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I-VISION BROADBAND

TOWARDS AN INTEGRAL VISION ON BROADBAND IN EINDHOVEN

(FINAL VERSION)

TU/e technische universiteit eindhoven

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1. INTRODUCTION

In 2003, the municipality in Eindhoven moved to the forefront in the implementation of glass fiber networks in the Netherlands and Europe with its document "Glasrijk Eindhoven" . The document provided a ten-year vision for a city-wide rollout of a glassfiber network until 2010 that should provide a variety of socio-economic benefits to the region[1].

In 2006, when the rollout of the glassfiber network started in the wijk Tongelre in Eindhoven, the new Coalition Agreement[2] of the Eindhoven Municipality came into force. A central concern in the Coalition Agreement has been the social gaps in the city. There have been gaps between rich and poorer districts ("wijken") in the city, different chances on the labor market, differences between "black" and "white" schools, differences between healthy and poor citizens. The Coalition Agreement defined a number of very practical socio-economic objectives to overcome these gaps (see Appendix 1). However, it did not specify the role of the municipal glassfiber network in contributing to these objectives.

[1] These socio-economic objectives included to:

a) Improve the attractiveness for business, living conditions for citizens and study conditions for students;
b) Provide an impulse for the municipal and regional knowledge economy, in particular as a stimulus for technological oriented business activity;
c) Attract higher qualified work and provide positive impact to the service sector, hotel and catering industry as well as small- and medium-sized enterprises;
d) Contribute to the improvement of social cohesion, participation and quality of life. This should avoid a "digital division" in society.
e) Contribute to the high-tech image of the region ("Frontrunner in Technology" and "smart community") (GemeenteEindhoven, 2003).

[2] Coalition Agreement, 2006. *Eindhoven – Eén. Slagvaardig op Weg naar een Sociaal, Sterk en Betrokken Eindhoven*. Gemeente Eindhoven.

In Europe, municipalities have increasingly become aware that municipal glassfiber networks can contribute to the short and long-term socio-economic benefits in regions. There has been some agreement that glassfiber networks have performance advantages vis-à-vis traditional technologies (Banerjee & Sirbu, 2005; Lehr, Sirbu, & Gillett, 2004) even if they have to compete against traditional access technologies (like cable and xDSL networks). As changes in the telecommunication markets have been fast over the past years, it has been difficult for policy-makers to develop an integrated vision on broadband (Bauer, Kim, & Wildman, 2003). To justify the implementation of municipal glassfiber networks, it has become important to evaluate their socio-economic benefits in areas such as economic growth, community participation, education, quality of life and health. However, such evaluation studies have been rare and emerged just recently (Gillett, Lehr, & Osorio, 2004; Hitt & Prasanna, 2007; Mueller, 2007).

In the Netherlands, a number of evaluation studies on broadband access have emerged since 2003. They showed that users benefitted from broadband access with increased usage (Kools & Serail, 2003). But they also postulated that residential users do not "wait for glassfiber access technologies" (Vermaas, 2007). In this context, the project has been aimed at examining the effects of glassfiber access on the usage of broadband services in the Eindhoven region. In contrast to earlier studies (Vermaas, 2007), broadband access is defined as a 10 Mbit/s symmetric internet connection. This distinction allows characterizing the current qualitative difference between glassfiber and other more traditional access technologies (such as xDSL and cable modems). The focus has been on the extent to which

these technologies have been able to improve the internet usage of residential users as well as small- and medium-sized enterprises.

Important questions in this context have been the following: What has been the international and national experience on municipal glassfiber networks (see section two)? To what extent did access to glass fiber networks stimulate usage of new broadband services among residential users (see section three)? To what extent did glassfiber networks stimulate the adoption of broadband services by small- and medium-sized enterprises at industrial parks (see section four)? What are future research priorities in the area (see section five)?

Box 1: Challenges for Eindhoven's municipal glassfiber network

- **Eindhoven municipality has been at the forefront of municipal glassfiber network implementation in Europe**
- **Current situation: Rollout of municipal glassfiber network has started**
- **Current challenge: Further rollout throughout the city**
- **Future challenge: Linking glassfiber network to expected socio-economic benefits for companies and residents**
- **Need for an integrated vision on broadband**

2 MUNICIPAL GLASSFIBER NETWORKS: THEIR SHORT-TERM VIS-A-VIS LONG-TERM EFFECTS

2.1 MUNICIPAL GLASSFIBER NETWORKS: THE QUALITATIVE DIFFERENCE

Municipal glassfiber networks are qualitative different from traditional access networks (like xDSL and cable modem) that they allow to provide triple-play services (voice, data and video) based on an (at least) 10 Mbit/s symmetric access connection. These networks which are mostly based on Fibre-to-the-Home architecture are next generation networks (NGN).[3] Next Generation Networks are characterized by a number of features related to a) commonly agreed definitions according to international accepted standards; b) they allow an uncoupling of services from the network; c) they should permit open access to the network and d) they should provide sufficient communication capacity for users. The distinction between "next generation" infrastructure and current generation of infrastructure provided by local cable television or telecommunication companies is crucial as these companies (still) offer broadband access at data rates that are typically significantly below 10Mbps and do not (generally) support triple play services.[4]

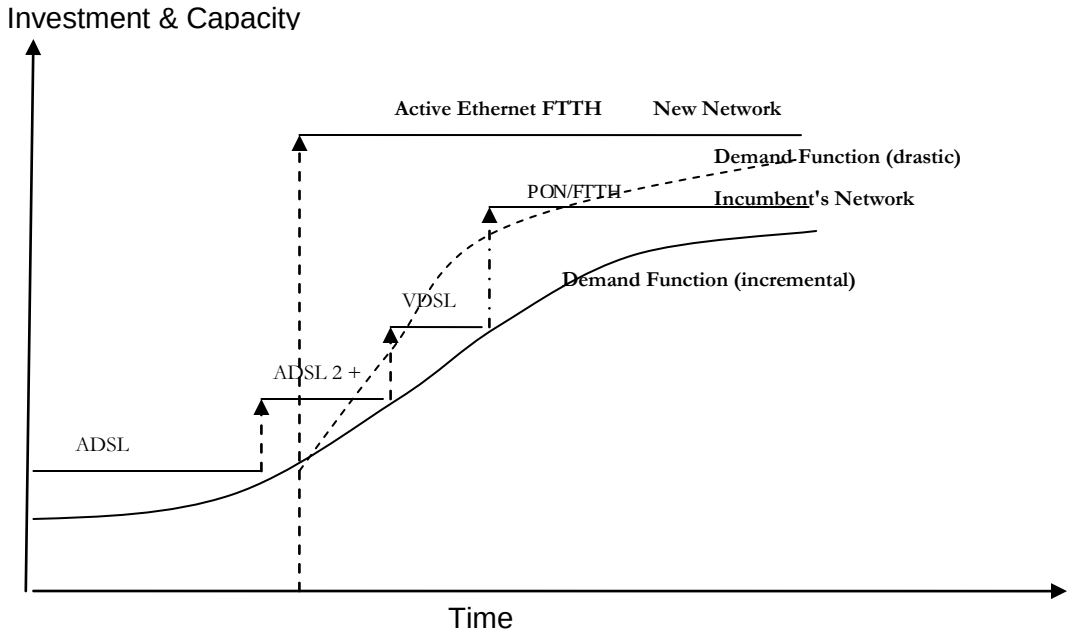
However, as Figure 3 shows incumbent (cable and telecom) companies with their traditional access technologies (cable modems and xDSL) will take an evolutionary routes to upgrade their networks. Therefore it will be a matter of time until these companies will shift to glass fiber

[3] ITU Recommendation Y.2001

[4] This holds ture even if we currently observe that these carriers intend to upgrade their networks to provide these services and capacities.

technologies in anticipation of gradual growing demand for broadband, and in particular triple-play, services (demand curve incremental). Municipal glass fiber initatives, in contrast, are based on the assumption that there is a higher demand for these services which might shift drastically after the installation of a glass fiber network over time (demand curve drastic). However, these initiatives carry also the risk of higher investment compared to gradual upgrading of capacity provided by incumbent's networks.

Figure 1: Alternative Investment for broadband access networks

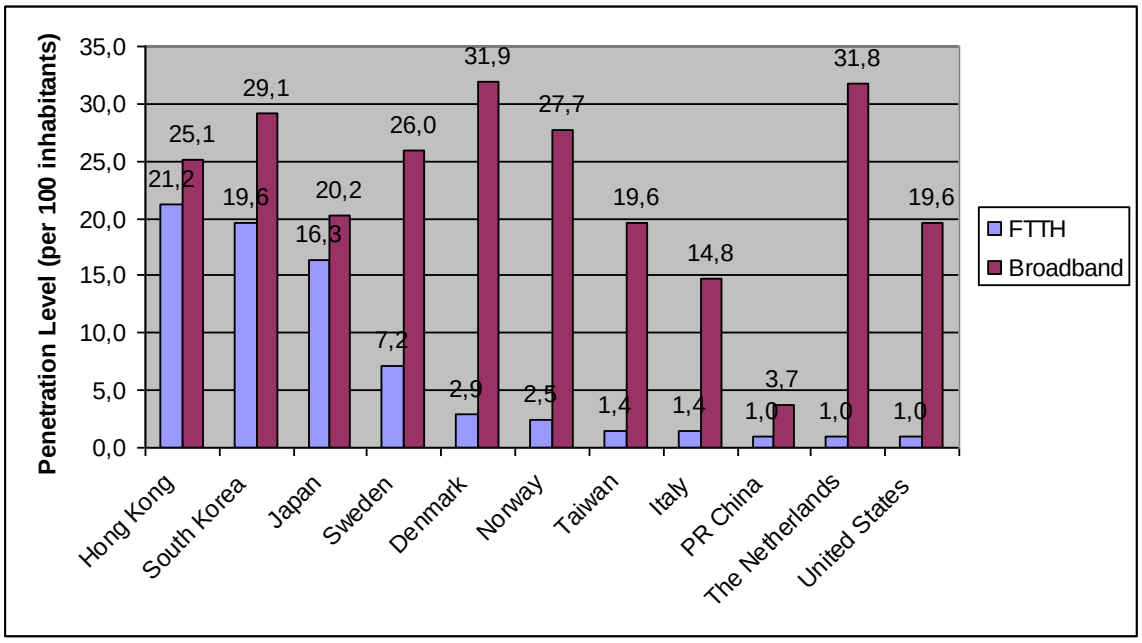


Source: adapted from (Sigurdsson, 2007)

2.2 GLASSFIBER NETWORKS AS COMPETING TECHNOLOGIES

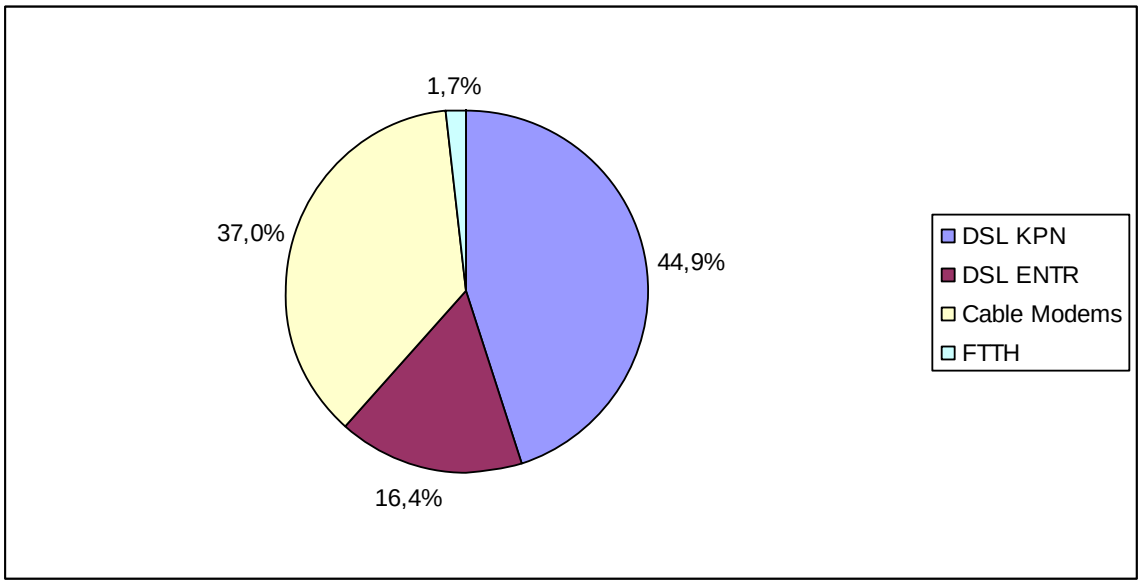
In the recent 12th Implementation Report of 2007, the European Commission concluded that "presence of competing infrastructures is key to broadband take-up" in the Netherlands (EC, 2007). Broadband penetration in the Netherlands surpassed in December 2006 the 30 percent mark (see Figure 1) and has been second highest in Europe (EC, 2007).

Figure 2: Broadband Penetration in Countries with Highest FTTH Levels, 2006



The lion's share of broadband access has been contributed by incumbent operator KPN (44.9 %) and the different regional cable operators (37.0 %). New access technologies such as FTTH networks currently contribute just a mere 1.7 percent to this market (see Figure 2). Compared to the 2005 the share of FTTH technologies on broadband access has increased from 0.5 percent (EC, 2007).

Figure 3: Broadband Access According to Access Technology 2006



2.3 THE REGULATORY RESPONSE TO MUNICIPAL GLASSFIBER NETWORKS

In the European Union (EU), the European Commission has acted in different ways towards dealing with municipal networks: First, these networks have, in general, been stimulated if it was considered as a part of the European drive towards realizing the goals of the Lisbon agenda 2004-09 to make the EU economies "the most competitive and dynamic knowledge-driven economy by 2010". Second, the New Regulatory Framework of 2003 was rather silent with respect to investment incentives of municipalities. Within the New Regulatory Framework of 2003 these initiatives could be exempted from ex ante regulation as these networks would operate in new "emerging markets" (Lewin & Williamson, 2005). Third, these initiatives have actively been investigated as to whether or not they are compatible with Article 87(1) of the EU Treaty. The FTTH initiatives of municipalities have been considered in line with Article 87(1) if municipalities acted: a) as an investor that invests similar to a private party ("market investor principle"); b) if the (local) government

invests in the passive infrastructure and opens access up to all interested private parties on non-discriminatory terms and c) as the (local) government intends to deliver services as part of general economic interest (Hencsey, Reymond, Riedl, Sanatmato, & Westerhof, 2005).

2.4 SHORT-TERM VIS-Á-VIS LONG TERM BENEFITS OF MUNICIPAL GLASSFIBER NETWORKS

In general, the rationale(s) for intervention of municipalities in broadband markets have been based on the assumption that broadband services running on glass fiber networks provide a variety of benefits to regions which will not be provided by the existing infrastructure. A number of broadband services running on glass fiber networks such as telemedicine or teleeducation will provide better quality solutions compared to narrowband (Bauer, Gai, Muth, & Wildman, 2002; Firth & Mellor, 2005). However, as shown in Table 1, a number of socio-economic benefits of municipal FTTH networks are just visible over the long term (3-5 years).

Table 1: Expected Socio-Economic Benefits from Broadband

	Expected effects of broadband (Examples)	
	Short Term (1/2 years)	Long Term (3/5 years)
Economic Growth		
- Regional Competitiveness (Duffy-Deno, 2003; van Winden & Woets, 2004)	Price advantages for firms in particular for SMEs	Increased location of firms, Location of headquarters of MNE
- Employment growth (Gillett, Lehr, & Osorio, 2004)	New employment opportunities	Growth employment, High skilled labor and Self-employment
- Productivity growth (OECD, 2004)	Access and use of broadband services	Impact on firm-level growth, Growth ICT sector
- Income Growth (Gillett, Lehr, & Osorio, 2004)	Increase value housing & rents, Increase personal income	Higher growth of income in region, lower prices
Community Participation		
- E-Government (Gillett, Lehr, & Osorio, 2004)	Information services	Increased participation of citizens
Quality of Life		
- Social cohesion (van Winden & Woets, 2004)	Improved contacts with neighbors	Developing identity in community
- Social exclusion (van Winden & Woets, 2004)	Increased participation in community	Developing new social institutions (e.g. local radio)
- Social capital (Hitt & Prasanna, 2007)	Developing personal relationships & friendships	Developing social networks
- Entertainment (Firth & Mellor, 2005)	Access and usage of new gaming services	Access and usage of new gaming services
Health		
- E-Health (Firth & Mellor, 2005)	Providing health information, discuss health concerns	Increasing health in region
Education		
- E-Learning (Firth & Mellor, 2005)	Improving access to educational material, instructions and teaching staff	Improving performances of schools

Just a few benefits are already visible over the short term (1 to 2 years). Short term effects are mostly gained through access and usage of broadband services delivered via glass fiber networks, i.e. services that provide a new quality of transmission based on at least 10 Mbit/s symmetrical connection to the internet (see Table 1). These services

include Internet Protocol Telephony (IP telephony), telemedicine, telecare, e-government. Long term effects can be expected due to changes in the organizational structure and innovation of companies, changed market conditions, institutional and cultural changes in neighborhoods, etc. Municipalities have a wide variety of instruments to facilitate and coordinate the development of municipal FTTH networks.

2.5 SOCIO-ECONOMIC OBJECTIVES WITHIN THE "GLASRIJK" VISION EINDHOVEN

A comparison between socio-economic objectives for municipal networks and the "Glasrijk" vision of the municipality in Eindhoven in 2003 shows that the important dimensions economic growth, community participation, quality of life, health and education have been addressed. Even if some assumptions (like financial participation in infrastructure) have to be reconsidered due to legislative and regulatory changes in Europe and the Netherlands, the "Glasrijk" vision still represents a sound document for further development in Eindhoven until 2010. Even if the coalition agreement did not explicitly refer to the "Glasrijk" vision, it addressed with education and health important areas to which municipal glassfiber could contribute (see Box 2).

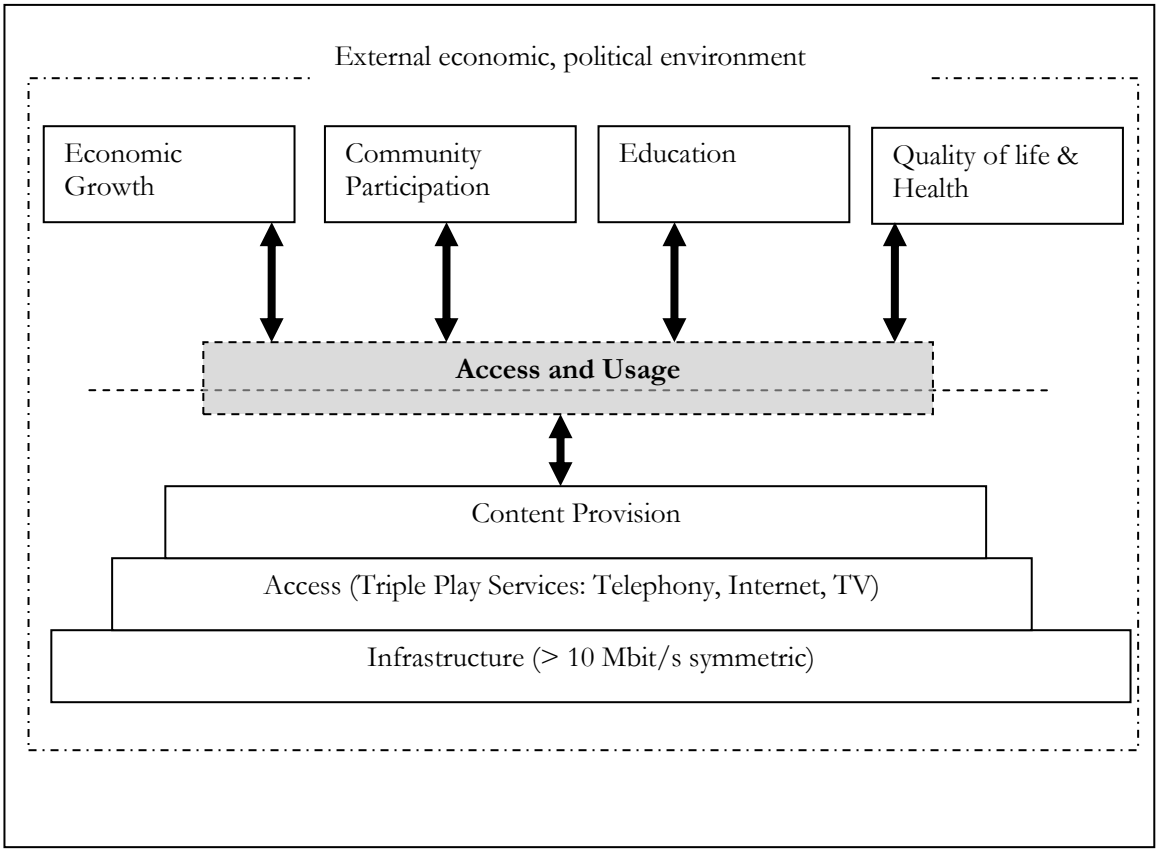
Box 2: Analysis of Glass fiber Initiatives of Municipality Eindhoven

- **Socio-economic objectives of "Glasrijk" Vision in line with current international developments**
- **Short-term benefits are visible, however long-term effects have to be evaluated in the near future**
- **Evaluation of initiatives will be using survey and interview techniques by focusing on the community participation and quality of life**

2.6 RESEARCH DESIGN: EXAMINING THE EFFECTS OF MUNICIPAL GLASSFIBER NETWORKS

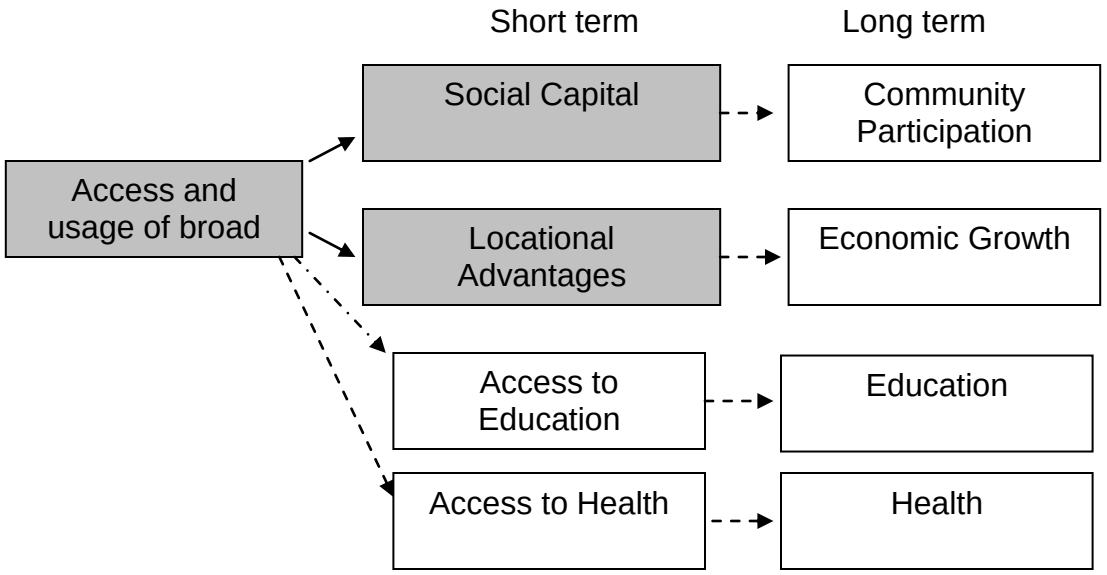
Most benefits of broadband initiatives are only visible after a period of time (mostly 3 to 5 years). Short-term benefits of broadband infrastructure initiatives are more difficult to detect and are mostly related to price-advantages for the usage of broadband services by residential and business users, higher degree of access to the glass fiber network, providing of new opportunities. The critical issue here has been "access and usage" of the broadband infrastructure and in particular services (see Figure 4).

Figure 4: Social and Economic Objectives for Glass fiber networks in municipalities



In the following, short-term effects of glass fiber networks are evaluated based on a) an quantitative analysis of access and usage of "Ons Net" in the neighborhood Tongelre and b) by providing qualitative evidence using interviews with private firms involved in the BRE consortium. For the evaluation of residential user benefits from "Ons Net" the focus was on community participation and quality of life. For the qualitative analysis, the focus was on the locational advantages related to price and bandwidth capacity (see Figure 5).

Figure 5: Research Design



As we will show in the following parts, the market failure approach which is underlying the response of the EU competition authorities on State Aid is seriously flawed when dealing with municipal networks. There are other justifications when dealing with municipal involvement in FTTH network initiatives which are appropriate even in "black areas" like the Eindhoven area (see Section 3). In the Eindhoven area, the response to new FTTH networks and new emerging broadband services has been different as it has been based on the "Kenniswijk" subsidy (see Section 4). However, it has until recently been unclear to what extent the municipal initiatives in different areas have let to short-term benefits for residential users as well as small- and medium-sized enterprises (SMEs) (see Section 5).

3. MUNICIPALITIES AND FTTH NETWORKS

3.1 JUSTIFICATION FOR INTERVENTION OF MUNICIPALITIES

3.1.1 Market Failure

Since 2000, a number of initiatives by municipalities have emerged aimed at the implementation of FTTH technologies in different regions in the Netherlands. In the Netherlands (as in other parts of Europe), a number of municipal initiatives have recently emerged which have partly been approved, partly been terminated due to European legislations. There seems to be a role in the implementation of FTTH networks if incumbent market parties are not willing or not able to provide sufficient broadband capacity within their local communities (B Sadowski, 2006).

The case for (local) government intervention in the building and operation of municipal networks rests on the assumption that these markets represent some form of market failure. A justification for (local) governments to intervene may arise if private investment alternatives are considered as inadequate. Private companies might have limited incentives to invest if the costs of deploying new infrastructure and operate new services are considered to be too high (and uncertain) relative to the revenue that can be expected. As a result, the number of private companies entering the market can be too low or even be zero as there are no incentives for any private carrier to offer service

A number of reasons can lead to a situation of market failure. First, if size of the market is small, a 'natural monopoly" can exist, i.e only one facilities-based provider can be sustained. Even in cases where there are two or three competitors, competition may fail to be sufficiently

robust. Due to the existence of of significant sunk, fixed, and shared costs in the provision of telecommunication infrastructure, substantial scale and scope economies can arise that may limit the number of providers that can be sustained. Second, private provider might fail to appropriate sufficient revenues due to externalities and spillover benefits to make private provisioning economically viable. Appropriability of the benefits from these investments is limited[5] as additional utility on the consumer side flows mostly from the commercialization of new complementary services and applications making use of the higher performance of the new infrastructure. Third, even if broadband infrastructure is available in certain local markets, a perceived "market failure" can emerge if there are not sufficient competitive alternatives in terms of the prices, the breadth of selection, or the quality of broadband services offered (Lehr, Sirbu, & Gillett, 2006).

3.1.2 Basic Infrastructure Rationale

Municipal networks can be justified based on the assumption that the municipaloity has a function in providing basic infrastructure services. Such services should a) be used by all citizens and are considered as essential services; b) they might have the characteristics of a natural monopoly (or have some form of public goods); and c) they are responsible for significant spillover benefits, which entail the role of government or complementary to it (Lehr, Sirbu, & Gillett, 2006).

[5] There might derive some demand in terms of e.g. traffic from users if they utilize services that can only be exploited on the new infrastructure.

3.1.3 Opportunistic Rationale

A third rationale can be related to situations in which the municipality is participating in the market due to the relatively low cost to expand into offering communication services. Such entry into the provision of telecommunication services can be aimed at taking advantage of scale and scope economies given that only incremental investment is required to expand into offering telecommunication services. There are a variety of reasons for municipalities to do so: For example if such investment allows to more cost-efficiently use information technology internally or in conjunction with other semi-public institutions (Lehr, Sirbu, & Gillett, 2006).

3.1.4 Innovation Rationale

A fourth rationale is if municipalities act as a Schumpeterian entrepreneurs as they perceive opportunity and act on this perception (Link & Siegel, 2007; B Sadowski, 2006). The rationale comes to the fore in market situations in wich (local) government intend to stimulate experimentation and learning of market (and non-market) parties with new infrastructure and services. Participation in the development of FTTH networks can be used by private market parties to experiment with the implementation of new infrastructure and services and to learn from these experiences. However, an important question in this context has been when (and for how long) should (local) governments act as Schumpeterian entrepreneurs in the provision of municipal glass fiber networks.

In market situations characterized by high costs, risks and limited appropriability, if one of these justifications holds, there is a case for (local) governments in providing subsidies and facilitating private-public partnerships (Martin & Scott, 2000). For an overview about the different justifications, incentives for private companies and perceived user benefits see Table 2.

Table 2: Rationales and private investment incentives

Rationales	Private investment incentives	Perceived effects on user groups
Basic Infrastructure	Limited (due to public goods characteristics)	Provision of essential services; Significant spillovers from infrastructure investment
Market failure	Limited (leading to insufficient market supply)	Reduction in prices, increase in quality and variety of supply
Opportunistic	Limited (but high public incentives due to low incremental costs)	Demand aggregation (e.g. lower prices, better services, higher bandwidth)
Innovation	Limited (due to high private risks & costs and limited appropriability)	Experimentation and learning platforms with new (advanced) infrastructure and services

3.2 MUNICIPAL NETWORKS: THE EUROPEAN EXPERIENCE

Since full liberalization of the telecommunication markets in 1998, municipal networks have been started to become a mass phenomenon in Europe. A forerunner of building up a fiber network in Europe has been the well-known example of the municipality of Stockholm, in Sweden, which started already in 1994 (Stockab, 2006). In 1998, the European Commission in their Report about Alternative Networks estimated that there have been approximately 50 networks in which municipalities participated in particular in Belgium, Germany and Sweden (CEU, 1999). Some of these networks were acquired by market parties or ended up as a failure in the late 1990s (B. Sadowski & Runhaar, 2000). However, since 2000s, municipal networks have started to grow rapidly (see e.g. (Preston, Cawley, & Metykova, 2007; Tookey, Whalley, & Howick, 2006).[6] A major factor contributing to this growth has been underinvestment of incumbent telecom and cable companies in new telecommunication infrastructure and services (Cave & Prosperetti, 2001; Fransman, 2002).

In the United States the experience on municipal broadband networks has shown that these networks show decreasing cost industry characteristics and require open access policies for their growth (Lehr, Sirbu, & Gillett, 2004). However it also showed that municipalities had to fight incumbent telecommunication companies in court (Tapia, Stone, & Maitland, 2006) and had to be creative about setting up public private partnerships (IBSG, 2006) to faciliate the growth of municipal broadband networks. However, the experience in the United

[6] Estimates put them currently at around 140 projects whereby three quarters of these projects have been initiated by municipalities.

States has also shown that these networks are complementary to competing private networks (Lehr, Sirbu, & Gillett, 2006).

In order to comply with the European legislatory and regulatory environment, municipalities have increasingly become involved in different private-public partnerships (PPP) models to foster growth of municipal networks. In a private-public partnership framework, the extent to which these different models include public or private resources (e.g. function of municipality, expertise at different layer) can be examined. These models have partly been developed as a reaction to the decisions of EU competition authorities to contest municipal networks in particular in "black areas".[7] However, in the EU, competition authorities have been lenient with respect to municipal projects in "white" and "grey" areas. Six projects in the United Kingdom and one in Spain were approved as State Aid compatible with Article 87(3)(c) of the EC Treaty. Regarding the two French projects in the department of Pyrénées-Atlantiques and the region of Limousin, the European Commission decided that they did not constitute State Aid. The European Commission did not oppose to the qualification of this public intervention as a compensation for a Service of General Economic Interest (SGEI) made by the French Authorities in their notification. In three of the approved projects (Atlas; Pyrénées-Atlantiques; Limousin) public funding was granted for the deployment of infrastructure, while in the other six[8] the subsidies were given to telecommunications operators for the provision of retail services to end-users (either residential, businesses or public authorities). A

[7] e.g. (CEU, 2006a)The case of the citynet Amsterdam still is under discussion on the EU level. (CEU, 2006b)

[8] Regional Innovative Broadband Support in Wales; Broadband for SMEs in Lincolnshire; Broadband in remote and rural areas in Spain; Broadband Business Fund; Broadband in Scotland remote and rural areas.

number of local broadband initiatives by municipalities have recently been approved by the European Commission. However, only a few have been implemented as a compensation for a service of general economic interest.

To provide municipal networks in "black areas", a wide variety of PPP models have developed across the European Union ranging from models in which municipalities act as initiator (public utility, sole private provider and franchise model) or coordinator to orchestrate market demand (coordinator model). They fulfilled important functions in providing incentives for municipal networks (e.g. subsidies or passive infrastructure) based on the initiative of private entrepreneurs and citizens (cooperative model) and of social housing corporations (social housing corporations model). Within a private-public partnership framework, these models can be characterized according to the extent to which private or public resources and expertise are utilized e.g in the different layers of the networks or the actors who initiate these partnerships (see Table 3).

Table 3: International Experience on Municipal Broadband Initiatives

PPP Model	Initiative	Function of Municipality	Network components and Access			Examples**	Authors
			Physical infrastructure (Dark Fiber)	Network (Backbone & Access)	Access, Services and Content		
Public Utility Model	Municipality (or city utility)	Offers retail services for consumers over its infrastructure that it owns and operates	Owned by municipality (or city utility)	All levels are managed and owned by (one or) more publicly-owned compan(y)ies		Wienstrom (Austria)	(Tapia, Stone, & Maitland, 2006)
Sole Private Provider Model	Municipality	Provides access to conduit or rights-of-way	Owned by Municipality	One service provider operates and manages the network		Stokab (Sw)	(IBSG, 2006)
Franchise Model	Municipality	Contracts with a private party to build and operate the facility	Operating Company		Multiple service and contents providers	Milan (It)	(Lehr, Sirbu, & Gillett, 2004)
Cooperative Model	Citizens/ Private Entrepreneurs	Supports the set up of a non-profit organization that negotiates with suppliers different services	Owned by non-profit organization	All levels are managed and owned by non-profit organization		Nuenen (NL)	(ICM, 2004; Lehr, Sirbu, & Gillett, 2004)
Social Housing Corporations Model	Social housing Corporations	Provides a nexus for the aggregation of demand of different social housing corporations	Owned by municipality or housing organization	Operating Company	Multiple service and contents providers	Rotterdam (NL)	(ICM, 2004)
Coordination Model	Municipality	Provides a nexus for the aggregation of demand of households, private companies and semi-public parties like hospitals	Municipality aggregated passive infrastructure	Operating Company	Multiple service and contents providers	CityNet Amsterdam (NL), Terrecablate (It)	(ICM, 2004; Lehr, Sirbu, & Gillett, 2004)

3.3 SUMMARY AND CONCLUSIONS

The results of the literature review and the international experience on municipal FTTH implementation provided the following results (see Box 3).

Box 3: Results of international analysis of municipal FTTH networks

- **Growing number of municipal fiber optic network in Europe since liberalization in 1998**
- **In Europe, involvement of municipalities in development of fiber optic networks has been limited by European competition law and national legislation in "black" areas (with prexisting broadband infrastructure)**
- **Rationales for black areas can be based on a) Market failure reasoning, b) Basic infrastructure reasoning, c) Opportunistic reasoning and d) Innovation reasoning.**
- **There are a wide variety of public-private partnership forms to coordinate the growth of municipal glassfiber networks that can involve municipalities to a different degree.**
- **All forms of municipal involvement are only temporary, that means there has to be a "window of opportunity" for which these interventions are appropriate.**
- **Proper assessment has to determine the appropriateness of these interventions by looking at the benefits of a) residential consumers and b) business users.**

4 MUNICIPAL FTTH INITIATIVES IN THE NETHERLANDS

In the Netherlands, several municipalities have acted (or intend to act) as "bureaucratic entrepreneur", i.e. by becoming involved or expressing interests in deploying a fiber-optic network in their region. In the region Eindhoven, the national government acted based on an "innovation rationale" in proposing a large-scale subsidy for experimenting and learning from new emerging telecommunication infrastructure and services called "Kenniswijk". Even if the "Kenniswijk" program was set up 2000, it did not really take off until 2003.

4.1 EINDHOVEN AND THE "KENNISWIJK" PROJECT

In 2003, the Eindhoven region became the target of a large broadband infrastructure and service technology (ICT) pilot program called "Kenniswijk" (Knowledge District) by the Ministry of Economic Affairs. It should propel the region two years ahead of the rest of the Netherlands in terms of ICT diffusion. This pilot project was also aimed at experimenting and learning for all participants involved (Kenniswijk, 2005). Investment in new infrastructure (in particular glass fiber technologies) and services by private companies and private-public partnerships was encouraged based on government subsidies. Real take-off of the different new infrastructure and service technologies was not expected before 2005 (Kenniswijk, 2005). After an initial period with a number of start-up problems,[9] the Kenniswijk program fostered infrastructural developments in Nuenen and Eindhoven.

[9] For the full report, see (Kenniswijk, 2005)

4.2 THE MUNICIPAL NETWORK IN NUENEN

The municipality in Nuenen[10] has been the first to roll-out a municipal FTTH network under the Kenniswijk subsidy. The initial idea of the Nuenen network was to set up a cooperative scheme under which infrastructure investment in a FTTH network could take place. Under the "Kenniswijk" subsidy scheme[11], Nuenen residents became eligible for a €800 subsidy[12] that was aimed at stimulating demand for new ICT services and infrastructure. In order to persuade the residents to join the cooperative "Ons Net", they received an offer of an one-year contract with "Ons Net" based on a 10Mbps symmetrical Internet connection that was free of charge.

This scheme was very successful and let already within the first year to a penetration rate of 97 percent. These demand stimuli affected residents in Nuenen in buying glassfiber access. The residents decided to transfer their subsidy to a private limited partnership called Netwerk Exploitatie Maatschappij (NEM) B.V. The NEM was set up to operate the new glass fiber network. Residents who transferred their subsidy to the NEM could become a member of a cooperative consortium called "Ons Net". The aim was that the cooperative consortium "Ons Net" would receive 95 percent of the shares in NEM. Therefore the residents of Nuenen would de facto become the owner of the new glassfiber network in Nuenen. The housing society "Helpt Elkander" as well as a

[10] Nuenen is a small municipality near the city of Eindhoven in the south of the Netherlands, well known because of the close relationship between the Dutch painter van Gogh and this town.

[11] Initially in 2000 was the objective of the "kenniswijk" project of the Ministry of Economic Affairs to provide within three years 30.000 households with fast internet connection via a glass fiber network. Afterwards, experiments with new broadbandservices could start.. The set up of the "Kenniswijk BV" (a limited company providing the subsidy) was aimed at stimulating the development of broadband services. The provision of glassfiber infrastructure should (initially) be done by market parties.Eindhoven (toegether with Helmond) were able to recieve for their respective regions such particular scheme ("Kenniswijkregeling").

[12] This subsidy included € 500 that had to be utilized to pay for access and € 300 that could be used to pay for at least one telecommunication service.

private bank and an entrepreneur would receive the rest of the shares in NEM. Based on this investment capital, the new glass fiber network could be implemented by a private telecommunication contractor.[13]

The initial analysis of experiences of the Nuenen network (de Rooij, 2006) let to three important conclusions: First the provision of FTTH infrastructure in this regional market had "natural monopoly" characteristics, i.e. new entry of other companies was unsustainable. That means there was just room for one infrastructure provider. Second, the provision of FTTH infrastructure and the provision of broadband services is not necessarily linked together. Unbundling of the network and services layer can be profitable for new service providers if the open access is well-defined at layer two. Third, the provision of government subsidies for a small market like Nuenen has been necessary to start up the development of the FTTH infrastructure, but for larger markets this is not anymore the case (de Rooij, 2006).

In a second study, it has been shown that scalability has been vital for FTTH networks if demand uncertainty has been very high (van Rijssel, 2006). By looking at the development of municipal networks in the Netherlands, it has been found, in addition, that the example of Nuenen has triggered a number of follow-up projects in the Netherlands. Private companies like GNEM and Lijbrandt were using the successful business model in Nuenen as a benchmark case to roll

[13] Due to problems of financing and unexpected costs, the initial success in implementing the Nuenen network has apparently been lost. Recently, a private company has taken a stake of five percent in NEM. Based on the priority stakes they received in NEM the company obtained the right to appoint the management board of NEM. That meant in effect that the Nuenen residents are not anylonger the owners of the network.

out FTTH networks in other regions in the Netherlands. They were starting to serve housing corporations and began to co-invest with them. Currently, private network constructors are taking over and private equity is funding new initiatives in Haarlem/Bollenstreek, Deventer and Arnhem. In the Amsterdam GNA initiative, financing is jointly provided by the municipality, housing corporations and private equity. This has provided a considerable boost in new installations of these networks that are planned for 2007 and beyond.[14] It stimulated the implementation of new infrastructure which has also be documented in an increase in the number FTTH networks in the Netherlands (see Tables 4 and 5). The trend in the Netherlands has been from piecemeal projects in co-operation with housing corporations to the roll-out of city-wide projects (in which housing corporations still play a major role). Involvement by the municipality in these networks is varying from direct initiation (e.g. Helmond) to passive participant (Deventer).

[14] Actually the first initiators of glass fiber networks in the Netherlands were student housing corporations equipping there dormitory buildings with Fiber-to-the-Building as early as 1994 (Stratix, 2006).

Table 4: Local Initiatives in the Netherlands by Municipalities (Dec 2006)

Municipality/Region	Initiator	Inititated / Started	Dec.2006 connected	Network	PPP Model	Network and Service Provision		
						Network Owner	Network Provision	Service Provision
Almere	Municipality	2001(2003)	1,700	FttH	Coordination	Municipality via Almere Fiber Company	First Mile Ventures	UNet (until 2008)
Amersfoort	Municipality	2005 (2006)	1,000	FttH	Coordination	BreedNet Amersfoort	BreedNet Amersfoort	Casema
Amsterdam	Municipality PC (GNA)	2003 (2006)	N.A.	FttH	Coordination	Glasvezelnet Amsterdam C.V.	BBned	Variety of Service Providers
Arnhem	SHC (Portaal) / PC (GNEM)	2006 (2007)	3,769	FttH	Social Housing Corporation	GNEM	GNEM	XMS
Deventer	SHC (Rentree)	2004 (2006)	1,200	FttH	Social Housing Corporation	SHC Rentree via Y3-net	SHC Rentree via Y3-net	SHC Rentree via Y3-net
Deventer	PC (Reggefiber)	2007 (2007	0	FttH	Coordination	NEM Deventer	NEM Deventer	NEM Deventer
Eindhoven	COOP ("Ons Net" Eindhoven)	2001 (2005)	6,500	FttH	Cooperative	"Ons Net" Eindhoven via NEM	"Ons Net" Eindhoven via NEM	Edutel
Enschede	SHC (Woonplaats& Domijn)	2003 (2005)	7,500	FttH	Social Housing Corporation	Initially SHC via Casanet	Initially SHC via Casanet	KPN-Casanet
Helmond	Municipality	2005 (2006)	0	FttH	Franchise	BBNed	BBNed	BBNed
Naaldwijk	PC (CaiW)	2004 (2004)	700	FttH	Franchise	CaiW	CaiW	CaiW
Nuenen	COOP ("Ons Net" Nuenen)	2001 (2005)	7,200	FttH	Cooperative*	"Ons Net" Nuenen via NEM	"Ons Net" Nuenen via NEM	Edutel
Nijmegen-Hazenkamp	COOP (Glazenkamp)	2005 (2006)	24	FttH	Cooperative	Glazenkamp	Glazenkamp	UCI-KUN (University)
Rotterdam	Municipality	2002 (2006)	4,000	FttH	Coordination	Glasvezel Rotterdam via Bbned	Bbned	Bbned
Utrecht	COOP (Lomboxnet)	2002 (2004)	1,000	FttH	Cooperative	Lomboxnet	Lomboxnet	Lomboxnet
Utrecht-Leidsche Rijn	COOP (Kersentuin)	2003 (2004)	94		Cooperative	Xs4all	Xs4all	Xs4all
Local Initiatives			34,687					

Table 5: Local Initiatives in the Netherlands by Social Housing Corporations, December 2006

Municipality/Region	Initiator	Inititated / Started	Dec.2006 connected	Network	PPP Model	Network and Service Provision		
						Network Owner	Network Provision	Service Provision
Amersfoort	SHC (De Velden/Portaal)	2005 (2006)	900	FttH	Social Housing Corporation	GNEM	GNEM	GNEM
Amersfoort	SHC (De Velden/Portaal)	2005 (2006)	3,000	FttH	Social Housing Corporation	GNEM	GNEM	GNEM
Arnhem	SHC (Portaal)	2005 (2006)	3,500	FttH	Social Housing Corporation	GNEM	GNEM	GNEM
Bussum	SHC (Patio)	2005 (2006)	1,000	FttH	Social Housing Corporation	GNEM	GNEM	GNEM
Hilversum	SHC (Patio)	2005 (2006)	2,000	FttH	Social Housing Corporation	GNEM	GNEM	GNEM
Leiden	SHC (Portaal)	2005 (2006)	6,000	FttH	Social Housing Corporation	GNEM	GNEM	GNEM
Naarden	SHC (Portaal)	2005 (2006)	1,000	FttH	Social Housing Corporation	GNEM	GNEM	GNEM
Nijmegen	SHC (Portaal)	2005 (2006)	4,000	FttH	Social Housing Corporation	GNEM	GNEM	GNEM
Soest	SHC (Portaal)	2005 (2005)	900	FttH	Social Housing Corporation	GNEM	GNEM	GNEM
Utrecht	SHC (Portaal)	2005 (2006)	4,500	FttH	Social Housing Corporation	GNEM	GNEM	GNEM
Hillegom	PC (Lijbrandt)	2005 (2006)	7,200	FTTC	Franchise	Lijbrandt	Lijbrandt	Lijbrandt
Lisse	PC (Lijbrandt)	2005 (2006)	24	FTTC	Franchise	Lijbrandt	Lijbrandt	Lijbrandt
Haarlem	SHC (Pré Wonen)	2005 (2006)	4,000	FTTC	Social Housing Corporation	Lijbrandt	Lijbrandt	Lijbrandt
Bollenstreek region	PC (Lijbrandt)	2005 (2006)	1,000	N.A.	Franchise	Lijbrandt	Lijbrandt	Lijbrandt
Various towns	SHC.	2005 (2006)	94	FTTB	Social Housing Corporation	Lijbrandt	Lijbrandt	Lijbrandt
Local Initiatives			**34123**					

(Source: (Stedenlink, 2007; Stratix, 2007) own investigations; PC – Private Company; COOP – Cooperative; SHC – Social Housing Corporation)

4.3 THE EFFECTS OF THE "KENNISWIJK" PROJECT

The "Kenniswijk" project was aimed at stimulating access and usage of new broadband services. Until now, research on the adoption behavior of users has been limited. In 2003, a survey ("nul-meting") among its users revealed the following insights: Many users utilized the network for the acquisition of health information, for educational information, and for information useful for finding a new job. Moreover, about 30% of the users increased their social capital by making new contacts with people, most of whom living outside the user's own quarter (Kools. & Serail, 2003). The study has been limited: First, it remained unclear, whether the positive consequences of broadband adoption are persisted. Maybe intensive network use was just shortlived because users were curious at the beginning, but lost their interest shortly thereafter. Second, the internet changed dramatically since 2003. Under the label "Web 2.0" a large number of new internet services emerged facilitating the making of new contacts and gaining popularity. These issues have not been examined.

Recently it has been claimed by K. Vermaas in her PhD dissertation[15] that glassfiber networks have just a limited additional value for residential users compared to existing access alternatives (ADSL and cable modems). In line with our research, she proposes that advanced broadband infrastructure development and the use of advanced broadband services are not inherently linked with each other (Vermaas, 2007). In other words, there is a delay between the implementation of broadband infrastructure and the take-off of

[15] K. Vermaas (2007) "Fast diffusion and broadening use: A research on residential adoption and usage of broadband internet in the Netherlands between 2001 and 2005", Utrecht, Utrecht University Press.

broadband services (see chapter two). However, she furthermore concludes that residential users are not interested in glassfiber networks as these networks are too expensive (Vermaas, 2007).

The critizisms against her research has been twofold: First, her study has been undertaken in the period 2001 – 2005 in which FTTH network users did not really exists. Therefore conclusions about this user population cannot be drawn from her sample. Second, the data gathered from on-line surveys of different periods are not representative for residential users in the Netherlands.

4.4 SUMMARY AND RESULTS

The national experience with municipal FTTH networks has shown that municipalities can have a function in coordinating and facilitating the developments of these networks (see Box 4).

Box 4: Results of analysis of national development of FTTH networks

- **The development of municipal FTTH networks in the Netherlands has been triggered by the Kenniswijk subsidy for the Eindhoven and Nuenen region in 2005**
- **These regions have been characterized by insufficient supply of glassfiber networks**
- **Market failure and opportunistic rationale for city (Eindhoven) in conjunction with innovation rationale for Kenniswijk subsidy in (Nuenen, Tongelre)**
  - **Market failure rationale: insufficient quality (speed) and variety of supply in conjunction with high prices**
  - **Opportunistic rationale: profiting from the aggregating from demand**
  - **Innovation rationale: Experimenting with new infrastructure and services in Nuenen and Tongelre**
- **A large variety of private public partnerships has characterized the growth of these networks in the Netherlands**

5. MUNICIPALITIES AND FTTH NETWORKS IN EINDHOVEN

5.1 THE "WINDOW OF OPPORTUNITY" IN EINDHOVEN

5.1.1 Rationales for investment in FTTH networks in Eindhoven

In Eindhoven, the municipality has taken the lead in providing FTTH networks for its citizens as well as bundling the demand for new broadband services for private users (companies) as well as semi-public institutions in the region. In 2003 the municipality of Eindhoven wrote the vision document 'Glasrijk Eindhoven' (Glass fiber realm) that proposed that by 2010 the whole of Eindhoven should have access to the municipal FTTH network (about 90.000 households). An important part of this ambitious objective was demand bundeling in the different industrial parks in Eindhoven.

Research by Smidts & Gillebaard (2005) of Dialogic Consulting the pre-existing supply of glasfiber infrastructure showed that most providers of telecommunication infrastructure were available in the region (see Table 6).

Table 6: The presence of established companies per district

Gemeente	BT	Casema	Essent	Euro-fiber	KPN	Priority Telecom	Relined
Best	✓	X	X	✓	✓	✓	✓
Deurne	✓	X	X	X	✓	X	X
Eindhoven	✓	✓	✓	✓	✓	✓	✓
Geldrop Mierlo	X	X	X	X	✓	X	✓
Helmond	✓	✓	✓	X	✓	✓	✓
Nuenen	?	?	X	X	✓	✓	✓
Valkenswaard	X	X	X	X	✓	X	X
Veldhoven	X	X	X	X	✓	✓	X

Smidts, M., & Gillebaard, H. (2005). *Glasvezelinfrastructuur in Noord-Brabant. Uitkomsten van de Inventarisatie*. Utrecht: Dialogic.

However, the provision of glassfiber infrastructure in the region in 2006 was not sufficient with respect to coverage and price (for an overview, see Appendix 2 and 3). This shows that there was

a) sufficient "market failure" justification for the municipalities in Eindhoven and Nuenen to start up building FTTH networks in Nuenen and Eindhoven for residential and business users, and
b) to coordinate the development of glassfiber networks between private parties and semi-public institutions (Ring van Brabant and industrial parks) based on "opportunistic" justification (to reduce costs for the internal use of advanced broadband services for the participants involved).

5.1.2 The Socio-Economic Impact of "Ons Net"

In the region Eindhoven, a variety of broadband initiatives have developed since 2000. The example of Nuenen (de Rooij, 2006) has been used to set up the cooperative "Ons Net" Eindhoven in 2004. The municipality Eindhoven and the social construction corporations ("woningcorporaties") Hertog Hendrik van Lotharingen, SWS (merged to Woonbedrijf), Trudo, Domein en Wooninc have signed a joint letter of intent to provide 6.000 households with FTTH connections. In 2005, Tongelre started as the first district in Eindhoven to provide broadband services via a FTTH network.

Recent research on the social and economic benefits of broadband infrastructure and services claims that there is no demand of residential users for FTTH networks in the Netherlands (Bongers, Kern, Batenburg, Holland, & Brennenraedts, 2006; Vermaas, 2007). In a research project sponsored by KPN, the Ministry of Economic Affairs, the Ministry of Education, K. Vermaas (2007) proposed that the supply of broadband services by incumbent companies is sufficient for

residential users. However, the data K. Vermaas is using has not only important limitations (e.g. using not an adequate sample), but does not include data on the residential adoption of glass fiber networks, as the large scale implementation of these networks just started in 2005.

Since the mid 1990, an international discussion has emerged on social and economic benefits of broadband networks which has been divided on the character of this relationship. The concept of social capital has been crucial in these studies. Social capital consists of the value that the size, type, and structure of social contacts have for individuals, groups, regions, or nations (e.g., Coleman, 1988; Portes, 1998; Flap, 1999).

The Theoretical Discussion on the Social Impact of the Internet

However, while studies on the social impact of the internet have been increasing since the middle of the 1990s still no consensus has been reached about the character of this relationship. As earlier studies suggest that internet use either might lead to an overall decrease (Kraut et al., 1998), increase (Rainie & Kohut, 2000) or supplement social capital of users (Wellman, Quan-Haase, Witte, & Hampton, 2001). Recent findings seem to converge to the conclusion that there might be larger positive effects only for more isolated groups, but not for the general population (Hlebec, Manfreda, & Vehovar, 2006; Stern & Dillman, 2006). Other studies focus on the transformation of the users' social networks (Di Gennaro & Dutton, 2007) and point to the need for a more detailed analysis of the different social or non-social forms of internet use that might affect the users' social capital in

different ways (Williams, 2006; Zhao, 2006). However, there has been a consensus that more differentiated analysis is needed to examine the relationship between new forms of Web 2.0 applications social interaction of users. With the emergence of Web 2.0 applications in particular connected to the growth of weblogs, social networking sites and user generated contents (O'Reilly, 2005), the discussion has refocused on increasing interaction between users and (a variety of) on-line services (Mabillot, 2007).

The social impact of the FTTH network in Eindhoven

Our project was focused on the extent to which new broadband services are linked to the new glass fiber network in the regions of Tongelre and Nuenen. Furthermore, we examined how users with broadband services differed from more "traditional" users. Previous research by Kools and Serail called "Nulmeting Kenniswijk" in 2003 showed already that users in the "Kenniswijk" region in Eindhoven differed (from other users) due to the higher percentage of internet access and their higher internet activities. They utilized telecommunication services mostly for information gathering as well as for job searches and as an alternative selling channel. However, in 2003, they rarely used these services for social integration in their region (wijk) or entrepreneurial activities (Kools & Serail, 2003). Based on the literature review and the previous research in the area, a set of hypotheses was developed (see Table 7).

Table 7: Hypotheses guiding the questionnaire research

Issues	H0	Hypotheses
Link infrastructure and services	H1	"OnsNet" stimulates the usage of high speed (> 10 Mbit/s) internet access among residents.
	H2	Glass fiber connections have an effect on the use of broadband services (e.g. for weblogs/forums) in the neighborhood.
Social capital	H3	High Speed "Ons Net" users maintain via services provided by "Ons Net" their social contacts.
	H4	High Speed "Ons Net" users extend their social contacts based on services provided via "Ons Net".
Social cohesion	H5	New broadband services provide opportunities to obtain social support for residents, if needed.
	H6	New broadband services provide opportunities for inhabitants to find like-minded contacts and practically helpful contacts (advice on different domains, such as juridical, medical, financial, and other problems).

Following our research design (see Figure 5), we studied the extent to which "Ons Net" directly and indirectly contributed to the development of social capital and social cohesion. To examine these hypotheses empirically, we developed a questionnaire that was, after some pre-testing, administered by a professional call center (B&N Panelwizard) in October 2007.

Descriptive Statistics

The data from the survey come from a sample of 885 respondents drawn from the area of Eindhoven (area Tongelre) and Nuenen. Tongelre consists of the neighborhoods Kouderhoven, Karpen, t'Hofke, Urkhoven, Doornakkers-West, Doornakkers-Oost, Muschberg/Geestenberg, Lakerlopen and Villapark. It harbors close to 20.000 inhabitants (2007). Nuenen is a small town in close proximity to Eindhoven with 22.700 inhabitants (1 January 2007).

The average income in the Tongelre area is €22100 per full-time employed person, but differs widely from Doornakkers-Oost with €13700 to Karpen €48900. Similarly, the unemployment rate in the Tongelre area differs with an average of 4.2 percent from Doornakkers-Oost 8.4 percent to Karpen with close to zero percent unemployment. Interestingly, the percentage of habitants with foreign origins (i.e. Turks, Antilleans, Surinamese and Moroccans) is higher in Doornakkers-Oost compared to Karpen) see Table 8.

Table 8: Income, unemployment and foreign origins of population in Tongelre

	Inhabitants	**Income**	**Unemployment in percent**	**Foreign origins in percent**
Villapark	1752	22400	1,7	1,6
Lakerlopen	2906	14900	6,1	22,5
Doornakkers-West	3462	15500	5,8	19,2
Doornakkers-Oost	2879	13700	8,4	28,0
Muschberg/Geestenberg	3857	16500	5,1	7,4
t'Hofke	3651	16700	4,9	11,4
Karpen	454	48900	0,0	1,5
Koudenhoven	521	28400	1,9	1,3
Average Tongelre	19482	22125	4,2	11,6

Our sample included from the Tongelre area in Eindhoven 360 respondents, from Nuenen 525 respondents. From the respondents in the Tongelre area 57.8 percent (208) were connected to "Ons Net". This has to be compared with Nuenen were 75 percent of all respondents were "Ons Net" users which is consistent with an earlier study. In our sample, we found the following distribution of "Ons Net" users according to neighborhoods in Tongelre, see Table 9.

Table 9: Distribution of "Ons Net" Users in Tongelre

Neighborhood	**Percentage in the sample**	**Connected to "Ons Net" in Percent**
Villapark	15,6	32,1
Lakerlopen	8,9	40,6
Doornakkers	16,1	72,4
Urkhoven	1,9	14,3
Muschberg/Geestenberg	23,6	82,4
t'Hofke	19,7	66,2
Karpen	7,2	38,5
Koudenhoven	6,9	28,0
Total / Average	100,0	57,8

According to different forms of professional activity we found the following distribution in Nuenen and Tongelre (see Table 10).

Table 10: Distribution according to professional activity

Professional Activity	Percentage in total sample	Nuenen	Tongelre
Full-time	38,5	37,5	40,0
Part-time	23,3	25,1	20,6
Different jobs	1,6	1,7	1,4
Students	5,1	4,8	5,6
Unemployed	2,5	2,3	2,8
With Pension	22,4	21,5	23,6
Others	6,6	6,2	6,0
Total	100,0	100,0	100,0

By having a closer look at the characteristics of "Ons Net" users in Tongelre we found that the these users differ with respect to full time employment compared to other users in the neighborhoods (see Table 11).

Table 11: Distribution of "Ons Net" Users in Tongelre according to full time employment

Neighborhood	"Ons Net"	Other users
Villapark	27,8	39,5
Lakerlopen	46,2	35,3
Doornakkers	45,2	60,0
Urkhoven	NB	NB
Muschberg/Geestenberg	58,6	42,9
t'Hofke	23,4	41,7
Karpen	40,0	12,5
Koudenhoven	28,6	23,5
Total / Average	42,3	37,4

Results of our analysis

In the following we present the results of the data analyses that answer the question whether users with a high speed internet access (>=10Mbit/s) differ in their use of the internet. In Tongelre, 53,7 percent of the members of "Ons Net" had such high speed access, 32,4 percent had a lower access speed of 2 Mbit/s.[16]

In our analysis, we focused on the social forms of internet use, such as the use of blogs, social networking sites, and others that might contribute to the making of new contacts and to the creation of social capital among the citizens of Eindhoven-Tongelre and Nuenen.

[16] Information 23 january 2008.

"Ons Net" Users and High Speed Broadband Access

The results of our analysis showed that high speed users who have been a member of "Ons Net" benefitted overproportionally from new broadband services. Both dimensions have been important a) a technical dimension, i.e. users with high speed access (more than 10 Mbit/s symmetric) and b) a social dimension, i.e. users had to be a member of the "Ons Net" cooperation. From our sample 485 respondents indicated to be a member of "Ons Net" and were a user of more than 10 Mbit/s internet connection. Our statistical model showed that the most influential variable having an effect on the behavior of users to choose a high speed access has been "Being a member of "Ons Net".

High speed access and differences in use of the internet

Secondly we found that high speed internet access at "Ons Net" facilitated social forms of internet use in two ways. It increased the likelihood that users utilize the internet for the making of *new social contacts*. Moreover, it stimulated the use of the internet for the *maintenance of already existing contacts*. The results of our analysis showed that high speed "Ons Net" consumers were using more extensively Web 2.0 applications (forums/blogs) and email.

Furthermore, our analysis showed that users of "Ons Net" were able to build up *more social capital*. We found that internet telephony and emails are mainly used to maintain existing contacts. For the development of new contacts, forum/blogs were mainly used.

Our analysis furthermore suggested that "OnsNet" high speed users were more successful than other users in *preserving* their contacts that existed already before they started with high speed internet use. Online communication contributed to the enlargement of the users' social capital.

High speed access and social cohesion in the neighborhood

We then examined whether high speed internet by "Ons Net" users benefited in terms of social cohesion in the neighborhood. We conceptualized social cohesion along different dimensions:

a) Social benefits including social support (like positive responses to the question: "Making contact to someone with whom you can talk about personal problems"),
b) Informational benefits (like positive responses to the question "Making contact with someone who can give advice on medical or juridical issues", as well as access to social resources (like "Contacts to the press").

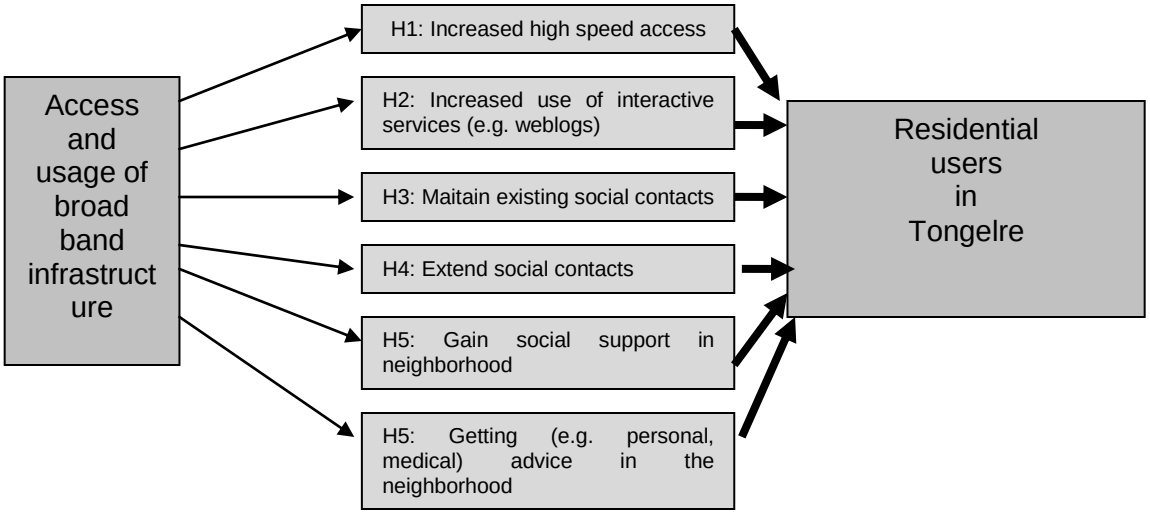
We found, furthermore, that through the use of Web 2.0 services like discussion fora users would gain concrete benefits and advice on work-related or private issues as well as on financial, medical and legal matters. In other words, these services have been tools to foster the social cohesion in neighborhoods.

High speed access benefits for low income/low education users

Our findings suggest, furthermore, that high speed "Ons Net" users with low income and low education benefitted more than high income and high education users. In particular, these low income/low educated users benefitted from making new contacts via the internet.

Our results are summarized in Figure 6.

Figure 6: Discussion of Hypotheses



5.1.3 Summary and Conclusions from the User Survey

In contrast to other studies in the area commissioned by the Ministry of Economic Affairs, KPN and others undertaken by Dialogic (Vermaas, 2007), we found that

Box 5: Results of User Survey in Tongelre

- OnsNet stimulated the use of high speed internet access.
- OnsNet stimulated users to utilize the internet for the making of new social contacts and for the maintenance of already existing contacts.
- OnsNet users were able to develop more social capital compared to other users.
- Interactive services like weblogs and forums have been important tools in neighborhoods to increase social cohesion due to social and informational benefits provided by these services.
- We expect that these results to be significant on the neighborhood level ("wijk) in Tongelre comparing "low income/education" with "higher income/education" neighborhoods

5.2 BENEFITS FOR BUSINESS USER OF FTTH NETWORKS

Business Users and Broadband Services

The theoretical discussion on the adoption behavior of business users in the late 1990s has shown that cost motivations have been the primary driver for internet use of small- and medium-sized companies (SMEs) (B. Sadowski, Maitland, & van Dongen, 2002). It seems that even with the emergence of broadband services for business users which characterize a new stage in the development of the Internet (Bar et al., 2000), this motivation still remains a primary incentive to adopt business services by SMEs. With the availability of new broadband services, however, it has become important for business users to have initially low price level for the adoption of broadband services. After the adoption of these services, they will remain "lock-in" to these services, i.e. their demand becomes price inelastic (Duffy-Deno, 2003). This represents a major opportunity but also a threat for business users. On the one hand, (public) incentives to link business users to broadband networks are only temporary. After the usage of broadband services, business users will continue to do so even if prices are rising. For SMEs, this represents also a threat as these companies can become "locked-in" with service providers that might raise prices (in a second period) after an initial first period of low prices. Large companies have more choices in this context as they have more bargaining power vis-à-vis service and infrastructure providers due to higher demand which might even allow them to provide these services in self-supply. Demand aggregation has been a strategy for SMEs to achieve similar cost and demand advantages vis-à-vis private suppliers.

Table 12: Reasoning for firms to engage in BRE

Issues	H0	Hypotheses
Use of infrastructure and services	H1	Increasing use of broadband services by private firms
	H2	Cost reasoning primary motivation to engage in the rollout of glass fiber infrastructure.
	H3	Large firms can use glass fiber infrastructure for new (business) opportunities.
Cooperative "BRE"	H4	Efficient way of providing customer owned network
	H5	Coordination problems in cooperative due to upgrading of network
	H6	Different usage pattern between small- and medium-sized enterprises (SMEs) and large firms (in BRE)

Customer-owned versus supplier-owned models for demand aggregation

The international experience has shown that municipalities can have a role in demand aggregation of SMEs (Lattemann, Kupke, Stieglitz, & Schneider, 2006; Tookey, Whalley, & Howick, 2006). However, distinctions between different models of demand aggregation of SMEs have rarely been made. In contrast to the carrier owned model, the customer owned model is intrinsicly based on open access (that means aviods discriminatory access), should guarantee quality of service and allow more easily further upgrading of the network. The choice for this model is depending on two criteria: the reluctance of existing carriers to invest in a carrier-owned model and the existing of demand for new broadband services. Customer-owned models have a number of characteristics that makes them an attractive option for demand aggregation of mostly SMEs. For the aggregation of demand in Rotterdam, the Project Group Realisatie Glazen Maas (2005) defined the characteristics of these models in the following way: Customer-

owned models allow users to take influence on the design phase of the network, are flexible with respect to upgradeability with respect to FTTH concepts, should be considered as an investment with long depreciation and can be a low cost option for users. However, these models have also disadvantages as the parties involved with different interest have to work closely together. In addition, for most parties involved network ownership and management are not considered as core activities (ProjectgroepRealisatieGlazenMaas, 2005). Customer-owned models have a major advantage, compared to the carrier-owned model that they reduce the threat of "lock-in" of business users. Customer-owned models have been the preferred models for the provision of FTTH networks for business users in the Eindhoven region.

Box 6: Advantages and Disadvantages of Customer-Owned Models

- **Customer-owned models are a way to aggregate demand for broadband services for business users in particular small- and medium sized enterprises under conditions of**
  - **Insufficient supply of broadband infrastructure and services by existing market players**
  - **Expected high demand for advanced broadband services by business users**
- **Customer-owned models have the following characteristics vis-a-vis carrier owned models**

	ADVANTAGE	*DISADVANTAGE*
Cost	**Initial high cost, but later low cost upgrading**	
Network Design	**Users can have an active role**	
Upgradeability	**Can be done**	
Network Operation		**Not core business**
"Lock-In"Effects with Carriers	**Can be avoided**	
Network Ownership	**If considered as long-term investment**	
Legal		**More complicated, mostly by setting up a limited partnership**
Financing		**Requires start-up financing**
Flexibility	**High, as customers are also owners**	
Risks		**Requires cooperation between different parties**

However, there has been rarely any experience with respect to the functioning of these models over time. Therefore, this part of the report has an explorative and qualitative character. It is focused on the experiences with three different customer-owned models: the Regional Broadband Consortium South East Brabant, the Broadband region Eindhoven (BRE BV) consortium amd Glass fiber Eindhoven (GVE BV).

5.2.1 Regional Broadband Consortium South East Brabant

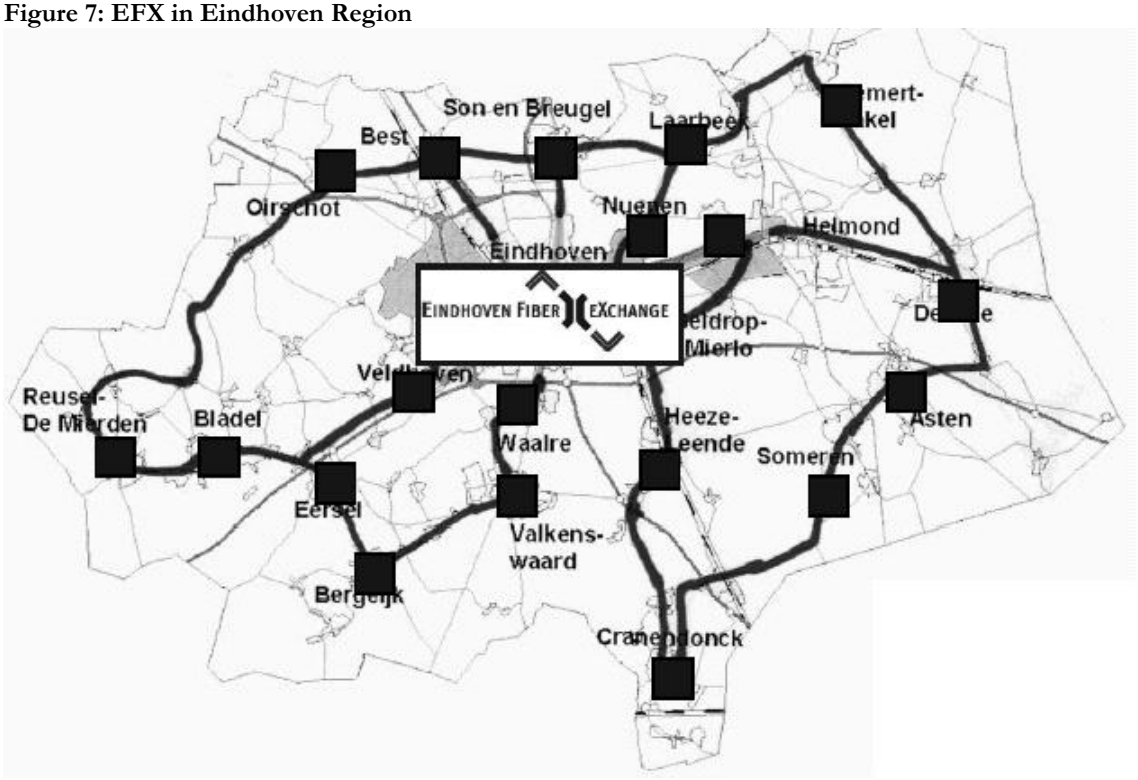
As a first step to bundle demand in the region, the Regional Broadband Consortium South East Brabant (RBC) was initially set up. Part of the RBC have been approximately 24 institutions (local goverment, non-profit as well as private companies). The initial idea was to implement a glass fiber ring ("Ring van Brabant") that should link 3 industrial parks, 100 schools and 50 residences for the elderly ("Verzorgingstehuizen"). The municipality Eindhoven was the initiator and coordinator of this initiative. As a first step the Ring of Brabant based on managed dark fiber linked the municipalities in Helmond, Geldrop-Mierlo and Veldhoven. This consortium has been vital for the growth of other consortia like Broadband region Eindhoven (BRE BV) and Glas fiber Eindhoven (GVE).

5.2.2 Broadband region Eindhoven (BRE BV)

As pilot project for demand bundeling, the implementation of glass fiber networks in the industrial parks de Hurk and Esp was started in April 2007. Initially the Broadband region Eindhoven (BRE BV) consortium (in which the municipality has been playing an important role) was set in 2005 up to bundle the demand for glass fiber connections and to develop the glass fiber ring around Eindhoven. BRE BV comprises of a number of mostly large companies (like FEI and Philips) in conjunction with large (semi-) government institutions like hospitals and foster homes (e.g. St. Catharia hospital, St. Anna Zorggroep), social housing corporations (e.g. Trudo and Woonbedrijf) as well as the municipality of Eindhoven. Part of the consortium is the Eindhoven Fiber Exchange (EFX) founded in August 2005 by Eindhoven

University of Technology and the municipality of Eindhoven. The objective of EFX has been to provide an exchange for communications networks for the region of Eindhoven by linking local, regional and interregional networks via the interconnection of glass fiber (see Figure 8). By developing one centralized exchange, other mutual connections can be established or removed to offer great flexibility to participants. This neutral and independent exchange is located at the campus of the Eindhoven University of Technology. EFX encourages research projects and participates in the testing of new technologies which provide new and innovative, crossconnection opportunities for the exchange. EFX serves as platform for experimentation and learning with new broadband services. Currently it only acts as a point where demand of different private and semi-private parties is bundelt but there are new emerging options for example in the area of wireless technologies that are still unexplored. To realize these options an "innovation" rationale of the municipality would be warranted.

Figure 7: EFX in Eindhoven Region



The BRE BV consortium has its own purchase organisation and derives from this its cost advantages due to demand aggregation. As there are variety of stakeholders in this consortium decision-making has been difficult as well as the parties providing active services have been limited.

5.2.3 Glass fiber Eindhoven (GVE BV)

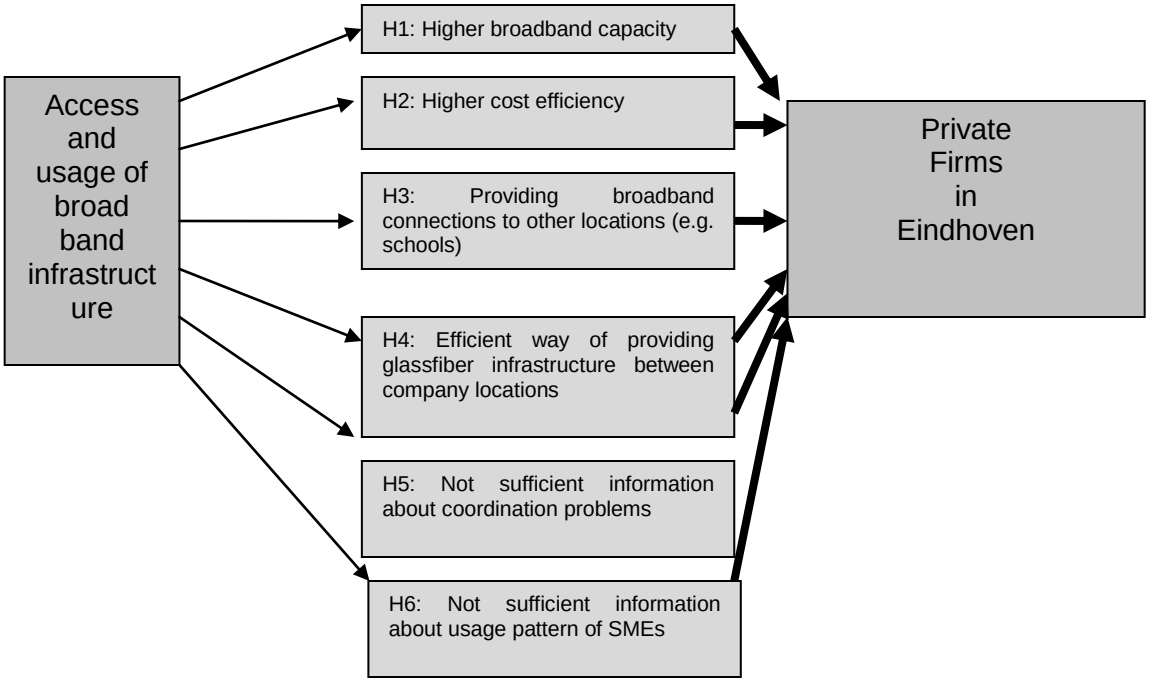
Another consortium that has been involved in the aggregation of business demand has been the Glass fiber Eindhoven (GVE BV). For both parks Glass fiber Eindhoven (GVE BV) has been used that is based on the demand aggregation of users. Participants in the model set up limited partnership (BV) and buy dark fiber between their own locations (customer owned). The BV enters into an agreement with a contractor, buys the network and makes it available to the participants on the basis of the user agreement. In these partnerships, the municipality carriers proportional risks and is involved under the same financial conditions as other market parties (market investor principle). In this model, the municipality is not only acting according to opportunitistic rationales (e.g. to decrease costs) but should also strive for larger general economic and social benefits (MINEZ, 2006).

In the industrial parks de Hurk and Esp was the demand for broadband services very high. Companies in de Hurk were aiming for large scale implementation of a broadband infrastructure as they were more affected by competition and were aiming at gaining a competitive advantage with such network. In addition, the board of entrepreneurs

(ondernemingsvereniging) was very active involved in the set up of a broadband network. In Esp which is a smaller industrial park, there was some enthousiasm about such project among company managers. In both industrial parks, a critical mass of business users for new broadband services was needed. In December 2007, 40 percent of coverage from business users committing themselves to the project in Esp was realized. However, in de Hurk this percentage was at about 35.

The function of the municipality has been to provide finance and give orders to companies as well as organize meetings. As the municipality does not directly gain from these network, its function is to provide an attractive locational advantage for companies that are aiming to locate in Eindhoven. In this way, the municipality stimulates these initatives also to improve the usage of ICT in companies and to foster innovation processes in companies, in particular in SMEs. Furthermore, the interaction between institutions for higher eduction and private companies should be stimulated. The aim of the municipality is in addition to stimulate the exploitation of a flexible infrastructure.

Figure 8: Results and Hypotheses for Private Firm Usage



In general, we found qualitative support for our first four hypotheses (broadband capacity, cost-efficiency, increased broadband connections between locations of companies and BRE as efficient way of providing glassfiber infrastructure). We could not get sufficient information concerning the last two hypotheses (coordination problems BRE, usage patterns SMEs) (see Figure 9).

5.2.4 Summary and Conclusions

We approached for the qualitative analysis a number of participants from the BRE BV consortium in order to gain insights into their perceptions of the working of this consortium. The interviews were undertaken during the period October to December 2007. A number of participants from the BRE BV consortium were approached. Our

interviews among these users showed the following picture (for the interview questions see Appendix 4):

Box 7: Results of analysis under business users

- Business users have, in general, been satisfied with FTTH networks;
- cost reasons and quality requirements have been important for companies to engage in FTTH networks; and
- they expect a more integrate vision for the development of the different FTTH networks in the region from the municipality.

6 SUMMARY, CONCLUSIONS & FURTHER RESEARCH

6.1 SUMMARY

In order to develop an integrated vision (I-vision) on municipal network development in the Eindhoven region, we first studied existing policy rationales to invest in municipal networks in their appropriateness with respect to the existing regulatory and legal framework in the European Union and in the Netherlands (section two). As the innovation rationale for the Tongelre network has been important (as part of the Kenniswijk subsidy 2003- 2005), for the networks in industrial parks market failure rationales have been advanced. As the Eindhoven region gained some experiences with cooperative (customer-owned) models during the period of the Kenniswijk subsidy, these models have been applied to the development of municipal networks for residential as well as business users in order to aggregate demand (section three). Within a public – private partnership (PPP) framework, these customer-owned models are based (to different extent) on the contribution of (semi-) public institutions and private firms technologically (at different layers of the network), economically (e.g. with respect to financial contributions) as well as politically (e.g. with a different role for the municipality).

6.2 CONCLUSIONS

As the FTTH projects among residential users and business users both showed positive results in 2007, these projects have been undertaken "at the right time at the right place". In other words, the initial role of the municipality in encouraging the adoption of customer-owned models by residents ("Ons Net") as well as private firms and (semi-) governmental institutions ("BRE BV) has been favorable for the growth of these initiatives. However, as these different projects have been

isolated (in particular the different business-related initiatives), it is currently important for the municipality to re-define its role in these initiatives and to develop an integrated vision for Eindhoven. In addition, the municipality has to think about additional initiatives e.g. that bring low-income residents on-line, increase the viability of and the social cohesion in "bad neighborhoods". For initiatives in industrial parks, even customer-owned models seem to provide a better alternative compared to carrier-owned models, the continuous evaluation of these initatives is necessary to avoid an "over-engagement" of municipalities in terms of investment and coordination efforts.

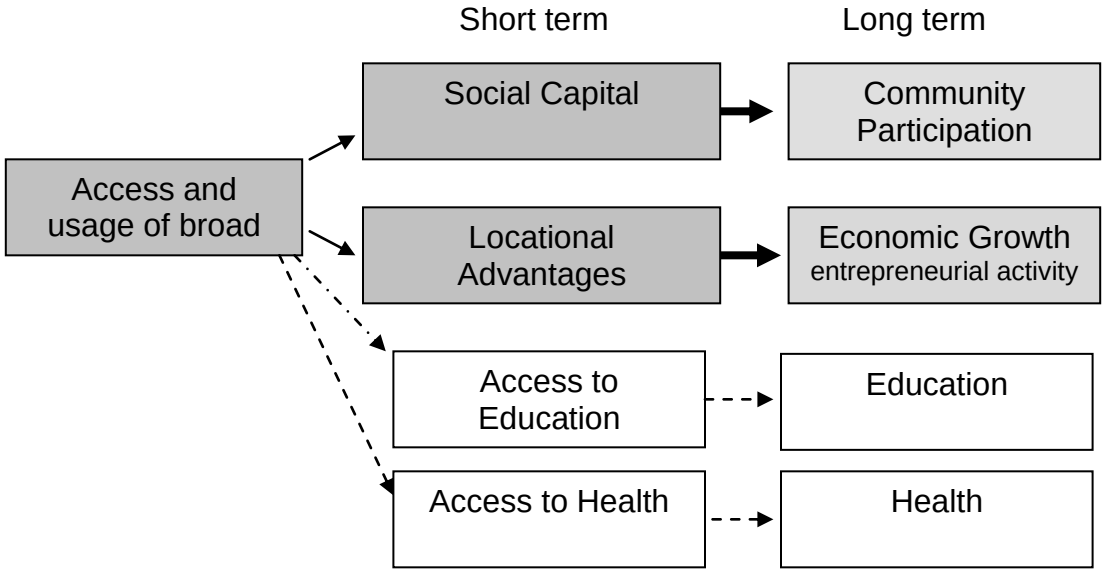
6.3 FURTHER RESEARCH

Our previous attempts to send emails to residential users of "Ons Net" in Tongelre (Eindhoven) based on the existing mailing lists of these cooperatives could not be realized. However, there might be another opportunity to do so in 2008. This might allow us to use database from "Ons Net" for a large scale survey (>1000 respondents). Another idea has been to match the responses from the survey with "objective" data on internet traffic in these two areas, which can be provided by NEM or partly also by Edutel could not yet be realized. As these traffic data have already been used in other studies (Fukuda, Cho, & Esaki, 2005; Siekkinen, Collange, Urvoy-Keller, & Biersack, 2007), this approach seems promising to link user data to actual traffic data. This would allow us also to check for other issues such entrepreneurial activity (related to economic growth) and community participation issues (see Figure 8).

There are other options for further study which we did not exploit related to the role of local governments in initiative for broadband

access and education (in particular schools) as well as broadband access and health (this is related to issues like the local provision of telediagnostics and telemedicine).

Figure 9: Further Research



7 TOWARDS AN INTEGRATED VISION: POLICY OPTIONS FOR MUNICIPALITIES

Municipalities have a variety of policy options to provide incentives for the development of FTTH networks in their regions. In Eindhoven, the Municipality has chosen a two-fold strategy aimed at providing incentives to stimulate demand as well as stimulate supply activities for the provision of glass fiber infrastructure and services running over

this infrastructure (Gemeente, 2003). There are a variety of policy options in which these developments can be continued (See Table 14).

Table 13: Different policy options for local government

Role local government	Vision Glasrijk	Future options
Demand Side		
Measure demand		1. Continuous demand assessment (survey or online registrations) 2. Monitoring growth in traffic in neighborhoods
Aggregate demand	1. Bundling of demand in own organization 2. Local government as launching customer	1. Extension programs (training business in effective use), 2. Sectoral pilots (e.g. telemedicine, e-government, distance education)
Stimulate demand	1. Stimulus of demand for broadband of companies 2. Support neighborhood initiatives for broadband demand 3. Direct demand stimuli for residential users	1. Community technology centers (training disadvantaged citizens in ICT use)
Supply Side		
Providers	1. Establishing non-profit organization for exploitation of glass fiber network 2. Other financing options	1. Providing grants or loans
Users		Providing particular services and equipment
Community Groups		Planning grants and training

However, there are a number of options the municipality can use to stimulate municipal glass fiber networks ranging in particular in the area of rulemaking (providing and defining access to local facilities, coordinating of planning, negotiating with suppliers) and in developing parts of the necessary infrastructure themselves by targeting specifics groups of users and specific aspects of infrastructure. In these cases,

however, municipalities have to define their role in the supply of infrastructure and services (i.e. their particular business case).

What we propose based on the results of our research is the following:

1. Further support for the rollout of glass fiber infrastructure in different parts of Eindhoven city. This might actually also call for an active policy in facilitating rollout in parts of the city which are just below the threshold level for residential customers.

(Explanation: As the rollout of the glass fiber infrastructure has been considered by market parties at least since the end of 2007 as a threat to their revenue streams, their marketing campaigns are aimed at just targeting the marginal residential user necessary to gain critical mass in particular areas in Eindhoven (Olsthoorn, 2007)).

2. The glass fiber infrastructure in the city of Eindhoven will become necessary for a wide variety of networks requiring a glass fiber backbone to provide new services.

(Explanation: A glass fiber backbone is a must for WiMAX which can provide in a complementary manner targeted services e.g. telemedicine for particular neighborhoods. If such backbone is not available the growth of new services will be retarded).

3. The municipality has a role in providing a testing and experimentation environment for new services in Eindhoven.

(Explanation: Internationally there is a lot of testing and experimentation with wired and wireless networks also provided by municipalities underway (Ballon, Pierson, & Delaere, 2005), however currently it is unclear what are the technical and market characteristics under which these networks might succeed. Therefore it is necessary for the Municipality of Eindhoven to foster these developments. It currently might be appropriate for a municipal WiMAX network in Eindhoven to support the testing of these new technologies (B. Sadowski, Nucciarelli, & Verheijen, 2008).

4. It will become more and more a necessity to link the growth of infrastructure to the growth of new innovative services. This requires targeted initiatives in which the municipality might be just one (but active) partner on the negotiating table.

(Explanation: Our current vision on the development of different wireless networks in city of Eindhoven is more of a bottom-up approach in which different neighborhoods will be targeted with particular innovative services like telemedicine requiring a variety of partners from social housing corporations to health insurance companies. These wireless networks can later connect to other networks with other services in a different neighborhood).

5. To experiment and test new services it will become necessary to continuously monitor the demand in the different neighborhoods. This should be done as a regular (annual) exercise to "filter" the different needs and demand for new services.
6. It is still too early to propose measures for municipal initiatives in industrial parks in Eindhoven. For the time being, we would advice

to complement our qualitative (interview) study with more quantitative (questionnaire or semi-standardized interview) research on demand for broadband by small- and medium sized companies. Furthermore, it will be interesting to further examine options provided by large firms in the BRE consortium to contribute to the growth of glass fiber network in the region.

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Appendix 1: Objectives in the Coalition Agreement (2006) and "Glasrijk Vision" (2003)

On the basis of this vision, the municipality of Eindhoven developed a two-tiered strategy to facilitate the development of a glass fiber network in the region. On the one hand, this strategy focuses, on the demand side, by

a) fostering the bundling of demand in government and semi-governmental organizations;
b) acting as "launching customers" for own service provisioning and providing stimuli for usage of broadband services by partnering institutions;
c) providing incentives for the demand for broadband at industrial parks (fostering bundling of demand and offering stimuli for the demand of companies);
d) facilitating local initiatives of residents with respect to the demand for broadband services; and
e) providing directly incentives for residents to use broadband services.

On the supply side, this strategy has been aimed at

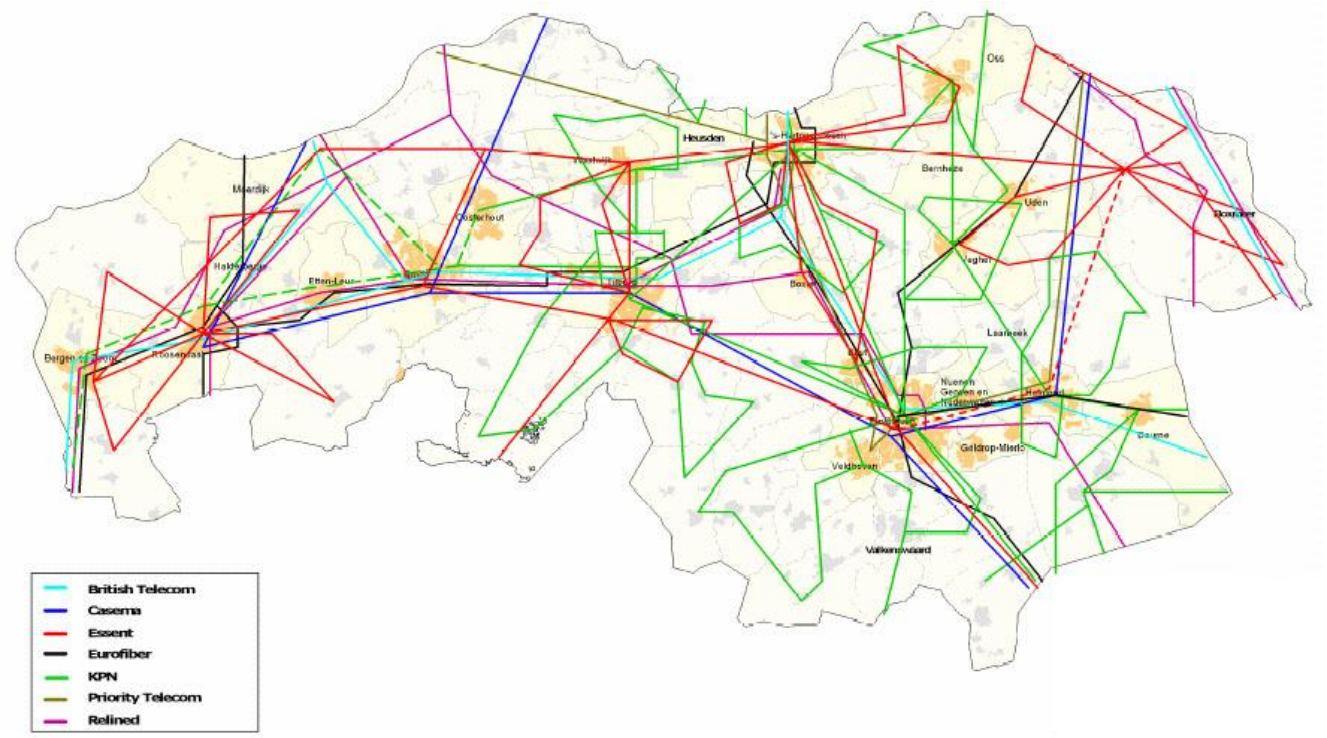
a) establishing a non-profit organization which should be instrumental in coordinating the large scale roll out of glass fiber in the region;
b) procurement (of parts) of the glass fiber infrastructure to stimulate the supply of glass fiber networks in the region;
c) development of complementary local initiatives (like financial incentives) to lower the threshold for the adoption of glass fiber infrastructure (GemeenteEindhoven, 2003).

General Objectives	**Glassrijk Eindhoven (2003)**	**Coalition Agreement (2006)**
	Vision and Objectives	***General Socio-Economic Objectives (pages 1-2)***
Economic Growth		Improving economic restructuring
	Locational advantages for companies (5)	International Profile as Top Technology Region
		Link between education and work
Quality of Life and Health		Social Division
		Poor/ Rich Districts ("wjken")
		Chances on the labor market
		"Black"/"White" Schools
		Healthy / Sick people
		Level of intervention District ("Wijk")
Community Participation		***Citizen and Public Administration*** *(pages 2-12)*
		Security and Maintance
		Social Order and Security
		General supervision in Districts
		Electronic service provision
		Restructuring of industrial parks
		Investment in ICT applications & Coordination of glassfiber development
Education	**Intersting for students (5)**	***Youth and Social Agenda*** *(pages 12-13)*

Appendix 1: cont.

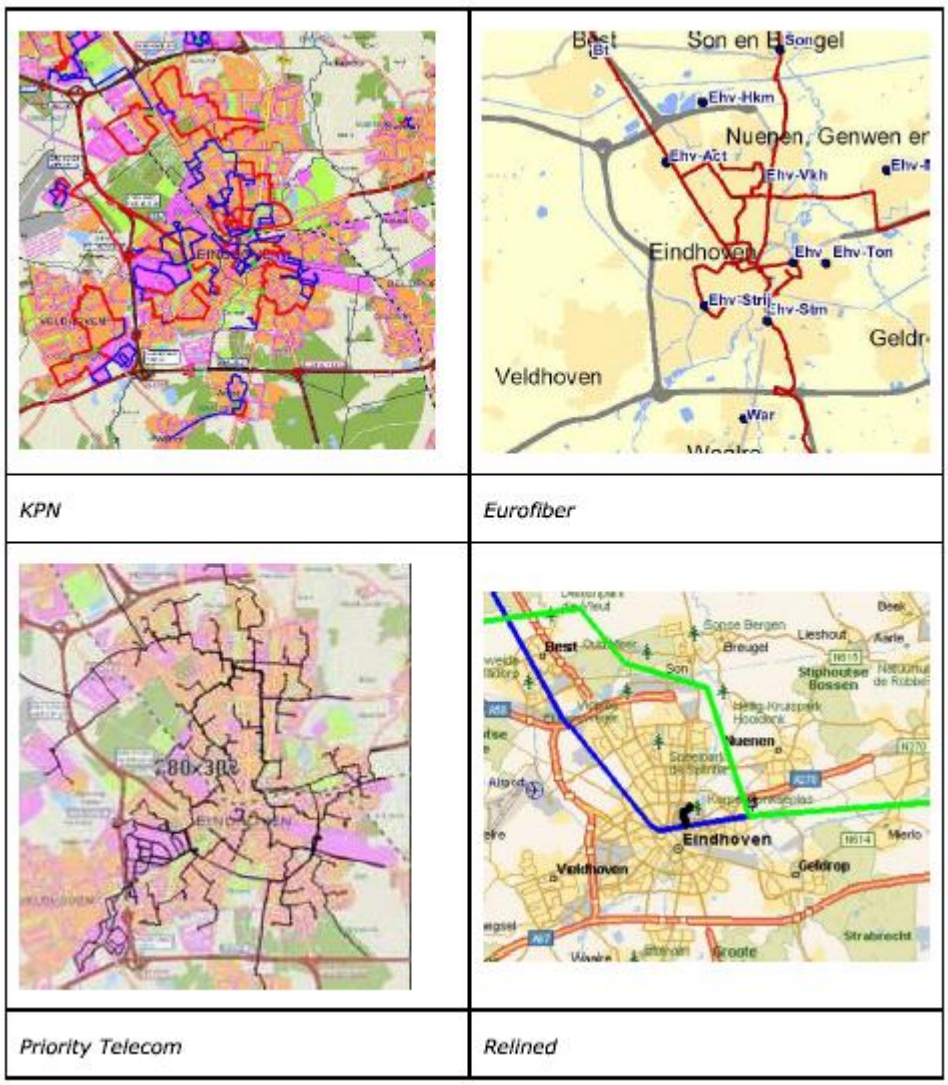
General Objectives	Glassrijk Eindhoven (2003)	Coalition Agreement (2006)
Quality of Life and Health		***Health and Welfare*** *(pages 13- 17)*
		Unequality on the labor market
	Support for initiatives of residents with respect to demand for broadband, Directs stimulation of demand by residents	District oriented planning for distadvantaged districts ("wijken")
		Cultural Diversity
		Facilitating volunteer work
		Improving health
		Culture and Sports
		Promoting sports organizations
		Space and Living (pages 17-19)
		Role van Social Housing Corporations
		Environment and Waste Disposal (pages 20-23)

Appendix 2: Glassfiber Networks in the Eindhoven Region



Smidts, M., & Gillebaard, H. (2005). *Glasvezelinfrastructuur in Noord-Brabant. Uitkomsten van de Inventarisatie*. Utrecht: Dialogic.

Appendix 3: Glassfiber Networks per Carrier (excl. Edutel)



KPN | *Eurofiber*

Priority Telecom | *Relined*

Smidts, M., & Gillebaard, H. (2005). *Glasvezelinfrastructuur in Noord-Brabant. Uitkomsten van de Inventarisatie*. Utrecht: Dialogic.

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Appendix 4: Detailed statistical results

"Ons Net" users have been much more likely than other users to have a high speed internet access (significance χ^2 =122.4, p<.001). High speed "Ons Net" consumers were using more extensively email (significance χ^2 =8.602, p<.003), internet telephony (χ^2 =8.731, p<.003), and forum/blogs (χ^2 =8.332, p<.004). Even if the first two activities do not lead to new contacts, they are used to maintain existing contacts. Our regression results confirmed these findings when controlling for education, gender and house ownership. We could confirm the link between the different forms of internet use with the development of social capital in the case of internet telephony.

The analysis of the relationship between the use of forum/blog activities by "Ons Net" high speed users and the making of private (strong) contacts showed significant results (χ^2 =18.24, p<.001). Similarly the relationship between forum/blog activities of users and new on-line acquaintances (weak contacts) was significant (χ^2 =41.58, p<.001).

As we wanted to know more about the characteristics for users to choose a high speed connection, we formulated a logit model that related the measure for high speed access, denoted for convenience as *HIGHACC*, to a vector of regressors x_i. The underlying regression has been defined as:

$$HIGHACC_i^* = ß' x_i + \varepsilon_i \quad (1)$$

where ß are the estimated coefficients and ε_i is a normally distributed error term. We observe

$$\text{HIGHACC}_i = \begin{cases} 1 & \text{if HIGHACC}^* > 0 \\ 0 & \text{otherwise} \end{cases}$$

(2)

where *HIGHACC* = 1 represents the probability that a user utilizes high speed access and $HIGHACC_i$ = 0 if he does not. In other words, there is a critical threshold of the index called *HIGHACC** in a way that if $HIGHACC_i$ exceeds *HIGHACC** the user will choose high speed access otherwise he/she will not. The application of a logit model allowed us to estimate the probability that users choose high speed access conditional on a number of independent variables. The main interest of the present study is to find out how the independent variable for "Ons Net" (denoted by OSN) affects the dependent variable (*HIGHACC*) controlling for other variables in the model like education (*EDU*), nationality (*DUT*), house ownership (*HOU*), gender (*GEN*) and age (*AGE*). In the questionnaire, membership of "Ons Net" is identified as positive response to the question whether (or not) the user is via "Ons Net" connected to the internet. For the variable *ONSNET* a positive sign is expected.

Our logistic regression showed the following results:

$$HIGHACC = -1.61 + 2.72OSN + 0.47EDU + 0.31DUT + 0.56HOU + 0.01GEN + 0.10AGE$$

The model was highly significant (χ^2 =95.88, p<.001). The variable of interest OSN was positive and highly significant. All other independent variables for education, house ownership, nationality, gender and age have not been significant.

Table 14: Logistic Regression High Speed Access

Regression	1
Variables	High Speed Access
Constant	-1.610
	(1.056)
OnsNet	2.717***
	(0.303)
Educ	0.475
	(0.105)
Dutch	0.314
	(0.432)
House	0.559
	(0.362)
Age	0.005
	(0.010)
Gender	0.0967
	(0.326)
Observations	461
χ^2	95.88
P	0.000***
- 2LL	153.48
Pseudo R^2	0.238

Note: *** = significant at 1 %; ** = significant at 5 %; * = significant at 10%. Standard errors are in parentheses. The estimates are robust maximum-likelihood probit estimates.

We found, that the usage of blogs and discussion fora increases the likelihood that the user regularly spends some time (15 minutes or more per week) with new contacts that s/he made through the internet (χ^2 =9.82, p<.002). Moreover, from the communication in blogs and fora he gained some concrete benefits. We found that the usage of blogs and discussion fora increased the chance that the user met somebody on the internet with whom he/she…

- would discuss work-related problems (χ^2 =25.05, p<.001);
- would discuss private issues (χ^2 =32.86, p<.001);

- would provide a (good) reference, if needed (χ^2 =23.26, p<.001);
- would help in case of moving to a new house (χ^2 =9.44, p<.002);
- would provide advice in family matters (χ^2 =21.08, p<.001);
- would provide financial advice (χ^2 =18.89, p<.001);
- would provide legal advice (χ^2 =16.80, p<.001);
- would provide medical advice (χ^2 =7.26, p<.007).

In other words, these interactive services are tools to foster the social cohesion in neighborhoods. For services like internet telephony or email we did not find similar results.

As Table 15 shows, the social capital increasing effects of the use of these services cannot be explained by socio-demographic differences. The effects keep significant when we control for a number of these differences. Table 15 shows the effects of the use of blogs and discussion for a on three concrete benefits, namely on the chance to meet someone who can provide work related advice (regression 1), private advice (regression 2) or someone who would be willing to help in case a resident would be moving to another house (regression 3).

Table 15: Logistic Regression Social Cohesion and User Characteristics

Regression	1	2	3
Variables	Work related Advice	Private Advice	Moving to new house
Constant	0.298	- 0.307	- 0.554
	(1.285)	(1.015)	(1.299)
IntServ	1.22**	1.23***	0.730***
	(0.418)	(0.316)	(0.408)
Educ	- 0.267*	- 0.204*	- 0.213*
	(0.116)	(0.116)	(0.116)
Dutch	0.728	0.429	0.626
	(0.778)	(0.558)	(0.767)
House	- 0.904*	- 0.678*	- 1.190*
	(0.412)	(0.332)	(0.399)
Age	- 0.034*	- 0.025*	- 0.019*
	(0.139)	(0.106)	(0.013)
Gender	-0.720	-0.292	-0.397
	(0.425)	(0.312)	(0.402)
Observations	823	823	823
χ^2	39.41	42.16	24.18
P	0.000***	0.000***	0.000***
- 2LL	105.80	167.42	113.42
Pseudo R^2	0.157	0.112	0.096

Note: *** = significant at 1 %; ** = significant at 5 %; * = significant at 10%. Standard errors are in parentheses. The estimates are robust maximum-likelihood logit estimates.

Appendix 5: Interview questions for half-standardized questionnaire (in Dutch)

- *Wat heeft het gebruik van een eigen FTTH netwerk voor voordelen voor uw bedrijf? (qua kosten, snelheid, kwaliteit, upgradability, etc.). Wat was de belangrijkste factor om deel te nemen aan de aanleg van het FTTH netwerk van BRE? (bijv. overstappen omdat kwaliteit en snelheid beter zijn)*
- *Hoe gebruikt u het FTTH netwerk? Voor welke soort breedbanddiensten of alleen voor verbinding tussen bedrijven (eigen concern)?*
- *In hoeverre is het customer owned model van BRE geschikt voor de behoefte van uw bedrijf? Wat zijn de nadelen?*
- *In hoeverre heeft de gemeente haar voortrekkende rol (regie functie) bij de aanleg kunnen vervullen?*
- *Wat verwacht u van de ontwikkelingen van FTTH initiatieven op de industrie terreinen? (andere technologieën, het instappen van KPN, Draadloos)*
- *Wat zijn uw ervaringen met glasvezel tot nu toe?*
- *Wat verwacht u van uw glasvezel netwerk van BRE in de toekomst? (andere diensten? Ander model?, Investeringen?)*