Using the economics of platforms to understand the broadband-based market formation in the New Zealand Ultra-Fast Broadband Network[1]

Fernando Beltrán
f.beltran@auckland.ac.nz
University of Auckland Business School
12 Grafton Road
OGGB Off. 472
Auckland, New Zealand

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1. Introduction

The government of New Zealand is currently building a nation-wide fibre-optics network, a project known as the Ultra-Fast Broadband (UFB) initiative that will lay out an entirely new infrastructure with the capacity to fast track innovation in network-based business models and new applications. Ultra-fast broadband access is defined as a minimum 100 megabits per second (Mbps) downlink and 50 Mbps uplink; the UFB network will cover 75 percent of New Zealanders over ten years. Crown Holdings Fibre (CFH), the government agency in charge of UFB deployment, has invested NZD $1.5 billion (or about USD $1.1 billion) and a similar investment is expected from invited private partners with whom CFH has established regional network operators also known as Local Fibre Companies (LFCs). UFB is complemented on the rural sector with the Rural Broadband Initiative, RBI, for which about NZD $300 million were directed.

A major overhaul of the telecommunications landscape in New Zealand is on its way and as of 2012 consumers are being informed about fibre availability and a more vigorous competition in the Internet access, voice and video services markets. In 2011 the largest telecommunications company in the country, Telecom NZ, was split into a wholesaler, Chorus, and a retailer, Telecom, which has also kept the mobile business. Also in 2011 four LFCs – the largest being Chorus – were selected to build and operate wholesale services on the fibre-optic network. Although Chorus will dominate 70%

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of the UFB network, new business opportunities for existing operators, small and large, will open because the UFB network will forbid its owners, that is, the LFCs, to provide retail services.

In the broadband ecosystem facilitated by the UFB initiative, market creation does not follow evolution patterns which are typical of other markets; conditions will be created faster than in any other markets such as those spawned out by the commercial utilization of technological innovations. Thus, not only is the fibre project aimed to reach all New Zealanders with broadband access but it also seeks to stimulate the provision of services by entrepreneurs other than the LFCs. UFB will be an open-access infrastructure with LFCs providing wholesale services to Retail Service Providers (RSPs) who will, in turn, either provide communication services and applications to end-users or sell them to resellers.

This paper presents the short history of New Zealand's UFB thus far and provides a description of the institutional arrangements in place for the development of the country's broadband ecosystem. It discusses the regulatory and policy decisions that will shape the broadband access market highlighting the basic principles upon which it lies: access on equal terms and equitable treatment of market participants (CFH, 2011e). Furthermore, it analyses the regulated price structure negotiated with LFCs for their wholesale market offers. Relying on a normative economics approach that uses recent advances in the theory of platform-based markets with cross-network effects - also known as theory of two-sided platforms - it proposes a novel view of the way markets over the UFB will unfold. On one hand, the theory is used to explain the rationale behind regulatory decisions already made and their effect on the development of UFB-based markets for contents and services. Such analysis is followed, on the other hand, by the introduction of a simple taxonomy for the RSPs which provides the framework to argue in favor of the most likely scenarios for service deployment and competition to develop over the UFB. The analytical framework reveals that the UFB ecosystem will be fraught with cross-network externalities which are the basis for regulatory decisions already adopted and the source of particular forms of strategic behavior adopted by the UFB-based market innovators.

The paper is structured in six sections that will provide the policy, market, and technical aspects of New Zealand's UFB and economic analysis of parts of the broadband ecosystem, starting with a review of foundational results on the theory of two-sided platforms (section 2). Subsequently,

with the UFB designed as an open access network, openness and network neutrality along with some regulatory issues are reviewed (Section 3). Then a historical view of New Zealand's UFB project from its origins up to its current state is provided alongside with the mechanisms proposed for operation, maintenance responsibility and eventual ownership transfer (section 4). The latter is followed by a description of the technical aspects and the pricing structure negotiated by the winners of the tender process and CFH (section 5). Lastly the paper offers an analysis that uses a two-sided platform model to understand the rationale behind early regulatory decisions affecting the access market; the economics of competition on the content markets is also analysed to offer an insight into the future development of UFB (section 6).

2. The economics of two-sided platforms

Businesses across a wide variety of industries operate in a way that two or more groups of customers find it in their best interest to interact with each other using a business platform. Even though the concept of platform is not new, many new-economy industries, especially those developed because of the Internet, operate as platforms that bring together at least two types of customers. Examples of two-sided platforms include financial exchanges, software platforms, advertising-supported media (Evans et. al, 2011), payment systems (Rochet and Tirole, 2002) (Rochet and Wright, 2008), video games consoles, on-line auction sites, yellow pages services, shopping malls, real estate brokers, PC operating systems, to name a few.

A 2009 OECD report on two sided-markets states: "*Two-sidedness is a matter of degree. Sometimes the two-sided nature of a business is critical for the analysis. Other times it is an interesting aspect of the industry that should be thought about but that is not fundamental. And still other times it is irrelevant*." (OECD, 2009; page 25) This paper argues that studying the impact of network effects on competition among communication service providers that operate on an open-access, high-speed broadband platform can benefit from modeling the network as an **access** two-sided platform. Also, since an open-access platform enables new players to seek access and develop their business, it is argued that some of those players may build their business case around the formation of a **content** two-sided platform.

Pioneering work on the economics of two-sided platforms was done by Jean Rochet and Jean Tirole (Rochet and Tirole, 2002; 2003) who introduced the term "two-sided market". On a two-sided

platform the price level is the sum of the prices charged to the two sides and the price structure is the allocation of the price level between consumers on the two sides of the market (OECD, 2009). The most commonly accepted feature of a two-sided platform is its ability to affect the total welfare through changes in the price level and the price structure (Rochet and Tirole, 2003); in other words, a two-sided platform can affect the volume of transactions by charging one side and reducing, by the same amount, the price charged to the other side (Rochet and Tirole, 2003).

More inclusive approaches are found in Weyl (2009) who states that a two-sided markets is characterized by the importance (intensity) of the interdependencies between the two sides, or Evans (2003) who refers to the existence of "*two customer groups who benefit from interacting and for whom a platform can provide efficient intermediation services between the two groups*".(Evans, 2003)

Rochet and Tirole (2006) analyse non-neutrality of the pricing structure in a two-sided platform by considering its efficiency, associated transaction costs and the presence of externalities. They show that the fact that "*end-users cannot reach an efficient outcome through bargaining*" is a necessary but not a sufficient condition for the price structure to be non-neutral; in other words, even if the Coase theorem[2] fails, the price structure may be neutral. Existence of indirect network effects and the customers' impossibility of arbitraging the platform's price structure are also conditions for the platform to be able to set a non-neutral price structure. Evans et al. (2011) conclude that a platform implements a pricing structure to make use of indirect network effects while not being possible for customers to arbitrage their way around it.

The early work of Rochet and Tirole centers on transaction-sensitive platform charges also known as usage charges. Alternatively Armstrong (2006) studies a model in which a platform charges a fixed membership fee to consumers joining the platform. His model of two-sidedness involves two groups of agents interacting via a platform where the benefits of any one group from joining it depend on how many members of the other group join the platform. These cross-group externalities are interpreted in the following way: holding the platform's charged prices constant, the utility derived by one member of a group is higher with an increase in the number of members of the other group.

[2] The Coase Theorem asserts that regardless of the initial allocation of property rights and in the presence of externalities and no transactional costs, bargaining will lead to an efficient outcome.

Armstrong's work (2006) extends the analysis of monopolistic platforms to competition between platforms. He discusses three factors that determine the structure of prices offered to the two sides of a platform: 1. the relative size of cross-group externalities; 2. user charges as either membership (fixed) charge or usage charge, and 3. agents' preference for subscription to a single platform (single-homing) or multiple platforms (multi-homing). The paper examines conditions for platform profitability considering the monopoly case, competition between two platforms where customers choose to single-home, and a competitive bottleneck case where one side single-homes while the other multi-homes. His models only deal with a membership fee as it is argued that usage fees weaken the cross-externalities.

Rochet and Tirole (2006) extend Armstrong's (2006) work and consider a mixed model with membership and usage externalities and derive optimal pricing formulas. In general, it is concluded that optimal pricing follows the standard Lerner formula[3] with some reinterpretation needed, which is to consider the marginal cost c of the Lerner formula as an opportunity cost: when usage is priced on side 1, an additional transaction amounts a net cost of $c - p_2$ (less than the marginal cost) where p_2 is the price charged to the other side; when membership is priced, an extra consumer on one side raises the surplus on the other side by the membership fee b, which would allow the platform to raise its price on the other side.

Recent work by Weyl (2010) uses a monopolistic model that emphasizes the platform's ability to choose an allocation of users (the participation rate) and allows for use heterogeneity where previous papers did not. Although consumer heterogeneity is modeled by assuming a distribution function over the type of a consumer Weyl's results confirm and make apparent the difference between standard pricing in a multi-product environment and two-sided platform pricing: optimal social price equals marginal private cost less the marginal external benefit brought about by network effects.

The normative approach of the surveyed literature on optimal pricing under cross-network effects supports the analytical framework of this paper, in particular the pricing principle that guides the analysis of the paper's last section.

[3] The Lerner formula relates the price p, the marginal cost c of production and the price elasticity e_d of demand of a certain product as follows: $[(p - c)/p] = - 1/e_d$

3. Open Access and Network Neutrality

New Zealand's UFB is a n open-access, next-generation network. The International Telecommunication Union (ITU) defines a Next-Generation Network (NGN) as "*a packet-based network able to provide services including telecommunication services and able to make use of multiple broadband,* (Quality of Service) *QoS-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies*" (ITU, 2004). NGNs appear as a collection of networks that could support a flexible platform for service delivery (Chae-Sub and Knight, 2005). Unlike the public switched telecommunications networks, or PSTN, NGN's IP base enables the independency of protocol layers (upper and lower). One distinctive feature of NGNs is its predicted ability to combine the best of both worlds, the PSTN and the Internet, with high speeds and QoS (Chae-Sub and Knight, 2005).

A NGN can be regarded as a platform over which providers, whose ownership is not necessarily shared with that of the platform, meet users who seek to purchase communication services; thus, access to lower layer (infrastructure) services is essential to the success of any provider's business plan. Internet, for instance, can be regarded as an open platform for innovation, investment, job creation, economic growth, competition, and free expression by the public (FCC, 2010); while Internet Service Provider (ISPs), either independent, or owned by telephone companies or cable operators are not necessarily concerned with open access, innovators, end-user application developers, and the public in general understand the virtues of open access to Internet. The Internet was designed as an open network with "no gatekeepers over new content or services" (Cerf, 2000); its layered, end-to-end architecture places network intelligence at the edges rather than at the core. Such technical features are the sources of the wide range of services and innovative offers only possible by avoiding central control and by incentivizing innovation at the edges.

The 'open access' debate can be briefly described as conflicts between the private interests of broadband providers and the public's interest in a competitive innovation environment centered on the Internet (Wu, 2003). After several years of dispute between the claims of the ISP of a large U.S. cable TV operator and the Federal Communications Commission (FCC)[4], the latter, in December

[4] In 2007, the U.S. largest home ISP Comcast throttled traffic generated and managed by BitTorrent, a peer-to-peer Internet service. Comcast explained to the public that their decision would protect other subscribers from internet traffic

2010, released its "Open Internet Order" on the accepted practices that ISPs should follow (Moya, 2010). The order is based on four core principles: transparency of the network management practices; no blocking of non-harmful and lawful content and applications; no unreasonable discrimination while transferring non-harmful and lawful content and applications; and reasonable network management practices (FCC, 2010).

The open access principle supports the network neutrality mandate recently reasserted in different countries. The network neutrality principle proposes that no operator can discriminate against content or traffic that travels on its network or against particular websites and devices used to access the Internet. Recently, some countries have enshrined the network neutrality principle in their laws. In June 2011 The Netherlands was the first country in Europe to do so (BBC, 2011). Since then, for instance, ISPs in The Netherlands can charge "bit-hungry content" extra fees but have to inform customers about the reason for it; they cannot block Voice-over-IP or VoIP provider Skype or the free text application WhatsApp; they cannot inspect customers' traffic either. Although customers and content providers welcomed this law, Internet service providers such as T-Mobile and Vodafone Netherlands aired their disappointment (BBC, 2011). With an obviously broader view, the European Commission adopted a "wait-and-see" policy to watch the markets closely (EC, 2011). But in a straightforward conclusive document the Council of the EU calls on the member states to '*encourage the application of the principle of net neutrality*' and invites the Commission to actively monitor issues of traffic management, charges and conditions that mobile operators impose on VoIP users, throttling of content and applications, discrepancies between advertised and actual data rates, and sharing of costs of traffic between ISPs (EUC, 2011).

In New Zealand the Commerce Commission sees no issues with network neutrality (CoCo, 2012); furthermore, CFH's contractual terms on UFB operation favours its own version of open access because of its support of a competitive outcome, which has been thought of as both suitable and attractive to the industry and private-sector investors. Thus, CFH has made open access a key principle underlying the UFB initiative by asserting that "*services provided by a LFC should be offered to all access seekers on the same terms and conditions except where variations can be*

congestion. Although critics and the U.S. Federal Communications Commission (FCC) deemed Comcast's network management behavior as against the open access principles, in 2009 the U.S. Court of Appeals for the District of Columbia sided with Comcast in the long-running dispute over the ISP's ability to manage its network traffic.

objectively justified, even if the access seeker is a competitor or a downstream arm of a network competitor" (CFH, 2010). It also stated its own take on the open access principle: "*Open access is a key principle underlying the UFB initiative, and means that ultra-fast broadband must be made available to any service provider that seeks access to it on equal terms*" (CFH, 2011e), adding that LFCs must deal with the market in an equitable manner, and allow consumers to switch easily between providers (CFH, 2011e).

4. New Zealand's Ultra-Fast Broadband Initiative

As a small, remote country New Zealand's ability to remain competitive in a global marketplace is clearly linked to the quality of its telecommunications infrastructure in both urban and rural areas (CFH, 2010). Telecom New Zealand (Telecom NZ) is the dominating telecommunication infrastructure operator in New Zealand; it provides both telephony (fixed and wireless) and Internet service around urban and rural New Zealand. Competitors in the Internet access market provide broadband service via Telecom's own infrastructure and by reselling its wholesale products (Milner, 2009).

About two thirds of New Zealand's total exports are from the agriculture, horticulture and forestry sectors, all mostly produced in rural areas, in which approximately 14% of New Zealanders live and work. The latter makes the rural sector an important contributor to the New Zealand economy. Nevertheless, as the dominant broadband operator, Telecom NZ has built little fibre backhaul infrastructure in rural New Zealand, which in turn means that broadband capability in rural areas is limited in both coverage and performance capability. In 2005, the New Zealand government acknowledged the country was lagging behind most of the developed world in penetration, while warning that Telecom had not met its targets for broadband penetration and not delivered on its promises for FTTN building. All of above was further highlighted by New Zealand's 22nd place in the OECD broadband capability and penetration rankings and 35th place out of 66 countries in terms of broadband QoS) (Milner, 2009).

In 2008 the newly elected National Government stepped up its campaign initiative to provide high-speed broadband to New Zealanders. Consequently the government proposed the deployment of a countrywide fibre-optics infrastructure into New Zealand cities (Milner, 2009). Although the Commerce Commission warned that "*if New Zealand was to overcome the tyranny of distance from*

markets and transform its economy into a high skill, high earning, knowledge economy … a starting point would be reform of the telecommunications regulatory framework" (Milner, 2009) regulatory reform alone would not be enough to create the right conditions to ensure higher and sustained growth rates. If the telecommunications sector is to become an engine for growth, propelling the economy in the right desired direction would need a crafted mixture of monopoly profits and cost reduction, increased competition, incentives for new innovative services, and spurring infrastructure investment; all of the above is the origin of the UFB.

The purpose of the UFB project is to accelerate the roll-out of an access network, deploying optical fibre infrastructure (next-generation infrastructure) to 75 percent of New Zealanders by the end of 2019. The priority of this project is broadband users such as businesses, schools and health services, in addition to greenfield developments in particular residential areas (CFH, 2010). UFB aims to guarantee residential broadband services at a speed of 100 Mbps downstream (from the internet to the user) and 50 Mbps upstream (from the user to the internet), with higher speeds for priority users.

CFH has invested NZD $1.5 billion on the UFB and at least the same amount of money is expected from private investors. In late 2009, the Ministry of Economic Development (MED) prepared and issued an 'Invitation to Participate' (ITP) by which potential investors would submit their proposals on how they would co-invest with the government to achieve the UFB objective in one or more candidate areas.

Neither the NZ government, through its Minister for CIT, nor the newly created CFH have been keen on addressing the regulatory functions necessary for the efficient development of the UFB market. Their public reluctance to establishing any clear regulatory guideline marked the debate on what many future market players regarded as a necessary regulatory framework.

Following the path of the timid New Zealand approach to telecommunications regulation in the 1990s, an unsuccessful attempt to address regulation (or the lack of) of UFB was the October 2010 announcement by the Minister for CIT that the UFB market would face a 10-year 'regulatory holiday', in fact excluding the LFCs from the Telecommunications Act until 2020 (Labour, 2010). The government stated that the 10-year regulatory holiday was aimed to encouraging certainty for the LFCs and its investors on their green-field market investment. The CIT Minister Steven Joyce

staunchly defended the 10-year regulatory holiday saying "*without a regulatory holiday, UFB service providers would face significant uncertainty*" and "*there's no established best-practice in the telecommunications industry for rolling-out and regulating ultra-fast broadband networks, so it's a matter of doing what's best at the time, with reviews of the regulatory environment every few years*" (Watson, 2011).

Without a clear regulation of the UFB market, some network management practices might not be transparent, competition will not be encouraged and customers may face monopoly power. Those negative aspects are issues that the regulatory authorities are not keen on especially after the United States and European Union released regulations protecting network neutrality (Crocioni, 2011; FCC, 2010). On the other hand, strict price regulation in the initial period of UFB market business operation, for instance, could limit the ability of respondents to "*put their best foot forward*" (Power, 2011). The government is obviously protecting private investors' incentives since money is sought to complete the UFB network. Furthermore, in order to protect business competition the government has to strictly oversee the LFCs' network management practices to make sure that access to the UFB infrastructure remains open. Under pressure from many sector players and political opposition, on May 18th 2011, the Minister announced that the regulatory holiday would be removed from the Telecommunications Amendment Bill, announcing instead that contractual mechanisms would be used to replace the provisions "*if significant changes are made to price or other key features of the UFB regime over the build period*" (Techday, 2011). It is also expected that the Commerce Commission will fully oversee the new regime to make sure customers are getting value for their money (Hall, 2011).

After careful consideration of the UFB network business model, CFH determined that the two lowest layers of the network, that is the physical layer (Layer-1) and the wholesale service layer (Layer-2) are required to be provided in a non-discriminatory standard in the initial period - which ends on December 31st 2019 - and must be provided in a "equivalence and non-discriminatory" standard afterward (CFH, 2010). Non-discriminatory provision of Layer-1 and Layer-2 services means that given equally specified QoS for two different RSPs, they must be charged the same price. It is also essential that any differences in treatment do not harm competition (MED, 2009). The latter would ensure that the LFC does not give itself an unfair advantage (whether explicit or

implicit, direct or indirect) when both the LFC and its access seeker customers compete in the marketplace for the provision of Layer-2 services (MED, 2009).

5. UFB in the Making

Crown Fibre Holdings Ltd (CFH) was created by the NZ government through its Minister for Communications and Information Technology (CIT) to manage the investment on the UFB infrastructure. CFH oversees UFB network's construction and operation, but both the Minister and Treasury will have an on-going oversight and monitoring role of CFH (CFH, 2011c).

In 2010, 14 parties, among them, Alpine Energy Limited, Central North Island Fibre Consortium, and Northpower Limited were shortlisted as private investors (Alpine Energy Limited, 2010). The new public-private partnerships are known as Local Fibre Companies (LFCs). After the two final LFCs - Christchurch City Holdings Limited (through its fibre business Enable Networks) and Telecom Corporation of New Zealand Limited (through its Chorus business) – were announced in May 2011 the amount of private investment amounted to about $1.1 billion NZD (CFH, 2011b).

Thus, New Zealanders will have to deal with a regional LFC according to the location of their homes and business as follows: in the Whangarei region (north) regional LFC is Northpower Limited. In Hamilton, Tauranga, New Plymouth, Wanganui, Hawera and Tokoroa regions (central North Island), users will deal with Ultrafast Fibre Limited, whereas in Christchurch, Rolleston or Rangiora (east-central South Island), the LFC is Enable Networks Limited. All other towns and cities, comprising about 70% of the country, will be served by Chorus, a unit of Telecom Corporation of New Zealand Ltd.

In May 2011, CFH separately released two agreements with Enable Networks Limited (ENL) and Chorus on UFB delivery (CFH, 2011a; 2011d). The two agreements complemented two agreements that CFH had previously settled with two other partners. Agreements signed by CFH and partners state that "*CFH funds the cost of fibre 'passing'* ", that is, the connection running down the street, whereas the partner must fund each 'drop' (CFH, 2011a).

A regional LFC will provide wholesale Layer-2 services to RSPs but will not be allowed to be or operate a RSP. For instance, the negotiation process between CFH and Telecom has ended in Telecom committing to divest into two completely independent operators: Chorus, a provider of

wholesale communication services and the retail operator Telecom (Telecom, 2011a). Chorus will be a nationwide access network operator that will offer services to RSPs on an open access basis, whereas Telecom will be a retail-focused telecommunications business comprising fixed-line, mobile and other ICT services (Telecom, 2011a). Chorus will deliver wholesale Layer-2 service to interested RSPs in New Zealand in a non-discriminated manner so that they can compete fairly with Telecom (Telecom, 2011b).

The open access requirement imposes a commercial model of service provision in which any service provider can reach any end-user (TCF, 2011). A simplified view of such services is adopted by CFH when calling such inputs the "building blocks" for commercialization of UFB end products, grouping them as downstream bandwidth, upstream bandwidth and Committed Information Rate[5], CIR (CFH, 2011b).

As a result of negotiations between FCH and the LFCs, the latter have posted price lists for wholesale service prices; the prices are on a "per customer per month" basis. By regulation a LFC will not be allowed to charge more than the specified monthly price when its client RSP signs up a new customer. Table 1 displays the caps that CHF and its partners have agreed on for entry level broadband connection, high-definition video, and entry level business service prices.

Product	**Downstream/Upstream data rates**	**2011 CCPM*** **(NZD)**	**2019 CCPM*** **(NZD)**
Basic Voice Channel	Greenfields or LFC-discretional	25.00	25.00
GPON Residential Entry	30Mbps/10 Mbps	37.50	42.50
GPON Residential Triple-Play	30Mbps/10 Mbps	41.25	46.25
GPON Business Entry	30Mbps/10 Mbps	49.95	49.95
GPON Triple-Play	100Mbps/50 Mbps	55.00	49.90
GPON 100/100	100Mbps/100 Mbps	175.00	175.00
HD Video Channel	10 Mbps for multicast video	5.00	5.00

Table 1. Products and prices for home/retail customers in the CFH-Chorus agreement.

(*) CCPM: Customer charges per month. Source: (CFH, 2011b)

Two product (Residential Entry and Triple-Play) charges will see a constant marginal increase per year during the first 9 years, whereas the rest will either be kept or see some decrease as is the case of Triple-Play 100/50.

[5] As stated in the agreements: "*CIR is a guaranteed minimum rate of data transfer for priority traffic. EIR, or Excess Information Rate, is the accepted rate of data transfer for low priority traffic.*" (CFH, 2011d)

Table 2 displays wholesale monthly prices for business products, whereas Table 3 displays Layer-2 service prices for schools, one of the groups considered as priority by CFH. P2P access products provide no QoS assurance, that is, their CIR is 0/0 and their caps will remain unchanged until 2019; all school access products are QoS-assured with a 10Mps/10Mps CIR.

Product	**Downstream/Upstream data rates**	**2011 CCPM (NZD)**
P2P Dark fibre	NA	355.00
P2P Layer 2 100 Mbps	100Mbps/100Mbps	380.00
P2P Layer 2 1 Gbps	1Gbps/1Gbps	455.00
P2P Layer 2 10 Gbps	10Gbps/10Gbps	1355.00

Table 2. Products and prices for businesses.

(*) CCPM: Customer charges per month. Source: (CFH, 2011b)

GPON[#]	**Downstream/Upstream data rates**	**2011 CCPM[*] (NZD)**	**2019 CCPM[*] (NZD)**
Education GPON 30/30	30Mbps/30Mbps	50.00	50.00
Education GPON 50/50	50Mbps/50Mbps	58.00	58.00
Education GPON 100/100	100Mbps/100Mbps	150.00	105.00
P2P			
Edu-P2P 1	100Mbps/100Mbps	275.00	210.00
Edu-P2P 2	1Gbps/1Gbps	330.00	265.00

Table 3. Products and prices for schools.

([#]) Gigabit Passive Optical Network, a network architecture that brings fiber to the premises by means of a point-to-multipoint scheme that enables a single optical fiber to serve multiple premises.

(*) CCPM: Customer charges per month. Source: (CFH, 2011b)

Consumers in any region will have access to UFB network at no charge from their LFC; in fact CFH has stated in its agreements with the LFC that "*Except in exceptional circumstances there will be no one-off wholesale connection charge for residential consumers to connect to UFB at a wholesale level*." (CFH, 2011). LFCs will sell Layer-2 services to RSPs, charging them – at regulated wholesale prices - for wholesale services used in the delivery of end-user (retail) services. Once a RSP purchases Layer-2 access, it can release its own products to end users most likely based on a triple play (Internet access, VoIP, IPTV) offer. LFCs are not allowed to trade with end-users directly but only provide wholesale access to RSPs who in turn will serve end-users (CFH, 2011)[6].

[6] CFH's agreement with Chorus states that "*Chorus will contract with RSPs who can then provide services to end users. As per the open access requirements, Chorus will operate only at the wholesale level - it will not sell services*

The extent of regulations on QoS is found in CFH's release of the Whosale Service Agreement (WSA) (CFH, 2011c). The WSA refers to a Primary Service Provider (PSP) as a provider of a residential service - a bitstream service provided to residential end-users or to resellers - that uses a UFB Standard Wholesale Service as an input. The latter corresponds to a service that meets or exceeds the minimum standard for the residential wholesale service (30Mbps downstream, 10 Mbps upstream with 2.5 Mbps CIR). Any provider, Primary or not, is responsible for all interactions with resellers and end users (including provisioning, billing, customer services, contact with the police and other government authorities, fault reporting and dispute management) (CFH, 2011c); in particular if the provider delivers voice services it must provide voice at an "acceptable quality" (clause 9.4; CFH, 2011c), which means that "*the Service Provider's network is to add no more than 40 ms of delay, including any trans-coding delay, and 10 ms of delay variation between an Interconnection Point and the point at which voice calls are handed over to other carrier networks*". As hearings and conversations proceed between CFH and its partners in the LFCs, and the parties interested in becoming RSPs, it remains an open question what the landscape for QoS will be in the UFB market.

6. A two-layer open-access 2-platform broadband market

The UFB markets can then be understood as the interaction of two basic markets: the access market and the content market. The ensuing analysis adopts a more generic language that uses the term "Access Platform" to refer to a business model that attracts two sides to connect to an open-access, broadband infrastructure, "Service Provider" to refer to a provider that purchases wholesale services from the access platform, and "Content Platform" to a service provider that builds its business plan as a platform.

Figure 1 illustrates the components of the access and content markets with Access Platform (AP) as the market structure the infrastructure builder has set up to attract Service Providers (SP) and end-users, and Content Platform (CP) as the market structure used for the delivery of retail services to end-users. Figure 1 also illustrates how the AP faces competition from competitive access providers that either offer ADSL or FTTP connections. By design, AP is not allowed to provide services to

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directly to end users. In turn, RSPs may use wholesale products from Chorus and the Local Fibre Companies to create retail UFB-based services which are sold to residents, businesses, schools and health premises." (CFH, 2011b)

end-users but a competitive access provider is not restricted from doing so; therefore some degree of vertical integration on the competitive access provider's side may be expected in response to the vertically separated structure of the AP network. Figure 1 also portraits a SP as an access purchaser from the AP; any SP can be regarded as a platform, the CP that attracts end-users on one side and service/content providers on the other.

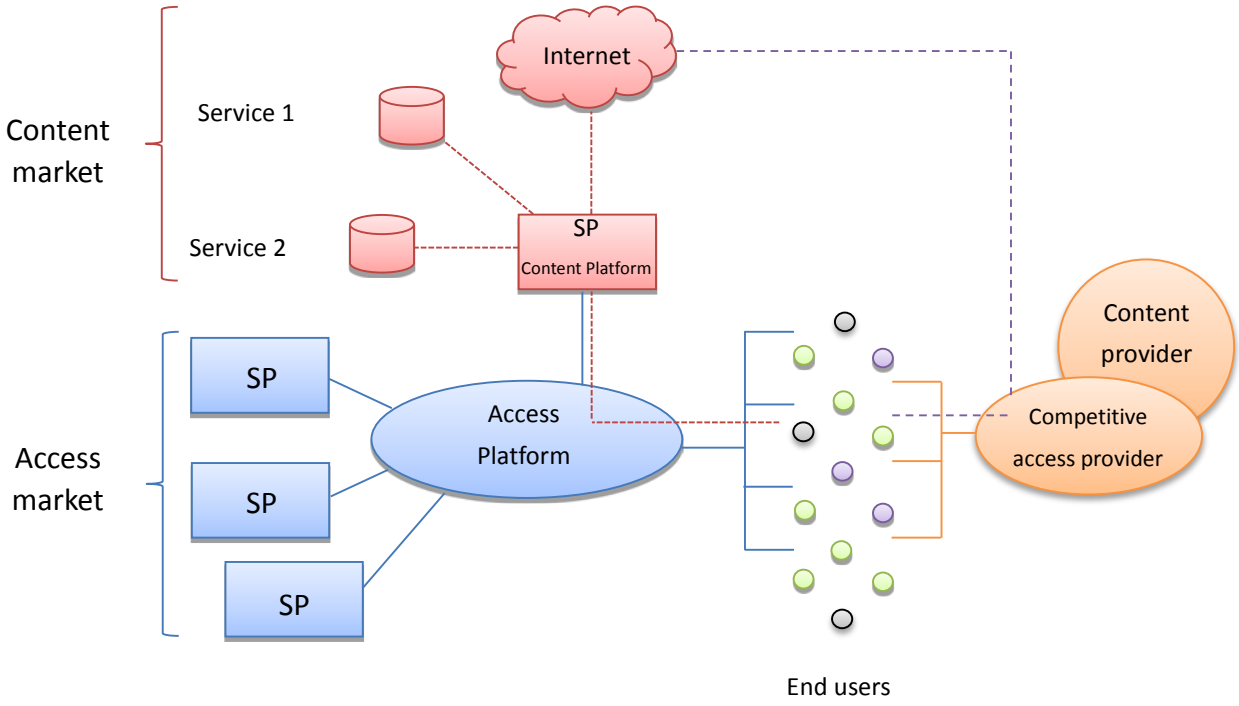

Figure 1. Schematic representation of access and content markets on an open access broadband network

Access markets: the access market operates on the AP where consumers pay no fees to join and SPs must pay regulated wholesale charges according to the demand they face[7].

Content market: the content market is a multi-platform competitive market where that operates through the content and service offers each SP brings to the market. Any SP may be a *de facto* CP if its business model is built around becoming a platform for other, content-based businesses to reach the end-users. Different business models may find themselves competing on the AP as Section 7 of this paper explains. Specialized preferences or particular consumption needs may see users purchasing

[7] For instance, in New Zealand a retail service provider will be charged NZD $41.25 per month for each GPON Residential Triple Play 30/10 connection it needs to purchase to provide one of its customers with a triple-play service. As with any other listed price, $41,25 is a cap on the maximum price LFC can charge the provider for such service.

services from alternative providers who may tailor their offer to special market niches.

Following is a discussion on the degree at which the two-sided paradigm may result appropriate and use results previously presented in (Armstrong, 2006) and (Rochet and Tirole, 2006) to shed some light on the optimality of pricing decisions either already made on the wholesale access market or to be made when a service providers establish themselves as content platforms.

6.1. The access market

In Figure 1 AP models the open-access broadband network. End-users are either residential, R, or business, B; residential end-users are charged no fees for connecting to the AP. SPs make up the other side of the market. AP is a monopoly that allows end-users to get access to the network and SPs to purchase Layer-2 services at regulated wholesale prices.

The access market is a prerequisite to the existence of a content market; end-users must be given a 'drop' of the fibre network so that they can get connected. On the AP end-users seek connection whereas SPs seek to use its Layer-2 services. When pubic funds are used to build the broadband infrastructure and as a form of incentivizing its uptake, the platform is not allowed to charge residential users for access. The price structure has been set in a way that the AP charges end-users no fees, while charging regulated, wholesale prices to SPs; wholesale prices are sold on the basis of individual connections so it is up to the number of signed up users by the SP the extent to which the platform will obtain revenues on the retailer side of the market. Prices charged to SPs for accessing wholesale services are part of agreements between the government agency and its private partners.

Assuming that N SPs connect to the platform any SP's business plan needs to estimate how many R-type users (residential) and how many B-type users (business) it will serve. For instance, SP1 could use typical wholesale services in the delivery of services to each user type; therefore, assuming that p_R and p_B are respective wholesale prices for services used as inputs in the delivery of end-user services, n^1_R and n^1_B the number of respective R-type and B-type users that SP1 estimates will sign up, SP1's revenue is:

$$I = n_R^1 p_R + n_B^1 p_B \qquad (1)$$

In other words I is the amount SP1 will pay platform A.

Denoting u_R the utility an R-type user derives from joining the platform, with respective u_B the utility for an B-type user, and α_R and α_B being respective measures of the benefit that an R-type user and a B-user enjoy from interacting with members of the other side of the platform, then

$$u_R = \alpha_R n - P_R \quad ; \quad u_B = \alpha_B n - P_B \qquad (2)$$

whereas the utility of SP1 can be represented as

$$u = \alpha[N_R + N_B] - \tilde{p} \qquad (3)$$

Here $\tilde{p}, P_R$ and P_B are the prices paid for by SP1, residential and businesses users, respectively, and α is the benefit derived by the SP from its interacting with the end-users on the other side. Even though end-user connection price is zero, it will be convenient to let user prices explicitly show in the utility functions all through the following analysis.

The number of end-users can be specified as a function of their utilities by using increasing functions $\phi_R(u_R)$ and $\phi_B(u_B)$ that represent the numbers (of R-types and B-types respectively) joining the platform; therefore

$$N_R = \phi_R(u_R) \quad ; \quad N_B = \phi_B(u_B) \qquad (4)$$

The same can be done for the SP-side of the platform:

$$n = \phi(u) \qquad (5)$$

If platform A incurs per-agent costs f_R, f_B and f to subscribe a residential user, a business and a SP, respectively, then the platform's profit function $\pi(\,)$ can be written as follows:

$$\pi(u_R, u_B, u) = N_R(\alpha_R n - u_R - f_R) + N_B(\alpha_B n - u_B - f_B) + n(p - f)$$

Using expressions (2), (3), (4) and (5), as in Armstrong (2006), we can restate the profit function as

$$\pi(u_R, u_B, u) = \phi_R(u_R)(\alpha_R \phi(u) - u - f_R) + \phi_B(u_B)(\alpha_B \phi(u) - u_B - f_B) + \phi(u)(\alpha_R(\phi_R(u_R) + \phi_R(u_R)) - u - f)$$

If the platform is profit-maximising then, using the fact that residential user price P_R is zero, first order conditions imply that price $\tilde{p}$ imposed to SP by the platform must satisfy,

$$\tilde{p} = f - \alpha_B N_B + \frac{\phi(u)}{\phi'(u)} \qquad (6)$$

As stated in Armstrong (2006) equation (6) can be expressed in the typical "markup over marginal cost pricing" form as in the Lerner index. In fact, defining $\eta(\tilde{p}|N_B) = \frac{\phi'(u)}{\phi(u)}\tilde{p}$ (6) can be rewritten as

$$\frac{\tilde{p} - (f - \alpha_B N_B)}{\tilde{p}} = -\frac{1}{\eta(\tilde{p}|N_B)}$$

where $\eta(\tilde{p}|N_B)$ denotes the SP's price elasticity of demand for a given level of participation of business users. The results above shows that when residential users are benefited with zero connection fee, if demand is elastic (or high $(\tilde{p}|N_B)$, which means that the SP's willingness to participate in the UFB can stand potential raises in the wholesale prices) the cost of connecting the SP to the network may be subsidized by the presence of business users on the other side. Such subsidy situation would also happen if the external benefits derived by business users are high. This results is built upon equating the AP's revenue, $R = n_R^1 p_R + n_B^1 p_B$, with the interpreted price $\tilde{p}$, which becomes a direct function of the wholesale prices p_R and p_B, and the demand levels n_R and n_B.

6.2. The content market

This section describes the main aspects of the content market. Then it makes a case for regarding a SP as a two-sided platform.

The content market operates with one or more SPs, which can be modeled as two-sided platforms, noted as CP in Figure 1. SPs allow end-users to purchase voice, video and data services; the SP may be a provider, an aggregator or a CP for the delivery of services. Any SP seeks to operate on the AP as the latter offers access to business and residential users using Layer-2 services.

SPs are largely responsible for the delivery of services to end-users; such services operate on the higher layers of the network hierarchy and are supported by Layer-1 (dark fiber) and Layer-2[8].

SPs are not expected to produce each service themselves. They can, for instance, aggregate video-on-demand or live TV channels and packetize them in bundles, so acting as a TV service provider; alternatively a SP may just be the platform on which several IPTV providers compete for viewers. A SP may also be the conduct for purchasing voice services as when the provider offers telephone access to telephone services provided by a third party, but it can also become a telephone

[8] For instance, as defined by the Metro Ethernet Forum.

provider itself. Being the only point of reselling Layer-2 services, the SPs' strategic business plan may become quite convoluted.

Consequently, several interesting questions pertaining RSPs' business strategies and consumer decisions arise: on one hand a SPs may resort to different service delivery and pricing strategies to compete in the content market; on the other, consumers face several decision problems: they may purchase SPs services as a bundle from a single SP or they can purchase individual services or other combinations from several, distinct SPs. The consumer problem becomes even more challenging as she can also decide to use her Internet access to purchase non-quality assured or best-effort services which would substitute to some degree for the SPs' QoS-assured voice and video services.

7. How UFB markets will unfold

The model of an open-access platform described in the previous sections and the technological components and analytical tools presented thus far provide the ground to explore the economics of the markets to be developed over the New Zealand's own UFB network. Understanding access and content as two separate, yet complementary aspects of the UFB markets is convenient to the kind of results presented in this section. The existence of cross-networks effects in the adoption (access) of network connection and the analysis of their effect on the LFC platform access decision by end-users reveal the welfare-promoting role of CFH's decision not to charge any connection fee to residential users. Cross-network effects on the content market over a service platform - of the kind a RSP may become – provide also the economic rationale for potential regulatory decisions. The latter two aspects are further studied in this section.

A groups of World Bank economists introduced the "broadband ecosystem[9]" concept (Kelly et al., 2009)to refer to the set of actors involved in the access market to network and services and their relationships. As the study also asserts "*defining broadband to include both the supply and demand sides of the market also leads to a rethinking of approaches to spur broadband access and use*" (Kim et al., 2010). Broadband government initiatives need to strongly support themselves on the design of investment incentives and the promotion of broadband use (Gómez-Torres and Beltrán, 2011) besides stating a clear vision of broadband network infrastructure for their country. In an open access

[9] In Kelly et al. (2009, page 3) broadband ecosystem is defined as "*a multilayered system of interconnected high-capcity communications networks, bandwidth-intensive services, applications, and users*"

broadband network such as the UFB, CFH is certainly creating an enabling environment for supply-side growth *in terms of the access to the network* (Kim, Kelly & Raja, 2010) as it was decided that LFCs would impose no connection charges to residential users. Thus, the result derived from the access market model of section 6.1 which states that when residential users are benefited with zero connection fee the optimal price charged to a RSP is subsidized by the presence of business users on the other side (if the price elasticity of demand by the RSP for a given a level of participation by business users is high) supports the zero connection fee policy. Given that the model treats the platform as a profit-maximizer – even though CFH policy predicament is that LFC are not commercially driven entities at least in the period before 2019 – the result can be interpreted as one that identifies at least one incentive for CHF's commercial partners.

Other concerns are raised by the content markets. Thus it will be helpful to view a RSP as one of the following types according to the taxonomy proposed here. Considering the degree of supply chain integration and with markets transitioning towards full use of the open access, multilayered broadband capabilities of UFB, an account of the ecology of RSPs should include the following types of players:

1. An integrated Triple-Play provider: a service provider that provides Internet access, VoIP and IPTV in a single offer usually known as Triple-Play. The provider aggregates and possibly operates all services; consequently in addition to its roles of ISP, the provider is a VoIP operator and an IPTV provider.
2. An evolving ISP providing Internet access plus VoIP. This happens when an ISP extends its offer to telephone services.
3. Open access platform: the RSP becomes a platform for the competitive, open provision of Internet access, VoIP and IPTV.

Following Weyl (2009), features of a RSP are suitable to an analysis that treats the firm as a two-sided platform; in fact some aspects of it can be captured with a model of two-sidedness as stated by Weyl (*footnote 2*, 2009). In the first place a RSP is a multi-product firm. It serves at least two sides of a market which is built on a platform where end-users (residential and business) and content and service providers meet. The RSP clearly has the capacity and incentives to charge

different prices on both sides. Furthermore, cross-networks effects emerge as the RSPs sign up content providers which may enhance the service portfolio for end-users. When the RSP mediates between users and content and service providers the RSP is a platform that serves at least two sides. Of course there are services that a RSP would deliver itself such as VoIP, to name one. RSPs then might behave as platforms whereby cross network effects would determine the strength of the market for certain services or as a provider that integrates the delivery of a specific service. Lastly, RSPs will contend for customers by setting prices for their services which will tend to be sold as bundles. Product differentiation and economies of scale will allow RSPs to develop some level of market power.

The types of Retail Service Providers discussed above offer many possible scenarios for analysis. A plausible scenario in which an integrated provider faces a group of smaller providers is now studied. The market scenario chosen here for analysis illustrates the existence of two different types of platforms: a one-sided, integrated provider (type 1) and a competitive, open-access platform (type 3); the former is a single player and the latter is represented by several competing providers[10].

The fundamental question is how competition for consumers will unfold in an environment in which an integrated operator competes with a group of smaller two-sided platforms that provide partially substitutive offers to the provider's own bundles. Reinterpreting Evans and Schmalensee (2008), when end-users and content providers cannot resolve the externalities themselves the provider's role is akin to a two-sided market whereas the larger operator may have the ability to internalize the network effects via integration of service and access provision. As long as the integrated operator is able to select output at which marginal revenue equals marginal cost, it will be able to determine profit-maximizing prices (Evans and Schmanlensee, 2008). The situation for competitive two-sided platforms becomes more complex as each will have to set prices that depend on the price sensitivity of demand on both sides: operators and end-users and the nature and

[10] In New Zealand, as of mid-2012, UltraFastBroadband Ltd., the second largest LFC has signed up 18 RSPs; North Power Fibre, the smallest LFC, has signed up 12 RSPs, whereas Chorus listed 57 RSPs in its register and Enable networks counts on 22 RSPs. These figures show the interest of a substantial number of parties to become RSPs. In any case and in all regions, small RSPs, which are make up most of the RSP ecology will face competition the largest communications company in the country: Telecom.

intensity of cross-network effects (Evans and Schmanlensee, 2008).

The question that takes central place in this analysis is the degree at which cross-network effects are present; Internet access illustrates the best example of cross-network effects: end-users seek access to Internet because of the many contents and services found on the other side. Such effects are certainly present in the Internet access market served by the large, integrated provider as long as it does not set a walled garden for access to Internet. End-users are assumed to only choose one platform to subscribe to: be it any of the competitive two-sided platforms or be it the integrated operator; but new content and service providers on the other hand, are expected to choose to connect to all platforms; in other words new content and service providers will find it necessary to multi-home. Finally, competition will most likely force competing platforms to differentiate their offers either pricewise or by providing differential QoS.

Optimal price formation in inter-platform competition may be studied by using Armstrong's "competitive bottleneck" model (Armstrong, 2006), in which two two-sided platforms compete in the market. Being a common practice for providers, multi-homing assumes that content and service providers find it more beneficial to reach a larger number of end-users than their cost of connecting to more than one platform. Therefore competitive platforms compete for end-users, not for content providers. The competitive bottleneck can be illustrated with a two-stage process by which end-users self-select either as subscribers of a triple-play service or as subscribers to individual services that they aggregate themselves; in the second stage there is competition between the two platforms for users. This situation can be interpreted as in Armstrong (2006): assuming that equilibrium is reached the competitive bottleneck model asserts that in any equilibrium the number of content providers on a two-sided platform is chosen to maximize the joint surplus of the platform and the end-users. As Armstrong says, "*the interests of group 2* (that is, the content providers) *are ignored*". In fact each platform holds monopoly power in the market for multi-homing. The theoretical result above suggests that by keeping prices high on the content provider side the platform might transfer its monopoly rents to the end-users in order to attract more (marginal) subscribers.

8. Conclusions

New Zealand's UFB is particular in its approach to accelerating the deployment of broadband

access to its citizens; alongside with Australia the two countries have embarked on public-private partnerships to build national broadband networks whose operators are not allowed to provide services to end-users, whereas third parties, known as retail providers can purchase wholesale, low-layer services as inputs to provide end-users with broadband-based communications services.

The main findings of this paper can be summarized as follows. End-users benefit from the presence of service providers in such open-access, broadband platform; the benefit is larger the more companies sign up as retail service providers. The platform offers connections for end-users and wholesale Layer-2 services for service provider, so allowing providers to meet end-users who expect to purchase from them a range of communication services. Policy has dictated that in the open access, broadband network known as UFB, users pay no fees to get connected to the platform. As service providers see value in signing up as retailers, cross network effects become evident as end-users benefit from the presence of more retailers and providers benefit from reaching a larger set of residential and business users.

In an open-access broadband ecosystem, when a zero-connection fee is instated for residential users, a profit-maximizing platform would find that the cost of connecting a retail provider is subsidized by the benefits business obtain from the presence of retail providers on the other side, if such benefit is high enough. Early policy and regulatory decisions regarding pricing for access seem to be justified by the two-level, platform approach adopted in this paper; also, two-sided platform pricing theory is helpful in analyzing one plausible competition scenario to develop in the UFB.

Retail service providers will compete by adopting various and, hopefully innovating, business models; they can bundle upstream content providers' outputs, or enter partnerships to provide contents, or attempt to specialize on particular type of services. The deployment of the network will take several years but already providers are signaling the type of provider they will become. Investigating how competition would unfold at the retail level when different business models compete for customers seems to be a promising direction for future research.

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