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The effects of trans-sectoral broadband services on digital inequality:  
The case of the Netherlands

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## Introduction

With the Community Guidelines in place (CEU, 2009), municipalities across Europe have been able to become more active in participating in the initial design and future development of community-wide fibre networks. Since the early 2000s, municipalities in the Netherlands (like Amsterdam, Eindhoven, Nuenen or Almere) have taken the lead in facilitating fibre networks in combining infrastructure implementation with the provision of Triple Play services (telephony, Internet and television) and IP TV. After the expected removal of roadblocks to municipal investment in the Netherlands due to the Crisis and Herstellenwet of 2009 (Crisis and Recovery Act) (Staten-Generaal, 2009), new municipal initiatives are underway. However, the current market outlook for these new broadband services is rather uncertain and their development is risky.

Attention in the recent discussion on the digital divide in advanced OECD countries has shifted from digital access to digital equality issues (OECD, 2008). In the Netherlands as a country with one of the highest broadband penetration in the world (38.1 percent) (OECD, 2009) this meant that digital inequality issues are becoming increasingly important as digital access seems achieved for the majority of Dutch citizens (CBS, 2008). The discussion on digital inequality has shown that higher access speed has a positive impact on higher usage of residential consumers as users utilize more of the existing broadband services and a greater variety of new services (Goldfarb & Prince, 2008; Hitt & Prasanna, 2007). In addition, trans-sectoral broadband services can provide a contribution to reduce digital inequality (Ida & Horiguchi, 2008). In this context, the study examines the market potential for different trans-sectoral broadband services for residential consumers. It was conducted during June 2009 among 8500 FttH (Fibre-to-the-Home) users in the city of Eindhoven and received a response rate of 31 percent. First, we asked respondents, in general, whether they would be interested in using trans-sectoral broadband services such as security cameras in the neighborhood or e-health services. In a second step, we examined in more detail the specifics of a set of seven trans-sectoral broadband services (telecommunication and broadcasting services, security services, health and eldercare services as well as society and life services).

In contrast to the claims of existing market parties our investigation indicates that there is a broad interest for trans-sectoral broadband services. When asked about particular trans-sectoral broadband services like for example security camera's or e-health services more than 70 percent of the respondents indicate that they are indeed interested. Even more surprisingly, 70 percent indicates that they would be willing to help test and experiment with trans-sectoral broadband services. Our data showed, in addition, that digital inequality issues remain if there is no conscious policy on how to foster the adoption of trans-sectoral broadband services among disadvantaged social groups.

## 2 Municipal Broadband Networks and the Digital Divide

Within the growing literature on residential broadband deployment (Cambini & Jiang, 2009), a number of studies have focused on examining the different forms of municipal NGA networks across Europe and the role of local governments in these initiatives. These studies have shown that during the implementation of NGA networks sufficient incentives should be provided to private firms, but that the incentives for other (semi-) public parties to participate in these initiatives are different (Nucciarelli, Sadowski, & Achard, 2010; B. Sadowski, Nucciarelli, & de Rooij, 2009). Furthermore, it has been shown that community-owned NGA networks are financially feasible (Lannoo et al., 2008; OECD, 2008; B. Sadowski, Nucciarelli, & de Rooij, 2009). However, the effects of municipal NGA networks on bridging the digital divide have rarely been analyzed.

In general, investment criteria for a private investor have mostly been taken as a benchmark to decide whether to design and implement municipal NGA networks. This view has explicitly used by the European Commission in designing the “market investor principle” for municipal networks like in the case of the Citynet in Amsterdam (CEU, 2006). However, this would mean that the public- and private sector should employ similar investment criteria (Fleming & Mayer, 1997). In this case, the cost of capital is determined using asset pricing models based on a mark-up over risk-free rates of return. However, this conventional view has been challenged in cases where the private sector has been unable (or unwilling) to generate the appropriate scale of investment and cost of capital is higher in the private than in the public sector (Fleming & Mayer, 1997). In their recent Broadband Guidelines (2009), the European Commission has acknowledged that the broadband market is not (always) a competitive market and that (local) governments can take initiatives to implement NGA networks if the existing market parties are not able or not willing to undertake this investment within a period of 3 years (paragraph 68). In addition, former Commissioner Vivian Reding proposed in 2008 that there should be a “risk premium of around 15 percent” for municipal NGA networks which should be taken into account by policy makers and regulators (Reding, 2008). This means that – by including social returns and social objectives – there are a variety of investment incentives in municipal NGA networks for public, semi-public and private parties (Cave & Hatta, 2009). This would also allow municipalities to explicitly include social objectives like digital divide issues into the design of municipal NGA networks.

There is a wide variety of broadband services running over broadband networks ranging from fixed and mobile broadband services, interactive television services and trans-sectoral broadband services (PriceWaterhouseCoopers, 2010). Only few studies have focused on different types of broadband networks and the extent to which they are able to run trans-sectoral broadband services such as e-learning, e-health or e-commerce (Bauer, Gai, Muth, & Wildman, 2002; Firth & Mellor, 2005). In this context, NGA networks are becoming increasingly important, in particular, for experimenting with and learning from the implementation of trans-sectoral broadband services (such as telemedicine or tele-education). In order to justify the implementation of municipal NGA networks, it has become important to evaluate the importance of these trans-sectoral broadband services with respect to socio-economic

benefits in areas such as economic growth, community participation, education, quality of life and health. However, research on demand for trans-sectoral broadband services has just recently started (e.g. Ida & Horiguchi, 2008).

Municipal NGA networks can be considered as having a function of public information utility (B. Sadowski, Nucciarelli, & de Rooij, 2009). That means, that equity motives are prevalent, i.e. that these new broadband services should allow disadvantaged people to participate more actively in social, economic and political life (Cave, 2010). Based on the equity motive, an investment should be undertaken by (local) government (using the Hicks-Kaldor criterion), if those who benefit from the project can afford to compensate those who suffer – that is, those who bear the direct costs of the investment or are exposed to its negative externalities (Fleming & Mayer, 1997). For investment in NGA networks, equity justifications have been developed based on the assumption that broadband development will lead to new digital divide between the people who have access and those who do not. A primary objective for NGA networks has been to bridge the digital divide (Verdegem & Verhoest, 2009)(CEU, 2009).

The term digital divide usually refers to the gap between people with effective access to digital and information technology and those with very limited or no access at all. The OECD defines digital divide as: “a division between individuals and households at different socioeconomic levels, regarding their chances to access or use information and communication technology” (OECD, 2002). A digital divide occurs when inequality in access to information and communication services among population groups exist (Yuguchi, 2008). The existence of a digital divide is often seen as a major barrier for development of individuals, regions and/or entire nations. As established by Kiyotaka Yuguchi this divide usually has geographic, demographic, and socio-economic dimensions (Yuguchi, 2008). However, the definition of digital divide in terms of simple lack of access to information and communication technologies for certain segments of the population has been challenged in the literature (Servon, 2002). As a result, the discussion has started to focus on issues of digital inequality and the question "what are people doing, and what are they able to do, when they go online?" (DiMaggio & Hargittai, 2001).

As upgrading to higher broadband speeds on existing networks seems to be related to number of user characteristics such as an income or price, the migration to a different (new quality of) network based on FttH apparently is a more difficult process. A central assumption on broadband upgrading has been that more capacity increases the extent of use and the variety of uses of new broadband services (Hitt and Prasanna 2007; Goldfarb and Prince 2008). With respect to a migration to FttH networks, it has been shown that user characteristics including income, service usage including motion-picture viewing, and type of residence have impact on migration to FttH networks, but the "information poor" fail to migrate (Ida & Skahira, 2008). But apparently, the information poor are the social groups who benefit most from these new networks as Sadowski, et. al (2008) conclude in their study of FttH users in the Netherlands. Their study shows that FttH networks can have positive effect on social capital if the development of the network is related to social objectives. In addition, they show that users with lower income and lower education benefit over-proportional from new Web 2.0 applications. In this respect, FttH access positively contributes to the development of social contacts of individuals and social cohesion of neighborhoods in which such access is available (Sadowski, Matzat, & Kwaaitaal, 2007).

### 3 Attractiveness and Characteristics of Trans-Sectoral Broadband Services

#### 3.1 Trans-sectoral broadband services: Conceptual model and Methodology

For FttH networks to reach full potential and to make optimal use of the possibilities offered, trans-sectoral broadband services have to be developed. So far, this development has been rather difficult. Trans-sectoral broadband services can be categorized in four main categories as suggested by Ida and Horiguchi (Ida & Horiguchi, 2008): Telecommunication and broadcasting services, security services, health and eldercare services, and society and life services. Table 1 provides an overview about these services. All applications are currently feasible but not yet widely implemented.

Telecommunication and broadcasting services	Security services	Health and eldercare services	Society and life services
Cloud computing	Home security	Automatic lights	E-government
Local TV	Smart Street surveillance	Emergency buttons	Emergency and disaster warning systems
Foreign TV-stations using IPTV	Video monitoring	Entry control	Neighborhoods websites
Free Video-on-demand	Video surveillance	Inactivity sensors	Online/offline courses
Network digital video recorder		In-home security	Policeman-online
Online back-up		Remote monitoring	Website building toolkit
Pay Video-on-demand		Remote monitoring of health functions	e-commuting
Steaming music		Video communication	
VOIP			
HDTV			
Internet on TV			

**Table 1: Potential trans-sectoral broadband services**

As can be readily seen the services identified differ widely in their use, technical difficulty, and level of development. Some are already well known or even available to customers like for example HDTV. Others like cloud computing are new but show great potential.

From this list, seven services are selected for the market analysis. The services selected had to meet a number of criteria. Firstly, they had to be technically feasible. Secondly, they should not be as advanced that they cannot be relatively easily explained to a wider audience. Thirdly, we made sure to include services from all four categories described above. Eventually the services selected have been the following:

##### 1. Network video recorder

A network video works in the same way as a regular digital recorder except for the fact that recordings are not stored locally but on a central server. This results in the most vulnerable part of a regular digital video recorder being placed outside the home. This is more efficient as storage capacity can be shared with many users, future upgrades to allow for more storage capacity necessary for HD recording can be done more efficiently, and a backup can provide additional security in the case of hardware failure. The

system allows using remote access via internet or mobile phone to set up the network video recorder while not at home. Functions like time-shifting are possible.

## *2. Videophony*

Videophony is based on technique by which two or more people communicate using sound and video. The picture transmitted should be on a quality level comparable to regular TV and exceed the “webcam experience”. In terms of quality and reliability, the demands should be similar to what regular telephone offers.

## *3. Inactivity sensors*

For this service, sensors are installed throughout the house. When no activity is detected for a prolonged period, a professional care provider (or someone else) is alerted.

## *4. Medical videophony*

Similar to a regular videophone, conversations with medical videophony are undertaken with professional care providers based on high-definition quality. This service can potentially offer positive effects on the health sector and provides more convenience for people who are chronically ill and have difficulty leaving the house but do require regular contact with medical practitioners.

## *5. Local TV*

Local TV should be based on TV station(s) which have a very local character partly or totally recorded by trained amateurs or fixed cameras. Examples are televised services from local churches, mosques or local sport associations. Also reporting of local events or video feeds from streets or places of interest in the city are possible. Such services can potentially contribute to enhancing social-cohesion in neighborhoods and cities.

## *6. Home security*

Home security cameras are installed and can be viewed remotely using an internet connection or cell phone. Also included in these systems is the ability to be alerted and receive images instantly if the alarm is activated. Fire and carbon-dioxide alarms could also be easily integrated into the offer and create additional value.

## *7. Access control*

This system allows to view from the TV who is at the door and if desired the door can be opened automatically. This system can also be used via mobile telephone. This way the decision whether or not to open the door can also be taken while being out of the house.

After the general part of the survey (de Pender and Sadowski, 2010), people were asked to consider one of the seven services identified and described above. Respondents were asked to evaluate this service

dependent on the answers provided in the general part of the survey. This was done to pre-sort respondents to prevent them from having to evaluate a service they would be very unlikely to find attractive at all (e.g. asking a 25 year old to evaluate inactivity sensors which are specifically aimed at senior citizens). However, some randomly selected respondents were added to each conjoint analysis to provide a control group to further validate our results.

€ 10 per maand Bediening via TV Installatie kosten € 50 Helpdesk via telefoon, e-mail en lokale winkel	€ 5 per maand Bediening via de computer Installatie kosten € 100 Helpdesk via telefoon en e-mail	€ 20 per maand Bediening via TV Geen installatie kosten Helpdesk via telefoon, e-mail en lokale winkel	Geen: Ik zou geen van deze opties kiezen
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**Figure 1: Example of conjoint question screen**

We asked respondents to choose between different characteristics as shown in Figure 1. As can be seen there are three choice options, each with four different attributes. All choices are displayed together with a none option. In total, such question was repeated 7 times for each respondent. Appendix 1 gives an overview of all choice-based-conjoint analysis performed with their attributes and attributes levels.

A conjoint analysis has been used to examine the stated preferences of users. The key characteristic of conjoint analysis is that respondents evaluate several product concepts with a number of conjoined attributes (product features). There are many different forms of conjoint analysis like for example adaptive-conjoint-analysis, adaptive-CBC, MaxDiff and conjoint-value-analysis but for this particular study, choice-based-conjoint (CBC) analysis was used. The main characteristic distinguishing choice-based-conjoint analysis from other types of conjoint analysis is that the respondent expresses preferences by choosing concepts (products) from sets of concepts, rather than rating or ranking them (Sawtooth Manual, page 357).

The fundamental premise for asking people this kind of questions, instead of people to rate or rank the importance of these several attributes directly, is that people cannot reliably express how they weight separate features of the product. However, we can deduce these preferences by using the more realistic approach of asking respondents to evaluate product concepts through choice-based-conjoint analysis (Orme, 2005). Additionally we have added a “None” option to all CBC questions. By selecting that option, respondents who do not have interest in any of the described services can indicate so. Including a none option makes the choice task more realistic because in real life people can usually decide between several similar products but obviously can also always refrain from buying anything at all. This improves the quality of the data, by letting respondents screen themselves out of questions containing only alternatives they would never consider (Johnson & Orme, 2003).

The data obtained from the survey was analyzed using conditional (fixed-effects) logistical regression. Per respondent 21 (3 choices times 7 questions) observations are reported. Number (nr) is the unique identifier to identify each respondent. The second column called “number and task” indicates the CBC task ranging from one to seven (see last digit). This task number is combined with the ID number to create a unique number. This is necessary because statistical programs like Stata require each task to have a unique identifier. Choice indicates which of the three available options was chosen. If for all three options the choice value is zero this indicates that the none option was selected. Such cases have been dropped from the analysis because the contribution to the log-likelihood of such cases is zero (StataCorp LP, 2005). Normally conditional logistical regression requires that observations be independent. Clearly this assumption is not valid here as 21 repeated observations are made on each individual. For this reason we have accounted for the fact that observations are independent between different persons (different ID numbers) but not necessarily independent for observation from the same person. This affects the standard error and variance-covariance matrix of the estimators but not the estimated coefficients. The other values of the dataset are the values of the different attributes either in Euro’s or dummy coded to represent the different attribute levels.

### 3.2 Segmentation of residential user groups

Over the last decades, segmentation has become a dominant concept in marketing literature and practice as segmentation of customers into different groups is used in marketing research (Wind, 1978). In order to divide heterogeneous group into more homogeneous subsets referred to in marketing literature as market segments (Mahajan & Jain, 1978), the segmentation concept developed by Motivaction was used (Corpeleijn & Schouw, 2004). This research company annually conducts a large scale quantitative investigation to monitor social and cultural trends in the Netherlands (Eggens, 2004). This segmentation concept goes beyond traditional social-demographic factors like age, education, and religious conviction. This is important because people are increasingly less stereotype. This is caused by ongoing individualization in the Dutch society (Motivaction). For this reason, the following seven user segments are identified (see Table 2).

Group	Description
Active individualists	<ul style="list-style-type: none"> <li>• Youngest group; students; Starters</li> <li>• Now: Fashionable; little interest in environment; renting</li> <li>• Future: No standard housing; gadgets</li> </ul>
Domestically oriented	<ul style="list-style-type: none"> <li>• Elderly, low education</li> <li>• Rental apartment; practical</li> <li>• Future: Conservative; service package</li> </ul>
Settled Idealist	<ul style="list-style-type: none"> <li>• All ages</li> <li>• Now: Own large houses; environmentalist; active and involved; home improvement &amp; gardening</li> <li>• Future: Expensive &amp; luxurious houses; change oriented</li> </ul>
Tolerant socializers	<ul style="list-style-type: none"> <li>• Age 24 – 45</li> <li>• Now: environmentalist, tolerant; big living-room; relatively wealthy;</li> <li>• Future: Owns house with historic value</li> </ul>
Neighborhood oriented	<ul style="list-style-type: none"> <li>• Age 25 – 45</li> </ul>

	<ul style="list-style-type: none"> <li>• Now: no interest in environment; passive; rents or owns row-house, traditional, self-employed;</li> <li>• Future: conservative; rents or owns row-house</li> </ul>
Hurried middleclass	<ul style="list-style-type: none"> <li>• Often young families &lt; age 35; relatively well educated;</li> <li>• Now: Status important; New houses; new gadgets</li> <li>• Future: Owns a house bigger and more luxurious</li> </ul>
Community minded	<ul style="list-style-type: none"> <li>• Often &gt; age 45, low education, often retired;</li> <li>• Now: traditional, well-balanced, health and family important</li> <li>• Future: No change</li> </ul>

**Table 2: Segmentation of population**

### 3.3 Empirical models and results

To examine the relationship between this user categories and different trans-sectoral broadband services, a market analysis under 8500 FttH users in the city of Eindhoven was undertaken. Our investigation shows that there is a broad interest for new services among FttH customers. When asked about particular trans-sectoral broadband services, like for example security camera’s or e-health services, more than 70 percent of the respondents indicate that they are interested. Even more surprisingly, 70 percent indicates that they would be willing to support Ons Net Eindhoven in experimenting with trans-sectoral broadband services. From the seven different conjoint analyses, performed three proved to have been too low response to make any statements on particular outcomes. These services are video calling, access control, and medical video calling.

#### 3.3.1 Home security

The first service investigated is the home security service. We asked respondents to evaluate advanced home security services using 7 CBC questions. In total 408 persons completed this module. The home security service includes security cameras’ being installed which can be viewed remotely using a computer or a cell phone with internet access. Also included is the ability to be alerted and receive images instantly if the alarm is activated. We also suggested that fire and carbon-dioxide alarms could be easily integrated into the offer and create additional value. A number of innovative companies are already offering such advanced security service, but none are active in the Netherlands. Examples of such companies include Xanboo<sup>1</sup> in the United States and Altibox<sup>2</sup> in Norway.

Previous research conducted in the Netherlands suggests that, at this moment, about seven percent of the Dutch population has a home security alarm of some form. However, sixty percent indicates that they would like to have one (Corpeleijn & Schouw, 2004). This combined with the fact that Eindhoven has relatively high crime rates compared to other cities in the Netherlands, in principle shows clear potential for a home security service. The study from Corpeleijn and Schouw concludes that the demand

<sup>1</sup> [http:// www.xanboo.com/](http://www.xanboo.com/)

<sup>2</sup> [http:// www.altibox .no/](http://www.altibox.no/)

for home security systems is predominately dependent on price (Corpeleijn & Schouw, 2004). As we will describe in more detail below this is not consistent with our findings (see Table 3).

Conditional (fixed-effects) logistic regression		Number of obs	=	3564		
Log pseudolikelihood = -718.08306		Wald chi2(5)	=	134.71		
		Prob > chi2	=	0.0000		
		Pseudo R2	=	0.4498		
(Std. Err. adjusted for 272 clusters in nr)						
-----						
	choice	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]
-----						
	monthlycos~e	-.1115342	.0098564	-11.32	0.000	-.1308525    -.092216
	and_computer	.7402114	.1273023	5.81	0.000	.4907034    .9897193
	and_cellph~e	.8766444	.1373918	6.38	0.000	.6073615    1.145927
	installati~e	-.0034683	.0006543	-5.30	0.000	-.0047508    -.0021858
	localshop	-.0981957	.0679932	-1.44	0.149	-.23146    .0350685

**Table 3: Significance of attributes in home security model**

The Table 3 shows the results of the empirical model for all respondents. The option to control the security systems via the TV was excluded from the analysis due to collinearity. We indeed found, as would be expected, both monthly subscription and installation cost to be significant indicators with a negative effect on adoption. However, there seems to be more acceptance with respect to installation cost. We found the installation cost / subscription cost ratio to be almost zero indicating that lower installation cost cannot be substituted by higher monthly cost<sup>3</sup>.

In contrast to Corpeleijn and Schouw we found other attributes besides price to contribute significantly to adoption as well. We found that the ability to control the alarm system using an external computer or cell phone to significantly enhance the probability of choosing to adopt such a system (see Table ). Our results also suggest that people would be willing to pay €6.50 per month more to be able to control their security system and receive live footage on their computer. The results also show that people value the possibility to control the system via mobile phone. If the possibility is offered to, besides controlling the system using a computer, also the use of a mobile device like a cell phone is possible respondents are willing to pay an additional €1.50. This combines to a total willingness-to-pay of 8 Euros a month more if the security system is accessible from any internet enabled device. Support from a helpdesk that is available locally by a shop in the neighborhood does not contribute to adoption of security systems.

Now we will look whether adoption patterns differ between different segments in the population. First we will analyze the number of times the none-option was chosen across segments. By doing so we can reveal segments that are more or less likely to purchase to have interest in the home security service.

<sup>3</sup> It is recognized that the difference in the effect sizes of monthly vs. subscription costs may be partly artificial because the variable monthly costs included more levels than the variable subscription costs.

Segment	Nr. times none option	Percentage	Percentage all none
Domestically oriented	351	79.6	50.0
Settled Idealist	669	63.7	41.1
Tolerant socializers	573	48.7	23.7
Neighborhood oriented	891	49.9	24.7
Hurried middleclass	1194	59.2	27.5
Community minded	453	63.4	37.1
Average	590	52	29.2

**Table 4: Number of times none option chosen in home security module per segment**

We found that on average 30 percent of the respondents does not have interest in a home security system at all. But this level of interest varies widely among different segments. Results show that community minded, settled idealist, and the domestically oriented segments have substantially less interest. A possible explanation might lay in the fact that the domestically oriented and community minded segments typically rent houses from the housing association and as such are less likely to invest in such a system. The fact that these groups have little interest is further explained by the fact that they do not value the possibility to operate the home security system or view footage using computer or cell phone. As this is the main benefit of having such system it is to be expected that they would be less likely to buy such a product (see Table 4).

The segments, which are more likely than average to be interested in home security systems are tolerant socializers, neighborhood oriented and the hurried middleclass. These are the younger segments with an average age between 25 and 45 and include many young families. However, there are also large differences between the demographics of these groups. The hurried middleclass is relatively wealthy, usually owns a house and attaches special importance to new technological gadgets while neighborhood oriented are passive, more likely to rent and conservative. For this reason, we conclude that especially age is important. Elderly persons might be not be in a position to enjoy most of the benefits the system offers because they possess insufficient computer skills or do not have an IP based mobile phone. Moreover, recent research in Eindhoven has found that, contrary to general believe, elderly do not see security as a major problem or issue (Zuidzorg, forthcoming). If this is indeed the case, this would provide an additional explanation for the relatively low interest among elderly.

### 3.3.2 Network video recorder

In this CBC module, respondents were asked to rate several alternative offerings regarding network video recorders. A network video works the same as a regular digital recorder except for the fact that recordings are not stored locally but on a central server. The system allows for remote access via internet or mobile phone to set up the network video recorder while not at home. Functions like time-shifting are also possible. A total of 568 people completed this module. Table 5 shows the results of the model.

```

Conditional (fixed-effects) logistic regression      Number of obs   =       5745
                                                    Wald chi2(5)    =       168.90
                                                    Prob > chi2     =       0.0000
Log pseudolikelihood = -1850.3468                Pseudo R2      =       0.1205

                                                    (Std. Err. adjusted for 440 clusters in nr)
-----+-----
choice |               Coef.   Robust Std. Err.   z     P>|z|   [95% Conf. Interval]
-----+-----
monthlycos~e | -.0075296   .000743   -10.13   0.000   -.0089858   -.0060734
and_computer | .1150381   .0623226    1.85   0.065   -.007112   .2371883
and_cellph~e | .1528031   .0680931    2.24   0.025   .0193431   .286263
installati~e | -.0047835   .00046    -10.40   0.000   -.0056852   -.0038818
    localshop | .0375013   .0485601    0.77   0.440   -.0576749   .1326774
-----+-----

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**Table 3: Significance of attributes for network video recorder**

The model predicted the adoption of a network video recorder is significant for all independent variables except for local shop.<sup>4</sup> We dropped the variable remote because it showed high collinearity with the variable for mobile phones. Both monthly costs as well as installation costs are found to be important attributes. As would be expected, a higher price for both monthly subscription cost as well as one-time installation cost would result in lower adoption rates. This effect is somewhat smaller for installation cost than monthly cost indicating that somewhat higher installation might be preferable to somewhat higher monthly cost<sup>5</sup>.

The function to set the recorder remotely using a computer with internet access, results in a willingness to pay an additional 15 euro subscription cost. If it is also possible to use a mobile phone to do this, respondents are willing to pay an additional 5 Euros. The variable local shop was not significant. Subsequently we looked at the interest in a network video recorder for the different segments of the population. We found that for all services tested, the network video recorder is the most popular trans-sectoral broadband service.

Segment	Nr. times none option	Percentage	Percentage all none
Domestically oriented	131	72.0	38.4
Settled Idealist	499	52.0	25.5
Tolerant socializers	335	48.8	15.5
Neighborhood oriented	451	47.7	16.3
Hurried middleclass	410	59.8	33.7
Community minded	102	69.4	42.8
Average	275	46.3	24.6

**Table 6: Number of times none option chosen in network video recorder module per segments**

In particular, the younger segments are more likely to be interested in a network video recorder compared to segments containing older people. Age therefore seems to be an important predictor for determining whether people are attracted in buying a network video recorder. Interest is especially high

<sup>4</sup> And\_computer significant at the 10% level

<sup>5</sup> It is recognized that the difference in the effect sizes of monthly vs. subscription costs may be partly artificial because the variable monthly costs included more levels than the variable subscription costs.

among the tolerant socializers and neighborhood oriented segments with respectively only 15.5 and 16.3 percent having no interest at all. A surprise finding is that the hurried middleclass displays relatively little interest despite of their relatively young age and interest in new technological features and possibilities. We propose that this might be due to the fact that because this segment is technologically savvy they use (or at least have to know-how to use) online possibilities like Hulu<sup>6</sup>, Youtube<sup>7</sup>, and Uitzendinggemist<sup>8</sup> to watch TV content and on-demand movie rental services and network media tanks to watch movies. For this reason they might not see the need to pay extra for a network video recorder services because they have already have other solutions available to them at little or no additional costs.

### 3.3.3 Inactivity sensors

One of the most important areas in which new trans-sectoral broadband services can become of vital importance is eldercare. The population of the Netherlands is aging at an alarming rate. Currently there are 4.2 million people older than 55 years of age. 2.3 million Citizens are over 65 years of age and 800.000 over 75. In 2025 more than 6 million people will be over 55 years of age on a total population of 17.1 million people (CBS 2006 / RIVM). These demographic changes create major challenges from both a social and financial perspective. Healthcare costs are expected to rise exponentially. Between 2006 and 2030 demand for nursing and care will increase with 34 percent (Nationaal Ouderen Fonds). This makes it necessary to enable elderly people to remain independent and at home for a longer time. Research conducted by SCP (Social and Cultural Planning office of the Netherlands) indicates that senior citizens who remain at home are happier compared to elderly people living in rest homes. Moreover, this creates an enormous potential to save on healthcare cost. The SCP estimates that savings can reach 16.000 euro's per year per person. Even elderly with severe limitation can often be treated more cost effectively from their homes. The SCP concludes that spending money on quality healthcare and services which allow people to remain independent will eventually reduce total costs. New services, like inactivity sensors, have the potential to contribute significantly to lessening both the social and financial difficulties presented by an aging population.

In order to use the inactivity sensor service, motion sensors have to be installed throughout the home. When, despite the fact that someone should be at home, no activity is detected for a prolonged period of time the systems alerts a friend/relative or a professional care provider. Because this is clearly a service aimed at elderly people, especially senior citizens were asked to partake in this CBC module. For this reason we have no data from tolerant socializers and neighborhoods oriented. In total 288 respondents completed this module.

We found that the way that the system is controlled has no significant effect. Moreover, we found that whether or not this service is supported a local shop in the respondent's neighborhood to be an insignificant variable as well. Using a computer or even a cell phone to control the system is likely to be too difficult given the high age of the target audience. Simpler, standalone solutions, will have to be

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<sup>6</sup> <http://www.hulu.com/>

<sup>7</sup> <http://www.youtube.com/>

<sup>8</sup> <http://www.uitzendinggemist.nl/>

developed to control such systems. However this might negatively influence the financial feasibility because the possibilities to share hardware with other services might be limited (Corpeleijn & Schouw, 2004). Moreover it is important that such a system is not clearly visible as especially elderly people often dislike such equipment being visible in their homes (Zuidzorg, forthcoming).

```

Conditional (fixed-effects) logistic regression      Number of obs   =      1956
                                                    Wald chi2(5)    =      97.10
                                                    Prob > chi2     =      0.0000
Log pseudolikelihood = -576.37742                Pseudo R2       =      0.1953
                                                    (Std. Err. adjusted for 156 clusters in nr)
-----+-----
choice |              Coef.   Robust      z     P>|z|     [95% Conf. Interval]
-----+-----
monthlycos~e |  -.0517916   .0058775  -8.81  0.000   -.0633114   -.0402719
  remote |  -.0741632   .1796987  -0.41  0.680   -.4263661   .2780398
and_computer |  -.0460815   .1755842  -0.26  0.793   -.3902203   .2980573
installati~e |  -.0040554   .0006481  -6.26  0.000   -.0053256   -.0027852
  localshop |   .0663563   .0819541   0.81  0.418   -.0942707   .2269834

```

**Table 7: Significance of attributes for inactivity sensors**

As already mentioned subscription cost and installation cost were found to be the only significant variables for inactivity sensors. There is more tolerance for installation cost than for monthly cost. This indicates that for this service it is better to have upfront installation cost than try to recover such cost by charging higher subscription cost. It might also be possible to only charge a person when a care provider is actually alerted<sup>9</sup>.

When we look at the different segments, it shows that respondents in general rate inactivity sensors to be less desirable than other services like for example network video recorder or home security. This was expected as, in contrary to other trans-sectoral broadband services, not all respondents who completed the survey currently have a need for such e-health services. The fact that respondents nevertheless show interest might be due to the realization that, though they do not need the service right now, they might expect to find it useful in the (near) future. An additional reason why e-health services and particularly services aimed at elderly receive lower appreciation has been because usually they are not fun or feel-good type services but are often emphasizing what people can no longer do and therefore have a strong stigmatizing effect (van der Leeuw, 2005). The fact that nevertheless on average 45 percent showed interest in at least one of the offerings regarding inactivity sensors is promising.

<sup>9</sup> It is recognized that the difference in the effect sizes of monthly vs. subscription costs may be partly artificial because the variable monthly costs included more levels than the variable subscription costs.

Segment	Nr. times none option	Percentage	Percentage all none
Domestically oriented	939	78.4	52.6
Settled Idealist	420	70.0	51.7
Tolerant socializers	-	-	-
Neighborhood oriented	-	-	-
Hurried middleclass	1143	62.6	40.2
Community minded	465	59.8	35.1
average	742	67.7	44.9

**Table 8: Number of times none option chosen in inactivity sensors module per segments**

Especially the community minded segment show an above average interest in inactivity sensors. This group contains many senior citizens who are often retired. Community minded people are more self-aware and active compared to the domestically oriented segment, which is the other segment with predominantly older people. As community minded people attach more importance to health it is not surprising that they also show more interest in health services. Moreover, they often own their house which might provide an additional incentive to invest in equipment allowing them to remain in their homes for a longer period of time. It is surprising that the hurried middleclass also shows an above average interest in inactivity sensors, as they are not the target audience. It is unclear what the rationale behind this. We hypothesize that this might be because they see potential in this system to help monitor their elderly parents or check the condition of their children. However further research would be necessary in order to check such hypotheses.

### 3.3.4 Local TV

The last service we looked into is local TV. This service provides video broadcasts with a very local character, partly or totally recorded by trained amateurs and/or fixed cameras'. Examples are, for example, televised services from local churches, mosques or local sport associations. Also reporting of local events or video feeds from streets or places of interest in the city are a possibility. Such services can potentially contribute to enhancing social-cohesion in neighborhoods and cities. A total of 347 respondents completed this module.

```

Conditional (fixed-effects) logistic regression      Number of obs =      1929
                                                    Wald chi2(4) =      114.30
                                                    Prob > chi2 =      0.0000
Log pseudolikelihood = -380.67512                Pseudo R2 =      0.4611

```

(Std. Err. adjusted for 202 clusters in nr)

choice	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]
monthlycos~e	-.1398717	.0160327	-8.72	0.000	-.1712952 -.1084481
and_computer	-.0207832	.1165776	-0.18	0.859	-.2492712 .2077048
installati~e	-.0112954	.0012285	-9.19	0.000	-.0137032 -.0088876
localshop	.0725065	.1106174	0.66	0.512	-.1442996 .2893126

**Table 9: Significance of attributes for local TV**

We found only the cost variable to be a significant predictor for this service. When looking at the odds ratio's especially monthly cost has a strong negative effect. The negative effect for installation cost is much smaller. This indicates that if monthly subscription cost have to be paid for local TV, interest in such a service is likely to be low. Though installation cost effects, as would be expected, interest in local TV negatively this effect is much smaller and some one-time installation cost might therefore be acceptable.<sup>10</sup>

Respondents characterized that watching via the computer as unattractive. Having the video channel available over the internet has no positive effect on the outcome. This has serious implications for development of local TV initiatives currently underway in Eindhoven. For such services to add value it is important that local broadcasts can be received on people's TV-sets and not only streaming via an internet browser. The possibility to offer them in combination with a setup box, which can also be used to watch digital TV could be an interesting offer as there is some tolerance for one-time installation cost. Moreover it would obviously enhance the value proposition of digital TV and could persuade households to adopt digital TV which might otherwise not do so.

Looking at the different population segments provides mixed results. The average percentage of people who indicate to have no interest whatsoever is about 39 percent. This makes local TV a less popular service than a network video recorder and home security but more popular than e-health applications like inactivity sensors.

Segment	Nr. times none option	Percentage	Percentage all none
Domestically oriented	438	77.2	63
Settled Idealist	1047	73.3	38.2
Tolerant socializers	681	75.5	39.5
Neighborhood oriented	795	77.3	47.0
Hurried middleclass	1167	70.3	36
Community minded	576	75.9	50
average	672	64.2	39.1

**Table 9: Number of times none option chosen in local TV module per segment**

<sup>10</sup> It is recognized that the difference in the effect sizes of monthly vs. subscription costs may be partly artificial because the variable monthly costs included more levels than the variable subscription costs.

The level of interest for local TV is similar for the segments settled idealist, tolerant socializers, and the hurried middleclass. These are the higher socioeconomic segments with people with relatively high education and broad interest in society. A commonly heard rationale behind local TV is that this would allow people who are less mobile, like for example elderly, to remain involved and connected to their local community. However, our investigation indicates that the segments containing many senior citizens, like the domestically oriented and community minded, show the least interest in this service. It are the younger and especially the more active segments who indicate to be interested in local TV. For this reason, local TV might enhance the ties of these active groups with the local community and increase social cohesion in neighborhoods and the city in general.

## 4 Summary and Conclusions

For FttH networks to reach full potential and make optimal use of the possibilities, trans-sectoral broadband services have to be developed. So far this development has been difficult. Our research identified the characteristics of trans-sectoral broadband services in four main categories: telecommunication and broadcasting services, security services, health and eldercare services, and society and life services. From this list, seven trans-sectoral broadband services were selected for the market analysis: Network video recorder, Video calling, Inactivity sensors, Medical video calling, Local TV, Home security cams and Access controls. A conjoint analysis was performed to evaluate several product concepts with a number of conjoined attributes (product features). The attributes included monthly subscription cost, install cost, way of controlling the service and level of helpdesk support. When looking at the product attributes it comes as no surprise that for all services described here both monthly subscription cost as well as installation cost are negatively related to their adoption.

When looking at the product attributes it comes as no surprise that for all services described, both monthly subscription cost as well as installation cost are negatively related to the attractiveness of the product. However, for all services the negative effect of installation cost is much smaller than for monthly subscription cost. Moreover, the negative effect of installation cost is similar for all service. This is not the case for monthly cost where the extent of the negative effect differs widely. For a network video recorder this effect is small and almost the same as the effect of installation cost. But in the case of local TV and home security the negative effect of monthly cost is much larger than the effect of installation cost. Apparently, respondents are accustomed to paying a monthly fee for a setup-box to watch TV. For this reason, they find this pricing strategy acceptable and charging a monthly fee instead of installation cost would be the way to go. However, in the case of, for example, home security people expect to pay for installation but not to have to pay monthly subscription fees. Hence, the effect for installation cost is significant but small in contrast to monthly subscription cost, which has a very large negative effect on the probability of adopting. We therefore conclude that for achieving the highest possible adoption rate it is important to choose a pricing strategy that is in accordance with peoples frame of reference on how the pricing strategy should be and not which would ultimately turn out to be the cheapest solution or most convenient solution.

Concerning the way of controlling the different services, we find that for the network video recorder and home security system both the computer and cell phone option significantly increase the attractiveness of the service. Given the fact that 38 percent of the respondents indicated to have a mobile phone, it is not surprising that the cell phone option has an even stronger effect than the effect of controlling the respective services using a computer. We therefore conclude that when the possibility is offered to control new services via mobile phones people value this service higher and thereby make adoption more likely. Furthermore, we did not find any significant effect for the local shop variable. There is no new service or population segment for which local shop adds significant positive (or negative) predictive power to our model. In other words, we did not find that the availability of support via a local shop affects the attractiveness, or likelihood of adoption, for any of the services described above.

But even more importantly, our investigation shows that there is a broad interest for new services among FttH customers. When asked about concrete services like for example security cameras or e-health services more than 70 percent of the respondents indicate that they are interested. Even more surprisingly 70 percent indicates that they would be willing to in the future to support Ons Net Eindhoven to test new broadband services.

In order to further interpret the results of the analysis we divided the total group of respondents into more homogeneous subsets referred to in marketing literature as market segments. The segmentation we used goes beyond traditional social-demographic factors like age, education, and religious conviction. This is important because people are increasingly less stereotype. We found that different segmentation groups in the population have different attitudes towards new services. The population segments tolerant socializers, neighborhood oriented, and hurried middleclass show an above average interest in new service development. The segments that show significantly less interest in new services are community minded and especially the domestically oriented. These are the groups with many elderly and retired people.

We found that different segmentation groups in the population have different attitudes towards new services. The population segments tolerant socializers, neighborhood oriented, and hurried middleclass show an above average interest in new service development. There are large socioeconomic differences between these interested segments. Tolerant socializers are relatively wealthy, highly educated, and have a cosmopolitan view. This in contrast with the neighborhood oriented who are much more passive, usually rent a house from a housing association, and have less favorable attitude towards different cultures and/or ways of life. Despite these large differences this are the two segments indicating to have the most interest in the proposed new services. These 2 segments together with the hurried middleclass form a substantial part of society. For this reason we conclude that new services are attractive to a large number of people in society irrespective of their education level, age, or employment status.

Overall, we conclude that large groups of people are indeed interested in new trans-sectoral broadband services. For most services, only 30 percent of the people chose the non-option all 7 times they were asked to evaluate product concepts. This seems to be consistent with our earlier finding that 70 percent

is interested helping test new services. However, we find that successful introduction of new services critically depends on how it is offered. Even small variations in the attributes used in our analysis can have a major impact on sales and profitability.

When looking at the data it is immediately noticed that the “No, I wouldn’t choose any of these” option was selected quite a large number times. At first sight, this might seem to reflect a general lack of interest in such new services. However when looking at the data at greater detail, a different conclusion seems warranted. For most services, only 30 percent of the people chose the non-option all 7 times (when asked during the evaluation of the service concept). This seems to be consistent with our earlier finding that 70 percent is interested in helping test new services<sup>11</sup>.

Other research performed in the Eindhoven region concludes that there is a broad interest in new services (Zuidzorg, forthcoming). Our investigation shows similar results. We also conclude that large groups of people are indeed interested in new services. However in contrast to previous research we did not only ask respondents about hypothetical services but offered concrete concepts including statements on product attributes like monthly subscription cost, installation cost, and several ways the services can be controlled. We find that such product attributes are vital for the success of a product. Even small variations can have a major impact on sales and profitability (Marn, Roegner, and Zawada 2004).

Though this result is promising for new service development it also provides some reason of concern. The segments that show significantly less interest in new services are community minded and especially the domestically oriented. These are the groups with many elderly and retired people. New health and eldercare services specifically aim at these groups. The fact that they show the least interest for such new services is for this reason worrisome. New services aimed at elderly are much more difficult to successfully implement and will require special implementation strategies and might reinforce new digital inequalities among residential users.

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<sup>11</sup> Which service respondents were asked to evaluate depended on the answers provided in the general part of the survey. This was done to pre-sort respondents to prevent them from having to evaluate a service they would be very unlikely to find attractive at all. (E.g. asking a 25 year old to evaluate inactivity sensors which are specifically aimed at senior citizens)

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## **Appendix 1: Overview over modules and attributes**

	Attr1 -Monthly cost	Attr 2 – Way of using / input device	Attr 3–Installation	Attr 4 – Helpdesk	None option	Nr. respondents
CBC1 -Network VCR	<ul style="list-style-type: none"> <li>€ 2</li> <li>€ 5</li> <li>€ 10</li> <li>€ 20</li> <li>€ 30</li> <li>€ 50</li> </ul>	<ul style="list-style-type: none"> <li>Using TV</li> <li>Using TV &amp; computer</li> <li>Using TV, computer and cell phone</li> </ul>	<ul style="list-style-type: none"> <li>€ 0</li> <li>€ 50</li> <li>€ 100</li> <li>€ 200</li> </ul>	<ul style="list-style-type: none"> <li>Helpdesk via e-mail &amp; Telephone</li> <li>Helpdesk via e-mail, Telephone &amp; local shop</li> </ul>	Yes	568
CBC2 -Video calling	<ul style="list-style-type: none"> <li>€ 0</li> <li>€ 5</li> <li>€ 10</li> <li>€ 20</li> <li>€ 30</li> <li>€ 50</li> </ul>	<ul style="list-style-type: none"> <li>Using TV</li> <li>Using TV &amp; computer</li> </ul>	<ul style="list-style-type: none"> <li>€ 0</li> <li>€ 50</li> <li>€ 100</li> <li>€ 200</li> </ul>	<ul style="list-style-type: none"> <li>Helpdesk via e-mail &amp; Telephone</li> <li>Helpdesk via e-mail, Telephone &amp; local shop</li> </ul>	Yes	272
CBC3 -Inactivity sensors	<ul style="list-style-type: none"> <li>€ 0</li> <li>€ 5</li> <li>€ 10</li> <li>€ 20</li> <li>€ 30</li> <li>€ 50</li> </ul>	<ul style="list-style-type: none"> <li>Using TV</li> <li>Using TV &amp; computer</li> <li>Using TV, computer and cell phone</li> </ul>	<ul style="list-style-type: none"> <li>€ 0</li> <li>€ 50</li> <li>€ 100</li> <li>€ 200</li> </ul>	<ul style="list-style-type: none"> <li>Helpdesk via e-mail &amp; Telephone</li> <li>Helpdesk via e-mail, Telephone &amp; local shop</li> </ul>	Yes	288
CBC4 -Medical video calling	<ul style="list-style-type: none"> <li>€ 0</li> <li>€ 2</li> <li>€ 5</li> <li>€ 10</li> <li>€ 20</li> </ul>	<ul style="list-style-type: none"> <li>Using TV</li> <li>Using TV &amp; computer</li> </ul>	<ul style="list-style-type: none"> <li>€ 0</li> <li>€ 50</li> <li>€ 100</li> <li>€ 200</li> </ul>	<ul style="list-style-type: none"> <li>Helpdesk via e-mail &amp; Telephone</li> <li>Helpdesk via e-mail, Telephone &amp; local shop</li> </ul>	Yes	86
CBC5 -Local TV	<ul style="list-style-type: none"> <li>€ 0</li> <li>€ 2</li> <li>€ 5</li> <li>€ 10</li> <li>€ 20</li> <li>€ 30</li> </ul>	<ul style="list-style-type: none"> <li>Using TV</li> <li>Using TV &amp; computer</li> </ul>	<ul style="list-style-type: none"> <li>€ 0</li> <li>€ 50</li> <li>€ 100</li> <li>€ 200</li> </ul>	<ul style="list-style-type: none"> <li>Helpdesk via e-mail &amp; Telephone</li> <li>Helpdesk via e-mail, Telephone &amp; local shop</li> </ul>	Yes	347
CBC6 -Home security cameras	<ul style="list-style-type: none"> <li>€ 0</li> <li>€ 5</li> <li>€ 10</li> <li>€ 20</li> <li>€ 30</li> </ul>	<ul style="list-style-type: none"> <li>Using TV</li> <li>Using TV &amp; computer</li> <li>Using TV, computer and cell phone</li> </ul>	<ul style="list-style-type: none"> <li>€ 0</li> <li>€ 50</li> <li>€ 100</li> <li>€ 200</li> </ul>	<ul style="list-style-type: none"> <li>Helpdesk via e-mail &amp; Telephone</li> <li>Helpdesk via e-mail, Telephone &amp; local shop</li> </ul>	Yes	408
CBC7 -Access control	<ul style="list-style-type: none"> <li>€ 0</li> <li>€ 5</li> <li>€ 10</li> <li>€ 20</li> <li>€ 30</li> <li>€ 50</li> </ul>	<ul style="list-style-type: none"> <li>Using TV</li> <li>Using TV &amp; computer</li> <li>Using TV, computer and cell phone</li> </ul>	<ul style="list-style-type: none"> <li>€ 0</li> <li>€ 50</li> <li>€ 100</li> <li>€ 200</li> </ul>	<ul style="list-style-type: none"> <li>Helpdesk via e-mail &amp; Telephone</li> <li>Helpdesk via e-mail, Telephone &amp; local shop</li> </ul>	Yes	133