



NEW ZEALAND
**INFRASTRUCTURE
COMMISSION**
Te Waihanga

State of Play: Telecommunications

Discussion Document

Foreword

Kupu takamua

Our wellbeing depends on our infrastructure

Our way of life depends on infrastructure. Whether it's moving freight to keep the supermarket shelves stocked, warming our homes, driving to work or calling our friends, there are few parts of our lives that don't rely on the services provided by infrastructure.

Infrastructure decisions have intergenerational impacts, so it is essential that we take a strategic view of the planning, development and operation of infrastructure in Aotearoa. New Zealand Infrastructure Commission was formed to give infrastructure this strategic voice, and the significance of this task is reflected in our Māori name, Te Waihangā, which means *cornerstone*.

Our first task is to develop a 30-year strategy for infrastructure - this paper is a part of this work. It takes a closer look at the current state of play in New Zealand's telecommunications sector. By understanding where we are now we can set a course for where we want to go and the steps we'll need to take to get there over the next 30 years.

New Zealand faces a range of challenges and opportunities over the next 30 years which will have significant implications for infrastructure. Our changing climate, rapidly growing cities, aging population and evolving global technologies will change what we need from infrastructure in order to maximise the wellbeing of New Zealanders. Each of us has our own experiences of infrastructure, so we look forward to receiving your feedback to ensure this State of Play report accurately reflects the current state.



Ross Copland
Chief Executive

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1 Executive Summary

Telecommunications infrastructure connects people and ideas. It connects families, whanau, communities and markets, and is essential in enabling a modern economy and diffusion of knowledge. It is critical to modern education services and increasingly important for essential services like healthcare, as more is done virtually. Further uses include the movement and storage of data that support businesses and other sectors like transport and energy. Ultimately, the influence of the sector and its infrastructure is significant across the four dimensions of wellbeing: Economic, Social, Cultural, and Environmental.

Today, the sector is well placed when considered in relation to the services that New Zealanders can access. It compares favourably with other countries in the OECD and performs strongly relative to other infrastructure sectors. The sector is coming to the end of a transformational period with the national rollout of fibre broadband. When the programme is complete, by the end of 2022, 87% of New Zealanders will have access to fibre, and New Zealand will be one of the leading countries in the OECD for fibre availability.¹ Considering New Zealand's international standing a decade ago, and the importance of connectivity for an isolated, developed nation, this is a remarkable achievement.

However, in spite of the substantial progress the sector has made, there are still issues that create barriers to wellbeing for some New Zealanders. Not everyone can access telecommunications services. This may be due to factors such as access to devices, having the necessary skills, trust, motivation, or the cost of connectivity.

Similarly, in a sector dominated by private capital, it is not always economic to provide affordable infrastructure. Rural communities across New Zealand feel this most acutely. While significant progress has been made through Crown-Private cooperation and infrastructure sharing, the long-term solution to addressing internet connectivity for rural communities is not clear.

The impact of Covid-19 has further highlighted the importance of these services. Those excluded from telecommunications connectivity were unable to access essential services such as healthcare and education. As the world moves increasingly online, digital exclusion stands as a growing barrier to economic and social participation.

For the sector, as the sun sets on one transformation another begins. Advancement in technology and an insatiable demand for data are leading to new technologies such as 5G, which is being deployed across New Zealand. These technologies continue to push the boundaries on what is possible with an internet connection.

As technologies develop, and applications, such as an Internet-of-Things (IoT), continue to change the way we live, security and the importance of protection against cyber threats will increase. That said, this is an exciting and important chapter in the history of New Zealand's telecommunications infrastructure. As connectivity continues to support our society, culture, environment, and economy, it is critically important the settings are in place for telecommunications infrastructure to address future needs and wellbeing of New Zealanders.

¹ Crown Infrastructure Partners, *Quarterly Connectivity Update*. 2020. p.4.
https://www.crowninfrastructure.govt.nz/wp-content/uploads/CIP-Quarterly-Rep-June_FINAL.pdf.

He Whakarāpopoto

He hono tāngata, ariā hoki te mahi a te hanganga whitimamao. E honoa ana ngā whānau, me ngā hapori me ngā māketē, ā, he mea whaitake hoki hei whakawhanake i tētahi ōhanga ōnāianeī, i te whakahōrapa hoki o te mātauranga. E whai tikanga ana anō ki ngā ratonga mātauranga ōnāianeī, ā, e piki haere ake ana tana whakaawenga ki ngā ratonga whaitake pērā i ngā ratonga whakahaumanu nō te mea e kake ake ana te rahi o ngā ratonga tuihono. Ko ētahi atu momo whakamahinga ko te nekenga me te tiakitanga hoki o te raraunga e tautoko ana i ngā pakihi me ētahi atu rāngai, hei tauira ko te ikiiki me te pūngao. Ko te mutunga anō, he nui tana whakaawenga i ngā wāhanga e whā o te ora: ko te Ōhanga, Pāpori, Ahurea, me te Taiao.

I ēnei rā, he tino pai te tūranga o te rāngai ina whakaōritengia ki ērā atu ratonga e āhei ana i ngā tāngata o Aotearoa. E mariu ana tana wāhi ki te whakaōritengia ki ērā atu o ngā whenua i te OECD, ā, e tino pai ana ngā hua ki ērā atu rāngai hanganga. E tae atu ana te rāngai ki te mutunga o tētahi wā hurihuri, arā, o te whakatakoto i te taura kaka ōmata huri noa i te motu. Ina oti te hōtaka, hei te mutunga o te tau 2022, 87% o ngā tāngata o Aotearoa e whai āheinga ana ki te ipurangi taura kaka ōmata, ā, ko Aotearoa tētahi whenua i te OECD ka riro hei motu kei te taumata mō te āhei o ngā tāngata ki te whakamahi ipurangi taura kaka ōmata. Ina whakaarotia te tūranga ā-ao o Aotearoa i te tekau tau i taha ake nei, me te whakahirahira hoki o te honohono i tētahi motu tū taratahi, whai rawa hoki, koia hoki he paetae mīharo rawa atu tēnei.

Tērā tonu ia ngā take e aukati ana i ngā tāngata o Aotearoa i te whakapiki ake i ō rātou ake ora, ahakoa te pai o te whanake o te rāngai. Tē taea e te katoa te āhei ki ngā ratonga whitimamao. Tērā pea ko ētahi o ngā take e pēnei nei te tūāhua ko te korenga o ngā taputapu, me ngā pūkenga, o te whakapono, o te manawa, tae atu ki te utu o te hononga.

I tētahi rāngai e whakaawetia ana e te moni punga tūmataiti, ehara i te mea ka whai hua ki te whakarato hanganga e ngāwari ana ki te āhei. E tino rongo ana ngā hapori tuawhenua huri noa i te motu i tēnei. Ahakoa he nui tonu ngā whakawhanaketanga i oti ai i te mahi ngātahi a te Karauna me ngā pakihi tūmataiti, me te tuaritanga hoki o te hanganga, kāore i te mārāma he aha te pae tawhiti hei whakatika i te āhei ki te hono ki te ipurangi i ngā hapori tuawhenua.

Nō te putanga mai o te Kowheori-19 kua miramira te hiranga o ēnei ratonga. Ko te hunga e awere ana i te āhei ki te hono ki te whitimamao kāore rā i āhei ki te whakamahi i ngā ratonga whaitake pērā i te whakahaumanu me te mātauranga. Nō te piki ake o te whirinaki a te ao ki te ipurangi, ka riro tonu ko te awere tahiko hei taiepa e aukati ana i te āhei ki te whai wāhi ki te ōhanga me te pāpori.

I te rāngai nei, tē ai he mutunga o te haerenga. Nō te whanake haere o ngā hangarau me te totohe whakakakao ki te raraunga kua mea kia whakawhanaketia ngā momo hangarau pēnei i te 5G, he momo hangarau e horaina ana puta noa i te motu nei. Ka haere tonu ēnei momo hangarau ki te whakapātaritari i ngā whāititanga o ngā āhuatanga e taea ana i tētahi hononga ipurangi.

I te whakawhanake haere o ngā hangarau, me ngā taupānga pērā i te 'Internet-of-Things (IoT), me te whakarerekē tonutanga anō hoki o te āhua o tō tātou ao, ka piki ake te hiranga o te haumarū me te parenga ki ngā tuma ā-ipurangi. Ahakoa tērā, he wā tino whakaihihi, he wā tino whakahirahira hoki tēnei i te hītoria o te hanganga whitimamao o Aotearoa. Ka haere tonu te āhei ki te hono hei mea tautoko i tō tātou pāpori, ahurea, taiao, ōhanga hoki, ā, he tino whakahirahira kua oti kē ngā tautuhinga te whakarite mō te hanganga whitimamao hei whakarato i ngā hiahia, me te ora hoki, o ngā tāngata o Aotearoa i te anamata.

2 Context

Horopaki

2.1 Who we are and what we do

The New Zealand Infrastructure Commission, Te Waihangā is working to improve New Zealanders' lives through better infrastructure. It aims to lift the level at which infrastructure is planned and delivered, taking a strategic approach so that we maximise the social return on our collective dollar, and stand well prepared in the face of an uncertain future.

Our Māori name, Te Waihangā, means a cornerstone, or to make, create, develop, build, construct, generate. Te Waihangā therefore reflects the significance of long-term planning in shaping New Zealand's future.

A major part of this work is the development of a 30-year strategy for infrastructure. The strategy will look ahead to 2050, and consider how infrastructure might support the environmental, social, cultural and economic wellbeing for all New Zealanders. This will be delivered to the government in September 2021, and will set out how we can make sure our investment in infrastructure delivers what we need, where we need it and at the right time.

2.2 About our sector State of Plays

We understand that our infrastructure works together - it is a system of systems. Our roads carry pipes and powerlines, and they connect to homes, workplaces and schools. For this reason, our strategy will focus on cross-cutting themes rather than infrastructure sectors in isolation. However, we believe that it's important we understand the infrastructure we have today, why we have what we have, and how it's already contributing to New Zealanders' wellbeing.

Our sector State of Plays are the result of desktop research, augmented by insights from our survey of infrastructure asset owners, and engagement with sector experts. These reports will be updated over time. We want to improve the picture as our understanding grows and different elements come in to focus.

2.3 Our next steps

As well as continuing to build on our picture of the State of Play, next steps include building our understanding of future trends and likely challenges, including climate change, incorporation of Mātauranga Māori, demographic change, and the role of technology. We will look at what our way of life might be 30 years from now. Based on all of this, we will begin to make recommendations as to how infrastructure might support New Zealand's future wellbeing.

We'll share our thinking on what will be included in the strategy, focusing on the cross-cutting themes that affect all sectors, the opportunities and challenges we can expect in the future, as well as our initial recommendations and options for consideration.

This will then be followed by a draft strategy that firms up our thinking on recommendations and provides greater detail as well as the evidence base behind them. From there, we'll develop the document that goes to Ministers.

2.4 Have your say

We'll share our work as we go and are keen to hear what you think, starting now. Tell us what you think about our State of Play reports – have we got it right or are there issues, information or problems that we've missed?

You'll also have the opportunity to comment on the draft strategy. We'll be continually refining and assessing our work based on the feedback we get from you and others.

3 About the telecommunications system

E pā ana ki te pūnaha whitimamao

3.1 The services provided by telecommunications infrastructure

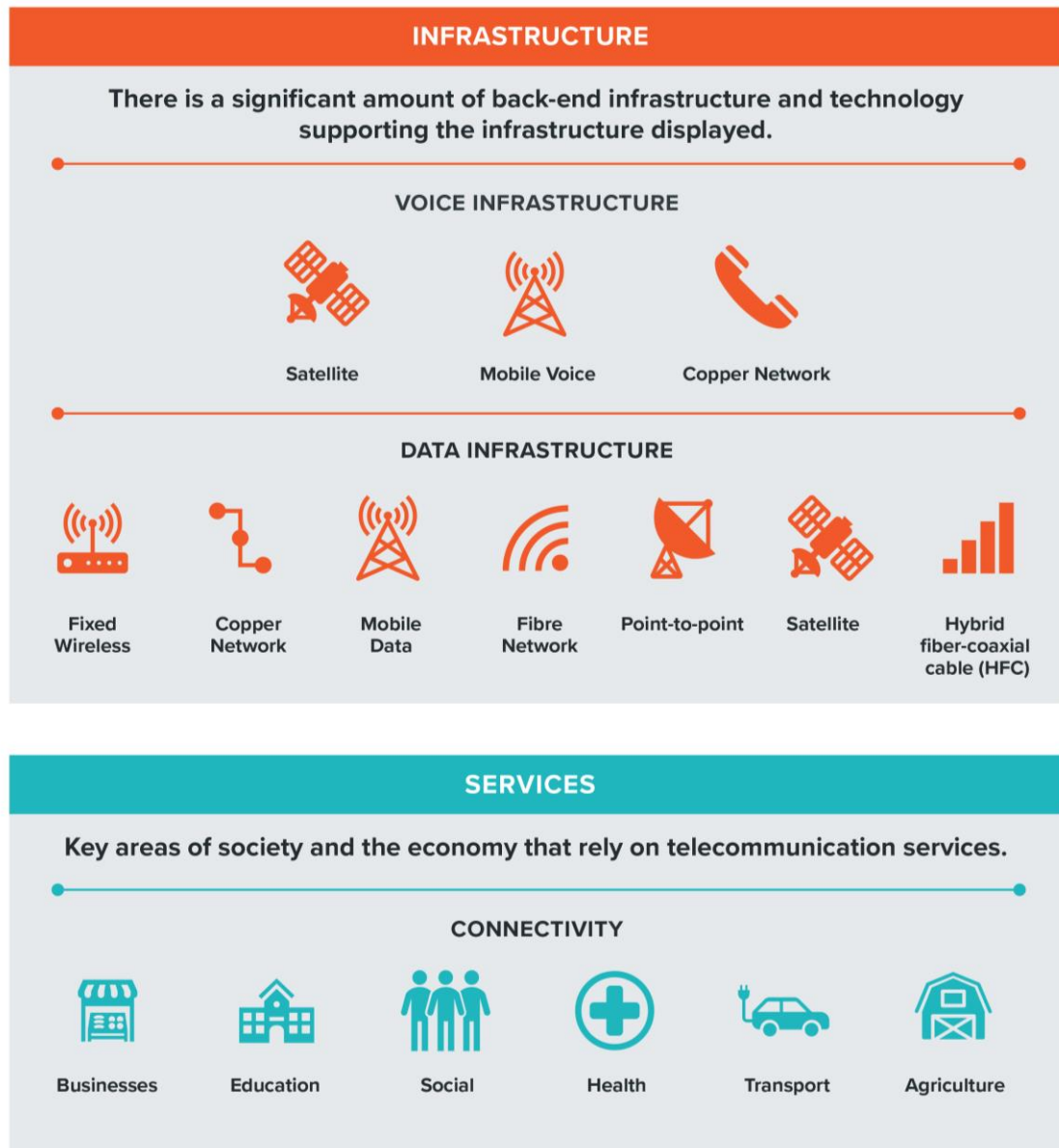
Telecommunications infrastructure covers the networks and associated property and equipment that carry voice and data between users across New Zealand and to other parts of the world. This includes:

- Voice services:²
 - Copper network
 - Mobile voice networks (3G and 4G)
- Data services:
 - Broadband internet services:
 - Fibre network
 - Copper network (VDSL and ADSL)
 - Fixed wireless
 - HFC (hybrid fibre-coaxial)
 - Point-to-point wireless
 - Satellite
 - Mobile data network:
 - 3G
 - 4G
 - 5G
 - Radio spectrum
 - Submarine communications cables
 - Data storage.

The connectivity of ideas and information provided by telecommunications infrastructure is important for our society, culture, and economic growth. It connects families, whanau, and communities across the country, New Zealand businesses domestically and to international markets, enables the virtual provision of health services, and provides a vast number of other services including the frictionless movement of data across sectors like transport and agriculture. The services and corresponding infrastructure are shown in Figure 1 below.

² Whilst today they remain somewhat discrete, we are observing the convergence between voice and data services onto the same network. Where they were discrete networks in the past, voice services are increasingly served via data that includes functionality like video calling.

Figure 1: Telecommunications infrastructure and corresponding services



Source: New Zealand Infrastructure Commission, Te Waihanga

As data is increasingly becoming an essential ingredient in a productive economy, the importance of services provided by telecommunications infrastructure has grown substantially relative to other sectors over the past decades. The National Bureau of Economic Research (NBER) in the US notes that investment in digital infrastructure has grown the fastest of all sectors and roughly tenfold from the 1980s to 2017.³ A similar trend has been observed in New Zealand, with

³ Jennifer Bennett, Robert Kornfield, Daniel Sichel and David Wasshausen, "Measuring Infrastructure in Bea's National Economic Accounts" National Bureau of Economic Research. 27446, p.4-33. DOI 10.3386/w27446

investment in telecommunications 4th in the OECD, proportional to GDP⁴ at \$1.7b in 2018/19.⁵ This highlights how connectivity has permeated through society and crystallised into significant investment.

Covid-19 highlighted the importance of telecommunications infrastructure, supporting work from home as well as the migration of essential services like education and health from in-person to virtual. However, the pandemic also highlighted concerns around the digital divide, illustrated by the Ministry of Education having to arrange internet connections and devices for households that lacked connectivity.⁶ While the digital divide has other facets not directly related to infrastructure such as skills, motivation, and trust, there are affordability and access issues that highlight service inequality.⁷ These issues are more likely to affect lower socio-economic communities, rural communities, Māori, seniors, people with disabilities, migrants, and those who have previously been incarcerated.

3.2 Physical assets

There is a wide range of infrastructure needed to provide voice and data services, and it is dependent on factors such as geography, economic feasibility, and the level of service desired.

Voice services are predominantly supplied by two networks: the fixed line network and mobile voice network. The first landlines arrived in New Zealand in 1881, and was followed by the development of a copper network that, at its peak, covered 98% of the country.⁸ In recent decades, three mobile networks have been built by Spark (previously Telecom), Vodafone, and 2degrees.

In the last decade, there has been a transformation of telecommunications assets consistent with step changes in technology. Since 2011, nearly 30,000km of fibre optic cable has been rolled out covering roughly 83% of New Zealand⁹ - see appendix four for more information. This is predicted to increase to 87% by 2022 which will deliver high-speed broadband services.¹⁰ Voice services are also available through the fibre network.

Modern mobile infrastructure is also foundational in telecommunication service provision. Loosely, these networks work by providing connectivity through cellular towers making use of the radio spectrum, with spectrum bands dependent on the technology. Currently, mobile coverage is

⁴ New Zealand Telecommunications Forum, *Key Trends in New Zealand Telecommunications: 2020 Industry report*. tcf-industry-report-2020-final-update-oct-2020-single-pages-lr.pdf, 2020. p.24.

⁵ Commerce Commission, *Annual Telecommunications Monitoring report*.

https://comcom.govt.nz/__data/assets/pdf_file/0021/212763/2019-Annual-Telecommunications-Monitoring-Report-Revised-version-12-March-2020.pdf, 2019. p.18.

⁶ "Internet access, computers and printed learning resources", Ministry of Education, last modified 24 November 2020. <https://www.education.govt.nz/covid-19/distance-learning/internet-access-computers-and-printed-learning-resources/>.

⁷ Woods, Dr Megan. "Digital Inclusion Blueprint." Digital Inclusion Blueprint. Accessed August 2020. <https://www.digital.govt.nz/dmsdocument/113-digital-inclusion-blueprint-te-mahere-mo-te-whakaurunga-matihiko/html>.

⁸ "The future of the copper network" Chorus, accessed August 2020. <https://www.chorus.co.nz/copper-network>.

⁹ The Treasury, *Quarterly Connectivity Update*. p.5.

¹⁰ The Treasury, *Quarterly Connectivity Update*. p.4.

available where over 95% of the population live and work but is expected to grow to 99.8% following several government initiatives (see Appendix five).¹¹

There are other technologies and infrastructure that provide connectivity depending on the situation. Mobile infrastructure can also offer wireless broadband through fixed wireless. Other technologies like point-to-point wireless and hybrid-fibre coaxial technologies are also available at specific locations across New Zealand.

There has been recent investment in New Zealand's data storage infrastructure. There are now numerous data centres across the country located in Auckland, Hamilton, Wellington, and Christchurch operated by organisations like Spark and Datacom.¹²

All of these services are enabled by three submarine fibre optic links that connect New Zealand to the world.¹³

Where fixed-line and mobile services aren't practical, connectivity can also be provided by satellite.

3.3 Capital flows

The relationship between natural capital and telecommunications infrastructure is relatively simple, raw materials are used to produce physical assets. This includes the steel, copper, fibre optics, as well as the land required to deliver services. Once the infrastructure is established, it again consumes natural capital for maintenance and operation.

The consumption of human capital is in the form of expertise to deliver the complex technology required to operate and maintain a national telecommunications network. This requires a significant and highly skilled workforce across the country. Unlike natural capital, connectivity is additive for human capital through enabling knowledge and skills. It is a key enabler for work, study, and recreation as was highlighted during the lockdown period of the Covid-19 pandemic.

In a similar vein to human capital, the use of social capital is reasonably unclear, although institutional stability is needed to provide any infrastructure service. However, telecommunications infrastructure makes a significant contribution to social capital. The connectivity of whanau, friends, and businesses is an essential ingredient in enabling our cultural identity, customs, values, and interests.

The flows of financial capital are well-defined. Both public and private financial capital is sourced from a diverse base and invested across the country. These monies are then blended with physical capital – the equipment, factories etc. – in the creation of the infrastructure we use. There is also capital flow in the fees charged for the consumption of services.

3.4 Wellbeing

Telecommunications has a broadly positive impact across the 12-wellbeing domains defined in the Living Standards Framework shown in Figure 2. There are no instances where a domain was

¹¹ "Mobile Blackspots" Crown Infrastructure. Accessed August 2020.
<https://www.crowninfrastructure.govt.nz/blackspots/what/>.

¹² "Cloudscene – Find data centers and cloud service providers", Cloudscene. Accessed August 2020.
<https://cloudscene.com/market/data-centers-in-new-zealand/all>.

¹³ "Cable Landing Stations in New Zealand", Submarine Networks.
<https://www.submarinenetworks.com/stations/oceania/new-zealand>. Accessed November 2020.

thought to be negatively impacted. However, it is important to note, these benefits may not be felt equally across New Zealand.

Figure 2: Impact of connectivity on the 12-wellbeing domains



Statistics New Zealand also measures over 100 indicators of social, economic, and environmental wellbeing. Under current wellbeing, two indicators are most relevant to the services offered by telecommunication infrastructure.

The first indicator, loneliness, is assessed across a two-year frequency and recorded at 16.6% of New Zealanders aged 15 and over feeling lonely at least some of the time in the last four weeks in 2018. This is up from roughly 14% in 2014, however marginally lower than 17% in 2016. This loneliness is most acutely felt by young people, female, Māori, and Asian peoples.¹⁴ Contact with family/ whānau and friends is the second key indicator that is relevant to telecommunication. However, this indicator is still under development.

¹⁴ "Wellbeing data for New Zealanders", Stats NZ. <https://wellbeingindicators.stats.govt.nz/>. Accessed August 2020.

There has been growing global collaboration on data sovereignty of indigenous peoples. In New Zealand this is led by Te Mana Raraunga whose purpose is to enable Māori data sovereignty and to advance Māori aspirations for collective and individual wellbeing.¹⁵

The Department of Internal Affairs (**DIA**), as part of their work on digital inclusion, maintain an individual's wellbeing is increased by being digitally included.¹⁶ Those who do not participate digitally are missing out on opportunities and services that are only available to those who do. This is reinforced by evidence from the UK and the Good Things Foundation, which showed that people who were digitally included had higher earning potentials, saved time, and had a higher likelihood of employment. For example, the report estimated time savings enabled by financial and government transactions online would be worth £1.1 billion to the UK economy by 2028.¹⁷

Whether it's data or connectivity, it is clear that the services provided by telecommunications infrastructure are fundamental in enabling the wellbeing of New Zealanders, and if anything, our reliance on telecommunications infrastructure will increase in the future.

¹⁵ "What we do", Te Mana Raraunga. Accessed August 2020.

<https://www.temanararaunga.maori.nz/kaupapa>.

¹⁶ "Digital Inclusion Outcomes Framework", Digital Government. Accessed August 2020.

<https://www.digital.govt.nz/dmsdocument/167~digital-inclusion-outcomes-framework/html>.

¹⁷ Digital Government, "Digital Inclusion Outcomes Framework".

4 What shapes the sector today?

He aha ngā whakaawenga ki te rāngai i ēnei rā?

4.1 Current ownership and governance of telecommunications infrastructure in New Zealand

New Zealand's telecommunications sector dates to the 1800s, when the government's first telegraph network emerged. The New Zealand Post Office became the lead agency for telecommunications and was responsible for the first telephone exchange in Christchurch in 1881. The Post Office would remain responsible for telecommunications until the 1980s, at which time Telecom New Zealand was created as a separate government-owned entity. In 1989, the sector was one of the first in the world to be deregulated leading to the privatisation of Telecom.¹⁸

Today, New Zealand's telecommunications sector includes a number of privately-owned companies, with government-led investment now often blended with private capital to provide infrastructure.

The Ultra-Fast Broadband (**UFB**) initiative dates back to 2008 in response to global telecommunication trends in Southeast Asia and the relative low quality of internet in New Zealand. The initiative aimed to provide 75% of New Zealanders with broadband connections offering 100Mbps download speeds and 50Mbps upload speeds. This precipitated major changes in the telecommunications sector.¹⁹

Firstly, to deliver UFB, Crown Fibre Holdings (**CFH**) was established to manage the \$1.7 billion government investment in ultra-fast broadband. CFH then contracted expertise to deliver the project on a public-private partnership basis including private co-investment. In 2017, CFH was given additional responsibility relating to bulk housing infrastructure and consequently was formally renamed and repurposed as Crown Infrastructure Partners (**CIP**).²⁰

As part of the contracting process to deliver UFB, Chorus won 69.4% of the rollout, requiring Telecom's structural separation²¹ in 2008, forming the separate companies of Spark and Chorus.²² Spark became a provider of services (a retail service provider) and retained the mobile network, with Chorus becoming a wholesale provider taking the majority of the existing infrastructure, including Telecom's copper network.²³

¹⁸ "Telecom corporation of New Zealand limited", Reference for Business, accessed November, 2020. Telecom Corporation of New Zealand Limited - Company Profile, Information, Business Description, History, Background Information on Telecom Corporation of New Zealand Limited (referenceforbusiness.com)

¹⁹ Fernando Beltran, "New Zealand's Ultra-Fast Broadband Network" (University of Auckland, 2012).

²⁰ "About", Crown Infrastructure. <https://www.crowninfrastructure.govt.nz/about/>. Accessed August 2020.

²¹ Structural separation is where the entity is split into two new entities with completely separate legal ownership.

²² "Chorus", Ultra-Fast Broadband New Zealand. Accessed November 2020 <https://ufb.org.nz/broadband-providers/chorus/>.

²³ New Zealand Herald, "Plenty of pomp as Chorus and Telecom Part." Accessed November 2020. <https://www.nzherald.co.nz/business/plenty-of-pomp-as-chorus-and-telecom-part/QOJJYOAKB5IQPB6KLJ2C2S6M5Y/>.

Consequently, New Zealand's copper network, which reaches 98 percent of premises and forms the basis of fixed-line phone, dial-up, and ADSL and VDSL internet, is owned by Chorus. The network is open for unbundling and open access, meaning other service providers can rent lines and obtain services from Chorus in order to provide their own retail broadband services.

Chorus is a publicly listed company in which the government retains a stake in the form of equity and debt instruments under the contractual arrangements relating to the UFB's deployment and the initial \$929 million of government capital that went into UFB rollout.

Together, the UFB, fixed-wireless, and mobile programmes are growing both access and the quality of telecommunications infrastructure. They are being driven through several partnerships between the government's Crown Infrastructure Partners, Chorus, and three other Local Fibre Companies (LFCs):

1. Northpower Fibre, a joint venture between CIP and Northpower Limited, provide 1.6 - percent of the network. Northpower Fibre is still 50 percent owned by Crown Infrastructure Partners and 50 percent owned by the Northpower. Northpower are owned by a community trust and the local lines company (electricity distribution business) based in Whangarei.²⁴
2. Enable Networks, a joint venture between Crown Infrastructure Partners and Enable Services Limited (Christchurch City Council) provides 15.3 percent of the network. Crown Infrastructure Partner's stake has been bought out by Christchurch City Holdings Limited (CCHL) meaning 100 percent is owned by the council through CCHL;²⁵ and
3. UFF was originally structured the same as the other LFCs until Waikato Networks Limited (WEL Networks Ltd 85 percent and Waipa Networks Ltd 15 percent) acquired Crown Fibre Holdings interest prior to the rollout of UFB2. The business was sold to First State Investments Ltd in May 2020.²⁶ UFF provides 13.7 percent of the network.²⁷

In 2017, CIP assessed that 90,000 rural homes and businesses would not be able to access broadband at speeds greater than 20Mbps. This resulted in the Rural Broadband Initiative phase two/Mobile Black Spots Fund (RBI2/MBSF) which has been rolling out rural fixed wireless and mobile coverage. CIP has partnered with nine regional Wireless Internet Service Providers (WISPs) and the Rural Connectivity Group (RCG) which is a joint venture subsidiary of the three mobile network operators.²⁸

²⁴ "Opening up new opportunities for Northland", North Power. Accessed November 2020. <https://northpower.com/fibre/about-us>.

²⁵ "Enable Networks", UFB New Zealand. Accessed November 2020. <https://ufb.org.nz/broadband-providers/enable-networks-lfc/>.

²⁶ Gavin Evans, "WEL, Waipa sell fibre business to overseas investor for \$854m", *New Zealand Herald*, May 12, 2020. <https://www.nzherald.co.nz/business/wel-waipa-sell-fibre-business-to-overseas-investor-for-854m/MN6JPBV6AGRWXFD3YOQN6APNNE/#:~:text=Hamilton%2Dbased%20WEL%20and%20neighbouring,State%20Investments%20for%20%24854%20million.&text=First%20State%2C%20which%20also%20owns,would%20remain%20headquartered%20in%20Hamilton>.

²⁷ "Ultrafast Fibre", Ultra-Fast Broadband New Zealand. Accessed August 2020. <https://ufb.org.nz/broadband-providers/ultrafast-fibre-lfc/>.

²⁸ "What is the Rural Broadband Initiative phase two (RBI2)? Crown Infrastructure. Accessed August 2020. <https://www.crowninfrastructure.govt.nz/rural/what/>.

The Provincial Growth Fund was also used as a tool to fund regional connectivity contributing \$40m towards RBI2/MBSF.²⁹

Other technologies are also being used to provide broadband services where it is currently difficult. In rural areas, Wireless Internet Service Providers or WISPs are offering faster broadband by connecting to a central fibre link and transmitting signals through hilltop receivers to isolated communities.³⁰

The government has also made several interventions in recent years to address other more specific areas of need:

- Fibre ‘backhaul’ links to be deployed on the West Coast and in Southland to improve resilience of connectivity in these parts of New Zealand.³¹
- A marae connectivity programme, providing broadband to marae around the country as well as equipment to take advantage of the broadband.³²
- A \$15m programme to improve capacity and backhaul on rural networks.³³
- A \$50m programme to boost broadband coverage and capacity across regional New Zealand.³⁴

Chorus and the LFCs act as wholesalers only for internet services, with Retail Service Providers (**RSPs**) providing services to customers. The retail market for UFB services is competitive with numerous RSPs providing services on the network.³⁵

Aside from the new network being rolled out by RCG, the existing mobile networks are wholly owned by Spark, Vodafone, and 2degrees. The underlying ownership of these major providers is as follows:

- Spark is a publicly listed company on the New Zealand and Australian stock exchanges.
- Vodafone New Zealand is 50 percent owned by New Zealand company Infratil and 50 percent by Canadian company Brookfield Asset Management. The transaction completed by Infratil and Brookfield took place in 2019 for NZ\$3.4 billion.³⁶
- 2degrees is 51.1 percent owned by Trilogy International a Canadian listed, American based wireless telecommunications business, and a Dutch company, Tesbri BV who own

²⁹ “PGF to improve regional digital connectivity”, The Beehive. Accessed November 2020.

<https://www.beehive.govt.nz/release/pgf-improve-regional-digital-connectivity>.

³⁰ Wispa New Zealand. Accessed November 2020. <https://www.wispa.nz/>.

³¹ “Better digital connectivity coming for West Coast and Southland”, The Beehive. Accessed August 2020. <https://www.beehive.govt.nz/release/better-digital-connectivity-coming-west-coast-and-southland>.

³² “Digital connectivity boost for urban marae” <https://www.beehive.govt.nz/release/digital-connectivity-boost-urban-marae> and “Investment to deliver better connected marae and communities in the regions” <https://www.beehive.govt.nz/release/investment-deliver-better-connected-marae-and-communities-regions>, The Beehive. Accessed August 2020.

³³ “Rural broadband upgrade to boost COVID-19 recovery in remote communities”, The Beehive. Accessed August 2020. <https://www.beehive.govt.nz/release/rural-broadband-upgrade-boost-covid-19-recovery-remote-communities>.

³⁴ “First project utilising \$50 million ‘shovel ready’ fund for rural broadband announced”, The Beehive. Accessed August 2020. <https://www.beehive.govt.nz/release/first-project-utilising-50-million-shovel-ready-fund-rural-broadband-announced>.

³⁵ “Broadband Providers”, Ultra-Fast Broadband New Zealand. Accessed November 2020. <https://ufb.org.nz/broadband-providers/>

³⁶ “Infratil announces acquisition of Vodafone New Zealand”, *Infratil*, May 14 2019. Accessed November 2020. <https://infratil.com/for-investors/announcements/2019/infratil-announces-acquisition-of-vodafone-new-zealand/>.

49.9 percent.³⁷ The Hautaki Trust historically owned 10 percent of the business but in 2017 when Trilogy International listed on the Toronto Stock Exchange, Hautaki exchanged its shares in 2degrees to shares in Trilogy International.^{38, 39}

There are three major international fibre submarine cables that connect New Zealand to the world. They are:⁴⁰

- **The Southern Cross Cable.** The first major international submarine cable that connected New Zealand to the USA in 2000. It was the only major cable connecting New Zealand between 2000 and 2018. It is roughly 30,500 km long, connects to Australia through Whenuapai, and to Hawaii from Takapuna. It is owned by Southern Cross Cables Limited, a partnership between telecommunications providers in NZ, Australia, and the US. Spark owns a 38 percent interest in the cable.⁴¹
- **The Tasman Global Access (TGA).** A 2,288 km cable connecting New Zealand to Australia, landing in Raglan. It is owned by Spark, Vodafone, and Telstra and was commissioned in 2017.
- **The Hawaiki Submarine Cable.** A 15,000 km cable connecting NZ to the US from Mangawhai. It was commissioned in 2018, with ~NZ\$455 million of capital privately sourced.⁴² The government supported the development of the cable through REANNZ, who were an anchor tenant for cable when it was launched.⁴³

³⁷ Rebecca Howard, "Tesbri gets greenlight to buy up to 49.9% of 2degrees". *NBR*, July 31 2017. <https://www.nbr.co.nz/article/tesbri-gets-greenlight-buy-499-2degrees-should-opportunity-arise-b-205905>.

³⁸ "2degrees founder ousted", *Otago Daily Times*, July 10 2012. <https://www.odt.co.nz/business/2degrees-founder-ousted>.

³⁹ "About", Te Huarahi Tika. Accessed August 2020. <https://www.thtt.co.nz/about-hautaki>.

⁴⁰ Submarine Cable map

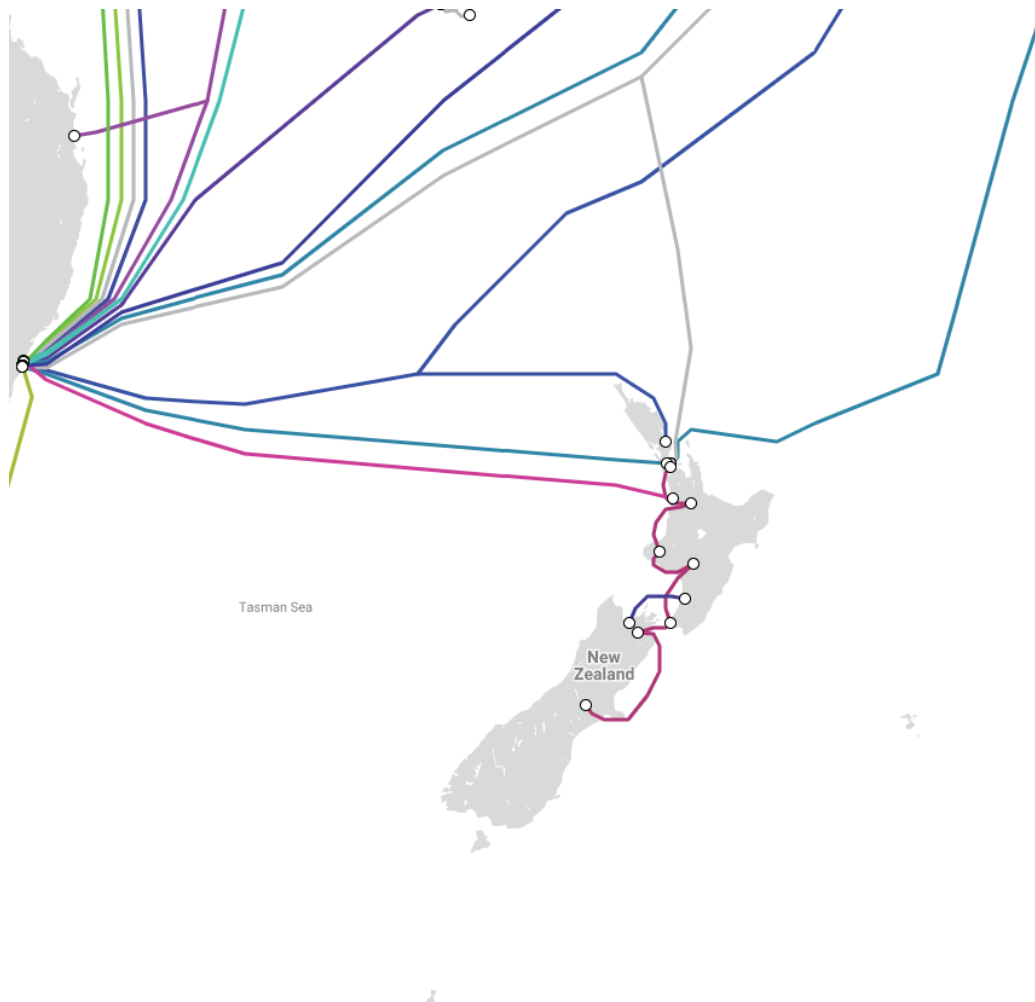
⁴¹ Winston Qiu, "Southern Cross NEXT Cable System Overview", *Submarine Networks*, March 1 2020. <https://www.submarinenetworks.com/en/systems/trans-pacific/southern-cross-next/southern-cross-next-cable-system-overview#:~:text=Southern%20Cross%20Cable%20Limited%20was,Southern%20Cross%20NEXT%20subsea%20cable>.

⁴² Tom Pullar-Strecker, "\$445m NZ internet cable opens for traffic". *Stuff News*, July 20 2018. <https://www.stuff.co.nz/business/105624605/445m-nz-internet-cable-opens-for-traffic>.

⁴³ "Hawaiki seals new capacity deal with REANNZ to boost global research collaboration", *REANNZ*, February 20 2020. <https://www.reannz.co.nz/news-and-events/hawaiki-seals-new-capacity-deal-with-reannz-to-boost-global-research-collaboration/>.

Major international cables, as well as domestic fibre links are shown in Figure 3 below.

Figure 3: New Zealand's submarine cable network



Another major international cable set for construction is the Southern Cross Next. This will operate in a similar partnership through Southern Cross Cables Limited, with the New Zealand interest funded by Spark. The cable will be approximately 14,000km, will connect New Zealand to the US and Pacific through Takapuna, and is expected to be ready for service in 2022. Domestically, the Acqualink Cable is another major piece of telecommunications infrastructure. The cable was built in 2001 and connects major international fibre links in Auckland down to the Waikato, Taranaki, Manawatu-Wanganui, Wellington, Marlborough, and Canterbury. The cable is owned by Vodafone.

Spark also owns and operates a 212 km submarine link between Nelson and Levin, that was commissioned in 2001..⁴⁴

⁴⁴ Te Huarahi Tika "About".

A summary of New Zealand's telecommunications ecosystem is shown in Figure 4 below.

Figure 4: New Zealand's telecommunications ecosystem



Another piece of important telecommunications infrastructure in New Zealand, is the radio spectrum, defined as electromagnetic energy of frequencies lower than 3000 GHz. It is managed by the Crown, through MBIE, on behalf of the public⁴⁵. Management of the radio spectrum is essential given the potential for interference with critical lifesaving infrastructure, for example air traffic radar.

⁴⁵ Radio Spectrum Management. Accessed November 2020. <https://www.rsm.govt.nz/>.

Frequency bands are planned for various uses depending on the purpose and technology. The government licences and auctions frequency bands for periods of up to 20-years allowing telecommunication services to be provided. From an infrastructure perspective, this is crucial in the provision of 3G, 4G, and 5G mobile infrastructure.⁴⁶ There is a direct trade-off between spectrum and amount of infrastructure needed to provide services – the more spectrum the fewer towers and vice versa.

In 2019, the Government gave the go-ahead for the 3.5 GHz band to be used for 5G networks, with spectrum rights being allocated in 2020 through auction. Due to Covid-19, the auction was cancelled, and a direct allocation process followed. This resulted in the offers of 40 MHz to Dense Air, 60 MHz to Spark, and 60 MHz to 2degrees, with Vodafone having long-dated existing ownership of a 3.5 GHz spectrum band.⁴⁷

Dense Air is an international telecommunications company based in London, operating spectrum assets in Europe, Australia, and New Zealand. They are a carrier of carriers, meaning they sell wholesale services, agnostic of retail carrier across 4G LTE and 5G spectrum. In addition to 5G spectrum, in 2018 Dense Air acquired 70MHz of spectrum in the 2.5Ghz band on the secondary market, with the intention of offering complementary services to the existing mobile network operators.⁴⁸

The Government has allocated part of the 3.5 GHz spectrum for Māori use.⁴⁹

4.2 The regulatory and policy environment

Given the risk of monopolistic behaviour in pockets of the telecommunications sector, the Commerce Commission plays an important regulatory role. The regulatory regime has evolved in recent years to reflect technological changes and has regulatory frameworks dedicated to particular subject areas such as fibre wholesale services or copper line wholesale services.

For copper line services, the Commerce Commission enforces a wholesale regulatory framework with service determinations, which includes setting the maximum price Chorus may charge retail service providers (RSPs) and the minimum service quality standards to be met. Pursuant to the Telecommunications Act 2001,⁵⁰ wholesale prices are set by the Commerce Commission.⁵¹ For several years, the network has been open for unbundling, which is where retail service providers install their own equipment in the network and only rent the bare copper lines.

In 2018, there were changes in the regulatory environment providing for the deregulation of the copper network from 1 January 2020 in those areas where fibre is available, and the right for Chorus to withdraw copper services subject to a number of consumer protections being in place.

⁴⁶ "Spectrum licensing and management rights", Radio Spectrum Management. Accessed November 2020. <https://www.rsm.govt.nz/about/our-work/spectrum-licensing-and-management-rights/>.

⁴⁷ "Preparing for 5G in New Zealand", Radio Spectrum Management. Accessed November 2020. <https://www.rsm.govt.nz/projects-and-auctions/current-projects/preparing-for-5g-in-new-zealand/>.

⁴⁸ "Mobile Market Study – Findings", Gale *et al.* Commerce Commission. p.31. Accessed August 2020. https://comcom.govt.nz/__data/assets/pdf_file/0022/177331/Mobile-Market-Study-Findings-report-26-September-2019.PDF.

⁴⁹ "Government enables early access to 5G spectrum", The Beehive. Accessed November 2020. <https://www.beehive.govt.nz/release/government-enables-early-access-5g-spectrum>

⁵⁰ Telecommunications Act 2001.

⁵¹ "Commission's role in telecommunications". Commerce Commission. Last modified 25 November 2019. Accessed November 2020. <https://comcom.govt.nz/regulated-industries/telecommunications/commissions-role-in-telecommunications>.

For fibre connectivity, a wholesale regulatory framework has been introduced that will replace the price controls through contracts that Local Fibre Companies and Chorus have with the Crown through CIP.

Chorus is subject to price/quality regulation which sets out the maximum allowable revenue they can earn. However, within that revenue cap there are no regulatory controls on Chorus' price discrimination ensuring consumers are protected from monopoly powers. The other Local Fibre Companies (Enable Fibre, Northpower Fibre, and Ultrafast Fibre) are subject to information disclosure – the same regulations as airports – which essentially makes financial/forecast information public. This form of regulation does not stop excessive profits but is a deterrent.⁵²

Similar to copper, the government had concerns about continued investment and innovation by the monopoly. This has been addressed via a number of interdependent mechanisms. Structural separation, competition from competing technologies, a building blocks regime and an obligation to unbundle.

At a high-level there are numerous network layers stemming from the Open System Interconnection model. For the purposes of unbundling, only the first two layers are of significance: Layer 1 being the physical fibre connection and Layer 2 being bitstream access or the movement of data between points.⁵³ An example of Layer 2 services would be a fibre plan of 100Mbps download, and 20Mbps upload that sits 'above' the physical fibre connection, Layer 1. Unbundled fibre services sit on top of Layer 1 meaning the retail service providers rent the physical connection but can develop bespoke Layer 2 services that support differentiated retail services to customers.

The unbundling that is being offered provides for an RSP to invest and use their own electronics – avoiding the cost of paying Chorus' electronics.⁵⁴ This requires the RSP equipment to be co-located with Chorus'. Fibre unbundling has yet to be implemented and depends on commercial negotiation by network operators in the industry.⁵⁵

Although there is a lower level of regulation than broadband, targeted regulation across mobile infrastructure has enabled competition to develop and facilitated the entry of the third mobile network operator (2Degrees) into the market. The Commerce Commission monitors performance, development, and competition in the telecommunications market and conducts inquiries/reviews where appropriate.

Regulation specifically governs the auctioning of spectrum bands under the Radiocommunications Act 1989, overseen by Radio Spectrum Management at MBIE. Under the Act, property rights were established for spectrum bands. Following a review in 2005, there is a defined spectrum auction design that ensures a competitive allocation.⁵⁶

⁵² "Fibre price-quality path and information disclosure". Commerce Commission. Last modified 26 October 2020. Accessed November 2020. <https://comcom.govt.nz/regulated-industries/telecommunications/projects/fibre-price-quality-path-and-information-disclosure>.

⁵³ "Untangling Fibre Unbundling", The Download. Accessed August 2020. <https://thedownload.co.nz/our-stories/untangling-fibre-unbundling/>.

⁵⁴ Sarah Putt. "Fibre network unbundling, the New Zealand way", *Computer World*, June 25, 2020. <https://www.computerworld.com/article/3563927/fibre-network-unbundling-the-new-zealand-way.html>

⁵⁵ "Unbundled layer 1 fibre service", Commerce Commission, last modified October 26, 2020 <https://comcom.govt.nz/regulated-industries/telecommunications/projects/unbundled-layer-1-fibre-service>.

⁵⁶ Ministry of Economic Development. *Spectrum Auction Design in New Zealand*. Wellington: Ministry of Economic Development, 2005. <https://www.rsm.govt.nz/assets/Uploads/documents/8380f2d85e/spectrum-auction-design-in-new-zealand.pdf>.

The New Zealand Telecommunications Forum (**TCF**) is the industry association, representing a large number of agents in the telecommunications sector.⁵⁷ It coordinates the development of access codes for regulated services and industry contributions on regulatory matters.

4.3 Market structure and how assets are financed

Because the fibre and copper line markets have monopoly power characteristics, these markets are regulated. The private capital made available for investment is therefore highly sensitive to the rate of financial return that the regulated pricing allows. Currently this results in a blend of public and private capital combining to charge users for the infrastructure they use.

In rural areas where there are only small numbers of users and it is not economically feasible for the private sector to build the network infrastructure needed, the Government has funded the Rural Broadband Initiative Phase 2 to increase number of households with broadband connectivity. These households pay for the infrastructure they use, but in combination with a taxpayer subsidy.

From an economic perspective this is efficient with users effectively paying for the level of service they use – internet plans for greater levels of data are generally more expensive. However, this increasingly presents a socio-economic issue where cost is a barrier to access infrastructure.

The effect unbundling will have on the market is yet to be seen. The unbundling of the copper network led to some competitive intensification. However, the wholesale price was regulated, and while there is a pathway to regulate the wholesale price of fibre in a similar way, the expectation is that a ‘fair-price’ will be established on a commercial basis. Similarly, given New Zealand’s relatively advanced global position in household fibre, the technology and economics of fibre unbundling is not yet well developed.

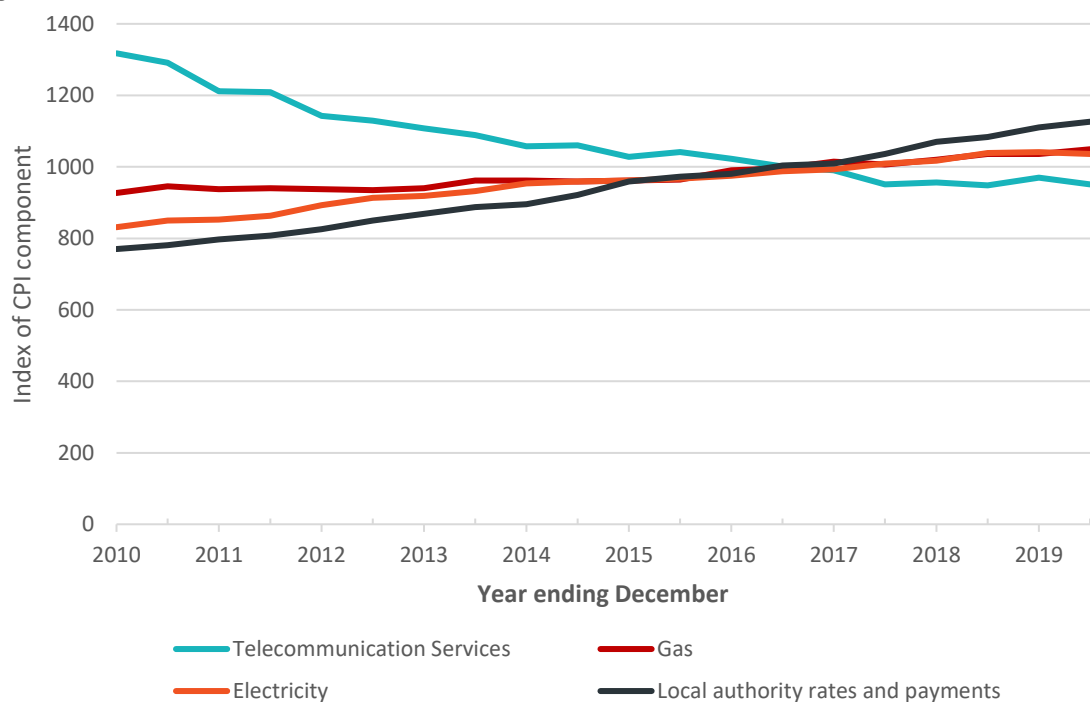
For mobile services, competition has improved over the course of the last decade after the entrance of 2degrees in 2009, with benefits to consumers in terms of choice, quality, and price – the price elements shown in Figure 5 below. This results in light regulation with the Commerce Commission reporting on price and quality in comparison to international standards. However, there remain significant barriers for new entrants into the mobile market, specifically around spectrum, the sharing of roaming services, and access to infrastructure.⁵⁸ Despite this, Dense Air have entered the market, acquiring spectrum and offering services to the three mobile network operators to address coverage pockets of their networks.⁵⁹

⁵⁷ “Member Brands”, The New Zealand Telecommunications Forum. Accessed August 2020. <https://www.tcf.org.nz/consumers/about-us/member-brands/>.

⁵⁸ Ministry of Business, Innovation and Employment, “*Announcements on the future of communications regulation*” accessed via <https://www.beehive.govt.nz/sites/default/files/Fact%20sheet%20-%20Announcements%20on%20the%20future%20of%20communications%20regulation.pdf>. Accessed August 2020. p.6.

⁵⁹ Gale *et al*, “Mobile Market Study – Findings” p.31.

Figure 5: Consumer Price Index: telecommunication services



Source: Statistics New Zealand, TCF

4.4 A sector where resilience is increasingly important

Recent research from the New Zealand Lifelines Council, an agency focusing on the resilience of lifeline utilities, points to the complexity of measuring the resilience of the sector given the rapid change in technology and complexity in interconnectivity.⁶⁰ Inherent to sectors with relatively high levels of private capital participation, the main driver of investment in resilience is the commercial incentive to keep customers connected. Evidence from the Christchurch earthquakes supports this, with most mobile services restored within 24 hours.⁶¹

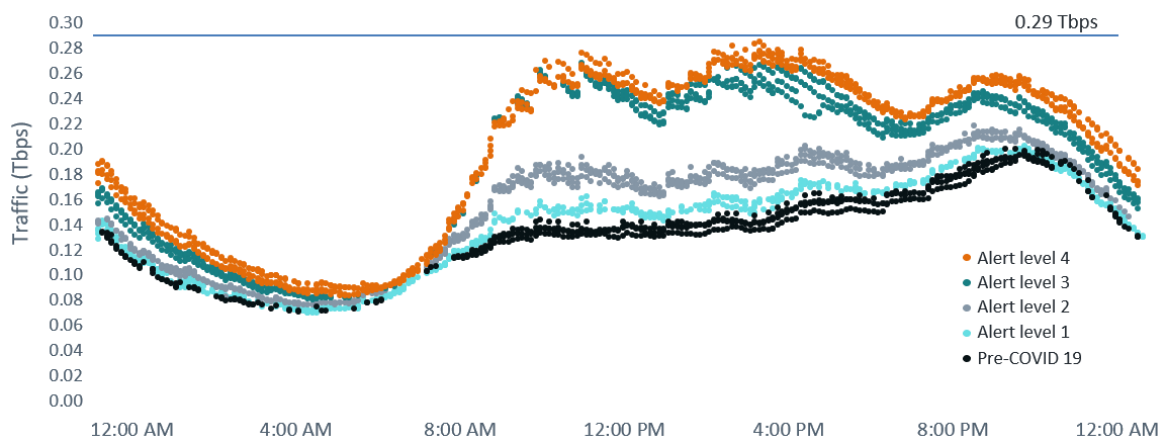
Recent evidence suggests that New Zealand's broadband internet services are resilient in a demand and supply context. Covid-19 resulted in stay-at-home orders on 26 March 2020, after which Chorus reported record levels of internet traffic during the early stages of the lockdown – shown in Figure 6 below. However, fixed-line broadband connections experienced no significant drops in download speed during the first week of the lockdown. Download speeds for DSL and UFB Fibre 100 services were unaffected on average, with only minor decreases for UFB Fibre Max services reported. The most impacted service was fixed wireless, for which speeds decreased by 20 to 25 percent.⁶² In general terms, broadband services were maintained at near-to-normal speeds enabling businesses, and providers of education and health services, to function despite the requirements of lockdown. This was a significant success for the sector and corresponding infrastructure.

⁶⁰ Civil Defence, *New Zealand Critical Lifelines Infrastructure National Vulnerability Assessment*. 2020. p.45. <https://www.civildefence.govt.nz/assets/Uploads/lifelines/nzlc-nva-2020-full-report.pdf>.

⁶¹The Treasury, *Infrastructure Evidence Base, Telecommunications Sector*. Published February 2014. <https://treasury.govt.nz/sites/default/files/2017-12/nip-evidence-telecommunications.pdf>.

⁶² Commerce Commission, *"Measuring Broadband New Zealand"*. May 2020. https://comcom.govt.nz/__data/assets/pdf_file/0020/216902/MBNZ-Autumn-2020-report-21-May-2020.pdf

Figure 6: Network traffic - Upstream



Source: TCF, Chorus

The Lifelines Council again provides rigorous research across mobile infrastructure resilience. There are several critical components of the infrastructure with the mobile exchanges the most critical from a network failure perspective. For this reason, the three main network operators are heavily protected with redundant links and automatic failovers. Furthermore, there is major dependence on the electricity network, with critical infrastructure having backup electricity supply often in the form of batteries. However, the Council notes that widespread outages after a period of time would impact telecommunications services.⁶³

In early 2020, the Commerce Commission launched a piece of work investigating the appropriate means of calling 111 in the event of power failure given the transition from copper lines to fibre. Historically copper lines work during power failure because they are powered from a source outside the premises.⁶⁴ However, as the country transitions to fibre and in some areas, copper will be withdrawn, there may be issues contacting emergency services in the event of power failure.

In response, the Commerce Commission has finalised a 111 contact code that recognises a subset of consumers who are more likely to contact emergency services and hence sets out mandatory requirements on the providers of certain telecommunications services with appropriate means of contacting 111 in the event of power failure.⁶⁵

Looking to the future, as technology has advanced and our societies have become increasingly digitised, telecommunications infrastructure will play an increasingly important role in national resilience. An example of this is transport infrastructure with digital connectivity now making it possible to work from home when there is physical disruption. This was highlighted in September 2020 when the Auckland harbour bridge was damaged, and the New Zealand Transport Agency urged people to work from home.⁶⁶ This has been accelerated by the Covid-19 pandemic, with connectivity increasingly an important contributor to national resilience.

⁶³ Civil Defence, *New Zealand Critical Lifelines Infrastructure National Vulnerability Assessment*. p.45.

⁶⁴ Commerce Commission, “*Commission 111 contact code*”. Published 11 March 2020. p.12. https://comcom.govt.nz/__data/assets/pdf_file/0020/212717/Commission-111-contact-code-Draft-decisions-and-reasons-paper-11-March-2020.pdf.

⁶⁵ Commerce Commission, “*Commission 111 contact code*”. p.12.

⁶⁶ “Auckland Harbour Bridge update – 1pm”. NZ Transport Agency, September 29 2020. <https://nzta.govt.nz/media-releases/auckland-harbour-bridge-update-1pm/>. Accessed August 2020.

5 How is the telecommunications sector performing today?

Kei te pēhea te rāngai whitimamao i ēnei rā?

The New Zealand Infrastructure Commission, Te Waihangā assessed the telecommunications across three metrics: the price of infrastructure services, the level of access to the services, and the quality of the services provided.

5.1 Broadband

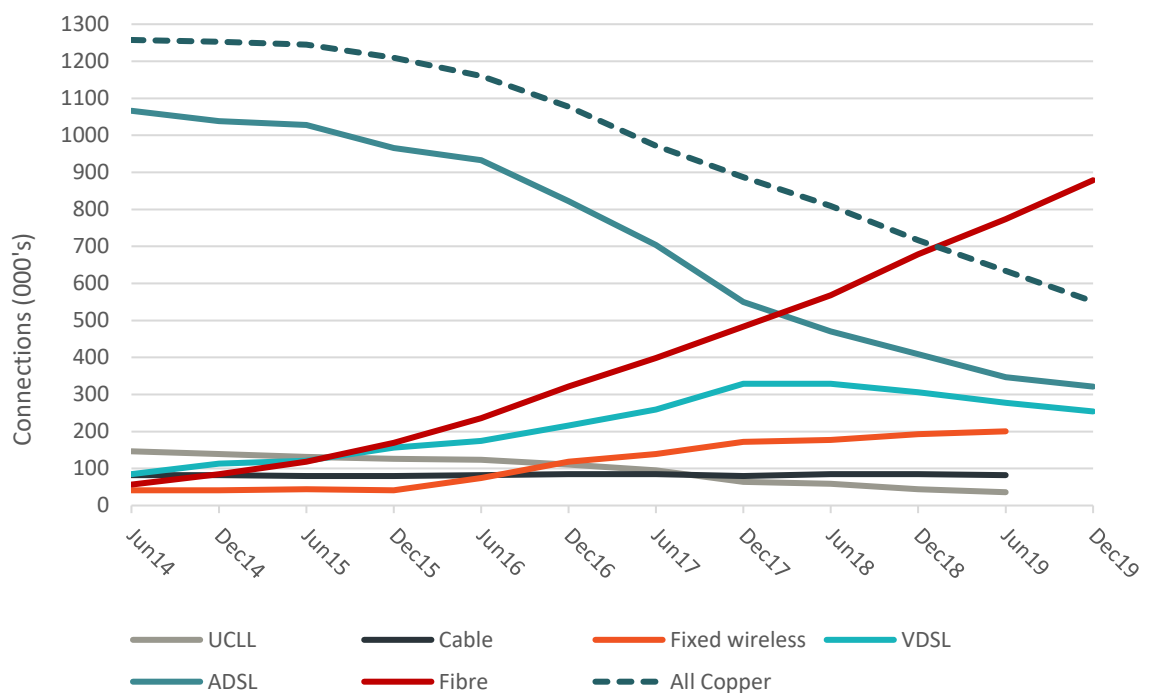
Of all sectors, telecommunications is facing the most rapid disruption in the form of new technologies and user demands on infrastructure. Data consumption on fixed broadband connections roughly tripled to 210 GB per month in the years 2015-2018.

In 2019, the number of fibre connections exceeded the number of copper connections for the first time – shown in Figure 7 below – highlighting the steady rollout of UFB with roughly 970,000 homes and businesses connected and an uptake of around 58 percent at that time. This is offering download speeds around 99 Mbps under a basic Fibre 100 plan and upwards of 600 Mbps on a maximum, Fibre Max plan.⁶⁷ The deviation in performance is not significant at peak times. This performance far exceeds the copper network of which there are still 270,000 VDSL users and 330,000 ADSL users getting download speeds of up to 44 Mbps and 9 Mbps respectively. Similarly, there are roughly 188,000 users of fixed wireless services with download speeds around 25 Mbps.⁶⁸

⁶⁷ Note that these aren't the only available plans in the market. These are the plans that are currently benchmarked by the Commerce Commission however there are new plans offering speeds of up to 4Gbps.

⁶⁸ Commerce Commission, *Annual Telecommunications Monitoring Report 2019*. March, 2019. p.6.
https://comcom.govt.nz/_data/assets/pdf_file/0021/212763/2019-Annual-Telecommunications-Monitoring-Report-Revised-version-12-March-2020.pdf.

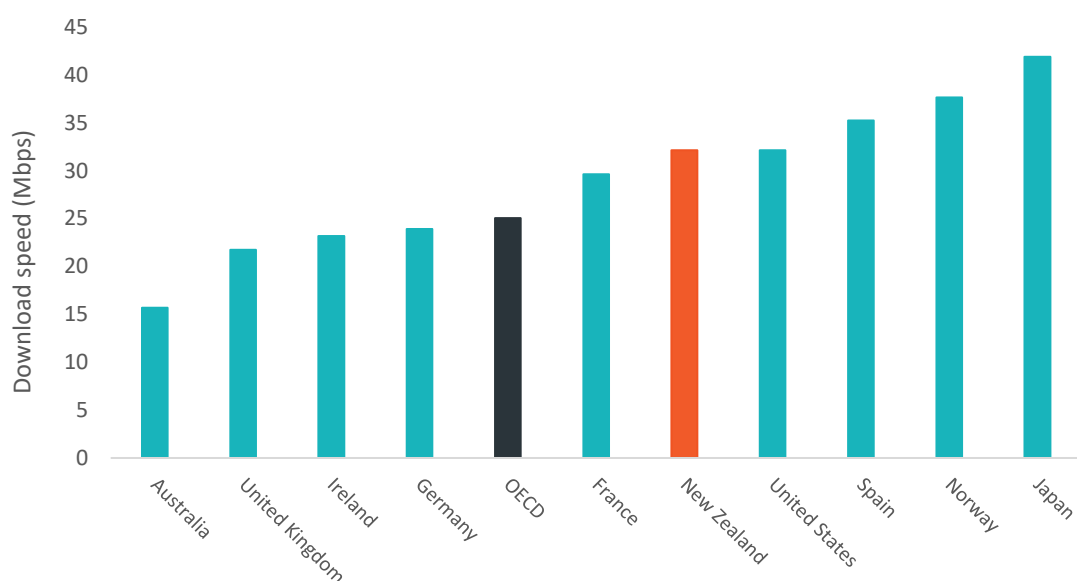
Figure 7: Fixed-line broadband connection by technology



Source: Commerce Commission, Chorus, MBIE, annual telecommunications questionnaire

The quality of New Zealand's broadband has improved significantly in recent times. A decade ago, average internet speed in New Zealand lagged the UK and Australia. Following the effective rollout of fibre and additional submarine cable links, New Zealand is now well above the OECD average and similarly placed to the USA with internet speeds averaging 33Mbps – shown in Figure 8 below.⁶⁹ As fibre uptake continues to increase our performance relative to the OECD is likely to improve. This is a significant success from an infrastructure perspective.

Figure 8: Average broadband download speed



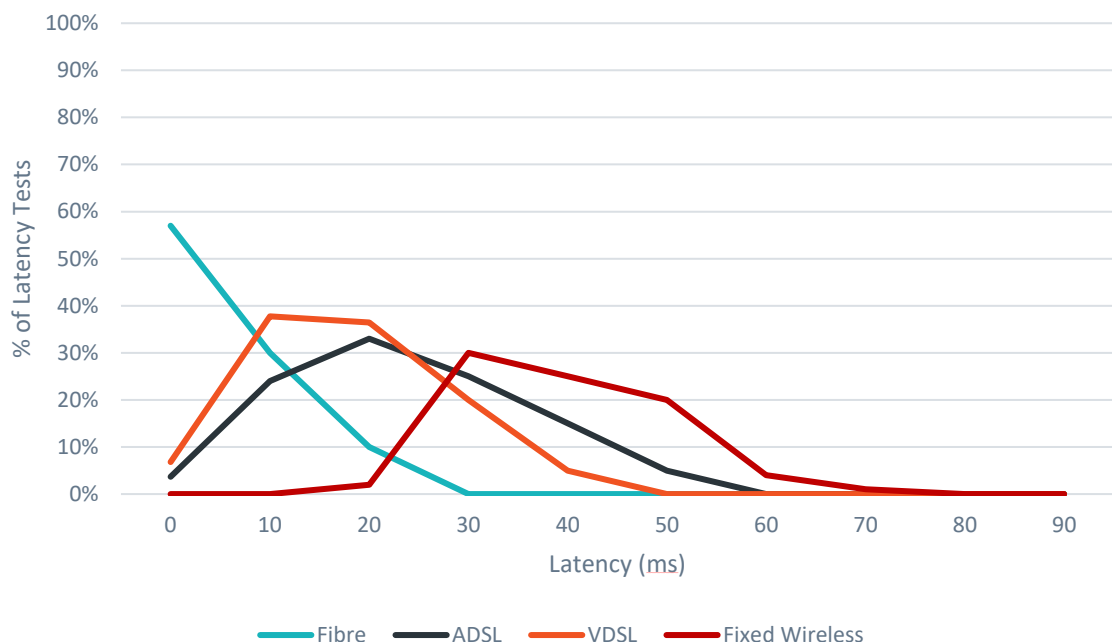
Source: Commerce Commission, Cable.co.uk

⁶⁹ Commerce Commission, *Annual Telecommunications Monitoring Report 2019*. p.16.

The quality and performance of New Zealand’s broadband was also stress tested during the disruption caused by Covid-19. The Commerce Commission looked closely at performance over this period through their Measuring Broadband in NZ Winter Report and found overall internet performance remained stable for the vast majority of households.⁷⁰

Latency, a measure of delay (or the time it takes for information to get from one point to another across a network) is also a key measure in assessing service performance, especially as experienced by users. As part of their winter report, the Commerce Commission assessed latency across plan types for uses like video conferencing, which became increasingly important as people relied on these services to work and learn from home. The results found the average latency across major video conferencing platforms were within a usable range across all plans. However, ADSL, VDSL, and Fixed Wireless services were more likely than fibre to experience delays during a call.⁷¹ Distribution of latencies by connections are shown in Figure 9 below.

Figure 9: Distribution of latency between households and test servers hosted in New Zealand (lower is better)



Source: Commerce Commission, SamKnows

Moreover, the analysis found there is no major discrepancy between urban and rural speeds of ADSL and VDSL. However, there was a small difference in the average speed experienced by fibre users in the upper North Island compared to those in the South Island, and this was more pronounced for FibreMax users.

The Commerce Commission also benchmarks the prices paid for fixed line broadband against Australia and the OECD on an annual basis, noting that it is difficult to precisely benchmark across countries given discrepancies in plans and international data protocols.

More detailed access and quality information is shown in Table 1 below:

⁷⁰ Commerce Commission, “Measuring Broadband New Zealand”, 2020. p.5.

⁷¹ Commerce Commission, “Measuring Broadband New Zealand”, 2020. p.7.

Table 1: Access and quality metrics by connection

	Performance standards	
	Access	Quality
Ultra-fast broadband (UFB)	End users (covered/percentage of coverage complete) ⁷² 1,004,385 homes and business connected to UFB, 83% of New Zealanders can now access the UFB with 87% by 2022. Uptake ³¹ 60% of homes and businesses with access to the UFB have connected	Download speeds (Mbps 24/7, peak) ⁷³ - Fibre 100: 99.2, 98.5 - Fibre Max: 648, 607.9 Upload speeds (24/7, peak) ³² - Fibre 100: 22.2, 22.2 - Fibre Max: 491.6, 491.5
Fixed wireless	End users ⁷⁴ ~188,000	Download speeds (24/7, peak) ³² 25.2, 21.5 Upload speeds (24/7, peak) ³² 15.3, 14.6
Copper (ADSL, VDSL)	End users ⁷⁵ - VDSL ~270,000 - ADSL ~327,000	Download speeds (24/7, peak) ³² - VDSL: 44.3, 43.6 - ADSL: 8.7, 8.5 Upload speeds (24.7, peak) ³² - VDSL: 13.2, 13.1 - ADSL: 0.8, 0.8

Source: Commerce Commission, Crown Infrastructure Partners, Chorus, The New Zealand Infrastructure Commission, Te Waihanga

At an entry level of service, which is loosely defined at 60GB per month at 10Mbps, New Zealand is very close to the OECD average, yet roughly 30 percent more expensive than Australia. Moving to medium and high users, up to 500GB per month at 100Mbps, New Zealanders pay around 20 percent more than the OECD average, placing us 34th out of 43 countries. Moving to ultra-high users, >500GB per month at 900Mbps, New Zealand is significantly cheaper than Australia and the OECD.

This points to internet that, for most users, is more expensive than Australia and the OECD with the exception of ultra-high users. However, the comparison is more complicated than it appears. Retail UFB prices are comparable to copper prices, and so consumers are essentially getting a better service for a similar cost.⁷⁶ This is a contributing factor to high levels of fibre uptake in New Zealand. Other factors including infrastructure quality, scale, cost of capital, and nascency of the

⁷² Crown Infrastructure, *Quarterly Connectivity Update*. p.5.

⁷³ Commerce Commission, *Measuring Broadband New Zealand*. p.11.

⁷⁴ Commerce Commission, *Annual Telecommunications Monitoring Report 2019*. p.6.

⁷⁵ Chorus, *Annual Report 2019*. <https://company.chorus.co.nz/file-download/download/public/2005>. Accessed August 2020. p.89.

⁷⁶ Broadband Compare. Accessed August 2020. <https://www.broadbandcompare.co.nz/>.

network may explain higher prices. Regardless, the price of internet services is high in New Zealand relative to OECD countries.

More detailed information is shown in Table 2 below:

Table 2: Fixed-line broadband only benchmarking

Broadband Only	NZ rank in OECD*	Price in NZD (PPP) Dec 2019			% difference from NZ	
		NZ	Aust.	OECD* Average	Aust.	OECD* Average
Entry Level 60GB 10Mbps	25/43	\$53	\$41	\$51	30%	4%
Medium user 150GB 30Mbps	34/43	\$70	\$61	\$57	14%	22%
High user Unlimited (500GB) 10Mbps	34/43	\$83	\$92	\$68	-10%	22%
Ultra-high user Unlimited (500GB) 900Mbps	14/34	\$85	N/A	\$175	N/A	-51%

Source: Commerce Commission, Strategy Analytics

Of note in this comparison is Australia's fibre network, the National Broadband Network (**NBN**). The NBN differs from New Zealand's in several ways. Firstly, the network is intended to be fibre to the nearest exchange or node, not fibre to the home as it is in New Zealand.⁷⁷ Secondly, the NBN was completed without major private sector participation as it was in New Zealand.⁷⁸ This creates different incentives and different outcomes for users, and any exact comparison with broadband in New Zealand is necessarily challenging.

5.2 Mobile

There is little publicly available data about the mobile infrastructure when compared to other infrastructure sectors.

The quality of service provided by New Zealand's mobile infrastructure is generally of high quality. In 2020, New Zealand was placed 11th globally in the average download speed across mobile services at 35Mbps. For comparison, South Korea sits at the top with approximately 60Mbps on the back of a 5G network, Australia are 7th at 43Mbps, and the UK at 36th with 23Mbps download speeds.⁷⁹

Mobile access is being addressed through two government led programmes (RB12/MBSF), which are set to be completed by 2023. CIP has responsibility for implementation of the programmes and has contracted for mobile services covering more than 100 tourist areas and over 1,000km of

⁷⁷ "nbn Fibre to the Node explained (FTTN)", nbn. <https://www.nbnco.com.au/learn/network-technology/fibre-to-the-node-explained-fttn#:~:text=An%20nbn%E2%84%A2%20Fibre%20to,form%20of%20a%20street%20cabinet.>

⁷⁸ "About", nbn. <https://www.nbnco.com.au/corporate-information/about-nbn-co.>

⁷⁹ Open Signal, *The State of Mobile Network Experience 2020: One year into the 5G Era*, Fenwick, S and Khatri, H. https://www.opensignal.com/sites/opensignal-com/files/data/reports/pdf-only/data-2020-05/state_of_mobile_experience_may_2020_opensignal_3_0.pdf_p.9.

state highway. Combined, these initiatives will result in 99.8% coverage of New Zealand by 2023..⁸⁰

There are roughly 6 million mobile connections across New Zealand. This is up from 4.9 million in 2012..⁸¹

Mobile phone services are less expensive in New Zealand than the OECD average, including plans for entry level, medium, high, and ultra-high users, but significantly higher than Australia. Almost 95 percent of New Zealand has access to 3G or better mobile reception – this is one of the highest rates in the world. Black spots exist, particularly in rural areas, including highways and tourism sites and this is being addressed through the RBI2 and MBSF initiatives..⁸²

More detailed information is shown in Table 3 below..⁸³

Table 3: Mobile phone services benchmarking

Mobile phone services	NZ rank in OECD*	Price in NZD (PPP) Dec 2019			% difference from NZ	
		NZ	Aust.	OECD* Average	Aust.	OECD* Average
Entry Level 30 calls + 500mb	11/38	18	13	25	33%	-31%
Medium user 100 calls + 2GB	17/38	28	13	36	110%	-24%
High user 300 calls + 5GB	26/38	48	13	50	263%	-5%
Ultra-high user Unlimited calls + 20GB	21/35	72	26	88	172%	-18%

Source: Commerce Commission, Strategy Analytics

5.3 Asset condition

There is little publicly available information on the condition of telecommunications assets.

Given the recency of the rollout, fibre assets are expected to be in good condition. There is little publicly available information relating to the copper network, the same being true for mobile assets.

However, there are frameworks and incentives in place to mitigate concerns around asset quality. Generally, the Commerce Commission monitors asset quality in areas without competition. Asset condition is also covered by information disclosure regulation, which requires entities to publish a range of financial and forecast information relating to their assets and investments. These requirements are set by the Commerce Commission and Chorus as well as other LFCs are all subject to such regulation..⁸⁴

⁸⁰ Crown Infrastructure. “What is the Rural Broadband Initiative phase two (RBI2)?”

⁸¹ Commerce Commission, *Annual Telecommunications Monitoring Report*. p.4.

⁸² Commerce Commission, *Annual Telecommunications Monitoring Report*. p.6.

⁸³ Noting that it is difficult to precisely benchmark price plans due to differentiation including bundled services, data rollover etc.

⁸⁴ Commerce Commission, “Fibre price-quality path and information disclosure”.

Where there is competition, economic incentives can mean asset failure will result in lower revenue and/or loss of customers.

6 How is the sector responding to what might come next?

Ka pēhea te rāngai e urupare ai ki tōna anamata?

6.1 Issues the sector is facing in the short-to-medium term

There is little publicly available information about the future direction that has been produced by the telecommunications sector. However, a number of observations can be made based on emerging trends or issues that are likely to shape the sector in the coming years.

6.2 Digital inclusion

The Government has concentrated focus on a digital transformation for New Zealand. While the program has many facets, a key pillar of the transformation is digital inclusion. Led by the Department of Internal Affairs in March 2019, the Government released a blueprint setting out the role for government in building a digitally inclusive New Zealand.

The blueprint highlighted four elements of digital inclusion: motivation, access, skills, and trust.⁸⁵ Access is the key element when it comes to telecommunications infrastructure and it can be broken into connectivity, affordability, and accessibility.

The government has made a major contribution to reducing the digital divide in recent years in terms of access through RBI2 and MBSF. However, infrastructure related issues remain outside the scope of major programmes which focus on rural areas.⁸⁶

Covid-19 was a catalyst in surfacing social inequality in digital access. With essential services like health and education forced online, those without access were disadvantaged. The Ministry of Education had to ensure every learner had at least one connection to learning during the Covid-19 period.⁸⁷ Similarly, the government received clear feedback from health providers around the country that the cost of mobile data can be a barrier to people accessing health information and services.⁸⁸ In response, the Ministry of Health agreed on a new data partnership with 2degrees, Vodafone, and Spark to ensure people without mobile data can still access health information services online.

In spite of the challenges, once completed the RBI2 and UFB programmes are expected to have made enhanced broadband available to 99.8 percent of New Zealand, with 87 percent having access to fibre.

⁸⁵ The Department of Internal Affairs. *The Digital Inclusion Blueprint*. March 2019. p.2. <https://www.digital.govt.nz/assets/Documents/113Digital-Inclusion-BlueprintTe-Mahere-mo-te-Whakaurunga-Matihiko.pdf>.

⁸⁶ The Department of Internal Affairs. *The Digital Inclusion Blueprint*. p.7.

⁸⁷ "Internet access, computers and printed learning resources", Ministry of Education.

⁸⁸ Rebecca McBeth, "Sponsored data to reduce digital divide", *Health Informatics New Zealand*, July 27, 2020. Sponsored data to reduce digital divide - Health Informatics New Zealand (hinz.org.nz)

Although prices for broadband and mobile services may not be affordable to some, prices need to be at a level to compensate for risk and enable investors to recover the cost of their infrastructure investment. To encourage investment, private agents must be able to gain value from risking capital in building and maintaining infrastructure that has an increasingly short life, and as a result, prices have to reflect this risk. At the same time, connectivity is increasingly important and potential price exclusion can be a growing cause of inequality. Broadly there are two options for resolving these counteracting forces: addressing the market where infrastructure may be unaffordable for some or focusing on the other forms of poverty that contribute to a lack of access to telecommunications infrastructure. To this end price, quality, and access are inextricably linked and must be carefully considered when addressing perceived issues.

Defining the role of the infrastructure itself in digital inclusion can be difficult, but what is clear is that New Zealanders excluded from an increasingly digital society will experience lower levels of wellbeing in the future.

6.3 A long-term solution to rural connectivity remains an open question

The negative impacts from a lack of connectivity are also felt by rural communities. In a sector where the private market funds the majority of infrastructure, providing services to rural communities is economically challenging.

Vast improvements have been made in rural connectivity over the last several years. In 2017, the Rural Connectivity Group (RCG) was established as the infrastructure provider to bring mobile and wireless broadband coverage under RBI2 and MBSF programmes. The establishment of the RCG – a joint venture comprising of the three major mobile operators in partnership with CIP – has led to more access and higher quality internet to at least 30,000 rural homes and businesses across New Zealand.⁸⁹

The RCG is an example of Government and industry collaboration as well as infrastructure sharing – the sharing of radio access network equipment and antennae, with retail services provided by each operator. This has been popular across the industry and worked successfully in overcoming the challenges of rural connectivity.

Notwithstanding the progress made on rural connectivity in recent years, there are still potential issues. The most significant is to find a long-term solution to rural connectivity when RBI2 ends, slated for 2022. Without Government participation, it remains unlikely that remote areas will attract private infrastructure investment, and so service could suffer. There is also a small population that will still not have access to enhanced broadband. Although this is expected to only be around 10,000 people,⁹⁰ connectivity is becoming increasingly important to modern life.

New technologies could provide the solution, with satellite broadband the most promising. Starlink, a subsidiary of SpaceX, is registered in New Zealand⁹¹ and naturally has the potential to solve the rural connectivity problem.

⁸⁹ Rural Connectivity Group. Accessed August 2020. <https://www.thercg.co.nz/>.

⁹⁰ Crown Infrastructure. “Rural Broadband”

⁹¹ Henry Burrell, “What’s Elon Musk’s Starlink doing in New Zealand?” *Business Desk*. 24 October 2020, <https://businessdesk.co.nz/article/technology/whats-elon-musks-starlink-doing-in-new-zealand>

Irrelevant to the technology that enables connectivity, the wellbeing of those who aren't connected is likely to be impaired, with the negative impact growing as our society continues to evolve digitally.

6.4 Resilience to cyber threats

The proliferation of internet services has also meant an increase in the risk posed by cyber security and the subsequent need for resilience. Recently, there have been a number of high-profile attacks, notably the distributed denial of service (**DDoS**) on the New Zealand Exchange leading to multiple days of severe disruption.⁹² Australia was also targeted in major, coordinated cyber-attacks in June 2020 leading to the Federal Government investing an additional A\$1.35b in existing defence funding over the coming decade.⁹³

Telecommunications infrastructure is the pathway for these attacks, and international submarine cables are often the first layer of defence. For this reason, New Zealand is geographically advantaged and with only three cables, exposure is limited. However, as cyber-attacks become more sophisticated, they are increasingly difficult to intercept at either end of the international cables.

The second line of defence, sitting on top of the telecommunications infrastructure, are the IT services employed by businesses. With cyber-attacks growing in number and sophistication, this is becoming a more important barrier in defence.

The impact of cyber security and its costs on the future direction of infrastructure has yet to be seen, but the emergence of technologies such as IoT mean the risks posed by cyber threats will be a growing issue for the sector.

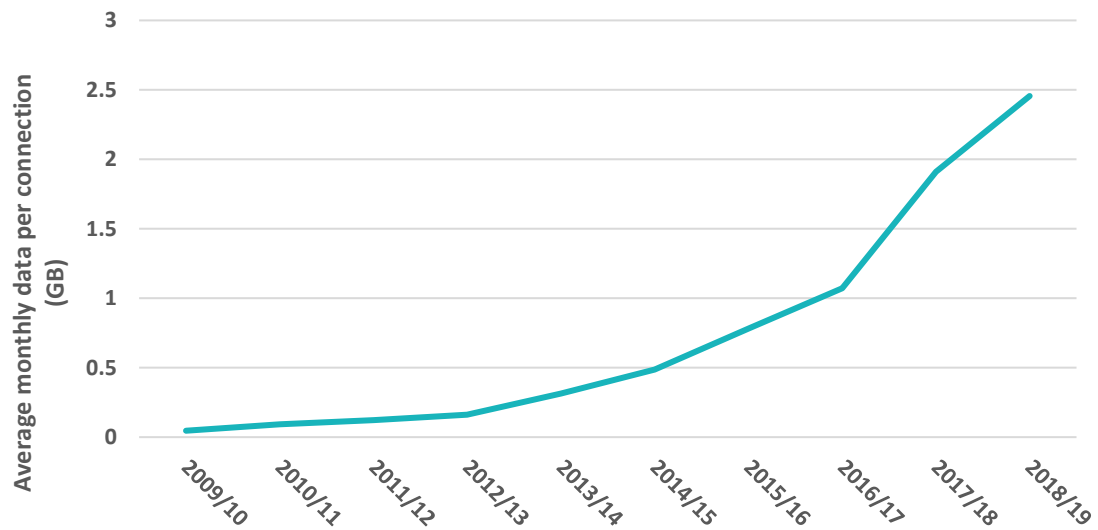
6.5 Anticipated rapid demand-led growth is driving investment in new technology

Although well anticipated, the sector has seen significant growth in demand in a short space of time with mobile services rapidly overtaking fixed-line voice services. There has also been rapid growth in the demand for data. Mobile data consumption has been close to doubling every year since 2015 – shown in Figure 10 below.

⁹² Eleanor Ainge Roy, "New Zealand stock exchange hacks: who is behind them and why now?" *The Guardian*. 1 September 2020, <https://www.theguardian.com/world/2020/sep/01/new-zealand-stock-exchange-hacks-who-is-behind-them-and-why-now-explainer>

⁹³ Jade Macmillan, "Cybersecurity spending gets \$1.35 billion boost in wake of online attacks against Australia", *ABC News*. 30 June 2020, <https://www.abc.net.au/news/2020-06-29/cyber-security-investment-link-attacks-scott-morrison/12404468>.

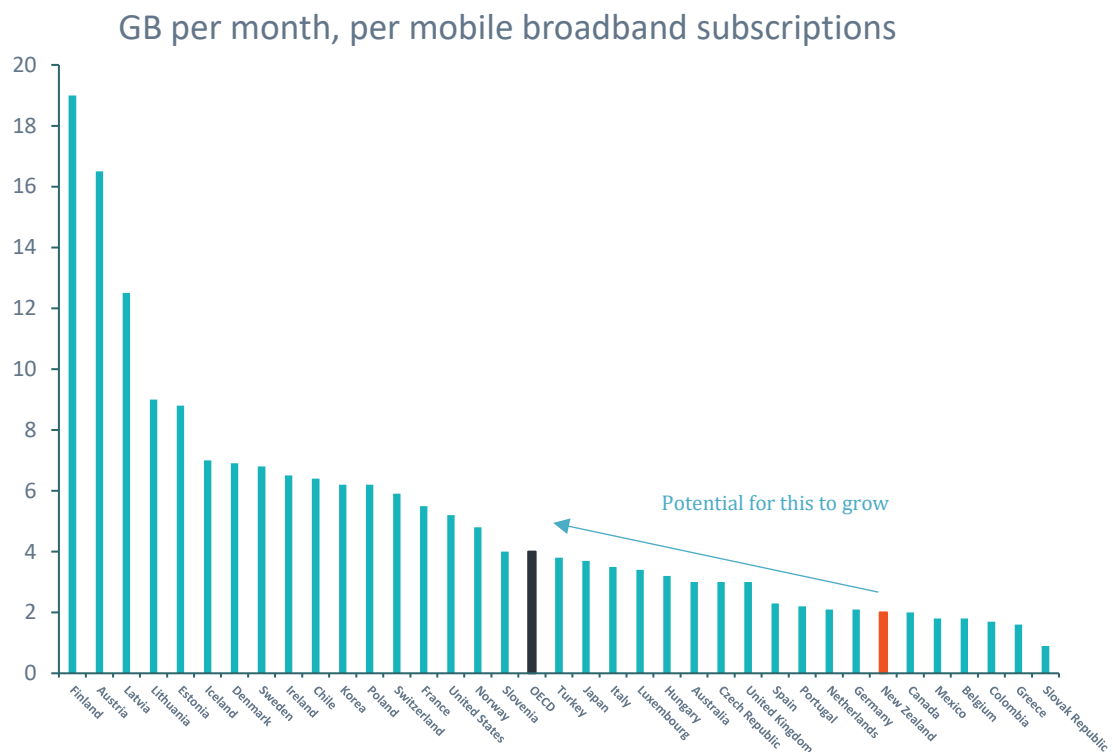
Figure 10: Mobile data consumption



Source: Commerce Commission

At the same time, New Zealand sits well below the OECD average in mobile data consumption per subscription (due to relative cost of mobile services in NZ), and so there is capacity for demand to grow – shown in Figure 11 below.

Figure 11: Average mobile data per mobile subscription (December 2018)



Source: Commerce Commission, OECD

The appetite for connectivity applies not only to mobile infrastructure but also fixed-line broadband. Data usage per fixed broadband connection has more than quadrupled from 2014/15.⁹⁴

Across both mobile and fixed-line broadband, there are clear demand-side trends in the context of infrastructure services: higher quantity, greater flexibility, and higher quality across social and economic spheres.

In response to consumer-led demand and enabled by advancement in global technology, Spark and Vodafone have begun the rollout of fifth generation or 5G mobile technology in New Zealand.^{95, 96} The technology will use similar wavelengths to those used in 2G, 3G, and 4G although slightly higher. A 3.5 GHz wavelength has recently been allocated which is the preferable wavelength for the deployment of 5G.⁹⁷ The government has allocated part of the spectrum to Māori for 5G use. It is anticipated that 5G may use wavelengths as high as 26 GHz, however these have yet to be decided by the Government and MBIE.

The 5G network offers a range of opportunities. In New Zealand trials it has been proven to be 20 times faster than 4G which typically offers speeds in the 30-80 Mbps range.⁹⁸ Furthermore, it offers lower latency and higher network capacity. This presents opportunities for increasing the quality of infrastructure services enjoyed by New Zealand consumers, as well as growing connectivity and internet speeds in rural areas, something that the rural connectivity group is expected to be involved in.

While the opportunities are vast, there are also distinct challenges raised by 5G. New Zealand's topography is not naturally suited to the propagation of 5G wavelengths. To be effective, millimetre waves generally need line of sight.⁹⁹ This is not well suited given the uneven, hilly nature of New Zealand and will mean there is a need for a greater density of smaller 5G transmitters.

Similarly, a reasonable return on capital should be expected if investors are to take on the risks in building new infrastructure. While the question of reasonable return on capital is closely monitored by the Commerce Commission, regulation will have to be nimble in ensuring New Zealand can continue to attract investment and retain a market that is competitive in rolling out new technology. This will be challenging given the demand trends across the country – in some rural areas where the need for telecommunication services are potentially higher, the economics will be further challenged by declining populations.¹⁰⁰

⁹⁴ New Zealand Telecommunications Forum, *Key Trends in New Zealand Telecommunications: 2020 Industry report*. p.14.

⁹⁵ "What is 5G?", Spark. Accessed November 2020. <https://www.spark.co.nz/5g/home>.

⁹⁶ "5G", Vodafone. Accessed November 2020. <https://www.vodafone.co.nz/5g/>.

⁹⁷ Radio Spectrum Management, "Preparing for 5G in New Zealand".

⁹⁸ Office of the Prime Minister's Chief Science Advisor, "5G in Aotearoa New Zealand". April 2020. <https://cpb-ap>

se2.wpmucdn.com/blogs.auckland.ac.nz/dist/f/688/files/2020/01/5G_in_Aotearoa_New_Zealand_08_04_2020.pdf_p.3.

⁹⁹ Joel Conover, "Tiny waves, big challenges: Getting 5G mmWave mobility right", *EDN*, November 15, 2020. <https://www.edn.com/tiny-waves-big-challenges-getting-5g-mmwave-mobility-right/>.

¹⁰⁰ "Subnational populations estimates: At 30 June 2020", Stats NZ. October 22 2020. Accessed August 2020. <https://www.stats.govt.nz/information-releases/subnational-population-estimates-at-30-june-2020>.

6.6 Data storage: a key opportunity going forward

With our societies becoming increasingly digital, data infrastructure has attracted significant global investment. New Zealand is no exception, with several organisations investing in data centres. In May 2020, the global technology company Microsoft announced its plans to establish a datacentre region in New Zealand which it labelled a major milestone towards delivering enterprise-grade cloud services.¹⁰¹

Given trends for domestic demand, it is likely investment will continue to flow towards data storage infrastructure. However, there are opportunities for the industry to expand into international markets. This was highlighted by government ministers following the potential exit of the Tiwai Aluminium Smelter. Ministers cited data centres as a potential use of clean energy supplied by the Manapouri power station which would also provide jobs in the region.¹⁰²

Growing geopolitical friction could also influence global data storage infrastructure. In recent years, US-China relations have worsened to the point of a trade war.¹⁰³ As a result, US attention has turned to telecommunications infrastructure. In August 2020, the Pacific Light Cable Network project, supported by Facebook and Google, connecting Los Angeles to Hong Kong was stopped due to the security concerns of the US government.¹⁰⁴ Shifting geopolitics can influence the direction of international connectivity providing both opportunities and challenges in New Zealand providing data storage services.

Looking to the future, the sector expects exponential growth in data consumption to continue. This will provide the industry with the opportunity to expand its footprint – potentially into South East Asian and Australian markets given New Zealand’s relative advantages.

6.7 Issues the sector is facing in the medium-to-long term

There is little publicly available information from the sector about the long-term future of telecommunications infrastructure. Similarly, given the exposure of the industry to fast-moving technologies, it is difficult to anticipate major future impacts.

Notwithstanding the potential for unknown technologies and their influence, satellite broadband is an existing technology attracting significant quantities of capital in developing high speed internet access across the globe.¹⁰⁵ It has the potential to both disrupt but also solve issues for New Zealand, especially rural connectivity.

¹⁰¹ Bob Glancy, “Microsoft to establish its first datacentre region in New Zealand”, *Microsoft*, May 6 2020. <https://news.microsoft.com/en-nz/2020/05/06/aotearoa-disclosure/>.

¹⁰² “Government will support the people and economy of Southland”, *The Beehive*, July 9 2020. Accessed August 2020. <https://www.beehive.govt.nz/release/government-will-support-people-and-economy-southland>.

¹⁰³ BBC, “A quick guide to the US-China trade war”, *BBC News*, January 16 2020. <https://www.bbc.com/news/business-45899310>.

¹⁰⁴ BBC, “Google-Facebook ditch plans to dock giant data cable in Hong Kong”, *BBC News*, August 31 2020. <https://www.bbc.com/news/technology-53972238>.

¹⁰⁵ Reuters, “SpaceX raises \$1 bln in funding from Google, Fidelity”, January 21 2020. <https://www.reuters.com/article/spacex-investment/spacex-raises-1-bln-in-funding-from-google-fidelity-idUKL4NOUZ6KX20150120>.

SpaceX is a global technology leader of satellite broadband through their Starlink project,¹⁰⁶ that aims to send tens of thousands of satellites into space in creating a megaconstellation that would provide global broadband coverage.¹⁰⁷ The aspiration of the programme is to provide high speed broadband internet to areas where access is expensive, unreliable, or unavailable.¹⁰⁸

These technologies have the potential to close gaps in service provision across New Zealand where current services are both economically and geographically challenging.

¹⁰⁶ Amy Thompson, "SpaceX launches 60 Starlink internet satellites, sticks rocket landing", *Space*, September 3 2020. <https://www.space.com/spacex-starlink-11-satellites-launch-september-2020.html>.

¹⁰⁷ Caleb Henry, "SpaceX submits paperwork for 30,000 more Starlink satellites", *Space News*, October 15 2019. <https://spacenews.com/spacex-submits-paperwork-for-30000-more-starlink-satellites/>.

¹⁰⁸ Starlink. Accessed August 2020. <https://www.starlink.com/>.

7 Conclusion

Hei whakatepe

Overall, the telecommunications sector is in a good condition. It compares favourably with other countries in the OECD in terms of service quality, access, and price. The services delivered to users of the infrastructure are not currently major barriers to New Zealand's natural, social, human, and financial wellbeing.

Despite the positive performance of the sector as a whole today, it will not be easy to remain globally competitive; something that for New Zealand – as a developed, isolated, yet digitally enabled nation – will be increasingly important in supporting wellbeing. To that end, there are a number of areas where Te Waihangā may choose to add its voice in an attempt to grow the wellbeing of New Zealanders.

As well as continuing to build on this telecommunications state of play, next steps include building our understanding of future trends and likely challenges, including climate change, incorporation of Mātauranga Māori, demographic change, and the role of technology. We will look at what our way of life might be 30 years from now. Based on all of this, we will begin to make recommendations as to how infrastructure might support New Zealand's future wellbeing.

We'll share our work as we go and are keen to hear what you think, starting now. Tell us what you think about the following approach to developing the State of Play reports – have we got it right or are there issues, information or problems we've missed.

8 Appendix one: Process, assumptions and limitations

Āpitihianga tuatahi: Te tukanga, ngā whakapae, me ngā tepenga

8.1 Our process

This State of Play was developed between July and October 2020 drawing on publicly available information. Key data sources include:

- The Commerce Commission: Measuring New Zealand's Broadband series;
- The Commerce Commission: Annual Telecommunications Monitoring Report 2019, Key facts;
- Crown Infrastructure Partners: Quarterly Broadband Updates; and
- New Zealand Telecommunications Forum (TCF): Key Trends in New Zealand Telecommunications 2020 Industry Report.

A full list of all literature cited can be found in the reference list (Appendix three).

Findings were cross-checked against the results of a survey of infrastructure asset owners, carried out by Mobius Research and Strategy Limited on behalf of Te Waihangā between September and October 2020, which asked about the issues, risks, and opportunities as perceived by asset owners across the sector.

On completion of the initial draft, we also met with individuals from a range of organisations across the sector to get their views on a high-level summary of our findings, and to understand their thoughts on current challenges. A draft of the complete report was also peer reviewed by Te Waihangā's Board and by a sector expert.

8.2 Limitations

While every effort is made to ensure the accuracy of the information contained herein, Te Waihangā, its officers, employees and agents accept no liability for any errors or omissions or any opinion expressed, and no responsibility is accepted with respect to the standing of any firms, companies or individuals mentioned. Te Waihangā reserves the right to reuse any general market information contained in its reports.

9 Appendix two: Glossary

Āpitihanga tuarua: Rārangi kupu

UFB: Ultra-fast broadband

UFF: Ultrafast fibre

CIP: Crown Infrastructure Partners

CFH: Crown Fibre Holdings

ADSL: Asymmetric Digital Subscriber Line (copper broadband)

VDSL: Very high bit rate Digital Subscriber Line (copper broadband)

HFC: Hybrid fibre-coaxial

LFC: Local Fibre Company

CCHL: Christchurch City Holdings Limited

RSP: Retail Service Providers

ISP: Internet Service Providers

WISP: Wireless Internet Service Providers

TCF: New Zealand Telecommunications Forum

2G: Second Generation

3G: Third Generation

4G: Fourth Generation

4G LTE: Fourth Generation Long-Term Evolution

5G: Fifth Generation

Mbps: Megabits per second

Gbps: Gigabits per second

MHz: Megahertz

GHz: Gigahertz

RBI: Rural Broadband Initiative

RBI2: Rural Broadband Initiative 2

MBSF: Mobile Black Spots Fund

RCG: Rural Connectivity Group

NBN: Australian National Broadband Network

MBIE: Ministry of Business Innovation and Employment

DIA: Department of Internal Affairs

LSF: Living Standards Framework

IoT: Internet of Things

OECD: Organisation for Economic Cooperation and Development

PGF: Provincial Growth Fund

NBER: National Bureau of Economic Research

GDP: Gross Domestic Product

NZTA: New Zealand Transport Agency

DDoS: Distributed denial-of-service

NZX: New Zealand Exchange

10 Appendix three: References

Āpitihanga tuatoru: Ngā tohutoro

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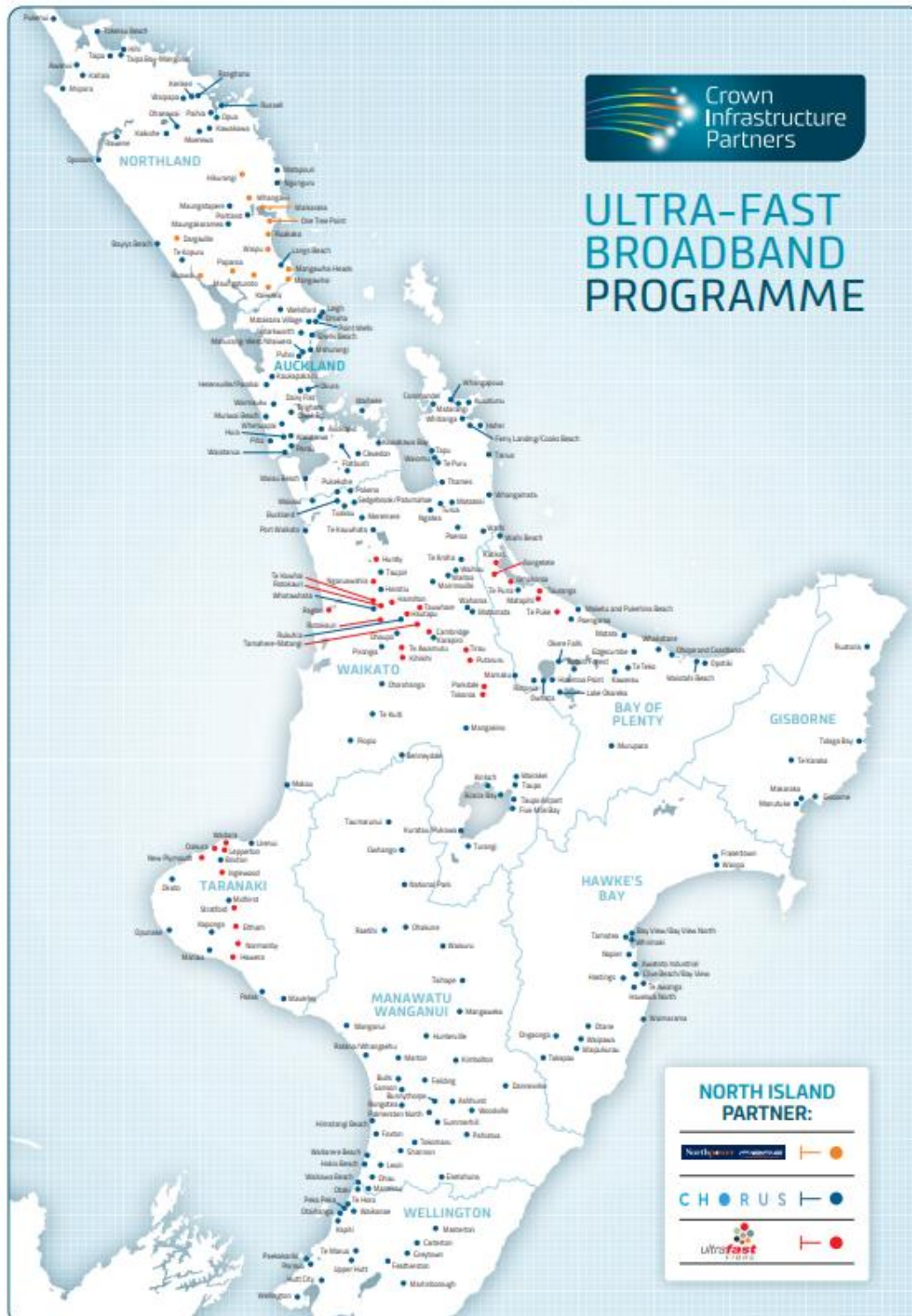
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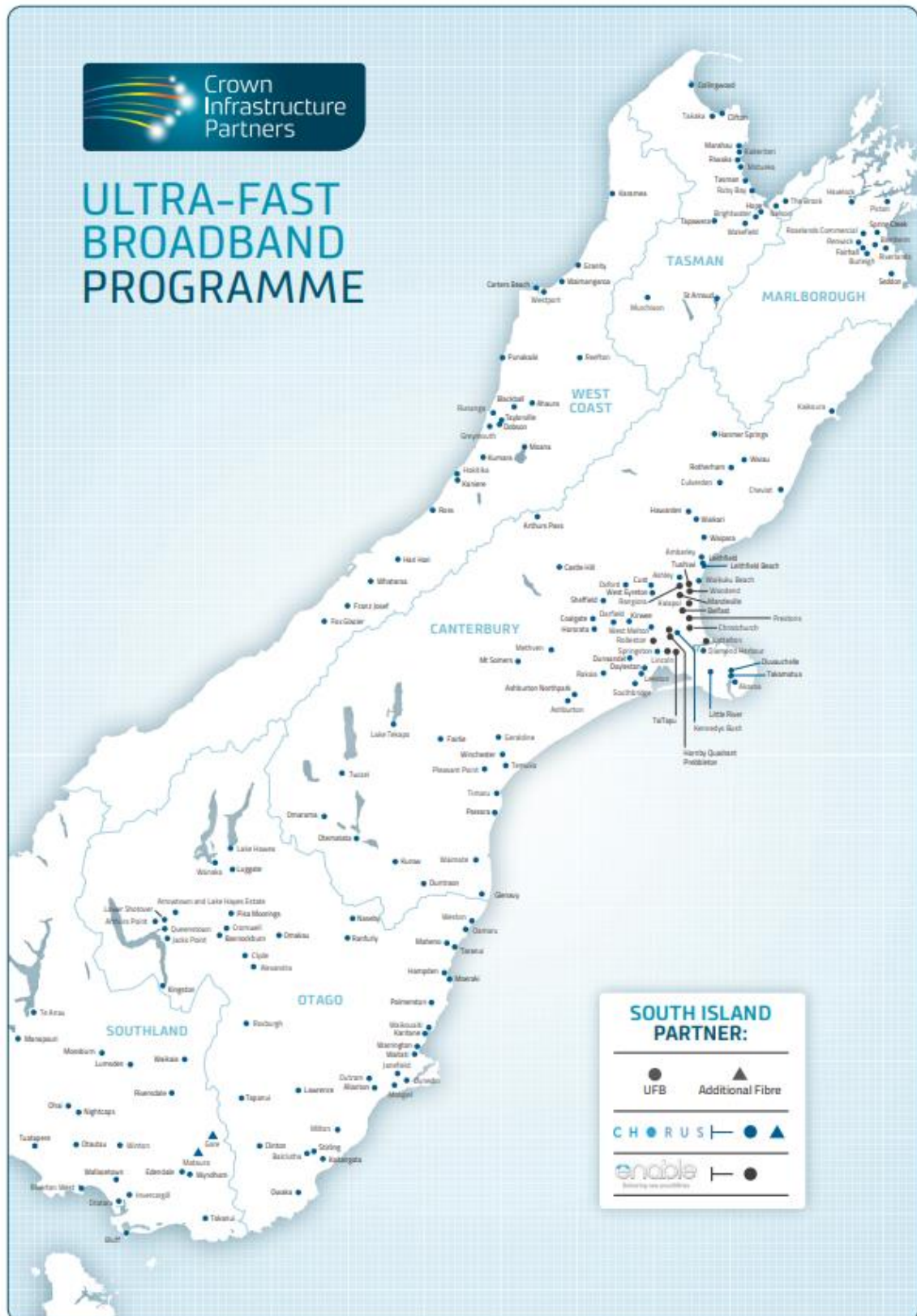
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11 Appendix four: UFB rollout schedule – CIP

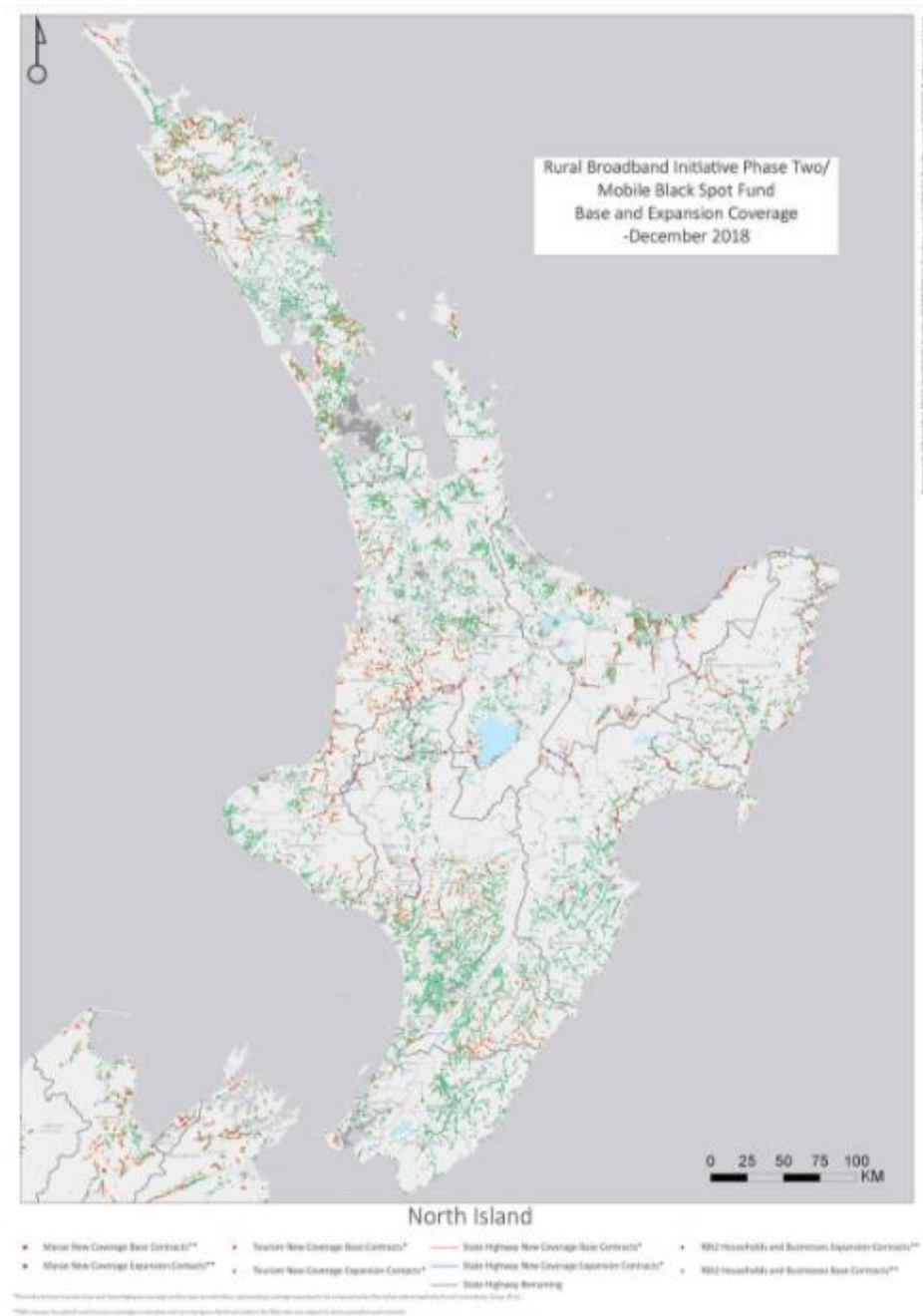
Āpitiwhanga tuawhā – Hōtaka whakahōrapa UFB – CIP

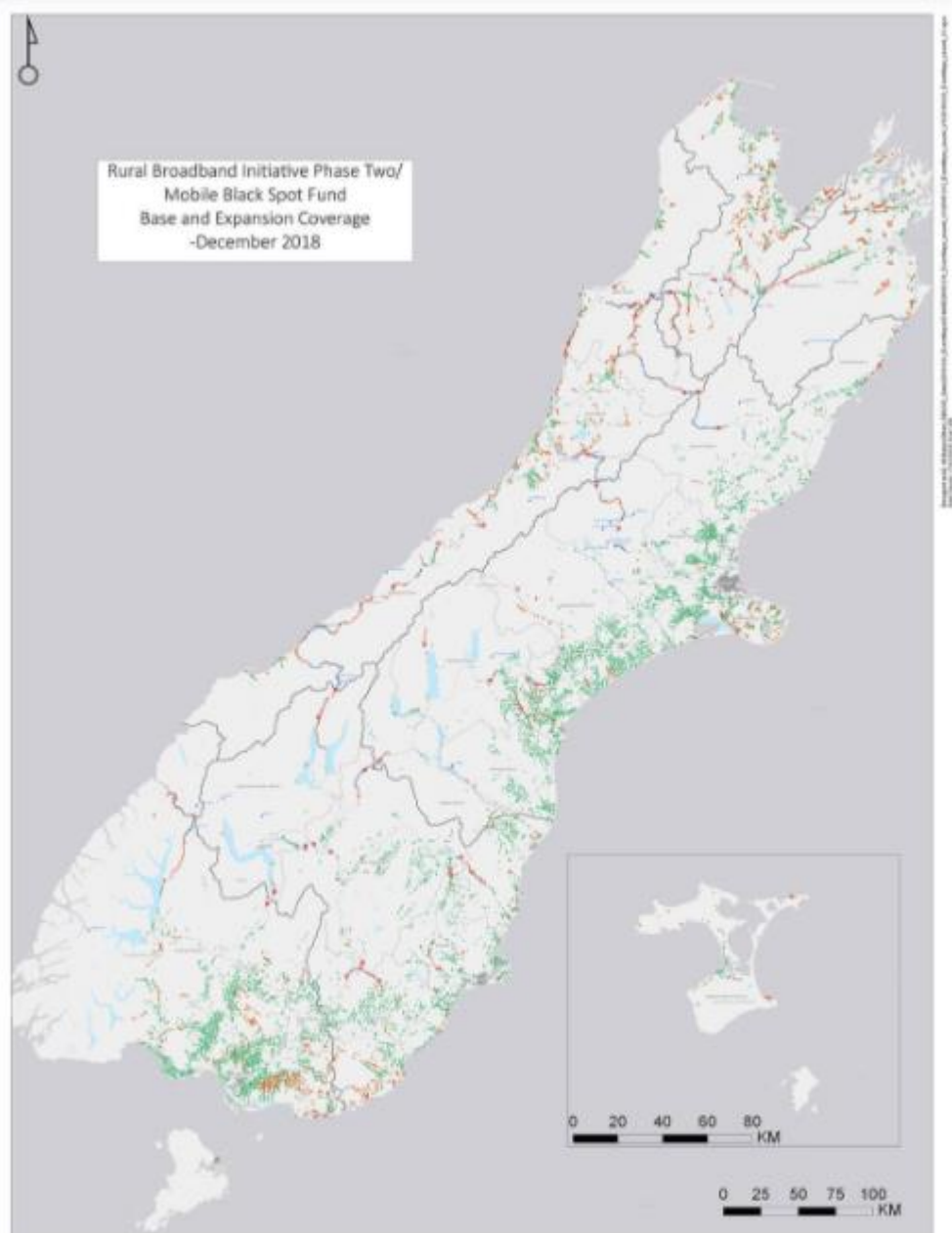




12 Appendix five: Mobile coverage addressed through RBI2/MBSF – CIP

**Āpitihanga tuarima – Āheinga tohu
kawereo e whakatikangia ana mā
RBI2/MBSF – CIP**





South Island and Chatham Islands

- Mobile New Coverage Base Contracts**
- Mobile New Coverage Expansion Contracts**
- Tourist New Coverage Base Contracts*
- Tourist New Coverage Expansion Contracts*
- State Highway New Coverage Base Contracts*
- State Highway New Coverage Expansion Contracts*
- R&B Households and Businesses Expansion Contracts**
- R&B Households and Businesses Base Contracts**
- State Highway Remaining

*Based on the information provided by the relevant providers, the coverage is expected to be in place by the end of the year. **Based on the information provided by the relevant providers, the coverage is expected to be in place by the end of the year.