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Fiber to the Home and Competition: Developments in the Netherlands & Canada

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Abstract
This study provides preliminary insights into how fiber to the home (FTTH) networks affect competition in the broadband Internet access market, and how, and if, competition on FTTH networks can be sustained. This study focuses on both the Netherlands and Canada, the former being one of the fastest growing FTTH markets with regulation geared towards stimulating open access by mandating unbundling, and the latter being a market with no regulation in place regarding FTTH and limited rollout to date. Even though it is too early to paint a full picture of developments in the competitive landscape, early findings suggest that in markets that are competitive prior to FTTH rollout, regulatory interventions including unbundling policies have positive effects on rollout, and may also stimulate facilities based competition. However, the extent to which service based competition on FTTH networks will develop remains a question at this point.

Keywords: FTTH, broadband, Netherlands, Canada, open access, regulation, competition

1. Introduction

Last mile broadband infrastructure increasingly relies on fiber optics technology to facilitate growing bandwidth needs. South Korea, Hong Kong and Japan are global leaders in fiber to the home (FTTH) rollout where respectively 31%, 23.4% and 21.3% of residents access the Internet through fiber optics technology (Compter & Schepers, 2008). In Northern Europe and the U.S. FTTH is also becoming increasingly popular, but however still accounts for only 1-3% of residential Internet connections.

Characterized by high upfront investment costs, worldwide stakeholders are experimenting with regulation and business models to make fiber projects viable. Further, some argue that FTTH will make other last mile technologies obsolete, with the potential to lead to monopolistic network ownership and services provision. To this end, there is a growing call by policy makers, academics and consumer groups alike to build open access models to foster service provision by multiple service providers. Therefore, questions arise as to what extent FTTH will impact the competitive landscape of telecommunications markets.

Even though many fiber networks are still in their early phases of operation, this study aims to provide preliminary insights into how FTTH networks affect competition in broadband Internet access markets. To this end, this study aims to answer two questions: First, how is FTTH changing the competitive landscape of telecommunications markets? And second, what factors underlie sustained growth of, and innovation in, FTTH networks?

This study focuses on both the Netherlands and Canada; the former being one of the fastest growing FTTH markets with regulation geared towards stimulating open access by mandating unbundling, and the latter being a market with no regulation in place regarding FTTH. We identify and analyze a number of cases in the Netherlands and Canada and investigate the extent to which it increases competition in the

respective markets as well as the role regulation has played in the former. Data are collected as part of an ongoing study of the Dutch and Canadian broadband Internet access markets. To date, 32 managers and CEOs from the broadband Canadian and Dutch Internet markets have been interviewed.

The paper starts with a brief overview of literature. In sections 3 and 4 the cases of the Netherlands and Canada respectively are discussed. Next, section 5 provides a comparative discussion of the two countries. Section 6 finishes with conclusions.

2. Competition in Broadband Markets

Services and applications are expected to drive the future demand for bandwidth (Cawley & Preston, 2007). Even though relatively few innovative content services have been developed to date (Cawley & Preston, 2007), the possibility to deliver TV related services over the Internet in triple play bundles including telephony and Internet access services, has spurred upgrades of existing infrastructures as well as the rollout of new fiber to the home (FTTH) networks. Further, there is increasingly widespread belief that in the future consumers will buy triple-play services from one provider rather than buying telephony, TV, and Internet access services separately (Janssen & Mendys-Kamphorst, 2008), which will continue to increase bandwidth demands.

While a variety of Internet access technologies are theoretically capable to deliver these advanced services, such as hybrids of fiber and coax cable or VDSL, among others[1], Fiber to the Home (FTTH) is considered by many as the last mile technology of the future due to its very high transmission rates; it has even been called 'the final broadband service' (Ida & Sakahira, 2008). However, high upfront investments have refrained many telecom companies to date from large scale rollout; a reason why opting for 'evolutionary' network upgrades is sometimes argued to provide more necessary flexibility (see also Fijnvandraat & Bouwman, 2006).

Despite these concerns, in a few Asian countries including Japan, Taiwan and Hong Kong, FTTH has reached significant penetration levels. Two major factors have been indicated to underlie these success stories: First, broadcasting (the provision of TV related services) has been a major revenue driver, in addition to the regulatory obligation of unbundling (see e.g. Falch, 2007; Ida & Sakahira, 2008; Kushida, 2005; Takachi, 2006). These unbundling policies that are also increasingly being implemented in Europe, are geared towards service based competition; taking place in light of open access debates. Open access mandates openness of conduits (fiber, copper, coax cables) to intermediaries, or services providers, and are accompanied by rules related to access provisions, enabling those service providers seeking access with equal (non-discriminatory) opportunities to deliver content and services (based on FTTH Industry Special Interest Group, 2008; Hogendoorn, 2007).

As a means to stimulate service based competition, requirements for open access, and hence unbundling of FTTH networks takes the 'old' debate of facilities versus service based competition a step further. Achieving facilities based competition (i.e. the availability of -and competition between- two or more last mile infrastructures) for years has been the ultimate goal of many regulatory authorities. Although facilities-based competition has traditionally been perceived as desirable - as services based competition at times enables too much control of the incumbent over competitive providers - it tends to be difficult to achieve. Large upfront investments required for a market entrant to roll out new infrastructure, requires immediate generation of significant traffic volumes in order to be profitable (e.g. Christodoulou & Vlahos, 2001). Hence, service-based competition is seen as a potentially fruitful alternative: entry costs are much lower when entrants lease infrastructure or resell the incumbent's services (Christodoulou & Vlahos, 2001). Further, as the "ladder of investment" or "stepping stone" theory suggests (Cave, 2006; European Regulators Group, 2005), service-based competition has the potential to lead to facilities-based

[1] For a comprehensive overview of high bandwidth technologies see Fijnvandraat & Bouwman (2006).

competition by allowing entrants to gradually invest and acquire capital assets as they expand their customer base (Cave, 2006).

In light of FTTH network rollout, there are two lines of thought with regard to service vs. facilities based competition. One camp argues that FTTH should not be regulated, and thus no unbundling policies should be enforced, as it is this lack of regulation that has stimulated investment. Indeed, it is believed that the recent rollout of fiber networks by AT&T and Verizon in the U.S. have been driven largely by the lack of regulation (but also by significant competition by cable providers) (Chow, 2007). However, reflecting a difference in preferences by regulatory authorities for facilities vs. service-based competition, in contrast stand recent deployments by NTT in Japan and Korea Telecom in South Korea that have been pushed by their respective governments to open their fiber infrastructure to competition (Chow, 2007). There are a number of underlying reasons for stimulating service based competition. First, some believe that fiber networks could potentially replace existing infrastructure given their theoretical 'technological superiority' (i.e. capacity to deliver highest speeds) (Janssen & Mendys-Kamphorst, 2008) – and thus eliminate facilities based competition. In addition, given the widespread agreement that the high sunk costs of FTTH networks lead to significant economies of scale at the physical network layer (Sadowski, De Rooij, & Smits, 2006), it is unlikely, at least for a while to come, that multiple FTTH networks will be built in any one area. Hence, without unbundling obligations, these networks have the potential to lead to monopolistic ownership and services provision (e.g. Janssen & Mendys-Kamphorst, 2008).

So how can unbundling, with the goal to stimulate service based competition, be achieved? An often overlooked aspect regards the architecture of networks. As a matter of fact, architecture largely determines if, and how, unbundling may occur, as well as how ownership and services provision structures develop.

The most common architectures implemented for FTTH today are point-to-point (PtP) and passive optical networks (PON). Service based competition over FTTH networks can take place through unbundling of the datalink layer or the logical layer (2003). As indicated by Sadowski et al. (2006), open access scenarios in the Netherlands indeed differ technologically, with access provided at distinct layers of the network. Unbundling of the datalink layer can be established through unbundled dark fiber with a Point-to-Point (PtP) architecture, also known as Home Run, whereas logical layer unbundling may take place through both PtP and Passive Optical Network (PON) architectures (Banerjee & Sirbu, 2003). With point-to-point architectures, each home is connected through a separate fiber from the Central Office (CO), or Point of Presence (PoP). With PON architectures, sharing of fiber takes place beyond the CO location – a passive splitter sends signals from a feeder loop to 32 subscribers (Sadowski et al., 2006). Hence, PtP networks need more fiber and thus are more expensive, but also have the greatest capacity as users share less fiber. Nevertheless, a Point-to-Point architecture is known to be more expensive than other architectures, but however does support unbundling of the physical plant and at the logical layer (Banerjee & Sirbu, 2003). Further, PON architectures are known to be significantly more complex to unbundle (Sadowski et al., 2006).

Many debates surrounding FTTH have focused on the role of industry structure in stimulating the growth of fiber networks (Sadowski & Nucciarelli, 2008), particularly the sole-supplier environment vs. the wholesale-retail split. In the sole-supplier environment one provider is responsible for both infrastructure and service provision. In the wholesale-retail split, one party provides the infrastructure, and provides this on a wholesale basis to service providers that may, or may not take on an operator role by providing active infrastructure – depending on the architecture.

Even though inherently related, the role of architecture in these debates has gained relatively limited (explicit) attention. While the sole-supplier environment is often based on PON architecture, it can also very well be supported through PtP architecture. However, the wholesale-retail model is most easily

achieved by PtP architectures. According to Banerjee and Sirbu (2006), a model with a wholesale-retail split (i.e. dark fiber) prohibits the passive infrastructure provider to price discriminate, and can set only one price for dark fiber access. The wholesaler could provide all services a vertically integrated provider sells. Hence, an increasing number of stakeholders refers to PtP as the best architecture. However, even though an increasing amount of research points to the benefits of open access and in particular through Point-to-Point architectures, it has also been found that a vertically-integrated model may be more appropriate for small-scale networks (e.g. Sadowski & Nucciarelli, 2008), and that without government subsidy, small scale FTTH networks are unable to create service based competition (Sadowski et al., 2006). Thus, a question remains as to what extent the size of FTTH networks influences the extent to which service based competition is viable in upper layers of the network (Sadowski et al., 2006).

Thus, choices made today with regard to partnerships and network architectures may have a significant influence on competition and market development in the future. Next, we examine how regulation and other factors have influenced FTTH rollout and choices for architecture, as well as how this has subsequently influenced competition. We first start with a discussion of the Netherlands, a fast growing FTTH market where unbundling requirements are imposed. This will be followed by a discussion of FTTH rollout in Canada, a country with limited competition in the broadband market in general, and no regulatory obligations specifically geared towards FTTH networks.

3. FTTH Developments in the Netherlands

3.1. History and Market Overview

The Netherlands is a frontrunner in broadband uptake. The OECD ranks the Netherlands 2nd in the uptake of broadband with 35.8 subscriptions per 100 inhabitants (OECD, 2008). It currently ranks lower with regard to FTTH deployment (12th), but however has recently made great strides forward and the number of connections is expected to grow significantly over the coming years (Compter & Schepers, 2008). In early 2009, 4% of broadband connections are with fiber (BuddeComm, 2009). Projections are that about 70-80% of the Netherlands will be covered with FTTH connections by 2020-2030 (Compter & Schepers, 2008), or even 95% as projected by BuddeComm (BuddeComm, 2009). From March 2008-March 2009 the number of homes passed has grown by 85% from 188.000 to 349.000 (Stratix, 2009). However, 62% of these homes are ready for service (i.e. have fiber brought into the meter cupboard). The number of active subscribers in turn has grown from 84.000 to 139.000 from 2008-2009 (Stratix, 2009). Stratix (2009) estimates that by the end of 2011 nearly one million homes will be passed. In early 2009, already FTTH projects in 61 projects have already been initiated (Stratix, 2009).

All networks in the Netherlands are based on a three layered model, including the passive infrastructure layer, active infrastructure layer, and services layer. The passive infrastructure regards the dark fiber. The provider leases this to a (wholesale) active operator that lights the fiber and operates the active infrastructure. The active infrastructure includes electronics such as customer premise equipment (CPE) (Compter & Schepers, 2008). The active operator may provide service directly to consumers, or may provide wholesale services to third party ISPs who in turn provide services to customers. In the Netherlands, each FTTH network is designed such that at least two active operators can operate on any one network. This is due to the architecture that in all networks is based on Point-to-Point architecture, which enables an unbundled local loop, and just like with unbundling of copper, allows for collocation, making use of (newly built) Central Offices. The services layer in turn includes all services that can be offered over the network, which typically includes Internet access, television, and telephony (triple play). Currently, in many networks more than one layer is managed by just one provider/company (Compter & Schepers, 2008).

Reggefiber is by far the Netherlands' largest passive infrastructure provider; if not the Netherlands' sole passive infrastructure provider – although a new passive infrastructure provider that has the potential to

grow fairly large, is about to enter the market [14]. Reggefiber has ongoing FTTH projects in over 35 cities: 336.000 homes have been passed to date, and 106.000 of these homes subscribe to services over these new networks (Van Rooijen, 2009). Besides projects under the brandname Glashart, by the end of 2007 Reggefiber also participates in approximately 14 FTTH operators (passive infrastructure operators) (Compter & Schepers, 2008).

According to a manager in the FTTH market, Reggefiber Wholesale is the largest active operator in the Netherlands. Next comes incumbent telecom operator KPN, followed by BBNed and Solcon (both DSL providers). These are also Reggefiber`s current active operators (Van Rooijen, 2009). Besides these players, there are a few very small operators that are active on one or two networks.

Starting in 2007, KPN and Reggefiber started cooperating on FTTH and in October of that year KPN's first FTTH project, in Almere, was announced, where KPN assumed the role of active operator and service provider (Compter & Schepers, 2008). In addition, KPN became involved in the Enschede FTTH project at all three levels: as passive infrastructure provider, active operator and service provider. In 2008, KPN obtained a 41% share in Reggefiber (while Reggeborgh holds 59%). It has an option to expand its share to 60%, if it fulfills a number of performance criteria (Stratix, 2009); in more detail, when it achieves rollout milestones of 1 and 2 million homes (Van Rooijen, 2009). Currently, KPN is wholesale provider on a number of networks, and also service provider through its own retail brand.

BBNed has also assumed a significant role as active operator. BBNed's service providers for the residential market; Alica and InterNLnet, are also active on FTTH networks. BBNed furthermore provides wholesale services to other service providers on a non-discriminatory basis (Compter & Schepers, 2008). According to research conducted by TelecomPaper, the future role of BBNed is contested. Both Reggefiber and KPN not mention BBNed as a significant competitor (Compter & Schepers, 2008).

A variety of investment models exist in the Netherlands, with both pure private investment and public private partnerships. Different stakeholders are involved ranging from the financial sector to municipalities and (social) housing corporations. The key point has been found that investments in FTTH need to be viewed as infrastructure, rather than a telecommunications investment. As typical telecommunications investment need a quick turn around; i.e. need a ROI in a few year`s period, which has been found to be nearly impossible to achieve. For example, Reggefiber`s largest stakeholder views fiber as a real estate investment. In the case of one of the Netherlands` most well known FTTH projects, Amsterdam Citynet, where both the municipality and the housing corporation are involved as investors, the network is estimated to become profitable after six years. However, in most municipalities where FTTH is being rolled out, municipalities themselves are not active investors. According to one stakeholder in the Dutch FTTH sector, municipal investment has occurred primarily in Amsterdam, Rotterdam and Eindhoven – three of the Netherlands` five largest cities. However, municipalities typically do get involved in FTTH projects by facilitating the provision of licenses etc.

Of course, profitability is highly dependent on take-up rates. According to a research participant that has been involved in a number of FTTH projects in the Netherlands, currently most networks have about 20-40% take up rates. Some are a little higher, some are a little lower. In some instances 'demand bundling' has taken place by signing up subscribers prior to rollout – particularly the Reggefiber Glashart projects have relied on this approach. Taking advantage of community FTTH champions, volunteer organizations try to 'market' FTTH to neighborhoods and have people sign up prior to rollout. In areas where demand bundling takes place, once 40% coverage is reached, the network is being rolled out. It is found that in the areas where such an approach has been used, final take up rates usually work out well. However, not everywhere demand bundling takes place – and as indicated by one research participant, this approach does not necessarily fit for all neighborhoods. Approaches are hence based on the social fabric of

neighborhoods. An other method is indeed sometimes applied by KPN, that often estimates traffic statistics and then takes a risk by opting for particular areas. According to one research participant, KPN then basically pre-orders with Reggefiber, indicating that it will lease e.g. 40% of the network. Thus, there is no one-size-fits all solution. Nevertheless, according to Stratix (2009), the most significant uptake rates have been achieved in smaller towns with close knit communities. Of course, this may be due to local marketing campaigns. The final take-up rates needed are still unclear however. According to research conducted by TelecomPaper, the business cases for both the passive and active infrastructure layers are based on a take up rate of 50%; i.e. 50% of connected homes should subscribe.

3.2. The Role of Regulation in Fostering FTTH Rollout and Competition

KPN's minority participation in Reggefiber triggered regulatory action followed by court appeals that significantly shaped the Dutch FTTH market. In 2008 the Dutch competition authority NMA gave approval to the joint venture between KPN and Reggefiber. Part of the approval was a requirement to offer telcos non-discriminatory wholesale access at €14.50 to €17.50 per month per line (BuddeComm, 2009). Nevertheless, as a response to the approval of the joint venture, CLECs and a number of cable operators appealed in court against the NMA decision (Stratix, 2009).

The Dutch regulatory authority OPTA furthermore published its decision "Market Analysis: Unbundled Access at the Wholesale Level in December 2008 (OPTA, 2008b) after an earlier draft published in June of the same year. The decision extends wholesale access obligations from copper (xDSL) to fiber. The decision is based on the premise of significant market power by KPN, even though KPN is a minority shareholder in Reggefiber. Formally, OPTA's mandate does not apply to infrastructure companies, but to telecommunications services companies only. Hence, KPN's participation in Reggefiber provided OPTA an opportunity to regulate access provisions related to Reggefiber`s dark fiber rollout (Stratix, 2009). Therefore, it is not surprising that the decision was being appealed in court (Stratix, 2009); in September 2008 Amsterdam Citynet already provided a response to the draft of OPTA's decision (from June 2008) as a firm not under control by KPN (Stratix, 2009), claiming that OPTA had overstepped its authority to extend regulation. With various appeals there was a possibility that OPTA would not at all be allowed to regulate Reggefiber (Stratix, 2009). Nevertheless, on July 28, 2009 the NMA put forward a final decision that largely holds up the OPTA decisions (NMA, 2009)[2], with rules applying to any organization in which Reggefiber holds a stake. The decision includes a requirement for open access to the local loop (i.e. unbundled local loop) by ISPs, price caps on unbundling rates, backhaul access, etc. to prevent discrimination and to guarantee competition, but also allows for volume discounts of up to 20% for the activation of 26.000 or more fiber pairs per FTTH network (BuddeComm, 2009).

OPTA started its market analysis and consultation processes in the very early stages of FTTH activity, which, according to an FTTH manager has led to primarily one architecture being used in all Dutch FTTH projects: Point to Point (PtP) instead of PON, which is very different from common approaches in Asia and the U.S. Nevertheless, even though regulation seems to imply a need for PtP architecture, prior to OPTA`s decision almost all parties in the Netherlands have chosen for PtP architecture because it was perceived by many as 'future proof' and enables unbundling. Indeed, Amsterdam CityNet has had the passive and active infrastructure under separate ownership from its very beginning. Reggefiber however in the early days owned both passive and infrastructure itself (i.e. Reggefiber Wholesale operated the network), but has also turned towards a split in passive and active infrastructure ownership. Thus, the development of regulation "requires implicitly that this architecture [PtP] must be used" according to an FTTH manager. But, as the manager also has learnt, in many debates regarding FTTH often the importance of architecture and topology are overlooked.

[2] See http://www.nmanet.nl/nederlands/home/Besluiten/Besluiten_2009/6397BCM.asp

3.3. The Current Status of Services-Based Competition

Given the regulatory interventions, in the Netherlands all fiber networks have been developed in a way such that at least two active operators can operate on top. However, because FTTH rollout is still in its early stages, difficulties in rollout and developing a subscriber base are being experienced by both passive infrastructure providers and active operators.

Amsterdam`s Citynet indeed has had to cope with a number of issues. To date, 43.000 homes have been passed with fiber in Amsterdam. Due to problems in apartment buildings with gaining access to facilities, only 8.000 of homes are ready yet for service, and 3.000 homes have subscribed to service to date (Stratix, 2009).

Besides experiencing a number of practical problems with rolling out the dark fiber itself, such as gaining access into houses behind the front door, making sure the cable is nearly invisible, etc., the uptake of actual subscriptions has at times been problematic. Active operator BBNed is said to have underestimated technical problems and the marketing model did not work properly. Due to the technical problems, ISPs were hesitant to start making marketing expenditures, and were waiting for others to start their marketing activities.

In some projects difficulties have been even worse, sometimes even leading to failures as well: Lijbrandt Telecom in January 2008 had to postpone rollout of its FTTH network in the city of Lisse due to lack of demand: the threshold of 40% was not met. Similarly, in the city of Arnhem (De Laar neighborhood), the 40% threshold could not be met, and operator XMS and passive infrastructure provider NEM Arnhem had to put the project to a stop (Compter & Schepers, 2008). According to Stratix, the Rotterdam FTTH project has stalled with only a very small group of users taking advantage of the part of the network that was rolled out (Stratix, 2009). FTTH endeavors in The Hague and Utrecht have also been terminated (Stratix, 2009).

Of course, the various problems have provided learning points to a number of projects. Amsterdam Citynet and some other projects decided it would be better to give one active operator exclusivity for a number of years, and to couple the active operator and service provider together – which would make the marketing responsibilities more straightforward; and thus hopefully lead to higher uptake. Exclusivity periods have been granted at a number of networks according to the CEO of Amsterdam Citynet, including Citynet itself – which however is already set to expire in August 2009. Multiple customers are needed, and hence some time is needed to get everything flowing. While of course this will give a first to market advantage, there are however also risks associated with it.

It was also learned at Amsterdam Citynet, where active provider BBNed enables Internet services provision by four ISPs – two independent ISPs (that however already had established a relationship for DSL provision) and two that are owned by BBNed – that service providers tend to want to act as operators as well.

Thus, the question remains as to what extent competition will occur at both the active operator level and service provider level. According to various sources in the Netherlands, usually pure retail provision is not deemed very profitable, and hence is not often desired. Indeed, relatively few independent retail ISPs are still active in the Netherlands – with an aggregate market share of no more than 5% (OPTA, 2008a). The rest are all associated with an infrastructure provider/operator. At Amsterdam Citynet experience indicates that most service providers want to be operators as well, which in the near future at the Amsterdam Citynet will indeed be possible. Indeed, as Stratix reports, Amsterdam will be the first network in the Netherlands with multiple active operators (Stratix, 2009). KPN is expected to obtain access to the network, and in addition it is speculated that all large CLECs (DSL providers) will seek to collocate at Amsterdam Citynet (Stratix, 2009).

However, it is observed that the 3-layer model in the Netherlands seems to be becoming a 2 or 2.5-layered model. The 3 layered model assumes that there are wholesale operators that only play that role, however, "in practice, it is observed that the service layer and operator layer often times are combined in one party". That means that the market of independent service providers leasing wholesale bandwidth in minimal. According to one FTTH manager, "there are hardly business models for ISPs that are independent, that are not a wholesale operator themselves. Thus, wholesale and retail are usually combined". However, operators often do lease wholesale bandwidth in areas where they are not present themselves […] This is only a small part of their business because it is not highly profitable, but to ensure complete coverage". He also relates this to DSL unbundling, which soon led to vertically integrated parties. Moreover, according to it turns out that in the Netherlands but also in many other countries independent ISPs that only focus on retail do not "stand a chance of survival". Those that do survive have their own infrastructure and footprint. Margins are too low for pure retail, "except in countries where there is forced separation such as Japan". This belief was reinforced by the observation in Amsterdam where no parties were interested in retail during BBNed's exclusivity period. "In the future it will indeed become a model with a separated infrastructure layer and at the operator level [layer] they can compete"

The linking of FTTH development to DSL is seconded by another research participant, who believes that the market will develop similar to the DSL market, where only a limited number of parties was interested in placing DSLAMs. He believes this will be similar in the case of FTTH. Even though currently there are only networks with one active operator, it is too early to say how competition on fiber networks will evolve.

Of course the number of active operators will depend on investment. Depending on the structure of systems, it can be more or less complicated to become an operator over fiber. It is explained that is depends on prior choices. The OPEX (operational expenditures) over fiber is essentially low. Once systems are structured well, costs go down quickly. `But it takes some learning how to do this`. This is also believed to be similar to DSL: the first couple of years there were some troubles associated with DSL, but it soon became relatively easy. "And fundamentally, the OPEX is lower". ISPs can interconnect at the AMSIX when they use the Reggefiber network. But interconnection depends on how the various parties arrange it themselves.

The lines have to be activated per customer and on top of these costs come the systems. The investments for active operators are therefore still significant. At Reggefiber the connection per home is €150-200 on an annual basis per line activated. In addition comes a €6000 rent for an Area PoP and a €7200 rent for a connection Area PoP-City PoP. Finally, there are one time fees that include €100 to activate a connection and €3000 to activate the Area PoP (Van Rooijen, 2009).

Even though collocation prices might not be that high, scale is nevertheless regarded as important. One research participant from the FTTH market believes that a couple of tens of thousands of connections are needed. The extent to which small operators have a business case is therefore unclear. It also depends however on the financial stability of (or financial injections to) an active provider; for example, the relatively small player BBNed does have large company Telecom Italia behind it.

3.4. Facilities Based Competition and the Future of Alternative Infrastructures

In the Netherlands many operators are currently focusing on FTTH. However, cable providers are by and large sticking to their last mile cable systems. Interesting however is the limited focus currently on a combination of Fiber to the Curb (FTTC) and VDSL, which is also capable of delivering very high speeds.

Until as recent as 2007, KPN seemed to see its future in a combination of FTTC and VDSL, but however has changed its focus on FTTH instead. In 2005 KPN announced that from 2006-2010 approximately 28.000 street cabinets would be connected to fiber and VDSL. Still in early 2007 KPN announced to bring FTTC nationwide (Compter & Schepers, 2008). Even though formally, in early 2009, KPN still says to be evaluating its pilots for FTTC/VDSL, over the last two years KPN's focus has significantly shifted, where currently FTTH seems to have gained priority (BuddeComm, 2009; Stratix, 2009). In august 2009 it is reported that KPN serves six neighborhoods in five cities with trial services (TelecomPaper, 2009). Consulting company Stratix believes that FTTC/VDSL may in the future be used by KPN as an alternative to serve relatively sparsely populated areas (Stratix, 2009).

A variety of factors likely underlie this decision. According to Stratix (2009), there is a significant disadvantage of having equipment installed in street cabinets vs. a passive plant in neighborhoods: street cabinets are more vulnerable and accident prone, are power hungry, require significant maintenance and may not be backed up by diesel power supplies per municipal regulations, and the cost of rewiring copper cables to street cabinets are higher than expected (Stratix, 2009).

To this end, interesting developments come from service provider Tele2. In August 2009 it is announced that it will start providing FTTC with VDSL as of September 2009 in 40 cities and towns, with an expected growth to 2 million households by the end of 2011 (TelecomPaper, 2009). Tele2 will actually provide the service, named "Fiberspeed", from the Central Office rather than from street cabinets. As a current DSL provider with active equipment, Tele2 only needs to replace DSLAMs, routers and the like with VDSL equipment, rather than also having to extend its fiber reach closer to the home and thus eliminating significant investments. As a result, not all 7 million households in the Netherlands can be reached, and in addition, slower speeds than KPN's VDSL services can be reached (60 Mbps download, 6 Mbps upload) (TelecomPaper, 2009).

Tele2's VDSL footprint however still lags behind that of major cable operators Ziggo and UPC, that reach 4 and 2.8 million households respectively (TelecomPaper, 2009). These cable operators do not seem to be planning to change to FTTH or any other alternative last mile technology. They are largely upgrading to DOCSIS 3.0. Cable provider UPC was the first European cable company to roll out EuroDocsis 3.0, in 2007 (Compter & Schepers, 2008). Speeds of 120 Mbps were achieved (Compter & Schepers, 2008). Similarly, cable companies Casema, @Home and Multikabel were upgrading their networks, and hence, none of the cable providers has expressed plans for FTTH rollout (Compter & Schepers, 2008). Only few smaller cable operators have decided to replace their cable network with fiber to the home (Stratix, 2009).

Even though it still remains unclear how FTTH rollout affects the number of ADSL and cable subscribers in FTTH areas, research by TelecomPaper reports on both ADSL and cable providers admitting to have lost market share, and particularly cable providers responding to this with local marketing campaigns (Compter & Schepers, 2008).

In more detail, after implementation of DOCSIS 3.0, cable company UPC adopted a local campaigning style similar to local marketing efforts for some FTTH efforts where community information evenings were organized (Stratix, 2009). This local focus was employed mainly in cities where FTTH projects were planned (Stratix, 2009). This in turn has led to a shift away from nationwide advertising to an increased number of FTTH service providers to adopt local marketing campaigns, with community gatherings and people going from door to door (Stratix, 2009). In addition, currently nationwide commercials are being aired by cable operators to attract new customers; specifically referring to the upgrading of their networks. For example, Ziggo indicates that currently speeds of 50 Mbps are available, to be upgraded to 80 Mbps in the fall, and more than 100 Mbps next year.

The well developed cable and DSL market in the Netherlands however may also pose a constraint on FTTH growth. Therefore, the availability of triple play services will play an important role in stimulating take-up (Compter & Schepers, 2008). Even though this is often believed to give an advantage to cable companies that have long standing relationships with content providers, as BuddeComm (2009) notes, the basic cable model entails selecting content for subscribers and delivering it in packages, or pay per view. Also, according to BuddeComm (2009), KPN has lost customers to cable provider UPC due to its inability to provide a competitive TV service.

To conclude, the Netherlands is fast moving due to heavy competition across infrastructures. Next, we turn to the very different case of Canada.

4. Canada's FTTH Rollout

Canada presents a significantly different picture with regard to the rollout of FTTH. And more generally speaking, while the Netherlands is known as one of the frontrunners of broadband rollout and take-up in general, Canada – even though the first country in the world to provide residential broadband access in 1996 – has significantly dropped in OECD rankings over the last couple of years. Recent research suggests that Canada is falling significantly behind and has a fairly uncompetitive market place for Internet provision (Van Gorp & Middleton, 2009).

Canada however does have a number of scattered, very small FTTH projects going on, mostly initiated by non-incumbent, small providers. But the scale of rollout does not compare to the Netherlands, as total numbers still keep the percentage of FTTH at 0%[3]. This section will discuss a number of Canadian FTTH projects, which vary significantly with regard to stakeholders involved and architectures employed. In addition, differences can be observed in resultant services being offered. Even though to date predominantly small providers have ventured into relatively small FTTH projects, it must be noted that recently Bell Alliant has announced plans to invest 50-60 million Canadian dollar in a FTTH network in the city of Fredericton. The other main players in the Canadian Internet access market to date have primarily been engaged in small pilot projects: According to one participant, telecommunications incumbents Bell (eastern Canada) and Telus (western Canada) have done a few pilot projects for FTTH, and in addition, Bell, Rogers and Telus have also engaged in FTTC rollout in combination with ADSL (VDSL), but "it's very small and scattered". In more detail: Telus has tested FTTH with 25 Mbps downstream and 1 Mbps upstream according to a research participant. No public announcements have been made however with regard to future commercial rollout. Incumbent Sasktel of the province of Saskatchewan however does not have any plans; and the idea prevails that only in the big cities FTTH networks will be viable. Next, we turn to a discussion of four cases of fiber projects in Canada.

4.1. Four Cases of Fiber Rollout in Canada

4.1.1. Alberta Supernet & FTTH in Olds

The Alberta Supernet is an Alberta government-initiated fiber project that primarily provides for backhaul connectivity. The network has become operational in 2005. The Supernet connects some 429 communities in Canada with fiber optics technology, as well as provides connections to schools, government offices, hospitals and libraries[4]. Alberta`s ISPs in rural communities, many of which had problems obtaining backhaul connectivity, now can take advantage of the Supernet which is based on an open access model.

Bell and Axia obtained contracts to build and operate the Supernet. As a result of the Supernet, currently 278 communities have obtained highspeed internet access (Axia), while previously only few communities

[3] See OECD Broadband statistics [oecd.org/sti/ict/broadband], December 2008.
[4] See http://www.albertasupernet.ca/

had highspeed access (speeds beyond dial-up) outside of the Calgary and Edmonton areas (Axia). Nevertheless, many communities still do not have residential highspeed Internet connectivity, which, according to one research participant is due to the Supernet being expensive as well as Bell being "the ISP of last resort", which "has to serve communities where it will never make any money". Further, for the backhaul connectivity, this research participant indicates that "competitors are now undercutting these prices".

The Supernet is based on an open access model. Any service provider is allowed to use the Supernet to provide services. In order to enable competition between small and large providers, this means the Supernet does not provide volume discounts or price breaks for multi-point connectivity[5].

With the Supernet providing primarily backhaul services, one town in Alberta has taken the fiber a step further. In the town of Olds, located approximately 90 km north of Calgary, six years ago an FTTH project was started as a community development initiative. Olds has been experiencing an exodus of people leaving for Calgary. Starting with a community consultation process, it became apparent that local residents and businesses were aware of the government putting in the Alberta Supernet. Even though initially the government believed that the private sector would take up the last mile connectivity, this did not happen and hence the people of Olds were interested in extending the Supernet to their homes and businesses. The Olds Institute for Community and Regional Development - a volunteer based organization - is currently still in charge leading the project.

The FTTH network has a potential of 4000 connections. Olds is looking for connection speeds of 60-80 Mbps symmetrical for its FTTH network. Services such as HDTV, VoIP, and movie-on-demand are targeted to become available over the network. It is unclear as of yet how many residents are really interested to sign up. It is indicated however that a 20% uptake rate would represent an insufficient demand to justify investment.

Going ahead with planning, Olds received funding from the government (including the Rural Alberta Development Fund). In the summer of 2009, a company contracted by Olds is designing the network, and is estimated to be finalized by July 2009, after which the building can start. With an estimated building period of 8 months, but with winter coming, it is hoped that by August 2010 the network will be operational. Nevertheless, the actual building of the network will only start if a service provider has been contracted.

To this extent, during the summer of 2009 talks are going on with a number of potential service providers, including private U.S. firms. There is a slight preference in Olds for contracting a large operator, as it is believed to be beneficial as "their services are anything but spectacular, but they always work". However, given that the Olds community plans to maintain ownership of the network, it is also recognized that "they are concerned about using something they don't own". Therefore, to date the major telcos have been "reluctant" to sign up.

Given the interest by U.S. firms, the foreign ownership restriction provides a hurdle. Companies have to be 80% Canadian owned. To this extent, during the summer of 2009, two American companies have already taken up Canadian lawyers to see what the possibilities are. One idea is for a foreign company to lend money to Olds, then put the network in, and pay the company back. However, this would leave Olds to operate the network, which is not really Olds' intention, as it is a volunteer led community initiative. Another possibility would be to hire people, but that is still a complex endeavor. To that extent, it is also believed that a big company might be in better shape to deal with maintenance, rather than having a few people be responsible for dealing with operational problems.

[5] See http://www.axia.com/open_access_networks/benefits.asp

In addition, other hurdles are found in the enabling content provision in the context of Olds' wish to provide TV related services over the network as well. As indicated by one of the volunteers involved, while in the U.S. there are no specific regulations of what type of content to supply, in Canada there are requirements to broadcasting aboriginal and French content, which adds to the complexity.

The network will be based on GPON (Gigabit Passive Optical Network) architecture – an architecture that by many is believed to make unbundling very difficult. While not completely impossible, it does not rely on collocation. It is perceived in Olds that major telcos always work on GPON architectures. In addition, it is believed that there will not be a large enough customer base in Olds to split into different service providers. However, it is believed that GPON does enable multiple players to operate on a single network. Further, "if we had another 3-4 million we might go with Home Run [Point to Point architecture] type of thing, where every home would have a fiber dedicated, but it costs a lot more money. We can't afford that". Given that only one provider is foreseen, and in order to keep rates and services provision competitive, Olds will remain involved in setting rates etc. "if we feel we are being mistreated, then the contract wouldn't be renewed".

Meanwhile, Olds keeps working on getting its network designed and contracting an operator. But, given that it is a community based, and volunteer-led, project, there are many difficulties in keeping the project run well: "We thought there were all kinds of people who did this stuff, but every corner we turn is a new corner. It's been a real journey of education, and of successes and frustrations".

4.1.2. Dark Fiber in Ottawa in Search for a Service Provider

Even though Olds is in the beginning phase of planning its fiber rollout, and is still working on contracting an operator, the following case of Ottawa we report on a project where fiber has already been rolled out, but nevertheless with a disappointing result.

The Ottawa FTTH project constitutes a trial project by Canarie – the non-profit organization in charge of providing advanced network capabilities to Canada`s research and education community. The business plan for Ottawa assumes 10% take-up: while in theory the network could serve 4000 homes, the goal is to connect 400 homes. As is explained by a stakeholder in the Ottawa project, "finding a business case to deploy is very difficult, because of what is called the 'tyranny of the take-up'. Most business models for fiber to the home require a minimum of 40% of customers to sign up. That's very difficult to achieve." To this end, a fairly novel business model has been developed: The plan is for access to fiber to be bundled with energy bills; that is, an energy reseller company will take up FTTH offerings in its package, where discounts can be provided for FTTH subscriptions. Other services in these bundles may include e.g. free water heater, home renovations, free long distance phone calls, etc. Due to common difficulties with achieving significant take-up rate, this type of model is believed to have more potential than simply providing FTTH services on a stand-alone basis. In addition, customers will be "encouraged" to "own their fiber, and this is to ensure network neutrality, so the customer can connect to the service provider of their choice at any time or switch providers because they own the fiber".

Nevertheless, even though arrangements have been made with an energy reseller, there is a problem finding an ISP to actually deliver the service. This has led to the projected to stall, and hence no consumers have been signed up. The problem of finding a service provider is, according to a stakeholder in the project, is due to hardly any retail ISPs being left in Canada: "We've talked to all sorts of companies, it's extremely tough. They've been there, they have competed against Bell, they have gone bankrupts, they're not going to do it twice." For fiber projects to find an ISP to provide services over an FTTH network found to be difficult in Canada, and relates to the current competitive landscape of the Canadian Internet market. As is explained by two research participants: ISPs have to compete with incumbents with lots of money. If an ISP has to compete with an incumbent, the incumbent could easily

drop prices locally, or even offer services for free for 2 years, which fully undermines the position of the new ISP. A small new provider cannot easily drop prices.

4.1.3. Dark Fiber Operational in Coquitlam, BC

A more successful story comes from the city of Coquitlam in British Columbia. In Coquitlam, a suburb of Vancouver with about 120.000 residents, a dark fiber network has been built where fiber is leased to service providers. Currently already 4 service providers have been contracted. As a Fiber to the Premise (FTTP) project, currently only high-rise buildings, businesses and malls are being connected. This follows projects such as in the Netherlands in Amsterdam and Rotterdam, where the easiest buildings are connected first. However, in the longer term it is expected that all homes will be connected, and thus true FTTH is expected to be provided to all of Coquitlam.

Qnet, the non-profit the dark fiber provider, is a utility company. The city of Coquitlam is the only shareholder of Qnet, and initiated the project to stimulate competition in telecommunications, as well as to stimulate economic development of the city of Coquitlam.Through the rollout of fiber, it is believed that the city becomes more attractive for businesses to locate themselves in the city, and will also enable people to work from home rather than having to drive to work in e.g. Vancouver. The investment model is based on a 25 year return period. Profits are foreseen in about 10 years, which then will be used to pay back the loan used for the initial investments.

The network has been operational since December 2008. Services provided over the network range from regular internet services provision to television like (on demand) services. In order to enable unbundling and thus competition, the network is based on a Point to Point architecture. As has been discussed before, one of the key factors to make FTTH business models viable is the take rate, which must be significantly high in order to recoup investments. To this extent, Qnet works together with its service providers to market services to end users in order to get a cash flow going. This is also the reason why at first the high density areas are targeted. Moreover, new housing development projects are thus not desirable for FTTH projects as it takes a while before all homes in new neighborhoods become occupied and thus a significant subscriber base arises.

Currently there is a network of about 50 km of fiber. Bell, an incumbent telco, is among the operators leasing the dark fiber of Qnet. Operators currently pay about CAD $400 per month to lease one fiber strand (and thus connect to a building). Nevertheless, the main costs are in still in backhaul provision. The backhaul for Qnet providers is currently 100 Mbps, which is of course shared, and thus with multiple users at the same time speeds will go down easily.

4.1.4. FTTH in Rural Ontario

In rural Ontario a number of very small FTTH projects have been initiated. One ISP that is active in rural Ontario explains that an FTTH project was started to serve customers that were not yet well served, because incumbent Bell does not provide “access to telephone cables in a way that we need them”. Different access technologies were considered: wireless, copper and FTTH. Wireless was deemed least viable due to features of the terrain where trees and hills require very high towers, which would become too expensive. Further, it was found that material for fiber was actually cheaper than for copper and moreover fiber is believed to have a good lifespan.

As a fairly new ISP, currently there are only 36 fiber subscribers with 60 more lines to be rolled out in the upcoming months. Large scale investments are difficult however: it is indicated that banks do not easily want to fund fiber as an infrastructure, as they do not view fiber as a ‘seizable asset’.

Currently, the fiber network can provide speeds up to 100 Mbps within the local network. However, due to backbone constraints, speeds offered to customers are comparable to DSL service offered in another

town (i.e. 5 Mbps download; 512 kbps upload). It is indicated that incumbent Bell refuses to sell anything faster than 10 Mbps. Other (faster) solutions by competitive backhaul providers require a substantial monthly outlay, and thus more customers are needed in order to get a Gigabit connection.

To date, FTTH is used for regular Internet services, and not yet for content services such as TV. An interest in providing IPTV is expressed; however, a broadcasting license would be needed, and bring some regulatory hurdles, which overall makes it a very expensive endeavor – at least for now. In addition, "the biggest problem is that any ISP other than very large ones like Bell (incumbent telco) and Videotron (incumbent cable company) and such, most of the television content providers don't want to talk to providers who have less than hundreds of thousands of clients". Further, being a very small provider, "right now there is plenty to do in terms of the focus of just getting more customers online as opposed to doing more service. Once we get to the point where we have a lot more customers online, then it makes sense to start looking into other services we can add on it".

4.2. Key Concerns in Canada: Investment, Backhaul & Absence of a Regulatory Framework

The four cases highlight a variety of struggles. Broadly the key issues can be categorized into investment, backhaul, and regulatory problems. Next these will be described in more detail.

4.2.1. Investment

To rollout FTTH, telcos typically have a ROI period ranging from 6-10 years [100], depending on the number of homes that are connected and subscribe. Thus, publicly traded companies cannot easily invest in infrastructure. One of very few telcos doing this is Verizon in the U.S. Another 'type' of investment is needed. In other sectors longer return periods are more commonly accepted, such as e.g. municipalities. Municipalities can have a business case spanning over 20 years, and in addition can justify investments for societal and economic developmental benefits.

The rural FTTH provider in Ontario that indicated that banks do not want to fund fiber as infrastructure, indicates that government should step in to provide loan programs in order for ISPs to pay for this infrastructure: "banks do not want to fund infrastructure because they don't consider the fiber optic network you're building as a seizable asset […] So, realistically, if there was one thing the government could do that would really stimulate fiber roll out is to offer a loan program to pay for this infrastructure, because then communities could do that, but the catch is that you have to have a provider like myself who can drive the process. […] The problem is that not all municipal governments have an understanding of what needs to be done for the infrastructure, or even understand how much it costs to run these sorts of projects".

4.2.2. Backhaul

Backhaul to the internet exchanges in Canada is often a costly, and slow, experience. Generally speaking, Canada's backhaul in most areas is largely determined by a monopolist, which may be Bell, Shaw, Telus, etc. Hence, backhaul is a common problem in many rural areas. This is why many rural areas in Canada still do not have high speed connectivity. As is explained by ISPs, backhaul through for example Bell (a common backhaul provider) demands significant scale for discounts or high speeds. Many small (rural) ISPs are therefore limited to 10 Mbps backhaul. But often for one very small community this is still to expensive. With particularly limited volume being a problem for rural ISPs to obtain backhaul connectivity, the province of British Columbia has contracted Telus five years ago to provide rural communities with backhaul. About 120 communities have since then been connected with 10 Mbps backhaul. Nevertheless, given the focus on highspeed, one research participant indicates that the province is not highly satisfied with only 10 Mbps.

In addition, one research participant indicates that the Columbia Mountain Open Network (CMON) – also a rural FTTH initiative - has failed due to backhaul problems. The backhaul was too expensive to arrange.

Telus and Shaw did not want to provide backhaul services. Observing problems with backhaul connectivity in many areas, Qnet decided to tackle the backhaul issue in order to make its FTTH project viable. But, importantly, Qnet, being located near Vancouver, has the luxury of the availability of a number of backhaul providers in the area, including e.g. Bell and All Stream, plus a number of local backhaul providers. Qnet made it as easy as possible for backhaul providers to connect to Qnet's network. Backhaul providers do not need to pay for locating equipment at the Qnet interconnect point, and do not need to pay for use of the fiber, that Qnet has rolled out to an easy interconnect point. Further, the idea prevails that in the future it would be possible for the service providers operating on Qnet`s dark fiber to cooperate and aggregate data backhaul, and commonly find an (open access) backhaul provider at decent terms and conditions, also as more and more small companies in fiber business can increasingly easily arrange backhaul.

Open access backhaul however is still rare in Canada. Alberta is the only province with a significant open access backhaul: Alberta's SuperNet, operated by Axia. Nevertheless, in Alberta the access network (the last mile) is not arranged, and thus a chicken and egg problem can be observed.

Nevertheless, one research participant indicates that backhaul is mostly a problem for rural communities, and not so much for urban areas: "It's generally less of a problem in bigger cities if you have a carrier neutral exchange, but it is a problem in rural areas. In fact the national broadband taskforce that was setup [..] about 10 years ago recommended the construction of what was called condominium fiber to these communities to enable many providers to provide backhaul access".

4.2.3. Absence of a Regulatory Framework and Limited Government Involvement

In Canada currently no particular regulation applies to FTTH. This lack of regulation, but also the wider regulatory environment relating to the broadband Internet access market as a whole, has its impact on FTTH developments. During interviews, a wide variety of issues are mentioned with regard to regulatory issues; ranging from the lack of involvement of both regulatory authority CRTC (Canadian Radio-television Telecommunications Commission) and the ministry responsible for (tele-)communications policy, Industry Canada. Often heard complaints regard (1) the simple lack of any vision for future broadband rollout on both sides, (2) the lack of competition in the Canadian market, including the prohibition of foreign ownership in the communications sector, and (3) the CRTC focusing primarily on the large incumbents, making it difficult for small providers to even be heard by the CRTC. These issues are discussed in more detail below.

First, with respect to the lack of vision coming from the CRTC, one research participant indicates that, "as opposed to the FCC in the States", the CRTC is "doing an adequate job for what their mandate is, but there has been no real vision, or any attempts to push Canada forward. That's not their mandate". Moreover, one of the underlying issues with the CRTC might be its limited focus on broadband, as compared to other areas of its mandate including telephony and broadcasting. As the same participant continues, "from [the CRTC's] perspective, they're really much more a telephony and Canadian content regulator. So they see, in terms of telephony, a number of players, and so forth, so they think things are nice and groovy. There's far less focus on broadband itself, either wireless or wired".

Second, more general problems of limited competition in the Canadian Internet market have an impact on FTTH rollout. The co-owner of a small rural Ontario FTTH provider also indicates that he would like to see improvements by the CRTC: "I think that especially when it comes to fiber infrastructure. I mean, one of the practical limitations that you have in a lot of areas is that it doesn't make sense for there to be multiple cables owned by different providers transversing the same route. If you look at how much it costs to run a kilometer of fiber, it doesn't make sense to spend that money multiple times. So yes, I would like to see the CRTC address that and look into that, especially recognize that broadband is an essential service nowadays, they've been avoiding defining broadband as an essential service and I feel

that doesn't reflect the realities of the market". Another participant, contemplating the future of broadband in Canada, and the role of FTTH in particular, indicates that "Until the government changes the law, and the CRTC changes the regulation, I don't see any change. Because, we don't allow foreign ownership of telecom companies, there's very little competition in Canada, we have some of the highest prices in the world, and see little interest by government or regulator to ensure competition. I don't see much of a chance here in Canada of this [FTTH rollout] going much further." He furthermore believes that structural separation is needed in Canada; i.e. to have one set of companies that owns the infrastructure, but does not sell services.

For small providers it is also sometimes difficult to get a dialogue going with the CRTC; or simply to feel to be heard. At dark fiber provider Qnet surprise was expressed given the lack of interest of the CRTC in its dark fiber endeavors, particularly "because if you look at the purpose of the CRTC, that is to stimulate competition and telecommunications market development". Qnet has contacted the CRTC multiple times, but never received any inquiries from the CRTC. Nevertheless, Qnet does not need to be registered at the CRTC, as it does not provide telecommunications services, which is likely why the CRTC does not bother to engage with Qnet. But frustrations with the CRTC are also mentioned by others. For example, the co-owner of the very small FTTH provider in rural Ontario discussed above, indicates that "especially for small providers, getting our viewpoint heard and understood in a way that fits in with the format that the CRTC expects their applications in is very difficult". Furthermore, "I would like to see that they [CRTC] have some more considerations for the small providers, because the small providers are the ones who are making the point of there being competition in the marketplace and keeping prices fair and improving the state of our infrastructure".

Other issues such as revolving door issues in the CRTC board and perceived favoring of incumbents by the CRTC are also highlighted: "The right hand guy that was the assistant to the CRTC was seconded to the CRTC by Telus, and just took his old job back at Telus" [4], and in addition, "if you look at the latest rounds of filings with the CRTC from MTS Allstream, from Axia, from Sasktel and a number of the other ISPs, they're all raising alarm on how easy it is for the ILECs to get new hearing after new hearing after they've already been told a number of times – "No, this is the way it's going to be guys, get your act together and this is where it is," and then they get another delay and another delay", and finalizing by saying "What's alarming in the last year or two is that the CRTC seems to be losing some of its backbone".

Of course, given that the CRTC only has a particular mandate, the role of Industry Canada is important as well, as it is in charge of developing policy and putting forward a vision on the future of the Internet in Canada. Industry Canada`s role stimulating FTTH is perceived differently by various stakeholders. According to one research participant there is a "little bit, but not much" interest from government in broadband network rollout. Referring to the $250 million rural remote broadband project, he indicates that "no announcements have been made about how that is going to be deployed, or what technology they will use or how the program will work." In addition, "some former executives from Nortel are lobbying the government to build a national broadband program, like in Australia and in the United States, but I think that's a long shot". Further, "the CRTC just enforces regulation established by telecom policy. So it's the telecom policy branch of Industry Canada that really has the responsibility, if they want to ensure competition, and advocate for greater broadband in Canada. But there seems to be a total lack of interest there".

On the other hand, the Coquitlam dark fiber model has gained attention by both the Province of British Columbia and Industry Canada. Both have expressed interest in the open access model and the need for duplication of the model across the province/country. Generally speaking, Qnet has had more dialogue with Industry Canada than the CRTC. It is believed to be the case because of the CRTC's focus on broadcasting rather than telecommunications.

4.3. A Way Forward?

Fiber is slowly being implemented in Canada – for large part because it has become cheaper than copper. The general idea of FTTH delivering very high speeds is not lived up to in Canada. Even though within the network high speeds could be reached – as it is just a matter of equipment – backbone problems impede FTTH to live up to expectations of very high speed. Small ISPs cannot afford to connect to high speed backbone due to costs and scale. Hence, they must go with local incumbent (e.g. Bell). Bell for example provides speeds up to 10Mbps only for backbone connectivity.

The previous cases sketch a bleak picture of Canadian FTTH developments, which relates to the more general status of the Canadian broadband market. According to [15], "all small independent ISPs in Canada, they still go after the business market. Except for small towns they have given up on the retail market, because it's impossible to compete against a Bell or Rogers and so forth. Even though there are all of these CRTC regulation on resale and so forth. When you're competing against the same company that owns the infrastructure it's almost impossible. And so they don't want to in any way compete against them, because they'll just get clobbered". Moreover, "what you need is a very big company to compete against Bell, a Rogers. A small independent ISP does not have the financial resources, so if things get down and dirty, to withstand the onslaught. This is why foreign competition is important, if it's a bit carrier like Deutsche Telekom or KPN or something, they can come in, they can make this huge investment in the market place, and they can withstand if Bell or Rogers starts to play a dirty competitive game. But if you're a small ISP it's impossible".

Given the low numbers of independent ISPs left in the market, dark fiber does provide an opportunity for more competition. Incumbents from the different geographical areas will become able to compete out of their original service territory. Bell's use of Qnet serves as an example. While Qnet of course is still a very small area, growth of dark fiber networks across the country could help Canada go beyond its current duopoly status.

In relation to the limited competition in the Canadian broadband market, it is also interesting to note that as opposed to the Netherlands, where cable operator UPC made a big deal of Amsterdam's involvement in FTTH rollout, in Canada incumbents have not objected to FTTH projects. In the case of Qnet, in British Columbia where incumbents Shaw and Telus are active, the incumbents remained silent. Qnet has involved them in presentations and have been offered to lease fiber from Qnet. Their lack of objection likely stems from two issues. First, Qnet does not provide a competitive threat: Shaw and Telus will not compete with Qnet based on service provision, as Qnet purely offers the access technology. Second, the ISP market in Canada is known as uncompetitive. As again reiterated by a manager at Qnet, incumbents have in the last decade been able to outcompete small independent ISPs. Many ISPs have gone bankrupt because their margins to operate were too low; for example with ADSL margins are very low. The CRTC has not done much to avoid this. Due to the low number of ISPs likely Telus and Shaw did not feel a competitive threat.

Finally, for FTTH to live up to expectations, typically it is believed that triple play services (TV, telephony, and Internet access) are necessary. While telephony and Internet services are fairly easy to deliver, television services are more complex to deliver. The provider needs broadcasting license as well as the rights to deliver particular content, and thus partnerships with content providers. Clearly, this is not easy to arrange by a new, small, market entrant.

5. Discussion

The cases of the Netherlands and Canada bring very different pictures to the fore. In the Netherlands FTTH rollout has been regulated significantly. Possibly even the threat of regulation has led to all projects being based on a Point-to-Point (PtP) infrastructure that all projects have used, and that enable

unbundling in a straightforward manner. Moreover, a PtP dark fiber infrastructure allows for different types of architectures to be implemented by active operators, given them a chance to diversify. Canada on the other hand has been unregulated. Few FTTH projects have been initiated, and those projects that have been started vary significantly in terms of initiator (incumbent vs. municipality vs. small independent rural ISP), architecture employed (PtP vs. PON), and outcomes; including difficulty or even failure to contract an operator or service provider. As a matter of fact, very few lines have been rolled out, and due to backhaul problems, in most projects speeds over fiber connections are limited to 5 Mbps download, whereas in the Netherlands speeds tend to be significantly higher (e.g. for Citynet ISP Alice provides 20 Mbps symmetrical[6]).

Given the limited activity in Canada, unsurprisingly there has not been much effect on competitiveness in general in the Internet access market. Moreover, it was found that the incumbents hardly reacted to the rollout of dark fiber in Coquitlam, which seems indicative of a perceived lack of competitive threat on the incumbents` side. On the bright sight however, for example Bell expressed interest in the dark fiber network and moreover, the first large scale FTTH project is about to start in the city of Fredericton by Bell Aliant. Even though the network will likely not be unbundled, and it remains to be seen what speeds will be provided, it may trigger a competitive response by the local cable company.

As opposed to Canada, in the Netherlands the competitive landscape is changing, arguably as a result of recent FTTH rollout. Across infrastructures extensive marketing campaigns are taking place. Cable operators are upgrading their networks to DOCSIS 3.0, and are aggressively advertising these (upcoming) high speeds. Therefore, at least for the time being, cable seems a viable competitor to FTTH. Furthermore, even though theoretically fiber speeds would be higher, cable providers have an advantage with the provision of TV related services. The combination of FTTC with VDSL is less likely to become a significant alternative, as incumbent KPN has seemingly shifted its focus away from the latter.

Within any one FTTH network – at least with regard to pure retail Internet services provision – it remains unclear to what extent competition will take place. It is too early to tell. But, with the exclusivity period of active operator BBNed at Amsterdam Citynet ending at the time of writing of this paper, and with pointers that KPN, but likely also other current CLECs (DSL providers), will enter the scene, the outlook for competition across active operators seems good, which will naturally imply a choice of services. However, the extent of scale that is needed is not yet clear, and thus it remains unknown how many active operators any one network could facilitate. Finally, even though competition among pure retail service providers might not be great, development of innovative services may open a new market for service providers, beyond the traditional triple play services. For example, currently on Amsterdam Citynet two out of six service providers offer services other than those in traditional triple play bundles.

6. Conclusions

This study investigated how FTTH networks affect competition in broadband Internet access markets and aimed to identify factors that affect and sustain growth in FTTH markets. Preliminary findings suggest that in markets that are competitive prior to FTTH rollout, regulatory interventions including unbundling policies have positive effects on rollout, and may also stimulate facilities based competition.

By studying cases of the Netherlands and Canada, the study found that while in the Netherlands major telecom operators (except cable operators) are focusing on FTTH, in Canada little activity can be observed yet. In Canada a number of small FTTH networks are being rolled out, primarily in rural areas and often times initiated by small independent ISPs or municipalities. Further, most of these networks in Canada still deliver low speeds. Investment is one of the key bottlenecks in rolling out FTTH. It is often times too expensive for investment by a telecom operator. In the Netherlands a viable solution was found

[6] See http://www.glasvezelamsterdam.nl/index2.php

in rolling out dark fiber and involving municipalities, housing corporations and others. When perceived as infrastructure, return on investment periods can be extended beyond the typical investments in the telecommunications industry that need a return on investment in just a few years. For this reason, the existence of multiple operators on one network gives the best prospects for profitability. This is in line with recent findings of a Yankee Group study that found that it is more profitable for an infrastructure owner to provide wholesale services instead of being the sole service provider (Felten & Swain, 2009). In relation to this, a majority of research participants involved in the FTTH business generally agree that stimulating competition is done best by rolling out dark fiber, using a PtP architecture, rather than (G)PON architecture, as the latter does not easily enable unbundling and provides limited control for competitive providers.

The study reported on the great strides forward in fiber rollout in the Netherlands. However, the full impacts on competition remain to be seen. Take up rates at places are at certain places are below expectations, and service providers in e.g. Amsterdam have not taken a leading role in marketing to customers. An interesting finding however was that potential service providers prefer to act as operators as well. And indeed, there are pointers that multiple operators are interested in competing as active operators at Amsterdam Citynet as soon as the current active operator's exclusivity period ends. Nevertheless, the number of pure retail service providers is expected to be low. Yet, future services competition may occur through the offering of innovative services taking advantage of the key features (i.e. high capacity) of FTTH. Finally, even though currently it remains unknown how much service based competition can be facilitated, unbundling of PtP networks seemingly provides the best opportunity to enable competition.

Observing the cases of the Netherlands and Canada, as well as taking into account developments in high growth FTTH markets in Asia such as Japan and Korea, government and regulatory involvement may be key to the rollout of fiber networks. Indeed, in Canada the federal government and regulatory authority are largely absent in stimulating FTTH rollout. Nevertheless, also in Canada slowly some activity at the local level by government (municipalities) can be observed, that in few areas is trying to get involved in creating a more competitive telecommunications market and enhancing socio-economic development of their communities. But, even though regulatory interventions may have been a driving force in guaranteeing competition and driving rollout in the Japanese, Korean and Dutch markets, to better the situation in Canada more basic changes to the competitive landscape of the broadband market in general, are needed. The lack of competition and innovation in Canada's Internet access market (Van Gorp & Middleton, 2009) requires significant stimulus. Innovation by incumbents in the largely duopolistic market is very limited, and small operators experience significant trouble with backhaul or even finding an ISP that is willing to operate over a dark fiber network.

Therefore, significant changes in the regulatory environment are needed to stimulate competition. In line with previous research on the Canadian broadband market (Van Gorp & Middleton, 2009), this study finds that changes in foreign ownership restrictions and more attention to the role of small ISPs and their regulatory needs will be a start to increase, and restore, Canada's halted broadband innovation. Even though in the Netherlands there is believed to be little room for small independent ISPs, in Canada small independent ISPs play an important role in stimulating broadband uptake in rural areas, which are deemed unprofitable by incumbents. However, given that significant scale is needed to obtain backhaul agreements, they are in a difficult position. Hence, particular regulatory attention must be paid to the needs of these ISPs. With respect to FTTH in particular, the study identified a need for scale. Hence, competition over FTTH networks in Canada may only work in the cities, but might be significantly more difficult to achieve in rural areas. Hence, a flexible approach is needed to suit both urban and rural areas.

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