

van Winden, Willem; Woets, Paulus

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Urban Broadband Internet Policies in Europe: A Critical Review

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**URBAN BROADBAND INTERNET POLICIES IN EUROPE:
A CRITICAL REVIEW**

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Authors:

Willem van Winden

Paulus Woets

European Institute for Comparative Urban Research (Euricur)

Erasmus University Rotterdam

P.O. Box 1738 (room H12-33)

3000 DR Rotterdam

The Netherlands

Telephone: +31 10 408 2740

Fax: +31 10 408 9153

Internet: www.euricur.nl

E-mail: vwinden@few.eur.nl / woets@few.eur.nl

Abstract

Cities and regions in Europe play an increasingly active role in providing and/or promoting broadband access to the Internet. Reasons for such policies can be spurring economic development and strengthening social inclusion. In this article, we describe and analyse local policy interventions in the broadband infrastructure market and present a typology of five different kinds of policy: community networks, supply policies in newly built / redevelopment areas, demand policies, generic supply policies and group-oriented supply policies. Subsequently, we confront the various benefits of the local policies with their associated risks and costs. The theoretical arguments and explanations are backed up by several empirical case studies: Chicago, Eindhoven, Groningen, Manchester, Rotterdam and Stockholm.

1. Introduction

Cities and regions in Europe play an increasingly active role in providing and/or promoting broadband access to the Internet. Some cities are concerned that weaker groups will have little chances to get broadband access, and should be helped (i.e. SQW Ltd, 2002). Others take a more offensive stance, and promote broadband access to strengthen the local image, attract innovative companies and/or highly-skilled people. Peripheral cities take action to tackle spatial discrimination by telecom companies.

Some researchers (Leighton, 2001 is the most outspoken) warn for the many pitfalls and negative side effects of broadband policies; others are more moderate, or even argue that governments should intervene to prevent a broadband divide (Graham, 2002). Much of this literature addresses national policies. However, there are strong indications that policies on the local level are gaining in importance (Umino, 2002).

In this article, we will describe and analyse local policy interventions in the broadband infrastructure market. We will confront the various (alleged) benefits of the local policies with their associated risks and costs.

Section 2 defines what broadband is, and mentions a number of technologies that convey it. In section 3, as a context, we describe some recent developments in Europe's broadband market. In section 4, we present a typology of local/regional broadband policies, based on a number of examples from mostly European cities. In section 5 we discuss and analyse the potential benefits that local broadband policies can bring, and compare the policy types along this line. In section 6, we discuss the costs and risks of the various types of intervention and confront the case studies with the arguments listed in the literature. Section 7 concludes.

This paper is based on an in-depth study of e-strategies of a number of European cities. Besides a thorough literature study, we obtained information by analysing policy documents and web resources and interviewing key persons in a number of cities, which have an active broadband promotion strategy. We have studied the cases of Groningen, Eindhoven, Manchester, Rotterdam and Stockholm in depth, but use other examples as well.

2. What is broadband?

A broadband connection delivers high-speed access to the Internet or other networks. The term broadband is not unambiguously defined. Some (the Dutch Independent Postal and Telecommunication Agency OPTA, the American Federal Communications Commission FCC) place the boundary between narrowband and broadband networks at a speed of 128 Kbps (kilobits per second). Others use the term broadband to refer to communication lines or services of 1.5 Mbps (megabits per second) or above (BDRC, 2001). Others (Andriessen, 2001) define its minimum capacity at 10 Mbps, and argue that this capacity should be sustained rate and symmetrical per connection, as well as future-proof in a way that higher capacities can be realised later at relatively low costs. Woets (2002) defines broadband connections as 10 Mbps or more, arguing that this is the capacity needed to make the exchange of high-quality movies, images and sound possible. In this article, we use the FCC's definition, defining broadband as always-on connections with data speeds exceeding 128 Kbps. This definition is mostly used by policymakers, and also marks the difference with dial-up Internet connections (normal telephone connection and ISDN).

Broadband is different from "narrowband" in two important respects: first, it offers much more capacity, and second, broadband technologies entail an "always on" connection: the user does not need to dial into a network, but is always online. This constant connection greatly facilitates the use of a network, and leads to more intensive use.

Broadband enables to use the Internet for new purposes. It greatly facilitates the exchange of large files like movies, images and sound. This creates opportunities for business and leisure applications. For workers, broadband makes it easier to "telework" as connecting to the company network and swapping large files is much more easy. Other applications are video-on demand, online gaming, videoconferencing, and many other interactive features.

Broadband can be delivered by several technologies. The most commonly used technologies include: DSL, coaxial cable, powerline, optic fibre, satellite, UMTS and WLAN. Table 1 gives an overview of the different technologies discussed below.

Table 1. Overview of broadband technologies

Technology	Bandwidth downstream	Bandwidth upstream	Interactivity
DSL	512 Kbps – 8 Mbps (ADSL)	128 Kbps – 640 Kbps (ADSL)	Asymmetrical / symmetrical
Coaxial cable	Up to 27 Mbps	Up to 2.5 Mbps	Asymmetrical
Optic fibre	50 Mbps – 20 Gbps	50 Mbps – 20 Gbps	Symmetrical
Powerline	1–2 Mbps	1–2 Mbps	Symmetrical
Satellite	2 Mbps	56 Kbps	Asymmetrical
UMTS	100 Kbps – 2 Mbps	100 Kbps – 2 Mbps	Symmetrical
WLAN	10-40 Mbps	10-40 Mbps	Symmetrical

Source: BDRC, 2001

DSL (Digital Subscriber Line) is a broadband Internet technology that uses copper phone lines. It offers an always-on service, and also enables simultaneous access to both the Internet and voice/fax capabilities of the telephone line. DSL only needs minor technological adjustments in the local equipment connection points to make the copper line network DSL proof. One drawback of DSL is that the service can extend only three miles from a telephone company's switching office, which means that remote houses cannot be connected. DSL is now the most commonly used broadband technology in Europe; incumbent telephone operators dominate DSL (The Economist, 2002).

Coaxial cable brings broadband Internet via the television cable network. Some minor technological adjustments are needed to prepare the coaxial cables for data transport. The average speed of cable Internet is lower than DSL. To make the cable suited for higher data speeds and symmetrical data traffic, these networks have to be upgraded. Television cable companies have a dominant position in this market since they own the infrastructure.

Optic fibre enables very high-speed data traffic. In the last decade, much has been invested in fibre optic "backbones", either in the form of "city rings" or as backbones connecting major cities. Telecom companies use these high-capacity lines to accommodate telephone and Internet traffic, and many larger companies have leased capacity to link their establishments on several locations. Linking these fibre backbones to individual houses (fibre-to-the-home) or buildings (fibre-to-the-building or fibre-to-the-block) would create the possibility for very high-speed Internet for consumers and SMEs. However, constructing the "last mile" in existing built-up areas is expensive, as

it requires a lot of digging. In new development areas last mile construction is significantly cheaper. Currently, in Europe only very few homes are connected to fibre.

Powerline is broadband Internet via the electricity network. The technology requires few additional installations (because existing infrastructure is used). It can handle symmetrical data traffic and makes it possible to easily create in-house data transfer networks. The electricity companies owning the networks have a dominant position in this market. As virtually all European citizens have electricity access, the technology seems promising. However, there are some technical problems that hamper broad deployment. Several companies (e.g. Siemens, Nortel) that were active in powerline pulled out because interference with radio traffic, civil aviation and emergency service transmissions was feared (<http://www.theregister.co.uk/content/22/27221.html>).

Broadband Internet via *satellite* is barely available in Europe. The costs of building a broadband satellite network are huge. Also, it is impossible to upload information via satellite; this implies that broadband via satellite still needs a supplementary data connection for uploading. The biggest benefit of the system lies in the enormous area that satellite can cover. This may prove to be a competitive technology to supply peripheral areas with broadband Internet. Companies that have an edge in offering broadband services via satellite are those that already own/use satellites for other purposes: these include some governments, big broadcasting companies and several telecom providers.

UMTS (Universal Mobile Telecommunications Service) is the follow-up to the second generation of mobile phones (among others GSM). UMTS is the European third generation (3G) of cellular mobile communications. At the time of writing, UMTS is about to be launched, but it may take several years before UMTS will be rolled-out on a large scale since it requires huge investments in new electronic infrastructure,¹ and considering the tight financial situation most telecom providers with UMTS licences are experiencing. The data transfer capacity of UMTS is limited compared to the other technologies discussed in this section. However, most of these technologies are not meant for use on the move, while this is exactly what makes UMTS promising. Only WLAN (and to a certain extent satellite) also have this benefit.

WLAN (Wireless Local Area Network) is also known as Fixed Wireless Access (FWA) or Wireless Local Loop (WLL). This technology uses radio microwaves to transmit digital information. The availability of WLAN in Europe is still limited, but the number of areas with WLAN access is growing fast (Netherlands example: www.hubhop.com). The technology was first used by companies to set up local loops; now, increasingly, companies like hotels, restaurants and shops and individual consumers are using WLAN to offer broadband wireless connections to people who are within the reach of a WLAN transmitter-receiver. The costs of WLAN networks are quite low and still decreasing sharply; and WLAN makes it possible to share the costs of one broadband connection by a large number of people. WLAN may become a widely used solution to set up wireless local networks, on the other hand it may prove to be a competitor of UMTS, if enough people open up their WLAN networks to the outside world.

3. Developments in the broadband market and spatial patterns of adoption

In the electronic infrastructure market, four types of actors can be discerned. The *network owner* is the company that possesses the electronic infrastructure. It may have built the network itself, or it may have ordered a construction company to do so. The network consists of a passive ('dark' in the case of fibre) infrastructure. Second, there is the *network operator*, which activates the network, making it possible to transfer data through the information infrastructure. The third link in the chain is the service provider. These can be Internet Service Providers (ISPs) or Application Service providers (ASPs) or any other type of service provider. And finally, *content providers* offer products/services over the Internet: movies, radio, games, news, business or financial information etc.

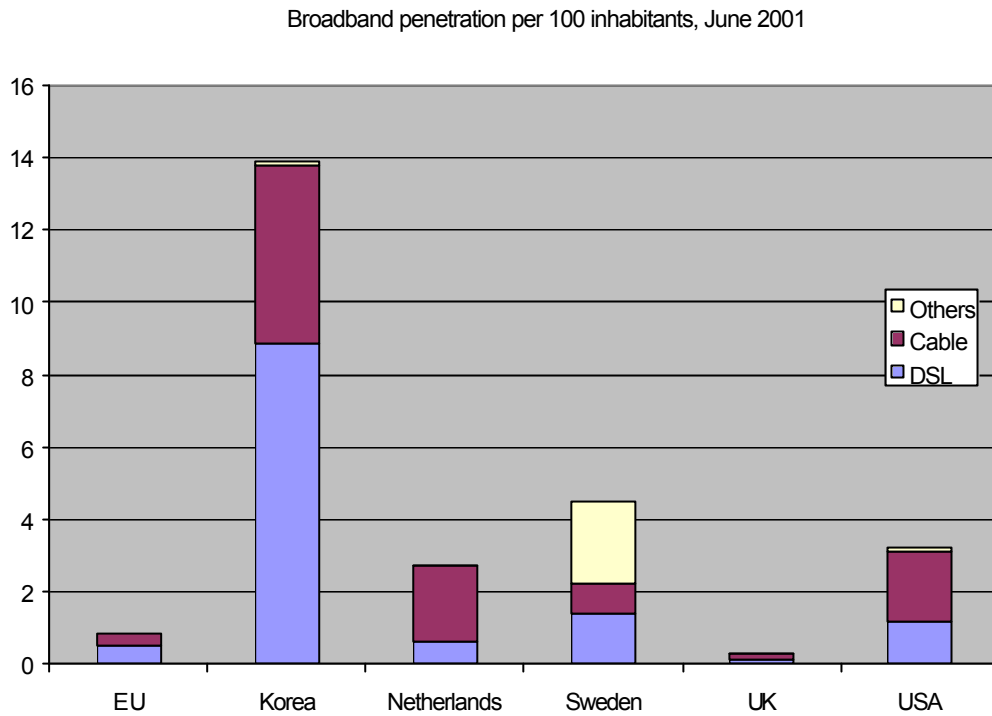
In Europe, until the 1980s, telecom was considered a state activity, and national telecom monopolies covered all four areas. However, in the last two decades markets have been deregulated and liberalised. The basic idea was to promote competition and innovation by privatising the telecom companies, separating the four layers, allowing newcomers to access existing infrastructures and construct new ones, and creating a single European market, enabling companies to expand abroad. Since then, the telecom industry has seen considerable dynamics. Telecom prices have decreased sharply, niche markets were developed (for instance telecom companies that serve large corporate clients), and customers have more choice (see Kridel et al, 1996 or Fraquelli and Vannoni, 2000, for

discussions about the impact on regulation and competition). In the emerging market for mobile communication, several newcomers have gained substantial market share. The rapid adoption of Internet during the late 1990s has generated many new companies, for instance ISPs and content providers. Technological and regulatory developments have created a volatile environment with changing competitive relations. In the broadband market, telephone companies face competition not only from newcomers but also from cable companies that have started to accommodate voice and Internet traffic; with UMTS, mobile telecom operators become relevant players in the market for (broadband) Internet access as well.

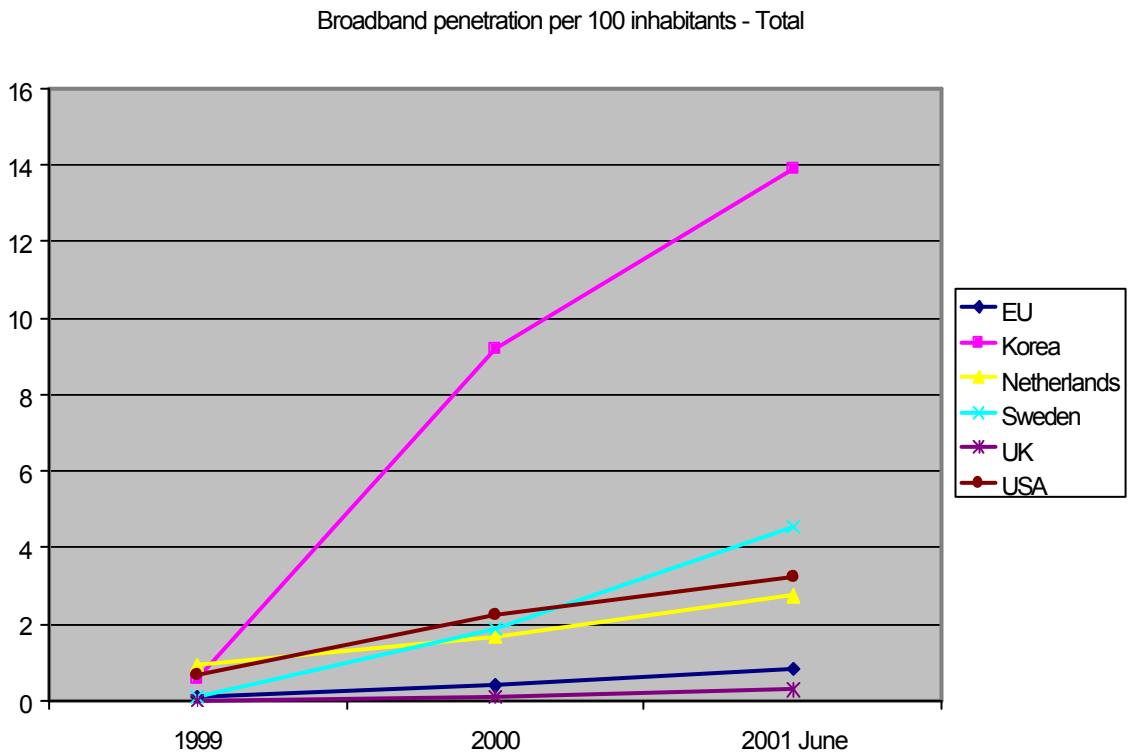
Despite all efforts to promote competition, the position of the former national monopolists is still dominant, especially in consumer markets for (mobile) telephone and Internet connections. Concerning broadband via copper lines (DSL), incumbents are still by far the dominant suppliers. Local loop unbundling does not really seem to work (The Economist, 2002). Some point to the obstruction by incumbents to open up their networks to newcomers. These incumbents would frustrate competition by any means to keep their dominant position, leading to less choice, higher prices, and, as a result, a lower uptake by consumers. (Others also blame the new entrants; see The Economist, 2002). In many remote areas, the telecom incumbent is still a monopolist and often doesn't even offer DSL. Cable companies also offer broadband, but competition is limited, as the unbundling legislation does not yet apply to this sector (Dombey and Guerrero, 2003). Besides, many areas don't even have cable connections.

Broadband adoption

The level of broadband adoption varies considerably among countries, and also the types of access are different. Figure 1 shows that penetration rates in the US (more than 3 users per 100 inhabitants) are much higher than in Europe (less than 1 user per 100 inhabitants). Korea shows the highest number: 14% of the population has broadband access. In Europe, Sweden is the frontrunner, with a high percentage of fibre connections. In most countries, cable and DSL are the main conveyors of broadband. In the UK, the uptake is still very low. Figure 2 shows the development of broadband adoption in the period 1999-2001. The Korean growth was explosive in this period, while in Europe growth was much weaker.

Figure 1. Broadband penetration in various countries

Data source: OECD, 2001

Figure 2. Growth of broadband penetration, 1999 - mid 2001

Data source: OECD, 2001

Broadband in space

The supply of broadband is not equal in space. In general, the supply of broadband is the highest in the larger metropolitan areas, where the demand is biggest. These regions are well endowed with competing infrastructures (copper and coaxial cable). Also, in these areas companies can connect to optic fibre, as many of these places are nodes of optic fibre networks. Metropolitan areas also tend to have more operators that compete on the existing infrastructures. In the Netherlands, the two mostly used broadband technologies are DSL and coaxial cable: both are mainly offered in urban areas, DSL being available in more places than cable. (In figure 1 cable still is more abundant than DSL in the Netherlands in 2001; last year, however, DSL overtook cable's leading position.) Three companies own cable networks and four companies own DSL networks in several parts of the country (www.mordax.nl). All these enterprises lease their networks to Internet Service Providers (ISPs). Incumbents (KPN in DSL and Casema in cable) have the largest networks. Broadband suppliers offer their services at uniform prices throughout their market, even when local providers set prices significantly below these levels (province of Zeeland). The number of broadband providers differs significantly among Dutch urban areas: whereas big cities (Amsterdam) are endowed with many providers, smaller places have just one or two providers (Appingedam). Some companies and municipalities are planning to construct optic fibre networks, but up till now fibre is only present in telecom backbone infrastructures and city rings. Similar situations prevail in other European countries.

Cities tend to have a better broadband supply than rural areas or remote places, but also, cities tend to be the first places where new technologies are available (Leighton, 2001; Prieger, 2001). As a result, consumers and companies can choose from newer technologies. Also within metropolitan areas there are differences. In Manchester for instance, not all neighbourhoods have cable connections. In Rotterdam the number of broadband suppliers differs between neighbourhoods. In cities, as Graham (2002) notes, new apartments and districts are better connected than apartments/districts already in place. In Helsinki, some new development areas are endowed with optic fibre, and are thus much better connected than other parts of the city. In many cities, business districts are best connected. An extreme example is the City of London, where a multitude of broadband providers offers business solutions. Graham (p.34, 2002) argues that in many

cities a digital divide is being created: *Clusters and enclaves of 'superconnected' people, firms and institutions often rest cheek-by-jowl with large numbers of people with non-existent or rudimentary access to communications technologies.*

In smaller or remote towns, the situation often is even less rosy. In many small places without cable infrastructure, there is only one telecom provider, a *de facto* monopolist. For broadband, consumers depend on the willingness of the telecom provider to prepare their network for DSL. Even in the Netherlands, a small and densely populated country, several villages are not endowed with DSL and stay deprived of broadband.

As shown, broadband adoption is rising throughout Europe. However, governments on several levels are not satisfied with the adoption speed, and fear that certain groups or areas will remain without broadband.

From all of these perspectives, broadband increasingly gets policy attention. On the European level, regulatory measures have been taken to promote unbundling infrastructure from services, in order to increase service competition, on the copper network, and, more recently, on cable networks (Dombey and Guerrera, 2003). Also, national governments promote or plan to invest in broadband networks, or promote the development of broadband services, from the view that it might enhance national competitiveness. Some governments are concerned that the capacity limits of copper and coax cable are in sight, and that higher capacity infrastructure is needed to provide citizens with future-proof connections (fibre-to-the-home, for instance).

More recently also lower-level governments (local and regional) have become active in stimulating broadband. In the next section, we discuss five types of local broadband policies.

4. Urban and regional broadband Internet policies

In our survey in European cities, we encountered a number of local broadband policies. We have divided them in five types: 1) The formation of community networks, 2) generic supply policies to provide citizens and companies with broadband, 3) policies to increase broadband supply in newly built / redevelopment areas, 4) policies to bring broadband to specific groups in the city and 5) policies aimed to boost the demand for broadband. Table 2 contains the typology of the policies, and summarizes each type's policy objective and rationale. Below, each type is described and exemplified.

Table 2. Typology of local broadband policies

Type of policy	Policy objective	Rationale for intervention
Community networks (Groningen, Chicago)	Reduce government's telecom costs, Improve local broadband infrastructure and service provision	Private sector fails to invest. Bundling public telecom demand creates critical mass for broadband infrastructure
Generic supply policies (Stockholm)	Attract businesses and citizens by improving local infrastructure	Private sector fails to invest. Public company can do a better job, and will evoke more competition on service level
Supply policies in newly built / redevelopment areas (Rotterdam)	Increase the attractiveness of these areas for inhabitants and businesses	Putting fibre in the ground is relatively easy and cheap in newly built areas. It will evoke strong service competition
Group-oriented supply policies (Manchester)	Offer deprived groups / areas broadband access at affordable prices to stimulate social & economic development	Market fails to bring broadband to deprived groups, with negative societal consequences.
Demand policies (Eindhoven)	Improve the provision of broadband infrastructure and services, with positive impact on quality of life and attracting innovative (ICT) companies to the region	Demand subsidies can resolve "chicken and egg" deadlock that keeps companies from investing in new infrastructures

4.1 Community networks

In many places in Europe and the US, community networks are being constructed. In one typical form of a community network, local governments create an optic fibre infrastructure that links up public and semi-public organisations in the city, and let service providers compete on that network.

The city of Groningen (located in the northern part of the Netherlands) is an example. Like any Dutch city, Groningen is endowed with copper and coax cable infrastructure. Every citizen and company has access to this. However, Groningen companies pay more for broadband connections than companies in several other towns, because of the long distance from Groningen to Amsterdam where the main Internet exchange is located. In Groningen, prices for glass fibre (leased lines) are 5 to 10 times higher than in the Randstad area (NOM, 2002). To improve the local broadband situation, the city has taken the initiative to create a Community Broadband Network. On the long haul, the Community Network plan aims to create a citywide public fibre network. In the first stage the goal is to connect around 170 public buildings in the city of Groningen to the network. The city has calculated that substantial costs savings can be achieved when the

telecom expenses of all the participating organisations are capitalised and invested in the network. The city can cheaply roll out a fibre network as it already owns two city rings, empty tubes that can relatively cheaply be filled with fibre. In the city's concept, the network will be owned by the municipality or a 100% public company. Private firms will provide the services via the network. It is hoped and expected that compared to the current situation, more services will be offered at lower prices. In a later stage, also companies and citizens are to be connected. The community network is in an advanced stage of development: the business model is ready and there are detailed plans and cost expectations for the construction stage.

The Chicago CivicNet is a well-known early example of a community network. The concept of CivicNet is to bundle the communications spending of all the municipal agencies. CivicNet positions their \$32m annual spending for voice and data communications in the role of anchor tenant, which enables CivicNet to construct a fibre network. Unlike in the Groningen case, the government does not actually own the fibre (Krebs, 2001). The city contributes to make the network cheaper, because it has access to valuable resources such as tunnels and conduits. For instance, using sewer pipes for fibre lines sharply reduces the costs of digging and trenching. In its role of anchor tenant, the City of Chicago is offering the opportunity to other users –businesses, corporations, healthcare organisations, non-profit institutions and community organisations – to use the network as well. With the aggregated communication demand of all these actors, CivicNet offers substantial business for services providers.

Groningen and Chicago are not the only cities with plans to develop a community network. Similar initiatives are taken in a number of cities, including Barcelona, Valencia, Leeds, Bologna, and The Hague.

By building community networks, cities increasingly do what private companies don't: creating optic fibre networks that connect individual buildings. Compared to private telecom companies, cities have three strengths: A great ability to bundle demand, thus creating critical mass for a high-capacity network, their control over the physical infrastructure (ducts, sewage systems) that greatly facilitates the creation of such networks, and the relatively cheap loans that cities can obtain.

4.2 Generic broadband supply policy

A second type of broadband policy concerns the generic supply of broadband. In this type, cities/regions roll out broadband infrastructure throughout the urban area. The absolute European frontrunner regarding such a policy is the Stockholm municipality in Sweden. Back in 1994, the city decided to set up a public company, Stokab, to build a fibre network. One of the reasons for doing this was unwillingness of the private sector (Telia, the Swedish telecom incumbent) to connect individual buildings to fibre. The city started the public company to roll out a fibre network throughout the city. The underlying vision was that a wide availability of superior broadband would make the city more attractive for inhabitants and companies. The city owns € 5.5m in Stokab shares and has provided the company with € 63m in loans. Stokab is an operator-independent provider that leases dark fibre connections to operators, private companies and other organisations (Isenberg, 1998). The network development started in the city's commercial district and by now covers most municipal centres and commercial areas in the region. Most of the connections reach up to blocks or curbs; the 'last mile' doesn't consist of fibre yet. By 2002 Stokab had constructed 5,000 kilometres of fibre cable. The network has developed beyond Stockholm: 26 municipalities in the Stockholm region are connected as well. A total of € 150m has been invested in the network. Since 1997 Stokab is profitable and turnover has risen steeply.¹ Some 50 operators are Stokab's clients. Most of them are service providers, but also private companies that prefer to have a dedicated network. An important customer of Stokab is Bredbandsbolaget; this ISP offers 10 Mbps symmetrical connections to households and SMEs. In March 2001 Bredbandsbolaget had about 125,000 households connected (BDRC, 2001, p. 117).

4.3 Broadband investment in newly built / redevelopment areas

Another way local governments are involved in broadband is in newly constructed areas. It is relatively easy and cheap to provide these areas with fibre-to-the-home. The city of Rotterdam is an example. The cities' development corporation puts fibre optic infrastructure in the ground in two such areas. In total, 6,750 homes will be connected to fibre. The city will be the owner of the infrastructure. A private company is to win a concession to activate the network, and other companies are invited to lease capacity and/or to offer services (TV, radio, Internet and voice) over the network. The municipality encourages competition on the network, which will hopefully result in

more and better services at lower prices. In the two pilot areas, local government invests € 4.6m. In the longer run, the city's ambition is to connect every house in the municipality to broadband. This would cost an estimated € 200m for the passive network (Woets, 2002).

4.4 Group-oriented supply policy

As a fourth type of broadband policy, some cities seek to bring broadband to deprived groups, to tackle an emerging 'broadband divide'. Manchester provides a good example. Recently, the city of Manchester has decided to invest in a Wireless Local Area Network (WLAN) in the deprived neighbourhood of East Manchester. In an ambitious scheme, the City Council is now providing East Manchester with a WLAN. This will enable people in the area (4,500 houses) to access the local intranet for free. People who want to access the Internet need to pay the normal monthly fee to an Internet Service Provider, of around € 24. Not only houses will be connected, but also community centres, schools and several public Internet access points. In the rollout of the network, these are the first to be connected. A private company is constructing the network. The maximum speed will be 10Mbps. This is a high speed: a typical DSL user in the UK gets a speed of 512Kbps for a monthly fee of €40.

Currently, in Manchester every citizen can have dial-up Internet access using the fixed telephone network, and in many places, cable Internet is available. However, in practice, in several deprived neighbourhoods (such as East Manchester), many people don't have a landline connection, for several reasons. Some people were simply cut off because they didn't pay the bills; others switched to mobile. These people have no chance to be connected to the Internet. The urban broadband policy aims to fill this gap by offering people the opportunity to be online even when they don't have a fixed telephone connection. The municipality hopes that the WLAN access increases social inclusion by offering the opportunity to get information and education, get into contact with other people and institutions in the neighbourhood and possibly obtain a job.

4.5 Demand promotion initiatives

As a fifth type of broadband policy (a less common one), some cities try to promote the use of broadband Internet, as well as the development of broadband by giving demand subsidies. Eindhoven is a prime example. The city has the slogan to be "leading in technology". It believes that an increased use of broadband can boost the local economy

and attract information and knowledge intensive companies. From this perspective, it has set up a project called Kenniswijk ('Knowledge neighbourhood'): the aim is to stimulate the development of ICT broadband services and applications for end consumers. In co-operation with private enterprises and societal organisations, the city planned to create a "pilot area" with broadband infrastructure and services, consisting of 38,000 households (84,000 inhabitants). The project started in 2001, and is subsidized by the Dutch government and Eindhoven municipality. The national government supports the project with € 45.5m during a 5-year period. The basic idea of the project is to break the "chicken and egg" situation that stalls the development of the broadband market. On the demand side, the project organisation provides subsidies for inhabitants who subscribe to broadband (regardless of which technology they use). For this, € 13.6m is available. To stimulate the development of new innovative broadband services and products, organisations that come up with good product ideas are subsidized. An example of a project submitted for subsidy is called "Vlinderflats Internet TV". Local volunteers want to make a weekly TV program, to be broadcasted on the Internet. The idea behind it is to stimulate social cohesion in the area.

In the city's policy to promote the development and use of broadband applications, the "broadband demonstration centre" plays an important role. Here visitors can see broadband applications in action on a number of computer terminals. The centre is meant to show the added value of broadband, and also functions as a platform for software developers to demonstrate their latest applications.

On the supply side, national and European law forbids direct subsidies to telecom operators. The Kenniswijk organisation encourages companies to provide the area with fibre optic infrastructures (by bringing broadband parties together). The progress in this key aspect of the project been slow, and the objectives are far from realised. In spring 2002, finally, a small pilot project was started up, in which 360 housing units of two housing corporations were connected to 10 Mbps (up and downstream) broadband. Users pay a monthly fee of € 25, for which they get E-mail, homepage space, other services, and help-desk support. Key partners are the housing corporations (they will connect the homes), Volker Stevin Telecom (makes a broadband link between the homes and the Technical University), and Via Networks (will operate as ISP). The E-city organisation is responsible for the management and promotes the development of

broadband experiments. In the summer of 2002, a consortium of companies announced to connect another 1000-2000 dwellings to optic fibre. Individual households in the area can apply for a subsidy of € 800. Of this amount, € 500 is meant to subsidize the physical construction of the fibre link. This will not cover the total cost of the connection. The big question will be how many households will apply. If the number of applicants is large enough, the project will be scaled up to 15,000 households in the Kenniswijk area.

We have described a number of examples of broadband policies in the Netherlands, the UK, the USA and Sweden, but this number can easily be extended. Cities and regions throughout Europe are trying to promote broadband use in similar ways, often helped by national programs and funding. In the next sections, we want to critically assess the potential benefits of these policies (section 5) and the associated costs/risks (section 6).

5. Evaluating the benefits of local/regional broadband policies

In this section, we will discuss the benefits for the city of connecting to broadband. Based on the policy documents and literature, at least five types of benefits can be discerned. Urban broadband policies may add to 1) the urban attractiveness for citizens; 2) the urban attractiveness for companies, 3) an improved quality or lower costs of electronic services 4) savings on public telecom costs and 5) social equality.

Table 3. Tentative judgement potential benefits of local broadband policies

Contribution to...	Urban attractiveness for citizens	Urban attractiveness for companies	Quality of electronic services / lower prices	Public telecom costs savings	Social equality: equal broadband access
Type of policy					
Community networks (Groningen, Chicago)	0	0	+	++	0/+
Supply policies in newly built / redevelopment areas (Rotterdam)	+	+	+	0	0
Demand policies (Eindhoven)	+	+	0/+	0	0
Generic supply policies (Stockholm)	++	++	++	+	0
Group-oriented supply policies (Manchester)	+	0	0	0	+

Table 3 gives a tentative overview of the (alleged) benefits of each type of broadband policy, and attaches scores to each of the type of policies discussed in the last section. The scores should be treated with caution, since no in-depth analyses were done to obtain these results and because the number of case studies is limited. Still, it is interesting to discern the differing strengths of the broadband policies. We discuss them in more detail below.

Improved urban attractiveness for citizens. Broadband Internet connections may increase the attractiveness of places to live. Recent research supports this claim. Wired homes have the potential for being seen as more upmarket and desirable than others (Baines, 2002). Hampton and Wellman (2002) found that computer-mediated communication reinforces existing communities: broadband Internet is used as a complementary way of staying in contact with neighbours. In Netville, a Toronto suburb that functions as an ICT test bed, it was found that wired residents have significantly more contact than non-wired residents. Several policy documents stress the potential of broadband for improving the quality of services and amenities. According to Leighton (2001) broadband will significantly change and improve peoples' daily lives: people get improved opportunities to receive education in their own homes, intricate medical data can be swiftly send within and between medical institutions, and telecommuting, business conferences and personal communications will benefit from using broadband. In an advice to the government, the Dutch Expertgroup Broadband considers broadband access as the oxygen of society (Expertgroep Breedband, 2002). From a societal perspective, it argues, broadband availability can have positive impacts on education, governance, safety, culture, trade and leisure.

All the policy types have a positive score in this category, although the number of citizens they reach differs. Stockholm scores highest, because its network encompasses the entire region and offers most broadband connections. The community network scores a 0, as we have assumed that only (semi) public actors are connected. However, if such networks are extended to companies and citizens, the score becomes positive also.

Improved urban attractiveness for companies. Electronic infrastructure is increasingly recognized as an important location factor for companies, especially knowledge and information intensive ones (Healey and Baker Consultants, 2001). The Dutch

“Expertgroep Breedband” links the growth of broadband Internet to the positive growth of the ICT sector in The Netherlands, and argues that 50% of the productivity increase can be ascribed to ICTs, in which broadband plays a prominent role (Expertgroep Breedband, 2002). The cities and regions in our sample all regard the supply of broadband as a location factor: They hope to become more attractive for companies and citizens by offering better infrastructure and connections. Apart from general benefits, cities and regions perceive benefits from being (one of) the first to have high levels of broadband adoption, or “first mover advantages”. Eindhoven, for instance, hopes to become a “broadband laboratory” that attracts innovative service providers and other businesses that are interested in many citizens connected to broadband Internet. As can be seen from table 3, three of five policy types will probably increase the attractiveness for companies. In each of them, companies get better and/or cheaper Internet access. The community networks get a 0 score, as no firms are connected, and the group-oriented policies (Manchester) are only directed to individuals and households.

Improved quality of electronic services / lower prices. In the current situation, many cities have just one or two broadband Internet suppliers (typically, these are the incumbent telecom company that offers DSL on the copper telephone network and the broadcasting company that offers cable Internet). Even if cities have more suppliers, these parties are dependent on the networks of the incumbents since they don’t own their own networks. The incumbent players try hard to impede the delivery of competitors’ services, often with success. If local governments invest in new infrastructures, notably in optic fibre, the competition in the broadband market can be stimulated, if governments decide to give the network ownership a public character and offer multiple service providers the possibility to use the network simultaneously. This can lead to lower prices and improved services. From this perspective, the generic supply policy of Stockholm has the highest score; Manchester’s digital divide initiative has no impact, as there will be no service competition.

Public telecom costs savings. An explicit motive of some cities (for example Groningen) is to achieve telecom costs savings by creating a broadband community network that will handle all data traffic (including internal telephone traffic) from the organisations connected. The community network will replace all the telephone and data connections that were first bought from private companies. The cost savings can be

used to lower municipal taxes or increase service delivery to citizens. Also, cities hope to promote competition for services on the new public optic fibre networks. As can be seen from the table, the community networks have the highest score in this category. Modest positive impacts can be expected from generic supply policies (Stockholm). The impact of the other policy types is negligible.

Increased social equality; equal access to broadband. The lack of access to broadband limits the possibilities of accessing the Internet. This limited access to information can be considered as a form of social exclusion (Castells, 1998; Graham, 2002), which can be prevented/fought by giving people access to broadband. Many cities stress the importance of broadband as a means for obtaining ICT skills, strengthening inhabitants' knowledge, extending social contacts and increasing job opportunities. Manchester primarily sees social benefits in its WLAN initiative: it is hoped that connecting people will give them more self esteem, facilitate their way back to the labour market, and promote social inclusion through the formation of lively on-line communities. In table 5.1, Manchester's broadband policy gets the highest score, as it explicitly addresses poor-adopting groups. The community network policy has some potential, as many cities explicitly state that they see these networks as a tool for "e-inclusion" (by setting up public Internet points in schools, libraries, municipal offices etc).

6. Costs and risks of local/regional broadband policies

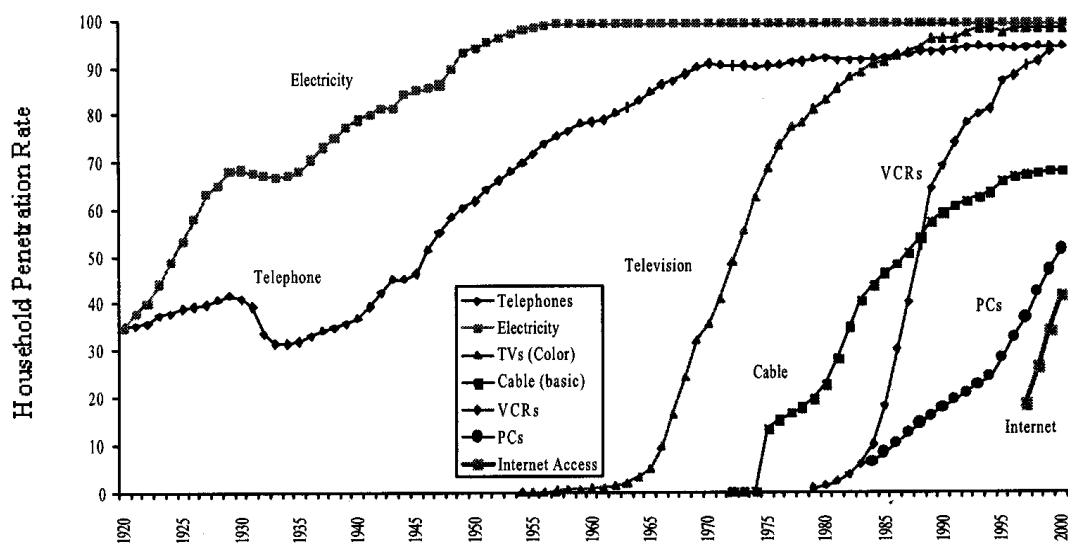
The potential benefits of the broadband policies do not justify the policies *per se*. As in any evaluation, they should be critically assessed, and weighed against the costs and risks of the policies. Also, the question should be raised whether an alternative allocation of (public) means could yield similar or better results: ICT investments should never be a goal in itself but a means to achieve economic development, social inclusion or other policy goals.

Many proponents of government intervention argue that the market outcome is undesirable: in their view, broadband adoption rates remain too low, and weaker groups are largely excluded. This would justify policy measures. But to what extent are low adoption rates a problem? The adoption of a new technology typically follows an S-shaped curve. In the first stage, adoption only grows slowly. Rich and/or highly educated people are the early adopters. From a certain point, the number of users grows

very quickly, as positive network externalities become stronger and prices fall. When the adoption rate reaches maturity, growth slows down again (Shapiro and Varian, 1999). This pattern can be observed for the adoption of electricity, telephone, television, cable television networks, PCs and Internet. See figure 3 for a number of S-curves.

Geographically, metropolitan areas are the first places where new technologies are available, and small towns, rural and remote areas follow later. Interestingly, with new technologies S-curves seem to become steeper: the time span between the introduction of the new technology and adoption by the majority has decreased dramatically. This observation puts policies to fight the “digital divide” or “broadband divide” into question. The issue should not be to fight a digital divide (either social or spatial), but to fight it where the divide is persisting and damaging. Concerning broadband, the typical S-shape curve seems to apply. Adoption rates, although still low in many countries, are rising quickly, and prices continue to fall. From this perspective, policy can best be targeted at two categories: weak social groups (like in Manchester), and people in remote areas. For both groups, the reasons for low adoption are very different, however. For weaker social groups, low adoption rates stem from low incomes, low educational levels, weak social support and high unemployment (Van Winden, 2001; SCP, 2000). Van Winden (2001) argues that the digital divide is a mere derivative of these factors, and concludes that generic social inclusion and labour market policies are indirectly more likely to promote ICT adoption than directly subsidizing ICT use.

Figure 3. Technology adoption S-curves in the US.



Source: Leighton (2001)

In addition, there are a number of costs/risks that should be taken into account concerning broadband policy: 1) costs to taxpayers, 2) unbalancing a competitive industry.

Costs to taxpayers. The costs of many broadband policies are ultimately carried by the taxpayer. Policymakers should realise that these funds are not available for other policy objectives, or should be raised with higher taxes. The burden is spread across all taxpayers, while the benefits accrue to only specific groups. In our cases, costs vary substantially. The costs of the policies are summarized in table 4. They are stated in terms of investments. Per connection, investments are the highest in Eindhoven, and substantially lower in the other cases. The Eindhoven investments, however, include infrastructure, access and services, while the investments in the other cities only involve infrastructure. The WLAN network in East Manchester is estimated to cost € 3.2m and will connect 4,500 houses, which implies € 710 per connection (van den Berg, Van der Meer, Van Winden, 2002). Much of this investment is carried by either national or European funds.

For Rotterdam and Stockholm, there are (potential) returns on capital as the passive infrastructure is to be leased out at commercial rates. Stokab is currently generating profits that come back to the municipality. The investments in Eindhoven are to a large extent provided through national funds.

Table 4. Costs and potential returns of broadband policies

Case	Total investment, in Euro's	Investment per connection in Euro's	Return on capital
Eindhoven	45m	1185	None
Rotterdam	4.6m	680	Potentially positive
Manchester	3.2m	710	None
Stockholm	150m	?	Positive

Note: the number of broadband connections for Stockholm is unknown; this implies that the investment per connection could not be calculated.

Unbalancing a competitive industry. The cities of Manchester and Rotterdam each clearly support one technology: fibre-optic technology and WLAN technology respectively. However, Leighton (2001) argues that policies can distort competition and disturb competitive relations if they clearly benefit one or a few companies, or favour

one particular technology. According to Umino (2002) the broadband development is so dynamic and in an embryonic stage, that it is too early for the government to implicitly exclude other possible technologies. Others (Eindhoven) claim that their policies are “technology neutral”, and do not favour any technology, infrastructure or service provider over another. Leighton (2001) however argues that even in the case of seemingly technological neutrality, existing dominant suppliers of broadband services are likely to benefit most, as well as suppliers of equipment to activate the infrastructures. This result is not neutral, as these technologies will be challenged by new ones. New competitors will emerge if they can challenge existing companies with lower prices or better service, or when they can enter markets that are not served yet. Thus, “government programs that benefit existing providers ultimately reduce incentives to develop advances in service” (Leighton, 2001).

In the cases of Groningen, Rotterdam and Stockholm, the city itself (in the form of a public company) becomes a player in the local telecom market, as owner or major shareholder of the fibre-optic infrastructure. Umino (2002) warns that this may lead to the creation of local monopolies. As a result, in the future, commercial players are less likely to invest in infrastructure in that area, even if better technologies are available by that time. The infrastructure market is distorted, although service competition on the infrastructure will probably increase. Umino (2002) mentions several other drawbacks of public ownership: 1) it is costly to maintain the network and upgrade it as technology changes; 2) public work projects are prone to inefficiency; 3) as a network owner, the government is badly placed to separate its regulatory role from its role as network supplier. This may lead to unfair competition.

In the longer run, no one knows what technologies will best provide broadband. If existing providers benefit from broadband promotion policies, this creates a disincentive for new technologies. Tax credit or subsidy policies (like in Eindhoven) enable existing providers to offer their old technologies at lower costs, or extend their market to geographical areas they would not service without such policy. For newcomers it is less attractive/profitable to enter a new market when existing providers already offer broadband. In the end, broadband policy may have the effect that newer and better technologies do not get a fair chance.

7. Conclusions

Broadband communications are widely believed to provide the foundation for the development of the information society. However, despite deregulation and other policies, the adoption of broadband in Europe is relatively slow. In some areas (notably remote places), the supply of broadband is low or even non-existent, and in the more urbanised areas, the use of broadband is limited. Increasingly, municipalities intervene in the broadband market, arguing that policy intervention is justified because the market fails to bring broadband to the cities at the desired speed, scale, quality and price. In their view, in particular the lack of competition and the continued dominance of incumbent suppliers are to blame. Also, telecom companies are assumed to fail to invest because they are in financial trouble, mainly due to the large sums they spent on UMTS licences.

This article has shed light on the way cities are becoming more active in broadband infrastructure policy. We have demonstrated *how* cities intervene in the market, *why* they do so, and *what goals* they want to achieve with their policies. We have confronted the potential benefits of the various policy types with an analysis of the costs and risks of associated policies. Based on this analysis, we draw a number of conclusions.

One option for cities is to do nothing and let the market do its job. Like any technology, DSL or cable Internet take-up will increase, and later, private companies may be willing to invest in fibre or other advanced infrastructure to bring even higher speed access. This option is cheap, but it may take a long time before broadband is available to large numbers of consumers and companies. This may undermine the competitiveness and productivity of companies and people in those cities.

Demand policies (like in Eindhoven) have the merit of distorting the market only slightly. However, they do not seem to bring the expected investments in broadband infrastructure. In the current development stage of the broadband market, and the situation of the incumbents (that dominate the DSL market), large scale investments in broadband infrastructure only come with heavy government support.

When the benefits, costs and risks are weighed, the most successful type of policy seems to be the generic supply policy in the Stockholm case, where the city has managed to build an extensive fibre infrastructure, and increase competition on services level. The strict separation of infrastructure ownership and services has been a key factor. The supply-model of Rotterdam (constructing fibre in newly built areas) and the

community network (Chicago, Groningen), on the long run may develop into a similar structure.

The counter argument that such broadband policy would “thwart a competitive industry” is questionable: in most regions the broadband market is not that competitive, since telecom and television cable incumbents dominate it. On top of that, these types of local broadband policy may well lead to more competition instead of less, when services competition is set to increase. Opponents argue that governments should not promote one technology, as given the rapid technological developments, no one knows what the future will bring. Although in theory this is true, optic fibre is widely regarded to be a long-run future proof broadband conveyor: it is used as a backbone infrastructure for all the other broadband technologies.

Broadband policy to fight a digital divide is questionable from a “dynamic adoption” perspective (S-curve), and in the case of Manchester is also quite costly. Where social inclusion is aimed for, an alternative allocation of means is likely to yield higher returns.

Cities invest a lot of money in broadband, and in the near future, many more millions are likely to be invested. This article hopefully contributes to this discussion. However, many questions remain still unanswered. First, broadband claims to bring a lot of benefits, but in depth studies are needed to find out to what extent, and under what conditions broadband really contributes to economic development, social inclusion, and a more efficient government. Another key question concerning urban development is how broadband adoption will affect location decisions of individuals/firms, and consequently spatial patterns (living/working), and whether urban regions will extent their competitive advantage over remoter towns through higher broadband deployment.

Notes

¹ Anders Comstedt lecture at Cisco E-City Advantage conference in Berlin, 4-5 February 2003.

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