Providing Incentives for Private Investment in Municipal Broadband Networks: Evidence from the Netherlands

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Abstract The growth of municipal glass fiber networks across Europe has since the 1990s been surrounded by high uncertainty and risk. As the existing legal and regulatory framework in the European Union (EU) provided sufficient grounds for an innovation rationale, the Dutch government decided in early 2000s to provide subsidies for a regional experimentation and testing environment called "Kenniswijk" (Knowledge District) with Nuenen as location for a glass fiber network. In order to examine the effects of this network, we utilize the concept of local experimentation and testing system, i.e. an environment in which different actors are able to explore and learn from the implementation of new infrastructure technologies and services in a (local) real life setting. By undertaking a techno-economic analysis, we found a) that government subsidies have been vital for local municipal network in Nuenen; and b) that the knowledge gained about the characteristics of this network facilitated further investment of municipal networks throughout the Netherlands.
Keywords municipal networks, innovation tationale, experimentation and testing system

1 Introduction

Since 2000, a number of local initiatives have emerged in the Netherlands aimed at implementing Fiber-to-the-Home (FttH) networks in different municipalities. At a first glance, this seems surprising as the Netherlands has been one of the leading countries with respect to broadband internet penetration in the world (OECD, 2007). Since the late 1990s, market parties accounting for the lion's share of broadband access (i.e. incumbent operator KPN and different regional cable operators) have shown that they are able to propel broadband internet to high levels of penetration. Interestingly, alternative access technologies such as glass fiber networks have until recently rarely been used and contributed in 2005 a mere 0.1 percent to the Dutch broadband access markets (EC, 2007). However, in the past two years these technologies have increasingly gained popularity. It seems that municipal initiatives (mostly based on collaborations of local governments, social housing corporations and new entrant companies) have been important in stimulating the growth of glass fiber networks in the Netherlands.

The development of municipal networks in the Netherlands has to be considered in the context of European liberalization of markets for network access in the late 1990s. As a result, a number of alternative networks emerged throughout Europe based on a wide variety of technical characteristics as well as ownership structures (CEU, 1999). Since 2002, the European Commission (EC) has become active in examining on a case-by-case basis whether or not these networks have been in line with European Union (EU) legislation. The EC has been in favor of these networks if they were considered as part of the European drive towards realizing the goals of the Lisbon Agenda in line with the new regulatory framework and compatible with Article 87(1) of the EU Treaty on State Aid. Under these conditions, municipalities had to justify their investment in and/or provision of new telecommunications infrastructure and services. Most of the legislative and regulatory discussion in the European Union has been on whether (or not) municipal networks can be justified in cases in which private investment alternatives are considered as not adequate or address some basic infrastructure needs in the region. In contrast to these justifications for the establishment of municipal networks, we will show that municipalities can provide experimentation and learning environments for new infrastructure and service technologies for different market and non-market parties in their respective region. Such local experimentation and testing system[4] can be defined as environments in which different actors can explore and learn from the implementation of new infrastructure technologies and services in a (local) real life setting. The success (failure) of these systems can be measured based on the extent to which

[4] Ballon et al. (2005) have introduced the idea of experimentation and learning platforms. However, their approach has not been (yet) used to evaluate these platforms. Here the literature on "localized knowledge spillovers" and "innovative milieux" has substantially contributed to the analysis of knowledge generation, knowledge spillovers and tacit knowledge (Breschi & Lissoni, 2001).

these environments are able to overcome systems failure (e.g. in the coordination of different actors), involve users in the innovation process and facilitate private investment.

In the following sections, we, first, discuss rationales and forms of local government involvement in municipal networks in the context of the existing legal and regulatory framework in the European Union (EU) (see Section 2). Second, we characterize the factors behind the recent growth of municipal networks in the Netherlands and examine the role of the Nuenen network as experimentation and learning platform for municipal networks by undertaking a techno-economic analysis (see Section 3). Thirdly, we discuss our findings and put them in a context of the current discussion on the European regulatory and legal framework (see Section 4).

2 Municipal Networks in the European Context: The Theoretical and Regulatory Discussion

2.1 Justifications for (Local) Government Involvement in Municipal Networks

2.1.1 Basic Infrastructure Rationale

Municipal networks can be justified based on the assumption that the municipality has a function in providing basic infrastructure services. Such services should a) be used by all citizens and are considered as essential services; b) have the characteristics of a natural monopoly (or have some form of a public good); and c) be responsible for significant spillover benefits, which entail the role of government or complementary to it (Lehr et al., 2006). This rationale has frequently been used in close correspondence to the concept of Universal Service Obligations (USO). However, for broadband services it is currently not (yet) applicable.[5]

2.1.2 Market Failure Rationale

The case for (local) government intervention in building and operation of municipal networks has traditionally been resting on the assumption that these markets can be used as a remedy for market failure, that is, private investment alternatives are considered as inadequate. In these cases, the number of private companies entering the market is too low or even zero as there are no incentives for any private carrier to offer service. These limited incentives are due to the costs of deploying new infrastructure and operate new services as they are considered too high (and uncertain) with respect to the expected revenue.

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 significant sunk, fixed, and shared costs in the provision of telecommunication infrastructure, substantial scale and scope economies can arise possibly limiting the number of providers that can be sustained. Second, a 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[6] 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 sufficiently competitive alternatives in terms of prices, breadth of selection, or quality of broadband offered services (Lehr et al., 2006).

2.1.3 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 telecommunication services. Such entry into the provision of these services can be aimed at taking advantage of scale and scope economies given that only incremental investment is required. A variety of reasons can lead municipalities to do so (e.g. if such investment allows to more cost-efficiently use of information technology internally or in conjunction with other semi-public institutions) (Lehr et al., 2006). In this way, municipalities can act as a Schumpeterian entrepreneurs as they perceive opportunity and act on this perception (Link & Siegel, 2007).

[5]Reding (2007) expects that an initiative by the EU to include broadband in the universal service obligation will not be finalized until 2009.

[6] 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.

2.1.4 Innovation Rationale

In dynamic market situations, characterized by high costs, risks and limited appropriability markets might not provide sufficient incentives to invest in new infrastructure and services (Martin & Scott, 2000). Investment in new telecommunication infrastructure and services can represent such market situation in which private investors are confronted with substantial (sunk) costs and high risks concerning both expected revenue streams. In addition, appropriability of benefits from these investments is limited 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. In such market situations, there is a role for (local) governments in providing subsidies and/or in getting involved in private public partnerships (PPP) to account for failure in the coordination of different market and non-market actors (Martin & Scott, 2000). These networks can be used by market and non-market parties to experiment with the implementation of new infrastructure and services and learn from these experiences (Ballon et al., 2005) (for an overview about the different characteristics see Table 1).

Table 1 Rationales, investment incentives and perceived effects of local government involvement

Rationales	Private investment incentives	Perceived effects on user groups
Basic Infrastructure	Limited (but have some 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

2.2 EU Regulatory and Legislative Framework for Municipal Networks: Conflicting Rationales

In the European Union (EU), the European Commission has acted in different ways dealing with municipal networks.

First, these networks have, in general, been stimulated if they were considered as a part of the European drive towards realizing the goals of the Lisbon agenda 2004-09 to make the EU "the most competitive and dynamic knowledge-driven economy by 2010". With respect to reaching the goals of the 2000 Lisbon Agenda, the European Commission has justified further investment in broadband infrastructure based on the argument that Europe is lagging behind in comparison with the United States and South Asian countries (Fransman, 2006). Even if broadband has rapidly been growing with penetration levels reaching 15.7 percent of the EU population in 2006 (58,5 million lines), up from 11.5 percent in 2005 and 7.3 percent in 2004, Europe is still lagging in the diffusion of broadband behind Japan, US or South Korea (OECD, 2007). In its effort to sharpen and renew the Lisbon objectives, the European Council stated in March 2005 that "knowledge and innovation" are vital as they are "engines for sustainable growth" (European Council, 2005). As broadband diffusion has been considered as a priority area within the objectives of the Lisbon Agenda, the EC has followed a two-way strategy to foster the development and diffusion of these new technologies: 1) to coordinate community-wide initiatives by Member States aimed at primarily stimulating joint research and development initiatives across the European Union and 2) to promote different National Action Plans by Member States.

In 2003, the European Commission provided a justification for investing in municipal networks if they were supporting growth in underserved areas (EU, 2003). In these areas, private initiatives did not exist at all ("white areas") or were insufficient to provide more than basic infrastructure and services ("grey areas"). For "black areas", i.e. with two or more broadband networks, this justification did not hold and was considered as conflicting with European legislation on State Aid. In 2005, with the set-up of the New Rural Development Fund, the EU was facilitating the implementation of broadband infrastructure and services in particular in rural areas. In October 2006, the EU explicitly referred to innovation as part of long-term structural policy in the EU. It added to the existing instruments for facilitating municipal broadband networks test and experimentation programs (EU, 2006).

Second, the New Regulatory Framework of 2003 does not directly address investment incentives for municipalities in broadband networks in local communities, but it refers to them in the context of markets that have "transitional problems". With the overhaul of the EU regulatory framework starting in 1999 with the publication of the Communications Review by the European Commission, a discussion started aimed at redefining the balance between incentives to build new networks and to access existing ones. As a result, a package of directives was introduced that represent the New Regulatory Framework of the EU. Within this framework, the Directive (2002/19/EC) on Access and Interconnection was aimed at discussing the conditions under which regulatory intervention should occur to the presence of some form of market dominance. It also provided room for ex-ante regulation in markets (like for broadband access) that have "transitional problems" as a result of technological developments. These markets - (expected to be) unable to generate effective competition and, therefore, subject to some sort of sector-specific regulation - were further specified in European Commission's Recommendation on relevant product and service markets. Within the New Regulatory Framework of 2003 municipal initiatives could be exempted from ex ante regulation as these networks would operate in new "emerging markets" (Lewin & Williamson, 2005). As the emerging market concept has been specified in the New Regulatory Framework, the European Commission has been more concerned with describing the (phasing out of) regulatory supervision over particular market (segments) rather than with providing incentives for infrastructure investment of new entrants. In cases of market failure, explicit reference has been made to the EU Competition Law. In particular, EC recommendations on relevant product and service markets have been aimed at identifying those markets which cannot be expected to generate effective competition and should, therefore, come under same sort of sector-specific regulation.[7] The concept of "new and emerging markets" - introduced by the new regulatory framework - explicitly recognizes the need to guarantee "first-mover" advantages so as to protect innovation incentives, and hence, the development of new infrastructures.

Third, municipal initiatives have actively been investigated as to whether or not they are compatible with Article 87(1) of the EU Treaty. Article 87 focuses on state subsidies that distort competition in the common market. As Article 87 is under discussion to provide "less and better aid" (Kroes, 2005), there are important repercussions for public intervention in broadband markets. Currently, there are three options for public involvement in these markets: 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 (SGEI) (Hencsey et al., 2005). The Green Paper on Services of General Economic Interest[8] has been central in defining the balance between common service obligations and economic efficiency arguments with respect to investment in broadband infrastructure and services. These options have provided different opportunities for involvement of municipalities in municipal networks.

2.3 Public-Private Partnership Models to Foster Municipal Networks in Europe

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 fibre 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 (Sadowski & Runhaar, 2000). However, since 2000s, municipal networks have started to grow rapidly.[9] 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 order to comply with the European legislatory and regulatory environment, municipalities have increasingly become involved in different private-public partnerships models to foster growth of municipal networks. In a private-public partnership (PPP) 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.

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[7] European Commission's Recommendation on relevant product and service markets (C(2003) 497).
[8] COM(2003)270 final.
[9] Estimates put them currently at around 140 projects whereby three quarters of these projects have been initiated by municipalities.

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".[10] 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[11] the subsidies were given to telecommunications operators for the provision of retail services to end-users (either residential, businesses or public authorities). A 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 in "black areas" municipal networks, 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).

Municipalities active in the investment in new telecommunication infrastructure have favored different forms of glass fiber networks to be implemented in their communities. Compared to existing infrastructure technologies (mainly xDSL and cable modems), glass fiber networks are long-lived, enable very high transmission rates (typically higher than 10Mbps, up to 100Mbps symmetric) and support triple play services (TV, Internet, Voice).[12] The basic architectures of glass fiber networks (point-to-point, active star and passive star) differ according to technical characteristics like the amount of deployed fiber, the extent of sharing of network resources between users, the complexity of open access and required investment.[13] Municipalities can get involved in the implementation of these networks at different layers: the physical or passive layer (providing e.g. for dark fiber leasing), the data link or active network operation layer (providing for dark fiber and link layer electronics) and network layer (providing basic network services) (see Table 2).

As the installation of fiber optic cables has been a costly undertaking and required specialized knowledge, incumbent cable and telecom companies have been reluctant to implement these technologies in the local loop as implementation would also cannibalize services running over their existing network infrastructure. For new entrant firms, the high costs of acquiring the required knowledge and installing the network equipment in conjunction with the risks related to uncertain returns from the operation of the network and provision of triple play services has made private investment in these networks less attractive. Experimentation and learning with the implementation of glass fiber networks has been a crucial factor for service providers as well as private companies in investing in these networks (Ballon et al. 2005).

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[10] e.g. CEU (2006). Commission Decision of 19 July 2006 on the measure n° C 35/2005 (ex N 59/2005) which the Netherlands is planning to implement concerning broadband infrastructure in Appingedam. Brussels, CEU.
The case of the citynet Amsterdam is still under discussion on the EU level. CEU (2006). State Aid nr. C 53/2006 (ex N 262/2005) – the Netherlands Citynet Amsterdam – Investment in a Glass fiber access network by the municipality of Amsterdam Brussels, CEU.

[11] 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.

[12] Infrastructure initiatives of municipalities have to be examined within the context of the growth of next generation networks (NGN). As NGN are based on commonly agreed definitions according to international accepted standards, they should provide the following characteristics: a) an uncoupling of services from the network; b) open access to the network and c) sufficient communication capacity for users (ITU Recommendation , 2001).

[13] All current FttH networks in the Netherlands are based upon the point-to-point architecture, in other parts of the world (including the US and Asia, PON networks are used as well).

Table 2 Different Models for Public Private Partnerships

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 et al. 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 et al. 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 et al. 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 et al. 2004)

3 The Experiences with Municipal Networks in the Netherlands

3.1 The different roads towards municipal networks

The Netherlands has been one of the forerunners in broadband penetration and FttH penetration in households (see Figure 1).

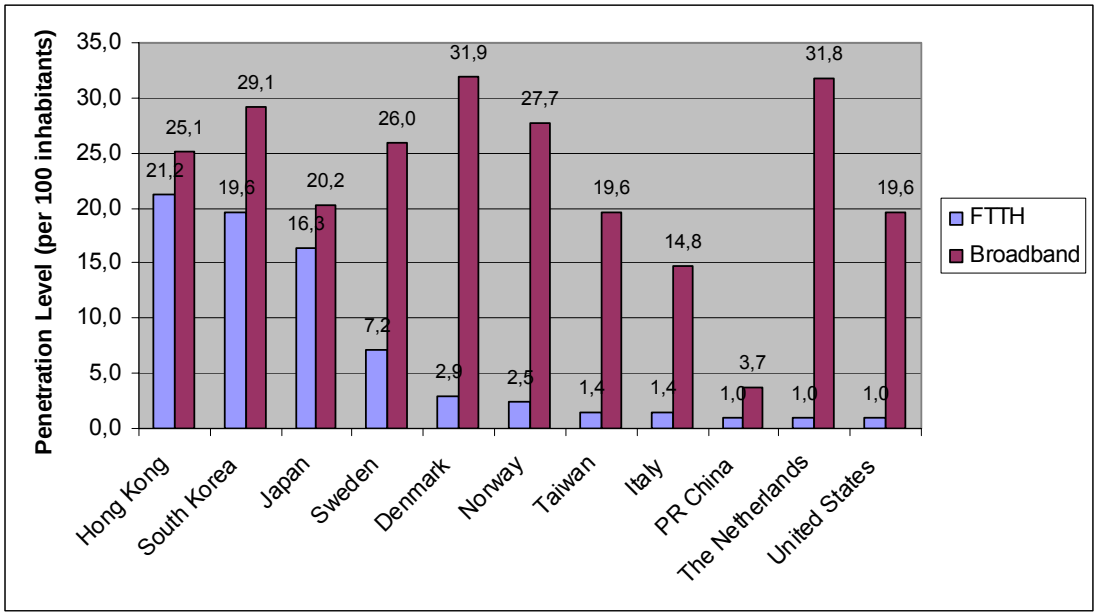

Figure 1 Economies with the Highest Penetration of FttH and their Level of Broadband Penetration, 2007
Source: (FTTHCouncilEurope 2007; OECD 2007)

Municipalities in conjunction with social housing corporations and private firms have been the main forces behind the growth of municipal FttH networks in the Netherlands. In the early 2000s, a number of national and local governmental initiatives emerged involving existing market parties (like cable operators and the national telecommunication operator KPN) that were aimed at proposing steps towards the upgrading of the national infrastructure in the Netherlands. In 2002, the national Broadband Expert Group concluded that "current telephone and cable networks will reach their capacity limits within the foreseeable future" and therefore there is "an evolutionary, and inevitable, development of fibre optic networks" (NationalBroadbandExpertGroup, 2002). In 2004, in a vision document, the "Impulscommissie", consisting of scientists, entrepreneurs and policy makers, proposed a national strategy for broadband that included a "guarantee funds" for infrastructure projects that should stimulate private investment (Deetman et al., 2004). However, these initiatives did not lead to a common national strategy of the parties involved.

Meanwhile, a number of municipal initiatives emerged from 2001 onwards aimed at implementing glass fiber infrastructures in cities like Amsterdam (Andriessen, 2003), Rotterdam (Andriessen, 2004), but also Almere, Den Haag and Eindhoven. They were using a variety of private-public partnership (PPP) models ranging from cooperative model (e.g. Nuenen, Eindhoven) over coordination models (e.g. Rotterdam) to franchise models (e.g. Helmond) and social housing corporation models (e.g. Enschede). These models were used to gather sufficient investment, to design, build ad guarantee the operation of these networks. The implementation of these networks did not start before 2004-2005 on a small scale mostly in co-operation with social housing corporations.

In 2000, the Ministry of Economic Affairs recognized that existing market parties had insufficient incentives to invest in new glass fiber technologies in the Netherlands due to their precarious financial position and their pre-existing investment (Passenier, 2005). This was in contrast to the late 1990s when the growth of demand for high-quality, high-speed flat rate Internet access, stimulated investment in regional and local fibre-optic networks even if FttH connections were rarely installed during this period (Rood & Velde te, 2003). In 2003, the Eindhoven region (and later Nuenen) became the target of the "Kenniswijk" ("Knowledge District") project by the Ministry of Economic Affairs. To overcome the stalemate with respect to private investment in new infrastructure and services, the Ministry of

Economic Affairs proposed a national research and development (R&D) program called "Kenniswijk" (Knowledge District) aimed at offering a place for "experimenting with innovative ICT products and services" which should be two to three years ahead of the rest of the Netherlands (Kenniswijk, 2005). Investments in new infrastructure (in particular glass fiber technologies) and services by private companies and private-public partnerships were encouraged based on government subsidies. Real take-off of the new infrastructure and service technologies was not expected before 2005. Due to its characteristics and specific purpose, the Kenniswijk subsidy was not considered as a form of State Aid. Even if not all objectives of the Kenniswijk subsidy were achieved, the evaluation of its effects was considered as positive (Bongers et al., 2006).

3.2 The Nuenen Network

3.2.1 The Cooperative Model "Ons Net" Nuenen

The municipality in Nuenen[14] has been the first to roll-out a municipal FttH network under the Kenniswijk subsidy. The original idea of the Nuenen network was to set up a cooperative scheme under which infrastructure investment in a FttH network could take place.[15] Under the "Kenniswijk" subsidy scheme, Nuenen residents became eligible for a €800 subsidy that was aimed at stimulating demand for new ICT services and infrastructure. 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. In order to persuade the residents joining the cooperative "Ons Net", they received an offer for a one-year contract with "Ons Net" based on a 10Mbps symmetrical Internet connection that was free of charge.

This scheme was successful and let, within the first year, to a penetration rate of 97 percent in Nuenen. The subsidy stimulated residents in Nuenen to implement new FttH infrastructure and triple play services (TV, Internet and Telephony) in their town. The residents decided to transfer their subsidy to a private limited company 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 NEM - could become members 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 in fact become the owners of the new glass fiber network. The housing corporation "Helpt Elkander" as well as a private bank and a private entrepreneur would receive the rest of the shares in NEM. Based on this investment capital, a private telecommunication contractor was able to implement the new glass fiber network in Nuenen.

3.2.2 The Network Model

The consortium "OnsNet" was initially set up as a network operator as well as service provider in a strict vertically integrated fashion. The functional network boundaries of the Nuenen network are outlined in Figure 2.

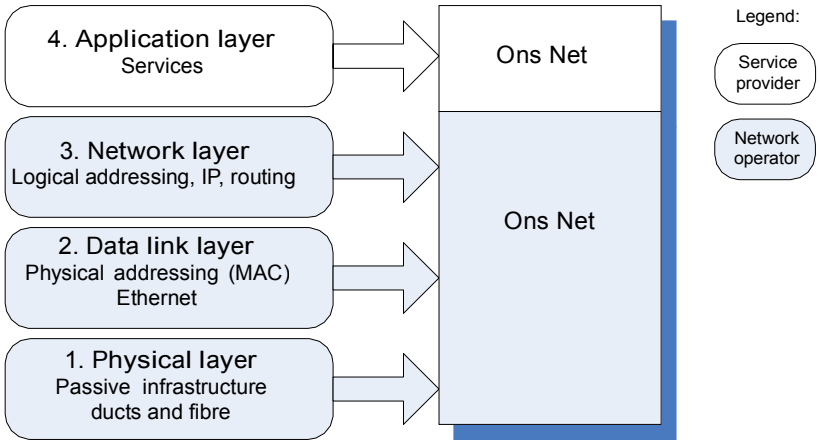

Figure 2 The Operation of the Municipal Network in Nuenen

[14] 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 town and the Dutch painter van Gogh.

[15] Due to problems of financing and unexpected costs, a private company has recently taken a stake of five percent in NEM. Based on priority stakes they received from NEM, the company obtained the right to appoint the management board of NEM. That meant in effect that the Nuenen residents are not anymore the owners of the network.

To be able to offer services, the network had its own Internet backbone and a TV broadcast headend. This was also necessary due to the requirements of the "Kenniswijk" subsidy that was set up to support the development of new services, not just infrastructure. The consortium "OnsNet" offered open access to its network to other service providers at layer three. The choice for a layer three system allowed a complete and integrated system which could be used by "OnsNet" to offer services. No additional equipment was needed which made an integrated three-layer system a more economic option compared to a two-layer system. Moreover, the implemented integrated three-layer system (provided by Swedish vendor PacketFront) was based on customized system for municipalities that were willing to provide services themselves, while still offering the option of open access for competitive service providers.

3.2.3 The Techno-Economic Model

Available economic and financial data (referred to its first year of activity in 2006) and main business model assumptions of the Nuenen network are shown in Table 3. We used the cost methodology provided by Lehr et al. (2006) with a few changed assumptions for our calculations.

Table 3 Techno-Economic Characteristics of the Consortium "OnsNet"

Name	OnsNet	
Proprietary	95% NEM; 5% others	
Provided services	Broadband connectivity	
Geographical area served	City of Nuenen	
Market size	7662 (100%)	
Number of connections in year 1	7.445 (~97%)	
Number of expected connection year 2	5747(~75%)	
Starting date of business activity	2005	
Passive Infrastructure	Fixed Costs (in €)	3.450.000
	Variable costs (in €)	1.870000
Active Infrastructure	Fixed Costs (in €)	800.000
	Variable costs (in €)	5.000.000
Interest passive/active network	10%	
Depreciation passive network	25 years	
Depreciation active network	5 years	

The fixed costs for the passive infrastructure included POP installations, basic distribution infrastructure and indirect labor costs. Part of the fixed costs for the active infrastructure has been core data equipment, core CATV broadband equipment, system management equipment and indirect labour costs. The variable costs for the active infrastructure consisted of access routes, customer premises equipment and subscriber CATV modules.

To take advantage of the maximum amount of subsidies, subscribers were offered with one year of free 10Mbps symmetrical internet service. In the first year (2005), it led to a penetration rate of about 97%. This high penetration rate had also a downside which is due to the necessity to deploy the network to serve almost the whole community. As a result, as soon as paid service began after year 2005, a drop in subscribers took place (to a 75% penetration rate) rendering part of the equipment disabled. Accordingly, table 4 displays investment costs calculated on the basis of a scenario without any available subsidy. With respect to the long-run cost calculation we are interested in, the penetration rate of years after 2005 is estimated to vary.

As the passive and the active networks have different payback periods and the costs for the active network are relatively higher, the subsidy of €800 has to be spread out over passive and active network. Moreover, network equipment is assumed to have a short depreciation time (5 years) while this time period for passive networks is expected to be longer (25 years). Our calculations showed, first, that government subsidies have been important for the installation of an FttH network in Nuenen; second, that the network displayed the characteristics of a declining cost industry (Figure 4); and third, that they can become profitable after a relatively short period of time even at low levels of penetration at about 40 percent (see Figure 5). Furthermore, access to at layer 2 was important for the extent of entry of private service providers.

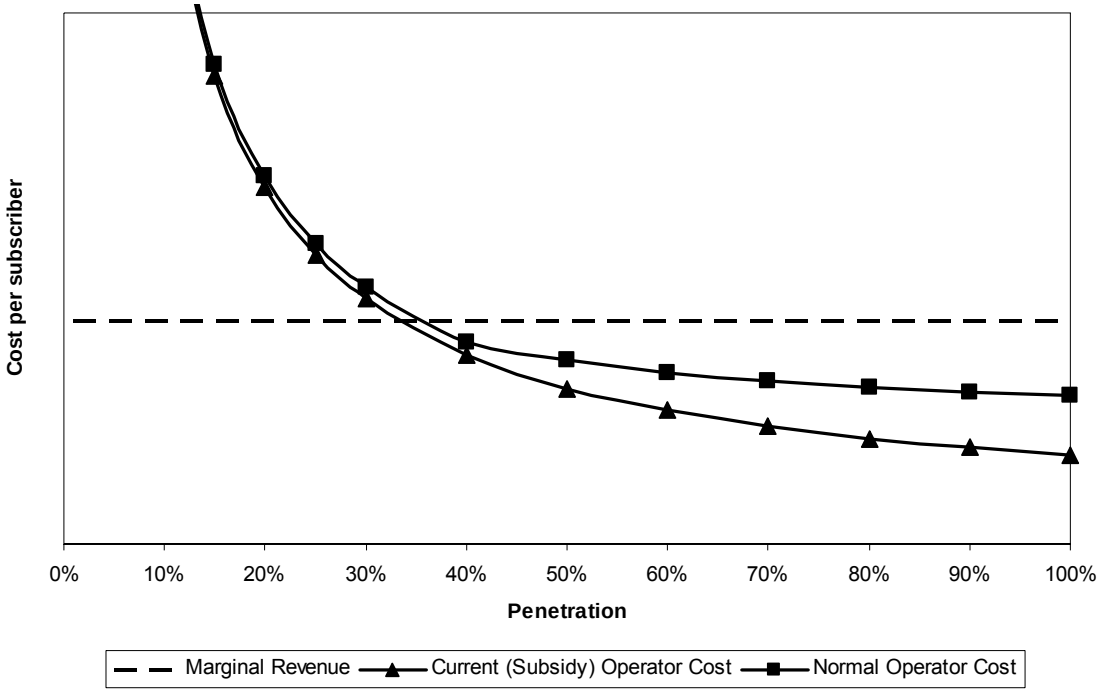

Figure 4 Long Run Average Cost Curves for a Network Operator (subsidized and normal scenario)

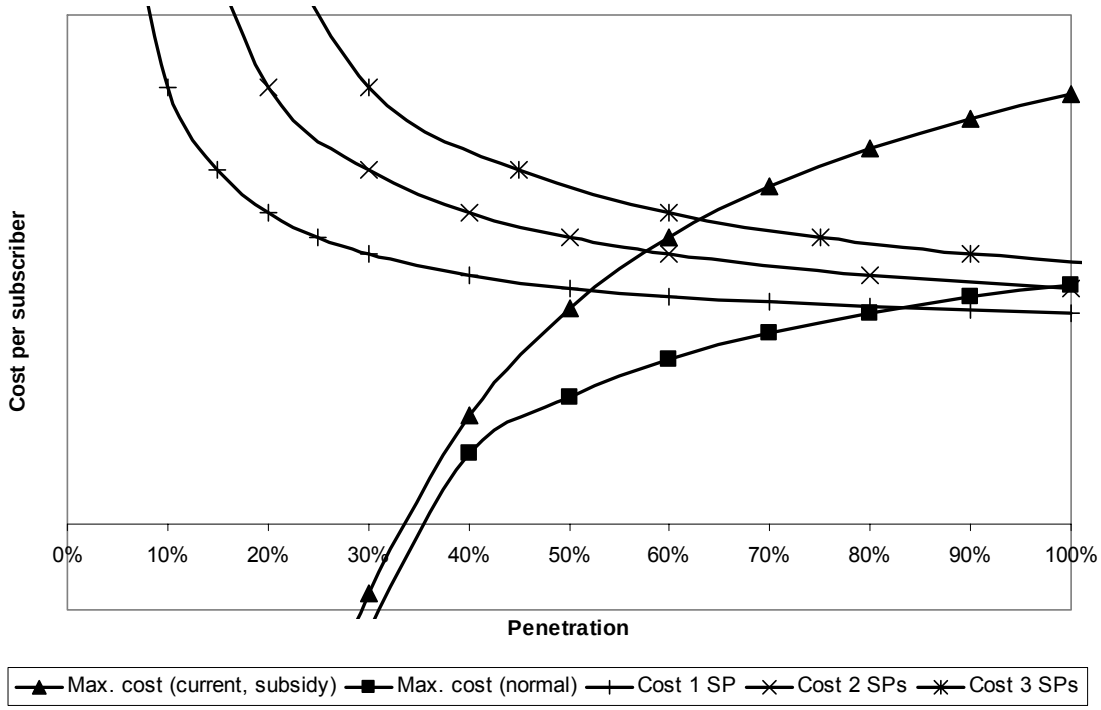

Figure 5 Competitive Entry (subsidized and normal scenario)

The case of Nuenen stimulated the implementation of new infrastructure which has also been documented in an increase in the number FttH networks in the Netherlands. Involvement by the municipality in these networks has been varying from direct initiation (e.g. Almere) to passive participant (e.g. Deventer) with social housing corporations as major participants.

From the small scale projects (like Nuenen), municipal networks developed further based on the roll-out of city-wide projects in which housing corporations still played a major part.

3.3 The role of social housing corporations in municipal networks in the Netherlands

Set up as foundations (stitching), social housing corporations (Woningbouwcorporaties) in the Netherlands are controlled by VROM (the Netherlands Ministry of Housing Social Planning and the Environment). These corporations provide the majority of rental houses with regulated rents in the Netherlands. They have a long history reaching back to 1902, when most Woningbouwcorporaties were set up as a result of the implementation of the Social Housing Act (Woningwet). In 2005, there have been 492 social housing corporations active in different regions in the Netherlands. Their brutto investment increased from €3.7 bn in 2001 to €5.5 bn in 2005 (CfV, 2007). During this period, the portfolio of activities of the Woningbouwcorporaties changed. Initially, these activities have only been aimed at building, renting out and administering subsided housing in the Netherlands. In addition, these corporations provided accommodation for the elderly, people with disabilities and health problems. In recent years, the activities of these corporations included also the building of private houses and improvements in the living environment in neighborhoods where dwellings are located. Furthermore, social housing corporations started to sell their subsidized dwellings to private individuals. In 2006, the Ministry of Housing Social Planning and the Environment provided a vision document that was, in particular, aimed at stimulating entrepreneurship in these corporations and to separate commercial from government supported activities. In early 2000s some Woningcorporaties recognized that municipal glass fiber projects can provide additional value for their private as well as social housing projects. Woningcorporaties in Rotterdam, for example, included the costs for these projects in their rental charges for social housing (Winsemius, 2007).

Later new entrant companies like NEM were starting to serve social 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 planned for 2007 and beyond (see Tables 4 and 5).[16]

[16] 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 December 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 (OnsNet 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 (Onsnet 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					

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

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 Corp)

3.4 The legislative discussion in the Netherlands

The emergence of regional initiatives was accompanied by a legislative discussion on the national Telecommunication Act in the Netherlands starting in 2006. Initially, the Telecommunication Act specified only the role of municipalities as providing "rights of way" (grafrechten) in Article 5.4. In January 2007, Article 5.14 was added that explicitly prohibited municipalities to "provide public telecommunication infrastructure and public telecommunication services" and to gain controlling interest in companies that provide these kinds of infrastructure and services.[17] The change in the national Telecommunication Act was embedded in the continuing legislative and regulatory discussion about the development of the municipal glass fiber network in Amsterdam.

4 Final Remarks and Future Research

The paper has shown that the existing European regulatory and legislative framework provides sufficient grounds for (local) governments to participate in municipal broadband networks based on a variety of rationales. We propose that the municipalities can intervene in markets if risks, costs and appropriability conditions are such that existing market parties are not interested or not able to invest in these networks and there is a public demand for new triple play services. Based on an innovation rationale, municipalities can contribute to the setting up of experimentation and learning platforms where private firms gain experiences with the implementation of new glass fiber infrastructure and broadband services. In the context of the Netherlands, the case of Nuenen has been interesting since: a) the network has initially been viable based on a cooperative model; b) the implementation of FttH networks are a viable proposition for new entrant firms; and c) they can trigger further investment in glass fiber infrastructure in other municipalities in the country.

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Appendix 1 Description of different municipal networks in Europe

City (State)	Initiative	Partnership/Ownership	Population/Connections	Main targets	Open access and layers
Stockholm (Sweden)	Stokab	Owned by Stockholm Stadhus which is owned by the City of Stockholm (*public ownership market oriented*)	800,000 (Stockholm) + Stockholm region	A) promote economic growth and stimulate the telecommunications market in the Stockholm region reducing the digital divide; B) In force of its mandate "public service on commercial terms", it aims at serving public needs in the areas of education childcare, recreation and culture.	Stokab is an operator-neutral network owner. As a consequence, its ICT infrastructure can be used by all operators and service providers. Stokab provides services itself but price competition is easily reachable
Vienna (Austria)	Wienstrom	Public partnership that aggregates the City of Vienna, Wienstrom (city-owned electricity company, 100%), Wiencanal (sewage company, 100%), Stadtwerke Wien and Wiener Linie	1.6 million people - (960,000 households)	A) provide the citizens with advanced healthcare, e-government, social services, e-learning and telecommuting solutions; B) be the leading broadband initiave in a strategic area near emerging Eastern European markets; C) reduce fiber-laying costs by at least half by using the sewer system	The project was addressed to be a "service of general interest". The city of Vienna owns – via its utilities – the whole FttH network. The network will be an open access platform for all service providers under equal conditions. The network will be an open access platform not limited to Internet Service Providers (ISPs) but also offered to differing services (e.g. health sector).
Province of Siena (Italy)	Terrecablate	Consortium 100% owned by the Province of Siena, 36 towns and 3 mountains communities of the Siena's sorroundings	It aims at connecting the entire Province of Siena which is a mix of small towns and rural areas	Fully public initiave with the main target of both reducng the digital divide among one of the most well know Italian touristic areas and enhancing innovation, service competition and social welfare	The consortium provides itself customers, businesses and public offices with high-tech services. It is the owner of the network and service provider at the same time.

Appendix 2 Description of different municipal networks in Europe (cont.)

City (State)	Initiative	Partnership/Ownership	Population/Connections	Main targets	Open access and layers
Amsterdam (The Netherlands)	CityNet	Public-private partnership where the owners of the fiber network (Glazvezelnet Amsterdam) are the City of Amsterdam (1/3), ING Investment Management (1/3), Reggefiber and housing corporations (1/3)	Project (ca. 750,000 households) divided in two phases: A)40,000 homes from 2006 to 2007 B) entire Amsterdam network from 2008 to 2013	The City of Amsterdam created a subsidiary (CityNet) to deploy a broadband network by re-usingexisting fiber infrastructure. Accordingly, a reduced amount of public funds are requested. The Amsterdam approach to the FttH scenario relies on the European concept of an authority operating under the Market Economy Investor Principle (MEIP).	The Amsterdam's is a 3 layer model designed to foster competition at both the access and servive level. Aside the passive layer, the active layer has been awarded to BBned while the service provider layer counts 75 actors ready to offer services. It leads to future lower prices and innovative services for consumers and businesses.
Milan (Italy)	Fastweb S.p.A. and Metroweb S.p.A.	Joint-venture between Fastweb S.p.A. and Metroweb (Milan Electric Utility 23,5 and Stirling Square Capital Markets 76,5)	It provides services to Milan area and a wide part of Northern Italy. By the end of 2010, Fastweb aims at covering also all Italian cities of more than 45,000 inhabitants	Private initiative led by one of the most relevant Italian telecommunications players. It was started as a local initiative to provide fast internet connection and triple-play services to the Milan area and then to some areas of Northern Italy. It is mainly the result of technologivcal convergence, market liberalization and incumbent inactivity	Fastweb was given èxclusive access to the Milan's network - build up by Metroweb S.p.A. - to deliver services.

(Source: Own investigations)