Technological Change, User Involvement and Public-Private Interplay: The Case of the Telecommunications in the Netherlands

Bert Sadowski & Alberto Nucciarelli

Eindhoven University of Technology, Den Dolech 2, 5612 AZ Eindhoven, The Netherlands, Tel.: 0031-402475510 Email: b.m.sadowski@tue.nl

- Work-in-progress -

20 August 2010

1 Introduction

Technological change in conjunction with market liberalization has fostered the emergence of a large variety of private-public partnerships (PPPs) in the telecommunication sector since the late 1990s in Europe (CEU, 1999). With their investment in complex infrastructure technologies like next generation (NGA) access networks, private companies have to cope with high (sunk) costs and risks while facing limited appropriability of benefits derived from these technologies (Martin & Scott, 2000). In these market situations, PPPs have been used as a vehicle to reduce private risks, share costs and provide some certainty about returns to be gained from the implementation of these infrastructure technologies (Link & Scott, 2001). As the provision of incentives for private investment has been a major objective of PPPs, these projects had to be in line with the European and national regulatory and legislative environment to avoid delays in their implementation or even abolishment, for example, due to violations of State Aid regulations (B. Sadowski, Nucciarelli, & de Rooij, 2009). Recently, different forms of PPPs facilitating the development of NGA networks have emerged as a response to changes in technology, market and demand uncertainty.

After a period of regulatory uncertainty mainly caused by a European regulatory and legislative environment in transition since 2000, the Broadband Guidelines implemented by the Commission of the European Union (CEU) of September 2009 (CEU, 2009) provided a more clearly defined framework for municipal broadband initiatives in Europe. Based on the Guidelines, municipalities across Europe received more opportunities to become active in participating in the design and development of next generation access (NGA) networks. The experience of Dutch municipalities in dealing with these networks has not only affected the legislative and regulatroy discussion on the EU level during the early 2000s, but also provided new insights into the structure and develompent of different PPP models. There has been a variety of forms of PPP models ranging from the bundling of demand for triple play services by private companies as well as semi-public and public organizations at particular locations (e.g. business parks) over separate infrastructure projects for private (e.g. city rings) to whole city-wide infrastructure projects for the public at large.[1] The common denominator of these different projects has been that incumbent market parties have been hesitant or unable to invest in new broadband networks. Therefore, the different PPP models developed initially as a radical departure from the duopolistic supply structure in broadband markets based on an incumbent telecommunication company and different regionally oriented cable operators.[2] During this first period, PPPs have mainly been used to experiment with and learn from the implementation of new fibre networks (reducing technology uncertainty). Most PPPs were based on vertically integrated supply structures with open access as the exception (B. Sadowski, Nucciarelli, & de Rooij, 2009). Recently new forms of PPPs have emerged forms as a reaction to high market and demand uncertainty which can better be described as "public private interplay" (PPI) involving a large variety of forms of interaction and collaborations between private companies, (semi-) governmental institutions and residential user groups (Gomez-Barroso & Feijóo, 2010; Nucciarelli, Sadowski, & Achard, 2010).

In order to examine these changes in the structure of PPPs, a comparative framework is required that allows to include in particular the effects of changes in the demand structure into the analysis of public-private interplay. Traditionally, the literature on PPPs has focused on the extent to which

[1] For the experience in the United States see (Tapia, Stone, & Maitland, 2006).
[2] In other words, there is a market failure of some form which can be corrected by setting up a PPP that might even stimulate competition in the market (Link & Scott, 2001).

contracts are an adequate mechanism to generate sufficient investment in infrastructure building and the management of services. In addition, the "public" part of the PPPs has mostly been considered as an activity executed by a (local) public authority or by a private party on behalf of (local) public authority. Our definition is broader including not only contractual agreements, but focusing also on non-contractual forms of interactions like user involvement or demand aggregation. This allows us to examine whether the forms of PPI provide for different outcomes in terms of efficiency and innovation.

The development of the market for NGA in the Netherlands since 2006 serves as an example to examine these issues. The paper uses data provided by 41 different municipalities in the Netherlands on organizational choice of PPP, price levels, degree of competition, innovation and geographical information collected for the period 2005-2010 (see Appendix 1 and Appendix 2).

2 Technological Change, Demand Uncertainty and Public-Private Interplay (PPI)

2.1 PPI as a response to Demand and Market Uncertainty

Different forms of PPI have developed in the Netherlands based on the assumption that the building of infrastructure and service delivery in the provision of broadband services can be separated and that an efficient bundling of these tasks will provide higher incentives for private parties to invest. In this context, PPI has mainly been considered as contractual arrangements whereby public parties participate in a private entity, or provide support for a private entity to deliver public infrastructure-based services (ICM, 2004), even if some of these PPI agreements did not include public entities (like cooperatives). The implementation of the first municipal NGA network in Nuenen in 2006 was based on the assumptions that technical uncertainty was low (as the technology involved was considered to be mature), but that mechanisms had to be found which could account for demand and market uncertainty surrounding NGA networks. The initial solution to the problem of demand uncertainty was an arrangement in which contracts were written in which governmental subsidies provided to residential users and guarantees granted by a social housing corporation and a private installation firm were used as a remedy. To reduce market uncertainty, a vertically integrated form of PPI was implemented in which the infrastructure provider was also responsible for delivering the service (B. Sadowski, Nucciarelli, & de Rooij, 2009).

The literature on complete contracts has been vital in understanding the role of initial contracts for PPPs. The literature distinguishes two distinct phases of project development in PPPs: the 'building' of a facility and then the 'management' of the public service provision using the facility. It is further assumed that the government can delegate both functions to two distinct private firms, as specialized skills are required to carry out the different tasks. If there are positive externalities across the different stages of production, bundling of the different tasks can be optimal (Mortimort & Pouyet, 2008). For both phases, initial contracts by parties involved in the PPP are crucial, as these contracts should specify the long-term effects in terms of quality of service and infrastructure provision. Moral hazard and asymmetric information can become important issues as they explain the (re-)actions of partners involved in the PPI to engage in strategic behavior. In Nuenen, asymmetric information, in this case the necessity to provide additional funding for upgrading the infrastructure of the municipal fibre network, provided an imbalance in power which allowed the private installation firms to gain a majority share (means: ownership) in the PPI in return for additional private investment.

In contrast to the complete contracting approach,[3] Hart (2003) argues that ownership of PPPs is important for investment in facilities for which building and operation can be separated. Bundling should be facilitated if production externalities can be gained over the different stages of the new facility, unbundling if there are no production externalities (Mortimort & Pouyet, 2008). Furthermore, there is no technology-related reasoning, which is sufficient for arguing in favor of bundling or unbundling of different tasks. The key issue surrounding the efficiency of different forms of PPPs has been whether or not it is possible to derive positive externalities (on the production side) from the bundling of different tasks and from building and operating the new facility (Mortimort & Pouyet, 2008). As ownership matters, it is also important to understand the initial phase of starting up a PPP in which the specific "terms and conditions" of the PPP are defined which should provide for some certainty for investment in infrastructure (Grimsey & Lewis, 2004).

Through the incomplete contracting lens, a number of more realistic assumptions can be included in the analysis of PPI. For example, what forms of PPI are there which provide remedies to problems of technology, market and demand uncertainty or which form of PPI has been more efficient in providing incentives in terms of infrastructure implementation and service delivery? In order to analyse the different forms of PPI, it is therefore important to focus on a) municipal NGA networks as a response to the problems surrounding technical change in broadband market; b) the extent

[3] As contracts for PPPs cover typically longer periods, e.g., 25 years, however, these contacts tend to be incomplete in many important aspects. During the envisaged contract period, events can occur that were unforeseeable (e.g., changes in demand or market).

to which residential user groups are involved (as response to demand uncertainty), and c) the structure of the consortium (as a response to market uncertainty).

2.2 Technological Change, Demand Structure and (Dis-)Incentives to Invest

In Europe, technological change in conjunction with market liberalization has been a major force changing the telecommunication industry since the late 1970s and early 1980s (Noam, 1992). The traditional model of providing telecommunication services in a vertically integrated fashion with companies operating networks (layer 2) and offering services (layer 3) has given way to a more disintegrated industry structure, in which new entry has taken place at both layers (Fransman, 2008). An important driver affecting the new structure and dynamics in the industry in the late 1990s has been the emergence of new technologies providing for broadband Internet. In contrast to narrowband or dial up, broadband technologies enable access to the Internet at significantly higher speeds [4]. A number of different technologies have been used to provide broadband Internet such as xDSL, cable modem and wireless technologies with different firms supporting the rollout of these technologies. Unitl recently, innovations based on high speed packet-switching and using asynchronous transmission mode the Internet protocol suite (allowing for interoperability of these technologies) have been central to the growth of these technologies (Kavassalis, Solomon, & Benghozi, 1996). Increasingly technological change has been driven by existing asynchronous broadband technologies like xDSL and cable modem in conjunction with the emergence of synchronous transmission modes

[4] Despite a wide variety of definitions of broadband speed ranging from 64 kbit/s to 2.0 Mbit/s, a commonly accepted definition by the OECD refers to download speeds in excess of 256 kbit/s (OECD, 2009). There have been a number of national broadband plans (e.g. Finland, United Kingdom or United States) in which basic broadband has differently been defined.

based on fiber technologies, which have jointly be defined as next generation access (NGA) technologies.[5] NGA networks are different from the old copper-based telecommunication infrastructure due to speed limitations and opportunities to provide advanced telecommunication services to users.[6]

In contrast to the traditional vertical integrated industry structure that provided for a closed set of services (called Plain Old Telephone Services) such as the transmission of voice calls and faxsimile, the new desintegrated industry structure allowed for a large variety of new services such as video-on-demand, interactive television, etc. (Krafft, 2010). Until the late 1990s, this development was accompanied by a growth of demand for high-quality and high-speed flat rate Internet access leading to a transition from dial-up narrowband connections to an ubiquitous always-on broadband environment (Bar et al., 2000). It also stimulated investment in backbone fibre networks.

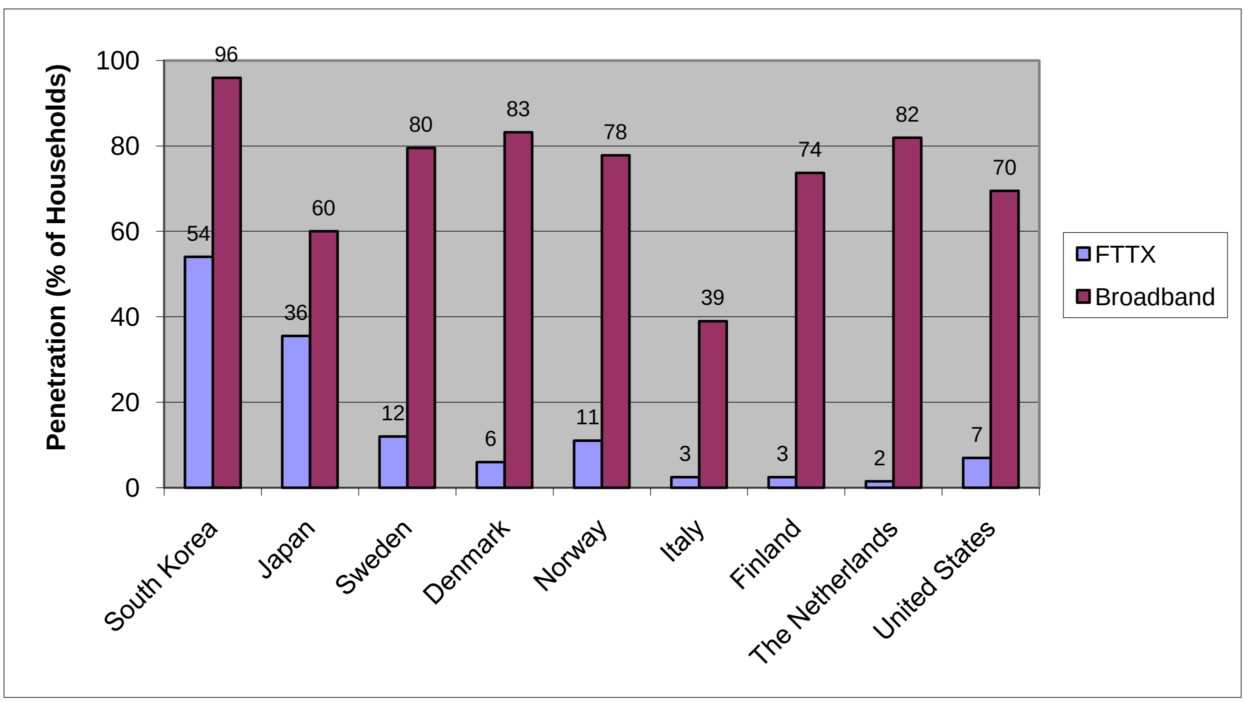
In the late 1990s, incumbent firms as well as new entrants equally invested in new infrastructure capacity based on the belief that higher investment are necessary to satisfy growing and expected demand (Fransman, 2004). In the wake of the financial crisis in 2000, investment in new infrastructure capacity dried up even demand for new broadband services was still growing. After a period of "bust" in which incumbent and new entrant firms were reorganizing their internal operations, investment did not grow at the same level as during the 1990s.

With the emergence of broadband network based on FttH (Fibre-to-the-Home) connections, incumbent and new entrant companies had to realign

[5] There has been an intensive discussion on the technical definition of NGA technologies by the European Commission (B. Sadowski & Smits, 2009).
[6] See (CEU, 2009).

their incentives with the new reality of these network technologies. FttH networks allowed for a higher quality of Internet access and were considered as the most future proof technology in the local loop (OECD, 2008). Still the growth rates of broadband technologies are still very high compared to traditional technologies (Krafft, 2010). Few countries (e.g. South Korea, the Netherlands) have been successful in reaching a high level of broadband penetration per households. However, the level of fiber technologies in broadband penetration differs across countries with South Korea and Japan in the lead and European countries like the Netherlands, but also Denmark and Finland still lagging (see Figure 1).

Figure 1: Penetration Rates Broadband versus FTTX



Source: OECD 2010, FTTH Council 2010. Own Calculations.

As fiber technologies have recently matured leading to reduction in technology uncertainty, they are still characterized by high initial capital investment costs, high demand and market uncertainty (OECD, 2008).

These uncertainties provided disincentives for incumbent companies as well as most new entrant companies to invest in these new technologies.

2.3 Private Investment Incentives and the Definition of PPI

To provide some certainty with respect to these high initial investment costs and account for the high market and demand uncertainty surrounding investment in fibre networks, public-private interplay have been used to secure long-term infrastructure investment in NGA networks and to enable the appropriation of benefits derived from retail level service provision. The functions of PPI agreements have been related to (i) sharing the risks of FttH infrastructure development among different parties and providing market certainty and (ii) stimulating the demand side by generating sufficient subscription to new broadband services and therefore eliminate uncertainty about future demand.

In general, PPI is characterized by i) long-term (not just short term) objectives for the provision of a specified type of public service in a given area; ii) involve one party that performs the strategic role of identifying user needs; iii) are based on some form of risk sharing (and sharing of other activities); and (iv) are rooted in the mutual contribution of competencies and resources for joint production. Based on these characteristics, the comparative analysis is able to move beyond the dichotomy (public utility models versus market-based PPP models) and can examine the different cases which involve also non-contractual forms of PPI (Nucciarelli, Sadowski, & Achard, 2010). Most of the regulatory and legislative discussion in Europe has focused on contractual forms of PPI.

3 User Involvement, Public-Private Interplay and Next Generation Access (NGA) Networks

3.1 The regulatory and legislative environment for NGA Networks

After a period of regulatory uncertainty in which case law dominated the discussion, the Commission of the European Union (CEU) took in June 2009 the initiative to better define regulatory and legislative context for municipal involvement in NGA networks (B. Sadowski & Smits, 2009). On 17 September 2009, it addressed with its Broadband Guidelines (CEU, 2009) not only the different options for municipal development in NGA networks, but also made an attempt to characterize NGA networks. It defined NGA networks as all fixed access networks, which consist wholly or in part of optical elements and are able to provide broadband access services with better quality (such as higher throughput) compared to services provided via existing networks based on copper lines (CEU, 2009). Even if this definition has been limited with respect to characterizing the new quality of fibre access technologies compared to existing broadband access technologies, it has been an important step forward in describing the new opportunities and the (dis-) incentive structure behind the growth of NGA networks for different market and non-market parties.

In the Netherlands, in November 2009 the regulatory and legislative discussion surrounding NGA networks received a new impulse with the establishment of a TaskForce Next Generation Networks, which was set up to provide advice to the Dutch parliament on the future of NGA networks. In its recommendations submitted to the Minister of Economic Affairs in March 2010, the TaskForce argued that municipalities, social housing corporations and provinces should take a more active role in facilitating the rollout of fibre networks at different locations in the Netherlands. Furthermore, it suggested that the regulatory agency OPTA should provide a better definition of open access to these networks in order to facilitate the growth of broadband services. In making a distinction between basic Triple Play and advanced broadband services (such as e-health or e-learning), the TaskForce suggested that there are a number of new models of public-private partnerships which can facilitate the development of advanced broadband services and allow for entrepreneurship (PriceWaterhouseCoopers, 2010). Although the recommendations of the TaskForce have been a step in the right direction in providing municipalities, social housing corporations and provinces with more influence over the development of broadband infrastructure and services, they have been less clear in defining the new quality of fiber networks, (dis-)incentives of existing market parties in engaging in fiber network rollouts and the role of residential user groups in the development of these networks.

With the Crisis and Recovery Act ('Crisis en Herstelwet') in place since March 2010 (Staten-Generaal, 2009), the Dutch government has also been able to abolish restrictions on municipal co-investment in broadband networks imposed in 2006. As this two-fold drive in terms of vision (provided by the TaskForce) and favorable legislative environment (based on the Crisis and Recovery Act) creates more leeway for local authorities, it also indicates that infrastructure initiatives by the national government in the area of NGA networks cannot be expected. This has been in line with "hands-off" governmental policy since early 2000s (B. Sadowski, Nucciarelli, & de Rooij, 2009). Therefore, the burden of influencing the structure and evolution of NGA networks in the Netherlands will be at least in the short term at the local (and maybe provincial) level requiring active interaction between private firms, residential user groups and local (semi-) public authorities.

In the Netherlands, fibre networks represent a small but growing percentage of the total broadband market. On the basis of the data received from providers of residential broadband, the Dutch regulatory agency OPTA reported in March 2010 a market share of about 2.26 percent for fibre networks compared to 1.84 in June 2009. Cable modem networks accounted in March 2010 for about 38.84 percent and xDSL networks for 59.50 percent of the broadband market (OPTA, 2010). Compared to the number of companies involved in the provision of residential broadband[7], just a few major companies are responsible for implementing in fibre network markets in the Netherlands[8].

3.2 Company Strategies: New entrants vis-a-vis Incumbent firms

The lion's share of new installations of fibre networks has been with the company Reggefiber, a new entrant in broadband markets, which started as an installation firm with the implementation of the first municipal network in the Netherlands in 2006.[9] After a headstart in the markets for broadband access in the late 1990s and beginning of 2000s (EAT, 2004), the incumbent operator KPN has been rather reluctant to engage in the implementation fiber networks at a large scale. With the approval of the joint venture between Reggefiber and KPN by the Dutch Competition Authority in December 2008 and the execution of the venture in January 2009, the situation changed and KPN was considered as a market party holding significant

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[7] These are about 16 companies involved in the provisioning of broadband connections for the residential and business market. OPTA has indicated that these are the following companies: @Home, BBNED, CAIW, CASEMA, DELTA, EASYNET, KPN, MULTIKABEL, ONLINE, REGGEFIBER, SCARLET, TELE2, UPC, VERIZON, VERSATEL, ZIGGO.

[8] From the 11 companies providing "high quality" broadband connections (BBNED, CAIW, DELTA, EASYNET, KPN, ONLINE, REGGEFIBER, TELE2, UPC, VERIZON, ZIGGO), just five companies are involved in the provision of residential fibre market (KPN, REGGEFIBER LIJBRANDT, CAIW, recently TELE2).

[9] In 2010, the firm accounted for about 50 percent of the fibre access market (in terms of homes passed) compared to 20 percent provided by the incumbent operator KPN (Stratix, 2010).

market power (SMP) in broadband access markets.[10] The initial decision by OPTA was later extended to Reggefiber and its local subsidiaries, which have been involved in a number of projects with local partners.

After a number of legal challenges against the municipal network in Amsterdam launched by the cable industry had failed in 2007 (B. Sadowski, Nucciarelli, & de Rooij, 2009), cable companies such as UPC or Ziggo began to abolish their national in favor regional pricing strategies. At the end of 2007, these companies started with marketing campaigns in areas like Eindhoven targeting low income residents with low price offers for cable access in order to destruct demand aggregation strategies for fibre networks by municipalities and new entrant firms (Olsthoorn, 2007). In parallel with this strategy, cable companies were gradually upgrading their networks to new DOCSIS 3.0 standards, which allowed for (theoretical) download speeds of up to 120 Mbit/s. In 2009, UPC started to market this new high-speed broadband service under the brand name "FibrePower" .

[10] As a result, the regulatory agency OPTA is discussing new guidelines for unbundling fibre access and has started a consultation process in April 2009. In addition, the obligation of KPN under the universal service regulation to provide a ''defined minimum set o f services to all end-users at an affordable price'' has (provisionally) been defined for areas with fibre only access. Even if it obliged KPN to provide a fibre-based telephony service at similar tariff conditions compared to a copper-based telephony services, it did not account for customer choice (like customer pre-select).

3.3 The Forms of PPI: User Involvement and the Structure of the Consortium

In order to stimulate progress in broadband markets, different local municipal initiatives emerged already in early 2000s aimed at providing new broadband services based on FttH networks to local communities. The first wave started in 2006, with the first municipal NGA network in Nuenen covering the whole town and in 2007 in (parts of) Eindhoven. Both projects were initially based on governmental subsidies and the involvement of different residential user groups to provide for sufficient levels of demand. From 2006 to 2008, there have been a number of municipal initiatives based partly on (local) government involvement or partly on financial support by social housing corporations. In these models, the function of these (semi-) public institutions has been to guarantee certain demand levels of service subscriptions. Since 2008, private installation firms (in particular, Reggefiber) have developed a number of local municipal initiatives based on demand aggregation of residential user communities that have driven fibre installations. Rather recently, the incumbent KPN has become engaged in municipal network initiatives mostly in conjunction with a number of service providers, which have been responsible for demand aggregation. Recent initiatives have been more market-driven as service providers try to provide jointly sufficient levels of demand aggregation.

In total, there have been about 26 initiatives in different municipalities in the Netherlands in 2006 providing for some 70,000 fibre connections. This number has grown to 77 initiatives with about 450,000 connections in 2010 (Stratix 2010). There have been different models of PPI involving a variety of players such as:

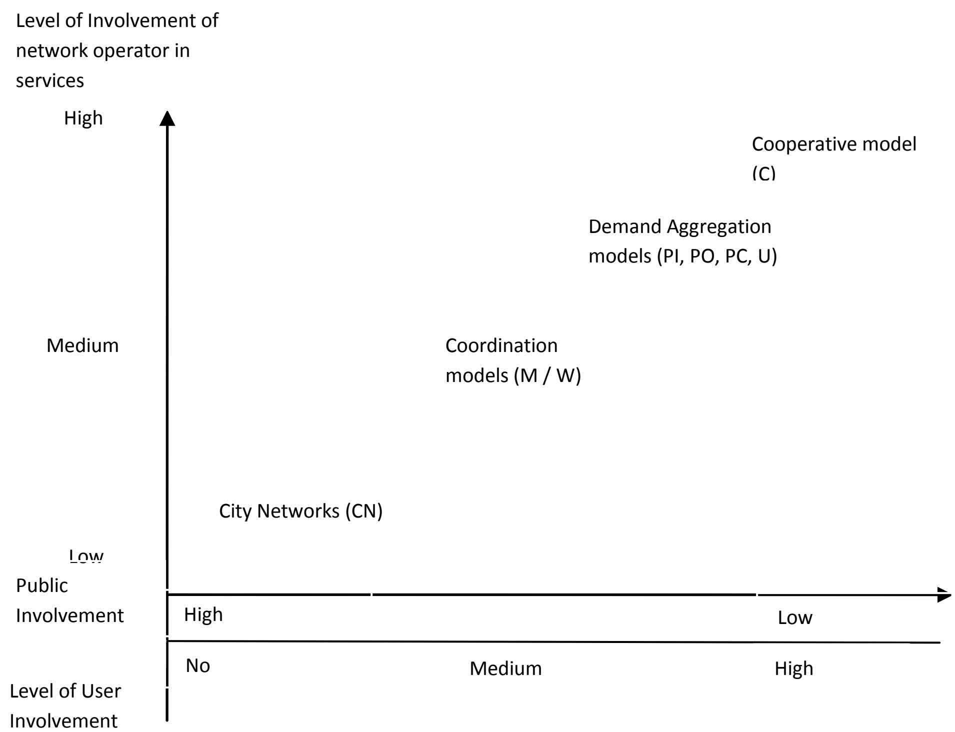
1) The cooperative model (initially Nuenen and Eindhoven - C);
2) Demand-aggregation models based on initiative by
   a) Groups of residential users (initiative lies with social entrepreneurs in local communities in conjunction with private installation company like Reggefiber or Lijbrandt or an telecommunication operator like KPN - U) ;
   b) Private installation firm like Lijbrandt (by organizing a critical mass of residential subscribers - PI);
   c) Telecommunication operator like KPN (by organizing a critical mass of residential subscribers - PO)
   d) Cable operator like CAIW (by organizing a critical mass of residential subscribers - PC);
3) The Municipal coordination model (responsibility lies with bureaucratic entrepreneurs within local authorities - M)(B Sadowski, 2006);
4) The Social Housing Coordination model (responsibility lies with entrepreneurs within social housing corporations - SHC); and
5) City network (based on investment in backbone network, responsibility lies with bureaucratic entrepreneurs - CN).

The different forms of PPI can be distinguished according to the degree of (residential) user involvement in the initiative ranging from high (cooperative model) to medium (different demand aggregation models and coordination models) to low (city networks). In the cooperative model, user involvement takes place beyond simple demand aggregation but also involves expression of needs for future services. Even if the initiator differs in demand aggregation models, sufficient critical mass for starting up a network and providing basic (triple play) services is the central issue, the expression of user needs is also important but to a lesser extent. In the different coordination models, municipalities or social housing corporations can provide guarantees in case certain critical levels of residential users cannot be achieved. In city networks, the generation of sufficient demand for services is task of private service providers, public parties are responsible for investment in lower (passive) layers of the network (see Figure 1).

The highest (local) public involvement has been in city networks (mostly based on public investment in passive infrastructure). Involvement of (semi-) public agencies has been medium for coordination models in which local governments or social housing corporations have been responsible for the coordination of different parties involved in the municipal NGA network, but not for the financing of the network. In other words, the identity of the owner of the network has been relevant if: i) social housing corporations have been responsible for underwriting some of the costs of the network by linking consumer 'ownership' to the investment in the network or ii) local municipalities were acting as consumers' agents by investing (sharing some risks) and/or acting as aggregators of consumer interests (and hence providing for consumer risk-sharing).[11] Public involvement by (semi-) public agencies has been to lesser extent in aggregation models as the task of coordination has been taken over by other parties (private firms - PI, operators – PO, cable companies - PC or user groups - U). Similarly, public involvement has initially been high, but has recently become a less important factor in cooperatives (C).

[11] Communication with Brownwyn Howell, September 2009.

Figure 2: PPI for Municipal Fibre Networks in the Netherlands



Lastly, the involvement of the network operator in service development has been highest in cooperatives (as infrastructure and service provision is vertically integrated) and lowest in city networks (as independent service providers are responsible for service provision).

Figure 2 below summarizes the different options of PPI.

3.4 Forms of PPI: Structure of Consortium and Efficiency

By looking at the data on fibre implementation in municipal networks in the Netherlands (see Table 1), an interesting observation has been that most initiatives have been started by private installation firms (like Reggefiber and Lijbrandt) (12 initiatives or 29.3 percent) and residential user groups (11 or 26.8), followed by incumbent telecommunication operator KPN (8 or 19.5 percent). However, KPN still is leading the total number of fiber installations in terms of homes passed (23 percent), followed by municipalities (21 percent) and residential user groups (20 percent). It is noteworthy that KPN has been less successful in converting fibre connections from "homes passed" to "homes connected" (19,27) compared to other fibre initiatives (Stratix, 2010).

Table 1: Municipal FTTH Networks in the Netherlands according to Initiative

Model	Initiative by	Num	% of all init.	Homes Passed (HP)	% of total HP	Homes Connected (HC)	% of total HC	Conversation Rate
Demand aggregation (Users)	User groups	11	26.8	110,969	20	43,352	23	39,07
Demand aggregation (Suppliers)	Installation Firm	12	29.3	99,266	18	53,242	28	53,64
	Telecom Operator	8	19.5	130,703	23	25,185	13	19,27
	Cable Operator	2	4.9	836	0	117	0	14,00
Municipal Coordination	Municipality	3	7.3	114,966	21	27,905	15	24,27
Social Housing Corporations	Social Housing Corporations (SHC)	2	4.9	17,942	3	7,506	4	41,83
Cooperative Model	Users, SHC	2	4.9	36,218	6	22,797	12	62,94
City	Municipality	1	2.4	47,353	8	8,676	5	18,32

Network								
	Total	41	100.0	558,253	100	188,780	100	

(Data: Homes passed and homes connected by (Stratix, 2010), own investigation)

Table 2 shows that the effects of the different models on coverage differ. Large municipalities like Amsterdam (11.37 percent of all households) or Eindhoven (25.46 percent) have a lower coverage compared to smaller geographical locations like Best or Helmond (see also Appendix 1 and Appendix 2). In particular, in these smaller locations private installation firms in conjunction with residential user organizations have been active.

Table 2: Muncipial Fibre Networks and Coverage (of Total Households)

Model	Initiative by	HP on total households (mean)	Min	Max
Demand aggregation (Users)	User groups	39.60	4.78	100.00
Demand aggregation (Suppliers)	Installation Firm	72.93	5.50	100.00
	Telecom Operator	66.15	5.18	100.00
	Cable Operator			
Municipal Coordination	Municipality	60.36	3.90	96.72
Social Housing Corporations	Social Housing Corporations (SHC)	12.83	8.41	19.26
Cooperative Model	Users, SHC	62.73	25.46	100.00
City Network	Municipality	11.37	11.37	11.37
	Total	53.37		

(Data: (Stratix, 2010))

For most municipal fibre networks in the Netherlands, a vertically integrated structure of infrastructure and service provision has until recently been considered as the "natural" solution to the problem of demand and market uncertainty. The function of (semi-) public organization and local residential user groups has mainly been to aggregate (uncertain) demand for fibre-based services, facilitate coordination and/or cover for initial capital investments in NGA networks (B. Sadowski, Nucciarelli, & de Rooij, 2009). Contracts between a vertically integrated network and service provider should guarantee sufficient long-term returns, cover the initial high capital costs and allow sharing the risks of network development. The service provider would receive, in addition, monopoly rights for a certain period of time. Recently, it has become apparent that these structures are not only prone to static inefficiencies, but that they do not provide sufficient incentives for future service level entry and innovation. Therefore, a number of recent initiatives have been based on a variety of service providers (see

Table 3). The discussion on service level entry has been accompanied by a debate on open access.

Table 3: Muncipial Fibre Networks and Service Level Competition

Model	Initiative by	Number of service providers (Range -Mean)
Demand aggregation (Users)	User groups	1-3 (1.45)
Demand aggregation (Suppliers)	Installation Firm	1-3 (2.67)
	Telecom Operator	2-4 (2.62)
	Cable Operator	1
Municipal Coordination	Municipality	1-5 (3.33)
Social Housing Corporations	Social Housing Corporations (SHC)	1
Cooperative Model	Users, SHC	4
City Network	Municipality	3

(Data: own investigation)

The data on municipal fiber initiatives further show that service offerings based on fiber are, in general more expensive than comparable offerings by established market parties (about 14.38 Euro higher). The city network in Amsterdam has been able to market its services just slightly above these offerings. The lowest prices can be expected in areas in which residential user groups, cooperatives and social housing corporations have been active. Higher prices are in areas in which private installation firms and telecommunication operators have implemented fibre networks. Surprisingly the highest prices are currently in areas in which there are municipal coordination models like Rotterdam (see

Table 4).

Table 4: Municipal FTTH Networks in the Netherlands: Price differences

Model	Initiative by	Mean	Min	Max
Demand aggregation (Users)	User groups	10.10	5.00	21.00
Demand aggregation (Suppliers)	Installation Firm	19.58	15.05	35.00
	Telecom Operator	12.51	5.00	35.00
	Cable Operator	21.00	21.00	21.00
Municipal Coordination	Municipality	21.51	15.00	34.49
Social Housing Corporations	Social Housing Corporations (SHC)	10.02	5.00	15.05
Cooperative Model	Users, SHC	10.02	-2.00	14.00
City Network	Municipality	5.00	5.00	5.00
Total		14.38		

(Explanation: price above comparable service offering for 100 Mbit/s, own investigation)

In addition, municipal fiber initiatives differ according to higher speed offerings based on fiber. Models based on residential user groups, the coordination of municipalities and social housing corporations the chances are higher that there are also higher speed offerings (above 100 Mbits).

Table 5: Municipal FTTH Networks in the Netherlands: Speed differences and advanced services

Model	Initiative by	Upload 200 Mbit/s	Advanced Services
Demand aggregation (Users)	User groups	Yes	Yes, at some locations
Demand aggregation (Suppliers)	Installation Firm	No	Yes, at some locations
	Telecom Operator	Yes, at some locations	No
	Cable Operator	No	No
Municipal Coordination	Municipality	Yes	No
Social Housing Corporations	Social Housing Corporations (SHC)	Yes	No
Cooperative Model	Users, SHC	NO	Yes
City Network	Municipality	No	No

(Explanation: own investigation, advanced services have been in particular in e-health and e-learning areas)

Recently, trials with new advanced broadband services have taken place at some locations in the Netherlands. In particular, these trials have been undertaken in areas in which user groups have been active and were cooperative models have been established. At some locations, also private installation firms have been active in developing new advanced broadband services (see

Table 5).

5 Summary and Conclusions

The paper has shown that different forms of PPI can be found in the Netherlands responsible for the establishment of municipal fibre networks. The forms of PPI differ with respect to user involvement, the contribution of activities by (semi-) public authorities and level of involvement of network operator in service provision. The different forms of PPI can have positive effects on stimulating the investment and pricing behavior of market parties in the market for next generation access (NGA) networks. Even if the number of PPI in relation to the total size of the broadband market in the Netherlands is still rather small, there are already local effects of these networks on price and innovation visible.

Through the transaction costs lens, the central question of this paper has been to what extent do the forms of PPI differ with respect to output, pricing and innovation? The results of the analysis show that even if some indicators show the expected effects like the conversion rate (still indicating high demand uncertainty), it is too early to conclude on the effects on pricing levels, competition or speed.

It seems that the different forms of PPI have their own criticalities with respect to the generation of sufficient demand (e.g. city networks), coordination costs (e.g. coordination models and cooperatives) and service level innovation (e.g. demand aggregation models). Furthermore, these models are differently affected by demand uncertainty (sufficiently covered by demand aggregation models) and market uncertainty (e.g. municipal coordination model). Future research has to show to what extent these models are providing sufficient leeway for service level innovation and infrastructure upgrading.

Initial contracts written by different parties still remain vital for further development of PPI and the evolution of the municipal NGA network even if these contracts are incomplete. It can be expected that non-contractual forms of PPI will become more important in the near future, as user involvement for new service development remains critical. Local authorities receive with these different forms of PPI a list of options for the implementation of municipal NGA networks in cases in which a) user needs have to be better defined (choice between cooperatives and user aggregation models); b) demand aggregation has to be undertaken (different aggregation models), c) coordination of market parties is required (coordination models) or d) initial investment (or guarantees) (city network model) is necessary. Regulators have to examine the development of NGA networks in greater detail and provide sufficient incentives for incumbent market parties for the migration of their broadband offerings to NGA networks.

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Appendix 1: Different municipal FTTH initiatives in the Netherlands 2010: Initiative, Households (HH), Penetration levels, Speed and Prices for Triple Play

Municipality	InitatorName2010	Initiator	HH2010	HP2010	HC2010	HS2010	UPMin2010	UpMax2010	PrMin2010	PrMax2010
Meppel	Lijbrandt	PI	13930	925	875	N.A.	25	100	44,95	84,95
Almere	Gemeente, Glashart	M	75400	60682	57500	7500	30	200	55,00	110,00
Dronten	BewonersInitiatief	U	16280	10040	7700	2000	30	100	55,00	90,00
Zeewolde	BewonersInitiatief	U	7740	7740	6100	1500	50	200	54,95	87,50
Arnhem	GNEM, Portaal	W	73080	6144	6144	1720	50	200	54,95	87,50
Elburg	Glashart	PO	8340	4500	3150	1300	50	200	54,95	87,50
Lochem	Glashart	PO	13710	710	530	245	35	100	35,00	65,00
Nijkerk	Glashart	PO	15170	8260	8150	2480	30	100	55,00	95,00
Nijmegen	Glazenkamp	W	86190	19507	19507	9472	50	200	54,95	110,00
Wijchen	Stichting Glasvezel	U	16100	8160	4500	1800	50	200	54,95	110,00
Best	OnsBrabantNet	PI	11590	11050	7500	7500	100	100	54,95	N.A.
Eindhoven	Ons Net	C	106230	27048	24545	15057	100	100	56,00	60,00
Geldrop-Mierlo	OnsBrabantNet	PI	16360	16360	10000	10000	100	100	54,95	N.A.
Helmond	OnsBrabantNet	PI	37830	2510	1633	1633	100	100	54,95	N.A.
Laarbeek	OnsBrabantNet	PI	8560	8540	5120	5120	100	100	54,95	N.A.
Nuenen,	Ons Net	C	9170	9170	8600	7740	100	100	72,00	N.A.
Schijndel	OnsBrabantNet	PI	9100	9100	8740	2730	30	100	49,95	84,95
Sint-Oedenrode	OnsBrabantNet	PI	6970	5900	5310	1170	30	100	49,95	84,95
Son en Breugel	OnsBrabantNet	PI	6280	6080	5470	1825	35	100	35,00	65,00
Uden	Glashart	PO	16750	15430	13887	4010	30	100	65,00	110,00
Valkenswaard	OnsBrabantNet	PI	13670	13360	7944	7944	100	100	54,95	N.A.
Veghel	Glashart	PO	14740	12913	10000	3870	30	100	55,00	95,00
Veldhoven	OnsBrabantNet	PI	18020	17470	9205	9205	100	100	54,95	N.A.
Amsterdam	Gemeente	CN	416430	47353	15078	8676	30	100	65,00	95,00
Hilversum	Glashart	PO	39880	39880	11960	550	30	100	65,00	110,00
Deventer	XMS	M	44180	42730	34185	13675	50	200	54,95	110,00
Enschede	Glashart	PO	75780	41060	16400	10500	30	100	65,00	110,00

Municipality	InitatorName2010	Initiator	HH2010	HP2010	HC2010	HS2010	UPMin2010	UpMax2010	PrMin2010	PrMax2010
Haaksbergen	Glashart	PO	9730	7950	7500	2230	30	100	65,00	110,00
Rijssen-Holten	Twennet	U	13170	11920	5960	5960	35	100	49,00	74,00
Amersfoort	Bewonersinitiatief	U	61780	21170	14913	7948	30	200	65,00	110,00
Bunnik	XMS	PI	5990	770	770	215		200	65,00	110,00
Nieuwegein	Bewonersinitiatief	U	26980	1290	1290	360		200	65,00	110,00
Soest	Initiatiefgroep Soest op Glasvezel	U	19930	4300	4300	1200	30	100	65,00	110,00
Utrecht	Bewonersinitiatief LomboXnet, ism, Kersentuin	U	157300	20152	20105	10537	30	100	65,00	110,00
Veenendaal	Bewonersinitiatief	U	24890	5920	5170	2360	30	100	65,00	110,00
Hillegom	Lijbrandt	PI	8730	7431	7431	5575	25	N.A.	49,00	N.A.
Krimpen aan de Ijssel	Caiway	PC	11760	71	71	71	25	90	49,00	99,00
Leiden	Portaal	W	61250	11798	11798	5786	30	100	65,00	110,00
Oegstgeest	Lijbrandt	PI	9810	540	540	540	10	N.A.	46,50	N.A.
Rotterdam	Gemeente	M	296420	11554	11554	6730	10	N.A.	35,51	46,41
Westland	Caiway	PC	38960	765	46	46	25	90	49,00	99,00
Total Fibre				558253	401181	188780				

(Sources: Stratix 2010, Glasvezel.nu, company information)
(Explanation: PI = Private Installation Firm, PO = Private Operator Firm, PC = Private Cable Opertor, M = Municipality, U= User Community, W = Social Housing Corporation, C = Cooperative, CN = Citynetwork)

Appendix 2: Different municipal FTTH initiatives in the Netherlands 2010: Initiative, Infrastructure and service providers, advanced services

Municipality	InitatorName2010	Initiator	Infrastructure Prov	SP1	SP2	SP3	SP4	SP5	AdServ
Meppel	Lijbrandt	PI	Glashart	KPN	Plinq	Tweak			
Almere	Gemeente, Glashart	M	Glashart	KPN	Tweak	XMS	Pling	Une t	
Dronten	BewonersInitiatief	U	Glashart	Solcon					
Zeewolde	BewonersInitiatief	U	Glashart	Solcon	XMS	Com One			
Arnhem	GNEM, Portaal	W	XMS	XMS					
Elburg	Glashart	PO	Glashart	Pling	Tweak				
Lochem	Glashart	PO	Glashart	KPN	Solcon				
Nijkerk	Glashart	PO	Glashart	KPN	Tweak				
Nijmegen	Glazenkamp	W	XMS	XMS					MAAT
Wijchen	Stichting Glasvezel	U	Glashart	XMS					
Best	OnsBrabantNet	PI	OnsBrabantNet	KPN	TriNed	Tweak			
Eindhoven	Ons Net	C	OnsNet	NEME	OnsNet	Herzinger	Edutel		DOA
Geldrop-Mierlo	OnsBrabantNet	PI	OnsBrabantNet	KPN	TriNed	Tweak			
Helmond	OnsBrabantNet	PI	OnsBrabantNet	KPN	TriNed	Tweak			
Laarbeek	OnsBrabantNet	PI	OnsBrabantNet	KPN	TriNed	Tweak			
Nuenen,	Ons Net	C	OnsNet	NEM Nuenen	OnsNet	Herzinger	Edutel		
Schijndel	OnsBrabantNet	PI	OnsBrabantNet	KPN	TriNed	Tweak			
Sint-Oedenrode	OnsBrabantNet	PI	OnsBrabantNet	KPN	TriNed	Tweak			
Son en Breugel	OnsBrabantNet	PI	OnsBrabantNet	KPN	TriNed	Tweak			DOA
Uden	Glashart	PO	Glashart	KPN	TriNed	Tweak			
Valkenswaard	OnsBrabantNet	PI	OnsBrabantNet	KPN	TriNed	Tweak			Lear
Veghel	Glashart	PO	OnsBrabantNet	KPN	TriNed	Tweak			
Veldhoven	OnsBrabantNet	PI	OnsBrabantNet	KPN	TriNed	Tweak			
Amsterdam	Gemeente	CN	Glasvezel Amsterdam	Alice	Concepts ICT	InterNLnet			
Hilversum	Glashart	PO	Glashart	XMS	Plinq	Tweak			
Deventer	XMS	M	XMS	XMS					
Enschede	Glashart	PO	Glashart	Plinq	Unet	Solcon	Casanet		

Municipality	InitatorName2010	Initiator	Infrastructure Prov	SP1	SP2	SP3	SP4	SP5	AdServ
Haaksbergen	Glashart	PO	Glashart	Plinq	Tweak				
Rijssen-Holten	Twennet	U	Glashart	Solcon	Tweak	ConceptsICT			
Amersfoort	Bewonersinitiatief	U	XMS	XMS					
Bunnik	XMS	PI	XMS	XMS					
Nieuwegein	Bewonersinitiatief	U	XMS	XMS					
Soest	Initiatiefgroep Soest op Glasvezel	U		XMS					
Utrecht	Bewonersinitiatief LomboXnet, ism, Kersentuin	U		XMS					
Veenendaal	Bewonersinitiatief	U	Glashart	XMS	Solcon				
Hillegom	Lijbrandt	PI	Lijbrandt	Lijbrandt					
Krimpen aan de Ijssel	Caiway	PC	Caiway	CAIW					
Leiden	Portaal	W	XMS	XMS					
Oegstgeest	Lijbrandt	PI	Lijbrandt	Lijbrandt					
Rotterdam	Gemeente	M	Ontwikkelingsbedrijf Rotterdam	interNLnet	Luna	Concepts ICT	Glashelder		
Westland	Caiway	PC	CAIW	CAIW					

(Sources: Stratix 2010, Glasvezel.nu, company information)
(Explanation: PI = Private Installation Firm, PO = Private Operator Firm, PC = Private Cable Opertor, M = Municipality, U= User Community, W = Social Housing Corporation, C = Cooperative, CN = Citynetwork)