1 June 2016

Members
Commerce Select Committee
Youth Parliament 2016

Inquiry into how New Zealand's information technology infrastructure could be developed to support the wider 'digital economy'

The Commerce Committee has been asked to conduct an inquiry into: "How New Zealand's information technology infrastructure could be developed to support the wider 'digital economy" on 19 July 2016. This paper has been prepared to assist the Committee with its examination. Issues are identified and possible lines of inquiry are provided for the Committee to consider. The Committee may also wish to raise these matters with the witnesses who have been asked to appear before the Committee to give evidence on this inquiry.

Introduction and definitions

Seventeen years ago, in 1999, the first broadband package was made available in New Zealand. A household starter plan provided a speed of 128kb/s and would cost $65 (in 1999 dollars) a month. Today, the average broadband connection speed in New Zealand is from 9.3Mbps down, with a 100 Mbps connection available for $80 in some areas (Akamai, 2016). An important driver of this improvement has been the Government's investment in New Zealand's information technology infrastructure.

The Government's Ultra-Fast Broadband (UFB) programme is rolling out fibre across the country, and by 2019 will enable at least 80 percent of households and businesses to access at least 100Mbps plans – 800 times the 1999 speed. The Rural Broadband Initiative (RBI) is also bringing broadband to 75 percent of homes and businesses outside of UFB areas. The Government is currently developing extensions to both programmes which will spread broadband further into New Zealand homes and businesses.

New Zealand's information technology infrastructure is the backbone that supports every Facebook post, Snapchat, and Tweet; as well as emerging technologies that are shaping our world and driving the digital sector forwards. Connectivity is powering innovation in artificial intelligence, robotics, the Internet of Things (IoT), autonomous vehicles, 3-D printing, nanotechnology, biotechnology, materials science, energy storage, and quantum computing; all of which have the potential to dramatically transform society.

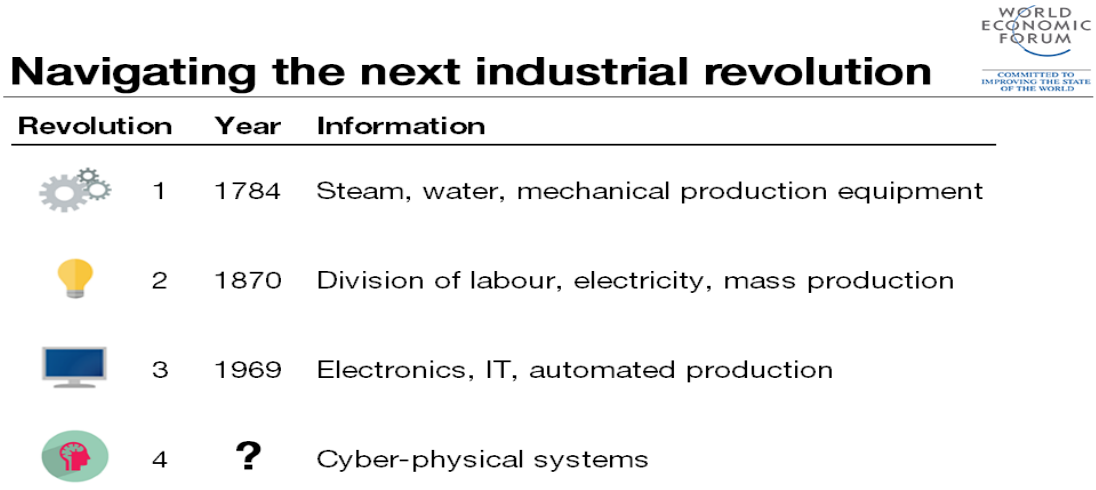
Efficient and reliable communication networks and services are the foundation for a strong digital economy. New Zealand needs to consider how this infrastructure is further developed.

The infrastructure New Zealand invests in supports our growing digital economy, and informs our social and economic lives in 2016 and beyond.

Information Technology Infrastructure (IT infrastructure) refers to the hardware, software and networks built to support information technology connectivity, and can refer to the leadership and management skills, the users of the network as well as the policies in place to manage the infrastructure (Byrd and Turner, 2000). New Zealand's IT infrastructure includes a network of copper wiring, fibre, fixed wireless, mobile towers, and radio spectrum. These technologies will be discussed further in this paper. The capabilities of the users and operators of the connectivity technologies are important to the development of the digital economy, and government has a role in fostering these skills. This will also be discussed.

The *digital economy* refers to the broader impacts that Information Communication Technologies (ICTs) and the internet are having on the economy, on how businesses operate, and how people live their lives. The growth of the digital economy is allowing New Zealand to participate in the global economy in new ways that overcome challenges of distance, as digital companies create weightless products. For example, Xero is a growing accounting software company that was founded in New Zealand, and it created a digital product that can be used anywhere in the world. It is widely recognised that the world is undergoing a fourth industrial revolution, characterized by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres (World Economic Forum, 2016). This revolution may disrupt the existing economic environment, causing many jobs to become obsolete, and new jobs in their place that require a different skillset.

Figure 1: The industrial revolutions (World Economic Forum, 2016).



Access to world class IT infrastructure could lift the productivity and competitiveness of New Zealand businesses, as well as enable better health and education services. Faster broadband will enable a greater range of applications and services to be adopted that benefit the New Zealand economy. The government is already investing $1.65 billion in the first phases of UFB and RBI, and will extend these programmes further.

Many of the questions and decisions faced by government when looking at how best to support the digital economy are around market intervention. If government favours one type of connectivity over another, or helps one company build infrastructure instead of leaving it to the market, it may be creating an artificial monopoly and inhibiting innovative solutions. Much of the connectivity infrastructure New Zealand uses has been supported or subsidised

by government, and policy decisions have been made about which regions to prioritise when building networks and infrastructure.

What type of digital economy are we trying to support?

Digital economy trends

The OECD has identified the following trends about the global digital economy (OECD, 2014):

- ICTs have triggered deep changes in economies and societies - in 2005, fewer than 60 percent of adults in OECD countries were internet users. In 2013 this had increased to 80 percent, and 95 percent of young people were internet users. There is still a digital divide between younger and older users.
- Technological developments are feeding further penetration - as internet speeds increase and the cost of devices decreases, more data-intense applications have become possible. The IT infrastructure is enabling digitisation of commerce, transactions with government, and social interaction.
- ICTs are fostering innovations across industries and sciences - The IoT is the network of physical objects - devices, vehicles, buildings and other items - embedded with electronics, software, sensors, and network connectivity that enables these objects to collect and exchange data. Infrastructure needs to be built to support IoT innovation.
- Globally, employment creation due to the digital economy and growth of the ICT sector has not grown – in 2001 employment in ICT roles made up 4.1 percent of all employment. In 2012 this had dropped to 3.8 percent. This means that while the sector is growing, it may not be creating jobs. This may be exacerbated further as digital disruption will make some roles obsolete, and reshape industries.
- New skills for workers, firms and users will be required (such as cybersecurity, general IT skills and/or mid-career retraining).

New Zealand's Digital Economy

New Zealand has the potential to become one of the most prosperous digital nations in the world. Just about every country in the world is looking to ensure they are positioned to benefit from these changes. A connected digital economy might include:

- **A thriving digital sector** where digital technology firms make up a larger part of the New Zealand economy, where more of our exports incorporate technology, and where our digital firms are partnering with other sectors and the government to create new products and services and new ways of doing business. In 2013 the computer system design sector generated $6 billion dollars in revenue, a $1 billion increase from 2009 (Ministry of Business, Innovation and Employment, 2015).
- **Technology-enabled digital businesses** where all New Zealand businesses are using the latest technologies and are developing new products and services through digital innovation so that they can grow, disrupt, and compete across the globe. Increasing numbers of businesses will find their markets disappearing as their competitors transform themselves, their products, and their services through digital innovation. The success of integrated digital services like Uber disrupt existing traditional business models, and businesses need to be able to future proof themselves to this change. A 2014 report found that if all businesses in New Zealand were digitally connected and using digital tools effectively, it would contribute an extra $34 billion to New Zealand's economy by 2025 (Sapere, 2014).

- **Connected and confident digital New Zealanders** where all New Zealand people are confident and able to function safely in the global digital world and can access the social, cultural, and economic benefits of being a 'Digital New Zealander'. This includes moving from technology 'users' to technology 'creators'. As automation and other digital innovations continue to change the nature of our work, people will also need to change, upskilling and reskilling. The OECD estimated that 65 percent of children today will do jobs that haven't been invented yet (OECD, 2014).
- **A digital future for government** where the public sector, including healthcare and education, is using digital technology to work smarter, make better decisions, generate value from New Zealand's information, and transform the way services are delivered. There are two government *Better Public Service* initiatives, Result 9 and Result 10, that are focused on providing digital services for New Zealand citizens and businesses. These initiatives cannot succeed without universal connectivity, as well as digital literacy for all New Zealanders.

To enable New Zealand to achieve this vision for a prosperous digital economy, fast and reliable IT infrastructure is critical as it allows businesses to connect with their customers, people to connect with their communities, and NZ to the rest of the world. Connectivity is just one part of the issue. We need to ensure that New Zealanders take advantage of the possibilities that digital connectivity offers.

What are the characteristics of New Zealand's connectivity infrastructure?

The World Economic Forum's 'Network Readiness Index' (2015) ranks New Zealand as 17th in the world for overall readiness to participate in the digital world. New Zealand ranks 9th for 'Infrastructure and Digital Content'. This ranking is determined by electricity output per capita, mobile network coverage (percentage of population), international internet bandwidth (kb/s/user), and number of secure internet servers. According to the latest Akamai State of the Internet report New Zealand ranks 7th in the world for average peak mobile speed, and 41st in the world for average fixed line connection speed, at 9.3Mbps, as per Figure 2 below (Akamai, 2016).

Figure 2: Asia Pacific internet speeds 2015 (Akamai, 2016)

Country/Region	Q4 2015 Avg. Mbps	Q4 2015 Peak Mbps
South Korea	26.7	95.3
Japan	17.4	82.9
Hong Kong	16.8	105.2
Singapore	13.9	135.7
Taiwan	12.9	78.8
New Zealand	9.3	42.8
Thailand	9.3	63.7
Australia	8.2	39.3
Malaysia	5.2	42.0
Sri Lanka	4.8	34.8
China	4.1	26.7
Indonesia	3.9	79.8
Vietnam	3.8	31.4
Philippines	3.2	27.0
India	2.8	21.2

To support the digital economy, New Zealand needs to stay competitive across all of these indicators. Current initiatives including the UFB and RBI programmes, the extension of these programmes, and the Mobile Blackspot Fund (MBSF) are all contributing to making New Zealand a leading nation in internet speeds and coverage.

International connectivity: The Southern Cross Cable

New Zealand has one fibre-optic submarine cable connecting it to international internet traffic. There are twin access points, a primary path between California and Auckland, and a protection path between Sydney and Auckland, which is only necessary if there is a fault on the primary line. It was recently announced that a second company will build another cable between New Zealand and the United States, via Fiji, which may increase competition and ensure New Zealand's connectivity resilience.

Figure 3: Map of Southern Cross Cable.

Copper Network

New Zealand's copper networks were originally built for phone lines, and currently ADSL and VDSL broadband is provided over these lines. ADSL runs at a speed of up to 20 Mbps down and 1 Mbps up, while VDSL can reach speeds of up to 70Mbps down and 10Mbps up. Copper has speed and performance limits and will depreciate and become more expensive to maintain. As fibre becomes more commonplace, this network may no longer have value to New Zealanders, or to ISPs.

UFB Rollout and the Rural Broadband Initiative

Government is investing $2 billion into the UFB Initiative and RBI. Together, these two programmes will bring the benefits of improved internet connectivity to 97.8 percent of New Zealanders, opening up a huge range of business, education, community and other opportunities. The regions that receive UFB connectivity in phase one of the roll out have been chosen based on population, so that the most people benefit from UFB. The government confirmed extensions to the UFB and RBI programmes in March 2015, and the additional towns to receive fibre to the premise will be determined following a competitive bid process, which is currently underway. UFB can provide speeds of up to 1000Mbps, as seen in Dunedin, which won the Gigatown competition in 2014. Most plans will offer a download speed of 100Mbps and an upload speed of 30Mbps, however plans with 200Mbps up and 200Mbps down are becoming increasingly popular as well.

UFB and RBI extension

The existing UFB programme will enable 75 percent of New Zealanders to access fibre to the premise by the end of 2019. The UFB programme will be extended to reach 80 per cent of New Zealanders, a further 200,000 people. The extension of the UFB programme will cost between $152 and $210 million in addition the Government's existing investment in UFB.

The existing RBI programme aims to connect 90 per cent of homes and businesses that are outside the UFB footprint with broadband at peak speeds of at least 5 Mbps by the end of 2016. A further $150 million will be provided to extend the RBI. The extension to the RBI includes a $100 million contestable fund for communities to improve their connectivity through fixed broadband, and a $50 million fund to extend mobile coverage in more remote parts of New Zealand, in the MBSF.

Mobile Black Spot Fund

In 2015, as part of a funding expansion for UFB, the Government allocated $50 million to improve mobile coverage in black spot areas along main highways and in popular tourist destinations. The objective is to increase mobile connectivity to rural and remote areas to improve the safety of life and property on main highways, increase social inclusion, and boost the economic development potential of key tourist destinations. As there are no significantly-sized permanent populations along main highways and key tourist destinations, the government has not set population coverage targets for this programme.

What is government's role in supporting the development of these connectivity technologies?

Recently the Government set a new connectivity target of 50Mbps available to 99 percent of all New Zealanders. When looking at Government policies on IT infrastructure, it is important to recognize the market failures that frame the investment. Before Spark and Chorus separated in 2011, one ISP owned the entire copper infrastructure in New Zealand, creating a monopoly on wholesale copper sales. Chorus was structurally separated from Telecom New Zealand in 2011, as a condition of winning the majority of the contracts for the UFB Initiative. Chorus cannot sell directly to consumers; instead it provides wholesale services to retailers.

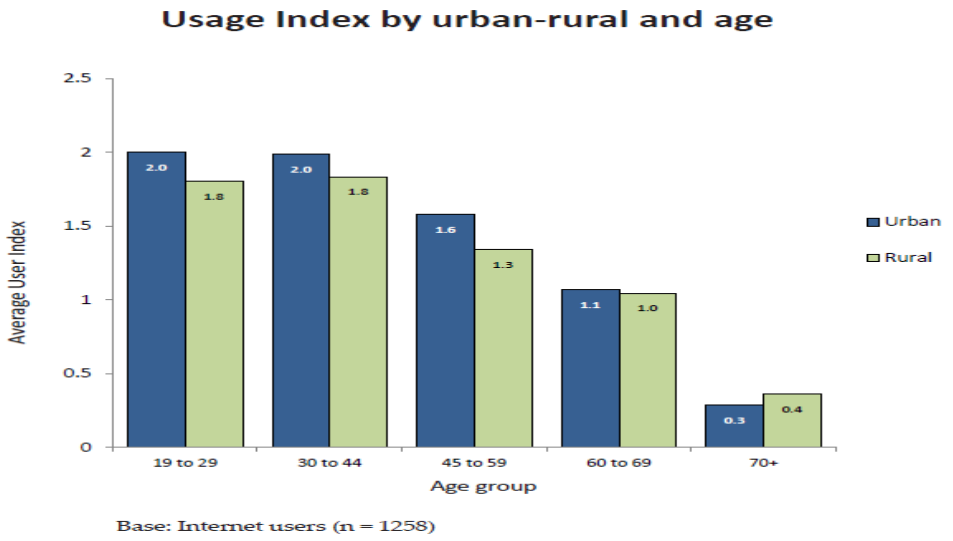
However, there is little economic incentive for a commercial company to extend expensive infrastructure projects into rural communities where there are few customers to utilise the service. The Government RBI and MBSF programmes are run to overcome this limitation of the competitive market, and while this has been received well by those who benefit from the programmes, there are still limitations to rural access.

Rural Connectivity

Phase one of the UFB and RBI programmes will deliver broadband speeds of at least 5Mbps to 97.8 percent of New Zealanders by 2019. The remaining population are in rural areas, with sparse population density (where at some point the costs outweigh the commercial benefits of building telecommunications infrastructure). Therefore, telecommunications companies may be unlikely to provide service to this remaining 2.2 percent of the population. But there are important economic and social benefits to making sure connectivity is available to rural areas.

The World Internet Project (WIP) conducts biannual surveys on household internet usage globally. The 2015 results do show a gap between the level of internet usage and the type of services being used between rural and urban populations (Figure 4 overleaf), however the causation is not clear. It could be that some rural users lack connectivity to achieve the activities they want to do online, or they lack the skills and knowledge to maximise the benefits of connectivity.

Figure 4: Internet usage index by urban-rural and age (World Internet Project, 2016)



In New Zealand there are user's associations and organisations who advocate for internet users on a wide range of issues. The Telecommunications Users Association of New Zealand (TUANZ) raises the profile of connectivity issues, particularly in rural New Zealand, noting that: "The availability of good quality high speed broadband in all parts of NZ is a critical economic enabler for the future of the NZ economy" (TUANZ, 2015).

TUANZ held a Rural Connectivity Symposium in 2015 which asked participants to articulate their current concerns. They summarised and published the key issues faced by rural communities (TUANZ, 2015), including:

- quality of connectivity; there is a perception of patchy mobile coverage and a lack of quality connectivity in rural areas,
- affordability; there is a sense that affordable quality services are difficult to obtain in rural areas,
- lack of awareness; rural communities may not understand the connectivity options in their areas, or understand the technical language required to evaluate the best options for them, and
- network capability; current rural networks seem to lack the capability to deal with demands made upon them, particularly at peak times.

Government has taken a variety of approaches to these issues:

- Investment via the UFB (to 80% of NZ), expansion of the RBI and the MBSF Programmes. These programmes will get faster connectivity to a large number of New Zealanders, but there will be a small number who will not be reached.
- Conditions attached to spectrum allocation, which place coverage obligations on mobile operators. This means that in order to purchase more radio spectrum to provide wireless services over, ISPs are obligated to extend their coverage to rural areas.
- Geographic averaging of copper pricing. Geographic averaging prevents providers from charging more for internet access in areas that are more expensive to service. This may mean that urban users are paying more for their service than it costs to provide, but it creates more equitable outcomes.

These approached have contributed to make equality of access possible in New Zealand, and by the end of the first phase of the UFB and RBI programmes, 97.8 per cent of New Zealanders will have access to broadband speeds of at least 5Mbps, but it is important that the right policy decisions are made to balance equality of access with the competitive market forces.

Emerging technologies for rural connectivity include fixed wireless, and satellite connectivity. It may be that one size does not fit in regards to connectivity solution, and connecting fibre to the home in rural areas may be more costly than a different technology.

Digital Inclusion

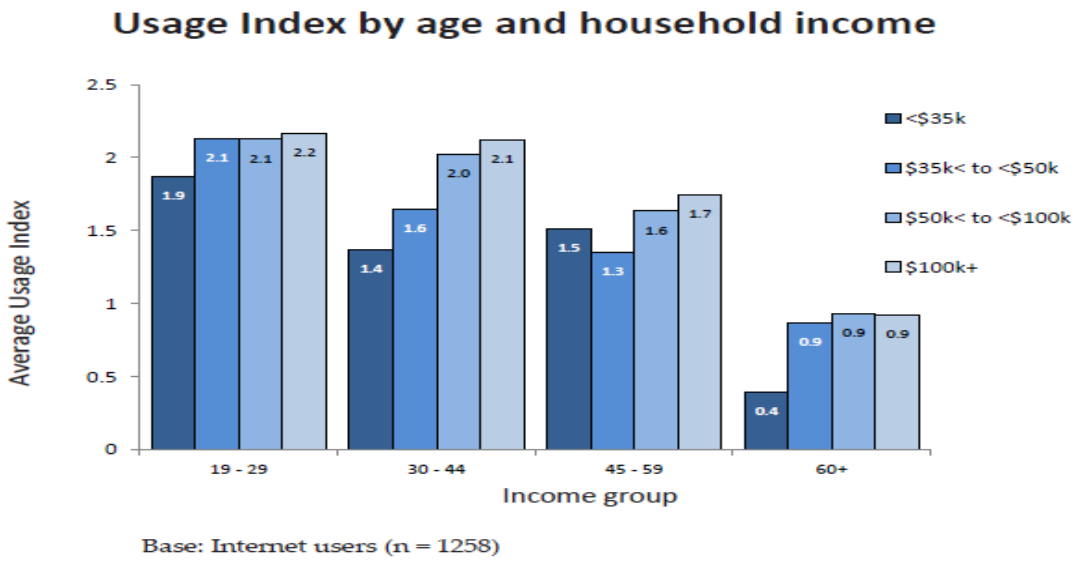
While the government IT connectivity programmes may provide the ability to connect to most New Zealanders, connectivity is not the only barrier to participating in the digital economy.

The term 'digital divide' refers to the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard both to their opportunities to access ICTs and to their use of the Internet for a wide variety of activities (OECD, 2001).

People who are unable to access information technologies or who are without the skills to use them run the risk of being excluded from possible social, educational, cultural and economic benefits. This may have adverse effects on their educational outcomes, employment prospects and other aspects of wellbeing. The WIP survey shows that internet usage increases based on income (see Figure 5 below).

There is a risk that the digital divide, while gradually narrowing, will also deepen as the internet becomes more pervasive, as the disadvantage will be more acute for those excluded. There are significant costs of digital exclusion from social and economic opportunities. A European think tank has estimated that a 10 percent increase in broadband penetration can increase GDP by 1.5 percent (European Union, 2015). No comparable figures are available for New Zealand, though a 2010 NZ Computer Society report estimated that lack of digital literacy costs New Zealand $1.7 billion annually.

Figure 5: Internet usage index by age and household income (World Internet Project, 2016)



Base: Internet users (n = 1258)

Approximately 341,208 households in New Zealand did not have internet access according to the 2013 Census. While this has likely decreased since 2013, current research suggests that in New Zealand barriers to participation in the digital economy fall into three broad categories:

Access – including:

- availability of broadband infrastructure at the home, school or community level
- affordability of connection, data, and/or devices, and
- accessibility for those with disabilities (Statistics New Zealand, 2013).

Awareness – including:

- information about what "access" options are available, and
- institutional and cultural knowledge, such as understanding the benefits of broadband and ICT (World Internet Project, 2016).

Skills – including:

- foundation-level digital literacy
- the capability to interact online in a safe way, and
- confidence in the security of online platforms (World Internet Project, 2016).

The way these factors interact means that people from low socio-economic backgrounds, people in rural areas, Pasifika and Māori, people with disabilities and senior citizens are more likely to experience barriers to digital participation.

What more might the government need to do to grow a prosperous digital economy?

To grow the digital economy, New Zealand businesses and individuals need to make the most of IT infrastructure they have access to, including addressing the following challenges (which are turned into questions in the 'members may wish to ask' section overleaf):

- **Uptake of fibre and general connectivity** – Uptake of fibre, where available, is over 20 percent, making New Zealand one of the fastest adopters of fibre technology in the world. However, many small businesses are not connecting at the same rates, or utilizing digital tools to be more efficient and productive.
- **Digital education** – As an estimated 65 percent of children today will be doing jobs that have not been invented yet, it is important that digital skills are taught from a young age. Given the increasingly important role of the Internet in education, all state and state-integrated schools have received UFB; the next step is to ensure teachers understand the devices and technology they are using in their classrooms, and that digital skills are taught throughout a child's education.
- **Computer science skills** – The digital sector can only grow as fast as the skilled workforce that supports it. New Zealand may need to actively encourage more people to study computer sciences at a tertiary level.
- **Digital skills in the workplace –** Even in non-digital sector jobs, digital skills will become increasingly more necessary across sectors, as businesses take their processes digital, or transform to connect with their customers online.
- **Migrant talent, and international investment** – To grow the digital economy, New Zealand may need to attract international talent to work across the country, and attract emerging technology entrepreneurs and investors.
- **Cyber security –** As New Zealand's economic and social interactions becomes increasingly digital, cyber security will become more crucial to keep information

safe and secure. Eighty three percent of New Zealander's have experienced a cyber breach, for example, having their email accounts hacked, and 61 percent did not change their behaviour as a result. The government has a cybersecurity strategy and action plan.

Report to the house

The Committee is required to report its findings on this inquiry to the House. The purpose of your report is first to inform the House and stimulate debate. In doing so your report should reflect both the oral and written evidence the Committee received, the issues the Committee considered in-depth, and the views of the members. From these the Committee should develop conclusions and recommendations to the Government.

Nicola Brown
Ministry of Business, Innovation & Employment
Report Writer
Youth Parliament 2016

Members may wish to ask:

1. How can we ensure that businesses understand the benefits of connectivity and can make the most of New Zealand's IT infrastructure?

2. How can we most effectively do this? What digital skills should a child gain during their primary and secondary education

3. Should we promote tertiary study and continuing education in computer sciences? How should we promote digital careers to the future and current workforce?

4. How can we upskill the existing workforce to be more digitally capable in their own careers?

5. How can we make New Zealand a destination for a migrant workforce, entrepreneurs and investors, to come to New Zealand, and help grow, the digital economy?

6. What should Government do to get cyber security information and tools to New Zealand citizens and businesses?

Glossary of Acronyms

ADSL	Asymmetric Digital Subscriber Line
ICTs	Information Communication Technologies
IoT	Internet of Things
MBSF	Mobile Black Spot Fund
RBI	Rural Broadband Initiative
UFB	Ultra-Fast Broadband
VDSL	Very-high-bit-rate digital subscriber line
WIP	World Internet Project

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Further Reading

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As well as considering this background paper, Youth MPs are welcome to undertake their own research on their committee topic (or on the Bill or any other aspect of Youth Parliament 2016). The Parliamentary Library has agreed to accept one question per Youth MP which they will endeavour to answer to inform your work. If you have not already done so, please contact jill.taylor@parliament.govt.nz to take advantage of this opportunity.