New challenges in municipal broadband network management: from vertical integration to wholesale-retail model

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New challenges in municipal broadband network management:
from vertical integration to wholesale-retail model

Bert Sadowski and Alberto Nucciarelli

*Economics of Innovation and Technological Change,*

*Eindhoven University of Technology, PO Box 513, 5600 MB Eindhoven, The Netherlands*

Abstract

Over the past years, municipal networks deploying Fiber-to-the-Home (FttH) technologies have increasingly been implemented in Europe. In order to achieve compatibility with the European Union (EU) legal and regulatory framework, a variety of public and private partnership (PPP) models have been developed throughout Europe aimed contributing expertise, finance, etc. to their growth. Recently, the debate has focused on the different industry structure that can foster the growth of municipal networks by moving from sole-supplier environment to a wholesale-retail split model. In undertaking a techno-economic analysis, the paper examines the viability of a wholesale-retail split model. It uses data from the implementation of an FttH network for a small town in the Netherlands. The paper demonstrates that the advantages in moving towards a wholesale retail split model and characterizes the necessity to define open access conditions for these networks.
1. Introduction

Since 2003, a number of local initiatives aimed at implementing Fiber-to-the-Home (FttH) networks and based on collaborations of municipalities, social housing corporations and new entrant companies have emerged 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. The European Commission (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 European Union (EU) Treaty on State Aid. Under these conditions, municipalities in the Netherlands had to justify their investment in new telecommunications infrastructure.

In the Netherlands, a variety of FttH networks have been developed since 2003. A few have been based on single vertically integrated FttH models, most involved a split between the wholesale and retail of services. The first model is based on an integrated industry structure in which network owner and service provider are the same entity. In the second (the wholesale-retail split) model, the network owner (the wholesaler) leases facilities to competing service providers (retailers), who then provide voice, video and data service over the shared network. In this case, the network owner provides mainly dark fiber on a wholesale basis.
In the following sections, we, first, discuss 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 different economic models in municipal networks in the Netherlands and examine in detail options for a wholesale-retail split in a small town by undertaking a techno-economic analysis (Section 3). Thirdly, in concluding remarks, we discuss our findings and put them in the context of the current discussion on the European regulatory and legal framework (Section 4).

2. Municipal Networks in the Netherlands: The Regulatory Discussion

In the 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
In its efforts 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"). 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). For "black areas", i.e. with two or more broadband networks, these justifications did not hold and were considered as conflicting with European legislation on State Aid.

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 - were, therefore, subject to some sort of sector-specific regulation. 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 and Williamson, 2005).
Even if 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. The concept of "new and emerging markets" 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 Service of General
Economic Interest (SGEI)\(^2\) (Hencsey et al., 2005). These options have provided
different opportunities for involvement of municipalities in municipal
networks.

2.2 Public-Private Partnership Models to Foster Municipal Networks in
the Netherlands

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 (Sadowski and
Runhaar, 2000). However, since 2000s, municipal networks have started to
grow rapidly (see e.g. (Preston et al., 2007; Tookey et al., 2006)\(^3\). A major
factor contributing to this growth has been underinvestment of incumbent

\(^2\) The Green Paper on Services of General Economic Interest (COM(2003)270 final) has been central in
defining the balance between common service obligations and economic efficiency arguments with
respect to investment in broadband infrastructure and services.

\(^3\) Estimates put them currently at around 140 projects whereby three quarters of these projects have
been initiated by municipalities.
telecom and cable companies in new telecommunication infrastructure and services (Cave and Prosperetti 2001; Fransman, 2002).

In order to comply with the European legislative 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"\(^4\). 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\textsuperscript{5} the subsidies were given to telecommunications operators for the provision of retail services to end-users (either residential, businesses or public authorities). The European Commission has recently approved a number of local broadband initiatives by municipalities. 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 (e.g. 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).

\textsuperscript{5} 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.
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).  

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. 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).

To examine the techno-economic characteristics of these models, we focused on two extreme cases: first, an integrated industry structure in which network owner and service provider are the same entity and; an industry structure in which wholesale and retail of services are separated, i.e. the network owner (the wholesaler) leases facilities to competing service providers (retailers), who

\[\text{\textsuperscript{6}}\] 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).

\[\text{\textsuperscript{7}}\] 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).
then provide voice, video and data service over the shared network. In the latter case, the network owner provides mainly dark fiber on a wholesale basis. This distinction allowed to focus on differences in the cost characteristics of these networks.

3. The Experiences with Municipal Networks in the Netherlands

3.1. The Emergence of Municipal Networks

Even if the Netherlands has been one of the forerunners in broadband penetration, the FttH penetration in households has been lagging (see Figure 1).

![Figure 1: Broadband Penetration in Countries with Highest FTTH Levels, 2006](image)

Municipalities in conjunction with social housing corporations and private firms have initially been the main forces behind the growth of municipal FttH
networks in the Netherlands. A number of municipal initiatives emerged from 2001 onwards aimed at implementing glass fiber infrastructures in cities like Amsterdam (Andriessen Commissie, 2003), Rotterdam (Andriessen, Commissie 2004), but also Almere, Den Haag and Eindhoven. They were using a variety of private-public partnership (PPP) models ranging from a 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 and guarantee the operation of these networks. The implementation of these networks started after 2004 on a small scale mostly in co-operation with social housing corporations (see Table 1).
<table>
<thead>
<tr>
<th>PPP Model</th>
<th>Initiative</th>
<th>Function of Municipality</th>
<th>Network components and Access</th>
<th>Examples**</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Franchise Model</td>
<td>Municipality</td>
<td>Contracts with a private party to build and operate the facility</td>
<td>Operating Company</td>
<td>Multiple service and content providers</td>
<td>Milan (It), Helmond (NL)</td>
</tr>
<tr>
<td>Cooperative Model</td>
<td>Citizens/ Private Entrepreneurs</td>
<td>Supports the set up of a non-profit organization that negotiates with suppliers different services</td>
<td>Owned by non-profit organization</td>
<td>All levels are managed and owned by non-profit organization</td>
<td>Nuenen (NL)</td>
</tr>
<tr>
<td>Social Housing Corporations Model</td>
<td>Social housing Corporations</td>
<td>Provides a nexus for the aggregation of demand of different social housing corporations</td>
<td>Owned by municipality or housing organization</td>
<td>Operating Company</td>
<td>Multiple service and contents providers</td>
</tr>
<tr>
<td>Coordination Model</td>
<td>Municipality</td>
<td>Provides a nexus for the aggregation of demand of households, private companies and semi-public parties like hospitals</td>
<td>Municipality aggregated passive infrastructure</td>
<td>Operating Company</td>
<td>Multiple service and contents providers</td>
</tr>
</tbody>
</table>

Table 1: Different Models for Public Private Partnerships
3.2. **Re-Defining the Role of Municipalities in Municipal Networks**

The emergence of regional municipal 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. 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.

3.3 **The Nuenen Network**

**The Cooperative Model "Ons Net" Nuenen**

The municipality in Nuenen 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

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8 There has been an exception for municipalities that have already been involved in these activities prior to changes in the Telecommunication Act (Article 20.5).  
9 Nuenen is a small municipality near the city of Eindhoven in the south of the Netherlands, well known due to the close relationship between the town and the Dutch painter van Gogh.
investment in a FttH network could take place. 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 had to be split over the active and passive network because of different cost and payback period for the active and passive network. Specifically, €500 had to be utilized to pay for the infrastructure 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 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.

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10 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 the 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.
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 (for more detailed information on the model see (de Rooij, 2006).

<table>
<thead>
<tr>
<th>Name</th>
<th>OnsNet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proprietary</td>
<td>95% NEM; 5% others</td>
</tr>
<tr>
<td>Provided services</td>
<td>Broadband connectivity</td>
</tr>
<tr>
<td>Geographical area served</td>
<td>City of Nuenen</td>
</tr>
<tr>
<td>Market size</td>
<td>7662 (100%)</td>
</tr>
<tr>
<td>Number of connections in year 1</td>
<td>7,445 (~97%)</td>
</tr>
<tr>
<td>Number of expected connection year 2</td>
<td>5747 (~75%)</td>
</tr>
<tr>
<td>Starting date of business activity</td>
<td>2005</td>
</tr>
<tr>
<td>Passive Infrastructure</td>
<td>Fixed Costs (in €) 3,450,000</td>
</tr>
<tr>
<td></td>
<td>Variable costs (in €) 1,870,000</td>
</tr>
<tr>
<td>Active Infrastructure</td>
<td>Fixed Costs (in €) 800,000</td>
</tr>
<tr>
<td></td>
<td>Variable costs (in €) 5,000,000</td>
</tr>
<tr>
<td>Interest passive/active network</td>
<td>10%</td>
</tr>
<tr>
<td>Depreciation passive network</td>
<td>25 years</td>
</tr>
<tr>
<td>Depreciation active network</td>
<td>5 years</td>
</tr>
</tbody>
</table>

Table 2: Techno-Economic Characteristics of the Consortium "OnsNet"

The fixed costs for the passive infrastructure include 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.
The Vertical-integrated model

The results of the techno-economic model showed that the network displayed the characteristics of a declining cost industry. Our calculations showed that the network in Nuenen became profitable after levels of penetration at about 35 to 40 percent. However, the subsidy has been important for the development of the network (Sadowski et al., 2006) in particular as it allowed the network operator to deploy the FttH infrastructure in the whole of town of Nuenen. The relationship between the different cost components of the network in terms of network costs and costs for service provision are shown in Figure 3.

![Cost determinants in Nuenen broadband](image)

Network costs (as well as total costs) are decreasing. In Nuenen, the network deployment was aimed at connecting the whole town. In addiction, construction to connect the houses was done in parallel with work to pass the homes with distribution cabling. Accordingly, no additional work was required
to connect the houses later. It meant that the very high network costs had to be
split among different subscribers. With rising penetration, the existence of
economies of scale allows to spread fixed costs among an increasing number of
customers with a sensible decrease of both network and total costs per
subscriber per month.

Figure 4: Profits and Revenues of the Municipal Network in Nuenen

Figure 4 displays profits determinants of the vertical integration model in the
Nuenen subsidized market. It completes data provided in Figure 3. Some main
aspects are described in the following:

1) in the vertical integrated model, the network owner also acts as a service
provider. It let to the existence of a total cost curve which is the sum of two
main costs curves related respectively to the maintenance of the network
(both the CapEx and OpEx for the active and passive part of the FttH
network) and the provision of services. The network costs curve is
descendent in its trend since the amount of costs can easily be split out over of the market size. This explains why with a penetration rate of 100%, network costs are around €15 per subscriber/month. Differently, the service cost is a constant since it embeds single customer costs/month in terms of service provisioning and economies of scale are not applicable any more. Its amount has been assumed to be €11 as the cost of a 3-play bundle service (de Rooij, 2006);

2) revenues (subscriber/month) are constant. It is assumed that the single market carrier charges customers with a €59.39 subscription fee (price for a triple-play service) in order to recover costs.

3) the curve of profits increases over higher penetration rates. It allows the carrier to reach positive profits around 30% of market penetration (namely, 30.8%).

The Wholesale-retail split model

In contrast to the existing vertically integrated model in Nuenen, we have been investigating the economic characteristics of a model in which the wholesale and the retail of services have been separated. In this model, the cost of service supply are not a burden on the network operator but carried by a separate service supplier. The network operator will benefit from the service provider using the network. This has some repercussions in terms of cost structure. According to our assumption, the network owner decides to charge a €20 fees to subscribers. In terms of cost structures, the service provider tries to achieve
profitability by covering its fixed and variable costs. The first category (fixed costs) deals with the fact that the network owner sells the access to the network to the service provider at an estimated rate of €25 per subscriber per month. However, the service provider is not sustaining network costs because all of them as far as the operational costs are allocated to the network operator. The second category of costs (variable costs) concern broadcasting rights, servers for the Internet services and marketing activities. They are fully sustained by the service provider and are estimated to be €11 per subscriber per month.

To test the affordability of the wholesale-retail model in the Nuenen market, profits of both the network operator and the service provider are plotted in Figure 5.

The profit curves displayed in Figure 5 show how the way to allocate costs to the market is able to impact the reliability of the wholesale-retail model, especially in a small market like in Nuenen. In this scenario, as the network...
owner makes the profitability of its business model worse – gaining profits at around 35% penetration rate – one service provider is not able to generate profits before reaching around 75% of the potential subscribers. Accordingly, though the Nuenen model provides positive results in term of network deployment (the network is broadly deployed in Nuenen), the dimension of the market itself is not big enough to allow a network owner and a separate service provider co-exist. The critical mass to cover costs is reached at higher penetration rate in the wholesale-retail scenario than in the vertical integrated one. It leads to consider a vertically integrated industry structure as a ‘must’ for a small-size market like Nuenen.

The Nuenen case with respect to the Dutch FttH scenario

The case of Nuenen stimulated the implementation of new infrastructure driven by new entrant firms like Volker Wessels Telecom and Lybrandt. These new players together with a number of other players (e.g. municipalities, social housing corporations) took responsibility for an increase in the number of FttH networks throughout 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 in 2007 based on the rollout of city-wide projects in which housing corporations still played a major part (Table 4 and 5). Most municipal FttH
networks in the Netherlands are based on vertically integrated network models in which the network owner is also the service operator (in the case of NEM) or there is just one additional service operator (which sometimes even is partly owned by) the network operator (recently the case in Nuenen).
<table>
<thead>
<tr>
<th>Municipality/Region</th>
<th>Initiator</th>
<th>Initiated / Started</th>
<th>Dec.2006 connected</th>
<th>Network</th>
<th>PPP Model</th>
<th>Network and Service Provision</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Network</td>
<td>Owner</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Specification/Network Provision Service Provision</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Owner</td>
<td>Provision</td>
</tr>
<tr>
<td>Amersfoort</td>
<td>Municipality</td>
<td>2005 (2006)</td>
<td>1,000</td>
<td>FttH</td>
<td>Coordination</td>
<td>BreedNet Amersfoort Amersfoort</td>
</tr>
<tr>
<td>Amsterdam</td>
<td>Municipality/PC (GNA)</td>
<td>2003 (2006)</td>
<td>N.A.</td>
<td>FttH</td>
<td>Coordination</td>
<td>Glasvezelnet Amsterdam C.V.</td>
</tr>
<tr>
<td>Arnhem</td>
<td>SHC (Portal) / PC (GNEM)</td>
<td>2006 (2007)</td>
<td>3,769</td>
<td>FttH</td>
<td>Social Housing Corporation</td>
<td>GNEM</td>
</tr>
<tr>
<td>Deventer</td>
<td>SHC (Rentree)</td>
<td>2004 (2006)</td>
<td>1,200</td>
<td>FttH</td>
<td>Social Housing Corporation</td>
<td>SHC Rentree via Y3-net</td>
</tr>
<tr>
<td>Deventer</td>
<td>PC (Reggefiber)</td>
<td>2007 (2007)</td>
<td>0</td>
<td>FttH</td>
<td>Coordination</td>
<td>NEM Deventer</td>
</tr>
<tr>
<td>Enschede</td>
<td>SHC (Woonplaats &amp; Domijn)</td>
<td>2003 (2005)</td>
<td>7,500</td>
<td>FttH</td>
<td>Social Housing Corporation</td>
<td>Initially SHC via Casanet</td>
</tr>
<tr>
<td>Helmond</td>
<td>Municipality</td>
<td>2005 (2006)</td>
<td>0</td>
<td>FttH</td>
<td>Franchise</td>
<td>BBned</td>
</tr>
<tr>
<td>Nuenen</td>
<td>COOP (&quot;Ons Net&quot; Nuenen)</td>
<td>2001 (2005)</td>
<td>7,200</td>
<td>FttH</td>
<td>Cooperative*</td>
<td>&quot;Ons Net&quot; Nuenen via NEM</td>
</tr>
<tr>
<td>Nijmegen-Hazenkamp</td>
<td>COOP (Glazenkamp)</td>
<td>2005 (2006)</td>
<td>24</td>
<td>FttH</td>
<td>Cooperative</td>
<td>Glazenkamp</td>
</tr>
<tr>
<td>Rotterdam</td>
<td>Municipality</td>
<td>2002 (2006)</td>
<td>4,000</td>
<td>FttH</td>
<td>Coordination</td>
<td>Glasvezel Rotterdam via Bbned</td>
</tr>
<tr>
<td>Utrecht</td>
<td>COOP (Lombxnet)</td>
<td>2002 (2004)</td>
<td>1,000</td>
<td>FttH</td>
<td>Cooperative</td>
<td>Lombxnet</td>
</tr>
<tr>
<td>Utrecht-Leidsche Rijn</td>
<td>COOP (Kersentuin)</td>
<td>2003 (2004)</td>
<td>94</td>
<td>Cooperative</td>
<td>Xs4all</td>
<td>Xs4all</td>
</tr>
</tbody>
</table>

| Local Initiatives         |                               | 34,687              |

Table 3: Local Initiatives in the Netherlands by Municipalities (December 2006)
<table>
<thead>
<tr>
<th>Municipality/Region</th>
<th>Initiator</th>
<th>Initiated / Started</th>
<th>Dec. 2006 connected</th>
<th>Network</th>
<th>PPP Model</th>
<th>Network and Service Provision</th>
<th>Network Owner</th>
<th>Network Provision</th>
<th>Service Provision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amersfoort</td>
<td>SHC (De Velden/Portaal)</td>
<td>2005 (2006)</td>
<td>900 FtTH</td>
<td>Social Housing Corporation</td>
<td>GNEM</td>
<td>GNEM</td>
<td>GNEM</td>
<td></td>
<td></td>
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<tr>
<td>Amersfoort</td>
<td>SHC (De Velden/Portaal)</td>
<td>2005 (2006)</td>
<td>3,000 FtTH</td>
<td>Social Housing Corporation</td>
<td>GNEM</td>
<td>GNEM</td>
<td>GNEM</td>
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<td></td>
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<tr>
<td>Arnhem</td>
<td>SHC (Portaal)</td>
<td>2005 (2006)</td>
<td>3,500 FtTH</td>
<td>Social Housing Corporation</td>
<td>GNEM</td>
<td>GNEM</td>
<td>GNEM</td>
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<td>Bussum</td>
<td>SHC (Patio)</td>
<td>2005 (2006)</td>
<td>1,000 FtTH</td>
<td>Social Housing Corporation</td>
<td>GNEM</td>
<td>GNEM</td>
<td>GNEM</td>
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<td></td>
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<td>Hilversum</td>
<td>SHC (Patio)</td>
<td>2005 (2006)</td>
<td>2,000 FtTH</td>
<td>Social Housing Corporation</td>
<td>GNEM</td>
<td>GNEM</td>
<td>GNEM</td>
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<tr>
<td>Leiden</td>
<td>SHC (Portaal)</td>
<td>2005 (2006)</td>
<td>6,000 FtTH</td>
<td>Social Housing Corporation</td>
<td>GNEM</td>
<td>GNEM</td>
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<td>Naarden</td>
<td>SHC (Portaal)</td>
<td>2005 (2006)</td>
<td>1,000 FtTH</td>
<td>Social Housing Corporation</td>
<td>GNEM</td>
<td>GNEM</td>
<td>GNEM</td>
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</tr>
<tr>
<td>Nijmegen</td>
<td>SHC (Portaal)</td>
<td>2005 (2006)</td>
<td>4,000 FtTH</td>
<td>Social Housing Corporation</td>
<td>GNEM</td>
<td>GNEM</td>
<td>GNEM</td>
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<tr>
<td>Soest</td>
<td>SHC (Portaal)</td>
<td>2005 (2005)</td>
<td>900 FtTH</td>
<td>Social Housing Corporation</td>
<td>GNEM</td>
<td>GNEM</td>
<td>GNEM</td>
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<tr>
<td>Utrecht</td>
<td>SHC (Portaal)</td>
<td>2005 (2006)</td>
<td>4,500 FtTH</td>
<td>Social Housing Corporation</td>
<td>GNEM</td>
<td>GNEM</td>
<td>GNEM</td>
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<tr>
<td>Haarlem</td>
<td>SHC (Pré Wonen)</td>
<td>2005 (2006)</td>
<td>4,000 FTTC</td>
<td>Social Housing Corporation</td>
<td>Lijbrandt</td>
<td>Lijbrandt</td>
<td>Lijbrandt</td>
<td></td>
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<tr>
<td>Bollenstreek region</td>
<td>PC (Lijbrandt)</td>
<td>2005 (2006)</td>
<td>1,000 N.A.</td>
<td>Franchise</td>
<td>Lijbrandt</td>
<td>Lijbrandt</td>
<td>Lijbrandt</td>
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<tr>
<td>Various towns</td>
<td>SHC.</td>
<td>2005 (2006)</td>
<td>94 FTTB</td>
<td>Social Housing Corporation</td>
<td>Lijbrandt</td>
<td>Lijbrandt</td>
<td>Lijbrandt</td>
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<td><strong>Local Initiatives</strong></td>
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</tr>
</tbody>
</table>

Table 5: Local Initiatives in the Netherlands by Social Housing Corporations, December 2006
(Source: (Stedenlink, 2007; Stratix, 2007) own investigations; PC – Private Company; COOP – Cooperative; SHC – Social Housing Corporation)
4. Summary and Conclusions

Our paper has shown that there are wide varieties of private-public partnership models that allow fostering the growth of municipal networks even if the existing legal and regulatory framework in the European Union (EU) imposes some limitations on (local) government involvement in these networks. As the focus was on the techno-economic characteristics of these networks, we compared a vertical-integrated model with a wholesale-retail split model by using data from a small-scale network in the Netherlands.

We found that for a small-scale market (like the one in Nuenen) a vertical-integrated model has been the most appropriate industry structure. For such markets, separate service suppliers will not achieve profitability in a wholesale-retail split model. As the vertically-integrated model has been adopted by a variety of municipal FtH projects in the Netherlands, it will become increasingly necessary to discuss the consequences of this model in terms of open access conditions. As current EU and national regulations insufficiently equipped to deal with these issues, new initiatives are required to guarantee open access.
References


