

Ultra-fast Broadband

The New Zealand Experience

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Abstract: This paper outlines the key learnings from the first decade of the Ultra-fast Broadband (UFB) and its associated Rural Broadband initiatives (RBI) in New Zealand. The UFB initiative provides the opportunity for 87% of New Zealand premises to have access to broadband using Fibre to the Premises (FTTP) technology. The remaining 13% of premises have access to enhanced wireless broadband. These initiatives are due for completion by year end 2023 and are showing promising results as at the end of 2019.

The success of these initiatives has not been achieved without a lot of challenges along the journey. However, as it is shown in the paper, the alignment of policy around broadband development across government and the establishment of a set of policy objectives and principles at the outset has enabled the initiatives to stay on track over time, relative to the original intentions. The establishment of these policy principles and the strict adherence to these principles throughout the execution of the initiatives has been the most significant learning from this substantial programme of telecommunications development in New Zealand.

Keywords: Ultra-fast Broadband, FTTP, Rural Broadband Initiative, NZ public policy

Introduction

At the 2008 elections in New Zealand, the leader of the National Party ([Key, 2008](#)) promised to improve the broadband services available to all New Zealanders through the introduction of a government-led Ultra-fast Broadband (UFB) initiative. The initiative was launched in late 2009, through a government-owned company called Crown Fibre Holdingsⁱ (CFH, www.crownfibre.govt.nz). The initial UFB deployment to 75% of New Zealand urban premises was to be completed by 31 December 2019, with a government funding contribution of NZD 1.5B. Looking back from early 2020, the initiative established in 2009 has achieved its

goals and has been subsequently expanded to encompass the provision of improved broadband services to over 99% of New Zealand premises by YE2023.

The establishment of the Ultra-fast Broadband (UFB) initiative in New Zealand is discussed in a 2009 paper published in the *Telecommunications Journal of Australia* ([Milner, 2009](#)) and early progress is described in a 2013 paper published in the same *Journal* ([MacMahon & Milner, 2013](#)). These papers provide an excellent background to the initiative, describe the essential parameters under which the initiative was established, and the progress made in the first few years. This paper will build on the foundation provided in these papers and identify the results that have been achieved through to the end of 2019. In particular, the focus will be on the identification of the key learnings that have evolved through the 10 years of execution of this substantial programme of investment in broadband telecommunications infrastructure for New Zealand.

Policy Alignment

Since the mid-2000s in New Zealand, the governments of the day have been reasonably well aligned regarding their policy objectives with respect to the delivery of broadband into the New Zealand market. This alignment really becomes apparent following the Telecommunications Stocktake undertaken by a Labour government in 2006 ([Cabinet Policy Committee, 2006](#)). This stocktake led to the Operational Separation of Telecom New Zealand ([Telecom, 2008](#)) and the requirement for the Wholesale arm of the business (called Chorus) to offer broadband services on a non-discriminatory basis to both the Retail arm of Telecom New Zealand and all other Service Providers within the New Zealand market on equitable terms. In addition, there was a requirement for Chorus to rollout Very High-Speed Digital Subscriber Loop (VDSL) technology from street-side cabinets fed by fibre optic technology (referred to as Fibre to the Node (FTTN)). The FTTN was to enable enhanced broadband service for at least 80% of all premises in New Zealand by 31 December 2011. This outcome was achieved but was subsequently overtaken by the Ultra-fast Broadband initiative established by the National Party in 2009. This substantial enhancement to broadband development in New Zealand was largely seen as a positive step by the then opposition parties. It should also be noted, though, that leading up to this decision there were a variety of alternative approaches explored by various commentators ([InternetNZ, 2008](#)).

The UFB initiative was managed on behalf of the National government through a Crown-owned company called Crown Fibre Holdings (CFH), which was constituted in late 2009. This company operated under a set of Policies and Principles agreed with government (see below) and executed a commercial tender process to select Partners to deliver the UFB under a Public Private Partnership (PPP) model ([MED, 2009](#)). An analysis of this model has been undertaken

more recently to determine how the approach applied to the UFB compares with other PPP models (e.g. for roading) applied in the New Zealand environment ([Howell & Sadowski, 2018](#)).

One of the key requirements for parties to become Partners was that they must not be majority owned by a Retail Service Provider (RSP) operating in the New Zealand market. Hence, for Telecom New Zealand to participate in the UFB initiative, it elected to Structurally Separate in 2011, with the resulting Wholesale Service Provider (WSP) retaining the Chorus name, and the RSP being renamed as Spark. This Structural Separation was implemented under a National government, with support from the then opposition Labour party.

The UFB initiative was successfully implemented over the next decade, notwithstanding several substantial challenges (identified below). In late 2017, a Labour-led Coalition party became the government of New Zealand following a National Election. Due to the policy alignment on broadband matters, the UFB rollout continued unabated through this political transition. In fact, the extensions to the UFB and the related Rural Broadband (RBI) and Mobile Blackspot Fund (MBSF) initiatives, commenced under the National government in 2016, were encouraged and enhanced during 2018 and 2019 under the Labour-led Coalition. It was also this government that celebrated the completion of the original UFB initiative on 20 November 2019 with a Parliamentary function.

UFB Policy Principles

The key policy principles behind the New Zealand government investment in the UFB initiative were as follows:

- The government would only invest in wholesale-only, open-access, common infrastructure, which under the UFB is best described as common fibre access infrastructureⁱⁱ (CFAI) – this is the investment component which was considered to be highest risk for commercial entities (see UFB Economics below);
- The CFAI within any designated geographic area (defined as a Candidate Area (CA)) would be delivered by a single WSP on a monopoly basis and the designated WSP must pass all premises (public, business and residential) within the designated area;
- The CFAI delivered by a given WSP must be made available on an equitable basis to any RSP who wishes to deliver a fibre-based broadband service to any premises or special entityⁱⁱⁱ passed by the common infrastructure;
- Any RSP participating in the UFB must not have a majority ownership in any WSP, in order to avoid any discriminatory behaviour in the market;

- Any existing access infrastructure within a Candidate Area, whether copper, fibre or wireless, could continue to operate in a manner like that which existed prior to the initiative being implemented (i.e. existing vertically integrated access service providers could compete with the WSP within the Candidate Area for the provision of broadband service to customers within that Candidate Area);
- The CFAI would be terminated at designated Points of Interconnect (POIs) associated with each geographic area covered by any WSP, typically resulting in two POIs per CA, to ensure diversity for robustness;
- The government would fund the WSPs for each premises passed up to a Cost per Premises Passed (CPPP) cap, which was agreed by competitive tender for each CA;
- The government funding was to be contributed either as equity in a PPP of which CFH was the public party and the WSP the private party, or as interest-free debt where the PPP was not an applicable instrument – in either case the government investment was capped by the CPPP figure multiplied by the number of premises located within a designated CA;
- The wholesale price for a reference set of wholesale broadband products was to be established at the commencement of the initiative and committed by contract with the WSPs – these prices would remain in force until a Regulatory Review scheduled for post 2020;
- The WSPs would be committed to comply with a set of contractual obligations to ensure that service levels involving delivery of the CFAI and the connection of customers to the CFAI were achieved in a timely and quality manner, with penalties for poor performance.

All these principles were implemented and enforced through active engagement by CFH throughout the deployment tenure. A robust review of these principles and the outcomes they have driven was undertaken by Webb, Toner & Cox in 2014 ([Webb, Toner & Cox, 2014](#)). Their conclusion was that the outcome has been largely successful.

UFB1 Economics

The economics of delivering the UFB across New Zealand has been front and centre of the initiative, even before it was first officially announced in 2008. The Treasury and the Ministry of Economic Development (as it was in 2008) had undertaken extensive economic modelling to determine the most cost-effective approach for the delivery of UFB. It was recognised that implementing Fibre to the Premises (FTTP) technology universally across New Zealand would be an economic disaster. Instead, it was determined that an economic modelling exercise

would determine a cap on the government investment in this technology. This would by definition mean that not all New Zealanders would receive broadband via this technology and other means would need to be identified to address the obvious gap that would remain. However, the provision of FTTP to most New Zealand premises was expected to deliver a sound benefit for the New Zealand economy (NZI, 2007).

The Treasury recognised that the commercial risk in the deployment of FTTP only applied to the deployment of the Common Fibre Access Infrastructure (CFAI), which needs to be deployed ahead of any connections to customers. This is the provision of fibre optic infrastructure from a central distribution point past each of the premises within a designated geographic area. It is the uncertainty of the uptake by customers to use the investment in CFAI that makes the commercial risk exceedingly high. As customers are connected to the CFAI, then the cost of each connection becomes much lower risk, as each connection comes with a known revenue stream. Hence the Government was adamant that any government investment in UFB should only apply to the CFAI costs and not to any connection costs.

Furthermore, it was recognised that over time the Service Providers would be able to recoup the investment in both the CFAI and the customer connections, but that the risk around the time to recoup the CFAI investment was highly uncertain and hence commercially risky. Thus, the government was keen for their investment to be more of an interest-free loan rather than a pure grant. This meant that there would be an expectation that, if the initiative was commercially successful over time, then the government would receive its investment back, less the time cost of money.

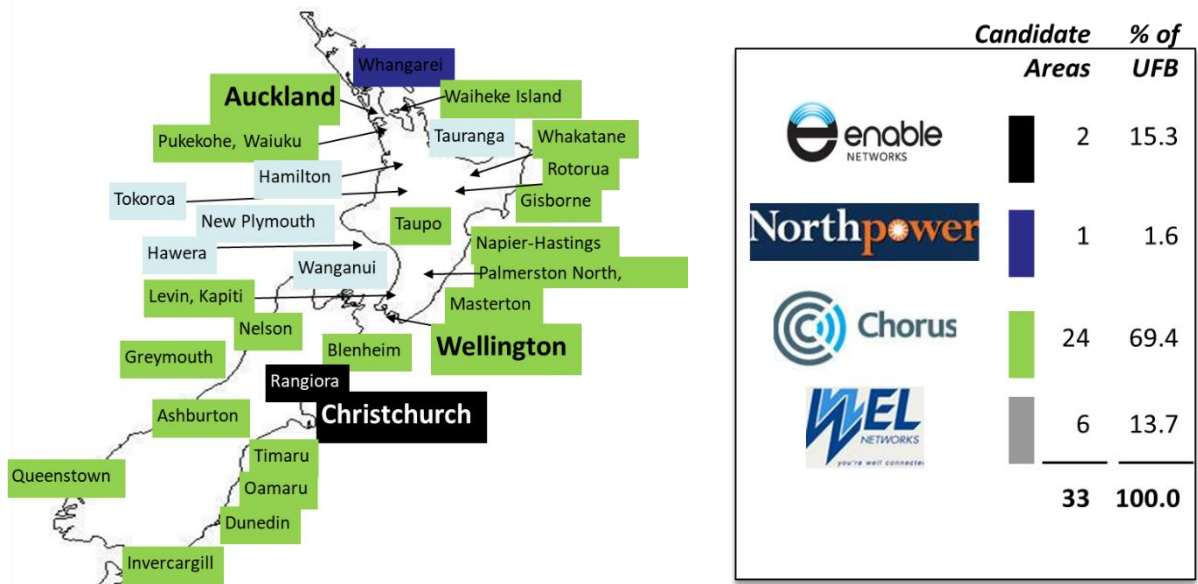


Figure 1. The result of the competitive tender process for the selection of Partners to undertake UFB deployment in 33 Candidate Areas (Source: CFH).

The modelling undertaken before the initiative was officially announced showed that around 75% of premises in New Zealand have an average frontage of around 20 m and that these premises could be passed by fibre optic technology at a reasonable cost. Furthermore, the modelling showed that, with the appropriate use of both aerial and underground fibre technologies, this proportion of premises could be passed at a cost of around NZD 1500 per passing. As 75% of premises in New Zealand represents around 1 million premises, then the initiative was dimensioned at NZD 1.5B of government contribution. The Cost per Premises Passed (CPPP) cap was set at a nominal NZD 1500, with the actual figure to be determined through the tender process related to the designated Candidate Areas which make up the 75% of coverage.

In order to achieve the parameters identified above, the 75% of premises needed to be all within urban boundaries. Through further geographic modelling, this defined a total of 33 urban areas which enabled the 20 m average frontage to be achieved. These 33 urban areas were defined to be the Candidate Areas (CAs) for the initiative. CFH then managed a competitive tender process for the allocation of these CAs to WSP partners. The tender was aimed at getting the partner for each CA that would deliver the lowest CPPP for a given CA. In practice, most bidding entities combined several CAs into bundles and tendered for the groups of CAs. The result of this process is shown in Figure 1, wherein 4 entities won the opportunity to partner with CFH to deploy FTTP across the 33 Candidate Areas. The resulting average CPPP across all CAs was less than NZD 1500 and the maximum for any single CA was less than NZD 1600, so the initiative was deemed to be economically viable.

Priority Premises

The government recognised that the economic benefit to New Zealand would most likely be derived from increased business activity and reduced costs of doing business in the early phases of the rollout. Hence the concept of priority premises was defined. Priority premises are essentially all premises that are not residential, and includes businesses, public facilities, and government buildings, such as schools. The priority was reflected in the contracted requirement for more than 95% of these priority premises, located within the Candidate Areas, to be passed by 31 December 2015, as compared to 100% of all premises by 31 December 2019. This requirement did have some impact on the way in which the deployment of the fibre was undertaken within the Candidate Areas and, in fact, caused some inefficiency in the deployment. However, the requirement to pass these priority premises early was largely achieved and did enable early uptake of services by small business customers and schools. The government saw this type of early uptake as incredibly positive.

The UFB Initiative

The government funding was administered through a wholly owned government entity called Crown Fibre Holdings Ltd (CFH). This entity was structured as a company under New Zealand law and had its own board reporting directly to two designated Ministers of the Crown. These Ministers set annual expectations for the functioning of CFH and interacted with the board on matters of governance. The board of CFH provided oversight of CFH, which consisted of around 20 permanent staff throughout most of its existence. The board members together with senior company executives also provided governance oversight within each of the WSPs (Partners) who were undertaking the implementation of the UFB within selected Candidate Areas. Mostly, this involved providing governance within a Joint Venture board, which was expressly formed to govern the PPP. This approach applied to three of the partners who were not publicly listed companies (these entities were either privately owned or community trust owned businesses). In one case, namely that involving Chorus as the partner, governance was applied through joint membership of a UFB Oversight Steering Committee reporting to the Chorus board. (The execution of a formal PPP with a publicly listed company proved to be challenging from both legal and disclosure perspectives.) These governance structures were clearly set out within the contractual framework established between CFH and each WSP as part of the competitive bidding process.

The Contractual framework used between CFH and the selected partners for the UFB initiative has been particularly important in the smooth execution of the initiative. Through the competitive tender process to select partners for the build, the CFH management established several contractual obligations on all of the partnerships, including:

- Network build timing with penalties for not meeting milestones;
- Network build quality standards, with penalties for poor performance;
- Wholesale product specifications to ensure national consistency for a reference set of products (WSPs could offer additional products if desired);
- Product price caps for the national reference products;
- Provisioning service levels, with penalties for consistent poor performance;
- Fault repair service levels, with penalties for consistent poor performance;
- Network performance related to a core set of performance parameters related to the common access network assets;

- Network availability performance requirements, to ensure sound network design and implementation practices.

All these functions are intended to migrate from the current contractual obligations into a revised regulatory regime to be implemented by the Commerce Commission post 2020. The contractual obligations remain in force until this transition formally occurs. Having this set of contractual obligations and the ability for CFH to enforce them has been a primary success factor in the implementation of the regime over the last 10 years. All the obligations have come under scrutiny at some time or other, with most issues being resolved through negotiation, although penalties have been applied from time to time, especially in the first few years of implementation.

In addition to the above, the industry was mandated to establish a Wholesale Services Agreement under the direction and approval of CFH, which defines the obligations that the Wholesale Service Providers have to their Retail Service Provider customers. This document was prepared through an industry forum under the New Zealand Telecommunications Forum (TCF) to ensure that it was "owned" by the parties to whom it applies. This set of obligations includes the following:

- The Governance of the relationship for the provision of UFB services between the Wholesale Service Providers and the Retail Service Providers;
- The obligations for each of the parties involved in any service transaction;
- The detailed specification of the products to be delivered to customers;
- The standards expected for any customer installation;
- The pricing, rebates and penalties associated with any customer installation;
- The general terms and conditions associated with any service transaction.

The initial Agreement is intended to be reviewed in 2020, to reflect the industry experience to date and to reflect any changes that may be required following the planned Regulatory Review. To date the Agreement has generally been considered to be fit for purpose, even if there have been some challenges between the parties. Most challenges have been able to be resolved within the context of the current obligations.

It should be noted that, within the above framework, all 4 partners implemented Gigabit Passive Optical Network (GPON) infrastructure for the CFAI in their respective CAs, all in compliance with the international GPON standard ITU-T Rec. G.984 (ITU-T, 2003). Initially, all partners also configured their GPON networks with a 24:1 passive split ratio, although some have reduced this ratio to 16:1 in more recent years. The maximum passive fibre run within

any CA has been kept below the 20 km limit within the standard and most fibre runs are well below this limit to enable some resiliency to be incorporated in the architectures. Within this overall commonality of architecture, there is plenty of scope for the individual WSPs to optimise their fibre counts per duct, fibre counts per cabinet, number of cabinets and splitters per cabinet depending on the geographic distribution and density of premises and the deployment of aerial versus buried deployment practices. Throughout the deployment, all four partners went through one or more architectural optimisation processes to best manage both CPPP and Cost per Premises Connected (CPPC) costs (further detail below).

New Zealand Consumers Retain Choice

One of the primary principles established by the New Zealand government associated with the UFB initiative was that New Zealand consumers should always retain the opportunity to exercise their choice in the selection of broadband services from the market. Under the UFB initiative, within the defined Candidate Areas, the selected WSPs must pass all premises (public, business or residential) defined within the respective CA. This means that the UFB initiative has over-built any existing access infrastructure within the CA, unless some commercial arrangement has been made to use existing access infrastructure that meets all the UFB Contractual Obligations.

At the same time, in New Zealand, no consumer can be forced to migrate to use the UFB-based services. Any use of the UFB access infrastructure by New Zealand consumers is purely through market-based forces. All consumers retain their choice of service provider and technology. Similarly, all forms of Service Provider can offer broadband services to New Zealand consumers in competition with the UFB, if they so desire, and so long as they do not conflict with the discrimination requirements noted in the UFB Principles and as promoted under normal Commercial Law. This means that all existing copper, fibre and wireless access infrastructure owned and operated by a variety of Service Providers can continue to be offered to consumers in competition to that offered under the UFB initiative.

Given this choice retention, it has been surprising to most commentators how quickly the uptake of UFB-based broadband services has occurred (see Figure 2). In fact, early adoption results were variable, as indicated in the results of a survey under the World Internet Project banner in 2015 ([Crothers et al., 2015](#)).

Initially it was thought that matching price for similar broadband capability would be critical to uptake: hence the introduction of a 30 Mbps down/10 Mbps up reference product into the market, in order to compete directly with the predominant VDSL over copper, fed from a FTTN cabinet. The wholesale price for this product was set to ensure that it could be competitive

with that of the equivalent VDSL product. For the first couple of years, this strategy was successful in converting customers to the UFB-based product as the fibre was rolled out. However, even for a similar product, the fibre-based version was perceived by consumers to be preferable in terms of quality relative to any alternative technology.

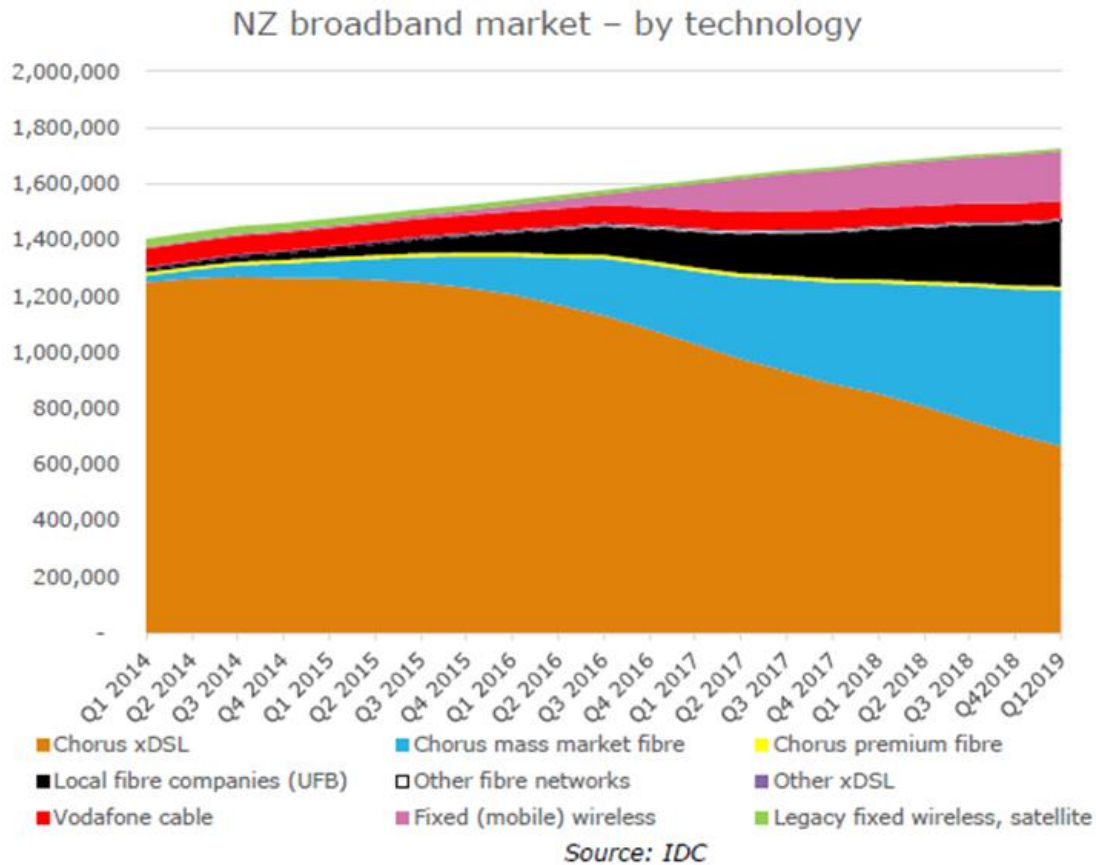


Figure 2. Broadband uptake in New Zealand by technology (Source: IDC).

It also quickly became evident that the market was willing to pay a small premium for enhanced broadband service over fibre. From 2013 to 2015, the 50 Mbps down/20 Mbps up UFB product at a couple of dollars premium became immensely popular. Then, around 2015, Chorus promoted its "Gigatown" competition, encouraging candidate towns and cities to compete to be the first town or city to be fully configured for Gigabit broadband services. Eventually, Dunedin won the title of "Gigatown" and the sale of Gigabit per second (Gbps) services was promoted widely in Dunedin. Of course, under the UFB model, all other CAs were easily upgraded to support Gbps broadband services and so this rapidly became the high-end norm for businesses and many residential customers. At the same time, this focus on higher and higher broadband speeds pulled through most residential customers to focus on 100 Mbps down/50 Mbps up as being preferred and for business customers 200 Mbps down/200 Mbps up became the preferred norm.

The evolution and uptake of broadband services under the New Zealand market driven model has been a surprise for most people in the industry ([Mirza & Beltran, 2013](#)). Given that all consumers have choice, it was originally predicted by the best market analysts that by the end of 2017 the uptake of UFB services in the Candidate Areas built out at that time would be 20% at best and that most of the products consumed would be below 100 Mbps downstream.

In reality, by the end of 2017, the actual uptake was 40% overall and some 6% of those connections were at Gbps downstream speeds. By year end 2019, the uptake across all CAs is more than 55%, with around 70% of those at 100 Mbps downstream and 10% at Gbps downstream. Chorus has announced that it will be offering 2, 4 and 8 Gbps down services in 2020 ([O'Neil, 2019](#)).

Not All Plain Sailing

The execution of the UFB initiative by the selected WSP partners did not commence smoothly. All had some challenges during the initial period of deployment and for some years thereafter.

NorthPower Fibre (NPF) was the first partner to begin fibre deployment, in the Northland region (see Figure 1). NorthPower is a very experienced electricity lines company with a very capable field force that does work all over New Zealand, as well as in Northland. They had already experimented with the deployment of fibre optic cable on the cross arms of electricity poles prior to the UFB initiative. This approach produces a very low visual impact, high speed deployment approach, with low cost per metre of fibre deployed. This approach, though, does require a highly skilled and qualified workforce and was only used by NPF in Northland. However, it did provide NPF with a rapid, low-cost launch into UFB deployment. On the other hand, it did also provide some constraints in terms of fibre architecture, which needed to be addressed during the build (in the initial deployment, the number of fibres per aerial cable run was insufficient to meet 100% uptake in demand, so higher density aerial fibre cables had to be sourced). Overall, though, NPF encountered the least challenges and completed their relatively small deployment quickly and efficiently with a CPPP well below the cap set by CFH.

Ultrafast Fibre (UFF), located largely in the Waikato and surrounding regions (see Figure 1), also started their build well using electricity lines company experience and a high proportion of aerial deployment — below the cross arms, as compared to NPF. However, they did encounter challenges with underground deployment, where poles were not available, and CPPP costs blossomed out, before being reined in by substantial changes to field practices and fibre architecture (using the optimisation parameters outlined above). The cost increases caused stress within the partner ownership structure and required careful governance through the PPP structure for a couple of years. Eventually though by 2016, the partner owners were

beginning to see the potential for the business to grow and prosper and so took the step to buy out the CFH equity early. This was a major step forward in the maturity of the UFB initiative and led to the UFB extension, as described below.

Enable Networks Limited (ENL) is the partner deploying UFB to around 13% of premises passed in the greater Christchurch city area. Enable Networks had been deploying fibre in Christchurch city prior to the commencement of the UFB initiative. Involvement as a UFB partner required substantial restructuring in order to transform the business from a vertically integrated Service Provider into a wholesale only service provider. Given the prior experience with fibre deployment, Enable Networks was keen to ensure that Christchurch would be provided with a highly fibre rich, fully underground infrastructure, which would ensure future-proofing for many decades to come.

Counter to this enthusiasm, though, Christchurch experienced a series of horrendous earthquakes during 2010 and 2011, which meant that the Enable Networks rollout had to contend with and potentially leverage off the rebuild of Christchurch city. The biggest impact of the earthquakes was a shortage of skilled labour to undertake the fibre deployment. This was due to the enormous effort being made to restore all forms of horizontal infrastructure across Christchurch, so creating an extremely competitive market for the skills required.

All the above factors led to an explosion of CPPP for ENL, which pushed up debt levels for the partner (given that the government contribution was capped). By 2014, it was recognised that ENL needed to change its fibre architecture and restructure its contractual relationships with its construction partners to dramatically reduce costs. By year end 2015 these changes were producing improved results and the construction was getting back on track, with CPPP values becoming more reasonable.

Chorus was the partner for around 70% of the UFB initiative across New Zealand (see Figure 1). Chorus was formed following the structural separation of Telecom New Zealand into a Wholesale Service Provider (Chorus) and a Retail Service Provider (Spark). As a result of this separation activity, Chorus was the last of the partners to be awarded with a UFB contract by CFH. In fact, for some time during this process, the largest city in New Zealand, Auckland, could well have been awarded to a separate entity, which would have reduced Chorus's UFB share to less than 50%.

Chorus was also a publicly listed company, which required that the contractual and governance relationship between Chorus and CFH needed to be established in a different manner to that of the other partners. In this case the government contribution was structured

along the lines of an interest-free loan mechanism, and the Governance oversight involved a Joint Oversight Committee reporting to the Chorus board.

Chorus had within it considerable experience in deploying fibre infrastructure as part of its legacy from Telecom New Zealand. However, what was not recognised initially was the sheer size of the build undertaking required to deliver on the Premises Passed milestones for the UFB initiative. The field force required was some ten times larger than that deployed for business as usual. Ramping up this skilled field force proved to be highly challenging for Chorus and resulted in penalty payments for missing the first-year deployment milestone. In addition, the existing contractual arrangements with field contractors did not prove to be appropriate for the UFB build and had to be renegotiated.

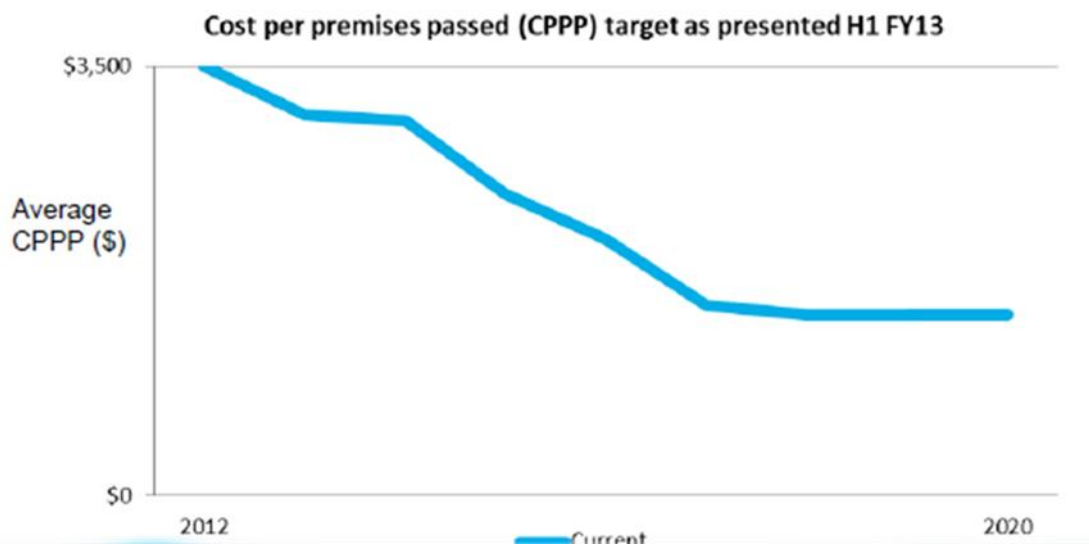


Figure 3. Chorus CPPP trend over the period from 2012 to 2020 (Source: Chorus)

This ramp-up difficulty was not helped by the initial deployment areas chosen by Chorus being high cost in their own right, due to frontages being closer to 30 metres rather than the 20 m average. In addition, these areas were not well suited to the use of aerial deployment. Hence, it was not surprising that the CPPP in 2012 was above NZD 3500. As shown in Figure 3, it was not until around mid-2016 before the high cost for CPPP was brought under control. During this early phase of the deployment, Chorus needed to fund the difference between the actual CPPP and the CPPP cap and so, as the number of premises passed mounted, so did the Chorus debt.

This caused stress within the newly formed Chorus organisation as the Chorus debt structure had not been optimised and so could not easily absorb the additional UFB debt. CFH provided Chorus with some relief within its financial capability in order to enable Chorus to restructure its debt position. After a difficult time during 2014, Chorus took all necessary steps to both restructure its debt and reduce its CPPP. The result of the efforts on managing the CPPP are

illustrated in Figure 3. Averaged across their CAs, Chorus is now achieving a CPPP roughly in alignment with that originally estimated in the economic modelling.

All four partners experienced significant challenges with Health and Safety throughout their build programmes. The magnitude of the build programme, with both aerial and underground construction in progress across hundreds of locations simultaneously throughout New Zealand, meant that all field practices needed to be exemplary to ensure a good health and safety outcome. This situation was highlighted in 2015 when a new Health and Safety Law was introduced for all workplaces in New Zealand. This highlighted the formality and diligence required to manage health and safety for all parties involved in the UFB build, from the labourer in the trench through to the CFH board. All the partners suffered some difficulties with health and safety practice and especially the reporting of their performance following the introduction of the new legal framework. Each of the partners had different challenges to overcome, from workers failing drug tests through to intense focus on safety in aerial practice.

As the challenges to the common fibre access infrastructure build were being overcome by each of the partners in their own way and through sharing of best practice, it soon became evident that the connection of customers to the common infrastructure was becoming the next big challenge. It should be noted that sharing of best practice was enabled by the UFB policy structure, in which each WSP is a monopoly provider within its CAs, so removing competition as a factor, and the prices for reference wholesale products was established by contract, so that little market collusion was possible.

Premises types and connections process

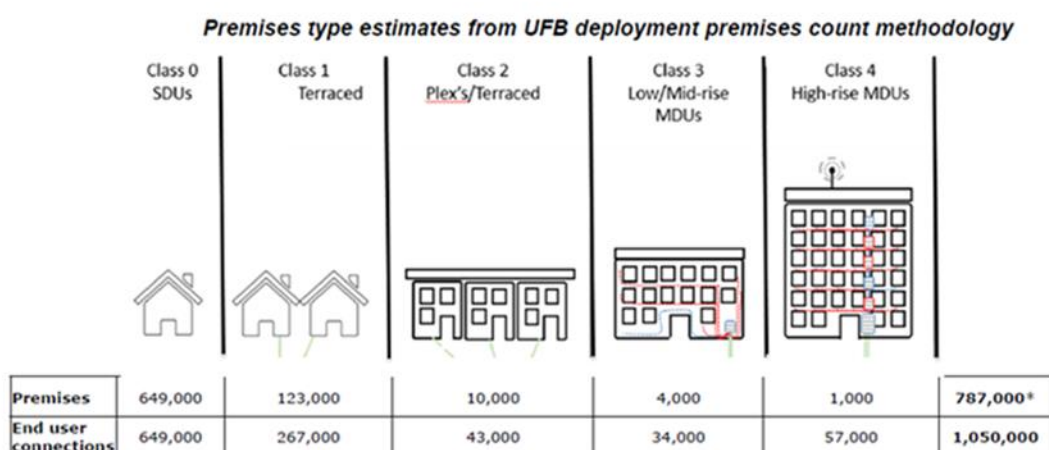


Figure 4. Premises types and estimates of volumes for each type within the Chorus CAs (Source: Chorus).

The provision of service to single dwelling units (SDUs) (see Figure 4) was relatively straightforward, although each partner had to work very hard on the optimisation of field practice to ensure the lowest cost connection to a quality standard that reflected consumer

expectations and contractual obligations. In this case, the cost pressure was applied by the RSPs as they had an essentially fixed wholesale price for the CPPP component and their ability to compete in the retail market depended on the additional CPPC component. Unfortunately, the values for CPPC varied greatly by type of premises being connected (see Figure 4) and the efficiency of the contractors performing the connection work for each of the WSPs. Initially the provision of a connection to an SDU took four-man crews two 8-hour days to execute. Today, this same connection can be typically performed by a two-man crew in half a day, which represents a reduction in CPPC by a factor of 8:1. Under the current scenario, the CPPC is around NZD 1000 for a “good” SDU connection, with the average sitting at around NZD 1500. These numbers are in alignment with the pre UFB economic modelling, which had the average total cost of an FTTP-connected residential SDU customer with a 20 m frontage at NZD 2500-3000.

The provision of connections to premises with shared driveways and multiple dwelling premises proved to be particularly challenging (see Figure 4). In all cases, initially there were major delays caused by coordination between the parties, including the Wholesale Service Provider, the Retail Service Provider, the field contractor and the customer. Getting all of these parties to perform their part in the connection process in a timely and cost effective manner proved to be very challenging, especially when the numbers of connections being requested was exploding, through consumer demand being beyond any expectation. Across the country, Chorus is currently connecting customers at the average rate of one per minute, around the clock. The CPPC for these premises can also vary considerably, from being exceptionally low in some modern pre-wired multi-dwelling buildings to being considerably higher in heritage multi-dwelling buildings.

The provision of connections into shared access and multi-dwelling premises required a change in the Law to address delays due to the need for Consents from all parties affected before installation could commence. This was an essential learning to ensure delivery success.

Rural Broadband Initiative 1

With the UFB initiative underway in 2010, the New Zealand Government was concerned that the broadband needs of the remaining 25% of New Zealand premises were not being addressed. They wanted to see some progress towards addressing the broadband needs of this sector of the population. This desire led to the formation of the first Rural Broadband Initiative ([Treloar, 2012](#)), which was implemented from within the Ministry of Economic Development, through a competitive tender process. This process led to the production of contracts with Chorus and Vodafone. This initiative had several objectives as follows:

- Extend the coverage of Fibre to the Node so that an additional 40,000 premises could access this technology;
- Upgrade the FTTN technology serving some 110,000 homes and businesses to deliver improved broadband performance – up to 40 Mbps down and 10 Mbps up;
- Connect over 1000 schools in rural New Zealand with Fibre to the Premises technology;
- Deliver FTTP to 39 rural hospitals and 183 rural libraries;
- Provide fibre access to more than 150 new Vodafone rural cell sites;
- Build over 150 new Vodafone rural cell sites and upgrade a further 330 Vodafone rural cell sites for 4G capability, so delivering up to 40 Mbps downstream to a potential of around 290,000 rural premises.

Figure 5 illustrates these outcomes.

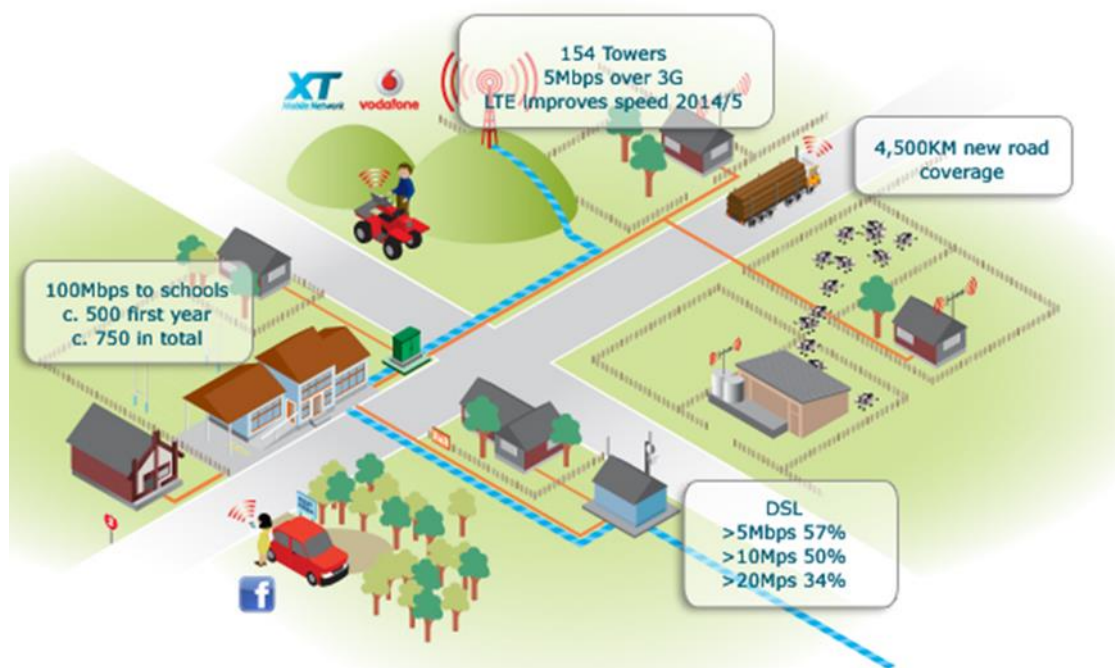


Figure 5. Rural Broadband Initiative 1 outcomes (Source: Chorus).

Although this initiative did achieve many of its objectives, it was found by 2015 to be very costly on a per-user basis and did not achieve the full uptake of broadband service as was expected.

UFB Extension

When it was found in 2016 that the government equity in some of the partnerships was to be returned to the crown early – most notably from UFF – CFH was tasked with determining

whether this money could be re-invested to economically increase the fibre coverage. By 2016 it was also clear that all of the partners were getting control of their deployment costs (see Section on “Not All Plain Sailing” above), so that within the defined CAs a CPPP of less than NZD 1500 was being consistently achieved on average. It was also clear by this time that uptake of the UFB was well above initial predictions, making the entire initiative more attractive commercially. All these factors led to the proposition that, with a modest relaxation of the government contribution cap, it was likely that many more towns across New Zealand could be enabled with UFB.

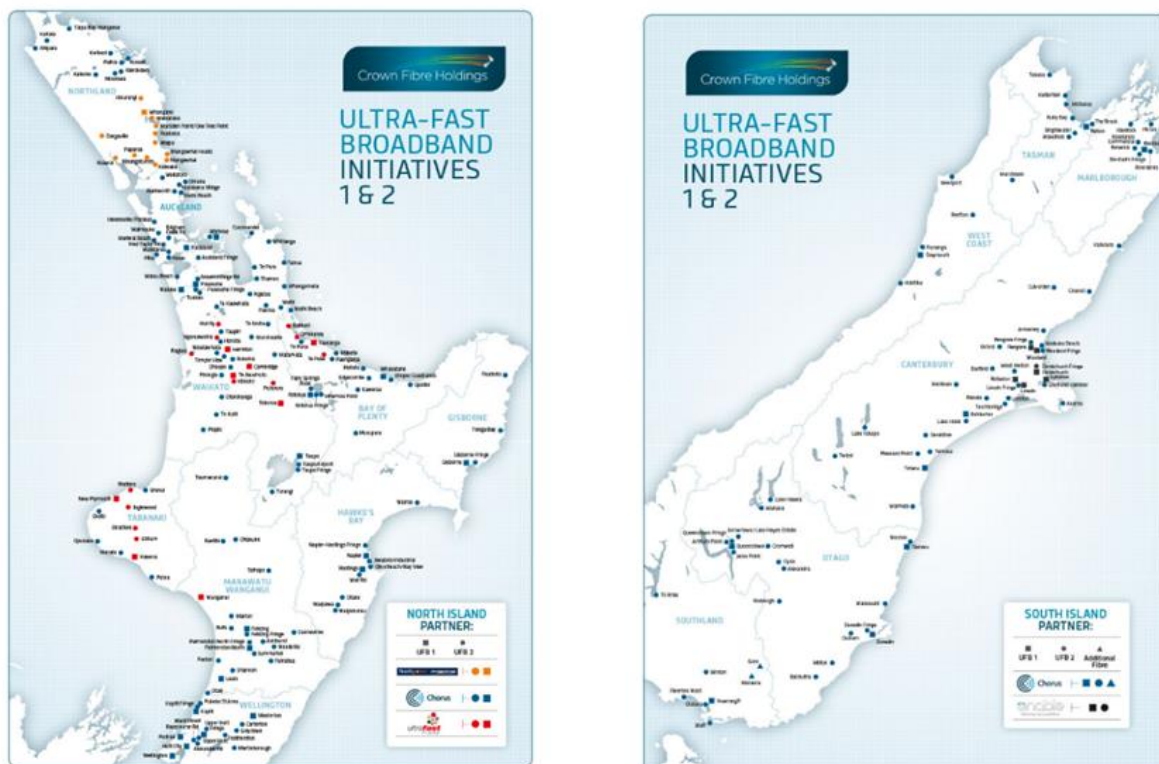


Figure 6. UFB coverage after the extension deployment is completed before YE2022 (Source: CFH).

A new round of competitive tenders was completed, and it was found that some 370 additional towns could be covered with a CPPP cap of NZD 2000 on average. These contracts were established and the UFB rollout was extended to cover more than 400 towns and cities, resulting in an increase in UFB coverage from 75% to 87% of all New Zealand premises (see Figure 6). The funding for this additional coverage was largely paid for by recycling the UFB1 funding, plus a modest additional contribution from the government.

It should be noted that the threshold cap of NZD 2000 for the CPPP was established as a cross-over point for the equivalent provision of service by alternative wireless technologies (allowing for the connection component to be included as well). Hence, beyond the 87% of coverage, it was considered to be more economic to invest in wireless technology to deliver a similar, but more constrained, broadband service to premises in these more remote areas.

Stage 2 Rural Broadband and Mobile Blackspot Initiatives

Having determined conclusively that it would not be economic to serve all New Zealand premises with UFB, the government was keen to ensure that the remaining nearly 13% of premises could be provided with broadband service with 50 Mbps downstream or better. This became the foundation for the second stage Rural Broadband Initiative (RBI2).

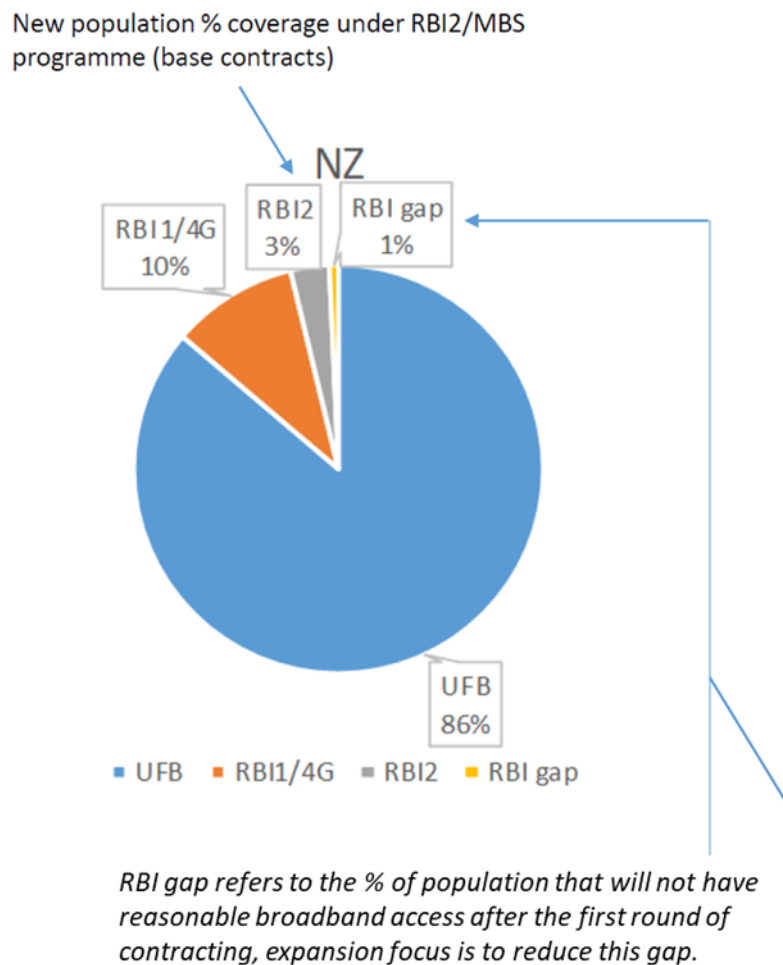


Figure 7. RBI1, RBI2 and MBS filling in the gap in broadband coverage (Source: CFH)

Unlike the UFB initiatives, the RBI2 was funded through a grant process managed by CFH, with funding being derived from the Telecommunication Development Levy. This levy has annual contributions from all telecommunication service providers based on market share and is essentially a Universal Service Fund designed to address issues of Common Good and Equity, such as to address user disabilities and remote access. The levy raises some NZD 50m per annum.

At the same time, the government also wanted to address another coverage issue: that of mobile cellular coverage along main roads throughout New Zealand. Most main roads and highways are provided with commercial cellular coverage from one or more of the three

cellular service providers operating in New Zealand. However, many roads of significance, particularly for tourists, have blackspots in coverage which are not economical to fill in on a commercial basis. The Mobile Blackspot Fund initiative is intended to fill in the coverage on most of these roads of significance and include some 168 tourist sites. Again, this initiative was passed to CFH to manage the execution.

The execution of these two initiatives simultaneously by the same oversight entity enabled synergies to be achieved, as much of the enhanced mobile coverage of the main roads also delivered wireless coverage to many rural premises. This enabled around 80% of the 13% of rural premises required to be provided with RBI service to be served by fixed cellular broadband service (see Figure 7).

The remaining RBI coverage (around 3% of the total premises) is also being delivered using broadband wireless, but of a different kind and by different players. Over the last couple of decades, the provision of broadband services in selected rural areas has been provided by Wireless Internet Service Providers (WISPs). These are typically entrepreneurial small businesses who install wireless infrastructure on hilltops around New Zealand. They use typically unlicensed spectrum to deliver 10-20 Mbps down/5-10 Mbps up broadband Internet services to customer premises scattered across the landscape within line of sight of the selected hilltops. As at 2015, there were around 50 such entities operating around New Zealand.

In order to leverage this existing capability, the RBI2 introduced a competitive grant process which enabled these WISPs to upgrade both their services and their coverage to address the broadband needs of most of the remaining rural customers not covered by any other means.

Around 20 WISPs were able to provide proposals to address the bulk of the remaining rural customer premises and deliver the 50 Mbps downstream service required under the RBI. Contracts were awarded over the 2016/17 years and the upgrade is to be completed by Year End 2023, although some WISPs have already completed their build programmes by the end of 2019.

During 2019, a further extension to the programme was made with the addition of Maori Marae (traditional meeting houses) to the coverage requirement. This coverage extension involves some 810 Marae and is funded through the Regional Development Fund and is scheduled to be completed by YE2023.

Overall Broadband Outcomes for New Zealand

By year end 2019, the UFB1 initiative was completed and the government celebrated this success in Parliament on 20 November 2019. The UFB Extension, RBI2 and MBSF initiatives

were also progressing well. Some 120 towns and cities around New Zealand have the UFB CFAI completed so that customers can access UFB services. This corresponds to the completion of fibre rollout to around 80% of New Zealand premises, with the remaining 7% expected before year end 2022. When the UFB program is complete, it is expected that New Zealand will sit within the top five countries in the OECD for fibre-based broadband availability.

Furthermore, some 84,000 rural premises, 810 Marae, 168 tourist sites and 1400 km of roads of significance will have much improved broadband coverage by year end 2023. This will mean that approximately 99.8% of New Zealand premises will be assured of access to broadband capability of better than 50 Mbps downstream.

Putting this outcome into financial terms, as at the end of 2019, nearly NZD 2.1B of funding has been committed through CFH. This consists of NZD 1.55B of UFB appropriations directly from government. In addition, NZD 180M has been committed from the Telecommunications Development Levy, which is effectively industry-based funding. The above has been supplemented by NZD 337M of internal CFH funding derived from the recycling of the original government appropriation. Most recently, there has been a further contribution from the Regional Development Fund to support the provision of service to Marae. Of this approximate NZD 2.1B of funding from various sources, there is an expectation that over NZD 1B will be returned to the Crown by 2036, when a couple of the interest-free loans mature. Hence the set of initiatives to greatly enhance the broadband capability for all New Zealanders is forecast to cost the Crown in the order of NZD 1B over 36 years.

The most important outcome of all, though, is the numbers of customers using the capability. Of the approximate 80% of premises passed by the UFB to date, some 55% have been connected to the UFB and are receiving the benefits of excellent broadband service (see below for speeds). This is even though there is no compulsion for adoption.

This represents close to 850,000 businesses and residences using fibre-based broadband. The rate of uptake is roughly twice that which was forecast at the beginning of the initiative by the experts, such as IDC. It should also be noted that the 55% uptake is an average over the entire build. Many towns and suburbs within cities are achieving 65-70% uptake, and it is expected that more than 80% uptake will be likely within a couple more years.

The product mix has also been rapidly changing as the initiative has progressed. This is illustrated in Figure 8. In early 2016 the predominant product consumed was less than 100 Mbps downstream, with Gbps downstream services just starting to emerge. Eighteen months later, the 100 Mbps and above downstream products were sitting at nearly 70% of the sales volume.

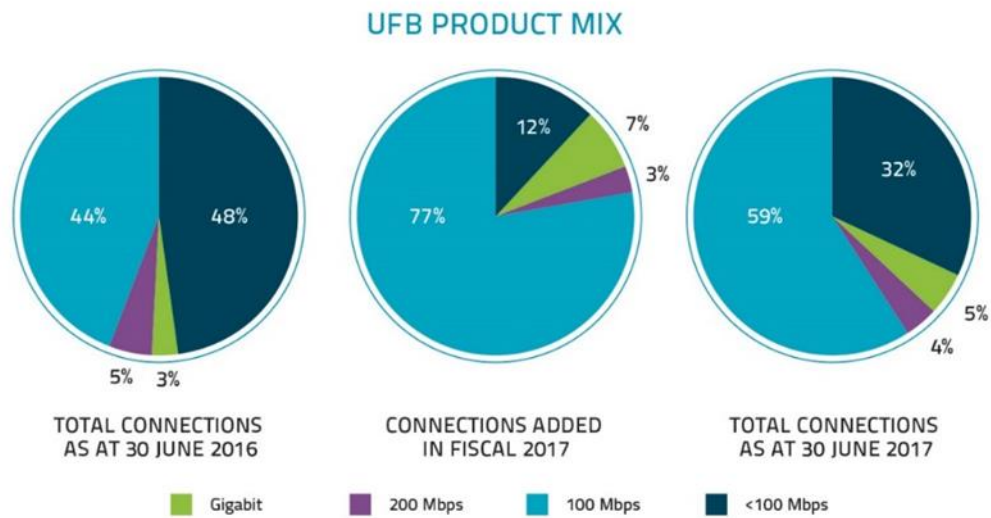


Figure 8. UFB product mix change during 2016 and 2017 (Source CFH).

By mid-2019 (see Figure 9) the largest selling product is 100 Mbps down with 20 or 50 Mbps up for residential customers, while the 200 Mbps symmetrical product is popular with business customers. In the same timeframe, Gbps downstream services were 9% of the sales volume and, by the end of 2019, this volume had increased to over 10%. By mid-2019, the average speed of UFB service was 179 Mbps down and consumers are continuing to migrate to higher speed plans.

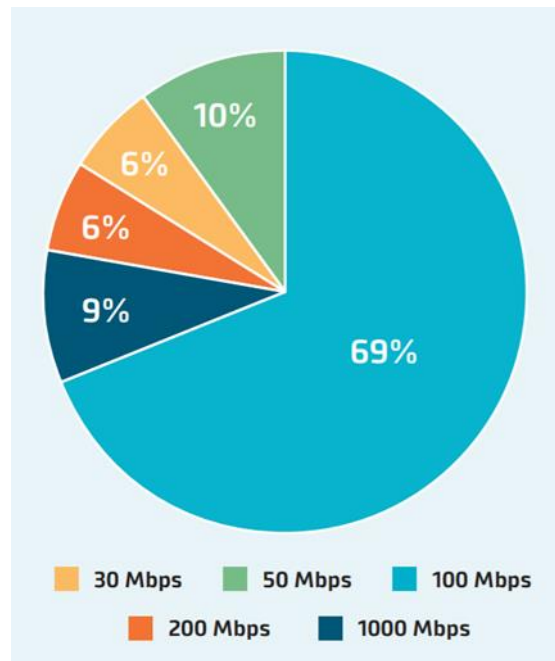


Figure 9. UFB product distribution as at mid-2019.

Currently, one of the largest Retail Service Providers offers the 50 Mbps down/20 Mbps up product as standard, with unlimited data volume and bundled Netflix and other content for

NZD 95 per month. For NZD 3 extra per month, consumers can purchase the same package with 100 Mbps down and 50 Mbps up, which is proving to be popular.

The Gbps services have also been rapidly reducing in price and are now very comparable with the 100 Mbps services. Depending on the packages bundled with the broadband, the Gbps services can now be purchased for below NZD 100 per month and are widely available below NZD 120 per month.

It should also be noted that the UFB performance is very much more consistent than that experienced in many countries. Often the headline speeds are only experienced by end users for short periods of time when usage by the surrounding population is low. When the network is heavily loaded, the actual speed experienced by end users can reduce by as much as 50% relative to the headline value. In comparison, all NZ providers are achieving results within 5% of the 100 Mbps downstream target for better than 95% of the time, where this is the headline speed purchased by the customer. This is a significant positive outcome for providers and for NZ business and society.

As the UFB uptake grows, so too has the uptake of the rural broadband products over wireless. In many rural locations fixed wireless products over cellular are being offered at comparable prices to that for the UFB and with downstream speeds approaching 100 Mbps and upstream speeds exceeding 20 Mbps. Data volumes for fixed wireless users are restricted to around 200-300 GB per month. If these limits are exceeded consistently, at least one RSP retains the right to convert the customer to UFB, if available at the location.

Similarly, there has been substantial uptake of wireless broadband over WISP infrastructure. Again, prices are comparable for 50 Mbps downstream products with data volumes typically capped at around 200 GB per month.

The use cases for the adoption of UFB are also continually evolving. There is no doubt that streaming media to all types of devices, but especially large screen, high definition TVs, is a major driver for residential uptake. However, the expanded learning experience for children in association with their schools is becoming a critical use case, especially for children in lower socio-economic groups ([Grimes & Townsend, 2017](#)). Here there are several innovative packages emerging to assist children to connect via UFB and RBI to their schools to access educational content at very reasonable prices (NZD 10 per month).

However, the biggest area for innovation is in association with small and medium businesses ([Murray et al., 2016](#)). Many businesses are finding that they can successfully operate their business from any location in New Zealand. This has meant that many small businesses are moving out of the high-cost big cities and are setting up in smaller towns and even rural

locations, where the cost of doing business is lower and the lifestyle is greatly enhanced. This opportunity is even encouraging New Zealanders from overseas to relocate back to New Zealand.

Conclusions

The Ultrafast Broadband initiative was formally launched by the New Zealand National Government in late 2009, through a special-purpose government entity called CFH. The UFB in New Zealand was driven by a strict set of policy objectives which promoted commercial principles, including competition, explicit economic outcomes and incentive mechanisms. Key to the outcomes being achieved was the use of a Public Private Partnership (PPP) mechanism, with the government funding into the PPP being capped in the form of what effectively looks like an interest-free loan. Within this structure there were strong incentives for the partnership to perform in terms of delivery in a cost-effective, quality and timely manner. At the same time, New Zealand consumers retained their right to choose the Service Provider and technology which best meet their needs. During the implementation period, political change has occurred but, due to an established policy alignment around broadband, these changes have had no negative impact. These are all essential learnings from the successful experience of UFB deployment within the New Zealand market.

Even with a strong framework of policy objectives, alignment and strong commercial principles, the challenges encountered during execution were massive and required considerable effort and adaptation to overcome. However, continued tight focus on the core principles did eventually enable the required outcomes to be achieved, on time and on budget. By 20 November 2019, the completion of the initial passing of 75% of urban premises by the UFB was celebrated through a function held at Parliament. Furthermore, during execution, the initiative was expanded to deliver UFB to 87% of premises across New Zealand by year end 2022 and, through associated Rural Broadband Initiatives, the provision of greatly enhanced broadband to 99.8% of New Zealand premises will be achieved by year end 2023.

The greatest testament to the success of the initiative, though, is the uptake by broadband users on the UFB and associated rural broadband infrastructures. As at the end of 2019 the uptake in those areas where the UFB build has been completed was over 55%. Some towns and suburbs within cities have uptake in 65-70% range. This is being achieved in an environment where all other technology choices remain in the market and there is no compulsion for the adoption of the UFB products. Furthermore, this uptake is being driven through the development of innovative applications and associated work practices that are beginning to impact positively on all parts of NZ business and society.

References

- Cabinet Policy Committee, (2006). Telecommunications Stocktake, Minute of Decision, POL Min (06) 7/9, 3 May. <https://www.beehive.govt.nz/sites/default/files/Cabinet%20paper%20and%20minute.pdf>
- Crothers, C., Urale, T., Smith, P., & Bell, A. (2015). The Roll-out of Ultra-Fast Broadband (UFB) in New Zealand, 2015. A Report to the Ministry of Business, Innovation and Employment (MBIE), World Internet Project New Zealand, AUT. https://icdc.aut.ac.nz/data/assets/pdf_file/0006/81870/WIPNZ-report-on-UFB-survey-2015.pdf
- Grimes, A., & Townsend, W. (2017). The Effect of Fibre Broadband on Student Learning, Motu Working Paper 17-03, *Motu Economic and Public Policy Research*, April. http://motu-www.motu.org.nz/wpapers/17_03.pdf
- Howell, B., & Sadowski, B. (2018). Anatomy of a public-private partnership: Hold-up and regulatory commitment in Ultrafast Broadband. *Telecommunications Policy*, 42(7), 552-565. <http://doi.org/10.1016/j.telpol.2018.05.001>
- InternetNZ. (2008). Broadband Strategy Options for New Zealand: Analysis of Possible Strategy Options. Network Strategies Report No. 28040, 10 December. https://internetnz.nz/sites/default/files/workstreams/Broadband_Strategy_Options_for_NZ_-_Stage_2_Report.pdf
- ITU-T. (2003). International Telecommunication Union - Telecommunications Recommendation. G.984, Gigabit-capable Passive Optical Networks (GPON). <https://www.itu.int/rec/T-REC-G.984.1/en>
- Key, J. (2008). *Better Broadband for New Zealand*. Speech presented at the Wellington Chamber of Commerce, Wellington, 22 April. <https://www.scoop.co.nz/stories/PA0804/S00523/key-better-broadband-for-new-zealand.htm>
- MacMahon, R., & Milner, M. (2013). Ultra-fast broadband in New Zealand: Early adoption experience. *Telecommunications Journal of Australia*, 63(1) 7.1-7.11. Available in <https://researchbank.swinburne.edu.au/file/87546502-1b85-4def-859c-e18286413d5f/1/PDF%20%28Published%20version%29.pdf>
- MED. (2009). Ministry of Economic Development: New Zealand Government Ultra-Fast Broadband Initiative, Invitation to Participate in Partner Selection Process, October. <https://www.crowninfrastructure.govt.nz/media/4824/invitation-to-participate.pdf>
- Milner, M. (2009). Playing the telecommunications game in New Zealand: The evolving story of telecommunications public policy in New Zealand. *Telecommunications Journal of Australia*, 59(2): 26.1-26.17. Available in

<https://researchbank.swinburne.edu.au/file/7a769794-d141-43e8-bc16-1ee86b302fof/1/PDF%20%28Published%20version%29.pdf>

- Mirza, F., & Beltrán, F. (2013). Drivers and Barriers to the Uptake of a FTTH Ultra-Fast Broadband in New Zealand. *TPRC 41: The 41st Research Conference on Communication, Information and Internet Policy*, 29 March. <http://dx.doi.org/10.2139/ssrn.2241514>
- Murray, K., Davies, P., Blick, G., & Ryan, M. (2016). Economic value of the take-up of ultra-fast broadband in New Zealand. *Sapere Research Group*, 5 July. http://srgexpert.com/wp-content/uploads/2018/02/Sapere_economic_value_of_UFB_uptake.pdf
- NZI. (2007). The New Zealand Institute: Defining a Broadband Aspiration: How Much Does Broadband Matter and What Does New Zealand Need? September. Available from <https://lancewiggs.com/2007/09/26/the-nz-institute-report-the-benefits-of-broadband/>
- O'Neil, R. (2019). Chorus unveils its 'Hyperfibre' 10Gbit/s service and schedule. *Reseller News from IDC*, 18 November. <https://www.reseller.co.nz/article/668749/chorus-unveils-its-hyperfibre-10gbit-service-roll-out-schedule/>
- Telecom NZ Ltd. (2008). Telecom Separation Undertakings, 25 March. https://www.beehive.govt.nz/sites/default/files/Telecom%20Separation%20Undertakings_o.pdf
- Treloar, N. (2012). Rural Broadband technologies and the Rural Broadband Initiative in New Zealand, *Telecommunications Journal of Australia*, 62(1), 8.1-8.8. Available in <https://researchbank.swinburne.edu.au/file/618401d9-07ec-477f-bf78-fca74a4ef30c/1/PDF%20%28Published%20version%29.pdf>
- Webb, M., Toner, T., & Cox, J. (2014). Taking the initiative: lessons from New Zealand's experience with the ultra-fast broadband initiative, *International Journal of Technology Policy and Law*, 1(4), 317-334. <https://doi.org/10.1504/IJTPL.2014.061665>

Endnotes

- ⁱ In 2017 Crown Fibre Holdings was restructured with an enhanced mandate and renamed Crown Infrastructure Partners (CIP). For ease of continuity for the reader, the company will be referred to as Crown Fibre Holdings consistently throughout this paper.
- ⁱⁱ The CFAI includes the fibre access infrastructure from a local point of interconnection to the street boundary of each of the premises within a designated geographic area.
- ⁱⁱⁱ Special entities include roadside infrastructure such as electronic signboards, mobile radio cell sites and any other facility not directly attributable to the specific premises.