographically dispersed NAPs (see KENDE, 2000, p.5).

Transit and peering arrangements among IBPs are not subject to sector-specific regulations, 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.⁷

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⁷ Of course, the 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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