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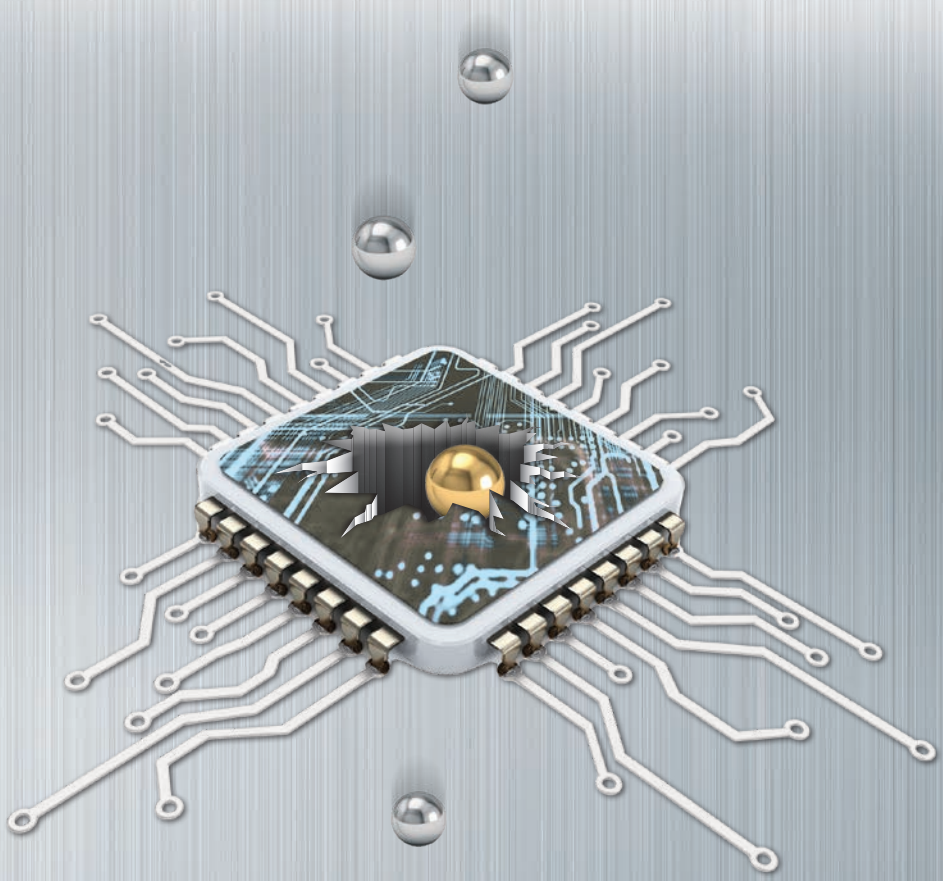

BANKWEST CURTIN ECONOMICS CENTRE

FALLING THROUGH THE NET

The Digital Divide in Western Australia

Focus on Western Australia Report Series, No. 11/18
August 2018

About the Centre

The Bankwest Curtin Economics Centre is an independent economic and social research organisation located within the Curtin Business School at Curtin University. The Centre was established in 2012 through the generous support of Bankwest, a division of the Commonwealth Bank of Australia. The Centre's core mission is to deliver high quality, accessible research that enhances our understanding of key economic and social issues that contribute to the wellbeing of West Australian families, businesses and communities.

The Bankwest Curtin Economics Centre is the first research organisation of its kind in Western Australia, and draws great strength and credibility from its partnership with Bankwest, Curtin University and the Western Australian government.

The centre brings a unique philosophy to research on the major economic issues facing the state. By bringing together experts from the research, policy and business communities at all stages of the process – from framing and conceptualising research questions, through the conduct of research, to the communication and implementation of research findings – we ensure that our research is relevant, fit for purpose, and makes a genuine difference to the lives of Australians, both in WA and nationally.

The centre is able to capitalise on Curtin University's reputation for excellence in economic modelling, forecasting, public policy research, trade and industrial economics and spatial sciences. Centre researchers have specific expertise in economic forecasting, quantitative modelling, micro-data analysis and economic and social policy evaluation. The centre also derives great value from its close association with experts from the corporate, business, public and not-for-profit sectors.

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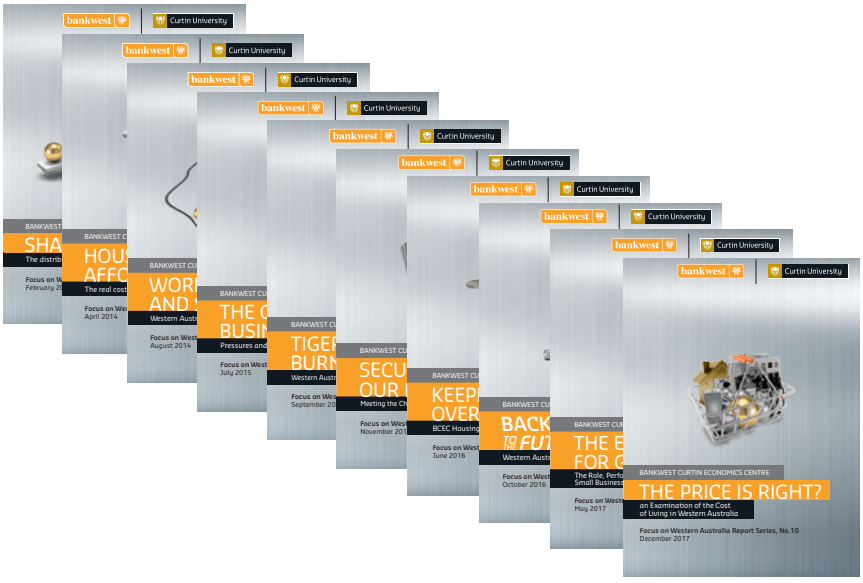
BCEC report series



Focus on Western Australia

This series presents a West Australia centric approach at analysing global events and domestic policy issues

First release 2014

Focus on the States

This series presents a critical comparison of topical issues between the states and territories of Australia

First release 2014

Focus on Industry

This series examines trends in important industries and sectors within the context of the West Australian economy

First release 2016

Foreword

Digital transformation underpins many of the technological advances in an era regarded as the 'Fourth Industrial Revolution'.

Digital connectivity touches on so many aspects of our lives. Mobile communications and internet technologies support our children's learning, the ways in which we now work, how we search for jobs, and how we gain access to financial and government services.

The internet also opens up opportunities for lifelong learning through remote and distance education, and allows greater workplace flexibility so we can spend more time with those we care most about.

It provides a platform for businesses to compete on a local, national and international stage, for communities to remain connected, and for individuals and families to access essential goods and services.

While new technology is transforming the way we live and work, this BCEC Focus on WA report explores the inequality of who has access to this technology – both individuals and businesses.

Western Australia does generally fare better than other states when it comes to household access to the internet, but there are still sections of the State's population that are missing out on the opportunity to remain connected and to access essential goods and services.

Geography, poverty, age and a lack of digital infrastructure create a risk of a divided society between those who are connected, and those who are not.

This is why it is critical to provide every member of the community with the opportunity to access affordable internet. This is not only a question of fairness. Digital connectivity has become a critical requirement for people to engage and participate effectively in seemingly all aspects of society.

The challenge for governments and society is to make sure that everyone is carried forward on the new digital wave.

Professor Alan Duncan
Director, Bankwest Curtin Economics Centre
Curtin Business School, Curtin University

Executive summary

New data technologies, big data analytics and intelligent software systems are transforming the way we produce, consume or distribute commodities, and increasingly, the way we access services. They are also changing the way in which we engage with our personal, social and business networks and communities.

The Economic Intelligence Unit (2018) has shown that Australia is ranked joint first globally in terms of preparedness for technological disruption. However, this report shows that there are clear divides between the haves and have nots across various measures of access, ability and affordability. At the household and individual level we evidence clear differences along geographic, demographic and socio-economic lines. Those most at risk of falling through the net in WA, and of becoming increasingly disconnected from society, include: those living in the most remote areas; families at higher levels of socio-economic disadvantage; older population cohorts and low income families, including children at risk of missing out on the educational benefits of ICT.

Analysis of expenditure patterns over time show that digital technologies are a necessity, particularly for those on lower incomes. The newly devised BCEC digital stress indicator identifies those households, by family composition and housing tenure, which are chiefly at risk.

This report also shows that the digital divide is also present across businesses, by employment size. The take up, use and perceived benefits of ICT, related data analytics, the internet of things and cyber-security is much lower for micro and small businesses. The Agriculture industry is particularly at risk, with many unable to access quality mobile and internet infrastructure. This impacts negatively across all aspects of the supply chain, and prevents industries from maximising the opportunities new technologies offer. Bridging such divides can benefit the WA and Australian economies, leading to increased productivity growth, with greater efficiencies and innovation leading to lower prices, new markets and increased value add – all critical factors in the context of global economies.

The report concludes with a discussion relating to how we can bridge the divide, the importance of shared responsibilities for all those concerned – from individuals, educators and educational institutions, industry, and community groups. The fact that technological disruption crosses all aspects of life, and across the life-course, implies that it also crosses all aspects of government –at the federal, state and local levels, but also across government departments. There is a need therefore, for an integrated strategy and policy, with a digital advisory body representing all major groups in WA required.

Key findings

Access, attitudes and ability

Internet access and usage

- 90% of Australian households had access to the internet in 2016, up from 71% in 2006.
- Across all states, levels of internet access are higher in the major cities and inner regional areas relative to more remote areas.
- 8 out of 10 of households in WA's most remote regions access the internet. This compares to 7 out of 10 households in the most remote areas of NSW and SA.
- Households in very remote areas of WA report a higher proportion (14ppt) of internet access relative to the average for very remote areas across Australia.
- 55% of households in East Pilbara do not access the internet.
- Those regions with lower (higher) internet access have higher (lower) proportions of Indigenous people, and are more likely to live in more (less) remote areas.
- Older age groups are less likely to access the internet.
- In WA, the 65+ age group fair better than in other states, with over 60% of this cohort accessing the internet.
- WA saw a 10ppt increase in internet access for the 65+ age group between 2012-13 (51%) and 2016-17 (61%).
- 74% of those in the lowest income quintile in WA access the internet. This compares to 99% for those in the highest income quintile.
- Those in the lowest income quintile in WA are more likely to access the internet relative to their counterparts in other states.
- There has been a sizeable improvement in internet access for those in the lowest income quintile in WA, increasing from 59% in 2012-13 to 74% in 2016-17.
- Across Australia, those with an education level of Year 12 or below have lower levels of internet access compared to those with higher education levels.
- In WA, those with an education level of Year 12 or below have higher internet access (84%) compared to their equivalent groups across all other states, with the lowest being in NSW (77%).
- 76% of unemployed persons in WA access the internet – 20 ppt lower than those in employment (96%).

The changing nature of engaging with the internet

- There is a lag in the take up of newer device types (such as tablets and internet TV) in the more remote regions of Australia. This gap is wider in WA.
- 57% of people in the highest income quintile use internet connected TV, compared to 26% of people in the lowest quintile.
- Banking (80%), social networking (80%), entertainment (79%) and purchasing of goods and services (73%) are the most popular reasons cited for accessing the internet.
- Health services (47%) and formal education activities (28%) are cited less frequently as reasons for accessing the internet.
- Between 2014-15 and 2016-17, online health services experiences a 24ppt increase in usage.
- A larger proportion of internet users in the most remote areas of WA access the internet for health services, social media, and purchasing of goods and services, compared to those in urban centres.

- In 2015-16, 36.8% of those in the lowest income quintile used the internet for health services, compared to 55.4% of those in the highest income quintile (an 18.6 ppt difference).
- Access to the internet will become increasingly more important for older people, with as more services go online.

Ability and attitudes towards ICT

- In WA, the main reason for not having internet at home is a perceived lack of need (56%).
- 74% of the people in WA without internet do not find it easy to get useful information on the internet.

Affordability and digital expenditures

Household expenditure on ICT

- The CPI has increased 60 points in the last 18 years while the Digital CPI has declined by 33 points.
- Average digital expenditure has increased substantially in WA from 2003-04 to 2009-10, and declined to 2015-16. Recent falls in digital prices have been driven both by product innovation and increased competition.

Cost of connectedness

- Between 2003-04 and 2009-10, the average WA household has almost doubled their total consumption of ICT. From 2009-10 to 2015-16, total expenditure decreased for all households but the decline is even sharper for singles (42%) and single parents (33%).
- ICT products and services are becoming ever more a necessity as society adapts to the new digital future.
- Although the typical level of digital spending for the poorest fifth of families is around $14.17 per person per week, 1 in 10 are observed to spend nearly three times as much – at least $36.89.
- 1 in 10 of the poorest fifth of families are committing at least 10% of total expenditure towards digital products and services.
- The incidence of digital stress is most pronounced among single parents (at around 10.5%) and non-elderly single women (12.2%), the latter rising by some 7.1 ppt in a little more than a decade.
- Nearly 1 in 6 single parents with 3 or more children are in digital stress.
- Around 8.8% of single parents with 3 or more children are spending more than 20% on digital goods and services, despite being on low incomes – double the rate of a decade ago.

Small business, large divide

Business access to broadband

- 95.4% of all businesses reported having internet access in 2016-17.
- Large businesses with 200+ employees are more likely to have a FTTP connection (30.1%) relative to smaller businesses.
- The Accommodation and Food Services industry has seen a large increase in internet access, with growth coinciding with the launches of AirBnB (2012) and Uber Eats (2016).
- The Agriculture, Forestry and Fishing sector is less likely than other sectors to use a DSL connection (31.3% in 2016-17), opting for wireless technologies (65.6%) to access broadband.
- 18.1% of small businesses in WA rated their mobile quality as low.

Business use of internet

- The gap between small and large businesses receiving orders via the internet has expanded between 2006-07 and 2016-17.

Key findings (continued)

- Businesses with 200+ employees are far more likely to use the internet for information sharing or data exchange.
- The gap between small and large businesses is slowly narrowing for financial activities, online training/ learning and remote work.
- Businesses with 0-4 employees are more likely to earn greater than 50% of their income by the internet than larger businesses.

Business use of IT

- Smaller businesses are more likely to report no IT support provided.
- 19.3% of businesses in the Agriculture, Forestry and Fishing sector have no IT support.
- The primary activity on social media for businesses of all sizes is to develop the company image or to market products.
- The low use of paid cloud computing in Agriculture could be a result of broadband connections and plans, with no satellite NBN business plans yet available.
- Businesses with 0-4 employees were the least likely to have management practices that support ICT, with 76.1% of these businesses reporting no management practice implemented in 2015-16.

Business perspectives of ICT

- Larger businesses place a greater importance on digital technologies than smaller businesses.
- High speed broadband is more likely to be reported as being of major importance for larger businesses.
- Skills make the greatest difference for IT use in larger businesses.
- For businesses with fewer than 200 employees, a lack of access to digital infrastructure is reported as a significant factor affecting IT use.

Infrastructure needs for our digital future

Infrastructure

- The volume of data downloaded by Australians has increased by more than 500% in 5 years.
- Data downloaded over wireless devices grew by 97.4% between Dec 2016 and Dec 2017.

Government and regulation

- Competition is expected to improve quality and reduce prices, thereby reducing digital inequality.
- Australian governments should consider whether additional privacy requirements are appropriate in Australia to meet international standards.

Social change and digital services

The changing face of service delivery

- For the non-Indigenous community, almost 78% of people lodge bill payments online. This compares to 36% of Indigenous people – a difference of 42ppts.
- Indigenous people are less likely to access government services online, relative to non-Indigenous people.
- 21% of non-Indigenous people access information or services related to healthcare online. This compares to only 8% for Indigenous people – a 13ppt gap.
- People's ability to engage and maximise the potential of ICT also requires a stronger grounding in STEM.
- Digital infrastructure must be part of an overall infrastructure plan.
- Digital technology impacts all aspects of the lifespan and crosses multiple government portfolios. There is a need for an integrated digital strategy.

Introduction

Digital transformation underpins many of the technological advances in an era that many regard as the 'Fourth Industrial Revolution'. New data technologies, big data analytics and intelligent software systems are transforming the way we produce, consume or distribute commodities, and increasingly, the way we access services. Information and telecommunications technology is shifting from being what was previously seen as a luxury to what is now an essential service.

The Economist Intelligence Unit (the EIU, 2018) recently release a report relating to how prepared economies are for technological disruption (2018). In this, Australia ranked in first position, jointly with Singapore and Sweden – a positive indicator of Australia's international standing. The EIU index was based on nations' overall access to the internet, digital infrastructure and openness to innovation. However, not everyone within Australia can take advantage of the remarkable opportunities in this new digital age. Barriers relating to access, ability and affordability mean that society is at risk of a digital divide being created between those who are connected, and those who are not. The risk is that a digital divide enhances and deepens social fractures – between those that have and have not. The challenge therefore is to ensure that everyone is carried forward on the new digital wave. This report provides a detailed analysis of the case of a digital divide for households, individuals and businesses in Western Australia to inform discussions and provide a foundation from which recommendations can be developed, owned, and actioned. In doing so, we make use of both publically available data, previously unpublished ABS data, and unique BCEC survey data.

The term 'digital divide' was first used in 1995 by the National Telecommunications and Information Administration (NTIA), who have since published a series of reports on those 'Falling through the Net' in the United States. While there is no agreed definition of the 'digital divide', it is commonly accepted to refer to *"inequalities as a result of ICT".* Depending on the context in which it is used, *"it refers either to inequalities between countries regarding diffusion of new information and communication technologies or between individuals regarding technical access to ICTs and technical training in the use of ICTs"* (Maier-Rabler, 2002: 18).

Of course the concept of 'a digital divide' is, in some respects, overly simplistic. Social barriers to internet and ICT usage are complex and span not only geography, but socio-economic and demographic indicators such as age, gender, income, education, and employment status. While an increasing number of people and businesses have access to internet infrastructure, not all are accessing and engaging with ICT in a manner that maximises utility and social connectedness. Therefore, for households and individuals, not only do we examine access to ICT, we also examine engagement, looking at the means (devices) through which people access the internet, and the reasons for using the internet (such as entertainment, health, education and banking services). The latter is particularly important in the context of ensuring that, as more services (including Government services) go online, the most vulnerable in our societies do not fall through the net.

Society's ability to adapt to and adopt technology over time is also a critical component. The pace of innovation and uptake of ICT is unprecedented. Therefore, as allowed for in the data, we address the existence of a divide over time. The latter is important for two reasons. First, in of itself, it is interesting to see if there is a 'catch up' over time for vulnerable groups in our society. Second, given that technology is ever changing, it is important to understand the factors contributing to a digital divide over time, to see what groups have been at risk in the past and present, and if such groups are likely to remain at risk.

An often neglected dimension of the digital divide is the one that exists across businesses by size and industry. Therefore we also address access, ability and perceptions of ICT by business size and industry. We suggest that there is an opportunity to increase productivity and competitiveness by bridging the digital divide that we show to exist for businesses across Australia. In addition to using publically available data at the national level, we make use of the BCEC Small Business Survey 2017 to address if there are differences in ICT access for small businesses across the regions in WA.

While the focus of this report is not on the ICT industry, it is important to address aspects of the industry, in an attempt to identify if aspects of the digital divide may be related to the nature and composition of the industry. Therefore, we provide some context on the evolution of the ICT industry in WA, the level of competition and the regulatory environment in which suppliers and consumers operate.

The report concludes with discussions relating to the impact of the digital divide in WA, means through which the State can bridge the divide, and suggestions for a way forward. This is a complex issue, which spans federal, state and local government levels and across many portfolios. Industry, government and not-for-profits, together with education institutions and the broader community all have roles to play in bridging the digital divide in across WA and Australia. The time is right, the time is now. No person, household or business should be left behind in the new digital wave.

Households apart:

Access, attitudes and ability

Introduction

One of the measures traditionally used to analyse the digital divide is the level of household and individual access to the internet. The pace at which the internet and related ICT technology, services and devices have and continue to reach society is unprecedented. Nicholas Felton (2018) has shown that to reach 50 million global users it took radio 38 years, TV 14 years and the Internet only 4 years. The speed at which technology enters our homes, businesses and lives in general has implications for how we can adapt, use and engage with such ICT. It also means that for those left behind, not only is there a divide, but there is a deepening of the divide, since such ICT has shifts from being a luxury to an item of necessity – a concept returned to later in this report.

This section of the report addresses household and individual access to ICT as well as attitudes and ability in using ICT. The question of affordability and expenditure patterns are addressed in the subsequent section. The issues of a digital divide is no longer a simple question of whether one has access to the internet or not. It expands to how one is accessing the internet (infrastructure and hardware being used), and the reasons for accessing the internet (engagement). The latter is of particular importance given that various services, across banking, government, health and entertainment, are increasingly being delivered online. We identify those groups that are most at risk of falling at the wrong side of the digital divide. In doing so, where possible, we look at variations across Australian states, and focus on regional differences within WA at the SA2 regional level. In additional to geographic domains, this section also analyses the case of a divide across various socio-economic and demographic characteristics.

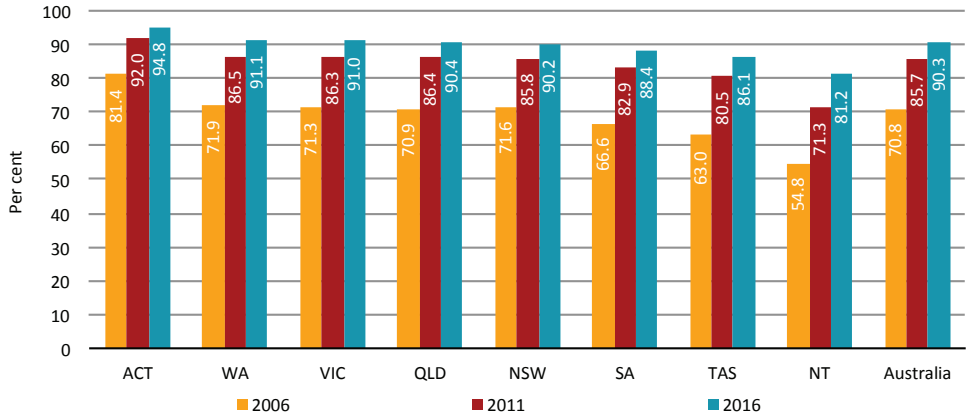
The right side of the road – Internet access and usage

Household internet access by state

On aggregate, households accessing the internet access is reaching saturation across Australia. As shown in Figure 1, approximately 90 per cent of Australian households had access to the internet in 2016. This stood at 71 per cent in 2006. On a state and territory basis, the ACT records the highest proportion of households accessing the internet, standing at 95 per cent. WA, Vic, Qld, and NSW all report similar levels of internet access, standing at approximately 90 per cent on Census night 2016. SA has slightly lower levels, (88%), followed by Tas (86%). The NT reports the lowest level of internet access (81%), although the latter has seen a closing of the gap since 2006, when only 55 per cent of households had access to the internet.

90% of Australian households had access to the internet in 2016. This stood at 71% in 2006.

Figure 1 Households with internet access, by state, 2006 to 2016



Note: States are ranked by internet access in 2016.
Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS Census of Population, 2006, 2011 and 2016.

In terms of internet access, it is important to look beyond the aggregate state level data to explore the digital divide. Below, we decompose state level data by region, and by socio-economic and demographic characteristics. Furthermore, the internet in of itself is not the be all and end all. How the internet is accessed and analysing the type of services for which it is accessed provide a richer and deeper understanding of the digital divide in WA. These are areas which will be addressed further in the following sections.

Across all states, levels of internet access are higher in the major cities and inner regional areas relative to more remote areas.

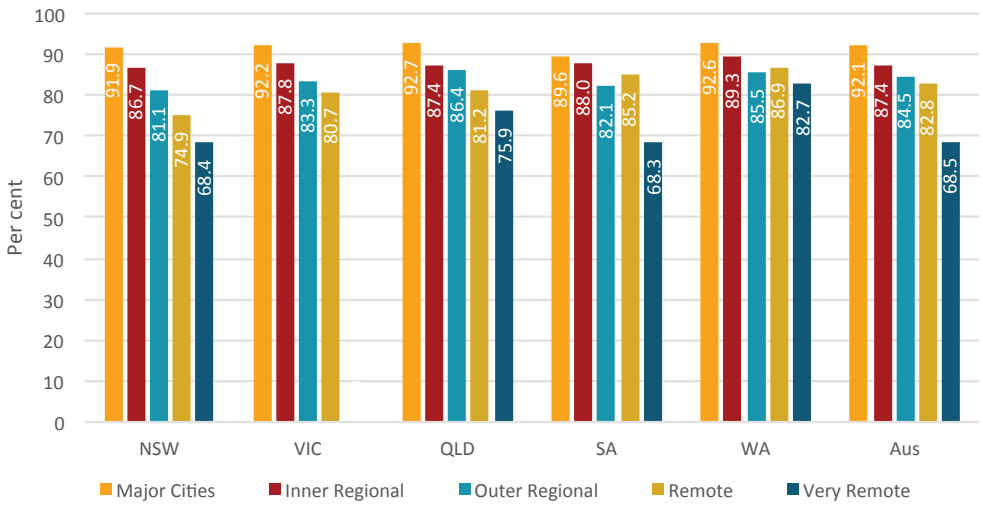
8 out of 10 of households in WA's most remote regions access the internet. This compares to 7 out of 10 households in the most remote areas of NSW and SA.

Internet usage by level of regional remoteness

Moving beyond the headline state level data for internet access, Figure 2 shows households accessing the internet in 2016 by level of remoteness. Across all states, levels of internet access are higher in the major cities and inner regional areas relative to more remote areas. Albeit small, for SA and WA, remote areas have higher internet access than those in living in outer regional WA.

Across the five levels of remoteness (major cities, inner regional, outer regional, remote and very remote), WA compares favourably with other states, with the most notable difference in the very remote regions. For the latter, 83 per cent of WA households have internet access. This compares with an Australian average of 69 per cent. It may be the case that infrastructure emerging from the needs of the mining industry have benefited those in very remote regions in WA, with higher levels also reported for the very remotes areas in QLD, another mining state.

Figure 2 Internet usage by level of remoteness, by state, 2016

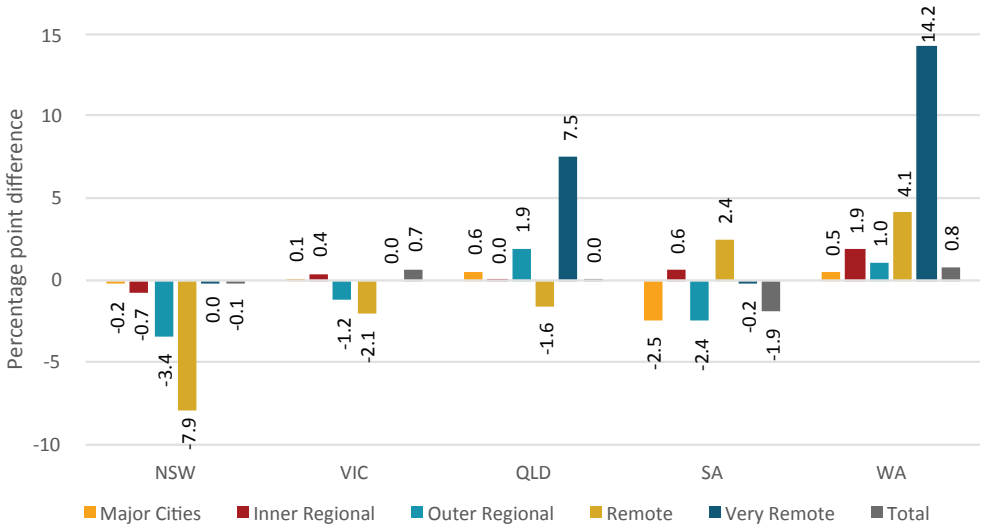


Note: Region is defined by level of remoteness, as per ABS data. Victoria does not have a 'very remote' category.
Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS Census of Population 2016.

The stronger performance of WA across the remote and very remote regions, is highlighted further in Figure 3. Compared to the Australian average for very remote areas, there is a positive 14 percentage point difference for very remote areas in WA, with a 4.1 ppt difference for remote areas. Remote parts of NSW report an 8 ppt lower level internet access compared to the average of remote areas across Australian.

Households in very remote areas of WA report a higher proportion (14 ppt) of internet access relative to the average for very remote areas across Australia.

Figure 3 Internet usage by level of remoteness, by state, relative to Australian average, 2016



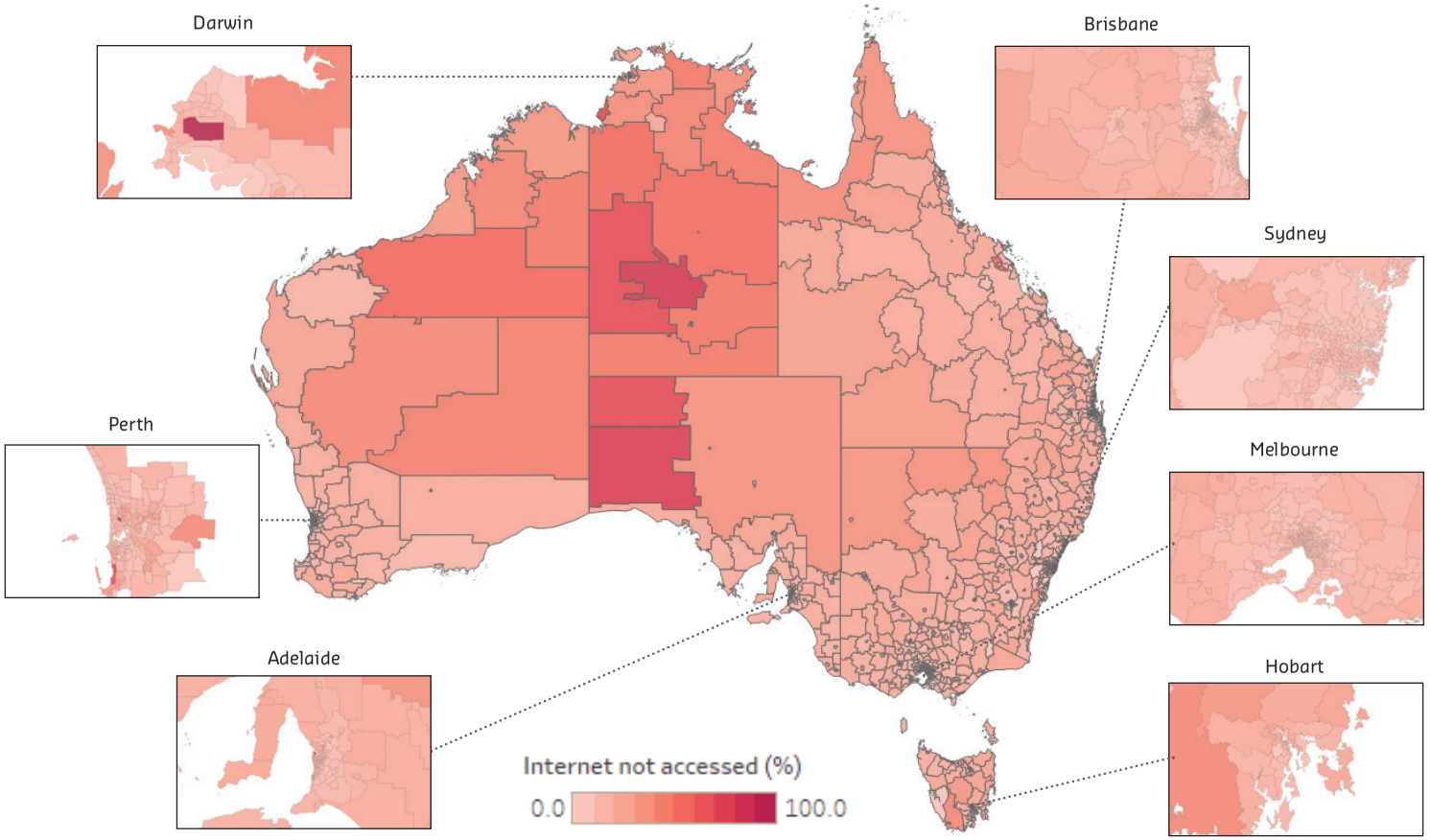
Note: Region is defined by level of remoteness, as per ABS data. Victoria does not have a 'very remote' category.
Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS Census of Population 2016.

Internet usage by SA2 region

Here levels of household internet access at a more disaggregated statistical areas level (SA2) are presented. Using this data, we map the level of internet access by SA2 region, whereby some clear differences are evident across Australia. The percentage of households not accessing the internet by SA2 region are displayed in the below heat map for Australia (Figure 4) and WA (Figure 5).

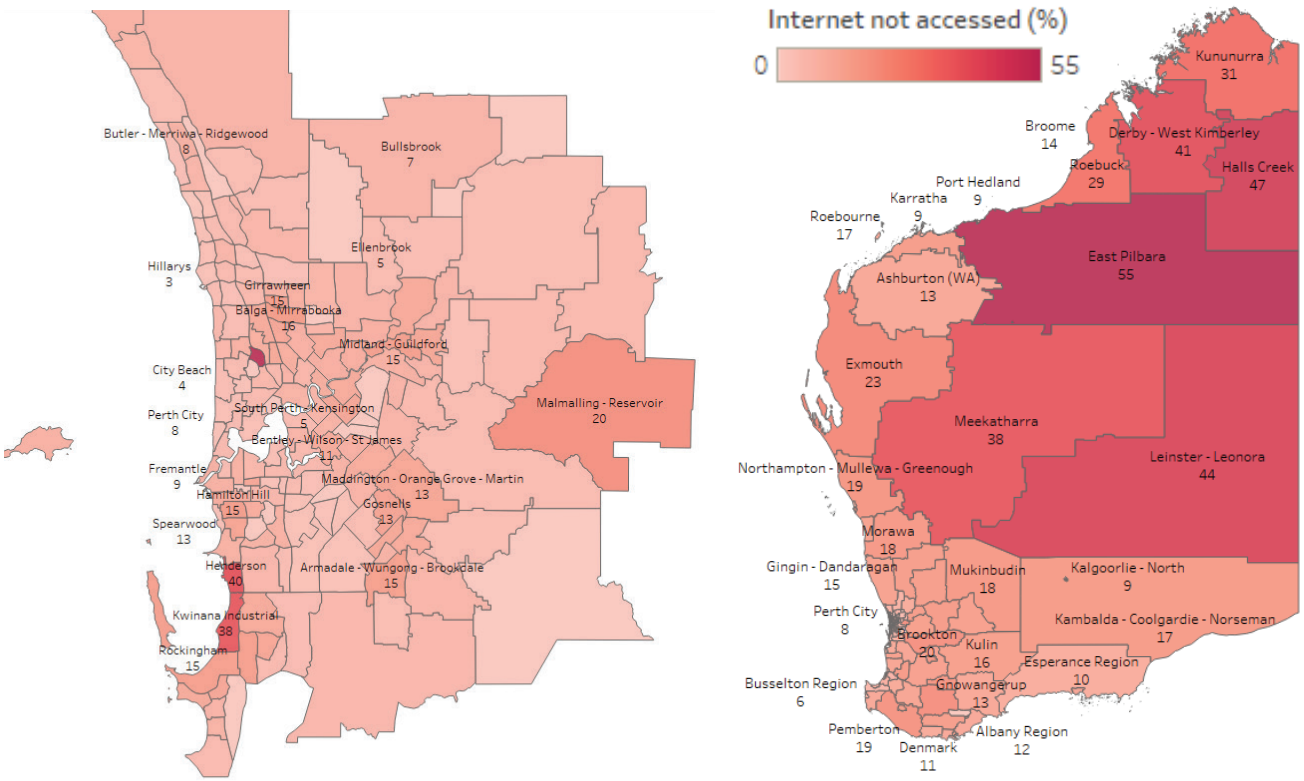
Differences in internet access at the SA2 regional level are evident, with a clear rural-urban divide across both Australia and WA.

Figure 4 Households not accessing the internet from dwelling, Australia and WA, 2016



Note: Census data extracted using Tablebuilder. Counting Persons, Place of Enumeration.
Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS Census of Population, 2016.

Figure 5 Households not accessing the internet from dwelling, WA and Greater Perth, 2016



Note: Census data extracted using Tablebuilder. Counting Persons, Place of Enumeration. Industrial areas of Osborne Park, Henderson and Kwinana Industrial are outliers due to low/zero number of dwellings.
Source: BBankwest Curtin Economics Centre | Authors' calculations from ABS Census of Population, 2016

55% of households in East Pilbara do not access the internet.

For WA, in terms of households accessing the internet, the lowest performing region is East Pilbara, with 55 per cent of households not accessing the internet in 2016. This was followed by Halls Creek (47%), Leinster-Leonora (44%) and Derby-West Kimberley (41%). The 21 regions (SA2) with the lowest rates of internet access are displayed in Table 1, while Table 2 shows the 21 regions (SA2) with the highest internet access. These tables also report the number of dwellings in these regions, along with their level of relative socioeconomic disadvantage (as denoted by the SEIFA score), the proportion of Indigenous populations and the level of remoteness.

SEIFA, an indicator of relative socio-economic disadvantage for areas, is derived through combining a number of socio-economic factors, such as unemployment rates, median incomes, and housing costs, amongst others. A SEIFA score of 1 demotes SA2 regions with the highest level of socio-economic disadvantage, with a score of 10 denoting SA2 regions with the lowest level of relative disadvantage.

Internet access is lower (higher) in regions with greater (lower) levels of socio-economic disadvantage.

Table 1 and Table 2 show a clear association between levels of internet access and relative socioeconomic disadvantage. Those regions reporting lower internet access are in areas of higher socio-economic disadvantage, with the reverse evident for those regions will lower levels of disadvantage. The majority of the 21 regions with the lowest internet access rates (Table 1) have a SEIFA score of 1, with the highest SEIFA of this group being 4 (Exmouth). Table 2 shows the top 21 regions (SA2) with the highest internet access. None of these have a SEIFA decile score below 8.

Lower internet access is also evident for regions with higher proportions of Indigenous population and in the more remote regions. Only one of the regions reporting low levels of internet access (Table 1) lies in a major city (Mandurah) with all others being in very remote (9 of the lowest 21), remote (3), outer regional (6) or inner regional (2) areas. For the case of Mandurah, it is interesting to note that this is an area that also suffers from high youth unemployment, and other socioeconomic issue, as captured by SEIFA.

Those regions with lower (higher) internet access have higher (lower) proportions of Indigenous people, and are more likely to live in more (less) remote areas.

Those regions with lower levels of internet access all report large Indigenous populations ranging from 2.5 per cent (Pemberton) to 70 per cent (Halls Creek). On the other hand, those regions with the highest rate of internet usage (Table 2) are all in major city regions with low proportions of Indigenous people.

Table 1 Households least likely to access the internet, by SA2 region, WA, 2016

SA2 region	Internet not accessed	Internet accessed	Total dwellings	SEIFA 2016	Indigenous population	Remoteness area
	%	%	No.	Decile	%	Category
East Pilbara	55.0	45.0	2,073	1	19.9	Very Remote
Halls Creek	46.7	53.3	2,757	1	69.6	Very Remote
Leinster - Leonora	44.2	55.8	3,024	1	33.5	Very Remote
Derby - West Kimberley	40.7	59.3	7,639	1	57.1	Very Remote
Meekatharra	38.5	61.5	1,955	1	20.4	Very Remote
Kununurra	30.9	69.1	7,607	1	26.3	Very Remote
Roebuck	29.3	70.7	3,105	1	45.5	Very Remote^
Carnarvon	23.0	77.0	5,232	2	17.4	Very Remote
Exmouth	22.9	77.1	7,118	4	4.0	Very Remote
Kojonup	20.7	79.3	3,577	3	7.0	Outer Regional
Brookton	20.4	79.6	3,157	2	9.1	Outer Regional^
Pemberton	19.4	80.6	4,423	3	2.4	Outer Regional
Northampton - Mullewa - Greenough	18.9	81.1	6,013	3	6.6	Remote^
Geraldton	18.9	81.1	9,983	1	10.9	Outer Regional
Katanning	18.7	81.3	3,825	1	7.9	Outer Regional
Narrogin	18.5	81.5	3,891	2	7.6	Outer Regional
Withers - Usher	18.1	81.9	4,609	1	7.7	Inner Regional
Morawa	18.0	82.0	3,527	3	7.1	Remote^^
College Grove - Carey Park	17.9	82.1	5,593	1	5.9	Inner Regional
Mukinbudin	17.8	82.2	2,582	3	4.1	Remote^
Mandurah	17.7	82.3	7,937	1	3.1	Major City

Note: Census data extracted using Tablebuilder. SEIFA decile is from 1 to 10, with decile 1 being the most disadvantaged and 10 being the least disadvantage relative to other SA2 regions in WA. ^Where two areas of remoteness exist, the area where the majority of the population resided is reported.

Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS Census of Population, 2016 and ABS Cat 2033.0.55.001.

Table 2 Households most likely to access the internet, by SA2 region, WA, 2016

SA2 region	Internet not accessed	Internet accessed	Total dwellings	SEIFA 2016	Indigenous population	Remoteness area
	%	%	No.	Decile	%	Category
Iluka - Burns Beach	1.5	98.5	8,360	10	0.4	Major City
Canning Vale - West	2.6	97.4	9,644	9	0.6	Major City
Hillarys	2.6	97.4	10,301	10	0.5	Major City
Cottesloe	2.8	97.2	6,642	10	0.4	Major City
Winthrop	2.8	97.2	5,740	10	0.0	Major City
Forrestdale - Harrisdale - Piara Waters	2.8	97.2	18,556	9	0.7	Major City
Floreat	2.9	97.1	7,544	10	0.3	Major City
Jandakot	2.9	97.1	2,328	10	1.1	Major City
Canning Vale - East	3.0	97.0	21,254	8	2.2	Major City
Currambine - Kinross	3.0	97.0	13,154	8	0.6	Major City
Banjup	3.1	96.9	16,663	9	1.2	Major City
North Coogee	3.1	96.9	2,091	10	0.5	Major City
Bateman	3.1	96.9	3,511	10	0.3	Major City
Ocean Reef	3.2	96.8	7,477	10	0.7	Major City
Leeming	3.3	96.7	10,295	10	0.4	Major City
Madeley - Darch - Landsdale	3.4	96.6	24,104	9	0.5	Major City
Duncraig	3.5	96.5	14,420	10	0.4	Major City
Mindarie - Quinns Rocks - Jindalee	3.5	96.5	17,463	8	1.2	Major City
Willetton	3.5	96.5	17,714	8	0.4	Major City
Singleton - Golden Bay - Secret Harbour	3.6	96.4	17,899	7	1.4	Major City
Glen Forrest - Darlington	3.7	96.3	6,637	10	1.1	Major City

Note: Census data extracted using Tablebuilder. SEIFA decile is from 1 to 10, with decile 1 being the most disadvantaged and 10 being the least disadvantage relative to other SA2 regions in WA.

Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS Census of Population, 2016 and ABS Cat 2033.0.55.001.

Older age groups are less likely to access the internet.

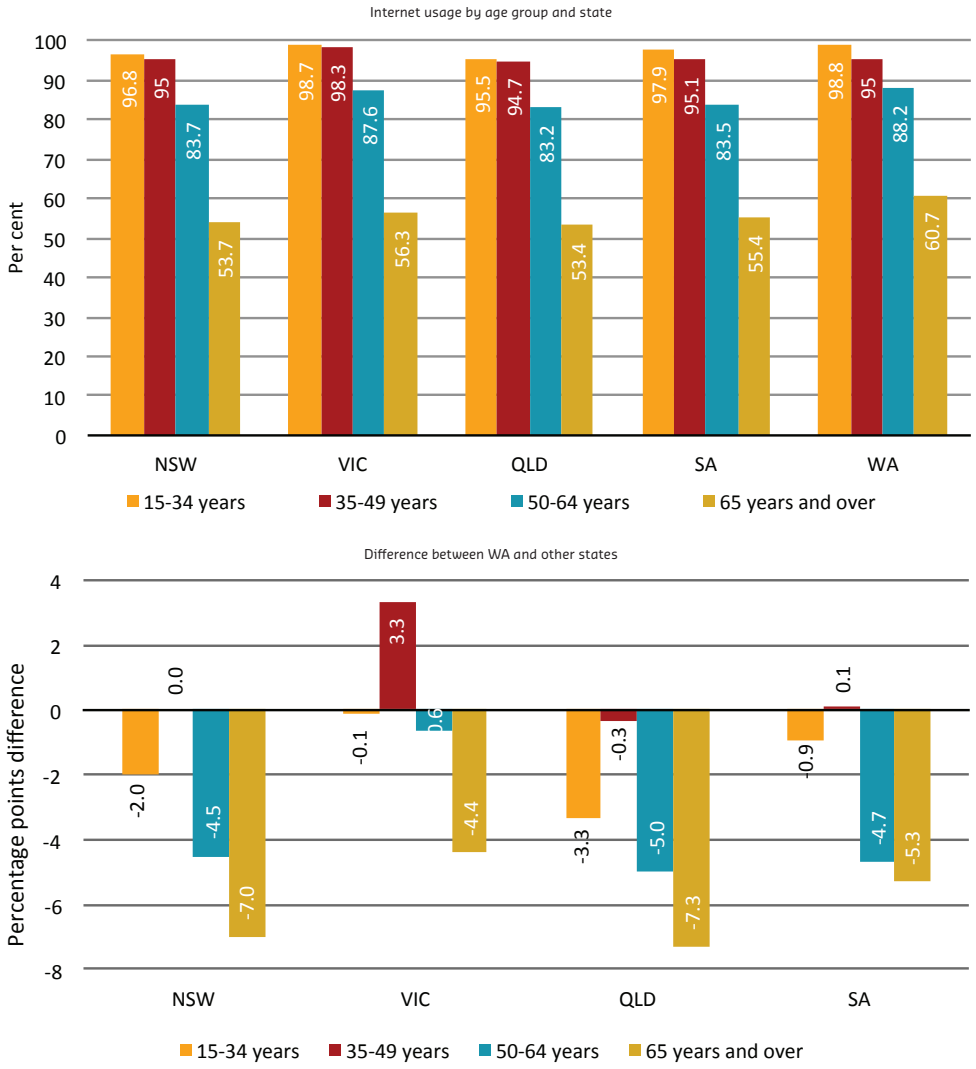
In WA, the 65+ age group fair better than in other states, with over 60% of this cohort accessing the internet.

Internet usage by age

Here, our attention turns to internet access by age groups. Using unpublished ABS data[1] provided through special request, it is evident that in 2016-17, those in the older age groups are less likely to access the internet. While this is to be expected, the scale of difference is significant, with the difference between the 15-34 age cohort and the 65+ age cohort for NSW, VIC, QLD and SA, being in excess of 40 percentage points (Figure 6, top).

In WA, the 65+ age group fair better than in other states, with over 60 per cent of this cohort accessing the internet, compared to 56 per cent for VIC, 55 per cent for SA, 54 per cent for NSW and 53 per cent for QLD. The percentage point differences between WA and other states across all age bands is shown in Figure 6 (bottom), and paints WA in good light across all age groups. The exception is in the 35-49 band, where VIC reports higher access (3.3 ppt) to that of WA.

Figure 6 Internet usage by age group and by state, 2016-17



Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8146.0, unpublished data.

1 For the remainder of this section of the report, we change our use of data from Census data to the Household Use of Information Technology (HUIT) data. HUIT data is designed specifically to look at issues relating to household and personal use of ICT. While having less detail on the small area level relative to the Census data, this dataset provides more currency (to 2017), and greater detail on devices used, services accessed, and cyber bullying, amongst others. HUIT data on household and person use of internet access is robust when compared to Census data.

With high proportions of internet access already reported for the 15-29 and 35-49 age bands in 2012-13, the latter see little improvement between 2012-13 and 2016-17 (Table 3). Over the same five year period however, there has been some improvement across all states for the 50-64 age group, with WA seeing a 5 percentage point increase.

However, the greatest improvement is evident in the 65+ age band. While starting from a lower base, an improvement in internet access for this age group is evident across all states. WA saw an increase of 10 ppts going from 51 per cent in 2012-13 to 61 per cent in 2016-17. Even larger improvements are visible for SA (13 ppts) and Victoria (13 ppts).

WA saw a 10ppt increase in internet access for the 65+ age group between 2012-13 (51%) and 2016-17 (61%).

Table 3 **Internet usage by age group and by state, 2012-13 to 2016-17**

	2012-13	2014-15	2016-17	Change since 2012-13
	%	%	%	PPT change
15-34 years				
NSW	95.1	97.6	96.8	+1.7
VIC	97.6	98.0	98.7	+1.1
QLD	96.0	94.7	95.5	-0.50
SA	98.0	97.4	97.9	-0.10
WA	95.5	97.5	98.8	+3.3
35-49 years				
NSW	92.4	93.1	95.0	+2.6
VIC	94.9	90.7	98.3	+3.4
QLD	92.7	92.8	94.7	+2.0
SA	90.6	91.5	95.1	+4.5
WA	94.1	92.8	95.0	+0.9
50-64 years				
NSW	77.8	79.1	83.7	+5.9
VIC	81.6	86.5	87.6	+6.0
QLD	82.5	83.3	83.2	+0.7
SA	81.9	81.1	83.5	+1.6
WA	83.2	85.0	88.2	+5.0
65 years and over				
NSW	44.9	51.3	53.7	+8.8
VIC	43.8	49.5	56.3	+12.5
QLD	47.7	50.0	53.4	+5.7
SA	42.7	50.6	55.4	+12.7
WA	50.7	52.5	60.7	+10.0

Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8146.0, unpublished data.

Those in the lowest income quintile in WA, are more likely to access the internet relative to their counterparts in other states.

Persons internet usage by income

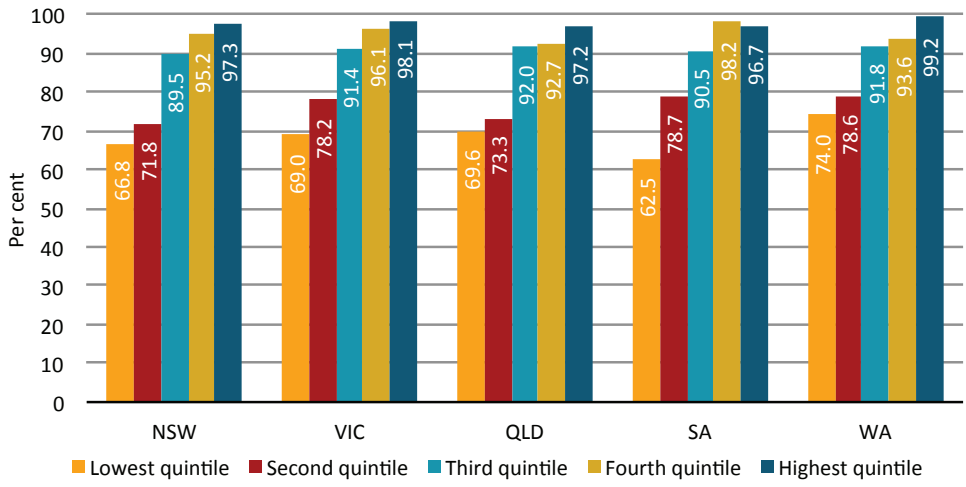
A key determinant of consumption expenditure is income. The BCEC Quarterly Economic Commentary (Cassells, Duncan and Kiely, 2018) has drawn attention to the role low wage growth (in addition to population and other factors) has had on lower consumption growth in WA in recent periods.

Income also matters in terms of accessing the internet. Figure 7 shows that, for all states across Australia in 2016-17, those on higher incomes have higher rates of internet access. The gap between those on the lowest and second lowest quintiles and those in the higher three quintiles is particularly evident. For WA, 74 per cent of those on the lowest income quintile access the internet. This is over 25 percentage points lower than that of the highest quintile in WA, who report 99 per cent access.

While the latter differences are unacceptable, those in the lowest quintile in WA do better that those with equivalent income levels in other states. For example, only 63 per cent of those in the lowest quintile in SA access the internet. It may be the case that WA's distance from other states, and levels of remoteness within WA make internet access a greater necessity for those living in WA, independent of income level.

WA's distance from other states, and levels of remoteness within WA may make internet access a greater necessity for those living in WA, independent of income level.

Figure 7 Internet access by income and by state, 2016-17

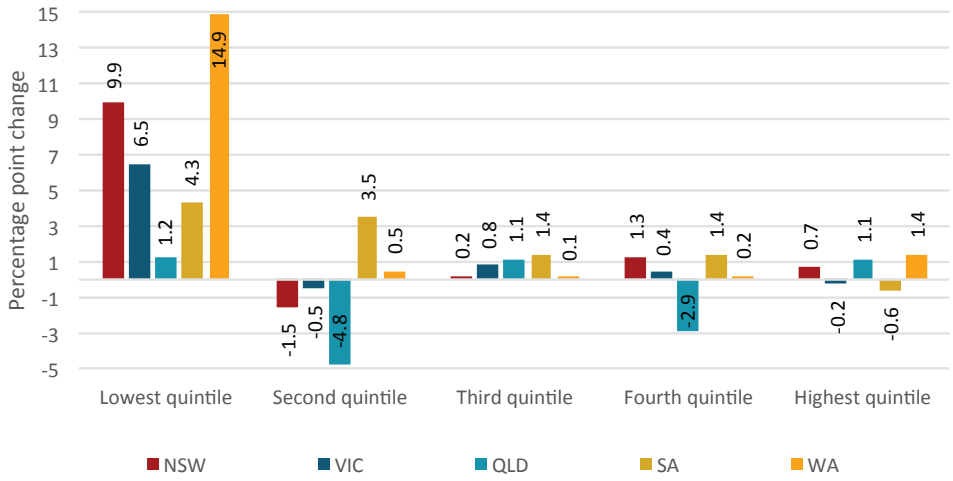


Note: Equivalised household income quintiles.
Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8146.0, unpublished data.

Since 2012-13 there has been little change in the use of internet for those in the second income quintile and the higher quintiles (Figure 8). There has been a greater improvement for those in the lowest quintile, particularly for WA, where internet access increased from 59 per cent to 74 per cent for this group. This suggests that increased competition, lower internet prices, and cheaper hardware (items returned to later in this report) are allowing those on the lowest quintile to catch up. However, the gap still remains large and more needs to be done to ensure that the most vulnerable in our society are not left behind in the digital age.

There has been a sizeable improvement in internet access for those in the lowest income quintile in WA, increasing from 59% in 2012-13 to 74% in 2016-17.

Figure 8 Internet usage by income quintile and state, 2012-13 to 2016-17



Note: Equivalised household income quintiles.
Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8146.0, unpublished data.

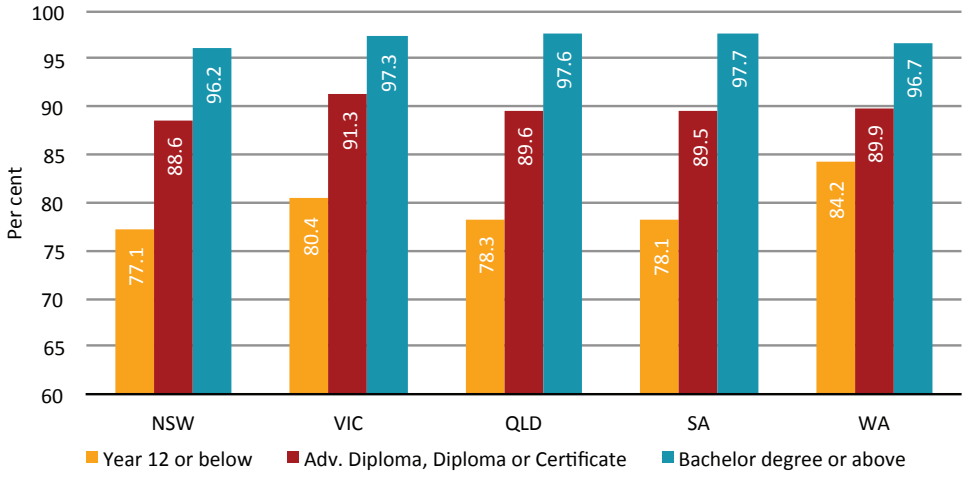
Across Australia, those with an education level of Year 12 or below have lower levels of internet access compared to those with higher education levels.

In WA, those with an education level of Year 12 or above have higher internet access (84%) compared to their equivalent groups across all other states, with the lowest being in NSW (77%).

Persons internet usage by education level

Various studies have demonstrated the strong positive relationship between human capital (which includes education) and level of income. It is not surprising therefore that a similar trend to that seen for income exists when we look at internet access by education level. That is, those with higher levels of education are much more likely to access the internet. This is evident for all states. For WA, those with a level of education of Year 12 or below do better (84%) than that reported in other states, with levels between 77 per cent for NSW and 80 per cent for VIC. By state, there is less variation across the other education groups.

Figure 9 Internet usage by education level and by state, 2016-17

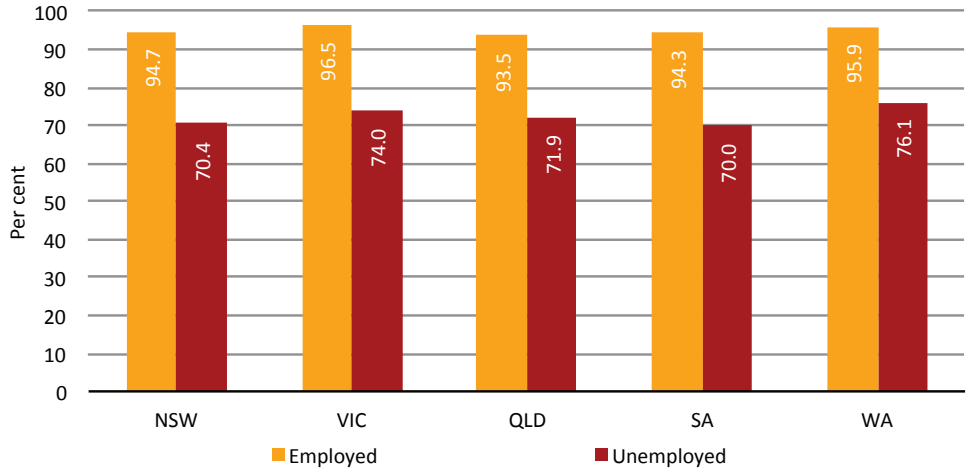


Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8146.0, unpublished data.

Persons internet usage by employment status

The BCEC Future of Work Report (Cassells *et al*., 2018) discussed in some detail the changing nature of work, its precarious nature and the ever increasing role of ICT. Coupled with the fact that there is an increasing tendency for jobs to be advertised and therefore found online, it is essential that those in unemployment have access to the internet. Figure 10 shows that employed individuals across all states have high levels of internet access. However, for those unemployed persons, state average internet access falls between 70 per cent (SA) and 76 per cent (WA). While WA again reports the highest level of access for this vulnerable group (76%), it remains almost 20 percentage points below that reported for employed persons (96%).

Figure 10 Internet usage by employment status and by state, 2016-17



Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8146.0, unpublished data.

76% of unemployed persons in WA access the internet – 20 ppt lower than those in employment (96%). This has serious implications given the changing nature of work and increased likelihood of finding work opportunities online.

The changing nature of engaging with the internet

There is a lag in the take up of newer device types (such as tablets and internet TV) in the more remote regions of Australia. This gap is wider in WA.

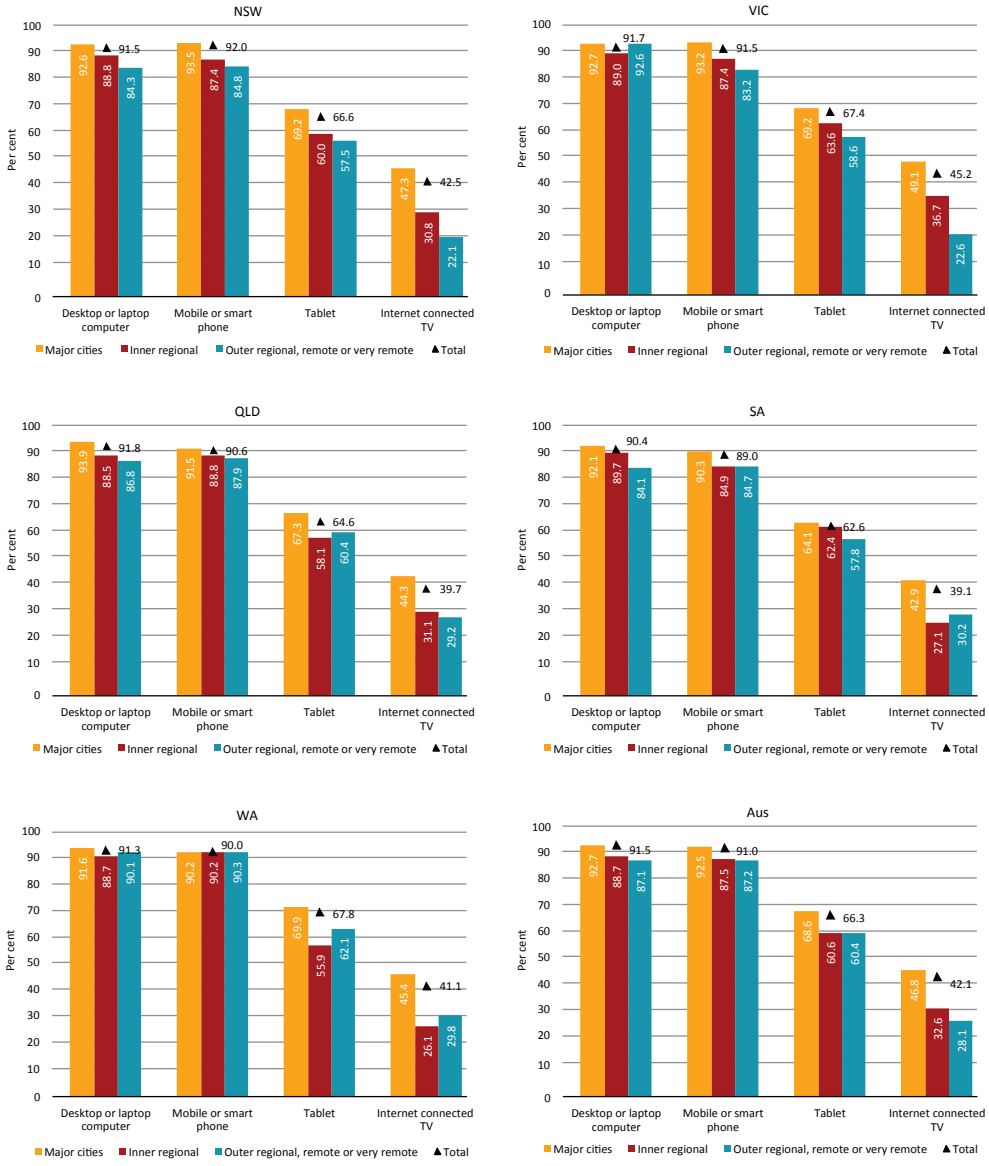
Up to this point, we have focussed on the gaps that exit between households and individuals in terms of accessing the internet. While internet access is a fundamental component of the digital divide, it does not stop there. Even for those with internet access, there is a divide in terms of how and why ICT is being accessed. Specifically, it is important to analyse gaps that may exists in terms of access to particular devices (which can effect quality of access, mobility and flexibility of access) and differences in services people engage with online. It is important to identify such gaps, again in an attempt to ensure that all groups have the ability and means to maximise the potential the digital age affords.

Type of device used

Desktop or laptop computers along with mobile or smart phones continue to be the dominant devices used to access the internet across Australia (Figure 11). The incidence of usage is similar for the latter categories across the various levels of remoteness, albeit, on average, higher usage in the more populous city regions.

In 2016-17, 66 per cent of persons in WA accessed the internet via tablets (66%). This was higher in the major cities region (69%), with lower usage in the more remote areas (60%). This difference by region is more pronounced for those using internet connect TV, where for Australia, 47 per cent of households in major cities access the internet through their TV compared to 33 per cent in inner regional areas and 28 per cent in outer regional, remote or very remote areas. For WA, in terms of internet connected TV the percentage point gap (19 ppt) between major cities (45%) and inner regional (26%) is larger than that of Australia (14 ppt).

Figure 11 Type of device used to access the internet by level of remoteness and by state, 2016-17

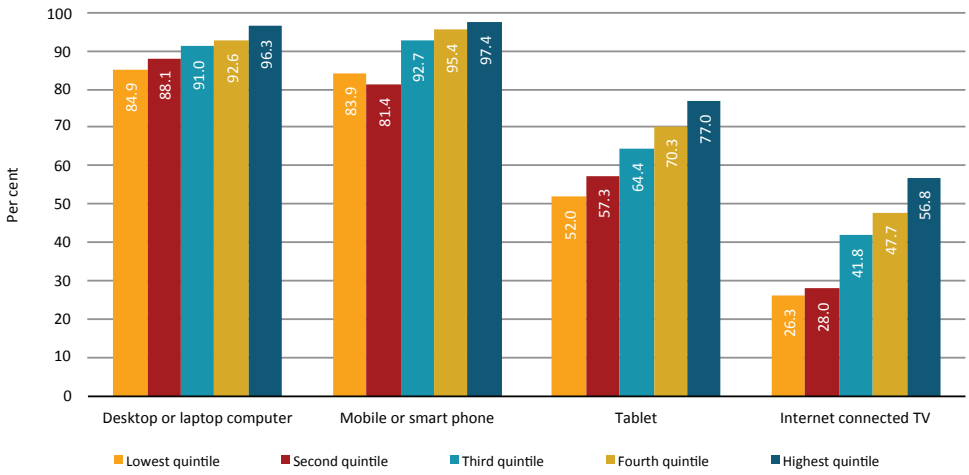


Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8146.0, unpublished data.

A key driver of the regional divide is likely to be linked to differences in income. Unfortunately, the data does not allow us to analyse regions by income level. However, Figure 12 shows that those persons on the lowest income quintiles have the lowest use of all device types. This difference is more evident in the 'newer' device types such as tablets and internet connected TV. For example, 57 per cent of people in the highest income quintile use internet connected TV, compared to 26 per cent of people in the lowest quintile. It would appear that, with time, as the price of devices declines (as has happened with desktops, and mobile phones for example), individuals' ability to access and therefore use such devices increases. Therefore we would expect that, over time, the use of internet connected TVs and tablets will increase for those on lower income levels, and the gap will decline. However, this may take some time, and during such time, new and better ICT will emerge, as will a new wave of digital division. Waiting for prices to decline is not the solution.

57% of people in the highest income quintile use internet connected TV, compared to 26% of people in the lowest quintile.

Figure 12 Type of device used to access the internet, by income, Australia, 2016-17



Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8146.0.

Health services (47%) and formal education activities (28%) are cited less frequently as reasons for accessing the internet.

Between 2014-15 and 2016-17, online health service experienced a 24ppt increase in usage.

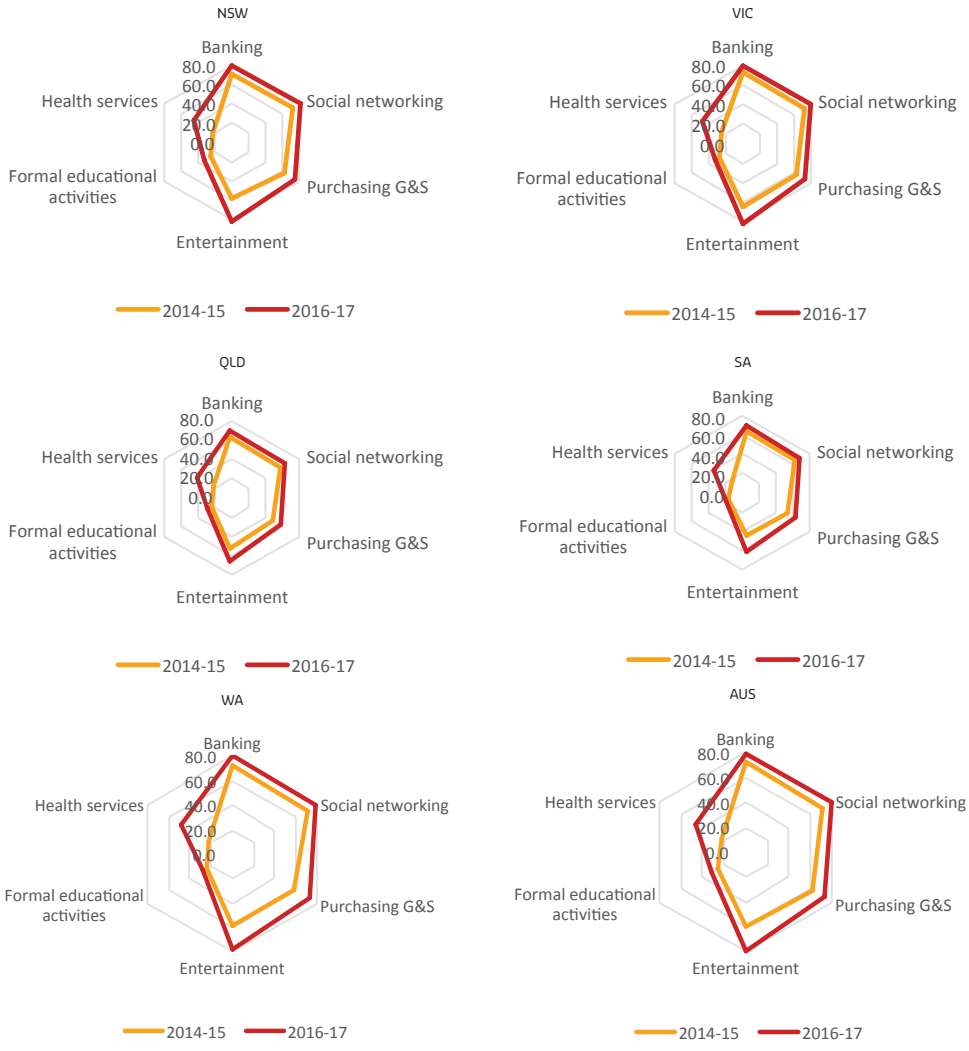
Reasons for accessing the internet

Of even more of interest to the 'how' we access the internet is the 'why' we access the internet. Services such as government, banking, health, and entertainment are increasingly going online, changing how we buy, consume and experience goods and services, and in turn changing how we connect with society, our colleagues, friends and family.

Figure 13 displays the reasons people accessed the internet, by state, in 2016-17. We also report the change from 2014-15. Banking (80%), social networking (80%), entertainment (79%) and purchasing of goods and services (73%) are the most popular reasons cited for accessing the internet. This is followed by health services (47%) and formal education activities (28%). With the exception of the latter, WA's usage is in line with that of other states across Australia. For formal education activities, WA's activity (28%) is lower than that of all states, with the most evident difference being in comparison to NSW (35%).

Across all states, over the short two year time frame between 2014-15 and 2016-17, there has been strong growth in accessing the internet for health services and entertainment. Between 2014-15 and 2016-17, online health services saw a 24.3 ppt increase in usage (26 ppt for WA), with a 20ppt increase in online entertainment services. Purchasing of goods and services increased by 11.5 ppt (14 ppt for WA), followed by social networking (7.9 ppt), banking (7 ppt) and formal education services (6.2 ppt).

Figure 13 Reasons for accessing the internet, by state, 2014-15 to 2016-17



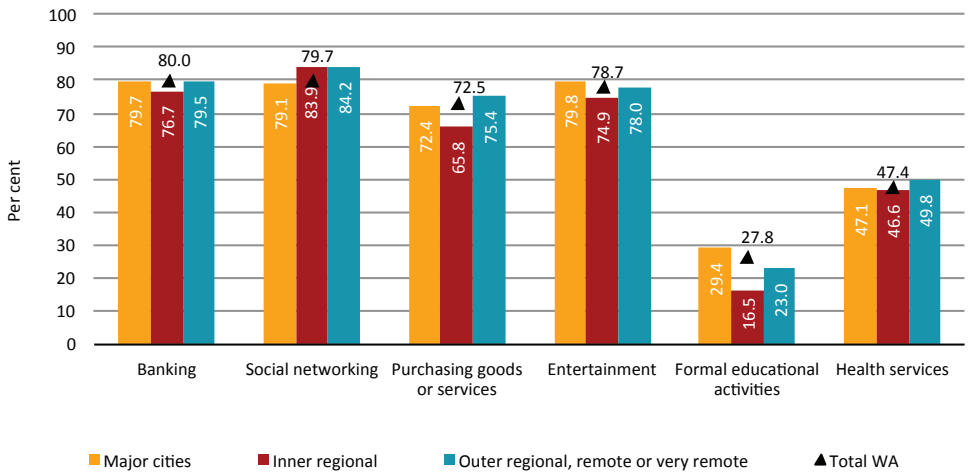
Note: Access over the previous 3 month period.
Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8146.0, unpublished data.

Looking in more detail at the reasons for accessing the internet within WA (Figure 14), some regional variations come to the fore. While small in magnitude, there is greater use of health services in outer regional, remote or very remote areas (50%) relative to major cities (47%) and inner regional (47%) areas. The most remote areas also make greater use of social networking (84%) than those in major cities (79%), and in purchasing of goods and services (75.5% relative to 72.4%). The latter may have implications for small businesses and local communities, with the possibility that those living in more remote areas rely less on local businesses, with a potential loss of community engagement.

By level of remoteness, with less variation for banking activities, there is a notable difference in formal education activities as a reason for accessing the internet. In WA, almost 30 per cent of those accessing the internet used it for formal education activities, compared to 23 per cent for those in outer regional, remote or very remote areas and only 16.5 per cent for those in inner regional areas.

A larger proportion of internet users in the most remote areas of WA access the internet for health services, social media, and purchasing of goods and services, compared to those in urban centres.

Figure 14 Reasons for accessing the internet, by level of remoteness, WA, 2016-17



Note: Access over the previous 3 month period.
Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8146.0, unpublished data.

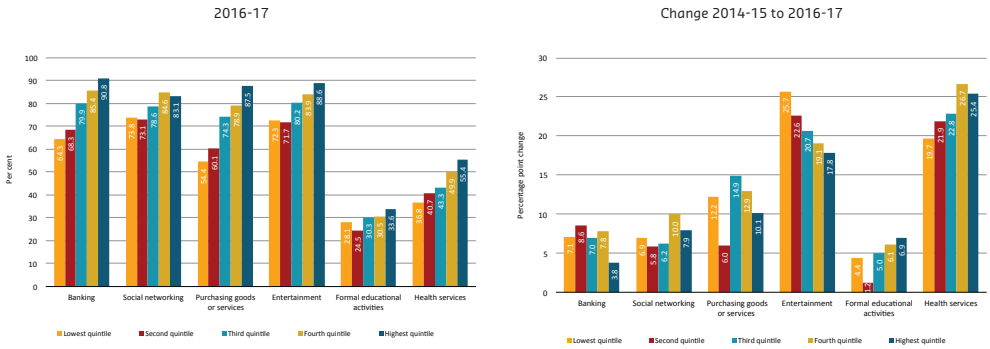
In 2015-16, 36.8% of those in the lowest income quintile accessed the internet for health services, compared to 55.4% of those in the highest income quintile (an 18.6 ppt difference). It is likely that this gap will widen further, before those on lower income levels catch up.

We now turn our attention to look at the reasons for accessing the internet by various socio-economic and demographic characteristics – namely income, education, employment and age. Starting by income, Figure 15 shows the reasons for accessing the internet by income quintiles for 2016-17 (LHS) and the change from 2014-15 (RHS). For 2016-17, those in the higher income quintiles use the internet more frequently across all uses. In comparing the lowest and highest income quintiles, the largest variation is in the purchasing of goods and services, with 54 per cent of those on the lowest income quintile doing so, compared to 88 per cent of those in the highest quintile - a 34 percentage point difference. This variation is also evident for banking, with a 27 ppt difference between those on the lowest and highest income quintile, and health services (19 ppt difference).

In comparison to 2014-15, in 2016-17, while all income levels experience greater access to all services, the gap is widening across many areas. While the gap is narrowing for banking, entertainment and purchasing of goods and services, usage in increasing at a faster rate for those in the highest quintile for social networking, formal education, and particularly health services, relative to those in the lowest income quintile.

For example, for health services, in 2014-15, 17 per cent of those in the lowest income quintile accessed the internet for health services, compared to 30 per cent of those in the highest income quintile (a 13 ppt difference). Looking ahead, in 2015-16, 36.8 per cent of those in the lowest income quintile accessed the internet for health services, compared to 55.4 per cent of those in the highest income quintile (an 18.6 ppt difference). It is likely that this gap will widen further, before those on lower income levels catch up. How long this will take, and the negative impacts on those missing out is uncertain, but is likely to have significant impact for many.

Figure 15 Reasons for accessing the internet, by level of income, Australia, 2014-15 and 2016-17

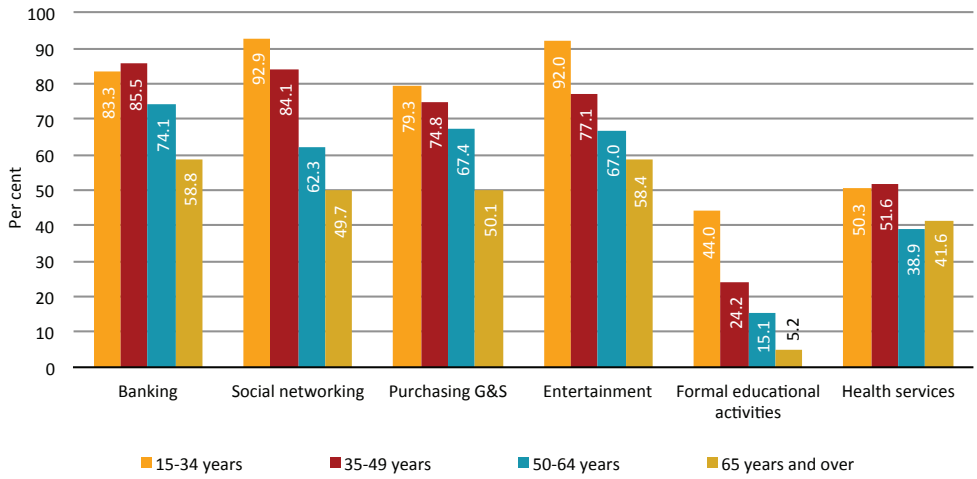


Note: Access over the previous 3 month period.
Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8146.0, unpublished data.

Turning our attention to age, some very strong differences emerge. Across all activities those in the 15-14 and 35-49 age bands report higher proportions across all of the reasons for accessing the internet. Keeping in mind that this data is reporting on usage for those accessing the internet, the divide appears to be two fold for older generations – first in terms of accessing the internet, and secondly in terms of engaging with the internet for particular services. The latter will become increasingly more important over time – with more government, health, social networking, banking and entertainment services going online. Therefore, it is not only a question of access, but also an issue of engagement. It is essential that older cohorts have the confidence, trust, knowledge and ability to not only access the internet, but use the government, health, commercial and social services required to live full, quality and meaningful lives.

The divide appears to be two fold for older generations – first in terms of accessing the internet, and secondly in terms of engaging with the internet for particular services. The latter will become increasingly more important over time, as more services go online.

Figure 16 Reasons for accessing the internet by age, WA, 2016-17



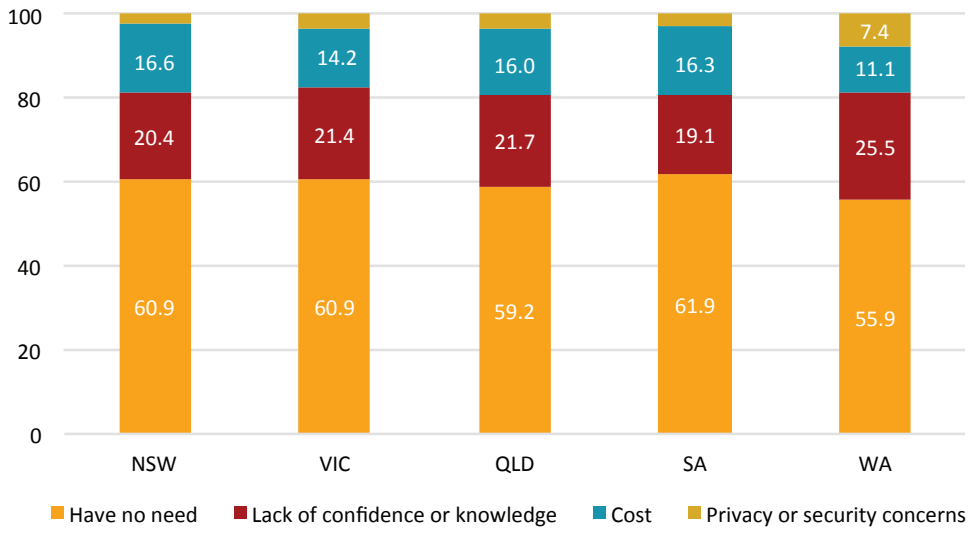
Note: Access over the previous 3 month period.
Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8146.0, unpublished data.

Ability and attitudes towards ICT

In WA, the main reason for not having internet at home is a perceived lack of need (56%).

In the 2014-15 cycle of Household Use of Information Technology data (HUIT, ABS Cat 8146) the ABS asked a specific set of questions relating to reasons why people do not have access to internet at home. Here we interrogate this data to find out the main reasons preventing Western Australians from connecting their homes to the internet as shown in Figure 17. Across all states, 60 per cent of the people who do not have internet at home do not seem to have the need to. Lack of confidence or knowledge is the main concern for 21 per cent of people and the cost of internet services only comes third, with 15 per cent of people in average citing price as their main concern. Interestingly, WA has a slightly different distribution compared to the rest of the states as 'lack of confidence' has in proportion a higher weight than 'have no need' or 'cost'. This means that people lacking confidence or knowledge to access internet is an important barrier for WA households to have internet at home (25%). On the other hand, the 'cost' of the service seems to be only a concern for 11 per cent of people in WA relative to 16 per cent for the rest of the States. Finally, there is also an important proportion of people in WA that declare privacy or security concerns as one of the main reason (7.4%).

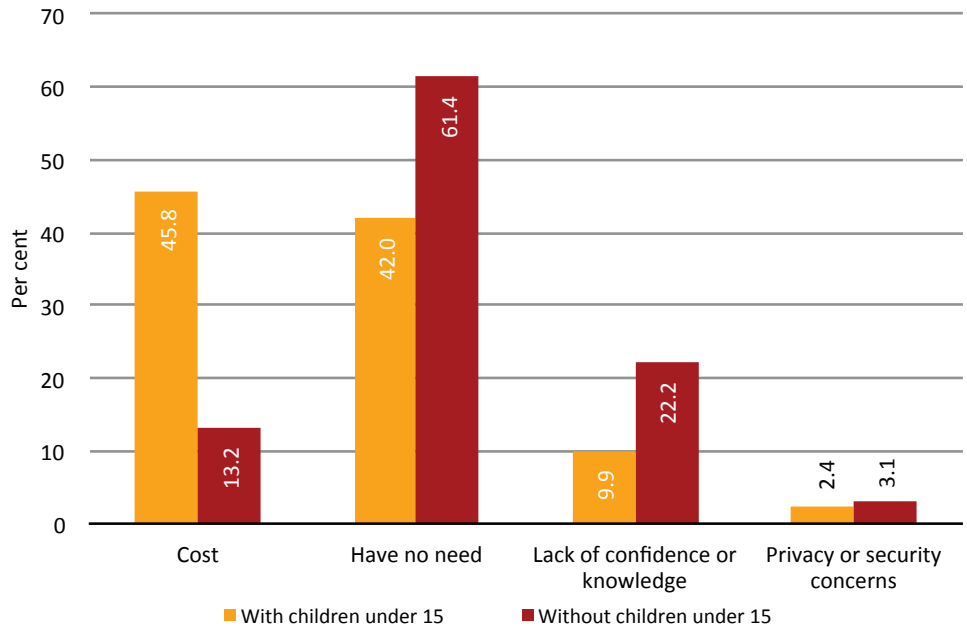
Figure 17 Reasons for not having internet access at home, by state, 2014-15



Note: 'Privacy or security concerns' have high standard errors and need to be interpreted with caution.
Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8146.0, 2014-15.

Figure 18 displays an interesting characteristic of the reasons for not having internet for households with children. From those families who have children under 15 the main reason for not having internet at home is the cost of the service for 46 per cent of them. This comes before the lack of need for the service (42%) and the lack of confidence (10%), which does not seems to be as an important issue for families with children as it is for the average population. What this graph points out is that households with kids perceive internet more like a necessary good than the average household. This is highlighted by the fact that the percentage of families with kids without internet is already very small so for those who do not access internet at home they seem to have a very strong budgetary constraint as observed in this graph.

Figure 18 Reasons for not having internet access at home, with or without children under 15 years of age, Australia, 2014-15

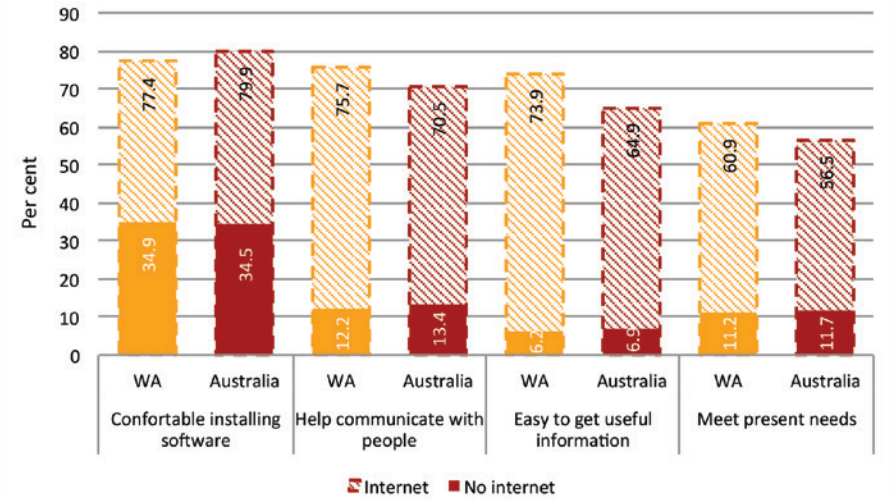


Note: 'Privacy or security concerns' have high standard errors and need to be interpreted with caution.
Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8146.0, 2014-15.

Figure 19 and Figure 20 explore the abilities and attitudes towards ICT and internet for Australia and WA. The data is provided by the HILDA survey of 2012 that contains a special module on Lifestyle in this year. People were asked to rank from 1 to 7 whether they strongly agree or disagree with varios aspects, as reported here. The bars in Figure 19 represent the people disagreeing with each statement, in yellow we have the proportion of people in WA and in red the proportion in Australia. We observe that there is significant difference between the people that have internet and those who do not when answering these questions. Only 35 per cent of Western Australians with internet do not feel comfortable installing a software versus 77 per cent for those without internet at home. This difference is even higher when we look at the people who do not find internet helpful to communicate, with only 12 per cent of the WA population with internet strongly disagreeing with this statement against 76 per cent for those without internet. Also 74 per cent of the people in WA without internet do not find it easy to get useful information on the internet, while only 6 per cent of those with internet find this assertion true.

74% of the people in WA without internet do not find it easy to get useful information on the internet.

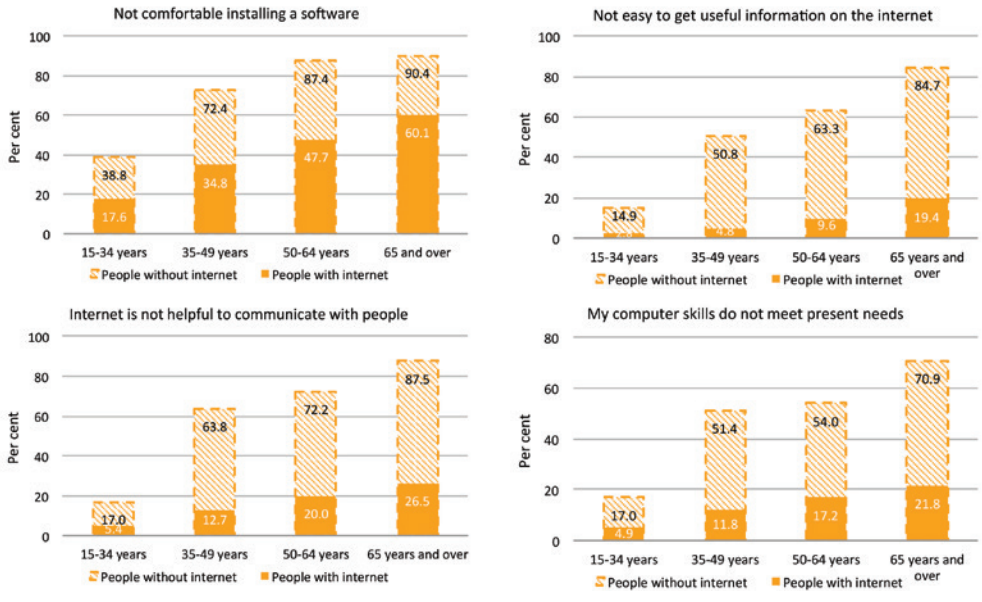
Figure 19 Attitudes and ability towards ICT and internet, Australia and WA, 2012



Source: Bankwest Curtin Economics Centre | Authors' estimates based on HILDA survey, special module Lifestyle, 2012.

Finally there is also an interesting difference in the attitudes and ability towards ICT by age that are presented in Figure 20. The 4 charts show the clear difference by age in ability and attitudes towards ICT as the bars increase with age and the gap between those with and without internet at home is higher. As for the general population, the clearest differences are observed for the second and third questions, especially for the last two segments of the population (50 years and over). 63 per cent of people between 50 and 64 years old without internet find it difficult to get useful information on the internet compared to 10 per cent for those with internet. This gap is even higher for the Australian 65 years and over, the gap between these two groups increase up to 65 percentage points. Similar results are found in the third graph: the difference between the people that find internet not useful to communicate is of 50 percentage point for the 50-64 years old and of 61 percentage points for Australians over 65 between those with and without internet at home.

Figure 20 Attitudes and ability towards ICT and internet by age, Australia, 2012



Source: Bankwest Curtin Economics Centre | Authors' estimates based on HILDA survey, special module Lifestyle, 2012.

Households apart:

Affordability and digital expenditures

Introduction

A key barrier to digital access and usage is cost, and this section of the report examines the issue of household expenditures on mobile, internet and telecommunications products and services. More than ever before, technology supports our children's learning, the ways in which we now work, how we search for jobs, and how we gain access to financial and government services.

Yet not everyone has equal access to this new digital world, whether because of greater needs or limited financial resources. A better understanding of the challenges of digital affordability begs a number of important questions. What do we spend on digital technologies, and how has spending changed over time? Which families bear a greater cost burden to stay connected? And which groups in society are most at risk of falling on the wrong side of the digital divide?

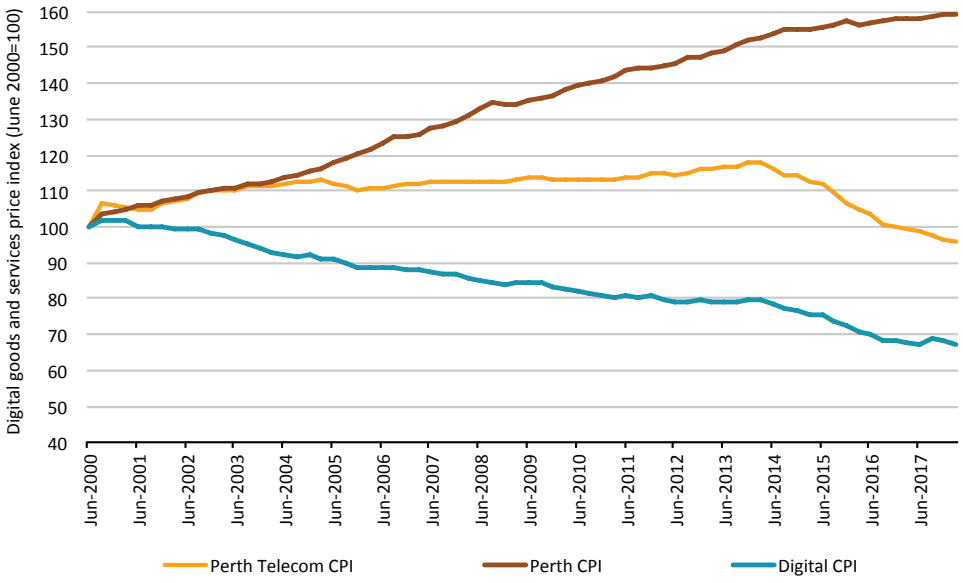
To understand patterns of household spending, it is helpful first to understand how the prices of digital goods and services have evolved over time. Product innovation has led to remarkable improvements in the capabilities of computers, tablets and mobile devices over recent decades. At the same time, the costs of ICT hardware and digital services have fallen. Of course, products at the cutting edge of digital technology and the newest mobile technologies, are expensive, but the quality and capabilities of these 'state of the art' products would have been unimaginable even five years ago.

Household expenditure on ICT

Competing price and technological developments in the ICT sector create challenges in capturing the 'real' price of digital products and services. The Australian Bureau of Statistics (ABS) seeks to respond to these issues by constructing a series of price indices for each major commodity group and sub-group of the consumer price index (CPI). The overall ABS CPI measures the average change in the price of a fixed basket of goods and services. Prices of specific commodities are combined into an aggregate consumer price index using weights based on typical household expenditures on each item. The quantities of specific items under each series of broad commodity groups – whether in food, clothing, recreation or communication – are standardised in order to make legitimate price comparisons over time.

Figure 21 shows the evolution of general the level of prices from June 2000, as well as ICT prices. The chart compares growth in the overall CPI for Perth (in red) and the published 'telecommunication equipment and services' sub-group price index (in orange) with a new composite price index created by BCEC to capture movements in the costs of a broader basket of digital and telecommunications goods and services (Digital CPI, in blue). This new digital CPI group index takes into account not only the 'telecommunications equipment and services' index but also the 'audio, visual and computing equipment and services' with their corresponding weights. This allows us to consider the prices of mobile, entertainment and internet services, as well as the prices of computers, tablets and phones.

Figure 21 CPI Index for telecommunication equipment and services, Perth and Australia, 2002 to 2018



Note: Base of June 2000 = 100.
Source: Bankwest Curtin Economics Centre | Authors' calculations based on ABS cat no 6401.

Figure 21 highlights a striking divergence in the evolution of the general level of prices and the quantity-controlled price of digital products and services. The overall CPI has increased by almost 60 per cent since 2000. The telecommunications CPI followed the same growth path as the general CPI until March 2004, before flattening with

The CPI has increased 60 points in the last 18 years while the Digital CPI has decline by 33 points. The observed decline in the price of ICT is mainly driven by adjustments in quality and quantities.

total gains of less than 10 points over the ten years to March 2014. Since then, the telecommunications CPI has fallen consistently, and now sits below the level at the start of the millennium. The broader digital CPI series, which takes account AV and computing equipment and services as well as telecommunications costs, has declined steadily over the last two decades, falling by a third since 2000.

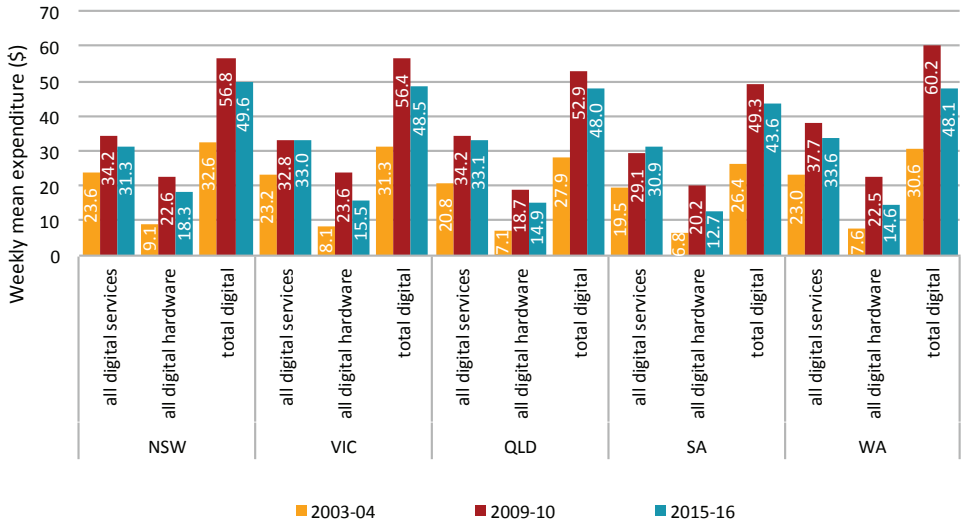
At least two factors are in play to explain these observed cost patterns for digital technologies. The first is the effect of product innovation in mobile, computing and internet technologies, leading to lower costs for the same 'quantity' of digital service. If the price of a mobile 3G plan remains the same from one year to the other but the quantity of data offered is higher, there is an actual drop in the price of the good. This is also true in the case of a technological change like the passage from 3G to 4G. As a result, families may spend the same amount of money for a mobile plan today as they did 15 years ago, but the quantity and quality of the service have both increased. Both effects are accounted for by ABS in the construction of the price indexes.

A second factor is the emergence of mobile service providers who resell wholesale services from other carriers. These Mobile Virtual Network Operators (MVNOs) have proliferated in recent years, and now capture more than a tenth of the mobile service market. The increased competition for mobile services through MVNOs may well have contributed to the sharp fall in the price of telecommunications services.

Household spending on digital technologies are examined using the ABS Household Expenditure Survey (HES), a nationally representative survey released every six years that collects detailed information on commodity expenditures and household characteristics. Our analysis uses the 2003-04, 2009-10 and 2015-16 waves of the HES, a period that captures the rapid transition of digital technology as well as the resource boom and slowdown period in Western Australia. For the empirical analysis of household spending, we have regrouped digital expenditures into three categories: mobile, internet and entertainment expenses. Each category is further separated into services and hardware spending, which allows for the construction of broader spending aggregates of digital services, digital hardware and total digital.

Figure 22 shows weekly real mean expenditure on digital services and hardware for each of the three HES waves from 2003-04 to 2015-16. The general pattern of digital spending shows a substantial increase between 2003-04 and 2009-10 across all states, followed by a more modest fall in spending in the subsequent period to 2015-16. Average digital spending in WA, at $48.10 per week, is now broadly on a par with New South Wales, Victoria and Queensland. The decline in spending on digital hardware reflects the substantial reduction in the digital CPI since 2014, as highlighted in Figure 21. Product and service innovations mean that the overall change in households' digital spending combines a lower 'unit' price of digital products and services with a significant increase in the 'quantity' and quality of digital purchases.

Figure 22 Real mean expenditure on digital services and hardware, by state, 2003-04 to 2015-16



Note: Expenditures have been uprated to September 2017 price level.
Source: Bankwest Curtin Economics Centre | Authors' estimates based on ABS Household Expenditure Survey, 2003-04, 2009-10 and 2015-16, and Cat. No. 6401.0.

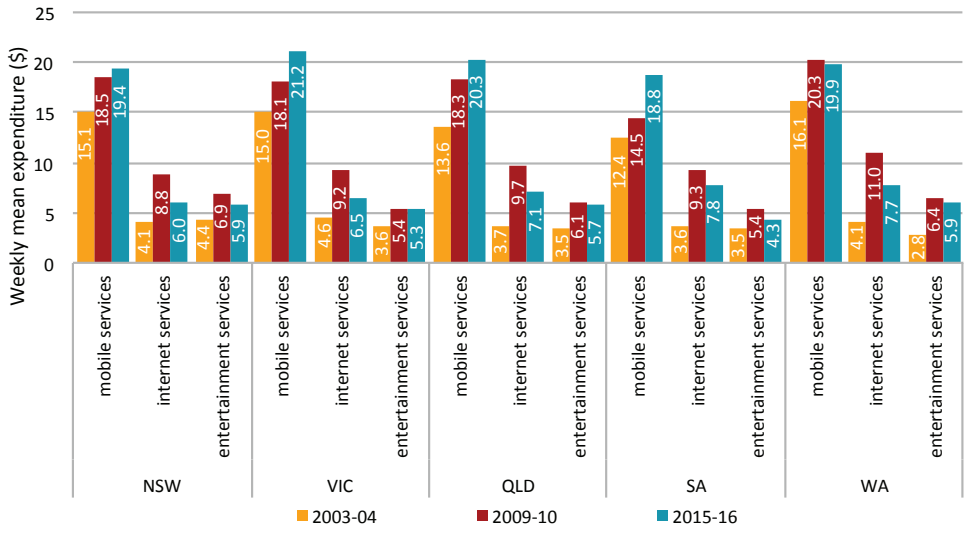
Digital spending in Western Australia broadly matched that of other states in 2003-04. However, during the peak of the mining boom period (2009-10) the expenditure on digital services was $4.50 higher per week compared to the rest of Australia, and $5.10 dollars higher if we focus on overall ICT expenditures. Such trends are in line with the findings in BCEC's previous Focus on Western Australia report on the cost of living in WA, and highlight the extent to which spending in WA has followed the economic cycle over the resources boom period.

In Figure 23 we focus on household's recurrent spending on digital services, in three areas: mobile, internet and entertainment services. Average spending in mobile services in Western Australia increased by around $4.20 per week from 2003-04 to 2009-10, but has remained stable over the subsequent six years. Current household spending on mobile reaches almost $20.00 per week according to the latest HES data for 2015-16. Spending on internet services increased by 140 per cent in Australia in the six years to 2009-10 but dropped by 30 per cent over the subsequent six years to 2015-16. Entertainment services spending follows a similar pattern, but with more modest changes over the period. WA spending on digital services are around 9 per cent higher in 2015-16 than the Australian average.

ICT expenditure significantly increased from 2003-04 to 2009-10, followed by a decline in expenditure in 2015-16 – mostly due to a sharp fall in ICT prices in 2014.

Expenditures on mobile services has steadily risen since 2003, reaching $20 dollars per week in 2016. Internet services have almost doubled, peaking in 2009-10 especially in WA.

Figure 23 Real mean expenditure by state, components, digital services, 2003-04 to 2015-16



Note: Expenditures have been uprated to September 2017 price level.

Source: Bankwest Curtin Economics Centre | Authors' estimates based on ABS Household Expenditure Survey, 2003-04, 2009-10 and 2015-16, and Cat. No. 6401.0.

In the next section, we seek to provide a more nuanced understanding of the differences between the quantity of digital technology consumed, compared with the expenditure on such technology.

As shown in Figure 21, the CPI for digital technologies has actually decreased over the past 15 years due to ICT product and service innovation, giving rise to lower costs for a standardised 'quantity' of digital product. To account for these effects, Figure 24 provides a representation of the 'quantity' of digital consumption by deflating the real dollar expenditures on digital goods in WA by Digital CPI, and offers some indication of how the quantity of digital consumption has changed over time.

Digital expenditure in WA has broadly followed the State's resources-led economic cycle. Expenses in mobile services in the rest of WA rose significantly from 2003-04 to 2009-10, going from $13 per week to $22. This increase was not as significant for Perth households, who spend only $2.40 dollars extra for the same period, and in fact spend less than the rest of WA in mobile services in 2009-10, reaching $20 dollars per week.

Between 2009-10 and 2015-16, this trend is reversed, with Perth households paying more in 2015-16 ($20.3) relative to their 2009-10 level, but also spending more than the rest of WA households ($18). The steepest decline in expenditures on ICT services during the economic slowdown is endured by internet services which drops $3.50 per week for Perth consumers and $2.20 dollars for the rest of WA from $11.20 and $10.60 per week respectively.

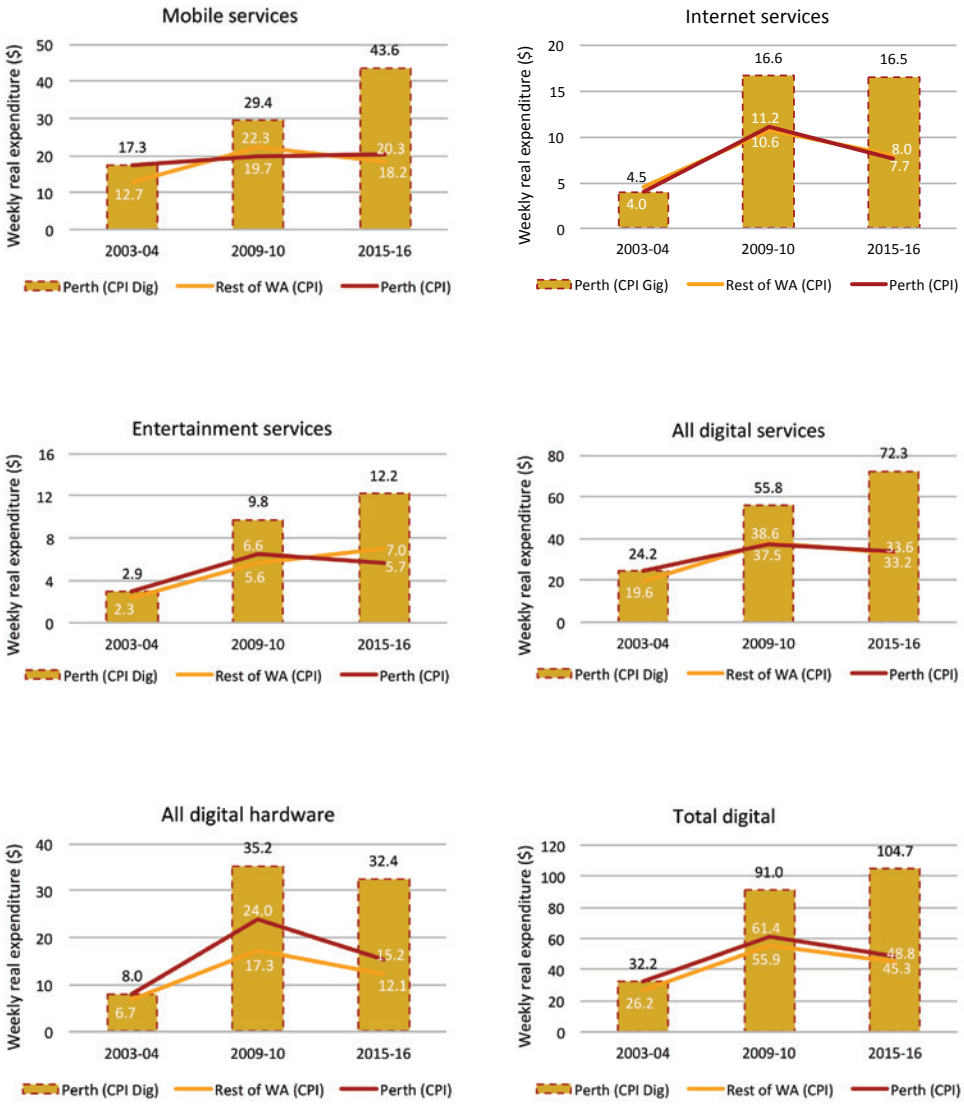
The fall in internet services expenses is the biggest contributor to the decline in all digital services, which has on average dropped $4.50 dollars in WA, sinking to $33.60 dollars in 2015-16. Nevertheless, all digital hardware suffers the highest decline in expenditure of all items. Perth consumers used to spend $1,248 per year on digital hardware in 2009-10 and now only spend the equivalent of $790.40 per year. The rest of the WA population also decreased their consumption on hardware items but to a lesser extent, they spent almost $900 per year for these goods in 2009-10, and expenditure declined by $270 dollars by the year 2015-16. However, when we look at total digital expenditures in 2015-16, there is not much difference between Perth and the rest of WA, the former outspend the latter by only $3.50, and total digital expenditure accounts for almost $49 dollars per week of Perth household budgets.

A different story comes out when we look at the real underlying consumption of ICT expenditures, as proxied by digital expenditures deflated by digital CPI. These are shown by the bars in Figure 24, and reveal a large increase in the underlying consumption of ICT between 2003-04 and 2009-10 and a more moderate rise between 2009-10 and 2015-16.

This analysis shows that when we account for adjustments in the quantity and the quality of ICT services and hardware, there has been a consistent and substantial increase in the consumption of digital products. While average spending on digital commodities is slightly lower today than in 2010, we are nevertheless consuming significantly more. If we look at the expenditures on ICT deflated by the digital CPI, the consumption of internet and entertainment services has quadrupled 2003-04 to 2015-16.

Mobile services have also risen 2.5 times compared to 2003-04 levels. This results in a threefold increase in the consumption of digital services over the period.

Figure 24 Real mean expenditure, Perth and Western Australia, 2003-04 to 2015-16



Note: Expenditures have been uprated to September 2017 price level.
Source: Bankwest Curtin Economics Centre | Authors' estimates based on ABS Household Expenditure Survey, 2003-04, 2009-10 and 2015-16, and Cat. No. 6401.0.

Cost of connectedness: The incidence of digital stress

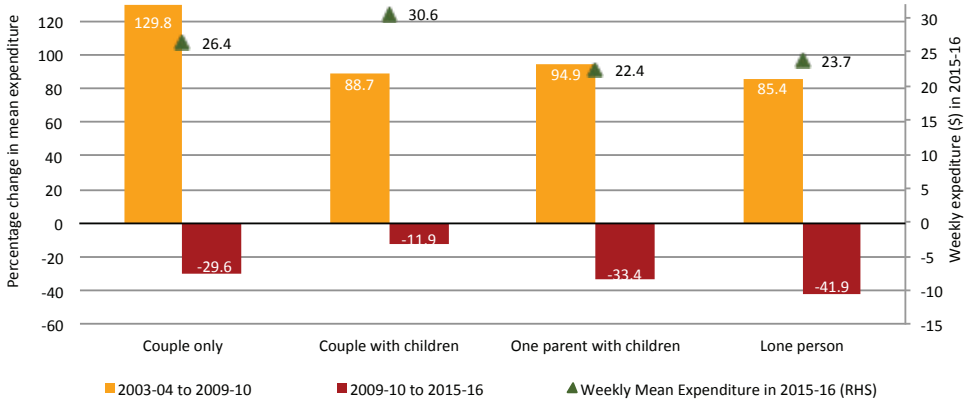
Digital technologies and internet connectivity play a far greater role in our children's education, in our work or in finding jobs, in accessing health and social services, and in our ability to connect with society. This highlights why digital affordability has become a real and significant issue for many families, especially those on lower incomes or with children.

In Figure 25 we show the real mean expenditure by household type, the triangles represent the weekly expenditures on total digital expenses (right hand side of the figure) and the bars show the percentage change in mean expenditure (left hand side). Couples with children outspend all the other families on ICT and allocate on average $30.60 per week to these purchases. On the other side, single parents with children have the lowest mean expenditure and they only spend $22.40 on ICT, $1.30 less than singles and $8.20 less than couples with children.

Looking at the 2003-04 to 2009-10 period, we observe that the average household in WA has almost double the total consumption of ICT. The real expenditure on ICT by couples increased at a significantly higher rate relative to the median family. In fact, couples exceeded by 20 percentage points the typical household expenditure and the money they spend on ICT rose by 130 per cent.

Between 2003-04 and 2009-10, the average WA household doubled their total consumption of ICT. From 2009-10 to 2015-16, total expenditure decreased for all households but the decline is even sharper for singles (42%) and single parents (33%).

Figure 25 Real mean expenditure by family composition, WA, 2003-04 to 2015-16



Note: Expenditures have been uprated to September 2017 price level and equivalized by the modified OECD scale.
Source: Bankwest Curtin Economics Centre | Authors' estimates based on ABS Household Expenditure Survey, 2003-04, 2009-10 and 2015-16, and Cat. No. 6401.0.

In contrast, the expenses of couples with children, single parents and lone persons are relatively close to the typical growth per household which hits 92 per cent. Between 2009-10 and 2015-16 the amount of money devoted to ICT decreased for all households. The decline is even sharper for singles and single parents with children whose expenditure fell by 42 per cent and 33 per cent respectively, after the mining boom phase. These two types of families seem to be the most affected by the economic slowdown in WA, especially if we compare them to couples with children that only encountered a 12 per cent decrease in ICT expenditures.

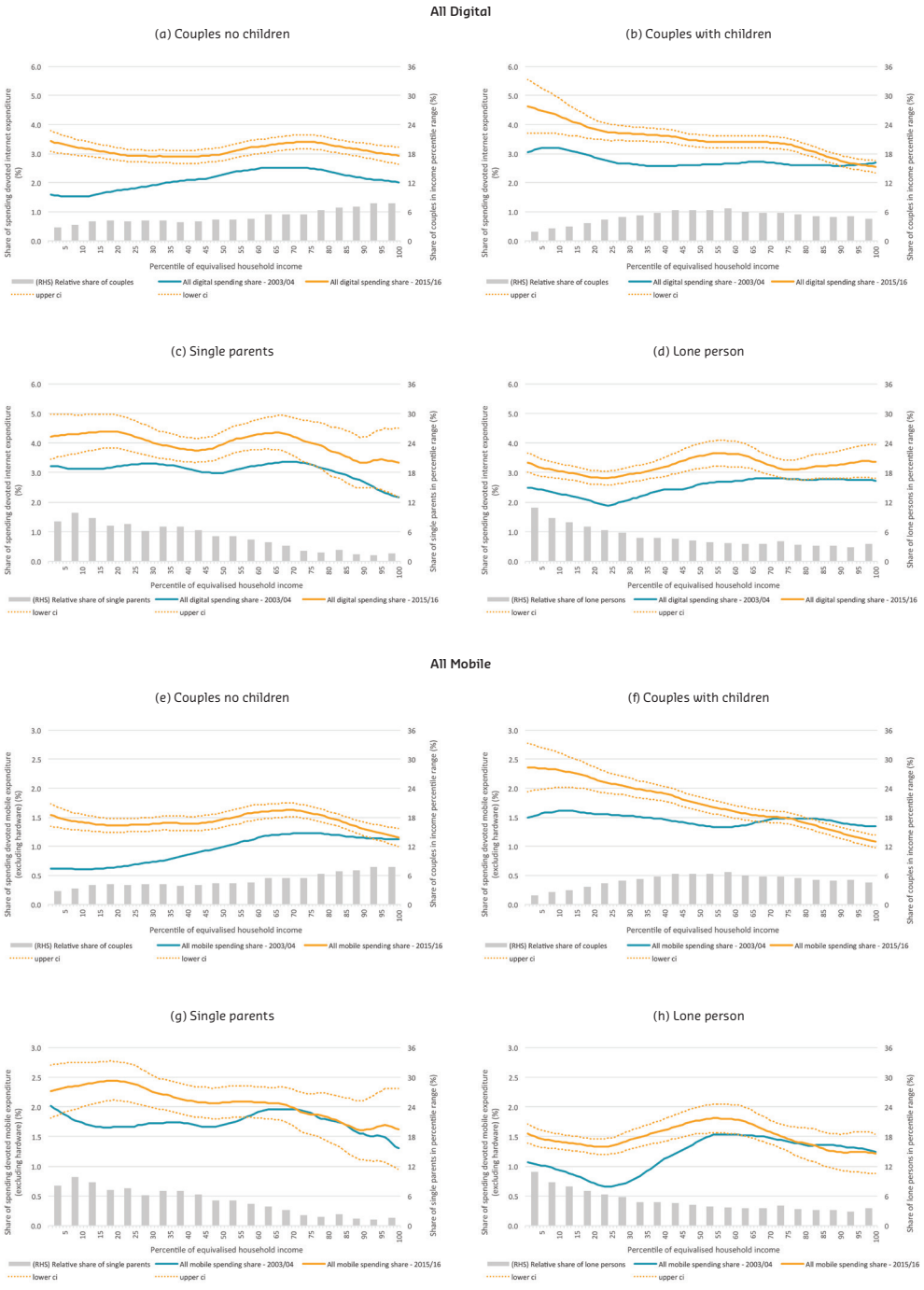
The charts shown in Figure 26 show how average digital spending as a share of total expenditure varies with income for different family types. These schedules also demonstrate very clearly that patterns of spending on mobile technologies and digital services have changed substantially over time, with greater shares of total spending being committed to digital products - especially among lower income families.

This reflects the reality that ICT products and services are becoming ever more a necessity as society adapts to the new digital future.

These findings confirm what we all now feel - that mobile communications and internet technologies have become ever more a necessity of 21st century life. The new digital future offers the most extraordinary set of opportunities for us all, whether in education and learning, work and job search, business and entrepreneurship, health care, or in social connectedness.

However, some families are at risk of falling on the wrong side of the digital divide. The costs of staying connected bear more heavily on the family budget for those on lower incomes. Those who cannot afford to keep pace with new communications technologies, or who face challenges in access by virtue of location or ability, are at risk of being excluded from the opportunities afforded by the new digital future.

Figure 26 Engel curves for various ICT expenditures, by family composition, WA, 2003-04 to 2015-16



Source: Bankwest Curtin Economics Centre | Authors' estimates based on ABS Household Expenditure Survey, 2003-04, 2009-10 and 2015-16, and Cat. No. 6401.0.

ICT products and services are becoming ever more a necessity as society adapts to the new digital future.

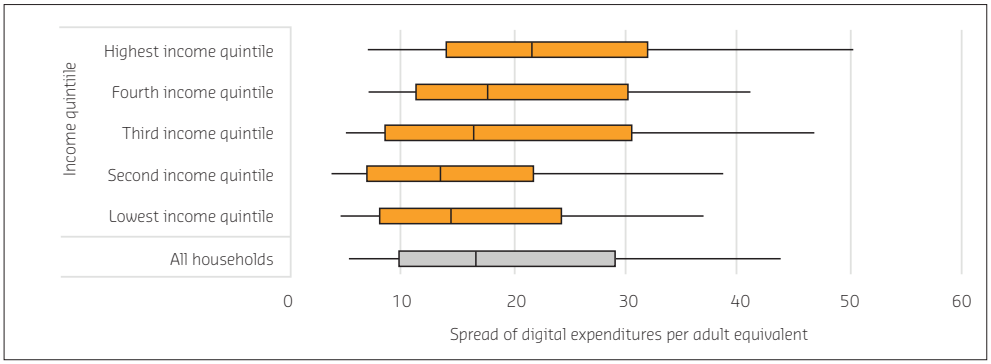
Although the typical level of digital spending for the poorest fifth of families is around $14.17 per person per week, one in ten are observed to spend nearly three times as much – at least $36.89.

Figure 26 conceals a far greater degree of variation in digital spending between families, driven either by differences in preferences and needs, as well as by income – the latter reflecting families' different capacities to pay for digital products and services.

Figure 27 shows the spread of per capita household spending on digital goods and services among WA households in each of five income groups, from the poorest fifth of families (the lowest quintile) to the richest fifth of families (the highest quintile). Although the typical level of digital spending for the poorest fifth of families is around $14.17 per person per week, one in ten are observed to spend nearly three times as much – at least $36.89. These spending patterns are not dissimilar to those among families in the second income quintile. The richest fifth of families typically spend $21.48 per person per week on digital products, with a tenth spending over $50 for each person in the family.

Figure 27 Variation in WA per capita household digital expenditures, by income quintile, 2015-16

State	Lower		Typical		Higher
Percentiles	10th	25th	50th	75th	90th
Lowest income quintile	4.25	7.90	14.17	24.10	36.89
Second income quintile	3.55	6.69	13.27	21.57	38.79
Third income quintile	4.38	8.28	16.29	30.46	46.92
Fourth income quintile	6.69	11.10	17.01	30.04	41.03
Highest income quintile	6.63	13.93	21.48	32.00	50.40
All households	**5.02**	**9.48**	**16.56**	**28.97**	**43.74**



Note: Income quintiles are based on the equivalized income, using the modified OECD scale.
Source: Bankwest Curtin Economics Centre | Authors' estimates based on ABS Household Expenditure Survey, 2015-16, and Cat. No. 6401.0.

Our earlier findings show clearly how spending on digital products and services has risen among poorer households as a share of total household spending (Figure 26). This is ever more the case now, with mobile communications, internet and digital technologies becoming an essential part of so many aspects of our lives.

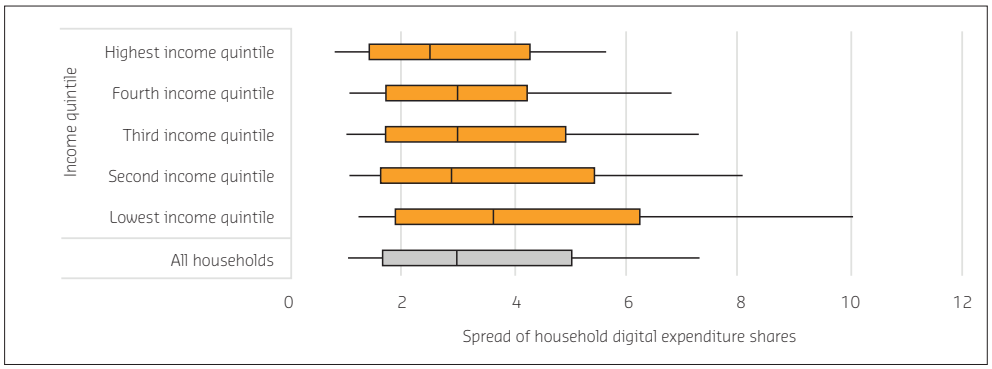
Most families can accommodate the costs of connectivity within the household budget. However, for some groups in society - especially families with children, those on lower incomes, in older age, or those with special needs - the costs of digital technologies impose more of a challenge.

The poorest fifth of families commit typically around 3.7 per cent of total expenditure (after housing costs) towards digital goods and services (see Figure 28). This compares with a digital expenditure share of 3 per cent for the middle (third) income quintile and 2.5 per cent for the richest fifth of families. However, we see a far greater spread of digital spending as a share of total expenditure among families in the lowest income quintile compared to those with higher incomes. Indeed, one in ten of the poorest fifth of families are committing at least 10 per cent of total expenditure towards digital products and services – a significant share of the household budget.

One in ten of the poorest fifth of families are committing at least 10% of total expenditure towards digital products and services.

Figure 28 Variation in WA household digital expenditures shares, by income quintile, 2015-16

State	Lower ←		Typical	→	Higher
Percentiles	10th	25th	50th	75th	90th
Lowest income quintile	1.2	1.9	3.7	6.3	10.0
Second income quintile	1.0	1.6	2.9	5.4	8.1
Third income quintile	1.0	1.7	3.0	4.9	7.3
Fourth income quintile	1.0	1.7	3.0	4.2	6.8
Highest income quintile	0.8	1.4	2.5	4.3	5.7
All households	**1.0**	**1.6**	**3.0**	**5.0**	**7.3**



Note: Income quintiles are based on the equivalized income, using the modified OECD scale.
Source: Bankwest Curtin Economics Centre | Authors' estimates based on ABS Household Expenditure Survey, 2015-16, and Cat. No. 6401.0.

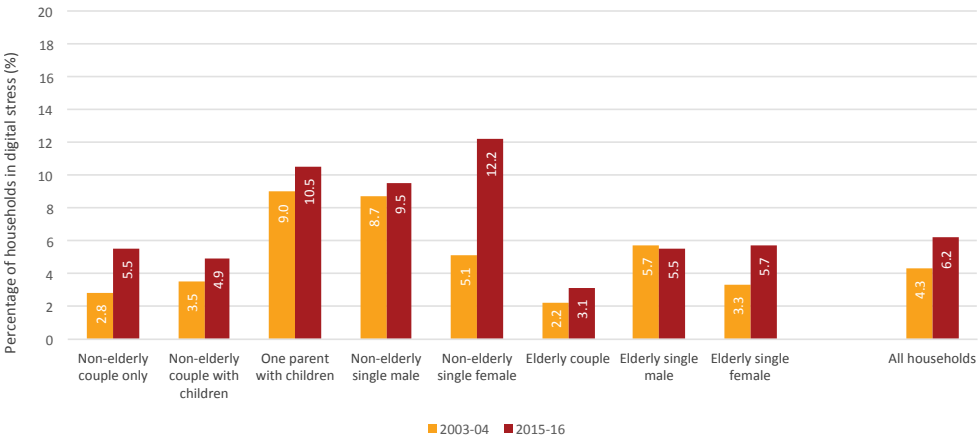
And which families face particular challenges in meeting the costs of mobile communications and digital technologies? One measure used in other areas of spending is to look at the proportion of families on relatively low incomes who commit more than a given share of their total budget on towards a certain group of necessities – with digital services now falling into this category.

A common standard defines households to be in housing stress if they pay over 30 per cent of their income in housing costs and are in the bottom 40 per cent of the distribution of household income (see Cassells *et al,* 2014). Similarly, Cassells *et al,* (2017) looked at the share of families who spend more than 10 per cent of their budget (after housing costs) on energy.

Food, shelter and heat are absolute necessities for all families, but with communications technologies becoming ever more essential in so many aspects of life, we report a similar pattern for digital spending. Specifically, we estimate the share of households spending more than 10 per cent of their budget (after housing costs) on digital services and in the poorest 40 per cent of the income distribution - a situation of digital stress.

Figure 29 looks at the prevalence of digital stress by family type, and the degree to which this has changed over time. On latest data for 2015-16 (as shown by the maroon bars in Figure 29), the incidence of digital stress is most pronounced among single parents (at around 10.5 per cent) and non-elderly single women (12.2 per cent), the latter rising by some 7.1 percentage points in a little more than a decade. Almost one in ten single men commit more than 10 per cent of their budget to digital spending, while digital stress has risen since 2003-04 for couples and elderly single women.

Figure 29 Prevalence of digital stress, by family type, 2003-04 and 2015-16



Note: Households characterised as in digital stress commit at least 10% of total spending towards digital services.
Source: Bankwest Curtin Economics Centre | Authors' estimates based on ABS Household Expenditure Survey, 2003-04 and 2015-16, and Cat. No. 6401.0.

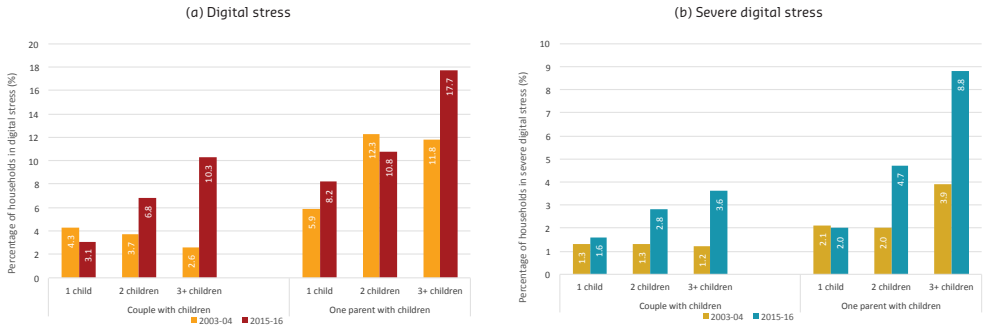
Families with children face progressively greater challenges in meeting the costs of mobile and digital technologies. Digital spending as a share of the total budget rises strongly with the number of children in the family. This can create particular stresses for those families on lower incomes, who nevertheless face pressure in meeting the needs and aspirations of their children.

Nearly one in six single parents with three or more children are in digital stress, with some 17.7 per cent committing more than 10 per cent of total spending after housing costs towards digital services – a rise of 5.9 percentage points since 2003-04 (Figure 30, panel a). Similarly, more than one in ten couples with three or more children are in digital stress, more than three times the rate among couples with a single child.

The contrast is even more striking when we look at the share of families spending more than a fifth of their total budget on digital goods and services – a situation of severe digital stress. This level of spending pressure is most common among single parents with three or more children, around 8.8 per cent of whom are on low incomes and are now spending more than 20 per cent on digital goods and services (Figure 30, panel b). This rate has more than doubled in just over a decade. Severe digital stress is lower among couples with children, but still rises with family size.

Around 8.8% of single parents with three or more children are spending more than 20% on digital goods and services, despite being on low incomes – double the rate of a decade ago.

Figure 30 Depth of digital stress among families with children: 2003-04 and 2015-16



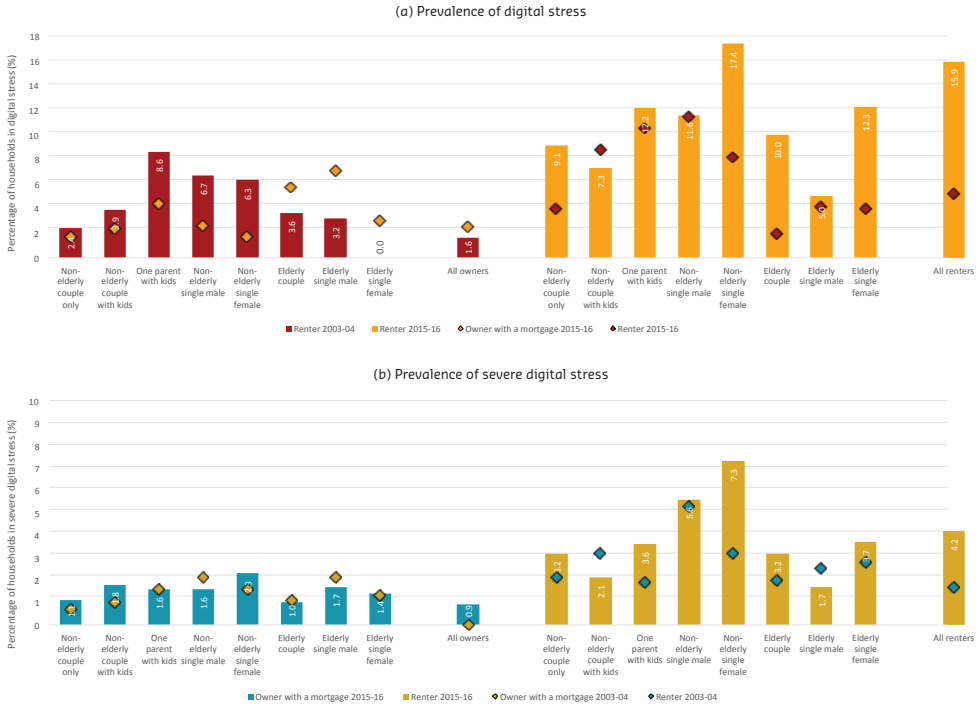
Note: Households are characterised as in digital stress if they commit at least 10% of total spending towards digital services, and in severe digital stress if they commit at least 20% of total spending.

Source: Bankwest Curtin Economics Centre | Authors' estimates based on ABS Household Expenditure Survey, 2003-04 and 2015-16, and Cat. No. 6401.0.

The costs of connectivity are especially pronounced among single women in rented accommodation. Around 17.4 per cent of single non-elderly female renters are in digital stress, spending more than a tenth of their after-housing-costs budget on mobile and internet products and services (Figure 31 panel a, right hand chart). Similarly, 12.3 per cent of elderly single women and 12.2 per cent single parents in rental housing face pressures in meeting digital costs. It is worth highlighting that single parents in mortgaged accommodation also face digital cost pressures, with 8.6 per cent in digital spending stress (Figure 31 panel a, left hand chart).

Looking at the more pronounced digital cost burdens among renters (Figure 31 panel b), we again see the highest incidence of severe digital stress among non-elderly single women (7.3% of whom are in severe digital stress) and non-elderly single men (5.6%).

Figure 31 Digital stress by tenure and family type, 2003-04 and 2015-16



Note: Households are characterised as in digital stress if they commit at least 10% of total spending towards digital services, and in severe digital stress if they commit at least 20% of total spending.

Source: Bankwest Curtin Economics Centre | Authors' estimates based on ABS Household Expenditure Survey, 2003-04 and 2015-16, and Cat. No. 6401.0.

Small business, large divide

Introduction

Part 3 of this report addresses digital inequality for the business sector. We ask detailed questions regarding the nature of digital inequality to find the characteristics that are driving differences in the digital capability of businesses, such as sector or business size.

Information technology, the internet, automation and other new technologies are driving the so-called "4th industrial revolution". Understanding which businesses and which sectors are engaging in these technologies and which are falling behind, is therefore vitally important at this stage to making sure that the Western Australian economy is prepared to take full advantage of this global economic change. If some businesses or sectors in Western Australia are not taking advantage of digital technologies, they risk being left behind during this fundamental change in the future of business. By assessing these inequalities this section identifies some key opportunities that are not yet being grasped by some sectors or businesses.

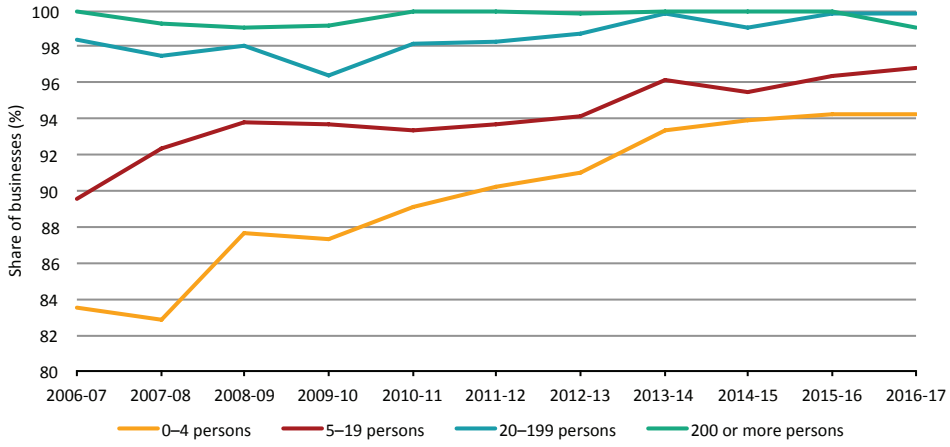
Business access to broadband

Access to broadband is vital for businesses in Western Australia to access the digital economy. Figure 32 shows the share of businesses with internet access between 2006-07 and 2016-17 by business size and of those with internet access, those with broadband as their main connection.

The share of businesses with internet access has continued to increase with 95.4 per cent of all businesses having internet access in 2016-17. While access to broadband continues to lag behind for businesses with less than 20 employees, 94.2 per cent of businesses with 0-4 employees have internet access. This suggests a small and diminishing divide between small and large businesses access to the internet. In addition, almost all businesses with internet access have broadband as their main connection since 2010-11 as shown in Figure 33.

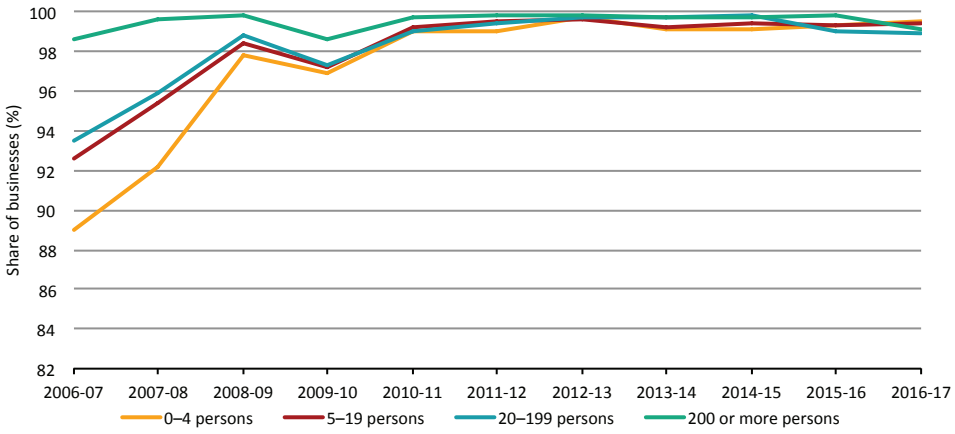
95% of all businesses reported having internet access in 2016-17.

Figure 32 Businesses with internet access, by business size, Australia, 2006-07 to 2016-17



Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8166

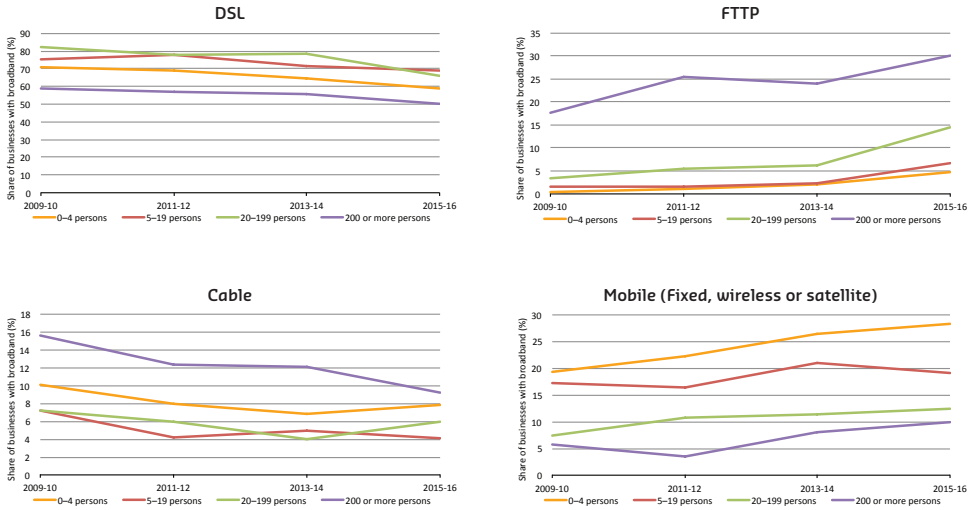
Figure 33 Share of businesses with broadband as main connection, by business size, Australia, 2006-07 to 2016-17



Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8166

The quality of broadband can vary substantially by the technology used to access the internet.

Figure 34 Main type of broadband connection used, by business size, Australia, 2009-10 to 2015-16



Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8129.0.

Large businesses with 200 or more employees are more likely to have a FTTP connection (30.1%) relative to smaller businesses.

While almost all businesses with internet access have broadband as their main internet connection, the quality of broadband can vary substantially by the technology used to access the internet. FTTP connections for example are usually many times faster than connections using other technologies. For businesses with broadband Figure 34 shows the main type of connection used.

Medium sized businesses of 5-19 employees and 20-199 employees typically depend on DSL (68.9% and 66.0% respectively in 2015-16) for their broadband connection. Surprisingly, small businesses with 0-4 employees are less likely to have DSL (58.7% in 2015-16) than larger businesses, but are more likely to take-up wireless or satellite connections (28.4%). This in part reflects the locations of small businesses in the Agriculture, Forestry and Fishing sector.

Large businesses with 200 or more employees are more likely to have a FTTP connection (30.1%) relative to smaller businesses. The share of businesses with a FTTP connection has been increasing for these large businesses over the entire period 2009-10 to 2015-16, but for smaller businesses the share has only increased between 2013-14 and 2015-16. The increase in take-up of fibre appears to have been a replacement of cable connections for these larger businesses. This is probably because both FTTP and Cable networks are predominantly in the main cities, while businesses in smaller towns and regional areas typically have fewer technology choices.

While there appears to be some division between business size for internet access and its various access technologies, this may be driven by industry characteristics. Table 5 shows the share of businesses with internet access by industry category between 2006-07 and 2016-17.

Businesses in the Accommodation and Food Services (88.4%), Agriculture, Forestry and Fishing (91.3%) or Transport, Postal and Warehousing (92.0%) industries are less likely to have broadband access than businesses in other industries. Alternatively, businesses in Information, Media and Telecommunications (99.1%), Financial and Insurance Services (99.0%) or Professional, Scientific and Technical Services (98.5%) sectors are more likely to have internet access.

Table 4 Businesses with internet access, by industry, 2006-07 to 2016-17

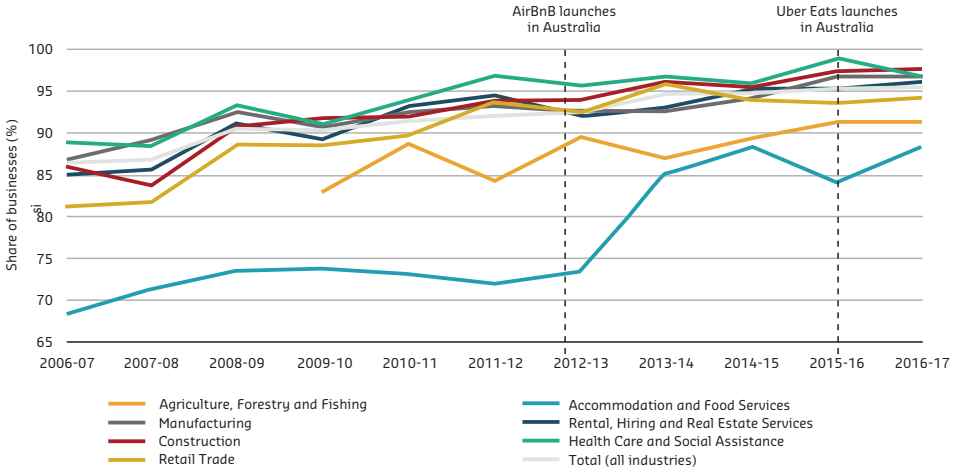
Industry	2006-07		2012-13		2013-14		2014-15		2015-16		2016-17	
	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank
Agriculture, Forestry and Fishing	na	na	89.5	15	87.0	16	89.4	16	91.4	16	91.3	16
Mining	91.0	6	97.8	5	98.5	4	99.3	1	96.5	9	97.1	6
Manufacturing	86.8	8	92.5	11	92.8	15	94.3	12	96.7	7	96.7	8
Electricity, Gas, Water and Waste Services	84.9	12	90.4	14	95.2	10	95.3	9	96.7	7	97.6	4
Construction	85.9	9	94.0	9	96.0	8	95.6	8	97.5	5	97.6	4
Wholesale Trade	94.0	4	98.7	3	97.0	5	98.2	5	97.0	6	95.3	11
Retail Trade	81.1	13	92.1	12	95.9	9	94.1	13	93.5	13	94.2	12
Accommodation and Food Services	68.3	16	73.5	17	85.0	17	88.4	17	84.0	17	88.4	17
Transport, Postal and Warehousing	80.5	14	94.4	8	95.1	11	92.7	14	92.5	14	92.0	15
Information Media and Telecommunications	97.8	2	99.4	1	98.7	3	98.7	2	100.0	1	99.1	1
Financial and Insurance Services	95.3	3	99.3	2	100.0	1	98.6	3	99.3	2	99.0	2
Rental, Hiring and Real Estate Services	85.2	11	92.1	12	92.9	14	95.3	9	95.2	12	96.0	10
Professional, Scientific and Technical Services	98.4	1	98.5	4	98.9	2	98.4	4	99.2	3	98.5	3
Administrative and Support Services	91.6	5	93.6	10	96.4	6	96.9	6	96.0	10	96.9	7
Health Care and Social Assistance	88.5	7	95.6	7	96.4	6	96.1	7	98.7	4	96.4	9
Arts and Recreation Services	85.5	10	96.7	6	93.6	13	94.4	11	95.3	11	92.9	14
Other Services	76.7	15	87.1	16	94.7	12	92.1	15	92.3	15	94.0	13
Total	**86.5**		**92.6**		**94.7**		**94.8**		**95.3**		**95.4**	

Note: Agriculture, Forestry and Fishing data is only available from 2009-10.
Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8166.0, Table 1.

Internet access for a selected number of industries is shown in Figure 35. Accommodation and food services has seen a large increase in internet access between 2012-13 (73.5%) and 2016-17 (88.4%) with a particularly large increase between 2012-13 and 2013-14 and an increase again in 2015-16. Growth coincides with the official launch of AirBnB (November 2012) and Uber Eats (July 2016).

The Accommodation and Food Services industry has seen a large increase in internet access, with growth coinciding with the official launches of AirBnB (2012) and Uber Eats (2016).

Figure 35 Businesses with internet access, by industry (selection), Australia, 2006-07 to 2016-17



Note: Agriculture, Forestry and Fishing data is only available from 2009-10.
Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8166.0, Table 1.

Figure 36 shows the main type of broadband connection for selected industries.

DSL is the main broadband connection used for all industries except Agriculture, Forestry and Fishing, but most industries have experienced an increase in both FTTP and wireless technologies as the main broadband connection used in 2016-17, replacing a share of DSL connections.

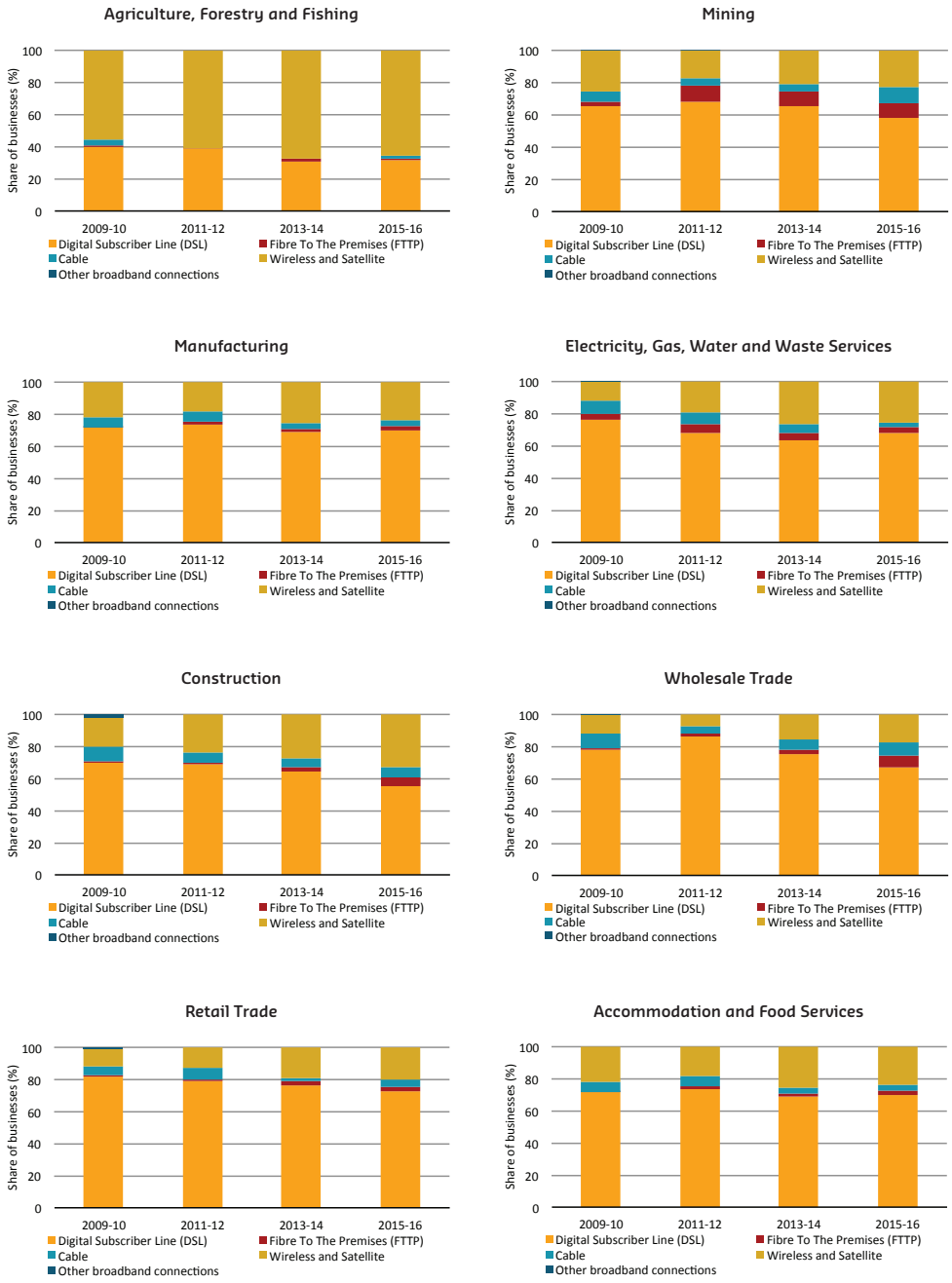
The Agriculture, Forestry and Fishing sector is less likely than other sectors to use a DSL connection (31.3% in 2016-17), opting for Wireless technologies (65.6%) to access broadband.

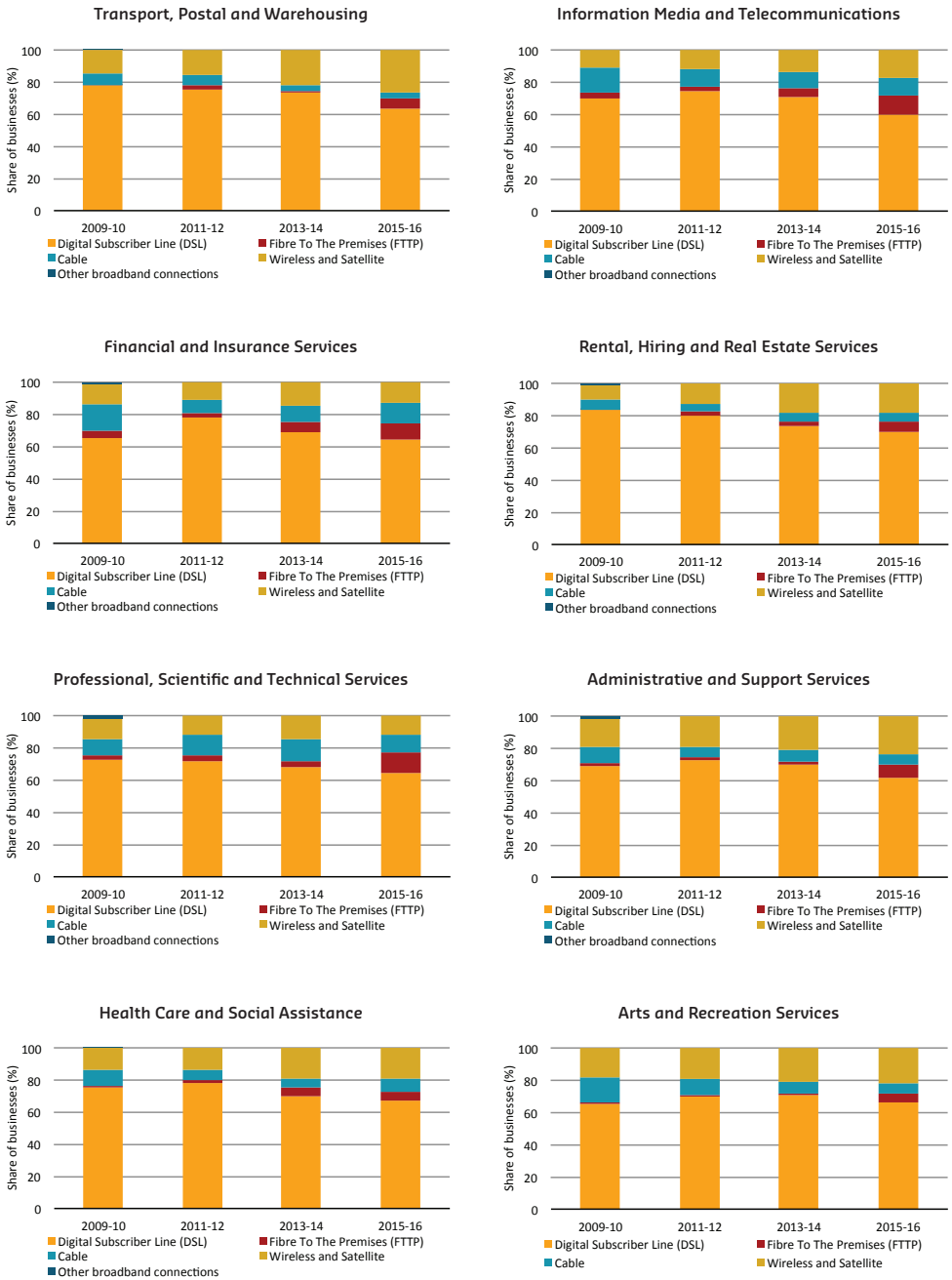
The Agriculture, Forestry and Fishing sector is less likely than other sectors to use a DSL connection (31.3% in 2016-17), opting for Wireless technologies (65.6%) to access broadband. While NBN Co's satellite, Sky muster, was launched in October 2015, connections to wireless broadband services for the Agriculture, Forestry and Fishing sector has remained stagnant. However, this masks a switch for agriculture businesses away from a Satellite connection to terrestrial wireless connections. While the breakdown by wireless technologies is not shown in the figure, the share of businesses in the Agriculture, Forestry and Fishing sector with Fixed or mobile wireless broadband connections increased (11.8% to 22.1%, and 18.1% to 28.4% respectively), but the share of businesses with Satellite connections dropped (25.5% to 15.1%).[2] On this basis, it would suggest that technological improvements or programs such as the mobile blackspot program could be having a greater impact on internet access for rural communities, than the NBN satellite. Nonetheless, new satellite connections are likely to be offering broadband to businesses that previously had no affordable connection to access the internet.

The mining sector experienced a large increase in FTTP connections between 2009-10 (3.1%) and 2011-12 (10.0%), as mining companies invested in high quality connections during the mining boom, which has since declined (to 8.9% in 2015-16).

2 These figures reflect the "main type of broadband connection used" rather than the number of connections. This switch could be a change in use rather than connectivity, as mobile capabilities improved during the period. i.e. more farmers may take advantage of smart phone capabilities in 2015-16 and consider this their "main type of broadband connection" than in 2009-10.

Figure 36 Main type of broadband connection used, by selected industries, Australia, 2009-10 to 2015-16





Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8129.0.

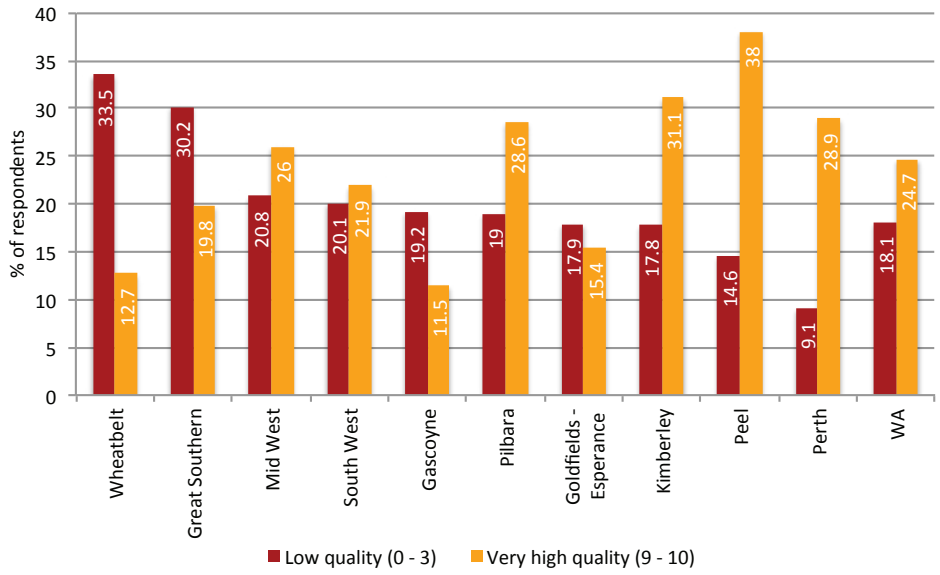
Findings from the BCEC Small Business Survey 2017

The BCEC Small Business Survey 2017 (Bond-Smith *et al*, 2017) collected information from 1,500 small businesses in Perth and across WA's regions. In particular, the survey asked respondents about the quality of mobile and broadband services.

Figure 37 shows the share of small businesses in WA by region that rated their mobile phone service as very high quality (9-10) or low quality (0-3). Across the state, 24.7 per cent of respondents rated their mobile service very high predominantly driven by high ratings in Perth (28.9%), Peel (38.0%), Kimberley (31.1%) and Pilbara (28.6%). Alternatively 18.1 per cent of small businesses in WA rated their mobile quality as low (0-3), particularly in the Wheatbelt (33.5%) and Great Southern (30.2%) regions.

18.1% of small businesses in WA rated their mobile quality as low.

Figure 37 Percentage of small businesses that rate the quality of mobile service infrastructure as low and very high, 2017

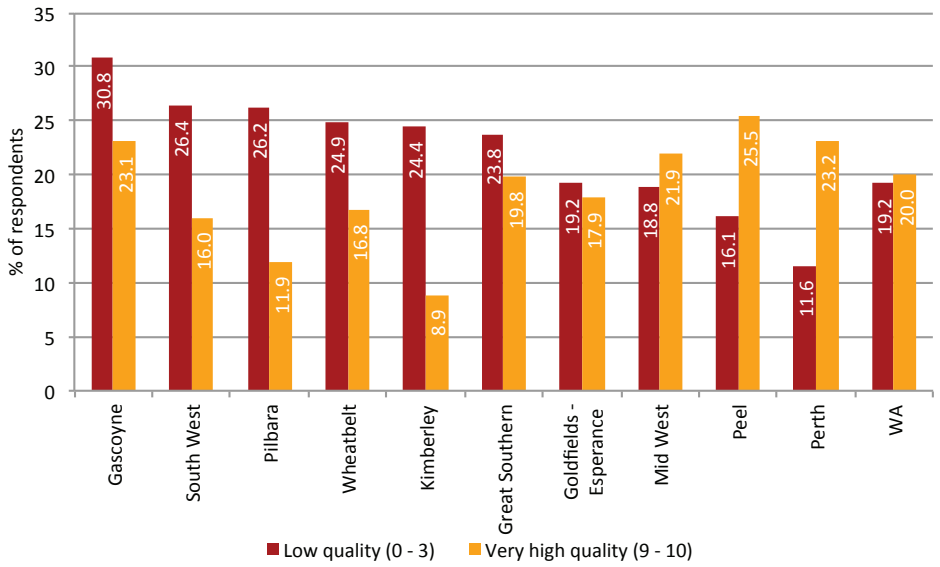


Note: Ranked by low quality.
Source: Bankwest Curtin Economics Centre | Authors' calculations from BCEC Small Business Survey 2017.

Figure 38 shows the share of small businesses by region in WA that rated the quality of their internet and broadband access as very high quality (9-10) or low quality (0-3). Across Western Australia, 20 per cent of small business owners rated their broadband as very high quality and 19.2 per cent rated broadband or internet as low quality. However, only the Perth, Peel and Mid West regions had a greater share of respondents rating their internet service as very high quality than low quality. The Gascoyne region had a high share of responses rating the quality of broadband as low (30.8%) and very high quality (23.1%) suggesting a sharp divide between Gascoyne residents. Alternatively, the Pilbara and Kimberly regions had a high share of responses rating the quality of broadband as low (26.2% and 24.4% respectively) and a small share rating the quality of broadband as very high (11.9% and 8.9% respectively). This suggests both a geographic divide between the quality of broadband for businesses in these regions compared with other regions in WA, a divide between businesses within those regions.

The Agriculture, Forestry and Fishing industry has the largest share (27%) of small businesses rating both their mobile and internet services as low.

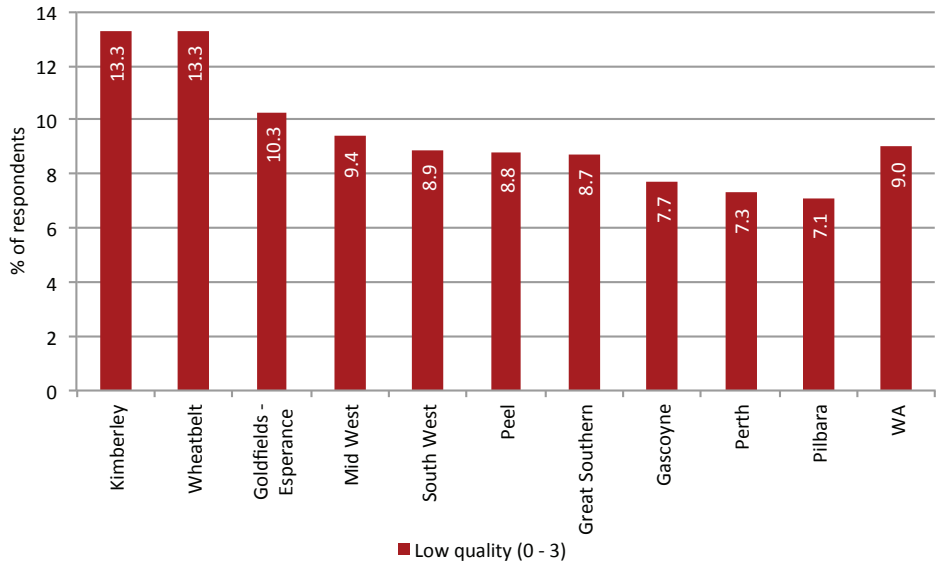
Figure 38 Percentage of small businesses that rate the quality of internet infrastructure as low and very high, by region, 2017



Note: Ranked by low quality. Internet infrastructure includes broadband access.
Source: Bankwest Curtin Economics Centre | Authors' calculations from BCEC Small Business Survey 2017.

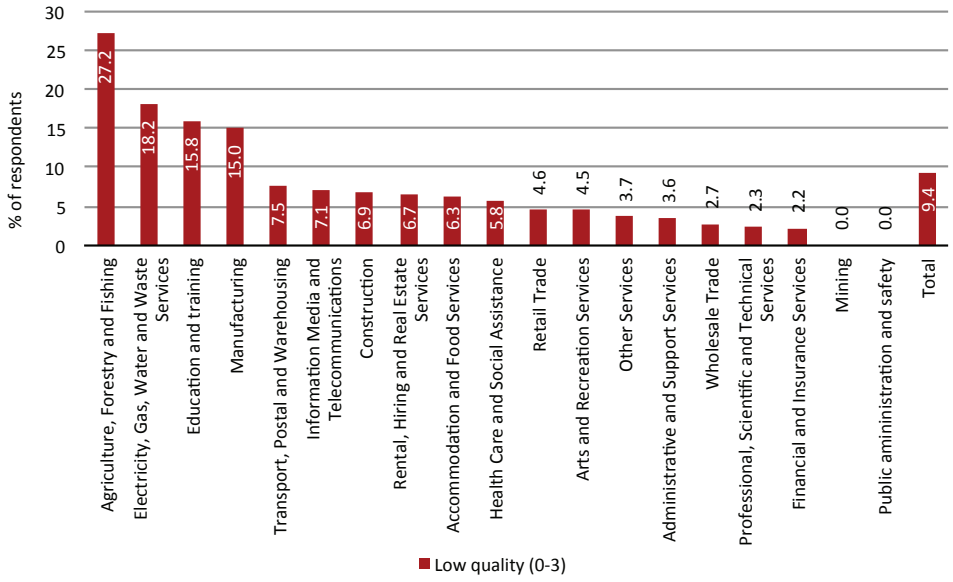
Figure 39 and Figure 40 show the share of small businesses (by region and industry) with both low quality mobile and low quality internet. The Agriculture, Forestry and Fishing industry has the largest share (27%) of small businesses rating both their mobile and internet services as low quality (0-3) and the smallest share rating both their mobile and internet services as very high quality (0-3). Naturally, the relationship between industry and region is strong, with a large share of businesses in the Kimberley and Wheatbelt reporting poor services. This effectively leaves them with no alternative mode of access.

Figure 39 Percentage of small businesses that rate the quality of both internet and the quality of mobile service infrastructure as low, by region, 2017



Note: Ranked by low quality. Internet infrastructure includes broadband access.
Source: Bankwest Curtin Economics Centre | Authors' calculations from BCEC Small Business Survey 2017.

Figure 40 Percentage of small businesses that rate the quality of both internet and the quality of mobile service infrastructure as low, by industry, 2017



Note: Ranked by low quality.
Source: Bankwest Curtin Economics Centre | Authors' calculations from BCEC Small Business Survey 2017.

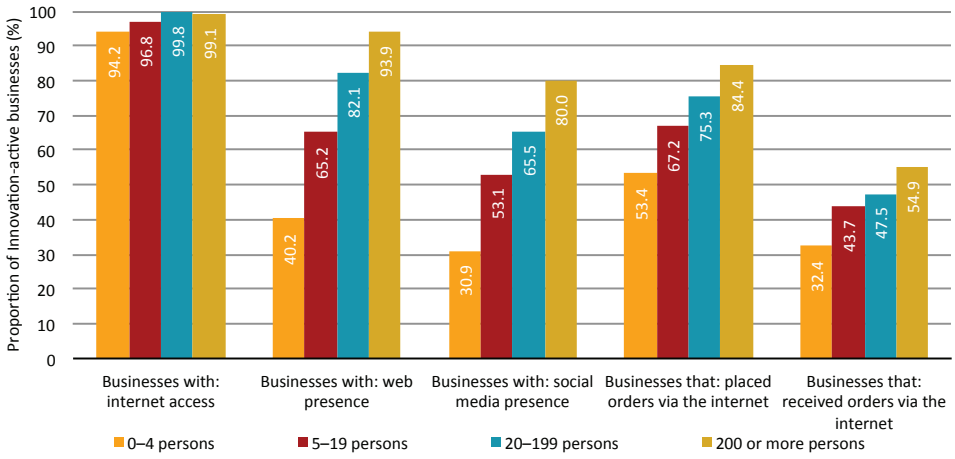
Business use of internet

Internet access is only valuable to businesses for what it can be used for. Figure 41 shows the share of businesses in Australia with a web presence, social media presence, and that place and receive orders via the internet.

While 95.4 per cent of all businesses have internet access, larger businesses are more likely to make use of these purposes than smaller businesses. Of Businesses with 200 or more employees, 93.9 per cent report a web presence and 80.0 per cent report a social media presence. This compares to 40.2 per cent of businesses with 0-4 employees having a web presence and 30.9 per cent having a social media presence.

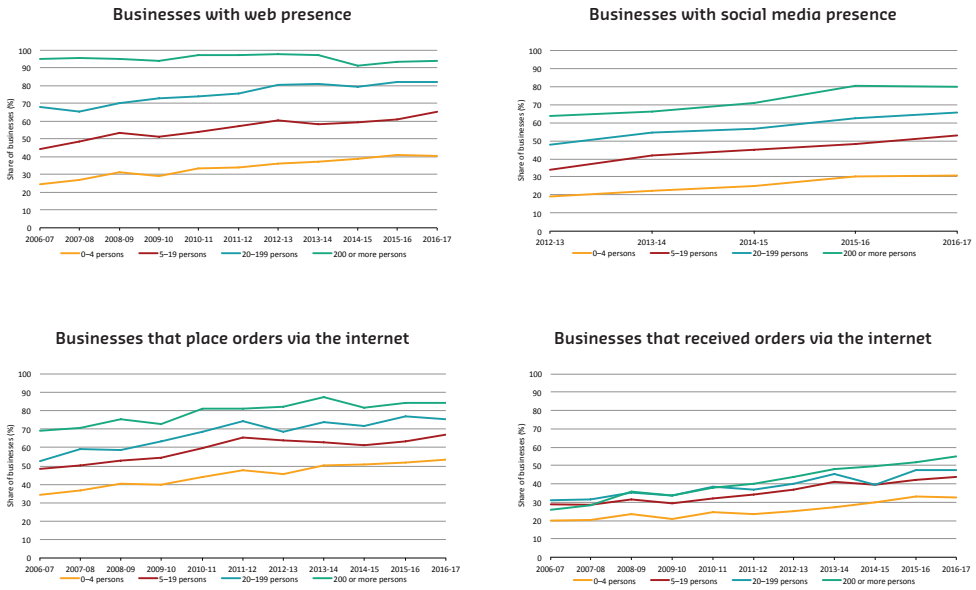
The gap between small and large business is smaller for placing and receiving orders via the internet. 53.4 per cent of small businesses (0-4 persons) and 84.4 per cent of large businesses reported placing orders via the internet in 2016-17 and 32.4 per cent of small businesses (0-4 persons) and 54.9 per cent of large businesses reported receiving orders via the internet in 2016-17.

Figure 41 Internet usage (various), by business size, Australia, 2016-17



Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8166.0, Table 1.

Figure 42 Internet usage (various), by business size, Australia, 2006-07 to 2016-17



Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8166.0.

Figure 42 shows how business use of the internet has changed between 2006-07 and 2016-17. Over time, the gap between small and large businesses with a web presence has narrowed, as smaller businesses websites, while larger businesses already maintain this web presence. On the other hand, the difference between small and large businesses having a social media presence has remained constant over the same period.

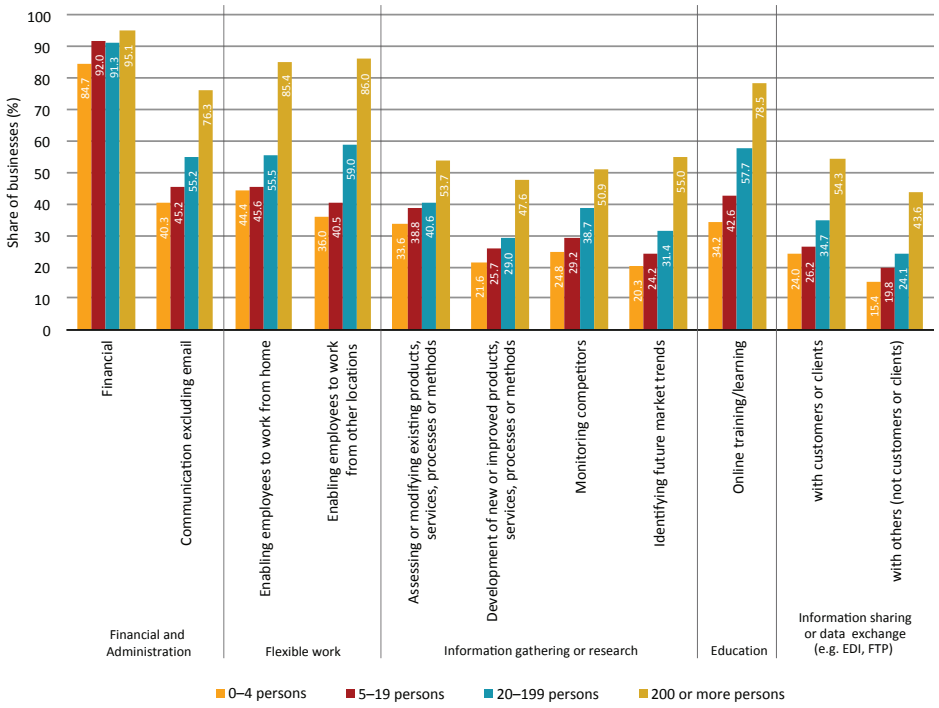
While the gap is smaller regarding internet based ordering compared to web or social media presence, the gap is not narrowing. In particular, the gap between small and large businesses receiving orders via the internet has expanded between 2006-07 and 2016-17.

Figure 43 shows the business activities which use the internet as a resource by business size. Businesses of all sizes use internet access for financial activities with more than 91 per cent of businesses with more than 5 employees making use of the internet for this purpose. However, amongst all other activities surveyed, businesses with 200 or more employees make much greater use of the internet than smaller businesses.

The gap between small and large businesses receiving orders via the internet has expanded between 2006-07 and 2016-17.

Businesses of all sizes use internet access for financial activities.

Figure 43 Selected business internet activities, by business size, Australia, 2015-16



Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8129.0, Table 4, 2015-16.

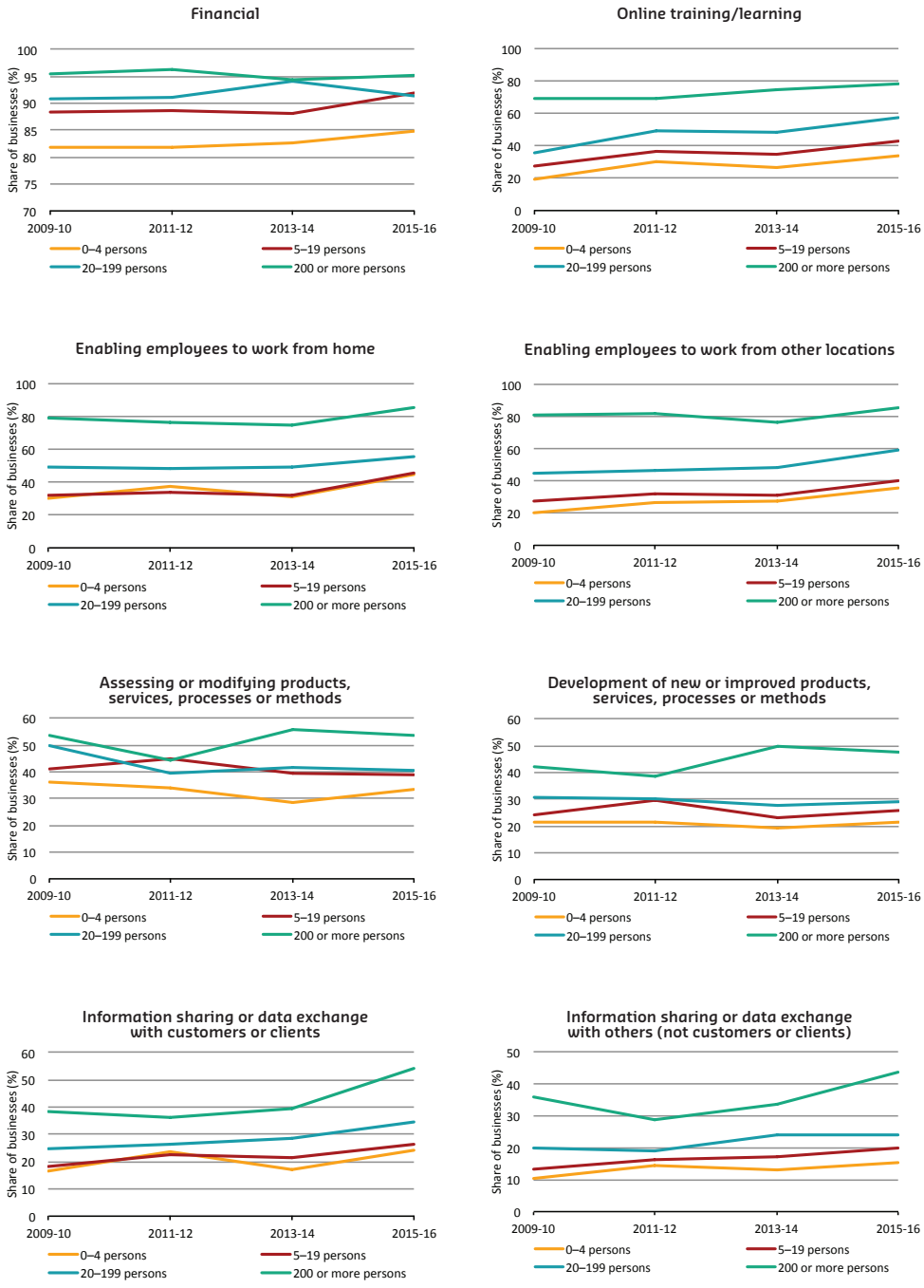
The gap between small and large businesses is slowly narrowing for financial activities, online training/learning and remote work.

In particular, a gap emerges for undertaking remote work, with more than 85 per cent of businesses with over 200 employees making use of the internet for employees to work from home or from locations other than the business's main office.

There are gaps by business size for using the internet for information gathering or research, particularly for identifying future market trends. Similarly, businesses with 200 or more employees are far more likely to use the internet for information sharing or data exchange (e.g. EDI, FTP).

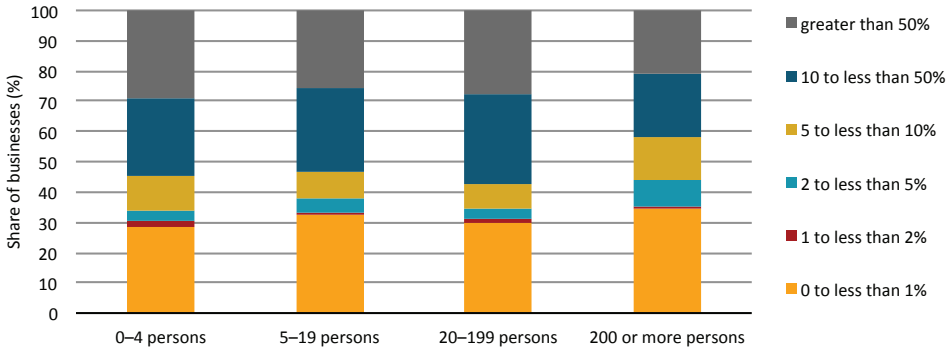
Figure 44 shows how these activities have changed over time from 2009-10 to 2015-16. Notably, the gap between small and large businesses is slowly narrowing for financial activities, online training/learning and remote work, but the gap is persistent. Yet, larger businesses are increasingly using the internet for research and for data exchange, widening the gap with smaller businesses.

Figure 44 Selected business internet activities, by business size, Australia, 2009-10 to 2015-16



Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8129.0.

Figure 45 Internet income as a percentage of total goods and services income, by business size Australia, 2015-16



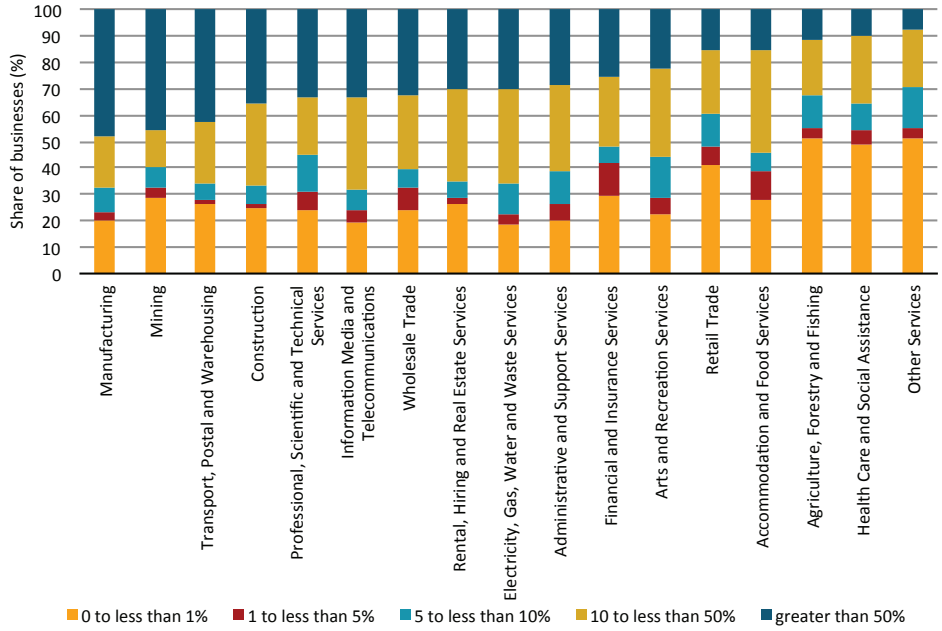
Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8129.0.

Businesses with 0-4 employees are more likely to earn greater than 50% of their income via the internet than larger businesses.

Figure 45 shows the extent that businesses that earn income resulting from goods and services ordered over the internet, by business size, where the commitment to purchase is via the internet.[3] Businesses with 0-4 employees are more likely to earn greater than 50 per cent of their income by the internet than larger businesses. This is despite other dimensions of digital inequality that imply a divide between small and large businesses. This highlights the importance of digital technologies to small businesses, and shows the opportunity for small businesses to reach a large customer base via the internet. Figure 46 shows internet income as a percentage of total income by industry. The Manufacturing and Mining sectors have the largest share of businesses earning more than 50 per cent of income via the internet.

[3] Excluded from these measures are orders, payments or transactions for which the commitment has been made using other arrangements.

Figure 46 Internet income as a percentage of total goods and services income, by industry, Australia, 2015-16



Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8129.0.

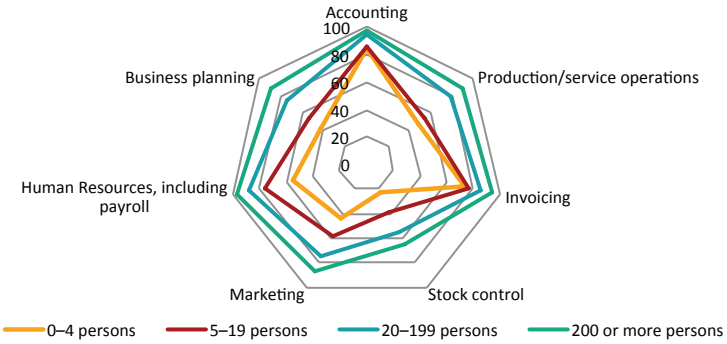
Business use of IT

Smaller businesses are more likely to report having no IT support.

While the earlier chapter reviewed how businesses make use of the internet, this section considers how businesses make use of Information Technologies in general.

Figure 47 shows the share of businesses using IT for various business processes by business size. While Finance was a common internet activity for all businesses sizes, with respect to IT use this is dominated by Accounting, while smaller businesses are less likely to report using the IT technologies for invoicing. Smaller businesses are far less likely than larger businesses to use IT for all other activities surveyed, although, some activities such as stock control or operations, may be less relevant for smaller businesses.

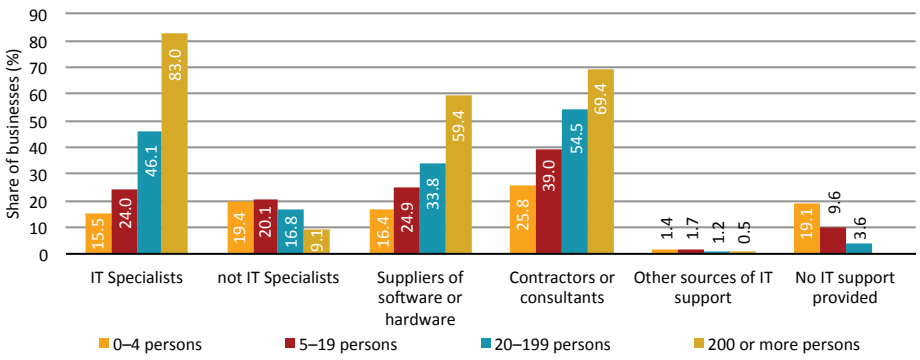
Figure 47 Share of businesses reporting IT use in business processes, by business size, Australia, 2015-16



Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8129.0, Table 3 2015-16.

Figure 48 shows the source of IT support by business size. Smaller businesses are more likely to report no IT support provided, with 19.1 per cent of businesses with 0-4 employees reporting no IT support. Businesses with 200 or more employees are most likely to use IT specialists (83.0%) or Contractors or consultants (69.4%) compared to smaller businesses. Smaller businesses are more likely to report IT support for non IT specialists.

Figure 48 Source of IT support, by business size, Australia, 2015-16



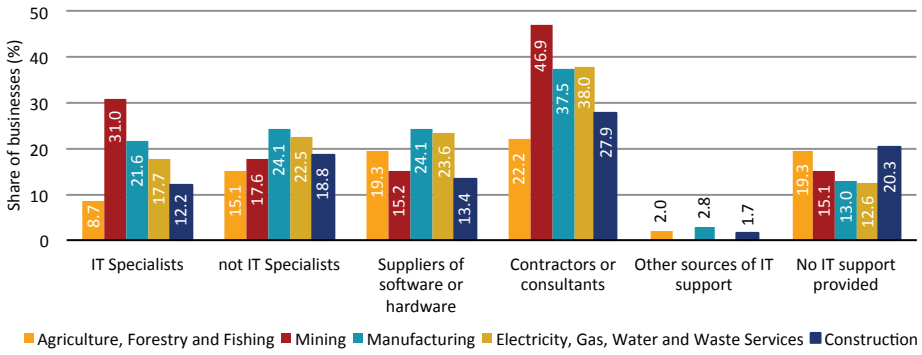
Note: Businesses with 200 or more persons and No IT support provided was not available for publication.
Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8129.0, Table 1, 2015-16.

Different industries have varying access to IT support. Figure 49 shows the sources of IT support for Australian businesses in the Agriculture, Forestry and Fishing, Mining, Manufacturing, Electricity, Gas, Water and Waste Services and Construction industries. The largest source of IT support for each of these sectors is contractors or consultants. In particular, contractors or consultants provide IT support to 46.9 per cent of businesses in the mining sector with the next largest source of IT support for mining businesses from IT specialists (31.0%).

No IT support is provided to 19.3 per cent of businesses in the Agriculture, Forestry and Fishing sector and to 20.3 per cent of businesses in Construction.

19% of businesses in the Agriculture, Forestry and Fishing sector have no IT support.

Figure 49 Source of IT support by industry (selected), Australia, 2015-16

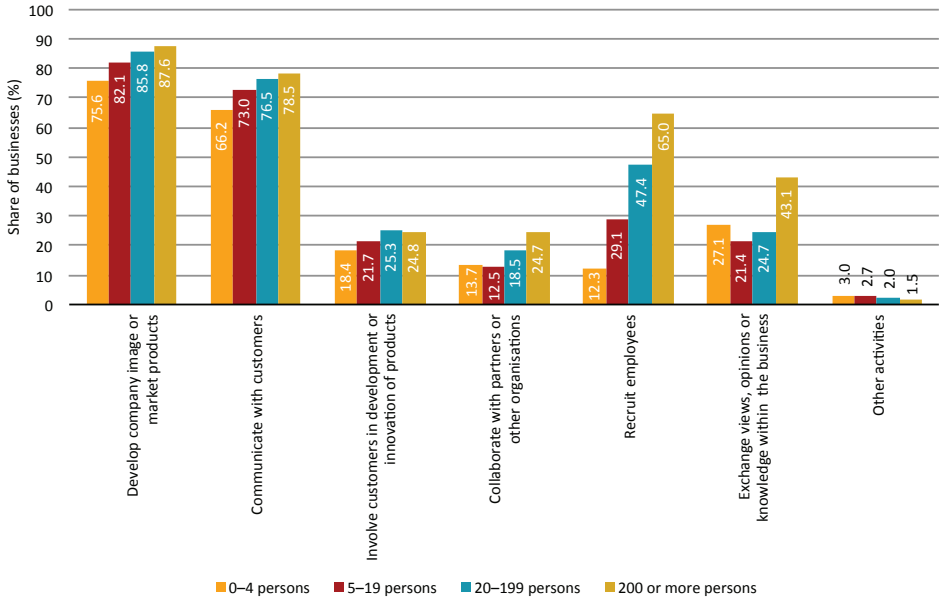


Note: Values for "Other sources of IT support" were not available for publication for Mining or Electricity, Gas, Water and Waste Services sectors.
Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8129.0.

Figure 50 shows the ways businesses with a social media presence make use of that presence by business size. Not only are larger businesses more likely to have a social media presence, larger businesses are more likely to report each of the activities surveyed. In particular, 65.0 per cent of businesses with 200 or more employees report using social media to recruit employees compared to only 12.3 per cent of businesses with 0-4 employees. The primary activity on social media for businesses of all sizes is to develop the company image or to market products, followed by communication with customers.

The primary activity on social media for businesses of all sizes is to develop the company image or to market products.

Figure 50 Social media activities used, by business size, Australia, 2015-16

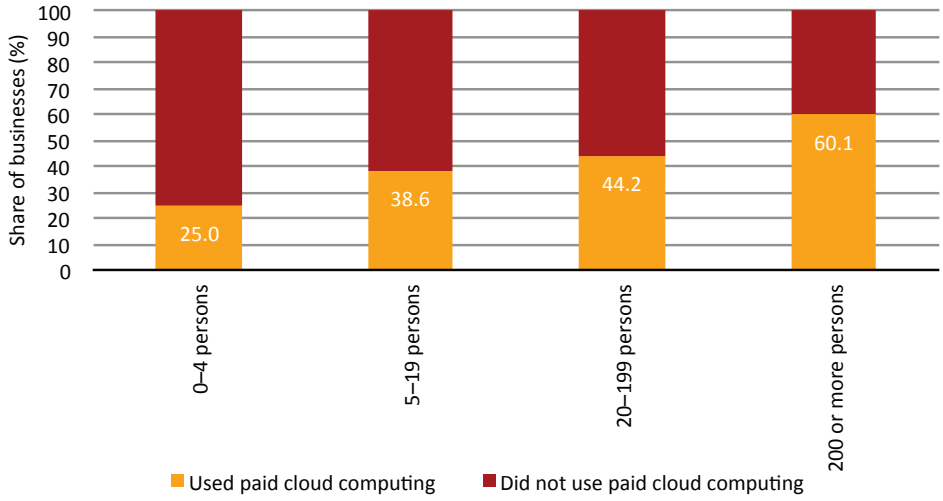


Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8129.0, 2015-16.

The low use of paid cloud computing in Agriculture, could be a result of broadband connections and plans, with no satellite NBN business plans yet available.

Figure 51 shows the use of paid cloud computing services by business size, with 60.1 per cent of businesses with 200 or more employees reporting the use of paid cloud computing. This compares to 25.0 per cent of businesses with 0-4 employees.

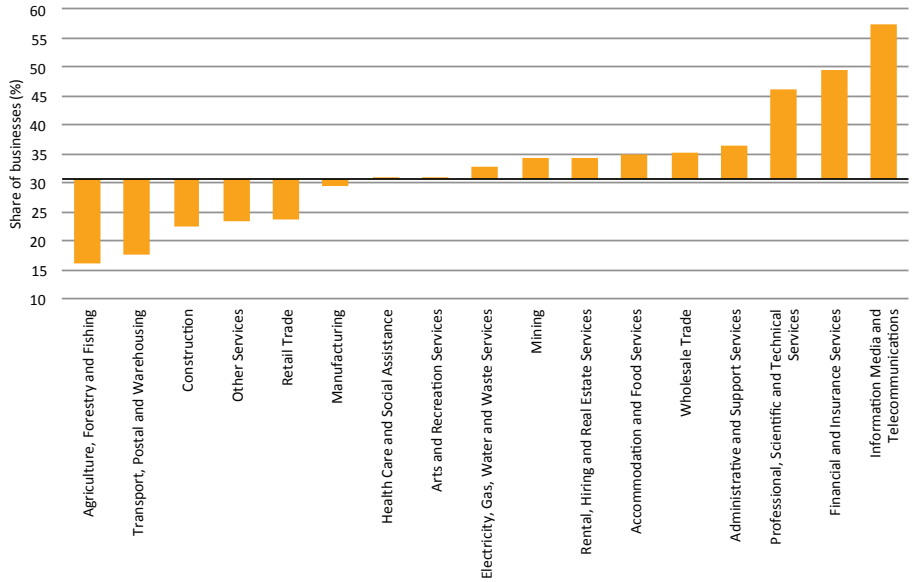
Figure 51 Use of paid cloud computing by business size, Australia, 2015-16



Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8129.0, Table 8, 2015-16.

Figure 52 shows the use of paid cloud computing services by industry. Not surprisingly, the Information, Media and Telecommunications sector is most likely to make use of paid cloud computing (57.3%) services while Agriculture, Forestry and Fishing is the least likely (16.2%). The low use of paid cloud computing in Agriculture, could be a result of broadband connections and plans, with no satellite NBN business plans yet available[4] and typically restrictive data caps on satellite or wireless broadband plans.

Figure 52 Use of paid cloud computing by industry, Australia, 2015-16



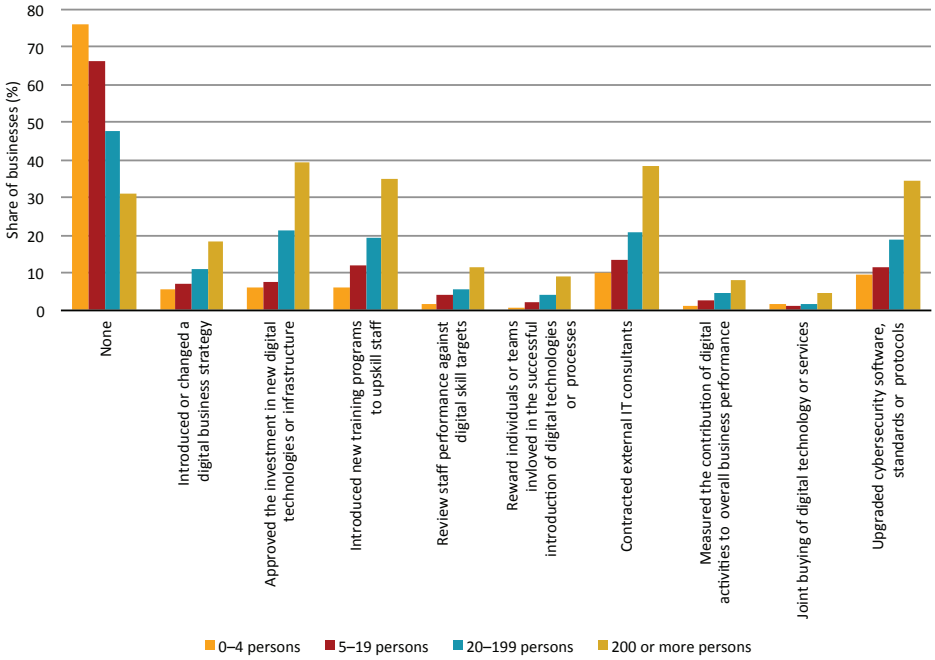
Notes: Industries ordered by least use of paid cloud computing to most. Bars show the difference compared to all industries.
Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8129.0, Table 8, 2015-16.

Businesses can promote the use of ICT within their business by undertaking various activities to support its use. Businesses with 0-4 employees were the least likely to undertake management practices to support ICT with 76.1 per cent of these businesses reporting no management practice implemented in 2015-16 to support ICT. Larger businesses are more willing to invest in ICT, with 39.2 per cent reporting approval of an investment in new digital technologies or infrastructure, 35.2 per cent reporting new training programs to upskill staff, 34.4 per cent reporting upgraded cyber security software, standards or protocols.

Businesses with 0-4 employees were the least likely to undertake management practices to support ICT. 76.1% of these businesses reported having no IT management practices in 2015-16.

[4] NBN co report that the NBN business satellite service is expected to be offered in early 2019. See https://www.nbnco.com.au/business/product-and-technical-information/business-satellite-service.html

Figure 53 Type of management practice implemented to support use of ICT, by business size, Australia, 2015-16



Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8129.0, Table 16, 2015-16.

Business perspectives of ICT

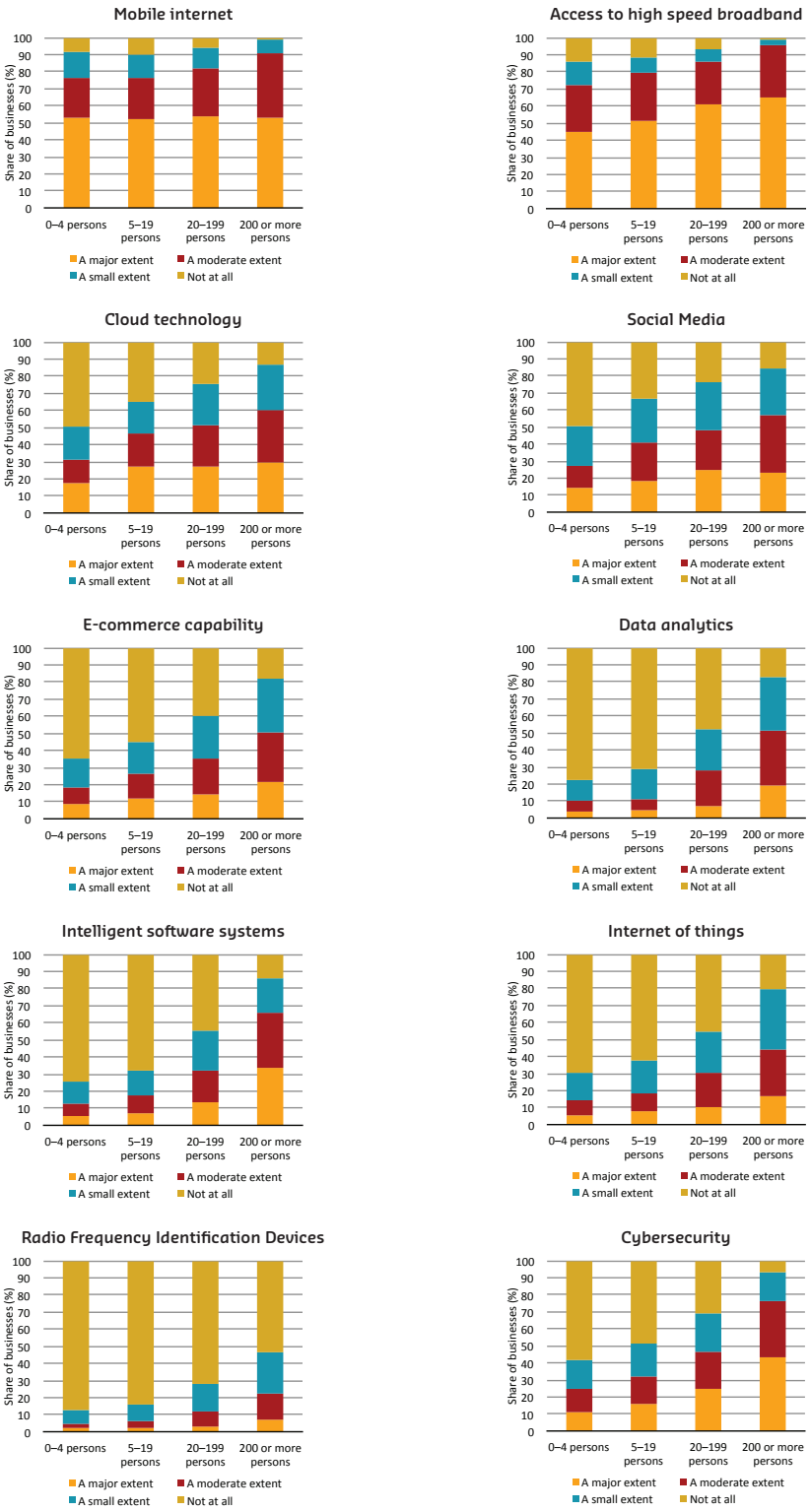
While the above analysis implies a technological divide between small and large businesses, it is important to consider the relevance of this divide to these businesses. To some extent, this divide could represent a reduced need for digitalisation in small businesses, while for some aspects it suggests a missed opportunity for small business. This section discusses how businesses perceive digital technologies.

Figure 54 shows the extent of importance placed on digital technologies for businesses of various sizes. Larger businesses place a greater importance on digital technologies than smaller businesses. Despite being more likely to take up wireless internet connections, businesses with fewer employees are more likely to report that mobile internet is of no importance to their business. Similarly, high speed broadband is more likely to be reported as being of major importance for larger businesses.

Larger businesses place a greater importance on digital technologies than smaller businesses.

High speed broadband is more likely to be reported as being of major importance for larger businesses.

Figure 54 Extent of digital technology importance, by business size, Australia, 2015-16



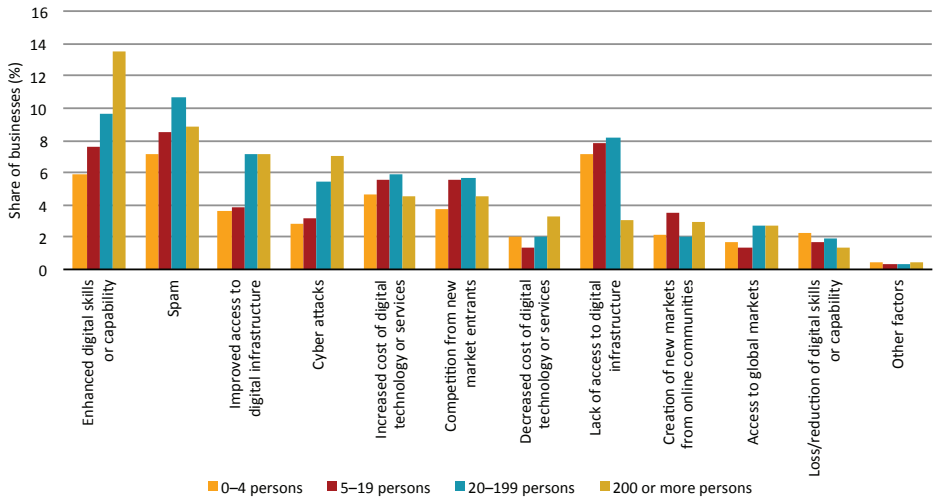
Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8129.0, Table 12, 2015-16.

Figure 55 shows the key factors affecting IT use by business size in Australia. Skills make the greatest difference for IT use in larger businesses. Businesses of all sizes report Spam as a key factor affecting their IT use. For businesses with fewer than 200 employees, a lack of access to digital infrastructure is reported as a significant factor affecting IT use alongside skills and spam.

Skills make the greatest difference for IT use in larger businesses.

For businesses with fewer than 200 employees, a lack of access to digital infrastructure is reported as a significant factor affecting IT use.

Figure 55 Factors affecting IT use, by business size, Australia, 2015-16



Note: Factors sorted by most affecting businesses with 200 or more persons.
Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8129.0, Table 16, 2015-16.

The analysis implies a small and typically diminishing digital divide between small and large businesses predominantly driven by industry and geographic differences, business perceptions of IT and the digital infrastructure available to different businesses.

Infrastructure

needs for our digital futures

Introduction

While the primary focus of this report is from a social rather than an industry perspective, in the context of addressing factors that may contribute to the digital divide in Australia and WA, this part of the report provides an overview of the supply side factors. We review how the digital economy in WA has reached where it is today, including the role that governments have played in developing, supporting and regulating the digital sector, and the performance of the current digital marketplace.

Infrastructure

This section provides an overview of the underlying infrastructure used to access the digital economy in Western Australia.

Connecting to broadband in Australia

Until recently, the main underlying infrastructure to access a fixed line broadband service in Australia was based on the old publicly switched telephone network (PSTN). The PSTN network uses copper wires to connect people's homes (referred to as the "local loop") to the traditional analogue phone system. Piggy-backing on this network, Analogue Digital Subscriber Lines (ADSL or DSL) access a fixed line broadband internet connection over the existing copper network. The speed of a DSL broadband connection depends on the length of the copper line between the premises and the exchange, with slower speeds for premises that are further away. Broadband can also be accessed by piggy-backing on the hybrid fibre coaxial (HFC) cable network traditionally used to broadcast subscriber television services. These networks are increasingly being replaced or used by the National Broadband Network (NBN) offering a connection to people's homes over fibre (FTTP – Fibre to the Premises; or FTTB – Fibre to the Building), a combination of fibre and copper (FTTN – Fibre to the Node) or HFC connection. Rural and remote areas rely on fixed-wireless and satellite services to access broadband services. Mobile networks offer portable internet services to mobile phones, tablets and other devices. As a result, the availability of broadband and the range of plans offered at a particular a location depends on the type of connection that is available.

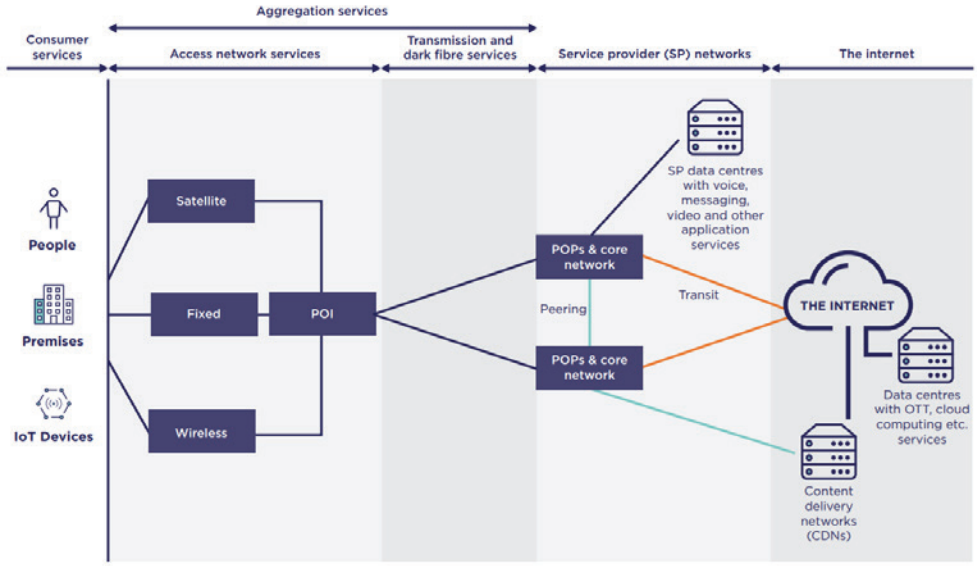
While the local network refers to the last few kilometres of the network, internet traffic comes from servers that are often located far away. This requires telecommunications companies to also purchase backhaul (local and domestic transmission) and international transmission to transmit internet content over much longer distances. In Australia, internet content that is delivered from overseas is transmitted across undersea cables to Perth and Sydney.

The key components of the infrastructure to provide internet services are:

- Fixed line access networks – these include the copper local loop, HFC cable networks, fibre to the curb/premises (FTTC/FTTP) networks, and fixed-wireless networks.
- mobile access networks;
- backhaul infrastructure; and
- International transmission via undersea cables.

The interaction between these components is described in Figure 56.

Figure 56 Provision of broadband services in Western Australia



Source: Bankwest Curtin Economics Centre | Infographic from ACCC (2018) Communications Sector Market Study Final Report, April 2018.

A brief history of infrastructure investment

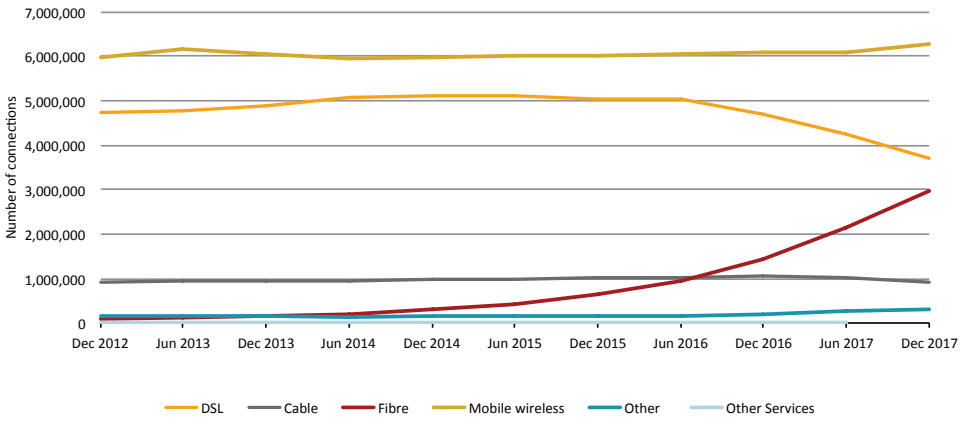
It is 21 years since the telecommunications market in Australia was formally opened to competition. Competition is intended to improve affordability and access to ICT services by lowering prices for consumers and spurring innovation to improve quality. Competition is supported by a regulatory regime that enables entry of competitive service providers, even if they don't have their own network infrastructure.

The first ADSL broadband services appeared in 1999 and the ACCC required Telstra to offer competitors access to its local copper network prior to launching its own retail ADSL services. The first unbundled services piggy-backing on Telstra's network were offered in 2003, spurring several years of intensive competition and investment that saw Australia's broadband penetration increase rapidly. Mobile internet also became available with Wireless Application Protocol (WAP) services in 1999, broadband speeds following in 2006 (3.5G) and 4G mobile from 2011. The first customers were connected to the NBN in 2010. Figure 75 in the Appendix shows key events in broadband infrastructure investment in Australia since 1999.

An appetite for speed and data

While Australians have had broadband for some time, over the last five years Fibre connections have shifted consumers away from slower DSL connections (Figure 57). This reflects the demand for high speed internet connections and the types of data heavy applications that are available over high quality broadband connections such as streaming video, online gaming, video conferencing, remote work and cloud based services.

Figure 57 Internet subscribers by type of access connection, Australia, December 2012 to December 2017

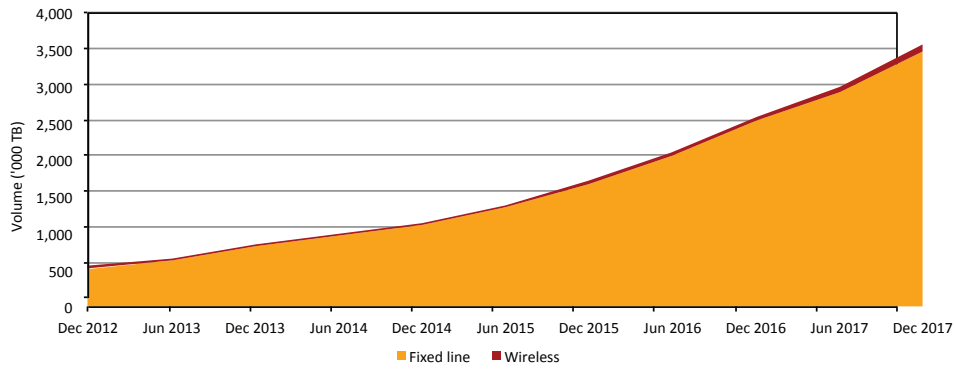


Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8153.0, Table 1.

This has seen the amount of data downloaded by Australians explode from 555,000 TB in the three months ending December 2012 to 3.6 million TB in the three months ending December 2017.

Furthermore, in 2017 data downloaded over wireless devices has started to grow at a faster rate than for fixed line connections growing by 97.4 per cent between December 2016 and December 2017 (Figure 58).

Figure 58 Volume of data downloaded, Australia, December 2012 to December 2017



Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 8153.0, Table 3.

The volume of data downloaded by Australians has increased by more than 500% in 5 years.

Data downloaded over wireless devices grew by 97.4% between Dec 2016 and Dec 2017.

The NBN

On 7 April 2009, the Commonwealth Government announced that it would invest in a National Broadband Network (NBN) that would operate as a wholesale-only, open access and non-discriminatory network to replace existing local access networks.[5] The ambition was to fundamentally redesign how Australian's access internet services and is Australia's largest ever infrastructure project. The NBN is expected to provide access to peak wholesale broadband download speeds of 25 Mbps and 50 Mbps to 90 per cent of the fixed line network. This initiative is intended to improve access to internet services and reduce digital inequality.[6]

In 2013 the Commonwealth Government announced that the NBN would switch to a multi-technology mix using a range of technologies including:

- Fibre to the Premises (FTTP)/Fibre to the Basement (FTTB);
- Fibre to the Node (FTTN);
- Hybrid-Fibre-Coaxial (HFC) cable;
- fixed wireless services; and
- satellite services.

Terrestrial NBN

FTTP/FTTB connects fibre optic cable between the building and the exchange. FTTN uses fibre optic cable to connect the exchange to suburban curb-side cabinets and the existing copper network to connect cabinets to buildings. HFC cables were initially deployed by Optus and Telstra to be used for subscription television services but subsequent upgrades have enabled fast broadband speeds. Fixed wireless services use NBN fibre for upstream services, connecting to homes and businesses using a transmission tower and TD-LTE 4G mobile broadband technology. To the extent that this mix of technologies causes any differences in the performance of NBN connections, this may lead to an increase in digital inequality. It will be important for policy makers to monitor the performance of NBN connections to ensure performance is adequate and digital inequality is not exacerbated by NBN Co's technology choices.

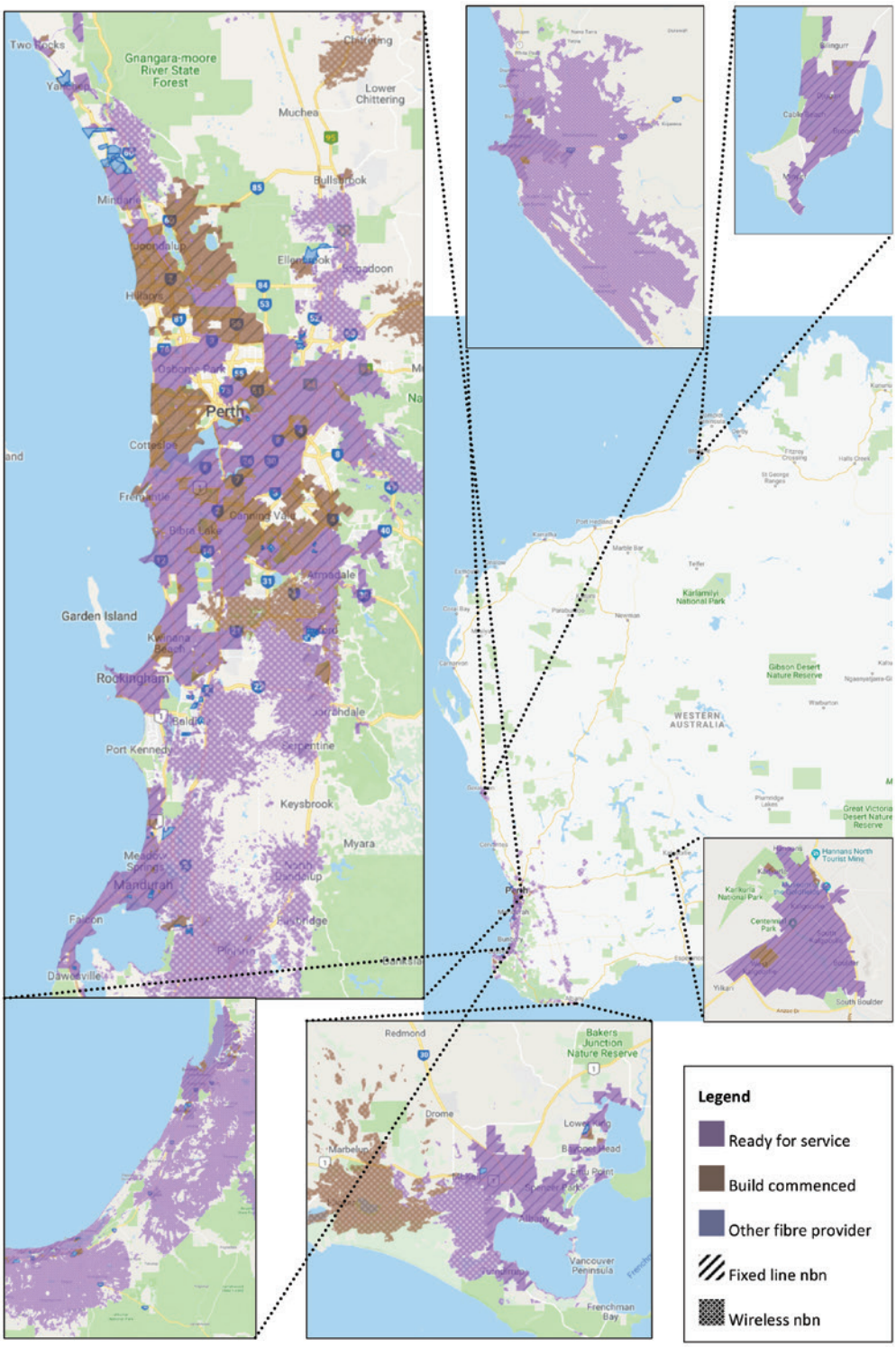
Figure 59[7] shows the current state of these fixed line NBN services in major Western Australian cities and towns. The maps show that many rural areas now have access to fixed wireless NBN services, which may have reduced digital inequalities between urban and rural households by offering affordable, reliable and quality services to regions where fixed line broadband was previously unavailable and mobile broadband was expensive and possibly of poor quality.

5 http://ministers.treasury.gov.au/DisplayDocs.aspx?doc=pressreleases/2009/036.htm&pageID=003&min=wms&Year=&DocType

6 NBN Co, states: "Our purpose is to connect Australia and bridge the digital divide." https://www.nbnco.com.au/corporate-information/about-nbn-co/our-purpose.html

7 This is not an exhaustive map of WA cities and towns. Selected cities and towns include Perth, Rockingham, Mandurah, Kwinana; Bunburry, Busselton; Kalgoorlie-Boulder; Geraldton; Albany; and Broome. Map is indicative only of availability at a NBN co Rollout Region level; availability at specific locations varies by address.

Figure 59 Terrestrial NBN coverage in selected WA areas

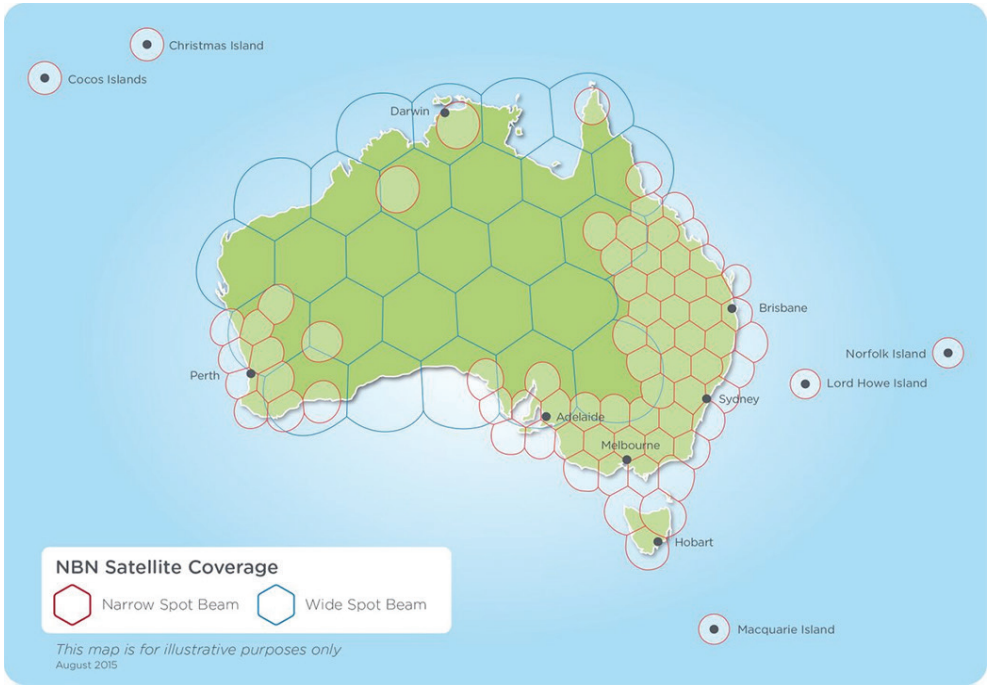


Notes: Shaded areas refer to NBN Co's Rollout region level. Some addresses in regions that are shaded "ready for service" cannot currently connect to the NBN.
Source: Bankwest Curtin Economics Centre | NBN co and finder NBN Tracker https://www.finder.com.au/NBN-tracker/map.

Satellite NBN

In 2015 and 2016 two satellites were launched, dubbed "Sky Muster" to provide NBN broadband access to areas where other technologies would not be commercially viable. These satellites offer wholesale services to ISPs with speeds of 12 or 25 Mbps download and 1 or 5 Mbps upload and various data allowance options. Services from these satellites use a combination of wide and narrow spot beams to deliver high-speed internet access. The use of such beams permits frequencies to be used multiple times, boosting system capacity. In addition, narrow spot beams have greater capacity than wide spot beams so are used in areas with greater population density. Figure 60 shows the coverage of these spot beams across Australia. Unique to Australia, NBN satellite services have a zero connection cost for customers and cross-subsidies from fixed line connections are expected to cover any losses for NBN Co to offer broadband in areas previous considered to be economically un-viable to reach via satellite. The ability to access affordable broadband services in remote and rural Australia goes a long way to reducing digital inequalities between remote communities and urban areas.

Figure 60 NBN satellite coverage

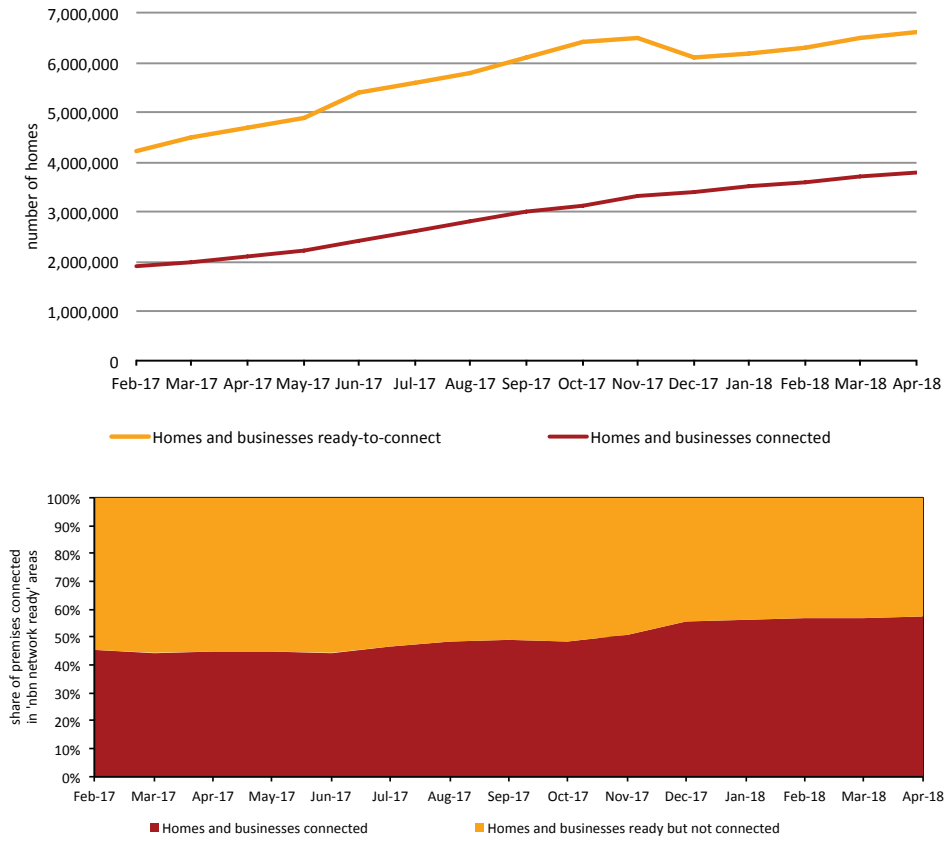


Source: NBN Co (2015) Satellite FAQ: Everything you need to know about Sky Muster, Septermber 2015 available at https://www.NBNco.com.au/blog/the-NBN-project/five-questions-with-NBNs-satellite-program-director.html.

NBN Progress

NBN Co continues to make progress building its network and connecting homes and businesses. Figure 61 shows recent progress with over 6.5million homes able to connect to the NBN and 58 per cent of homes and businesses in those areas taking up the connection. Progress may have increased following the adoption of a multi-technology mix, because some of the copper and HFC networks are already in place and can be re-used, whereas earlier connections were predominantly new fibre networks.

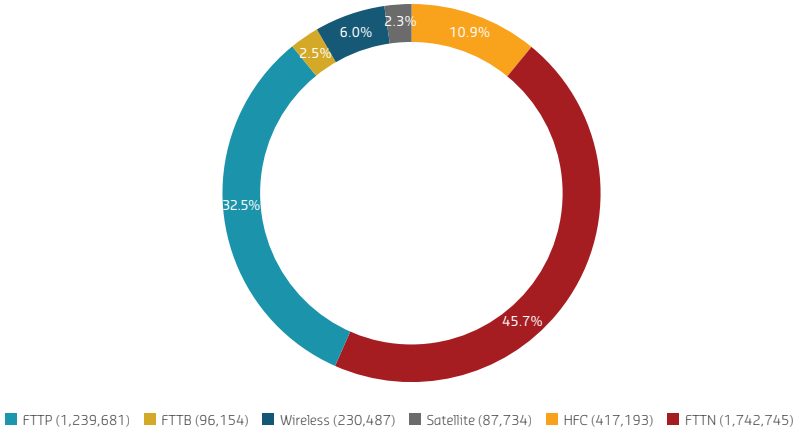
Figure 61 Terrestrial NBN connections, Australia



Source: Bankwest Curtin Economics Centre | Authors' calculations from NBN Co Monthly progress reports Feb 2017-Apr 2018, and weekly updates ending 11 May 2018 and 5 October 2017.
Notes: Data for June 2017 from NBN Co Weekly update ending 05 October 2017. Data for July from NBN co Weekly update ending 11 May 2018.

However, such progress statistics may be misleading due to the switch to the multi-technology mix because 56.6 per cent (2.2 million) of current connections are over the existing access network (HFC and FTTN) so were much faster to install than new FTTP or FTTB connections and may limit the quality of broadband connections or any upgrades in future compared to FTTP connections. While the switch to the multi-technology mix may have enabled a shorter build-time and more cost-effective network than FTTP, policy makers need to consider and monitor whether such pragmatic choices generate digital inequalities in future if legacy technologies mean that a portion of Australian households and businesses are unable to access and take full advantage of digital technologies.

Figure 62 NBN connection by technology type, 21 March 2018



Source: Bankwest Curtin Economics Centre | Authors' calculations from NBN Wholesale Market Indicators Report 31 March 2018.

Notably, NBN Co has prioritised regional areas which may help to reduce digital inequalities by improving broadband services for those households and businesses with the poorest service – As of 30 June 2017, 60 per cent of NBN activations are in regional classified points of interconnection.[8]

An island in the sea – domestic and international transmission

Access to the digital economy in Western Australia is supported by international connectivity. Australia is strongly dependent on international internet content – A large share of internet traffic is hosted offshore. International transmission to Australia is provided over undersea cables connecting Australia with the rest of the world. In Western Australia, the only international undersea cable presently operating is SeaMeWe3 linking Perth to Indonesia and Singapore (and onward to Asia, the Middle East and Europe).

8 ACCC (2017) NBN Wholesale Market Indicators Report 30 June 2017, available at: https://www.accc.gov.au/regulated-infrastructure/communications/national-broadband-network-nbn/nbn-wholesalemarket-indicators-report/reports.

Western Australia can also connect with the eastern states' international transmission links via domestic backhaul and transmission services. The main undersea cables connecting other states of Australia with the world are:[9]

- Southern Cross Cable Network – two cables connecting NSW with New Zealand, Fiji, Hawaii and California;
- Pipe Pacific Cable – connecting NSW to Guam to interconnect with various other international undersea cables. Domestic backhaul cables link Perth, Adelaide, Melbourne and Brisbane to the NSW cable;
- Telstra Endeavour links Sydney and Hawaii;
- Australia Japan Cable Network links NSW to Japan via Guam; and
- Hawaiki Cable links NSW, New Zealand, American Samoa, Hawaii and Oregon – *expected to be ready in June 2018*.

The Perth section of the SeaMeWe3 cable suffered 10 disruptions since 2013 including most recently on 11 May 2018, often leaving WA isolated and dependent on domestic backhaul links to eastern states and their undersea cables for international transmission. International connectivity issues in WA could cause digital inequality between WA and elsewhere, either by putting upward pressure on the cost of broadband services or by affecting the quality of broadband in WA.

While Perth and WA are relatively isolated, currently with a high dependence on the SeaMeWe3 cable, two new international submarine cables are nearing completion:

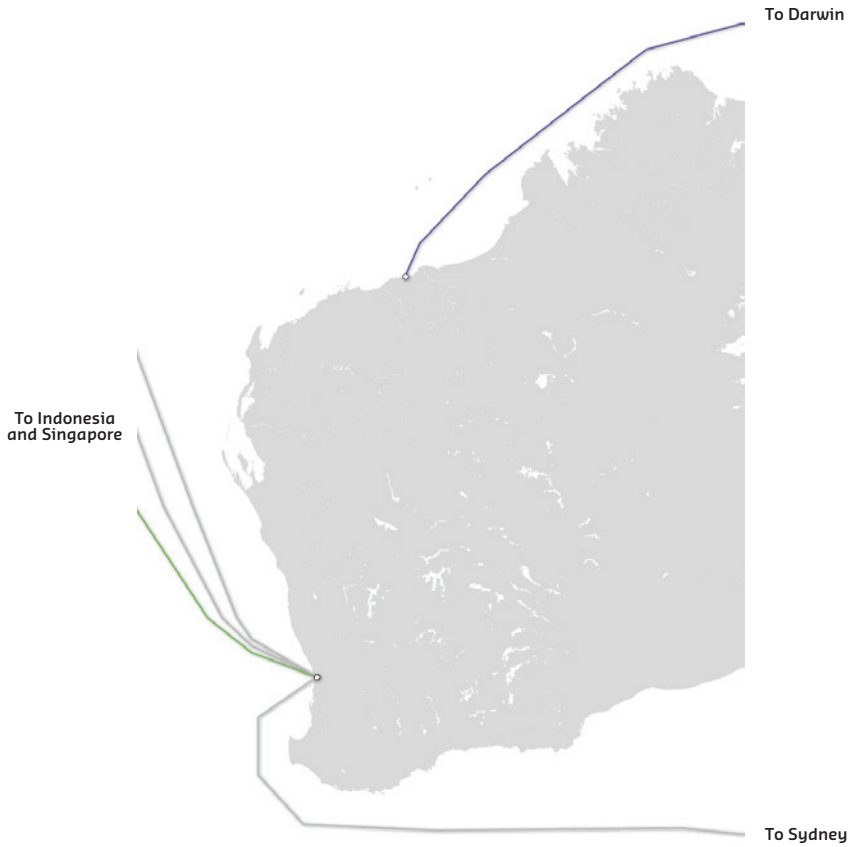
- Australia Singapore Cable links Perth with Indonesia and Singapore – *expected to be ready in July 2018;* and
- Indigo links Perth with Indonesia and Singapore (and Sydney) – *expected to be completed in early 2019*.

Figure 63 shows these international undersea cables, and domestic undersea cables to Sydney and Darwin.

There is a growing trend however for content to also be hosted locally in Australia, reducing our dependence on international transit, but also enabling Australia to perform a function as a "regional hub".[10] For example, Amazon and Microsoft have built regional data centres in Sydney, Melbourne and Singapore. Nonetheless, the relative isolation of WA means Western Australians still rely on long distance transit to Eastern States and Asia for internet access.

[9] This is not an exhaustive list. Other cables also link Australia with New Zealand, New Caledonia and Papua New Guinea.
[10] Network Strategies (2014) International bandwidth for New Zealand: are we finally getting a new fibre link? http://www.strategies.nzl.com/industry-comment/international-bandwidth-for-new-zealand-are-we-finally-getting-a-new-fibre-link/

Figure 63 Undersea transmission cables to Western Australia



Source: Bankwest Curtin Economics Centre | TeleGeography, www.submarinecablemap.com.

Government and regulation

Telecommunications infrastructure is often referred to as a natural monopoly, such that it is difficult to duplicate infrastructure to compete with an existing network. In response, governments have long been involved in the development and regulation of infrastructure to ensure that end users have access to quality services at a cost that is no more than necessary. Furthermore, the geography of Australia implies that many regions may be uneconomic to access essential services such that government intervention is required to offer ICT services in these regions.

A history of regulation to support competition

Competition encourages providers to price services closer to their underlying cost and to improve the quality of services offered over time. The Australian Competition and Consumer Commission (ACCC) was forward thinking in its initial regulatory decision to spur broadband competition by requiring Telstra to offer access to its local copper network to its competitors in 1999, prior to the commercial launch of Telstra's own ADSL service. Such access (referred to as unbundling the local loop), would enable competition to develop by allowing competitors to invest in their own equipment in Telstra's exchanges that make use of the existing copper lines to homes and businesses. Despite this decision the first residential services using the unbundled local loop were not offered until 2003. Several generations of DSL service have followed, spurred on by competition, including ADSL2, ADSL2+ and VDSL, each offering faster internet access.

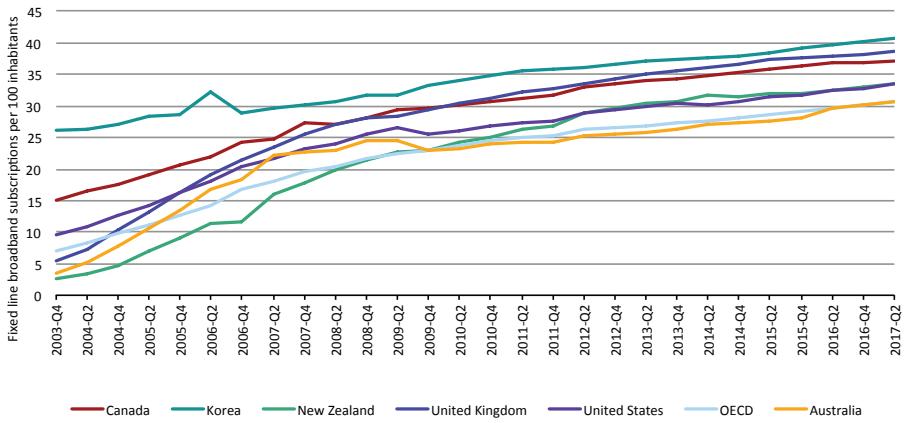
While the length of the copper line to a premises didn't matter for an analogue phone service, the speed of a DSL service over this copper infrastructure is strongly affected by distance. As a result, the exchanges which experienced the most unbundling were those with the highest number of connections and shortest distance to the exchange. To further enhance competition, the price to access the local network varied based on length, such that the underlying costs of the copper network drive the cost of a network connection. As a result, substantial improvements in service and competition could be expected for the densest areas of Australia's cities, but rural areas would be relatively unaffected by regulatory changes or competition. While newer generations of DSL broadband would allow faster broadband, they also faced greater constraint from the length of a copper line, inhibiting further competition beyond Australia's largest and densest cities.

While the regulatory system intended to stimulate competition, progress has often been relatively slow, with Telstra retaining a dominant position in the broadband market. Although Telstra first offered retail ADSL services in 2000, the first residential ADSL services offered by a competitor using Telstra's local network weren't available until 2003.

Such access issues for competitors affect digital inequality in a few ways. If competition is limited, the price of broadband services may be higher than necessary and limit its uptake by consumers. This can be seen in Australia with a legacy of low broadband penetration compared to other OECD countries, though Australia caught up with the rest of the OECD during a period of intense competition between 2003 and 2008 following the unbundling of the local loop. Figure 64 shows broadband penetration rates in Australia compared to a sample of OECD countries and the

OECD average. While Australia moved ahead of the OECD average between 2003 and 2008 on the back of competition stimulated by local loop unbundling, broadband penetration has since stagnated in Australia and in 2017 sits well behind many other developed countries.

Figure 64 Broadband penetration in Australia and selected OECD countries Q4 2003 to Q2 2017



Source: Bankwest Curtin Economics Centre | Analysis using OECD Broadband statistics, Fixed and wireless broadband subscriptions per 100 inhabitants (Dec. 2017), available at http://oe.cd/broadband.

To further enhance competition, in 2010 the Australian government legislated the structural separation of Telstra such that the wholesale-only network business cannot favour Telstra's retail branch over competitors when accessing unbundled services, a principle described as equivalence and non-discrimination.

Since 2012, the ACCC has also required Telstra to offer a wholesale ADSL service. Competition could develop in regions where unbundling was not economic for Telstra's competitors, enabling them to offer competitive nationwide services, even in rural areas. The fixed line services regulated by the ACCC are:

- unconditioned local loop service (ULLS)
- line sharing service
- PSTN originating access
- PSTN terminating access
- wholesale line rental
- local carriage service
- wholesale ADSL.

Some backhaul services in Australia are also regulated by the ACCC where it considers the service to be uncompetitive, such that the company that owns the infrastructure is required to offer services to users of those services including its competitors.

This regulatory approach of unbundling network infrastructure and services is now also being applied to the NBN where the ACCC assesses undertakings and makes determinations about the terms and conditions of access to services using the NBN.

Regulatory review

This section analyses the regulatory system in Australia to consider its impact on digital inequalities.

In Australia, broadband services are regulated by the Telecommunications Act 1997 with the aim to promote the long-term interests of end-users. Without a reference to inequality or other social purpose such as digital literacy, such a regulated purpose may not be in the interest of all end-users. Therefore, other policies and regulations are also used to target reductions in digital inequality. The Act relies on industry self-regulation to develop codes and standards with the ability for regulators to intervene as necessary. Self-regulation of standards and codes can be effective because implementation is responsive to technological change. Broadband is also regulated by the Competition and Consumer Act 2010 (CCA). The CCA provides the ACCC with tools to declare access regulation of monopoly and bottleneck communications infrastructure, including for new services such as the NBN, as technology changes over time. This should also make the telecommunications regulatory system responsive to technological change. The ACCC has recently completed a communications market sector study, concluding that current regulatory and competition arrangements in the communications sector are fit for purpose.[11] The review also provides a good example of regulatory support for industry self-regulation with the ACCC accepting court-enforceable undertakings from eight internet service providers to ensure that customers are not misled about the maximum speeds they can achieve on certain NBN FTTN/B plans.

Competition is expected to improve quality and reduce prices, thereby reducing digital inequality.

Competition is expected to improve quality and reduce prices, thereby reducing digital inequality because lower prices for internet and telecommunications overwhelmingly benefit poorer households where spending on such services is a greater share of household income. While regulation to support competition may reduce digital inequality by socioeconomic status, it could exacerbate digital inequality by region. Competition in regional areas may be limited where the only competitive service is a wholesale product through Telstra's network. For example, the ACCC notes that areas where only a Telstra wholesale service is available have little scope for product differentiation and little margin for price competition. As a result, other policies are required to reduce digital inequalities beyond competition measures.

The government's support for rural and regional broadband improves internet services in remote communities and constrains widening digital inequalities. For example, a user in a rural area moving to an NBN satellite service pays just over one third the price of a 3G fixed wireless plan for quadruple the speed.[12] Even though it is intended that satellite services are cross-subsidised by other NBN connections, satellite services are still more expensive. The government has recently indicated in its Regional Broadband Scheme (RBS) an intention to impose a charge on fixed line networks that compete with the NBN to help fund the NBN's non-commercial fixed wireless and satellite services. Efforts such as these to support NBN services in regional and remote areas that would otherwise not be commercially viable are intended to reduce the digital divide, but could be more effective if policies such as the RBS did not favour the NBN over alternative networks.

[11] ACCC (2018) Communications Sector Market Study Final Report, April 2018
[12] OECD (2017) The evolving role of satellite networks in rural and remote broadband access, OECD Digital Economy Papers No. 264, December 2017.

Australia experienced significant benefits from local loop unbundling between 2003 and 2008.

The unbundled local loop regulatory approach is common in developed countries. Australia experienced significant benefits from local loop unbundling between 2003 and 2008, as observed in Figure 64. This experience is common in countries with unbundled local copper networks. However, since 2008, Australia has returned to a slide in broadband penetration rankings in the OECD, perhaps due to regulatory and political uncertainty surrounding the NBN.

Regulation of the NBN is transparent, fair and non-discriminatory and set for long term investment, but policy uncertainty regarding the NBN during recent elections may have affected private investment. The NBN avoids duplication of network infrastructure and provides open access to ensure a competitive retail market. Furthermore, the government's mobile blackspot program ensures access to shared sites for cell towers in areas that may not otherwise receive coverage. However, the mobile blackspot program[13] has operated in isolation of the NBN and it may be possible for greater sharing of infrastructure for fixed wireless services on the NBN.

As far back as 2013, 144 out of 181 countries had or were planning national broadband policies.

As far back as the 2013, the Broadband Commission for Sustainable Development, set up by the ITU and UNESCO, reported that 144 out of 181 countries had or were planning national broadband policies.[14] A recent review by the OECD on the role of satellite networks for rural and remote broadband access highlighted that Australia was the only country surveyed where satellite broadband plans included no upfront fee to consumers as satellite is being used as part of the national broadband network.[15] This characteristic implies that satellite broadband users should not be disadvantaged financially by the type of access technology available at their location. Table 6 in the appendix shows an international comparison of several national and regional broadband policies.

In May 2018, the government announced that the ACCC will develop rules for the implementation of the Consumer Data Right. The Consumer Data Right implies that a consumer's user data is essentially controlled by the customer and can be shared with competitors or comparison services. The Consumer Data Right will support competition in the digital economy and help to reduce digital inequalities because it enables a user's customer data to be used more appropriately.

Australian governments should consider whether additional privacy requirements are appropriate in Australia to meet international standards.

On 25 May 2018, the European Union implemented its General Data Protection Regulation (GDPR) which contains new data protection requirements to harmonise laws across the EU and replace existing national laws. The new rules include similar requirements to the Privacy Act in Australia are designed to inspire trust in online services and provide legal certainty for businesses. The GDPR also only allows the sharing of personal information of European citizens outside of EU countries only if those countries have privacy laws that are considered equivalent to EU legislation. At present, Australia is not considered to provide adequate data protection by the European Commission, while the US, Canada, New Zealand, Switzerland and Argentina are considered to provide adequate protection.[16] Australian governments should consider whether additional privacy requirements are appropriate in Australia to meet international standards, and if so, the implementation of strengthened privacy rules and its international recognition could enhance our digital economic institutions.

[13] Department of Communications and the Arts https://www.communications.gov.au/what-we-do/phone/mobile-services-and-coverage/mobile-black-spot-program

[14] Broadband Commission for sustainable development (2013) National broadband policies, http://www.broadbandcommission.org/documents/publications/nationalbbpolicies.pdf

[15] OECD (2017) The evolving role of satellite networks in rural and remote broadband access, OECD Digital Economy Papers No. 264, December 2017.

[16] Twelve territories are considered to provide adequate data protection including Andorra, Argentina, Canada (commercial organisations), Faroe Islands, Guernsey, Israel, Isle of Man, Jersey, New Zealand, Switzerland, Uruguay and the US (limited to the Privacy Shield framework). https://ec.europa.eu/info/law/law-topic/data-protection/data-transfers-outside-eu/adequacy-protection-personal-data-non-eu-countries_en. Adequacy talks are ongoing with Japan and South Korea.

A competitive market?

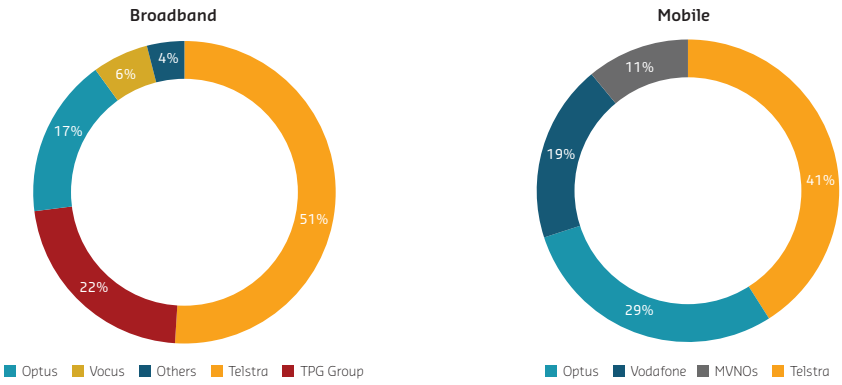
While consumers purchase services from a variety of retailers, once brands and subsidiaries are accounted for, Telecommunications markets in Australia are highly concentrated, with 96 per cent of services to residential addresses provided by only 4 businesses and 91 per cent of mobile connections provided by only 3 businesses.[17] Despite this concentration, the ACCC finds evidence of both price and non-price competition. The ACCC has recently completed a sector review of the communications market[18] and provides annual reviews of price changes in telecommunications services since 2017.[19] This section provides an overview of the findings in these recent competition reviews with updated analysis and perspectives on digital inequality.

96% of telecommunications services to residential addresses are provided by only 4 businesses and 91% of mobile connections provided by only 3 businesses.

Overview

Broadband and mobile markets in Australia show significant concentration. Concentration is used as an indicator of competition. In more concentrated markets it is more likely that a firm holds market power which may be used to charge consumers higher prices or save on costs by reducing quality. Figure 65 shows the market shares for broadband and mobile markets in Australia in 2016.

Figure 65 Broadband and mobile market shares in 2016



Source: Bankwest Curtin Economics Centre | Data from ACCC (2018) Communications Sector Market Study, sourced from Roy Morgan Research.

While Telstra holds a 51 per cent market share for broadband services, much of this concentration could be attributed to history, with Telstra being the incumbent provider, owning the fixed line network, a significant delay between Telstra offering broadband services in 2000 and competitors' offers becoming available in 2003, and limited unbundling in rural areas. High concentration could exacerbate digital inequality, particularly if there are fewer options for broadband in rural regions than in urban areas. Even with competitive options, if consumers see Telstra as the default option, market concentration could continue, and market power could impact digital inequality in regional areas.

17 ACCC (2018) Communications Sector Market Study Final Report, April 2018. https://www.accc.gov.au/system/files/Communications%20Sector%20Market%20Study%20Final%20Report%20April%202018_0.pdf
TPG has also recently announced that it will build its own mobile network to become the fourth mobile network operator in Australia, but with coverage initially limited to areas of Sydney, Melbourne, Brisbane, Adelaide and Canberra - https://www.tpg.com.au/about_pdfs/TPG%20Media%20Release%20-%20Unlimited%20Mobile%20Data%20Mobile%20Network%20Trial.pdf

18 ACCC (2018) Communications Sector Market Study

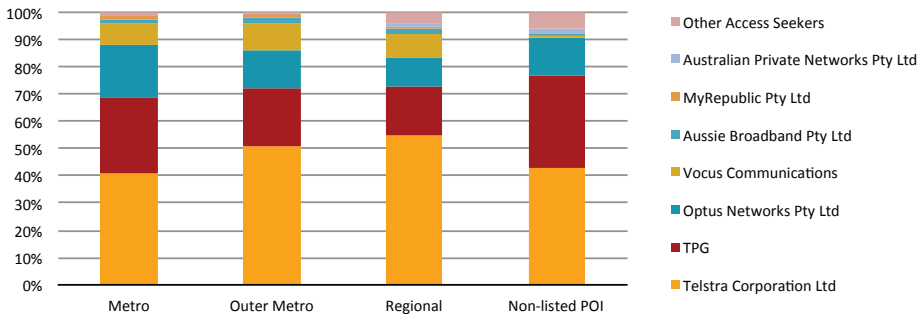
19 ACCC (2018) Competition and price changes in telecommunications services in Australia 2016-17, https://www.accc.gov.au/system/files/Competition%20and%20price%20changes%20in%20telecommunications%20services%20in%20Australia%202016-17.pdf

The emergence of Mobile Virtual Network Operators (MVNO) in recent years, which now hold 11 per cent of the market, may be a key contributor to increasing competition for mobile services and declining costs for telecommunications services as seen in Figure 21. These providers offer a mobile service by reselling a wholesale service from another carrier. All three mobile networks in Australia have MVNO customers and there may be considerable competition emerging in the wholesale market. In particular, MVNOs typically have less flexibility to differentiate their plans from incumbent providers, but differentiate their products by customer service, reduced or no in-store support and reduced margins. MVNOs also enable a challenger to build up a mobile customer base prior to investing in their own network. For example, TPG has recently announced it is investing in a new mobile network in Sydney, Melbourne, Adelaide, Canberra and Brisbane.[20]

Competition on the NBN

Our competition analysis focuses on the NBN (across all technologies) as the main network infrastructure that will be used by Australians to access broadband in the future. It may be expected that concentration may diminish as internet users switch to the NBN. This is particularly clear when comparing market concentration in urban and rural areas, since rural areas have not benefited to the same extent from local loop unbundling. Telstra's NBN market share on its copper network in regional areas is 96 per cent, dropping to 55 per cent for Telstra's NBN market share in regional areas, but Telstra's market share of NBN services in metropolitan areas is significantly lower at 42 per cent.[21] Figure 66 shows nationwide market shares on the NBN for Points of Interconnect classified as Metro, Outer Metro, Regional and non-listed. Nonetheless, there are positive signs for competition in regional areas.

Figure 66 NBN national market share by POI regional classification, 21 March 2018

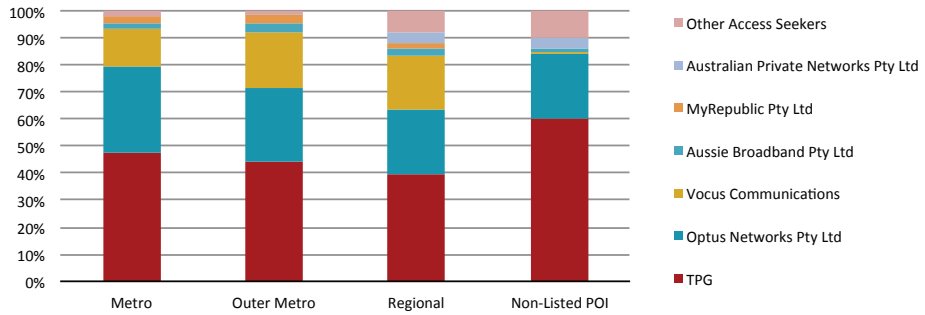


Source: Bankwest Curtin Economics Centre | Authors' calculations from NBN Wholesale Market Indicators Report 31 March 2018 https://www.accc.gov.au/regulated-infrastructure/communications/national-broadband-network-NBN/NBN-wholesale-market-indicators-report/reports.

[20] TPG (2018) TPG to offer Free Unlimited Mobile Data plan on its Brand New Australian Mobile Network, Media release, https://www.tpg.com.au/about_pdfs/TPG%20Media%20Release%20-%20Unlimited%20Mobile%20Data%20Mobile%20Network%20Trial.pdf
[21] ACCC (2018) Competition and price changes in telecommunications services 2016-17.

Figure 67 shows market shares, excluding Telstra, and finds that for regional NBN customers who do choose an alternative to Telstra, they are less likely than their metropolitan counterparts to choose the next three largest providers; TPG, Optus or Vocus.

Figure 67 NBN national market share by POI regional classification excluding Telstra, 21 March 2018



Source: Bankwest Curtin Economics Centre | Authors' calculations from NBN Wholesale Market Indicators Report 31 March 2018
https://www.accc.gov.au/regulated-infrastructure/communications/national-broadband-network-NBN/NBN-wholesale-market-indicators-report/reports.

Comparing market share for NBN connections across all states in Figure 68, internet users in WA are more likely than in other states (except ACT) to choose an alternative to Telstra, but overall concentration is similar to other states with 96.5 per cent of connections with the four largest service providers.

Figure 68 NBN market share by state and nationally, 21 March 2018

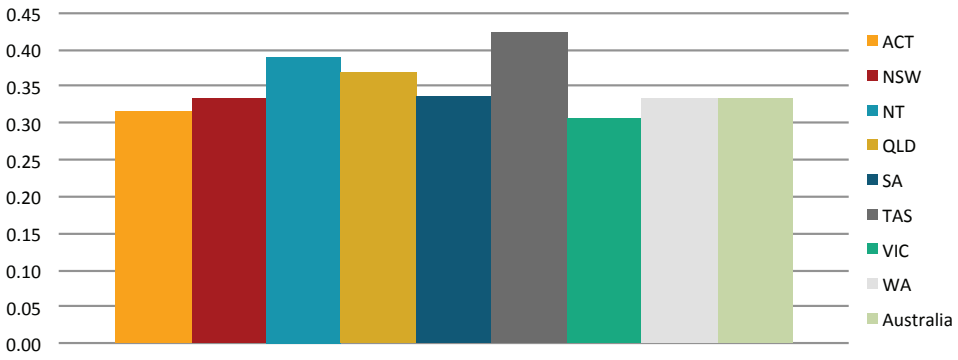
Source: Bankwest Curtin Economics Centre | Authors' calculations from NBN Wholesale Market Indicators Report 31 March 2018
https://www.accc.gov.au/regulated-infrastructure/communications/national-broadband-network-NBN/NBN-wholesale-market-indicators-report/reports.

This result is seen more clearly when analysing a Herfindahl index of market concentration for NBN as shown in Figure 69. The Herfindahl index measures the relative size of market shares and indicates the extent of competition between firms.[22] A lower Herfindahl index implies greater competition because the market is less concentrated. WA has a similar level of concentration to Australia as a whole, with ACT and Victoria the only states to show lower than average concentration or greater competition.

[22] It is calculated as the sum of the squares of market shares and ranges between zero (with a large number of very small firms) and one (with a single monopolist).

As with DSL connections, metro areas are less concentrated than outer metro or regional areas. That is, the HHI indicates that in regional areas, consumers are more likely to choose a larger service provider than in metropolitan areas.

Figure 69 NBN Herfindahl index by state, 21 March 2018



Source: Bankwest Curtin Economics Centre | Authors' calculations from NBN Wholesale Market Indicators Report 31 March 2018 https://www.accc.gov.au/regulated-infrastructure/communications/national-broadband-network-NBN/NBN-wholesale-market-indicators-report/reports.

Social change

and digital services

Introduction

Up to this point the report has focussed primarily on the three A's - Access, Ability and Affordability. These items have been considered from the perspective of households and individuals as well as from the perspective of businesses, by employment size. This section of the report takes a broader perspective, and discusses the increasing role ICT plays in our lives, the solutions it can provide and the challenges faced in integrating and using ICT.

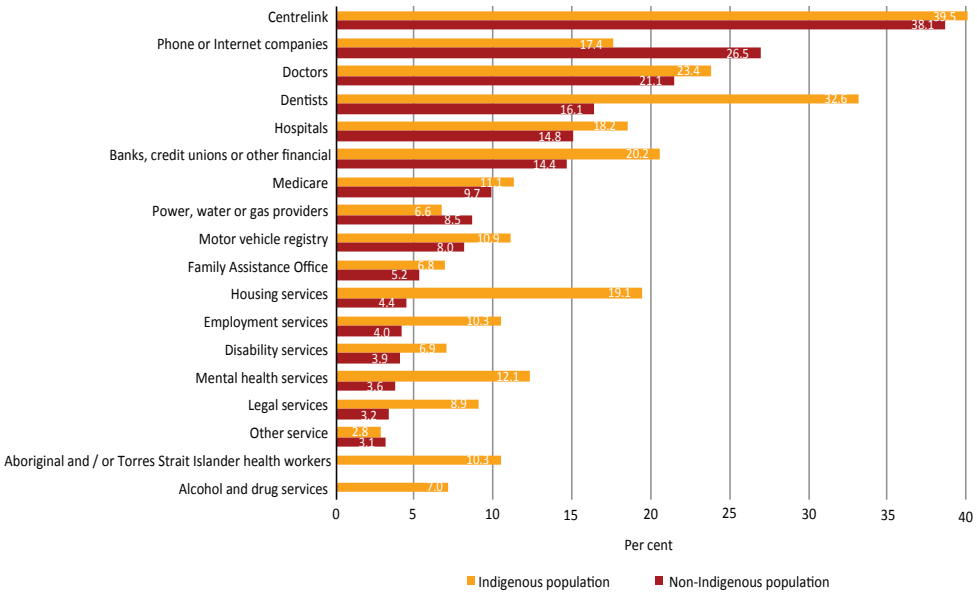
The pace at which ICT has entered our world, and continues to do, so is unprecedented. It impacts on family life, education, entertainment, the goods and services we buy including entertainment services. Increasingly, service providers are delivering services online – this includes government, health, entertainment and banking services, amongst others. We have seen that not all people can access such services equally. However, ICT also provides opportunities to deliver better access to services and the quality of services received, and in turn decrease inequality of access. ICT can play a role therefore, in improving connectedness, health and wellbeing, and social cohesion.

The changing face of service delivery – what does it imply?

In earlier sections of this report, the areas of internet access, ability and affordability were discussed in some detail. It was shown that significant divides across socio-economic, demographic and geographic domains exist across Australia and WA. Should barriers to access, ability and affordability be removed, ICT can play a major role in improving the quality and frequency with which all people can access services in WA. Here therefore, we ask if digital technologies can provide a solution for those currently experiencing difficulties accessing or maximise use of services, across the life-course. By analysing data on some of the most vulnerable and disadvantaged groups in our society, we demonstrate the opportunities and potential benefits that exist through bridging the digital divide.

First, we look at the services which people have difficulty accessing. 24 per cent of Indigenous persons reported having a problem accessing services (through physical, online and other means), a figure that is in line with non-Indigenous people. For those persons that reported difficulty in accessing services, Figure 70 reports the proportion of those people that reported difficulty, by service type. With the exception of phone or internet services and power, water or gas providers, Indigenous people reported higher difficulty in accessing services across all other services. Particularly striking is the differences between Indigenous and non-Indigenous reporting difficulty in accessing services related to medical needs (hospitals, doctors and dentists), housing, mental health and legal matters. For all groups the service people have most difficulty accessing is Centrelink.

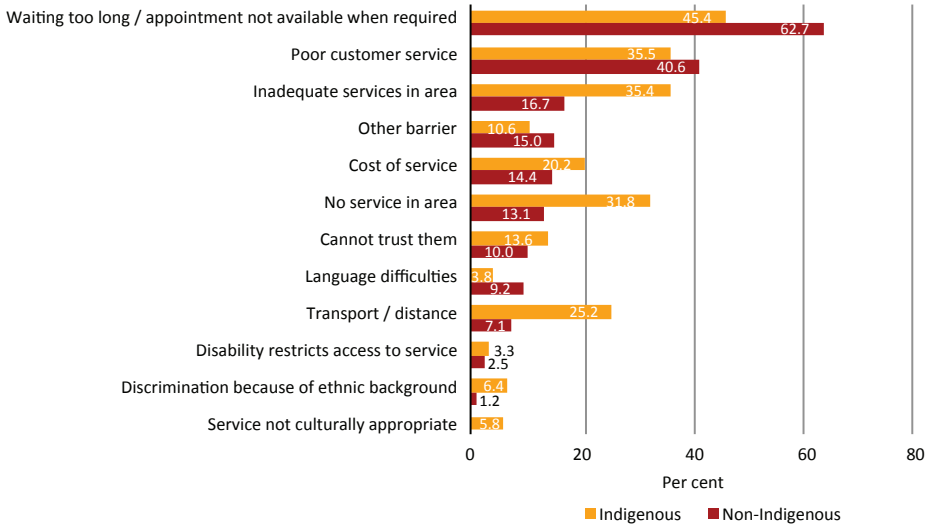
Figure 70 For those experiencing difficulty accessing services, which services do they have problems accessing, Indigenous and non-Indigenous populations, Australia, 2014-15



Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 4159.0, 2014 and 4720.0.55.002, 2014-15.

The primary reasons for experiencing difficulty in accessing services are presented in Figure 71. Waiting times were seen to be the primary difficulty for all people, followed by poor customer service. The latter is particularly large for non-Indigenous persons (63%), with no service in the area, and transport/distance, also primary factors. The latter factors are particularly important for the Indigenous population.

Figure 71 For those experiencing difficulty accessing services reasons why accessing the services was found difficult, by Indigenous status, Australia, 2014



Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 4159.0, 2014 and 4720.0.55.002, 2014-15.

For the various services discussed above (Figure 70 and Figure 71), many require on-site intervention and support. However, in some cases, and in combination with on-site presence, there are possibilities for digital services to provide solutions to optimise service delivery, increase efficiencies and improve overall wellbeing. Of course, as we highlighted earlier in this report, for many in remote areas, areas with high levels of disadvantage, and areas with high Indigenous populations, internet access is low. Access, ability and affordability issues need to be tackled in the first instance. Without the latter, the benefits provided by ICT to help close the gap in access to services, leading to better lifestyle and outcomes across the lifespan cannot occur.

For the non-Indigenous community, almost 78% of people lodge bill payments online. This compares to 36% of Indigenous people – a difference of 42 ppts.

Figure 72 looks specifically at the type of government services accessed online by Indigenous and non-Indigenous persons. For the non-Indigenous community, almost 78 per cent of people lodge bill payments online. This compares to 36 per cent of Indigenous people – a difference of 42 ppts. Large gaps between the two groups are also evident in the lodgement of tax returns, and lodgement of permits. These gaps are not acceptable. While direct causality cannot be made here, it is important to point to the fact that many Indigenous people, particularly youths, are incarcerated for late payments of fines and for non-renewal of driving permits. The impact of such incarcerations on individuals and their families, and on the broader society

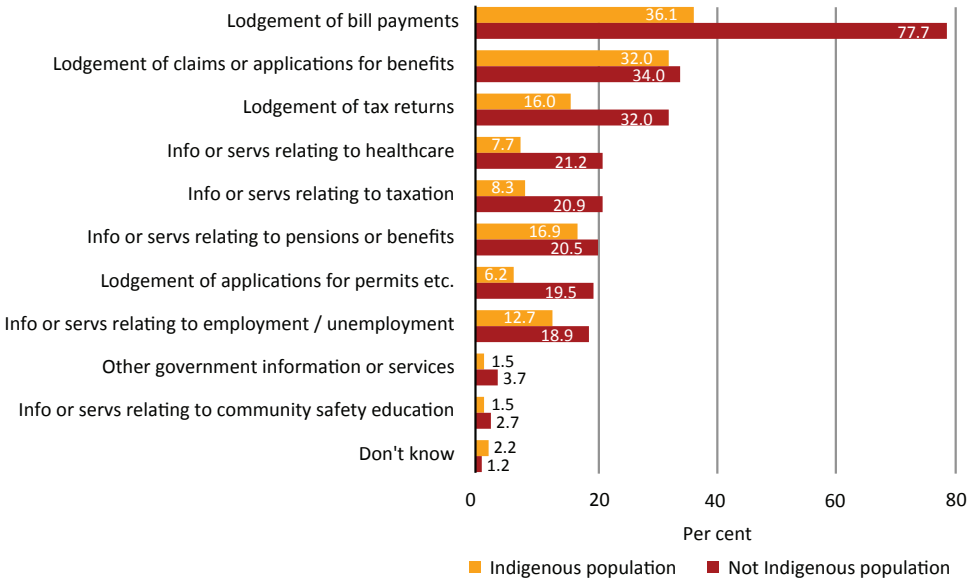
and economy are well documented and understood. Part of the solution extends to ensuring that all communities in our society have access, ability and can afford minimal ICT requirements to meet day-to-day needs. As previously shown, for many services, alternatives do not exist.

Related is the clear divide between Indigenous and non-Indigenous communities in how information about government services are obtained. Keeping in mind that in many cases there is a non-existence of services available to many Indigenous people, particularly those living in remote communities, it is imperative that they can obtain information and can access services online, where appropriate to do so. However, Figure 72 again shows that there is a gap in relation to the number of Indigenous people accessing information about government services online, relative to non-Indigenous people. This includes accessing information or services about taxation (12 ppt gap), healthcare (13 ppt gap) and employment.

Indigenous people are less likely to access government services online, relative to non-Indigenous people.

21% of non-Indigenous people access information or services related to healthcare online. This compares to only 8% for Indigenous people – a 13 ppt gap.

Figure 72 Government services accessed online, for Indigenous and non-Indigenous persons Australia, 2014



Note: Internet access over the last 12 months.
Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 4159.0, 2014 and 4720.0.55.002, 2014-15.

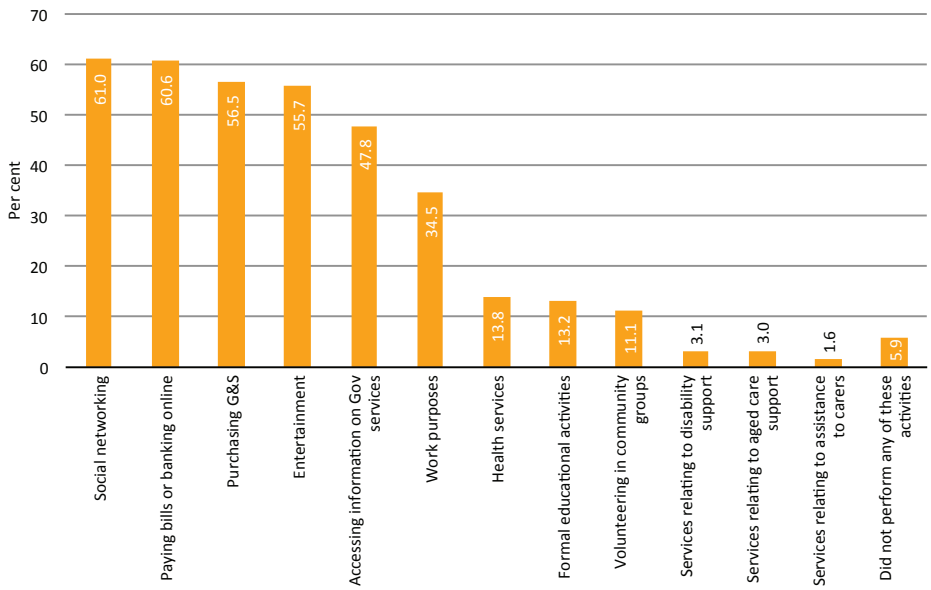
Living with a disability

In 2015, almost one in five Australians reported living with a disability, that is, 4.3 million people (ABS). The ABS defines a person as having a disability if they report having a limitation, restriction or impairment, which has lasted, or is likely to last, for at least six months and restricts everyday activities. Disabilities and levels of disability can vary greatly, and unfortunately, data limitations imply that we cannot compare engagement and use of ICT by the severity of disability. The purpose here therefore, is not to provide a detailed analysis of the role of technology and barriers to access for those living with a disability. More so, it is to demonstrate that digital technology is an essential infrastructure for those living with a disability. It is also shown that, for many living with a disability, additional barriers to accessing online services exist. Technology too of course, can form part of the solution in gaining access to more activities and services and therefore lead to better outcomes for one of the most vulnerable groups in our society.

Figure 73 reports on the reasons why people with a disability accessed the internet in 2015. It shows that having access to internet is essential for those with a disability, enabling them to connect to others in society and to access key services, including government services. That said, while not directly comparable, what is clear is that, relative to the census data reported earlier in this report, and the data reported on in Figure 72, those with a disability have significantly lower engagement with internet services than those living without a disability. This spans across areas such as social networking, payment of bills and entertainment services.

Given the severity of many disabilities, such a comparison is overly simplistic. There is a need to better understand the barriers of particular groups with disabilities, and to comprehend how technology can play a greater role in supporting and providing better outcomes for those most in need. This includes accessing health services, being able to work from home, and opportunities to purchase goods and services online.

Figure 73 Reasons for accessing the internet for people with a disability, Australia, 2015

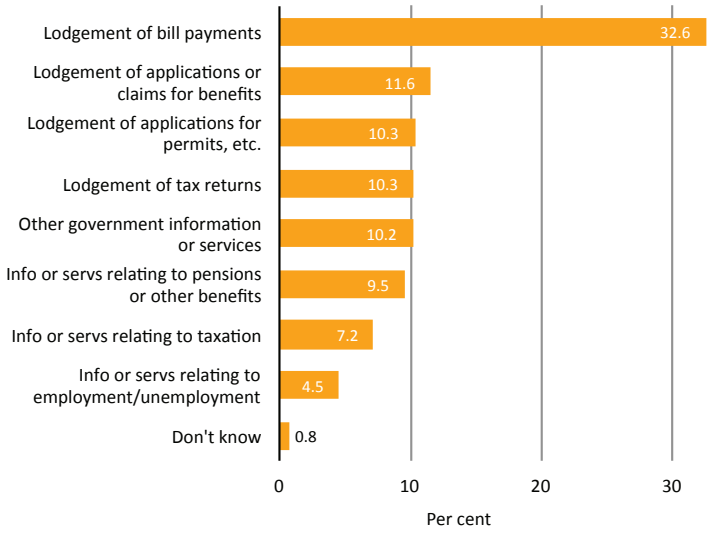


Note: Internet access over the previous 3 months
Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 4430.0.30.002, 2015

In comparing the data presented in Figure 74 to that of other data presented in this report, those with a disability report much lower rates of government services accessed online. Where appropriate, it is important to that those living with a disability are afforded the opportunity to engage in the digital economy, and that they are not further disadvantaged as more services go online. It is important that, for those unable to access online services, that alternative modes of access are provided for those most in need. This too expands to the elderly in our communities.

It is imperative that, for those unable to access online support services, alternative arrangements to access services are provided.

Figure 74 Government services accessed online for persons with a disability, Australia, 2014



Source: Bankwest Curtin Economics Centre | Authors' calculations from ABS cat no 4430.0.30.002, 2015

Social connectedness, education and the labour market

Digital technology plays an essential role in enabling people to stay connected. This includes immigrants staying connected with family members, social networking and expands to opportunities for lifelong learning. Used appropriately, remote and distance education can be a powerful mode in delivering education services. It can provide a means to access those who, for reasons of remoteness, illness and disability, or affordability, amongst other reasons, may otherwise be unable to access education.

People's ability to engage and maximise the potential of ICT also requires a stronger grounding in STEM (Science, technology, engineering and mathematics) subjects. Many believe that such subjects should be compulsory in school – given that the jobs of the future will increasingly demand such skills. In the meantime, more must be done to promote STEM subjects in schools, ensure appropriate facilities are available to make the teaching of such subjects interesting, and guaranteeing that there are quality teachers engaging innovatively with students. The early years are particularly important, as it is here that perceptions can be formed, and foundations can be laid.

Digital infrastructure is now critical infrastructure, providing the means through which people engage in employment, education, health, entertainment and social and financial services.

Digital technology impacts all aspects of the people's lives, and crosses multiple government portfolios. There is a clear need for an integrated digital strategy.

ICT too, provides an essential platform for people to engage in the increasingly global labour market. Nowadays, with greater emphasis being placed on the liveability of cities and regions, highly skilled immigrants and natives are attracted to places that offer flexibility or work and working from home – enabling them to reduce travel and spend more time with their families and friends. Quality internet and ICT access are essentials.

These examples are just a few discussed here to emphasise the importance of ICT and the need to ensure that every member of our community has access to affordable internet, and basic ability. Positive attitudes towards ICT also need to be formed. Equality of opportunity is not only a question of moral fairness, it is indeed becoming more vital in order to actively participate in seemingly all aspects of life.

The potential of ICT must be fully utilised to support all people in our communities. Digital infrastructure must be part of an overall infrastructure plan. Roads, rail, water, electrical and port infrastructures are all essential elements of our economy. They have provided a means through which people engage in employment, education and training, health and financial resources. They are also the means of engaging in social and community activities, and connect people to family, friends and new networks.

It is no accident that many great cities throughout the world, including Perth, are built on rivers – historically providing the mode of transport of people, goods, and services, and the gateway to the world. Digital infrastructure can no longer be looked upon as a 'nice to have'. Digital infrastructure must sit beside other infrastructures, and in doing so, there are economic efficiencies to be gained, through integrated planning, budgeting and rollout of infrastructure. It is also a key source for productivity growth and innovation – points previously pointed to in this report. Now is the time to act.

Digital technology impacts all aspects of the life-course and crosses multiple government portfolios. There is a clear need therefore, for an integrated digital strategy. The shape this may take, and other suggestions towards bridging the digital divide are discussed further in the summary and conclusions chapter that follows.

Discussion

and conclusion

Discussion and conclusion

Digital technologies have become an integral part of our lives, and our futures. New data technologies, big data analytics and intelligent software systems are transforming the way we produce, consume and distribute commodities, and increasingly, the way we access services. ICT is changing the way we engage with our personal, social and business networks and communities.

Using various metrics organised around the 'three A's' – access, ability and affordability - this Focus on Western Australia report presents a comprehensive examination of the opportunities, challenges and barriers faced by WA families, communities and businesses in gaining access to the digital world. While Western Australia benchmarks well overall in terms of digital connectivity, there remain clear divides in our state between those that are, and those that are not connected.

At the household and individual level we show that there are clear divisions along geographic, demographic and socio-economic lines. Those most at risk of falling through the net, and of becoming increasingly disconnected from society include: those living in the most remote regions; areas with high levels of socio-economic disadvantage; older population cohorts; and low income families. The latter is particularly worrying, with children in lower socio-economic areas at particular risk of missing out on the educational benefits of digital technologies, and from a young age, being excluded from digital pathways which will lead to better employment outcomes in the future. The divide therefore is not only wide, but deep and persistent.

Analysis of expenditure patterns over time show that digital technologies are a necessity, particularly for those on lower incomes. Using a novel indicator of digital stress, we assess which families are chiefly at risk. While typical spending on digital technologies for the poorest fifth of families is around $14.17 per person per week, one in ten is observed to spend nearly three times as much – at least $36.89.

Indeed, one in ten of the poorest fifth of families are committing at least 10 per cent of total expenditure towards digital products and services. The incidence of digital stress is most pronounced among single parents (at around 10.5 per cent) and non-elderly single women (12.2 per cent), the latter rising by some 7.1 percentage points in a little more than a decade. Around 8.8 per cent of single parents with three or more children are spending more than 20 per cent on digital goods and services, despite being on low incomes – double the rate of a decade ago.

This report also pays attention to an aspect of the digital divide that receives less focus – that is, the digital divide between businesses based on employment size. The take up, use, and perceived benefits of ICT, as well as recognition of the value of data analytics, the internet of things and cyber-security is much lower for micro and small businesses.

Industries such as Agriculture are particularly at risk, with the BCEC Small Business Survey 2017 showing that over 27 per cent of this sector have inadequate mobile and internet infrastructure. Having no alternative impacts negatively across all aspects of the supply chain, and prevents industries from maximising the opportunities new technologies offer. Bridging such divides can benefit the WA and Australian economies, leading to increased productivity growth, with greater efficiencies and innovation leading to lower prices, new markets and increased value add – all critical factors in the context of global economies. Digital technologies provide a multitude of opportunities, but as such, they need to be seized.

Towards bridging the divide

Drawing on the key findings in this report, we present some key steps towards bridging the digital divide, and limiting the depths of inequalities that might emerge unless we take action.

For the elderly in our society, confusion and mystery around digital technologies needs to be reduced. Many of those in the older age cohorts need to be provided with basic IT literacy and skills, but also need to feel secure and have trust in engaging in online services such as banking, online tax returns, and health and government services. Support in navigating government services, and online platforms such as My Aged Care need further attention.

Digital strategies for the elderly need to link to other aged strategies – such as Aging in Place. Federally funded programs to bridge the divide in ability and attitudes need to be locally connected – where local governments and community organisations have 'on the ground' intel and established relationships to engage at the community level. Furthermore, alternative arrangements for those unable to access or engage with online government services need to be provided.

Digital technologies also provide fantastic opportunities to support in the care of our elderly citizens. Technology can monitor and stay connected to those that may be living alone or suffer from dementia. However, privacy rights need to be assured, and in line with international best practice. Furthermore, while digital disconnectedness can amplify the sense of isolation, and in turn, lead to poor mental health, digital connectedness is not, in and of itself, a solution to isolation.

This report has shown that many families with young children face digital stress in the costs they face in gaining access to digital technology and services. The role of ICT in learning is growing exponentially. Vast volumes of information are now available online, and can bring huge benefits to learning when used appropriately. Such benefits mean that those not connected are falling into an even deeper divide. Therefore, for many households, schools in remote and lower SES areas, there is a live issue that many children are becoming increasingly disadvantaged in how they are educated. Schools require minimum ICT standards that ensure no child is excluded from the opportunities the economy presents when they enter the labour market.

Access and participation in STEM subjects is an essential, and many argue the need for such subjects, and mathematics at a minimum, to be compulsory. How STEM is perceived amongst all students, irrespective of gender, is also an area requiring attention. Having a diversity of people and genders brings diversity of solutions, diversity of opportunity and diversity of voice.

Teachers need additional supports and training to improve engagement with students around the use of ICT, and maximising the potential that digital technologies provide. While this is a moral issue, it is also an economic issue. Should WA close the digital divide in education, we will produce students with better STEM and digital skills who will in turn attract the best jobs and businesses to the WA economy.

Schools, TAFE and Universities play a fundamental role in engaging with the community, industry and families towards delivering better outcomes. There are opportunities to maximise existing resources, with minimal costs. For example, use of school facilities after hours (as well as libraries), can help bridge the gap for those in lower SES areas, providing alternative facilities to engage in education, which may not be available at home. Universities can support broadening access and reach, including online shared spaces – with opportunities for study and self-study across the life-course.

WA's size, its distance from other major economies, and the remoteness of the state's regions make digital connectedness even more of an imperative, but also presents

unique challenges. Ironically, digital technologies are a key element of the solution. Virtual real time connection for those in remote areas is a real alternative to ensure all get access to the best teachers, and learning experiences. Of course, it is a case of chicken and egg - such engagement requires high speed internet access.

Global connectivity and digital innovation presents a multitude of opportunities for businesses of all sizes to engage in new markets, increase productivity and improve competitiveness. Businesses need to move beyond using the internet for functional administrative and financial services. There is a need to develop greater awareness among businesses, irrespective of size, of cybersecurity risks.

However, many small business owners are time poor. Coordinated schemes need to be developed that offer training in the opportunities before them – and the risks they face - in the digital world. There is also a pressing need to establish more shared business services to raise awareness, promote information exchange, and offer practical solutions to ICT problems for entrepreneurs and small business owners, with a role for government in coordinating such facilities and support. The education system also has a strong role to play in promoting digital literacy among business owners, providing the new capabilities and skills that will enable them to thrive in the new digital world.

But none of this is possible without connectivity.

Digital infrastructure is now a critical part of our economic and social infrastructure - an essential element of life, providing the means through which people engage in work, education and learning, health, entertainment, financial and government services. Digital infrastructure has to be a core element of an overall infrastructure plan.

The information highway is every bit as important as the freeways that connect us. Digital infrastructure must sit beside other critical infrastructures (such as road, rail and ports). Indeed, there are great efficiencies to be won through integrated planning, budgeting and infrastructure rollout, particularly across the regions.

While a state digital strategy for Western Australia is currently in play, its primary focus is on digital transformation within the public sector. This is critical, of course, especially with an growing number of government services being delivered online. However, digital technology impacts all aspects of our lives, and crosses multiple government portfolios. This highlights the imperative for an integrated 'whole of state' digital strategy. A Digital Advisory body with representation from community, industry, and all levels of government and education should be an essential part of the strategy. How this is managed and who takes ownership is a point to be worked out.

The new digital future offers the most extraordinary set of opportunities for us all, whether in education and learning, work and job search, business and entrepreneurship, health care, or in social connectedness.

Yet there are groups in our society who are at risk of falling on the wrong side of the digital divide.

Those who face challenges in connecting to the digital world by virtue of cost or location, or who feel excluded from digital services through special needs or a lack of trust, confidence or capability, face a very real risk of being excluded from the opportunities afforded by the new digital future.

Waiting for someone to take the reins is not an option. Digital transformation is not standing still.

Now is the optimal time to act to ensure that no one falls through the digital net.

Appendix

Figure 75 Timeline of broadband investment in Australia 1999 to 2018

1999	• First ADSL services connected in Australia • November: Optus launches first WAP services in Australia.
2000	• September: Optus launches business xDSL services using the unbundled local loop. • November: Southern Cross Cable (undersea transmission) completed. • SeaMeWe3 undersea transmission cable completed.
2001	• Australia-Japan Cable (undersea transmission) completed.
2002	
2003	• Internode launches first residential ADSL services using the unbundled local loop.
2004	
2005	
2006	• Telstra launches first mobile broadband services (3.5G) in Australia. • November: Telstra offers ADSL2+ services.
2007	• November: iiNet launches first Naked DSL services.
2008	• October: Telstra Endeavour undersea transmission cable completed.
2009	• April: Government announces its commitment to build the NBN, NBN Co established. • October: Pipe Pacific Cable (undersea transmission) completed.
2010	• July: First customers connected to the NBN.
2011	• October: Telstra launches 4G LTE (Long-Term Evolution) (1800 MHz) services.
2012	• September: Optus launches 4G LTE (1800 MHz).
2013	• April: NBN switches from FTTP network to utilise a multi-technology-mix including FTTC and FTTN. • April: Government auction of "Digital Dividend" spectrum 700 MHz and 2500 MHz • In Perth and Esperance Telstra launches 4G LTE (1800MHz) services using 20MHz of contiguous spectrum. • June: Vodafone launches 4G LTE (1800 MHz) with 2 lots of 20MHz contiguous spectrum. • September: Optus launches TD-LTE (2300 MHz).
2014	• December: Vodafone launches 4G (850 MHz).
2015	• January: Telstra 4G (700 MHz) launches in capital cities and 50 regional locations. • September: Telstra launches VoLTE (Voice over LTE).
2016	• First NBN approved VDSL services.
2017	
2018	• Hawaiki Cable (undersea transmission) between NSW, NZ, American Samoa, and USA expected June 2018. • Australia Singapore Cable (undersea transmission) between Perth, Indonesia and Singapore expected July 2018.

Source: Bankwest Curtin Economics Centre

Table 5 International comparison of national and regional broadband policies

Country	Policy	Objectives	Entity	Technology	Regulation	Status
Australia	NBN	Connect 93% of population to >25Mbps broadband; Prioritising regional areas first	New entity	FTTP/ FTTN/ Fixed-wireless/ satellite	Wholesale only, open access	In construction and deployment
France	Plan France Tres Haut Debit	Connect 100% of population to high speed broadband	Public private partnerships	80% FTTP, 20% VDSO, cable, satellite, 4G.	Regulated network access sharing	Phase one (50% connected) completed end 2016. Phase 2 in construction and deployment
Malaysia	National Broadband Initiative	Achieve 50% household broadband penetration by end 2010; Internet centres and community broadband centres; 1 million netbook initiative to poor students; E-kiosks; CBC to the home; expanded cell coverage	Government department; public private partnership with Telekom Malaysia	FTTH, VDSL2, wireless High Speed Packet Access and WiMax	7 year moratorium on HSBB unbundling, Open access services on HSBB	Deployed.
New Zealand	Ultra-fast Broadband (UFB)	Connect 87% of population to FTTP by end of 2022	New entity and regional public private partnerships	FTTP	Wholesale only; open access	In construction and deployment
New Zealand	Rural Broadband initiative	Connect areas not served by UFB network	New entity and public private partnerships	FTTN/ fixed-wireless/ FTTP for schools, hospitals and health centres	Wholesale only, open access	In construction and deployment
Singapore	Next Gen NBN	Ultra-high speed broadband access of > 1 Gbps	Public private partnership	Fibre	Open access to wholesale dark fibre services	Achieved in 2013
United Kingdom	Britain's Superfast Broadband Future; Broadband Delivery UK	Support investment in superfast broadband 95%; Broadband (2Mbps) Universal Service Obligation 2020;	Private sector; public funded subsidies to extend coverage where not commercial.	HFC, FTTC, FTTP, wireless and satellite	Predominantly subsidised investment. Open access wholesale services under benchmarking or other price controls for at least 7 years.	Phase 1 (95% 24Mbps) and Phase 2 (95% 24Mbps) Deployed and achieved end 2017. Phase 3 (>95%) continuing.
European Union	Digital Agenda for Europe; Digital single market	Entire EU covered by broadband > 30 Mbps by 2020; 50% of households >100 Mbps by 2020; 33% of SME's to make online sales by 2015; all schools, transport hubs and main providers of public services and digitally intensive enterprises to have download/upload speeds of 1Gbps by 2025; major roads and railways should have uninterrupted 5G wireless broadband coverage, starting with fully-fledged commercial service in at least one major city in each EU Member State already by 2020.	Up to national governments	Up to national governments	Roll-out of very-high-capacity networks; Preserving access regulation of dominant maket players to ensure competitive markets.	In progress.

Source: Bankwest Curtin Economics Centre | NBN Co https://www.nbnco.com.au/; New Zealand Ministry of Business, Innovation and Employment http://www.mbie.govt.nz/info-services/sectors-industries/technology-communications/fast-broadband/broadband-and-mobile-programmes; Crown Infrastructure partners https://www.crowninfrastructure.govt.nz/; France Tres Haut Debit http://www.francethd.fr; Malaysian Communications and Multimedia Commission https://www.mcmc.gov.my/sectors/broadband/national-broadband-initiative; Infocomm Media Development Authority; https://www.imda.gov.sg/industry-development/infrastructure/next-gen-national-infocomm-infrastructure/wired/next-gen-nbn; Department for Digital, Culture, Media and Sport, Broadband Delivery UK https://www.gov.uk/guidance/broadband-delivery-uk; Federal Communications Commission https://www.fcc.gov/general/national-broadband-plan; European Commission, Digital Single Market https://ec.europa.eu/digital-single-market/.

Glossary

and technical notes

Glossary and technical notes

ACCC

Australian Competition and Consumer Commission – the regulator in Australia for competition and industry regulation.

ADSL or DSL

Analogue digital subscriber line refers to the digital broadband internet connection that piggy-backs on the traditional analogue phone system. While ADSL refers to the first generation of these technologies, DSL refers to all subsequent generations including ADSL2, ADSL2+ and VDSL (Very fast DSL).

Backhaul

Backhaul refers to long distance transmission components of a telecommunications network, typically within a single city or region.

Businesses by employment size

Small businesses are businesses that employ 0 to 19 people. Medium businesses are those that employ 20 to 199 people. Large are those that employ 200 or more people.

FTT'X'

Fibre to the Node (FTTN) – This refers to a fibre connection between the exchange and a curb-side cabinet with a copper line between the cabinet and the premises.

Fibre to the Curb (FTTC) – This represents one step deeper than FTTN, where fibre is closer to the premises, typically to a curb side "pit" rather than a cabinet.

Fibre to the Basement (FTTB) – This refers to a fibre connection to a building, such as an apartment building, where copper lines in the building connect each premises to telecommunications services.

Fibre to the Premises (FTTP) – This is a fibre connection between a premises and the service provider's network.

HFC

Hybrid Fibre Coaxial – This is the network traditionally used for subscription television services, but is now also used for broadband and phone services.

Local loop

The copper line that connects homes and businesses to telecommunications services at the exchange.

Mbps

Megabits per second – The typical unit of data transfer used to refer to internet connection speeds.

Micro businesses

Sometimes known as Micro businesses. Businesses that employ 1 to 4 persons.

NBN

National Broadband Network.

POI

Point of Interconnect – This is where a service provider requires a presence to connect with their own network in order to service customers on the NBN in that region.

PSTN

Publicly switched telephone network – This refers to the old analogue telephone system over a traditional copper network.

RFID

Radio-frequency identification.

Statistical Area Level 2 (SA2)

The Statistical Area Level 2 (SA2) is an area defined in the Australian Statistical Geography Standard (ASGS), and consists of one or more whole Statistical Areas Level 1 (SA1s). Wherever possible SA2s are based on officially gazetted State suburbs and localities. In urban areas SA2s largely conform to whole suburbs and combinations of whole suburbs, while in rural areas they define functional zones of social and economic links. Geography is also taken into account in SA2 design. SA2s cover, in aggregate, the whole of Australia without gaps or overlaps.

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