# A Proposal For The Development Of Municipal Fiber In Vancouver

A Case for Fiber

# >>>A Case For Fiber:

## A Proposal For The Development Of Municipal Fiber In Vancouver


### A Report By:

Tyus Chow
Scott Kim
Patrick Kong
Anthony Pookpun
Eugene Shen
David Wang
Jian Ping Xu
David Xu


Designed by Jian Ping Xu

# Table of Contents


Abstract 1

Introduction 2

The Need 4

Vancouver Is Already Expensive 4

Rising Internet Prices 4

Creating Jobs 5

Example A 6

Example B 7

Example C 8

The Plan 9

The Fiber Technology 9

The Backbone 10

The Delivery 11

The Deployment 12

Suggested Pricing 14

Other Possibilities 15

Conclusion 16

Appendix A 17

Notes 18

Works Cited 19

# Abstract

This report suggests that Vancouver develop its own municipal fiber optic broadband service. Access to the Internet has become essential for most consumers and businesses. However, the oligopoly of Telus and Shaw prevents fair market competition through their sheer size and infrastructure. This has led to Internet price increases that are faster than the rate of inflation despite negligible improvements in terms of speed and quality. A transparent municipal Internet service provider would provide stability and equal opportunity by being more finely tuned to consumer demands. Furthermore, establishing a fiber optic broadband service will increase Internet speed and quality and decrease its cost, which will stimulate BC's economy by creating new ICT jobs. We believe Vancouver could benefit greatly by developing this infrastructure, and help set a standard for Internet services across Canada.


# Introduction

Recent developments and the current state of the internet in Vancouver suggest that a municipal fiber optic broadband service should be implemented. At the moment, Vancouver is dominated by the oligopoly of Telus and Shaw. In British Columbia, we may have more than two ISPs (Internet Service Providers), but realistically these two have so much power in the market that the others are rendered nearly non-existent. Other companies such as Novus Networks, which only provide service to very limited areas, do not provide sufficient competition for these two companies. Over the past few years, prices have increased faster than the rate of inflation, while data-caps are constantly being reduced.[1] The implementation of a data cap benefits no one except the oligopoly as things like cord-cutting become more common. We currently have slower Internet speeds and are now even being penalized for using it. Little progress has been made to treat internet as a utility rather than a privilege.

True fiber optic internet service has not been distributed throughout Vancouver. Shaw and Telus have used the term “hybrid-fiber” to describe their deployment of FTTN, or Fiber to the Node. This involves running fiber to wider distribution points and then using traditional copper wiring for the last mile to the individual locations. However, this does not improve the service to such a drastic amount that would justify the prices that these two services are charging for it and the planned increases. The fastest speed available is only 100mbps in most areas which is relatively low compared to the progress made in other regions of the world such as in South Korea and Europe.

The lack of competition leads to a lack of innovation and progress. The domination of Shaw and Telus in BC’s ISP markets place a strain on download and upload speeds. The lack of fair prices and the speed limits are also prevalent in provinces outside of British Columbia. Many Manitoba Telecom Services

users in Winnipeg are "stuck with a maximum of 5 Mbps".[2] Major Internet providers such as Rogers, Shaw, and Eastlink are charging as much as $120 to $253 for only 10Mbps in Ontario, Western Canada and the Maritimes respectively.[3] Canada is ranked 41st in the world for download speeds and 65th for upload speeds. As technology advances so does the importance of having a stable and fast ISP. Whereas other countries are improving their upload and download speeds through upgraded infrastructure, Canada is stagnating, something which should not be acceptable.

The rest of the world is growing while we are staggering behind. Compared to the other countries of the world, Canada is currently ranking 53rd in terms of upload speeds. Our upload speeds average around 5.67 mbps while the world average is 7.6 mbps. Countries that have faster Internet speeds than us include Kazakhstan (10.77 mbps) and Mongolia (9.93 mbps). In Canada, British Columbia has one of the lower upload speeds in comparison to the other provinces and territories, with only 4.34 mbps.[4] In 2013, Canada's average download speeds are reportedly 16.6 mbps, while the world's fastest download speed is Hong Kong at around 44.14 mbps.[5] Upload speeds and download speeds are highly important to commercial and business uses. A slow upload and download speed prevents businesses from maintaining online services as efficiently as possible. Canada's ICT sector is suffering because of these slow speeds especially in the upload department with the advent of new services that rely on the cloud.

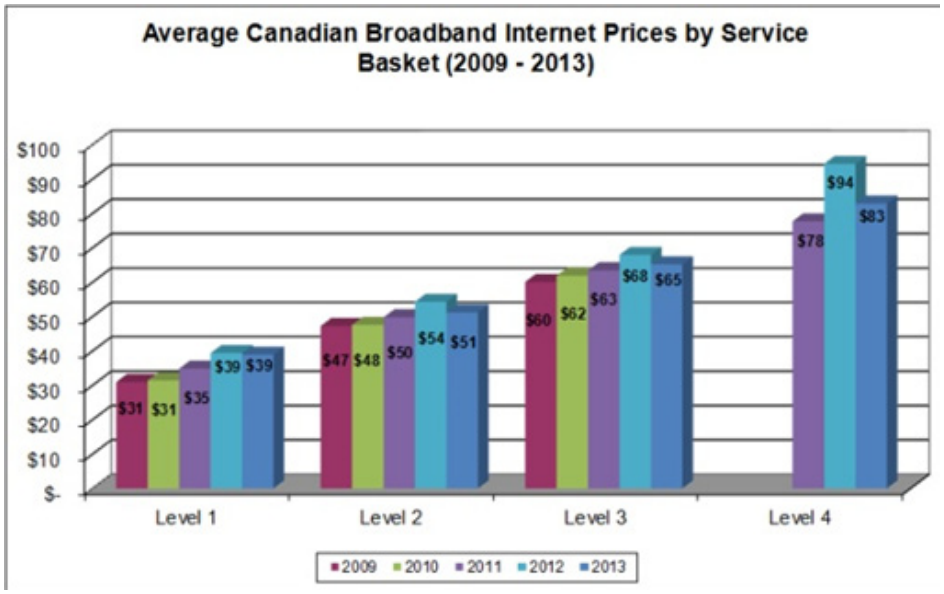
ISPs also have a tremendous amount of power as they are the organizations that provide internet access which makes monopolies and oligopolies even scarier. Recent incidents have happened over issues such as net neutrality which make this issue even more important. The lack of competition over internet providers has caused incidences where competitors are placed at an inherent disadvantage over the provider. Such is the case involving services such as famously Netflix and Comcast in the United States. A more local issue would involve Rogers and Shaw and the Shomi streaming service launched in retaliation to Netflix. The service has an inherent advantage in the fact that it does not count towards data caps unlike Netflix. In such a situation where streaming media can take a large amount of data, providers are forcing users into situations which only benefit the provider. With the amount of attention that net neutrality has received in the United States with the FCC (Federal Communications Commission), we believe this is not something to be taken lightly. This is due to the way ISPs work. ISPs are essentially connections of servers run in three different tiers which provide IP addresses to its customers so they can use the internet. IP addresses can be thought of as similar to addresses used to send snail mail. The servers are connected through peering agreements. Peering is essentially voluntary connection between networks to exchange traffic between the users of the networks. Due to the voluntary nature of peering, conflicts do erupt as mentioned earlier. With this amount of power, the lack of competition only makes the situation direr.

The goal of this report is to provide a possible solution to this oligopoly in the form of municipal fiber. Although this may seem extreme, we believe the government is the only organization that can bring about effective change in this industry. We believe that Vancouver has the potential to grow through the improvement of internet services through the deployment of municipal fiber through a loss-leader approach. The oligopoly of Telus and Shaw has been holding growth back. The end goal is to create a legitimate competitor that can actually compete against the 'Big Two' in this province and not a local monopoly which is the case in some provinces in Canada. Through the creation of a municipal fiber service in the city of Vancouver, British Columbia, we see the possibility of real change happening and growth that can happen that has never been seen before.

# The Need

## Vancouver Is Already Expensive

Vancouver is one of the most expensive cities in North America to live in. Compared to Toronto, Canada's largest city, rent prices are 9.56% higher, grocery prices are 4.48% higher, and purchasing power is 11.14% lower.[6] An apartment in the city centre of Vancouver will cost an average of $7500 per square meter which is 15% higher than in Toronto.[7] Renting a one bedroom apartment in the city centre costs an average of $1470 a month; this is 46% of the average monthly salary in Vancouver. This is $3220 after taxes.[8] With the cost of living as high as it is, the costs of basic utilities such as internet should not be increasing at the fast pace it is.


Source: Internet Prices. Digital image. Canadian Radio-television and Telecommunications Commission. Government of Canada, 2013. Web. 2 Apr. 2015. <http://crtc.gc.ca/eng/publications/reports/rp130422_5.jpg>.

## Rising Internet Prices

Shaw and Telus have been gradually increasing their Internet prices. The Internet 25 plan from Telus, which used to provide 500GB/month, has now shrunk to only 250GB/month. If the company had no problem with higher data caps before, why the sudden change? The recent changes in Internet plans are aimed at people who are cancelling their TV service in favor of online services such as Netflix.[9] Instead of providing better options for their customers, Shaw and Telus exploit their power as an oligopoly to attain more profits. The problem is that when one ISP increases the prices of their services, we expect the other to offer a better option. However, this is not always the case. We can see in December and

early January, Shaw also increased their prices with an 'upgrade' on their current packages. Monthly rates have been increased by up to 11% on some packages. Shaw also offered new tiers and options that were meant to provide "faster download speeds and greater values for customers." However, these new tiers are proving to be even less appealing options. Whereas a previous subscription of 60$/ month (which is now 67$/month) could provide 25mbps, the new tier offers only 15mbps for the same price.[10] The trend in increasing Internet service prices can be seen throughout Canada as well. The CRTC composed annual trends in growth and average Canadian broadband Internet prices have been steadily increasing, despite a small dip in 2013.[11]

The utter lack of competition between the two more incumbent ISPs, Shaw and Telus, is displayed through their constant price hikes. Customer satisfaction is also reportedly very low, particularly with the addition of Shaw's implementation of their new tier system.

## Creating Jobs

Some economists now regard ICT as a quaternary sector service while previously it was considered to belong in the tertiary sector. Greater Vancouver's ICT sector represents about 70 per cent of the ICT industry in British Columbia, which is comprised of more than 6,000 companies and more than 46,000 employees. In Vancouver, the ICT sector is primarily service-oriented. The focus is on computer system design and the related services, engineering services, software publishing, wired telecommunications, and computer and peripheral equipment manufacturing.

Vancouver has a good mix of both global and local ICT firms.

- Global Firms: Microsoft Corporation, Intel, IBM, Broadcom, 3M, Eastman Kodak Company, Harmon International Industries, Sophos, Oracle, Business Objects, Nokia, Honeywell International Raytheon and Seiko Epson
- Local Firms: A number of large anchor companies incorporated in Vancouver have provided a solid foundation for growth, including MDA, Sierra Systems, TELUS, PMC-Sierra and Sierra Wireless.

There is a growing pool of skilled ICT workers in B.C. including nearly 67,000 engineers, IT professionals, and production workers. This is largely due to welcoming immigration policies, which have contributed to the quality of Vancouver's ICT workforce. This is a significant factor in Microsoft's decision to open a software development operation in the Greater Vancouver area. Other sources of productive workers come from family and business ties to Asia, and foreign students at local educational institutions.[12] However, in regards to the Canadian ICT sector, Ontario and Quebec remain more dominant.

# Example A

## Lithuania (Europe)

Source: Capper, Phillip. Vilnius old town from Castle Hill, Lithuania. Digital image. Wikimedia Commons. N.p., 14 Sept. 2008. Web. 2 Apr. 2015. <https://upload.wikimedia.org/wikipedia/commons/8/8d/Vilnius_old_town_from_Castle_Hill%2C_Lithuania%2C_14_Sept._2008_-_Flickr_-_PhillipC.jpg>.

A case study has been done on the fiber optic Internet implementation in Lithuania. Although Lithuania is one of the many LEDC's in the world, its citizens enjoy the highest penetration of fiber access in Europe; the country even retains the top spot in fiber access in Europe. Its fiber access is only behind one country in this world which is Korea who has the highest fiber penetration and Internet speed. There's a very high level of competition in Lithuania in the market for Internet services, with over 100 ISPs serving 1.2 million households and 3.5 million people. However, in 2006, TEO decided to move its broadband investment up a gear by building of fiber connections directly into as many households as possible (FTTH). Within two years of TEO's fiber access deployment, Lithuania enjoyed the highest penetration of fiber in Europe, with 23% of households connected.[13]

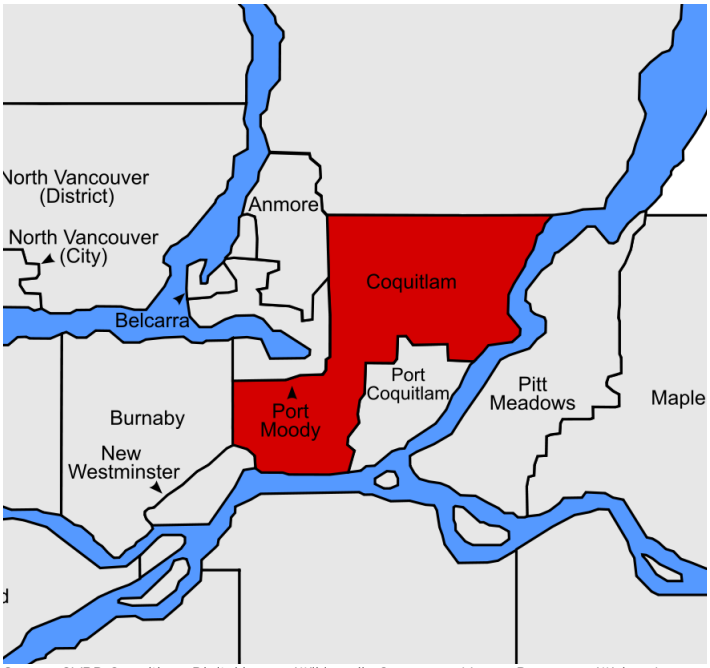

Source: Lithuania. Digital image. Wikimedia Commons. N.p., Oct. 2009. Web. 2 Apr. 2015. <https://upload.wikimedia.org/wikipedia/commons/thumb/e/ec/EU-Lithuania.svg/2000px-EU-Lithuania.svg.png>.

# Example B

Coquitlam Optical Network Corporation (QNet)
Coquitlam, British Columbia, Canada

Source: Salter, Greg. Coquitlam Town Centre Area. Digital image. Wikimedia Commons. N.p., 30 June 2014. Web. 2 Apr. 2015. <https://upload.wikimedia.org/wikipedia/commons/f/f7/Coquitlam_Town_Centre_Area.jpg>.

Coquitlam has its own fiber optic network called QNet, which uses the dark fiber that was in place already. Qnet provides Coquitlam with a significant asset in business and economic development. With the fiber optic in place, opportunities for jobs have become available for Coquitlam's residents and small and home-based business also receive benefits from the fiber. More of Coquitlam's residents turned towards home-based business due to the implementation of the dark fiber and as a result less transportation is required; hence less amount of carbon is produced. Qnet also only posts a small financial risk to tax-payers as the annual recurring cost savings has been around $ 357,000 which still allows non-tax revenue to be generated in the future.[14]




Source: GVRD Coquitlam. Digital image. Wikimedia Commons. N.p., 21 Dec. 2009. Web. 2 Apr. 2015. <https://upload.wikimedia.org/wikipedia/commons/thumb/c/c1/GVRD_Coquitlam.svg/2000px-GVRD_Coquitlam.svg.png>

# Example C

O-Net
Olds, Alberta, Canada


O-Net is another community owned Internet service provider that has implemented fiber optic as a means to distribute Internet. With the fiber optic in place, residents of its rural Albertan community can enjoy the maximum possible Internet speed of 1,000 Mbps or 1 Gbps.[15] The residents (8500 people) used to pay around $59-$90 for the Internet speed of 100 Mbps. However, after the fiber optic has been implemented, they can have access to Internet with maximum speed of 1 Gbps with the same price range ($59-$90). With this technology in place, has also transformed the college system in the community as before the fastest Internet speed was only around 40 Mbps and it was impossible for 4,000 students to use it at the same time. Now, with this technology in place, things have changed and students can now do research on various topics more efficiently; web-based textbooks also become viable as a tool for teachers and students to use.


Source: Map of Alberta. Digital image. Wikimedia Commons. N.p., 24 Sept. 2009. Web. 2 Apr. 2015. <https://upload.wikimedia.org/wikipedia/commons/thumb/9/92/Canada_Alberta_location_map_2.svg/2000px-Canada_Alberta_location_map_2.svg.png>.

# The Plan

## The Fiber Technology

We are proposing a hybrid solution of our own for the introduction of fiber optic service in the city of Vancouver with the ultimate goal of delivering a full fiber experience in the future. This is due to cost constraints as well as the nature of fiber optic services.

There are many different ways of deploying fiber optic cables to deliver Internet Service. Abbreviations such as FTTH, FTTN, FTTB, FTTC, or FTTdp are used to describe the methods of deployment. The most common forms that are used in North America are FTTH and FTTN. FTTN is known as Fiber to the Node and is the method currently used by Shaw and Telus. It is seen as a stepping stone towards FTTH or Fiber to the Home. This is because fiber optic cables are run from a distribution center to individual nodes that service a neighborhood. Nodes can be thought of as distribution points for the service. Traditional copper wiring is used for the last mile from the node to the individual buildings. This improves the quality of the service, but does not offer advantages in speed. For the purposes of this plan, the technology to be utilized will consist of a mixture of FTTH and a new technology called G.fast.

FTTH is known as Fiber to the Home and is the most well-known for the deployment of a full fiber optic internet service. It is the same delivery method used by Google Fiber, and other municipal fiber internet services. FTTH is when fiber optic cables are run from the main distribution point straight to a person's house/ building. No traditional copper wiring is used. Super-fast speeds are achievable through the use of FTTH with South Korea deploying 10Gbps networks this year.

G.fast is a new type of enhanced digital subscriber line (DSL) standard developed by the International Telecommunications Union. DSL is the technology that delivers Internet through copper phone lines used by ISPs like Telus. G.fast aims to bridge the gap between the traditional copper wiring that is present in many homes and the fast speeds fiber can bring. It is a variation of FTTdp or Fiber to the Distribution Point. G.fast works effectively when the loop delivering the internet service is less than 250m or near the customer's premises. This works by running fiber optic cable to a G.fast box that is right outside the customer's premises. From there, traditional copper wiring is used and near-gigabit speeds can be achieved. The G.fast boxes are as small as regular shoeboxes. Also, G.fast can later be transitioned into FTTH and we believe it is a more effective stepping stone compared to the current FTTN used. FTTN is unable to bring significant speed improvements, but G.fast can. British telecommunications provider BT has done trials with G.fast and has achieved speeds of 1000mbps. G.fast is able to achieve near 1Gbps speeds while still utilizing traditional copper wiring. This is achieved by using higher frequencies to deliver faster speeds. It is also more affordable to build out compared to FTTH. The benefits that G.fast can provide are enormous, but are unlikely to be used by any telecommunications provider in North America. Former FCC Chief of Staff, Blair Levin, has stated this before as these companies have little incentive to adopt the new technology without competition.[16]

Using the two technologies, we are proposing two possible methods of deployment.

**Method 1**

The first method is the use of FTTH wherever possible and G.fast when necessary. This would ensure a quick completion of the goal and is considered a more aggressive strategy. The reason G.fast is used in combination with FTTH is the fact that FTTH is not possible or economical in all scenarios. This can be seen in buildings where rewiring may not be a possibility. This would allow Vancouver to quickly compete against the other cities and countries of the world compared to the second method listed below.

**Method 2**

The second method is to solely use G.fast and gradually transition to FTTH. This method is not the most ideal method, but it is more affordable in comparison to the previous one due to the fact that G.fast can utilize the already in place traditional copper wiring that is in homes and buildings. Over time a transition to FTTH can take place as the necessary infrastructure would be in place to allow such a thing to happen. G.fast is more of a temporary solution to the fiber internet issue, but it is a more affordable and usable alternative compared to other methods of deployment such as FTTN which is used by the other ISPs.

## The Backbone

The construction of the network involves various technologies in addition to the ones mentioned above. There are multiple backbones and delivery methods available that can be used to be transport fiber internet which allows for greater flexibility.

There are two forms of backbones which can be used to deliver fiber optic internet: AON and GPON. AON stands for Active Optical Network and GPON stands for Gigabit Passive Optical Network. An AON network requires powered equipment at the distribution and switching stages such as routers. Doing so allows the customer to have fiber directly run to their house without the need for any special equipment at their premises. They have a longer range compared to GPON networks, but suffer a flaw in that since the connection is powered continuously from beginning to end, there are more points for failure. GPON networks only require powered equipment at the initial distribution point and the end point which is usually the consumer's residence. They are cheaper compared to AON networks and are less prone to failure and require less maintenance as only the beginning and end are powered. The downside is that they require a powered receiver on the consumer end compared to AON networks which do not. GPON networks also have a shorter range as mentioned earlier.

Despite the disadvantages, we have selected for this fiber optic network to be a GPON network. This is because GPON has already been deployed in many US networks such as Verizon's FiOS network and the prominent Google Fiber network. It is also due to the other benefits such as the low maintenance requirement.


## The Delivery

The physical delivery of the service can be done through many ways. The most common method is trenching, where the fiber cables are run through conduits under the ground. This is generally the most costly method and can make maintenance an issue. The methods proposed here are more affordable alternatives which serve a similar purpose.

A more effective alternative method is to use the poles we have on the streets to deliver fiber internet aerially. This is currently used by other Internet service providers such as Shaw and Telus as it is one of the most affordable ways to install and maintain cable, compared to other methods such as installing the cables underground using conduits, which is more costly due to the labor involved as well as the disruptions it can cause. There are some disadvantages to our proposed method of wiring the cable over poles, as it is more prone to failure due to factors such as the weather. However, this should not be a big problem due to Vancouver's mild climate and its placement near the Pacific Ocean.

Another method is the use of micro-trenching. This is a less disruptive form of trenching that gets rid of a lot of the disadvantages of regular trenching such as the disruptions it can cause. It is quick and offers minimal disruptions. Micro-trenching works by installing small conduits on the sides of roads and sidewalks in order to accomplish the same purpose as the previous methods stated as well as being more affordable. Of course, this does not take into account of the possible dark fiber that the city has already implemented which can be used in conjunction with the methods described here.

## The Deployment

In order to deploy fiber efficiently and effectively, we investigated the areas in which the deployment would take place. We looked at the population density of neighborhoods in Vancouver, as deployment would be more cost-efficient and faster if done in these areas first. It also allows for greater penetration of service and distribution of more affordable services. The neighborhoods have been grouped up into three categories: High-Priority, Medium-Priority, and Low-Priority. This is done using data from the 2001, 2006, and 2011 Census'. The fiber optic network will be built in a three phases from these prioritizations.

## Phase 1: High Priority Targets
## Downtown, Fairview, Kitsilano, Marpole, Renfrew-Collingwood, West End

These areas have been selected as they strategically give a good idea of how the service will be received. The choices of these neighborhoods are due to their density as well the developments that are happening in the neighborhoods. The densely packed Downtown and West End neighborhoods are crucial due to their density and in the case of Downtown the amount of business that takes place. The neighborhoods of Fairview and Kitsilano contain the Broadway Corridor which is another area of business making it also essential. The choice to also include Marpole and Renfrew-Collingwood is because of the growth these neighborhoods are experiencing. These areas will also serve as basis for future expansion in Phases 2 and 3. As well, Marpole is experiencing a lot of development due to its proximity to Marine Drive Canada Line Station. Marine Gateway, MC2, and Live Northwest are all examples of building projects currently underway in this neighborhood. This growth makes it ideal to launch fiber service to. Renfrew-Collingwood has impressive population growth as seen in the table in Appendix A due to similar reasons as Marpole. The Joyce-Collingwood Skytrain station is located in this neighborhood. The factors listed make these neighborhoods high priority targets and fiber deployment essential.

## Phase 2: Medium Priority Targets
## Kerrisdale, Killarney, Mount Pleasant, Oakridge

These neighborhoods were chosen based on their proximity to the existing areas that would have been covered by Phase 1. These areas also contain high population density and are actively in development which makes these areas suitable for Phase 2. Kerrisdale and Oakridge are near Marpole. Oakridge is currently undergoing redevelopment like Marpole as part of the Cambie Corridor Plan.

Killarney is near Renfrew-Collingwood and also has impressive population growth due to devleopment. Mount Pleasant is near Fairview and is seeing growth as multiple developments are taking place to revitalize the neighborhood.

## Phase 3: Low Priority Targets
## All Remaining Neighborhoods

If the above two phases are successful then a rollout for all the other remaining neighborhoods that have not been covered can begin. At this point the service can be considered a success.

## Suggested Pricing

**Plan 1**

| Download/Upload Speed (mbps) | Price (Not Including Tax) |
|---|---|
| 1,000 | $70.00 |
| 250 | $50.00 |
| 100 | $35.00 |
| 25 | $15.00 |

**Plan 2**

| Download/Upload Speed (mbps) | Price (Not Including Tax) |
|---|---|
| 1,000 | $100.00 |
| 250 | $75.00 |
| 100 | $50.00 |
| 25 | $25.00 |

This is the suggested pricing that we are hoping to achieve. This is in stark contrast to the prices offered by the other two Internet service providers. The service is provided on a loss-leader model similar to what other companies such as Amazon and Google have done. The goal is to create a significant change that will create growth that will cover the losses generated initially.

The pricing was taken into special consideration after looking at similar pricing by similar services such as Google Fiber and municipal fiber service's such as Lafayette's LUS Fiber. At the time of launching only the 1000 Mbps/1 Gbps and 250 Mbps service will be offered as this is to ensure that a loss is not taken for a long period of time. The lower two tiers of 100 Mpbs and 25 Mbps will be possibly offered at a later point to families which cannot afford the higher two tiers. The 25 Mbps service will only be offered to those who demonstrate low income and will not be offered to the general public as an option. This is similar to the BC Housing service the government currently runs. It is also unsustainable if a FTTH or G.fast service were to be run if 25 Mbps service was offered to everyone. Two possible pricing models have been drafted as seen above.

The goal of the service that is to be provided is to focus on affordability and we believe this change will come as a surprise that will hopefully ignite competition much like how Wind Mobile and Mobilicity did in their early days when the CRTC altered cellular laws. The other goals of these plans are to ensure net neutrality and be consumer friendly. There will be no data caps of any kind and no service contracts. A clear difference compared to what companies like Shaw and Telus offer to customers.


Source: LinkNYC Terminal. Digital image. LinkNYC. CityBridge, n.d. Web. 2 Apr. 2015. <http://www.link.nyc/assets/img/3.jpg>.

## Other Possibilities

A municipal Wi-Fi service could be launched at the same time as the fiber optic internet service is launched. LinkNYC is an example of a gigabit Wi-Fi strategy launched by the New York government in partnership with a group called CityBridge which consists of companies such as Qualcomm. The service replaces phone booths with Wi-Fi terminals which have advertising and other features such as a charging station. Our version would be similar to LinkNYC where terminals are created and connected to the network with fiber optic cable being deployed to offer Wi-Fi service. This deployment of municipal Wi-Fi would be ideal as two things could be accomplished at the same time. This type of service is listed for development in the Vancouver Digital Strategies Plan, but we believe this would be more effective than the city's current efforts of a city-wide strategy as this method allows a greater more relevant area to be reached. Solely improving the Wi-Fi is not ideal as it would exist without a solid foundation. The development of municipal fiber ensures a strong base for the development of municipal Wi-Fi.

# Conclusion

Equitable and affordable Internet access for all is a major challenge of modern society. Vancouver cannot continue its growth in the ICT sector without substantially increasing Internet quality and decreasing its costs to both household consumers and businesses. However, Telus and Shaw's oligopoly prevents further possible competition. As we have seen through our case studies of Coquitlam and Lithuania, the solution is to create a municipal fiber optic broadband service. If it is managed transparently by the government, then it will accurately cater to the needs of the people. Only through concerted government action with the support of the citizenry can we invest enough into fiber optic infrastructure to substantially increase Internet quality in Vancouver. We propose a three-phase action plan that will roll out our desired infrastructure throughout all of Vancouver, pending council deliberation and public approval. It is our desire that the resulting Internet service will be both fast and inexpensive for all due to the fact that the Internet is growing ever more essential with each passing day.

# Appendix A

### Deployment Statistics

Below are tables showing population statistics in the different neighorhoods chosen for the first two phases of development. They are gathered from the 2001, 2006, and 2011 Census'.

### Phase 1

| Year | Downtown | Fairview | Kitsilano | Marpole | Renfrew-Colling-wood | West End |
|---|---|---|---|---|---|---|
| 2001 | 27,990 | 28,405 | 39,620 | 22,415 | 44,950 | 42,120 |
| 2006 | 43,415 | 29,295 | 40,595 | 23,785 | 48,885 | 44,560 |
| 2011 | 54,690 | 31,445 | 41,375 | 23,835 | 50,505 | 44,540 |
| Total Change | +26,700 | +3,040 | +1,755 | +1,420 | +5,555 | +2,420 |

### Phase 2

| Year | Kerrisdale | Killarney | Mount Pleasant | Oakridge |
|---|---|---|---|---|
| 2001 | 14,035 | 25,785 | 24,535 | 11,795 |
| 2006 | 14,615 | 27,180 | 23,615 | 12,725 |
| 2011 | 14,735 | 28,450 | 26,400 | 12,440 |
| Total Change | +700 | +2,665 | +1,865 | +645 |

# Notes


1. For example, in 2015 Shaw raised its internet prices by up to 17%, while Vancouver's annual inflation rate is just 1.1%. Thomas Knowlton. "Customers 'Shocked' by Shaw Hiking Internet Prices." <http://www.techvibes.com/blog/price-hike-shaw-2015-01-06>; BC Stats. "Consumer Price Index annual averages." <http://www.bcstats.gov.bc.ca/StatisticsBySubject/Economy/ConsumerPriceIndex.aspx>.

2. Peter Nowak. "Why internet upload speed in Canada lags behind world average." <http://www.cbc.ca/news/technology/why-Internet-upload-speed-in-canada-lags-behind-world-average-1.2578682>.

3. Ibid.

4. Ibid

5. http://www.huffingtonpost.ca/2013/04/15/fastest-slowest-Internet-speed-by-country-canada_n_3085888.html

6. Numbeo. "Cost of Living Comparison Between Toronto and Vancouver." <http://www.numbeo.com/cost-of-living/compare_cities.jsp?country1=Canada&city1=Toronto&country2=Canada&city2=Vancouver>.

7. Ibid.

8. Ibid.

9 Erin Obourn. "Telus bails on unlimited internet, bandwidth plays on for a price." <http://www.cbc.ca/news/business/telus-bails-on-unlimited-internet-bandwidth-plays-on-for-a-price-1.2965470>.

10. Thomas Knowlton. "Customers 'Shocked' by Shaw Hiking Internet Prices." <http://www.techvibes.com/blog/price-hike-shaw-2015-01-06>

11. "Canadian Radio-television and Telecommunications Commission." Government of Canada, 2013 <http://crtc.gc.ca/eng/publications/reports/rp130422_5.jpg>

12. http://www.vancouvereconomic.com/page/information-communications-technology

13. "Fiber to the home (FTTH) Case Study - National incumbent in Lithuania leads fibre developments," Digital Agenda for Europe, 2014

14. Rick Adams, "Coquitlam Optical Network Corporation-QNet City of Coquitlam," Union of British Columbia Municipalities, 2010

15. Emily Chung, "Small Alberta Town Gets Massive 1,000 Mbps Broadband Boost," CBC News, 2013

16. David Talbot, "Adapting Old-Style Phone Wires for Superfast Internet," MIT Technology Review, 2015 <http://www.technologyreview.com/news/517381/adapting-old-style-phone-wires-for-superfast-Internet/>

# Works Cited


Banerjee, Anupam, and Marvin A. Sirbu. Towards Technologically and Competitively Neutral Fiber to the Home (FTTH) Infastructure. Rep. Carnegie Mellon University, 2005. Web. 2 Apr. 2015. <http://repository.cmu.edu/cgi/viewcontent.cgi?article=1451&context=tepper>.

Capper, Phillip. Vilnius old town from Castle Hill, Lithuania. Digital image. Wikimedia Commons. N.p., 14 Sept. 2008. Web. 2 Apr. 2015. <https://upload.wikimedia.org/wikipedia/commons/8/8d/Vilnius_old_town_from_Castle_Hill%2C_Lithuania%2C_14_Sept._2008_-_Flickr_-_PhillipC.jpg>.

Chung, Emily. "Small Alberta Town Gets Massive 1,000 Mbps Broadband Boost - Technology & Science - CBC News." CBCnews. CBC/Radio Canada, 19 July 2013. Web. 14 Mar. 2015. "Digital Agenda for Europe - European Commission." Digital Agenda for Europe. Fiber to the Home Council Europe, 1 Aug. 2012. Web. 14 Mar. 2015.

City of Vancouver. "Cambie Corridor Plan." Cambie Corridor Plan. City of Vancouver, 21 June 2013. Web. 14 Jan. 2015. <http://vancouver.ca/home-property-development/cambie-corridor-plan.aspx>.

CityHallWatch. "Vancouver's East-West Divide, Population Density, Political Clout, and Deeper Issues at City Hall." CityHallWatch Tools to Engage in Vancouver City Decisions. CityHallWatch, 26 Aug. 2013. Web. 12 Jan. 2015. <https://cityhallwatch.wordpress.com/2013/08/26/eastside_population/>.

COQUITLAM OPTICAL NETWORK CORPORATION - QNET CITY OF COQUITLAM. Publication. UNION OF BRITISH COLUMBIA MUNICIPALITIES COMMUNITY, 21 July 2010. Web. 14 Mar. 2015. <https://www.civicinfo.bc.ca/practices_innovations/coquitlam_optical_network_corp_qnet--coquitlam--2010.pdf>.
Crosby, Tim. "Active and Passive Optical Networks." HowStuffWorks. Infospace LLC, n.d. Web. 02 Apr. 2015. <http://computer.howstuffworks.com/fiber-to-the-home2.htm>.

Frenzel, Lou. "What's The Difference Between EPON And GPON Optical Fiber Networks?" Passive Optical Networks, PON, EPON, GPON, Fiber Optics. Prenton, 6 Jan. 2014. Web. 02 Apr. 2015. <http://electronicdesign.com/what-s-difference-between/what-s-difference-between-epon-and-gpon-optical-fiber-networks>.

GVRD Coquitlam. Digital image. Wikimedia Commons. N.p., 21 Dec. 2009. Web. 2 Apr. 2015. <https://upload.wikimedia.org/wikipedia/commons/thumb/c/c1/GVRD_Coquitlam.svg/2000px-GVRD_Coquitlam.svg.png>.

"Household Download Index." Download Speed by Country. Ookla. Web. 28 Nov. 2014. <http://www.netindex.com/download/allcountries/>.

"Household Upload Index." Upload Speed by Country. Ookla. Web. 21 Dec. 2014. <http://www.netindex.com/upload/allcountries/>.

"Information & Communications Technology." Vancouver Economic. Vancouver Economic
Commission, n.d. Web. 02 Apr. 2015. <http://www.vancouvereconomic.com/page/information-communications-technology>.

Innovative Canadian Enterprises Committee, comp. "ICT Sector Overview." Shared Services
Canada. Government of Canada, 29 Jan. 2013. Web. 2 Apr. 2015. <http://www.ssc-spc.gc.ca/pages/itir-triti/pdf/ICEAC-CCECN-Comm-2013-01-29-eng.pdf>.

Internet Prices. Digital image. Canadian Radio-television and Telecommunications Commission. Government of Canada, 2013. Web. 2 Apr. 2015. <http://crtc.gc.ca/eng/publications/reports/rp130422_5.jpg>.

LinkNYC Terminal. Digital image. LinkNYC. CityBridge, n.d. Web. 2 Apr. 2015. <http://www.link.nyc/assets/img/3.jpg>.

Lithuania. Digital image. Wikimedia Commons. N.p., Oct. 2009. Web. 2 Apr. 2015. <https://upload.wikimedia.org/wikipedia/commons/thumb/e/ec/EU-Lithuania.svg/2000px-EU-Lithuania.svg.png>.

Map of Alberta. Digital image. Wikimedia Commons. N.p., 24 Sept. 2009. Web. 2 Apr. 2015. <https://upload.wikimedia.org/wikipedia/commons/thumb/9/92/Canada_Alberta_location_map_2.svg/2000px-Canada_Alberta_location_map_2.svg.png>.

"New Micro-trenching Method Makes It Easier and Cheaper to Deploy Fiber." TeliaSonera. TeliaSonera, n.d. Web. 02 Apr. 2015. <http://www.teliasonera.com/en/innovation/access-is-king/2011/4/new-micro-trenching-method-makes-it-easier-and-cheaper-to-deploy-fiber/>.

Nowak, Peter. "Why Internet Upload Speed in Canada Lags behind World Average." CBCnews. CBC/Radio Canada, 20 Mar. 2014. Web. 03 Apr. 2015. <http://www.cbc.ca/news/technology/why-internet-upload-speed-in-canada-lags-behind-world-average-1.2578682>.

"Open Data Catalogue." Census Local Area Profiles 2001. City of Vancouver, n.d. Web. 02 Apr. 2015. <http://data.vancouver.ca/datacatalogue/censusLocalAreaProfiles2001.htm>.

"Open Data Catalogue." Census Local Area Profiles 2006. City of Vancouver, n.d. Web. 02 Apr. 2015. <http://data.vancouver.ca/datacatalogue/censusLocalAreaProfiles2006.htm>.

"Open Data Catalogue." Census Local Area Profiles 2011. City of Vancouver, n.d. Web. 02 Apr. 2015. <http://data.vancouver.ca/datacatalogue/censusLocalAreaProfiles2011.htm>.

Rendon, Juan. "Costs of Deploying FTTdp with G.fast." Huawei. Huawei Technologies Co., Ltd., 29 Aug. 2014. Web. 03 Apr. 2015. <http://www.huawei.com/en/about-huawei/publications/winwin-magazine/hw-364790.htm>.

Rowe, Jim. "Using Overhead Distribution Lines to Carry Fibre Optic Cables." Beyond Broadband. Independent Networks Cooperative Association, n.d. Web. 02 Apr. 2015. <http://www.beyondbroadband.coop/kb/using-overhead-distribution-lines-carry-fibre-optic-cables>.

Salter, Greg. Coquitlam Town Centre Area. Digital image. Wikimedia Commons. N.p., 30 June 2014. Web. 2 Apr. 2015. <https://upload.wikimedia.org/wikipedia/commons/f/f7/Coquitlam_Town_Centre_Area.jpg>.

Talbot, David. "Adapting Old-Style Phone Wires for Superfast Internet." MIT Technology Review. MIT, 30 July 2013. Web. 03 Apr. 2015. <http://www.technologyreview.com/news/517381/adapting-old-style-phone-wires-for-superfast-internet/>.

Vancity Buzz Staff. "T & T Supermarket and Cineplex Coming to Marine Gateway next to Marine Drive Station." Vancity Buzz. Buzz Connected Media Inc., 17 Mar. 2014. Web. 12 Feb. 2015. <http://www.vancitybuzz.com/2014/03/tnt-supermarket-marine-gateway-vancouver/>.