CommsDay Summit

Iñaki Berroeta
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9am

Introduction

Good morning everyone.

As always, thank you to Grahame and the CommsDay team for the invitation to speak.

This is my first major speech after the merger was completed, and I'm pleased to be speaking with you here in person and via video stream today.

2020 has been a defining year for telecommunications in Australia.

The COVID pandemic has highlighted the critical role that our sector plays in society.

It has been the glue that has kept friends and families connected when social gatherings were not possible.

It has been the vehicle that has allowed many businesses to continue operating through remote working arrangements and online orders while offices and stores were closed.

There is no doubt that COVID drove spikes in data usage as people moved to working and learning from home.

But those increases in data use were well-supported by Australian mobile network operators and the NBN.

And they reinforced the need for strong, resilient telecommunications companies.

As Australia learns to live with COVID - at least for the foreseeable future - we must look at the shifts in consumer behaviour beyond COVID.

Video is king, with video applications driving huge increases in data usage.

For example, TikTok data usage on our mobile network is up 250 per cent since March this year, and Netflix mobile data usage is up 125 per cent over the same period.

It is important to note that not only is usage of the internet evolving, but the way consumers are accessing the internet is also changing.

Consumers are making decisions based on the solution that meets their needs, rather than the type of technology.

How services are delivered - whether via a mobile or fixed network - is becoming increasingly irrelevant to them.

Research by the Centre for International Economics found that since March this year, the proportion of people using video and audio conferencing - such as Zoom and Teams - has increased from 30 to 45 per cent on fixed connections.

With many organisations moving towards a mixed working model - such as employees working 50:50 from the office and home - we expect this trend to continue.

As an industry, we must understand these shifts and ensure we are meeting consumers' needs and expectations.

The merger between TPG and VHA could not have come at a more significant time.

Of course, we would have preferred for it to happen a lot sooner.

But as a fully integrated company, we can now maximise the use of our

infrastructure to deliver the products, services and competition that Australians want and need.

The 5G evolution

With the new 5G-enabled iPhone now starting to land in the hands of consumers, there is a growing sense that 5G has arrived.

5G will take mobile communications to the next level.

Throughout my career, I have had the privilege of being part of the mobile network generational change from the first generation in the 90s through to 5G.

I have observed three phases in each generational change.

The first phase is the lead-up.

It is characterised by a lot of hype, excitement and anticipation. We've been in this phase for the past few years.

And we are now starting to enter the second phase.

Over the months and years ahead, we will see incremental shifts in consumer usage as compatible devices become available and handset prices come down.

Then, once enabled devices are in the hands of the mass market, there will be a third phase when the technology will give way to new possibilities.

The best things about 5G are the opportunities that are not yet here.

Just as 3G - once established - enabled the birth of the smartphone.

And 4G - once it gained momentum - supported the video and streaming revolutions.

5G will do things we haven't yet imagined, and it will be users that will drive this as they decide how they want to use the technology.

Currently, only about two per cent of the Australian market has a 5G-enabled smartphone, and that's expected to increase to around twenty per cent by the end of next year.

It will take several years before a majority of Australians have a 5G handset and will experience 5G.

Millimetre wave spectrum for 5G is also yet to come, and it will play an important part in the 5G ecosystem.

While it has a shorter reach and limited ability to travel through buildings and other objects, it is exciting because it will mean significantly more capacity and faster user speeds.

Millimetre wave spectrum will accelerate the potential of 5G, especially for mobile services in high foot-traffic areas such as CBD streets, and also for fixed wireless services.

But what is truly exciting about 5G is that unlike 2G, 3G and 4G - which were designed for people to use on phones - 5G is about connecting things.

Already on the Vodafone network, we have millions of SIMs connected to IoT devices, including 7 and a half million in the healthcare sector alone.

According to a recent Bernstein Research report, the number of connected things will outnumber connected people within a few years.

The amount of data exchanged between these things will eventually far exceed human-based consumption.

And high-bandwidth services such as drone surveillance, factory automation and

smart city applications will require the unique aspects of 5G.

Along with the Internet of Things, 5G is expected to lead to significant extra economic activity and job creation, particularly in mining, manufacturing and logistics.

Despite the challenges we have faced with the 5G vendor restrictions and the uncertainty caused by the ACCC's opposition to our merger, our 5G rollout is now full steam ahead.

Our customers can currently use 5G in parts of Sydney, Melbourne, Brisbane, Canberra, Adelaide, Perth and the Gold Coast.

In suburbs including the Sydney CBD, Parramatta, South Melbourne, Sunnybank Hills, Norwood, Canningvale and Surfers Paradise.

We're currently working on more than twelve hundred sites.

And by the end of 2021, with a standalone core, we are targeting 85 per cent population coverage in the top six cities.

Consumer behaviour is driving convergence

Over recent years, we have started to see clear shifts in the way consumers use the internet in their home.

As mobile speeds, capacity and data inclusions increase - and mobile prices decrease - mobile and fixed are converging.

The focus for customers is on the service being provided, not the infrastructure or technology delivering the service.

According to the CIE, the share of mobile only households has remained stable at 17 per cent over the past few years.

However, I expect this figure to increase in the coming years as the capacity of wireless networks takes an exponential leap with 5G and millimetre wave.

The CIE found - based on data usage alone - that mobile internet could meet the current needs of 67 per cent of fixed line users.

Above all, customers value price, speed and reliability of their broadband service.

They become frustrated with and have little patience for slow or unreliable connections.

In fact, around two thirds of Australians regularly switch manually from fixed to mobile when experiencing slow broadband speeds at home.

That figure doesn't include the quarter of all households who have a smart modem with 4G back-up, which Vodafone was proud to pioneer.

This behaviour is not surprising given mobile broadband speeds are regularly higher than fixed broadband.

Customers are also using their fixed and mobile connections for the same activities, with web browsing and streaming the most popular on both.

Ten years ago, mobile data consumption was zero point seven per cent of fixed broadband data consumption. Now it is seven per cent.

It's only when you look at the higher-data needs activities such as gaming, video conferencing and cloud computing that customers still prefer to use their fixed connections.

I expect that over coming years, more customers will move towards converged plans for all their connectivity needs.

Recognising this trend, we recently launched converged bundles on the

Vodafone brand.

These bundle up a household's NBN and mobile plans, creating a package which ensures customers are "always on" and offering market-leading value.

While our Enterprise teams have come together to offer converged "whole of business" solutions.

We are already making in-roads in this segment. For example, National Australia Bank recently chose TPG Telecom for fibre connectivity to its branches and also mobile services.

Another thing we are leading is the move towards unlimited mobile data plans.

We recently took this concept to the next level, launching Infinite data plans on the Vodafone brand.

Our Infinite plans provide customers with a choice of three higher data speed tiers once they reach their max-speed data limit.

As data usage and speeds continue to increase, we see this as the way of the future.

Mobile data has been consistently increasing around 40 to 50 per cent each year.

However, over the past twelve months, due to many people working from home and using their fixed broadband more, mobile data has increased around 20 per cent, which is still significant.

The merger is supporting convergence

It is only because of the merger that we can now do the things that we have always wanted to do for our customers by bringing together our fixed and mobile

assets.

Five hundred network upgrades were completed in the first two months after merger implementation, with 1.8 million Australians benefiting from the deployment of additional 1800-megahertz spectrum at around 320 mobile sites.

We are also integrating around four hundred legacy TPG small cells into our mobile network in Sydney, Melbourne, Brisbane and Adelaide.

And we have started rolling out additional dark fibre to more than 700 of our mobile sites.

This rollout is an extension of the project which saw TPG deliver fibre to more than three thousand Vodafone mobile sites in the second half of last decade.

All of these projects mean faster speeds and better performance for our customers.

In addition to strengthening our network infrastructure, we are maximising the use of our assets amongst our house of brands.

For the iiNet brand, we are migrating existing customers to our mobile network.

And we also plan to extend Vodafone's 4G backup service to NBN products on our other brands including TPG.

These initiatives are delivering on our commitment to deliver more for our customers as a merged company.

We are an infrastructure company

Where there are opportunities to use our infrastructure to offer the types of services that our customers want, we will.

As we ramp up our 5G mobile rollout, we intend to maximise this investment for our customers and shareholders.

I'm pleased to announce today that we will begin offering 5G fixed wireless products in the first half of next year.

As our 5G footprint grows and millimetre wave spectrum becomes available, we will look to expand our capability to more customers.

We recently completed millimetre wave trials in Carlingford in north-west Sydney on the 28 Gigahertz band.

These trials gave us a taste of the potential of 5G, reaching speeds of around 2 Gigabits per second.

5G fixed wireless is often referred to as simply a bypass of the NBN, but that assumes that every consumer wants the same telecommunications solutions - they don't.

Customers have different speed, usage and budget requirements.

In fact, for some time now we have been selling 4G fixed wireless services under the Vodafone brand.

This has been offered in areas where we have excess 4G capacity, and we have connected thousands of customers on this product.

5G will take our fixed wireless offering to a new level and provide customers with further choice.

A successful NBN is in Australia's best interests

As the second largest NBN retailer, the delivery of NBN services is - and will continue to be - a critical part of our business.

This is particularly important in the current environment where customers are relying more than ever on their NBN service.

In the June quarter, across our brands, we achieved the highest market share of NBN connections.

As demand for high-performance internet grows, NBN's modernisation makes sense.

Better fixed broadband is crucial for Australia's economic success and development.

With this in mind, we welcome NBN's recent announcement that it will extend fibre to more homes.

However, to unleash the full potential of the NBN for households, we need a sustainable pricing model.

The CVC charge is like driving a lap at Bathurst stuck in second gear.

Its removal and replacement with a flat-rate wholesale charge for NBN speed tiers will result in a significant increase in speeds for NBN customers, as well as ensuring NBN services are more affordable.

We also support NBN's presence in the Enterprise market.

This can help improve competition in under-served areas like regional Australia.

However, I am keen to see greater collaboration between NBN and industry so that taxpayers don't fund the duplication of existing fibre infrastructure for enterprise customers in well-served metropolitan areas.

This would be wasteful and inefficient.

Particularly when non-NBN network operators are about to be hit with a monthly seven dollar per premises charge, while NBN can freely decide to overbuild these same networks.

It is critical that we have the right environment to support private infrastructure investment.

To achieve this, we encourage NBN to partner with operators which already have enterprise fibre and other high-speed networks in place.

This will fast-track service delivery for customers and reduce the cost to taxpayers.

Delivering services to more Australians

Right across our business, we are also looking at opportunities to leverage our own infrastructure to offer customers more choice in internet products to suit their needs.

One of the most important structural changes we have put in place following the merger is bringing our fixed and mobile networks together and integrating the technology teams.

This “one network” approach will allow us to enhance the capabilities of our fixed and mobile technologies and deliver the maximum benefits of the merger to our customers and shareholders.

We have some fantastic fibre products on our TPG and iiNet brands which we intend to offer to more customers.

Our Fibre to the Basement network - which delivers typical evening speeds of 90 megabits per second - is available to almost 3,000 multi-dwelling buildings in most metro areas.

While on our HFC network, iiNet Ultra Cable broadband plans offer speeds of 300 megabits per second in Geelong, Mildura, and Ballarat.

For businesses, our Fibre One Thousand network offers 1 Gigabit per second to one thousand commercial buildings.

And we've just completed the rollout of Australia's first city-wide 10 Gigabit network in partnership with the City of Adelaide.

Conclusion

With 2021 now just over nine weeks away, I've been reflecting on the extraordinary amount we have achieved this year as a company.

When you consider that at the start of this year, we didn't yet have certainty that the merger would be allowed to proceed - and COVID was a threat that hadn't yet reached Australian shores - it has been a period of unprecedented transformation and change.

Since the merger was implemented in mid-July, we have seamlessly brought together more than five thousand employees from VHA and TPG to create our merged company.

We have people based all over the country and internationally - many of whom have been working from home - and all of them are linked together by technology.

Structurally, we have set the foundations for the company, with the Executive Team and the senior leadership team in place and working to deliver our strategy.

Our leaders are a mix of talent from both legacy businesses, and we are bringing all teams together formally under the organisational structure.

Right across the company, teams are already working together on projects with energy and enthusiasm.

From a cultural perspective, we share a challenger spirit and an unwavering focus on delivering the best for our customers.

And there is an overwhelming belief and confidence across the company that we are better together.

As we move forward, we are also embedding our values.

We recently announced that we are launching a new brand, felix, over coming weeks.

felix is telco reimagined - simple, seamless and sustainable.

It will be powered by 100 per cent renewable electricity, is carbon neutral and digital-only.

This is the first step in our broader company focus on environmental sustainability, and I look forward to sharing more with our customers, shareholders and the community in the future.

2021 is going to be an exciting year as 5G gains momentum and TPG Telecom cements its place as a strong force in the industry for consumers.

Thank you and take care.

FINAL REPORT

Mobile and fixed line convergence: An update

Current and future usage of fixed line and mobile broadband services

Prepared for
TPG Telecom

October 2020

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Executive summary

Convergence of mobile and fixed line broadband services refers to the increasing similarity of these services for suppliers and customers. Telecommunications in Australia is transforming, through the deployment of 4G and 5G mobile networks and the imminent completion of the NBN. These transformations have the potential to increase substitutability between fixed line and mobile broadband, which has implications not only for the future business models of telecommunications service providers, but also policymakers and regulators, who will need to adopt a more technology neutral approach.

To date, much of the attention given to mobile services has been due to its role in providing connectivity when people are away from their homes and businesses. However, a significant number of households use mobile networks as their only means of accessing the internet at home. There are even more households that are using a combination of fixed line and mobile technologies to improve the reliability of their communications.

The CIE and Woolcott Research have been commissioned by TPG Telecom to provide an update to our March 2020 and 2017 studies on the impacts of the rapid changes in mobile and fixed technologies and demand for broadband in the home. This report presents an update of the survey results for the month of September, and these results are consistent with those from the March survey.

Our previous study found growth in data usage on both fixed line and mobile connections consistent with a higher uptake of data intensive activities such as video streaming and gaming. The more recent September results point to large growth in video and audio conferencing within the home, which has been a key hallmark of the COVID-19 period. A recurring theme from our survey findings is the prioritisation of service quality and value for money. Customers continue to rely on a mix of both fixed line, mobile and other wireless access types in the home to avoid service disruptions and maintain a high-speed connection.

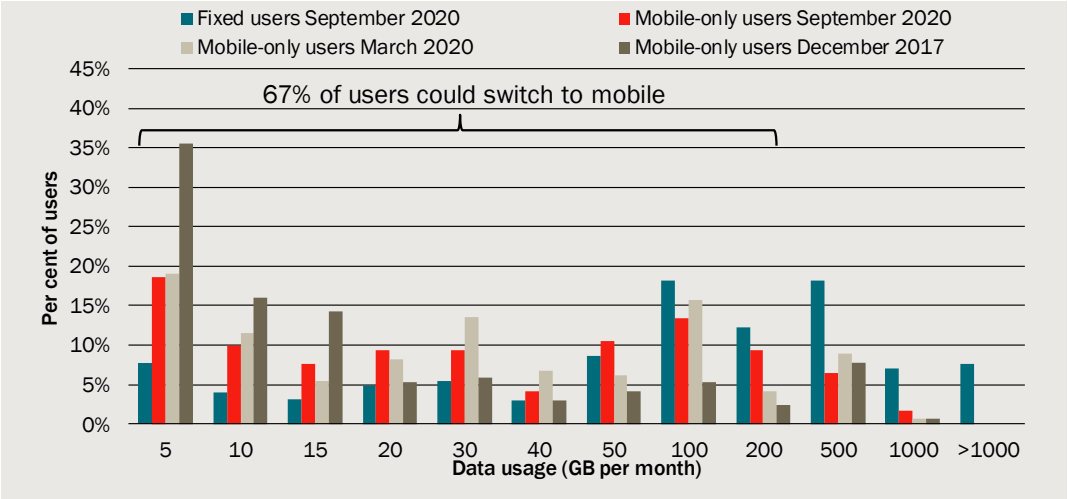
The ongoing advancements in technology and the way customers and industry come to view these advancements will also be of critical importance for policymakers seeking to maximise the benefits of the NBN. To date the fixed line and mobile investment debate has largely been focused on the relative importance of one technology over the other. The fact is both technologies are vitally important and are constantly changing and converging. This reality must continue to be incorporated into the strategic direction of Australia's telecommunications policy settings.

Data usage patterns by access type

- **We estimate that 67 per cent of current fixed line broadband usage could be met by a mobile service.**

There is considerable overlap in the data usage patterns of fixed line and mobile users and this overlap has become more pronounced over the year (chart 1). The September survey results show growth in mobile-only data usage up to 200GB per month, with the resulting pattern showing that around 67 per cent of fixed line users could have their download usage needs met by current mobile services (up from 58 per cent in March).

1 Overlap in data usage for fixed line and mobile only



Note: Higher data usage on mobile is more likely to refer to portable modems or other wireless broadband rather than mobile handsets.

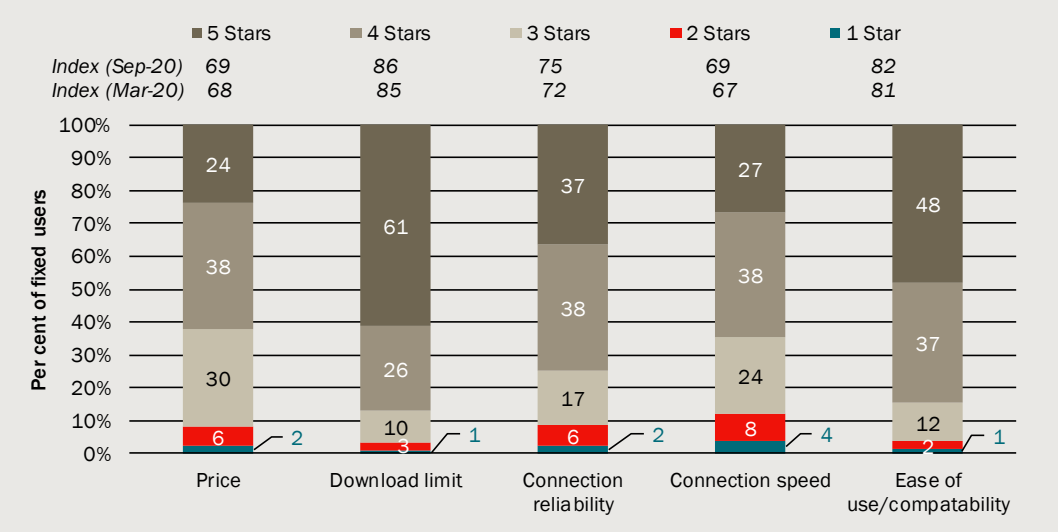
Data source: Survey data from Woolcott Research (commissioned by the CIE) (n=1011).

User experience on fixed line connections

There are a range of characteristics that make up the user experience when using home internet. These include, price, download limit, connection reliability, speed and ease of use/compatibility with devices. Chart 2.14 presents user ratings of their experience with each of these characteristics (5 stars being the highest rating and 1 star being the lowest). Overall:

- Customers are very satisfied with download allowances and compatibility
- 12 per cent of customers are dissatisfied with their fixed line connection speed (down from 13 per cent in March)
- 8 per cent are dissatisfied with their connection reliability (down from 9 per cent in March)
- 8 per cent of customers are dissatisfied with the price of their service (down from 10 per cent in March)

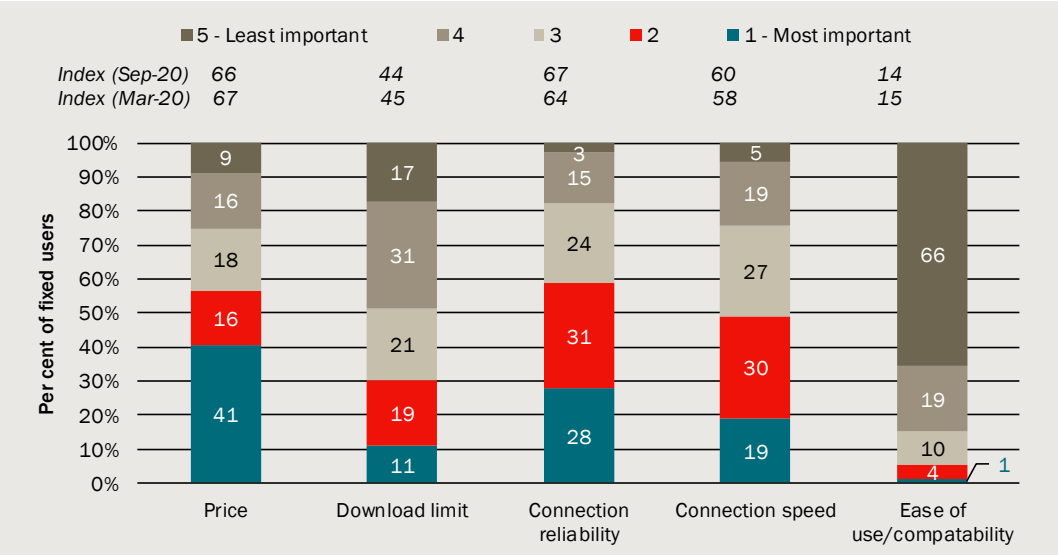
2 Rating of characteristics (out of 5 stars)



Data source: Survey data from Woolcott Research (commissioned by the CIE) (n=1011).

In terms of the importance of each of these characteristics (chart 3), users value the price and quality (connection reliability and speed) of their internet service more highly than other characteristics such as download limits and compatibility. Customers respond strongly to issues related to connection quality, with up to 57 per cent of respondents stating that they switch to a mobile or other wireless service while at home when experiencing slow internet or disconnections on their fixed line service. Interestingly, this proportion has fallen from the March result of 63 per cent.

3 Ranking of characteristics in terms of importance



Data source: Survey data from Woolcott Research (commissioned by the CIE) (n=1011).

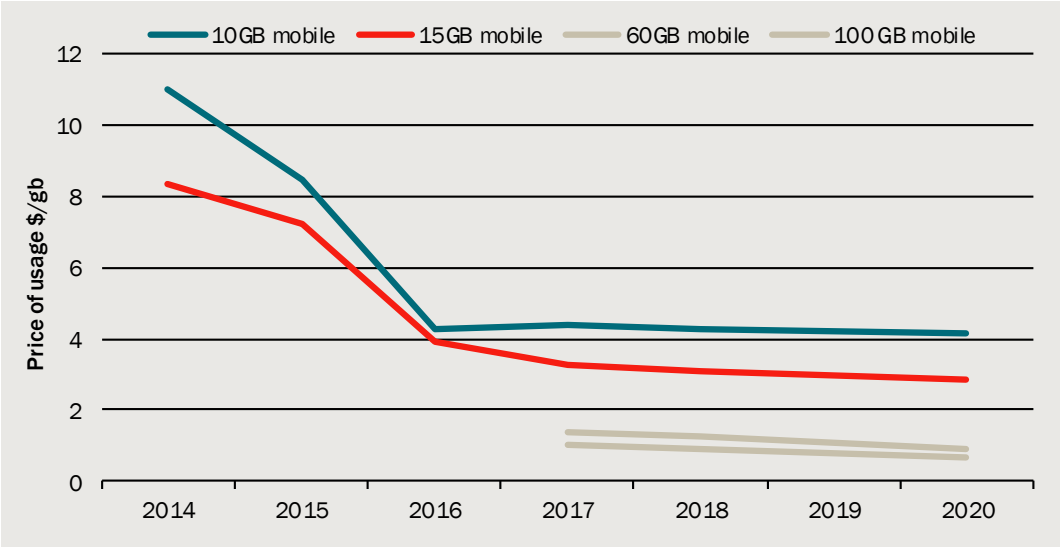
Notably, NBN Fixed Wireless services, which we have captured as a fixed line technology, have similar levels of customer satisfaction as fixed line services, although satisfaction on Fixed Wireless appears to have fallen slightly since the previous survey.

The price of data over time

Hedonic modelling of the price of data for mobile shows that it has fallen dramatically over time (chart 4). For example, the price of a data allowance of 15GB (not including the base price of mobile plans without a data allowance) has fallen from over $8/GB in 2014 to around $3/GB in 2020. In more recent years plans with larger data inclusions have become available. The price per GB is lower compared to plans with smaller allowances. For instance, the price per GB for a 100GB a month plan is under a dollar per GB. Because these plans are new, there are less data points available to track their price over time.

These estimates of the price of data are based on looking across a wide range of plans with different data (and other) inclusions. This finds that the price of data falls as plans get bigger – going from a 10 GB/month to 15GB/month has a higher cost than going from 50GB to 55GB. The estimates of the price of data for individual data limits (e.g. 10 GB/month) has stabilised somewhat from 2017 to 2020. However, the overall price of data will have fallen by more than this, as more customers have moved to higher data plans.

4 Price of data for mobile plans over time



Note: The values for 60GBand 100GB mobile were imputed in a straight-line fashion between 2017 and 2020 as observations were not collected in this year.

Data source: CIE hedonic modelling.

Trends in mobile and fixed line broadband convergence

Ongoing technology developments are bridging the gap between the capabilities of fixed line and mobile connections. As these services become more alike, some consumers will find them to be directly substitutable. Additionally, service providers may also find it favourable to employ a mix of technologies in providing connectivity solutions to their customers.

As such, we have identified two main types of substitution between fixed line and mobile services:

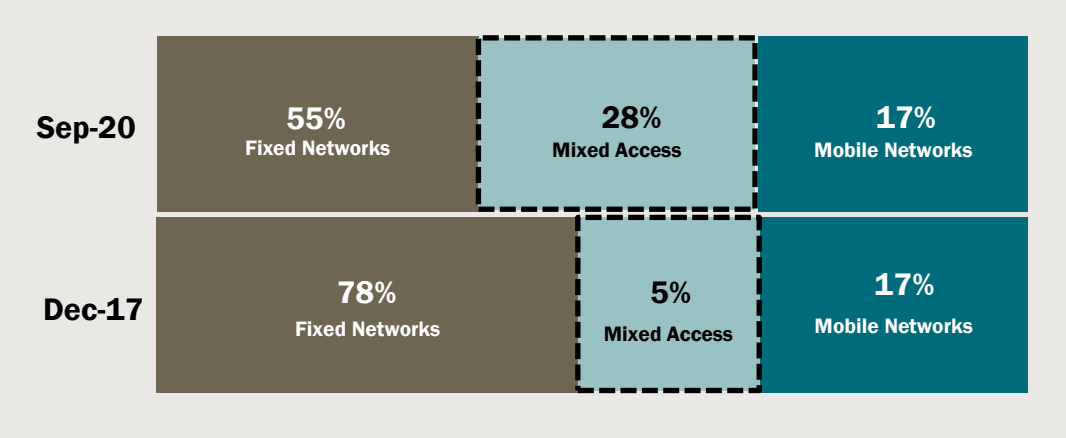
- *Supplier-led substitution* — where service providers substitute between fixed line and mobile technologies to provide connectivity solutions for their customers.
- *Customer-driven substitution* — where customers decide between access technologies according to their preferences over price and quality characteristics.

It is clear that the first of these has changed substantially since 2017, and also that customers are using multiple connection methods themselves to improve reliability of their communications.

Supplier-led substitution

A key finding from our 2020 surveys has been the expansion of supplier-led substitution in the form of 'mixed access' internet services. Mixed access refers to the use of a combination of fixed-line and mobile technologies including home wireless and smart modems. Compared to 2017, in which 5 per cent of users reported having a mixed access method (in the form of 4G home wireless[1]), 11 per cent of households in September 2020 are on a 4G or 5G home wireless connection while a further 17 per cent[2] reported having a smart modem that can connect to the internet using both a fixed line and 4G mobile connection. Based on our survey sample, households using mixed access connections comprise 28 per cent of all households with internet access.

5 Internet access by technology type in Australia



Note: Graphic is for illustrative purposes and is not to scale

Data source: CIE & Woolcott Research Survey.

Predicting future customer led substitution

Customer-led substitution in terms of only using a mobile connection at home has remained the same as in 2017 at 17 per cent. However, it is also evident that customers

1 Including NBN Fixed wireless

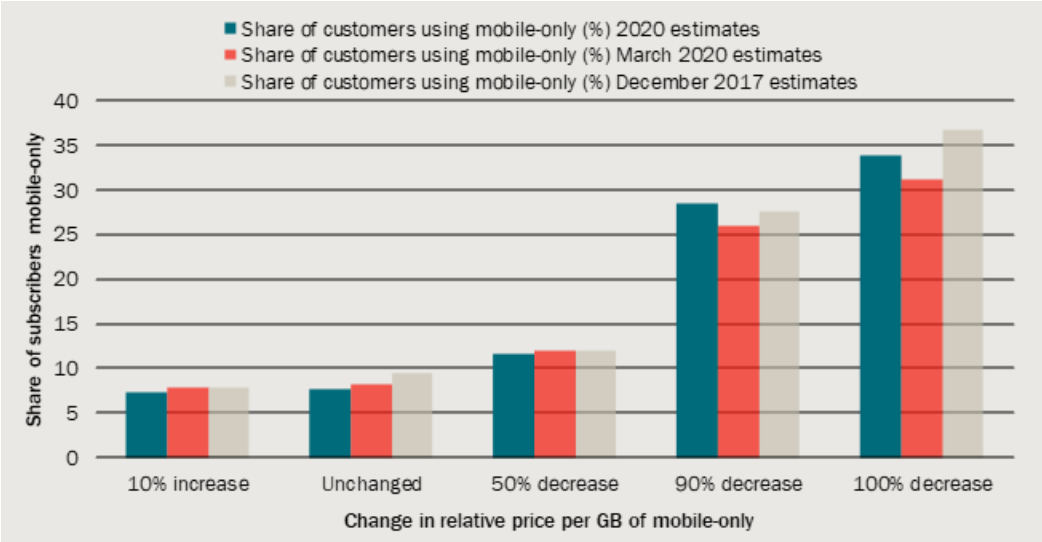
2 This group of respondents makes up 25 per cent of all of fixed line broadband users

are increasingly making decisions to use both fixed line and mobile services at home to ensure a reliable connection. 57 per cent of customers indicated they had used mobile more than once a month to ensure a reliable connection when at home.

In order to predict the customer decision to substitute their fixed line service for a mobile-only service we used the survey dataset to model substitution between these two services. This involved constructing a model of household choices between fixed line and mobile services, which enables for prediction of the mobile-only share under different usage and cost scenarios.

Chart 6 presents our estimates of the share of mobile-only households in the year 2025 under a range of scenarios where the cost of mobile services either increases, decreases or remains unchanged. We estimate that the share of mobile-only households would increase to around 34 per cent if the cost of mobile data were zero. While this is smaller than our previous estimate from 2017, it highlights that the price of data alone is not the only factor driving the decision between access type. As explored earlier, qualitative characteristics such as speed and reliability are also critical.

6 Estimated mobile-only share in 2025 under mobile-only price scenarios



Note: These results assume that data usage grows at 25 per cent CAGR (the ACCC Market study scenario).

Data source: CIE.

1 Introduction

Internet access within the home is provided by:

- fixed line services, where a physical cable connects the premises via ADSL, fibre, NBN Fixed Wireless[3] or NBN Sky Muster[4], or
- mobile services, which use mobile towers to connect handsets or other devices to the internet. This includes services marketed as "home wireless" connections.

Ongoing developments in broadband technology are expected to bridge the gap between the capabilities of fixed line and mobile connections. As the services become more alike, they become closer substitutes for one another. There are two main types of substitution between fixed line and mobile services:

1 **Supplier-led substitution** – where service providers substitute between fixed line and mobile technologies to provide connectivity solutions for their customers. Service providers may find it favourable to employ a mix of technologies and this is currently possible to a limited extent with mixed access methods such as:
   - 4G or 5G home wireless, which uses the same wireless technology used in mobile networks to wirelessly connect the household premises to the fixed network; and
   - smart modems, such as the Vodafone Wi-Fi Hub, which allow fixed line users to switch to the mobile network when there are service disruptions.
2 **Customer-driven substitution** – where customers decide between access technologies based on:
   - price of data
   - characteristics such as speed, reliability and compatibility with existing devices;
   - changing consumer trends such as a greater preference for using mobile for many online activities, and
   - this can also include customers using both mobile and fixed line technologies to supplement reliability or speed issues on either one of these services.

The focus of this report is on customer-driven substitution. However, the underlying capabilities and costs of the networks will be the critical factors for both types of substitution.

With respect to mobile broadband services, Australia's mobile networks are all capable of delivering a high-quality service. To date, mobile broadband excels at providing superior

3 Fixed wireless is considered to be a fixed line technology. Fixed wireless services provided by NBN co require an antenna to be connected to the roof of the premises, and are therefore not 'mobile'. See: https://www.NBNco.com.au/learn-about-the-NBN/network-technology/fixed-wireless-explained.html

4 NBN Fixed Wireless and NBN Sky Muster are considered fixed line technologies for the purposes of this study.

speeds and mobility via 4G and emerging 5G networks at the cost of generally smaller data inclusions and a higher price per GB. Fixed line connections maintain the advantage when it comes to providing high download inclusions at a cheaper price per GB, although mobile's capabilities are expected to catch up significantly as technology improves

Nature of the project

The CIE has been commissioned by TPG Telecom to provide an update to our March 2020 and 2017 studies on mobile and fixed line convergence.

This report:

- presents updated results of a survey of households about internet use at home, and uses this to assess current and future internet usage in Australia
- compares the characteristics of fixed line and mobile services as well as customer perceptions on these characteristics
- analyses the current and potential future levels of substitution using an economic model based on survey data
- explores the technology changes in fixed line and mobile services and how these may affect substitution, and
- examines how policy and regulatory settings will need to adapt to these changes.

2 Current and future internet usage in Australia

Key points:

- **Internet access in Australia is high and data usage across both fixed line and mobile connections has grown by around 50 per cent each year over the past 10 years.**
- **Activities performed online over fixed line and mobile connections are similar. Fixed and mobile-only broadband connections have the capabilities to meet most users' day to day needs.**
- **17 per cent of households are currently mobile-only in Australia. Smaller households with 1-2 people, as well as users between the ages of 18-24 and over 55 are more likely to be mobile-only. This share has remained relatively stable since our March 2020 and December 2017 surveys.**
- **Perceptions of the relative cost and quality of experience on fixed line and mobile broadband are major drivers of the decision to use either fixed line or mobile as the primary internet connection within the home. A substantial proportion of users are using mobile services as a supplement to fixed line services in the home.**
- **Around 67 per cent of fixed line users use 200 GB or less each month. There is considerable overlap in these usage patterns with mobile data usage, suggesting that the data needs of these users could be currently met by mobile.**
- **Data usage and demand for higher speeds are forecast to grow as more sophisticated applications, devices and IoT emerge.**

Current internet usage

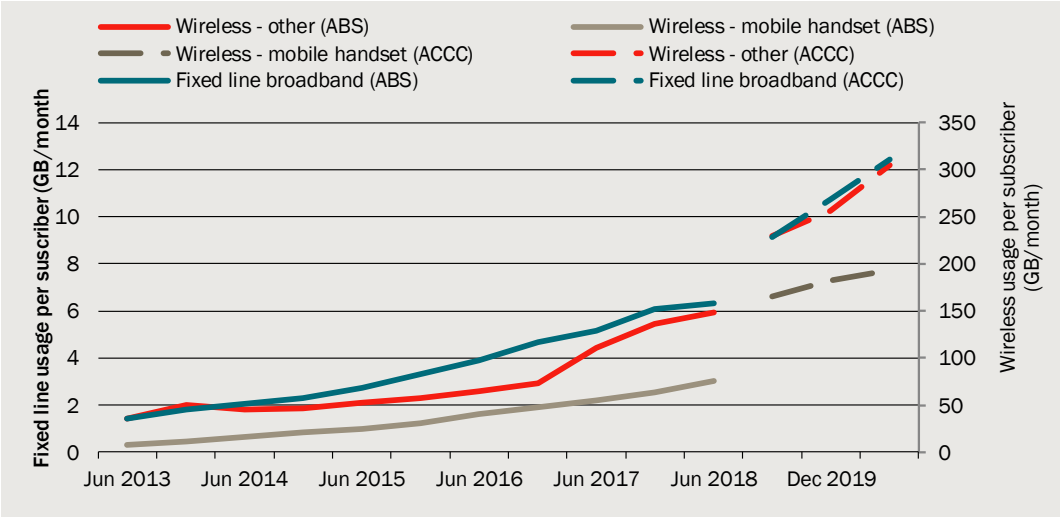
Internet usage in Australia is high, with over 14 million internet subscribers reported at the end of June 2018.[5] To put this into perspective, 86 per cent of households in Australia have access to the internet as of 2016-17, up from 67 per cent in 2007-08[6], reflecting a marked increase in household internet connectivity. In addition to this trend of greater internet connectivity, the intensity of internet usage (as measured by data usage) has increased even more so. There has been a trend increase in data usage for both fixed line and mobile internet (whether through a handset or other form of mobile device) (chart

5 Australian Bureau of Statistics – Internet Activity, Australia October 2018 cat 8153.0

6 Australian Bureau of Statistics – Household use of information technology, Australia 2014-15 and 2016-17 cat 8146.0

2.1). Data usage across both types has increased by around 50 per cent per year[7], highlighting the relevance of the internet as a major platform for an increasing number of activities.

2.1 Median monthly data use per subscriber



Data source: ABS 2018, Internet Activity, Australia, ACCC Internet Activity Record Keeping Rule (RKR) data June 2020,

Whilst both fixed line and mobile data usage have achieved similar rates of growth, the levels of data usage on fixed line connections is substantially higher. Average monthly fixed line data usage is around 311GB according to the most recent ACCC data, whereas monthly mobile data usage is closer to 7.7GB (for mobile handsets) and 12GB for other devices using the mobile network. The driver of the difference here is mainly technological as it is more expensive to provide a comparable level of capacity over mobile networks than fixed-line infrastructure. As such, consumers must pay a premium for larger data quotas on a mobile network, leading to typically less usage compared to fixed line.

Patterns of internet usage for fixed line and mobile

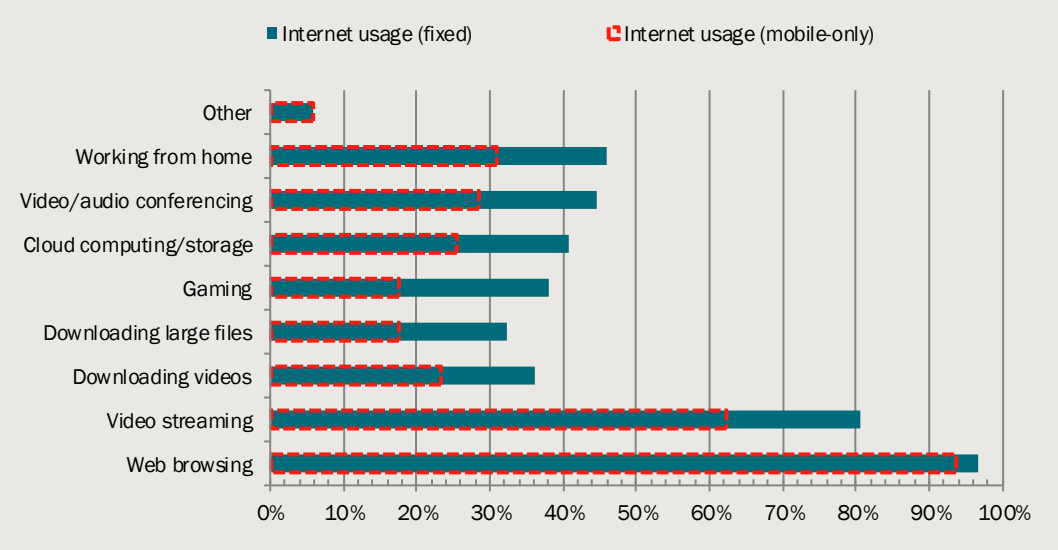
To better understand household internet usage patterns, The CIE in partnership with Woolcott Research and Engagement, conducted a survey of 1,011 households across Australia. This survey asked respondents to report on the nature of their internet usage, including whether their primary access method in the home was fixed line or mobile, what activities they used the internet for, as well as their data usage and allowance levels. Demographic information such as age and household size, composition and geographic location were also collected to provide a robust and well represented sample (see Attachment A for the survey questionnaire).

The patterns of internet usage across both fixed line and mobile internet obtained from the survey are revealing (chart 2.2). The most popular online activities include web

7 This is based on ABS internet activity historical data. There is a discontinuity between the ABS series, which is now discontinued and the more recent ACCC RKR dataset.

browsing (e.g. news, online shopping, and social media), performed by over 90 per cent of all fixed line and mobile-only internet users and video streaming (e.g. YouTube, Netflix, Stan or iView), performed by 80 per cent and 60 per cent of all fixed line and mobile users respectively. Compared to our March survey, the proportion of internet users reporting that they use video and audio conferencing has increased markedly from 30 per cent to around 45 per cent on fixed and from 22 per cent to 28 per cent on mobile only connections.

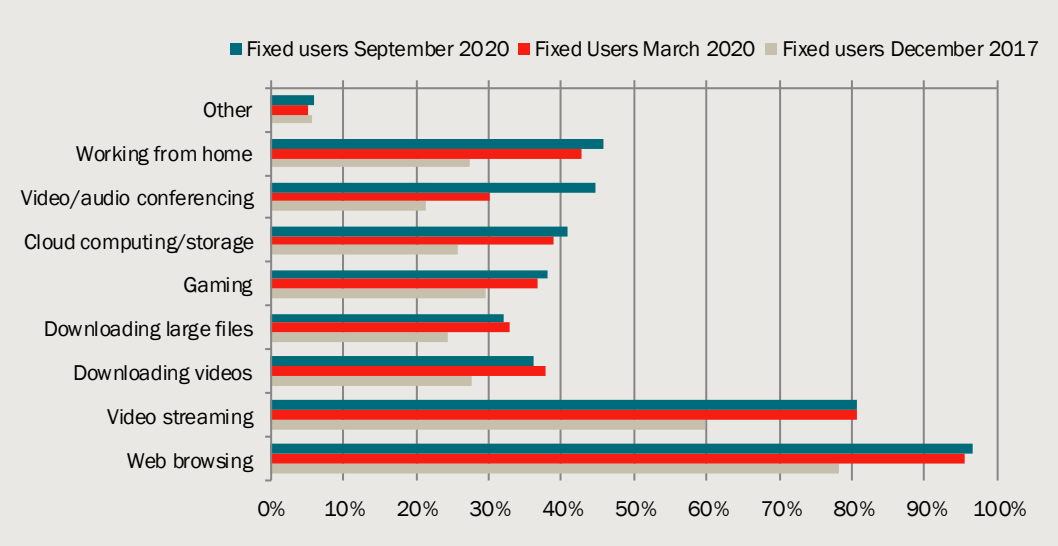
2.2 Internet usage by type of connection



Data source: Survey data from Woolcott Research (commissioned by the CIE) (n=1011).

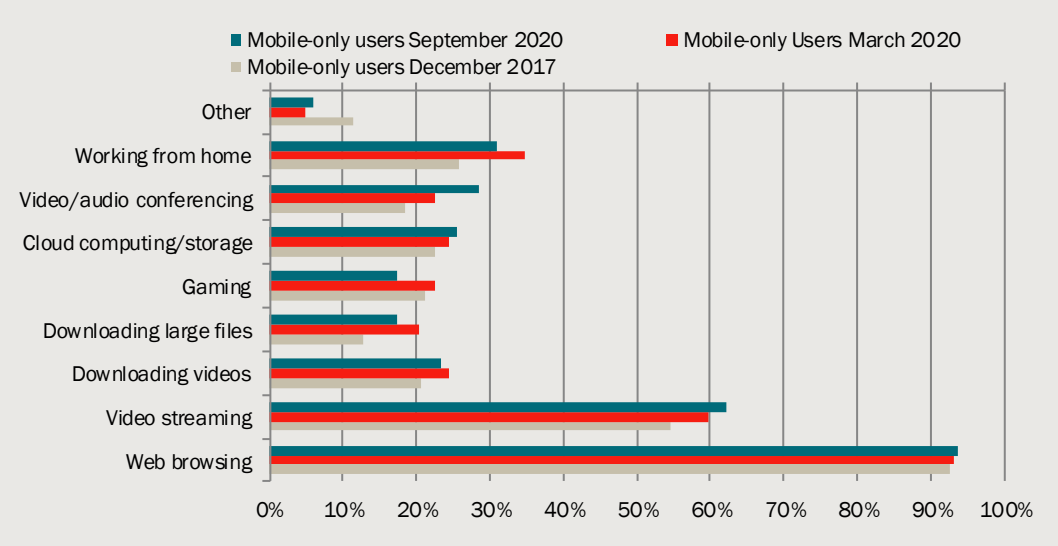
With the exception of video and audio conferencing, there has not been a significant change in the proportion of users performing other activities since our survey in March. This is true across both fixed line and mobile only users (charts 2.3 and 2.4).

2.3 Internet usage for fixed line users in 2017, March and September (2020)



Data source: Survey data from Woolcott Research (commissioned by the CIE) (n=1011).

2.4 Internet usage patterns for mobile users in 2017, March and September (2020)

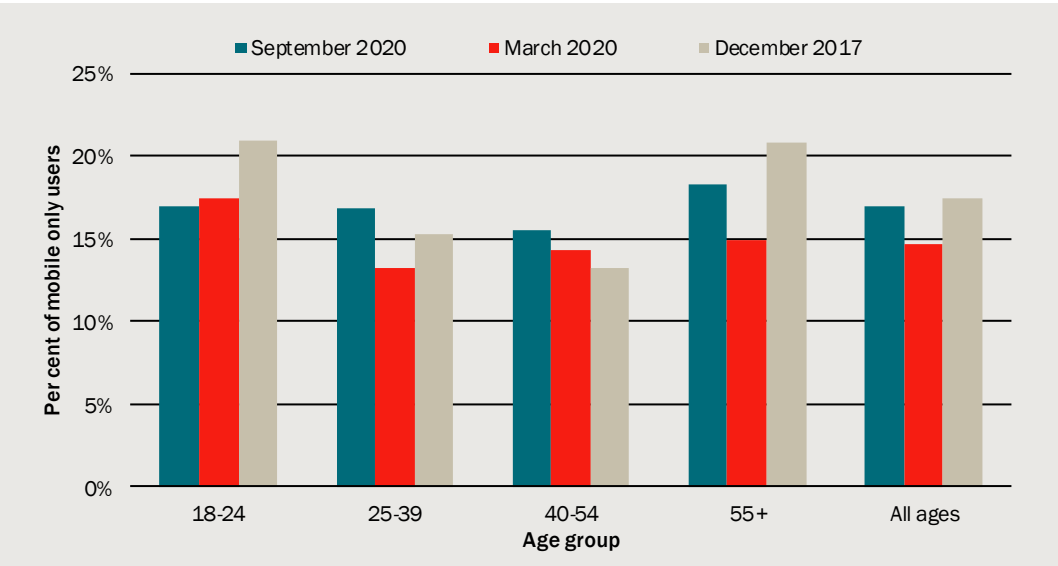


Data source: Survey data from Woolcott Research (commissioned by the CIE) (n=1011).

Where use cases are similar for fixed line and mobile (such as web browsing), the two access types may be perceived as closer substitutes since either fixed line or mobile-only internet could fulfil the purpose. The likelihood of mobile-only internet usage further varies by age (chart 2.5):

- historically, a higher proportion of mobile-only users are found in the 18-24 and over 55 age groups relative to other age groups, although there has been an increase in the mobile only share of users aged between 25 and 29
- those aged between 40-54 were less likely to be mobile-only users, which makes sense especially if this age group are more likely to comprise larger households and families with greater data needs

2.5 Proportion of mobile only users by age group



Data source: Survey data from Woolcott Research (commissioned by the CIE) (n=1011).

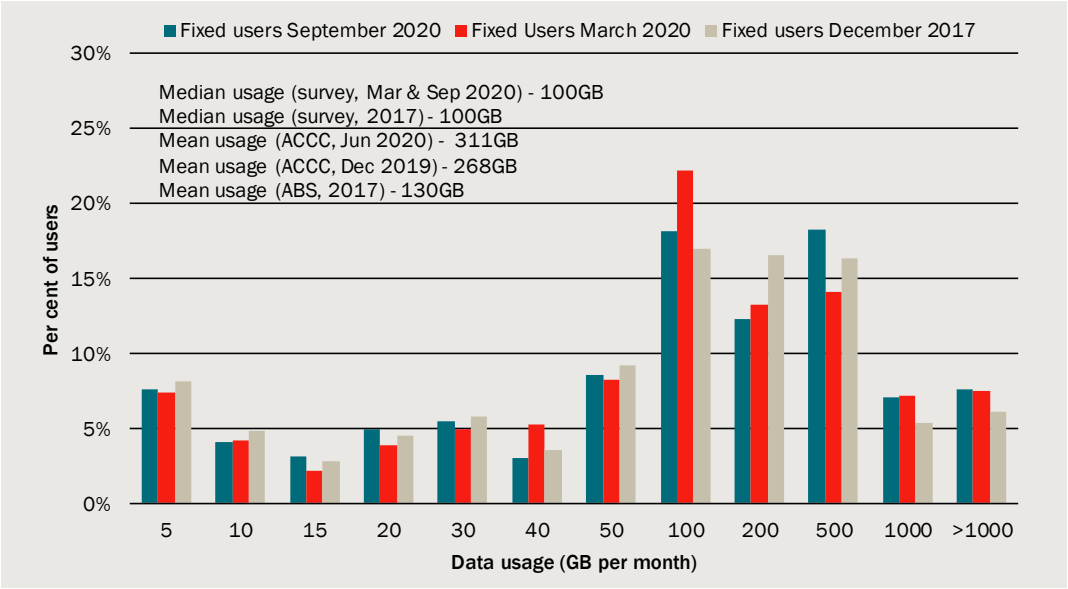
The prevalence of mobile devices has thus far not marginalised fixed line internet, with most households maintaining both a fixed line and a number of mobile internet plans. This indicates that many users continue perceive some level of product differentiation between the two access types.

Distribution of data usage for fixed line and mobile

Chart 2.6 presents a distribution of data usage on fixed line connections based on the recent September 2020 survey and the previous surveys from March 2020 and December 2017. Overall, the patterns are quite similar, with the exception of a higher proportion of users reporting the use of up to 500GB in September compared to previously. Median data usage has remained unchanged however, at 100GB per month in both 2020 surveys and the 2017 survey. This varies slightly to recent usage statistics from the ACCC Internet Record Keeping Rule (RKR) dataset, which has increased over time and is higher than the survey median in both reporting periods. The previous ABS Internet Activity survey has since been discontinued.

Around 55 per cent of households with a fixed line connection use 100GB or less per month (down from 58 per cent in March), while 15 per cent use 1000GB or more per month (unchanged since March). As the data inclusions on mobile plans continue to increase, this would suggest that the data usage needs of a sizable portion of fixed line users could be met by mobile services.

2.6 Distribution of data usage – fixed line connection



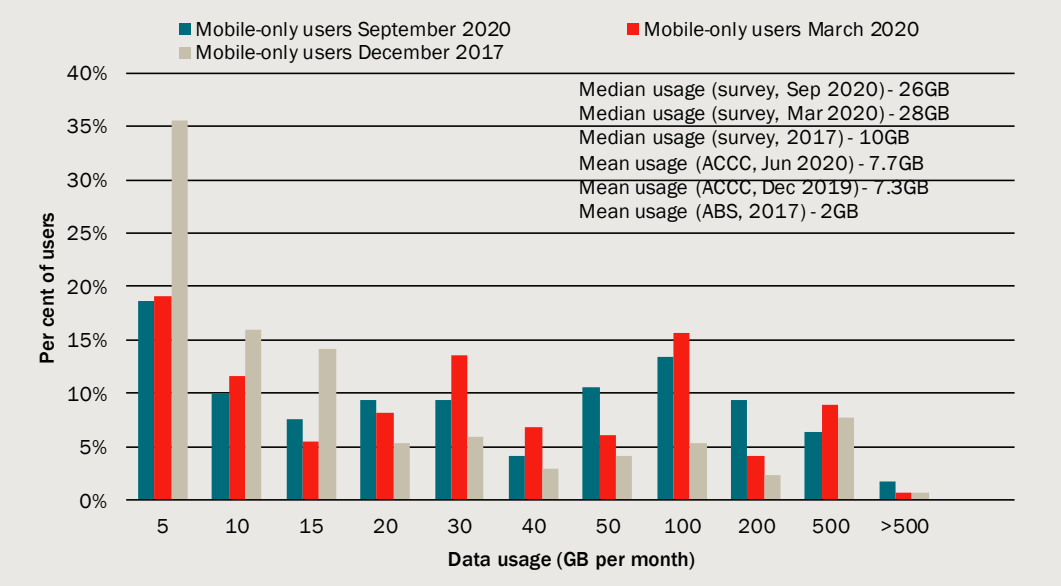
Data source: Survey data from Woolcott Research (commissioned by the CIE) (n=1011), ACCC Internet Record Keeping Rule dataset June 2020 (https://www.accc.gov.au/regulated-infrastructure/communications/monitoring-reporting/internet-activity-record-keeping-rule-rkr/june-2020-report)

Mobile data usage in the 30GB and 40GB brackets has fallen since March, while there have been stronger increases in the proportion of users using up to 50GB per month and 200GB per month (chart 2.7). While median usage has fallen to 26GB per month (from

28GB per month in the March survey), the patterns of growth around the tails of the distribution are such that mean usage has increased (from around 68GB per month to 70GB per month).

The ACCC mean usage estimates from the IKR dataset has also increased marginally between December 2019 and June 2020 from 7.3GB to 7.7GB. While these are much lower than the survey estimates, our survey specifically targets mobile-only usage within the home, while the ACCC's data targets mobile usage more broadly, including those who primarily use a fixed line connection within the home and so would naturally have lower usage levels than users who only use mobile.

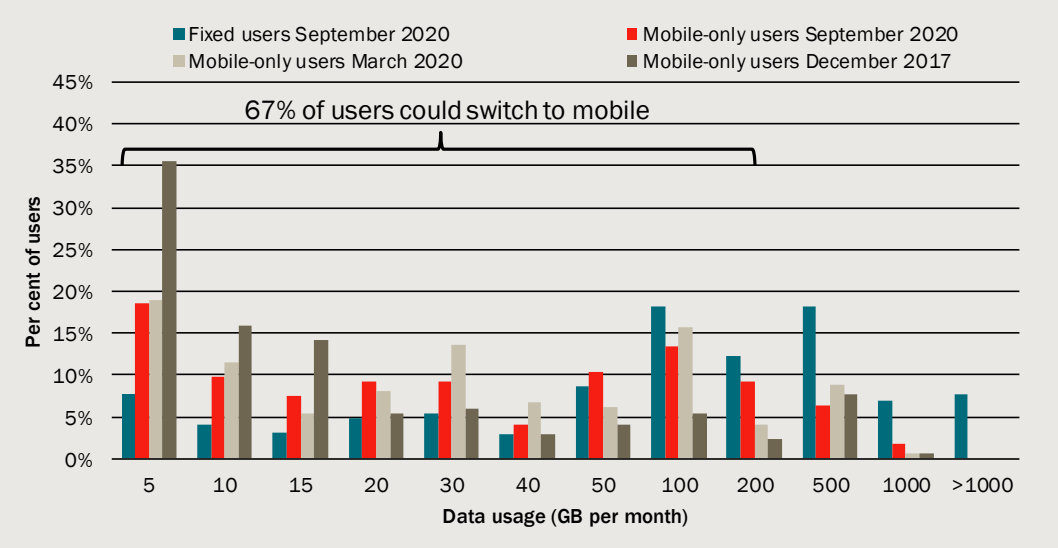
2.7 Distribution of data usage – mobile only connection



Data source: Survey data from Woolcott Research (commissioned by the CIE) (n=1011), ACCC Internet Record Keeping Rule dataset June 2020 (https://www.accc.gov.au/regulated-infrastructure/communications/monitoring-reporting/internet-activity-record-keeping-rule-rkr/june-2020-report)

Due to the growth in larger usage brackets for mobile only households, the overlap in data usage between fixed line and mobile is even more pronounced since the previous survey (chart 2.8), with there now being a stronger overlap for usage up to 200GB per month on both connection types. This lends support to the fact that, based on data usage alone, mobile internet could currently substitute for fixed line for 67 per cent of current fixed line users (this is up from 58 per cent in March). As further analysis will show however, there are there are other factors in addition to underlying data demand that determine preferences for fixed line and mobile internet, such as price and service quality.

2.8 Overlap in data usage for fixed line and mobile only



Note: Higher data usage on mobile is more likely to refer to portable modems or other wireless broadband rather than mobile handsets.

Data source: Survey data from Woolcott Research (commissioned by the CIE) (n=1011).

Preferences for fixed line and mobile internet connection

Internet subscribers have cited various reasons for preferring a fixed line connection over a mobile-only connection (table 2.9) including fixed line connections offering a more reliable and faster connection and compatibility with current devices (due to Wi-Fi capability offering the freedom and flexibility of being mobile within the home). The share of respondents that state connection speed as being the main reason for preferring fixed line connections appears to have fallen over time, from 50 per cent in 2017 to 44 per cent in September 2020.

2.9 Reasons cited for preferring fixed line over mobile

Main reasons for preferring fixed	Respondents September 2020	Respondents March 2020	Respondents December 2017
	Per cent	Per cent	Per cent
More reliable connection	63	61	64
Faster connection speed	44	49	50
Compatible with current devices	37	38	43
Other	15	12	13

Source: Survey data from Woolcott Research (commissioned by the CIE) (n=1011).

Other reasons cited for preferring fixed line to mobile internet include:

- fixed line services connect more devices that mobile
- fixed line services are better priced than comparable mobile offerings
- fixed line services are bundled with other services such as home phone and entertainment packages.

Similarly, internet subscribers have also cited reasons as to why they prefer mobile to a fixed line connection (table 2.10). For those that maintain a mobile-only connection in 2020, reliability and the mobile providing sufficient data allowance were cited as major reasons for preferring a mobile-only connection (although to a slightly lesser degree than in the March survey). In contrast, the 2017 survey highlighted price as the more common reason for a mobile-only connection, followed by download allowance and lack of availability of fixed line connections at premises.

2.10 Reasons cited for preferring mobile over fixed line

Main reasons for preferring fixed	Respondents September 2020	Respondents March 2020	Respondents December 2017
	Per cent	Per cent	Per cent
Fixed line not available at dwelling	19	12	28
Mobile download allowance is sufficient	37	44	32
Mobile internet is more reliable	38	46	na
Fixed line is too expensive	20	27	39
Other	9	7	14

Source: Survey data from Woolcott Research (commissioned by the CIE) (n=1011).

Other reasons noted for preferring mobile over fixed include:

- mobile internet is more convenient as most activities can be performed on a mobile device (especially where the household primary device is a mobile device such as a handset or tablet).
- users not being satisfied with the quality of their fixed line connection (including over NBN)
- mobile internet is perceived as cheaper than fixed line services.

Importantly, reliability and speed are cited both *for* mobile and *against* mobile. This indicates that the local service quality is critical in household decisions.

Data usage across different households and age groups

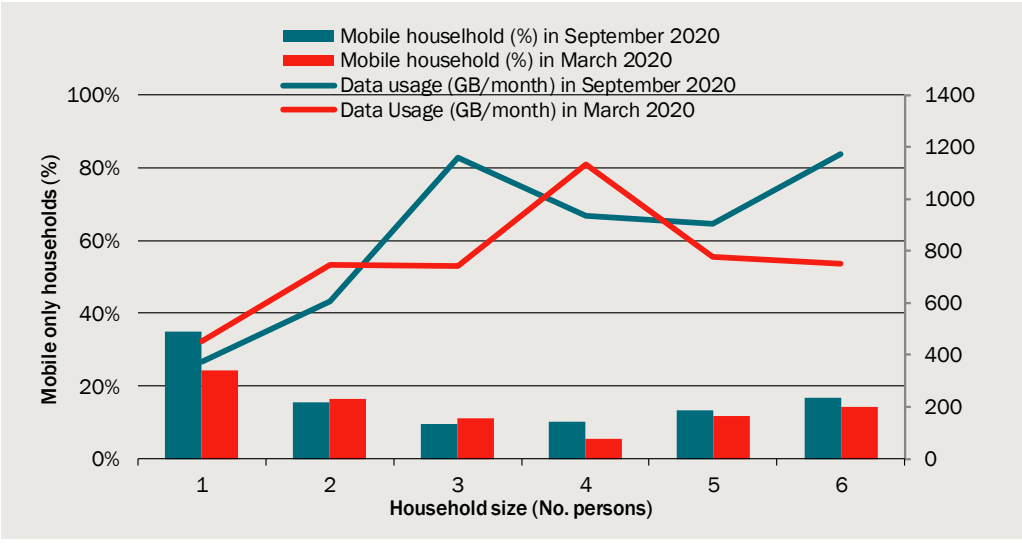
The nature of internet usage also varies with demographics. In particular, the size and composition of households can determine the extent of internet usage.

Data usage by household size

Data usage and type of internet access varies with the size of households (chart 2.11):

- smaller households are more likely to be mobile-only – 35 per cent of single households and 16 per cent of two-person households are mobile-only, compared to only 10 per cent of four person households.
- larger households use more data – on average, each additional member of a household is associated with 134 GB of increased usage (up from 56GB of usage in March). Larger households are also more likely to have unlimited download limits on their fixed line connection.

2.11 Data usage and type of access by household size



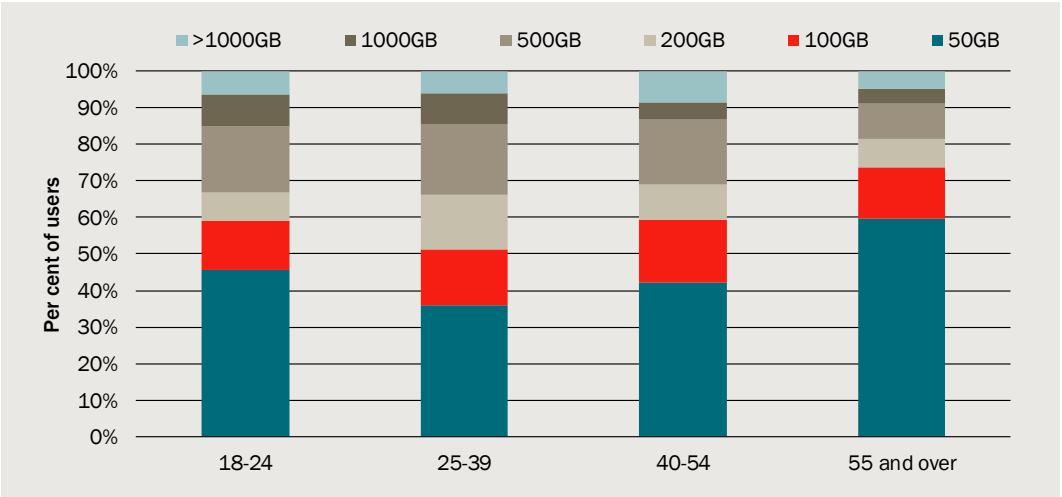
Data source: Survey data from Woolcott Research (commissioned by the CIE) (n=1011).

Data usage by age group

In addition to household size, the age of internet users also explains variation in data usage (chart 2.12).

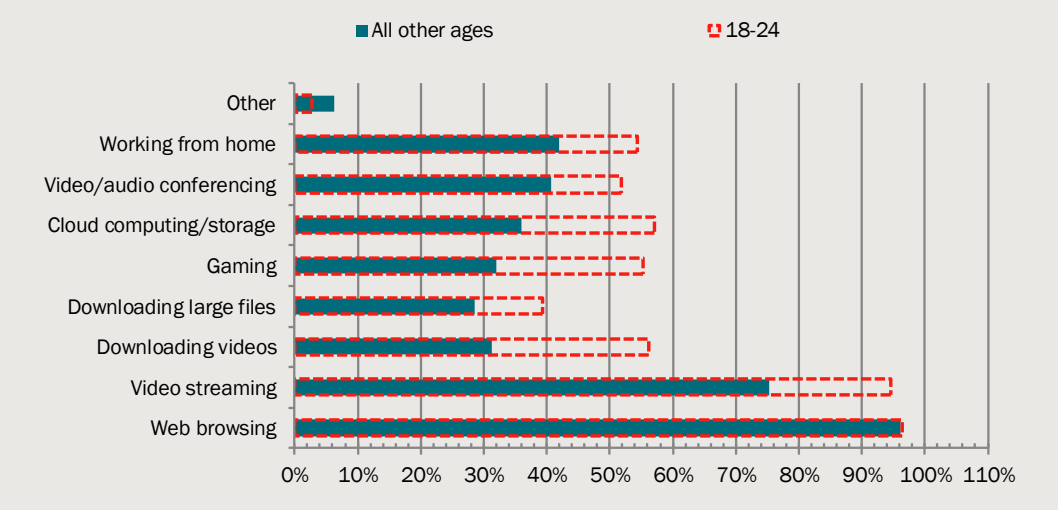
- Internet users aged 18-24 and 24-39 use more data compared to older generations.
- Around 60 per cent of internet users over the age of 55 use less than 50 GB of data on a fixed line connection per month compared with almost 45 per cent of users between the ages 18-24 and 24-39.
- Internet users between the ages of 40-54 were more likely to report monthly data usage over 1000 GB. Respondents in this age group were also more likely to be part of a larger household with dependents under the age of 18 who also use the internet, resulting in greater monthly usage.
- Younger internet users generally use more data due to more intensive internet usage patterns. Users in the age group 18-24 for example, are more engaged with social media, gaming and video streaming compared to the rest of the population (chart 2.13).

2.12 Fixed line data usage by age group



Data source: Survey data from Woolcott Research (commissioned by the CIE) (n=1011).

2.13 Internet usage of young Australians compared with the population



Data source: Survey data from Woolcott Research (commissioned by the CIE) (n=1011).

User experience on fixed line connections

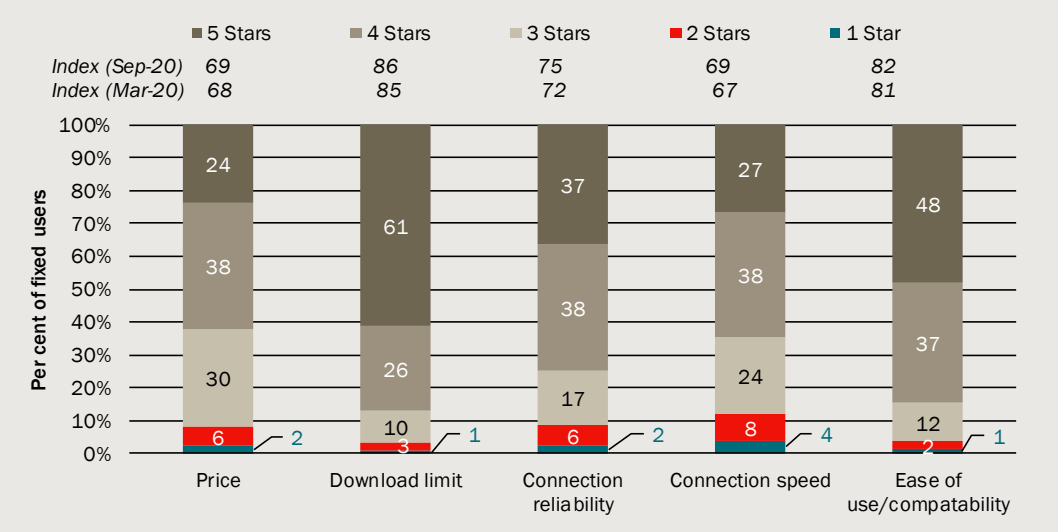
There are a range of characteristics that make up the user experience when using home internet. These include, price, download limit, connection reliability, speed and ease of use/compatibility with devices. Chart 2.14 presents user ratings out of five stars their experience with each of these characteristics (5 stars being the highest rating and 1 star being the lowest).

It is immediately clear that on the basis of download limits, fixed line customers are very satisfied, with 61 per cent of respondents giving a 5-star rating. Similarly, ease of use and compatibility is rated highly, with 48 per cent giving 5 stars and 37 per cent giving 4 stars. This makes sense once considering that fixed line connections can easily provide internet services to multiple devices within the home simultaneously.

Fixed line connections perform less well in terms of connection speed and reliability, with around 12 per cent of users being dissatisfied with connection speed, giving either 1 or two stars, and 8 per cent for connection reliability.

User experience across all characteristics has increased marginally since the March survey as shown by the index figures (score of 100 equates to 5-star rating while score of 0 equates to 1-star rating).

2.14 Rating of characteristics (out of 5 stars)

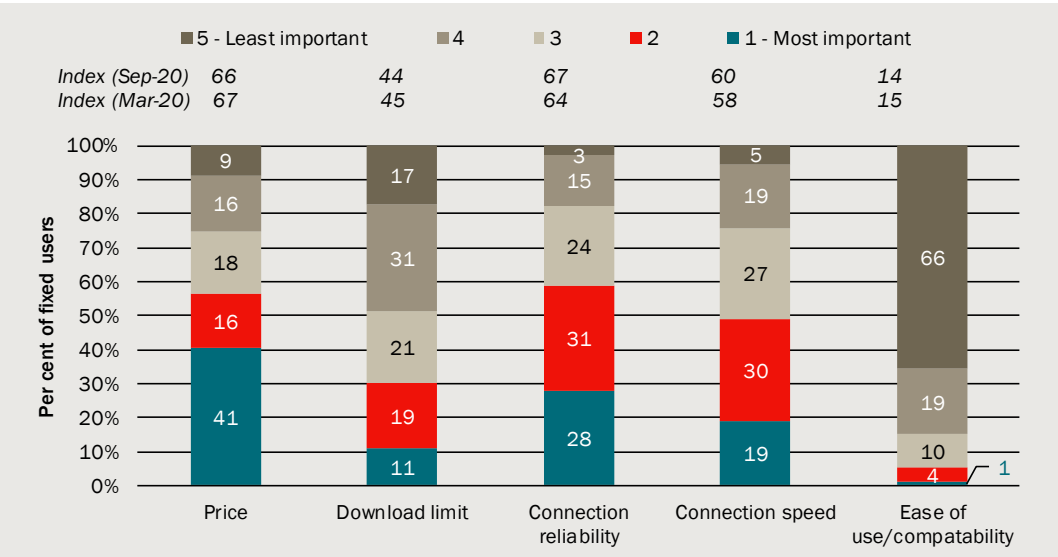


Note: Index measure aggregates the individual ratings (a score of 100 means all users rate the characteristic as 5-stars, while a score of 0 means that all users rate the characteristic as 1-star)

Data source: Survey data from Woolcott Research (commissioned by the CIE) (n=1011).

Users were also asked to rank the various characteristics of their internet usage in terms of importance (chart 2.15). The results indicate that users value price, connection reliability and connection speed the most. Download limit and ease of use/compatibility were seen as less important compared to the others, with 66 per cent of respondents placing ease of use/compatibility as the least important characteristic of their service. The rankings of these characteristics have remained consistent since the March survey.

2.15 Ranking of characteristics in terms of importance



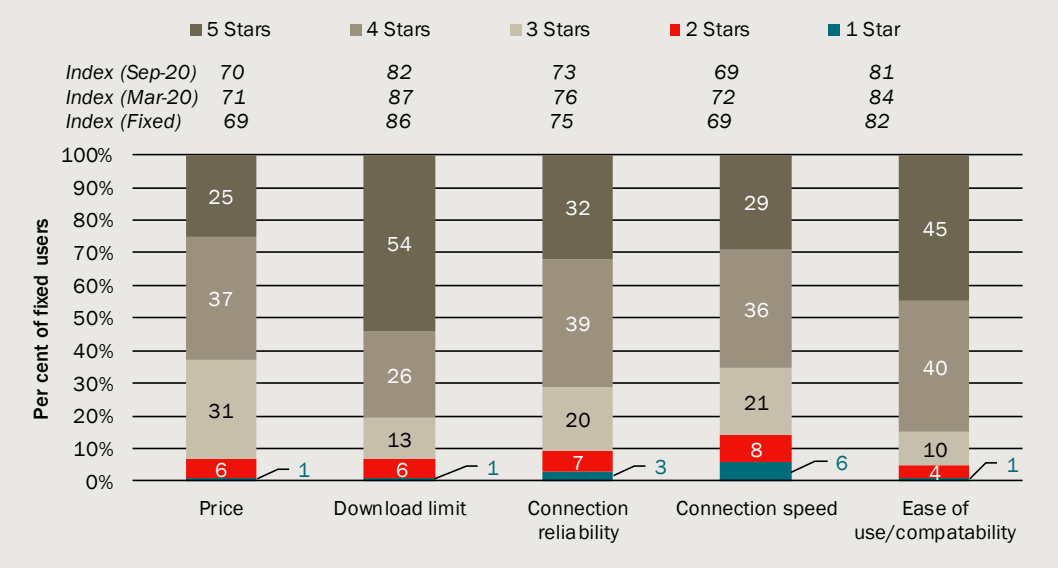
Note: Index measure aggregates the individual ratings (a score of 100 means all users rate the characteristic as 1 – most important, while a score of 0 means that all users rate the characteristic as 5 – least important)

Data source: Survey data from Woolcott Research (commissioned by the CIE) (n=1011).

User experience on NBN Fixed Wireless and Satellite connections

While the technology used to deliver NBN Fixed Wireless and Satellite services differs substantially from traditional fixed line connections, it does not appear that users in these groups have significantly different experiences with respect to quality and satisfaction. Compared to the March results, however, user experience has decreased slightly across all characteristics (chart 2.16).

2.16 Rating of characteristics (out of 5 stars) on NBN Fixed Wireless

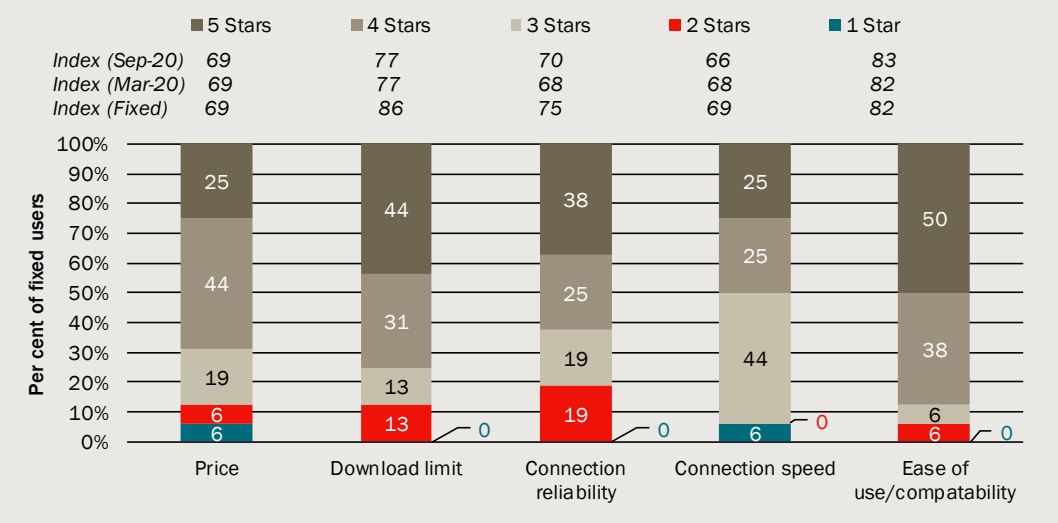


Note: Index measure aggregates the individual ratings (a score of 100 means all users rate the characteristic as 5-stars, while a score of 0 means that all users rate the characteristic as 1-star)

Data source: Survey data from Woolcott Research (commissioned by the CIE) (n=1011).

For NBN Satellite connections, the lowest ranked characteristic was connection reliability while the highest ranked characteristic was ease of use/compatibility. Overall satisfaction on satellite services is lower than fixed line connections across all characteristics except for price (chart 2.17).

2.17 Rating of characteristics (out of 5 stars) on NBN Satellite



Note: Index measure aggregates the individual ratings (a score of 100 means all users rate the characteristic as 5-stars, while a score of 0 means that all users rate the characteristic as 1-star)

Data source: Survey data from Woolcott Research (commissioned by the CIE) (n=1011).

The use of mobile connections within fixed line households

There is increasing evidence that households are using both fixed line and mobile connections within the home.

A key example of convergence in fixed line and mobile services is suppliers providing 'mixed access' through the use of modems with a 4G mobile back-up. Around 26 per cent of households with fixed line services indicated that they have a modem that can switch to 4G to keep them connected to the internet (table 2.18). This is a key example of supplier led convergence between fixed line and mobile internet for home access.

2.18 Proportion of fixed line households with 4G back-up modems

Has 4G back-up modem	Respondents September 2020	Respondents March 2020
	Per cent	Per cent
Yes	26	25
No	42	43
Don't know	32	32

Data source: Survey data from Woolcott Research (commissioned by the CIE) (n=1011).

Convergence is also being driven by deliberate choices to use mobile instead of fixed line connections within the home. This includes the use of 4G on mobile devices such as phones and tablets as well as dongles and portable home wireless modems.

Most users indicate that they will use a mobile service within the home instead of their fixed line service, with 31 per cent doing so a few times a month, 13 per cent a few times a week and 13 per cent doing so every day (table 2.19).

2.19 How often fixed line users switch to mobile services

Frequency of switching to mobile at home	Respondents September 2020	Respondents March 2020
	Per cent	Per cent
Never	20	16
Sometimes (a few times every month)	31	30
Often (a few times a week)	13	14
Very often (every day)	13	19
Don't have access to a mobile or wireless broadband service	15	10
Don't know	8	10

Data source: Survey data from Woolcott Research (commissioned by the CIE) (n=1011).

Users who make these decisions also provided reasons for doing so. The most common reason for using a mobile service in the home instead of the fixed line connection is due to outages or dropouts on their fixed line service (38 per cent of users). Around 28 per cent also indicated that they switch to mobile when experiencing slow speed on their fixed line service. This further highlights that connection speed and reliability are importance characteristics of internet usage and customer satisfaction.

2.20 Reasons why fixed line users switch to mobile services at home

Reason for switching	Respondents September 2020	Respondents March 2020
	Per cent	Per cent
No need to use fixed line service/plenty of data	26	22
Due to fixed-line outages or dropouts	38	40
Slow speed on fixed line	28	31
Other (please specify)	8	8

Data source: Survey data from Woolcott Research (commissioned by the CIE) (n=1011).

Drivers of future internet usage

Although internet usage levels vary across different groups and household types, internet usage growth on average has increased every year and is expected to continue as the applications of the internet for work and entertainment grow. The increase in demand for internet usage is related to a variety of factors, namely:

1 **the falling price of data, both on fixed line and mobile** – as our modelling in the next chapter will show, the price of data on mobile has fallen substantially, with the per unit cost of data lowest for plans with larger data allowances. In contrast a plethora of fixed-line plans offer unlimited download allowances, effectively driving the cost of data to zero.

2 **the increasing proliferation of high bandwidth applications and devices** – this is especially true given the increased demand for video traffic caused by streaming. Cisco estimates that the bit rate for 4k video is more than double that of HD while

HD is more than 9 times that of standard definition. By 2023, Cisco estimates that two-thirds of installed flat panel TVs will be ultra-HD, up from 33 per cent in 2018[8].

3 **the increasing number of internet connected devices (via IoT) being used by households and businesses** – Cisco estimates that connected home appliances and smart goods will represent half of all machine to machine connections in 2023. These connections will require greater bandwidth and lower latency[9]

The interactions of these trends, particularly 2 and 3, means that future internet demand will manifest across two dimensions:

- quantity of data — represents higher volume of data download and upload; and
- quality of data — represents the connection speed and reliability to enable seamless use of internet connected devices and applications.

We explore these two dimensions in the next chapter and show how they compare across fixed line and mobile connections.

8 Cisco Annual Internet Report 2018-2023 white paper, available at: https://www.cisco.com/c/en/us/solutions/collateral/executive-perspectives/annual-internet-report/white-paper-c11-741490.html

9 Cisco Annual Internet Report 2018-2023 white paper, available at: https://www.cisco.com/c/en/us/solutions/collateral/executive-perspectives/annual-internet-report/white-paper-c11-741490.html

3 Comparison of fixed line and mobile services

KEY POINTS

- **Data inclusions for mobile services are increasing and the price of data for mobile services is falling.**
- **Speed tests performed by fixed line and mobile customers suggests that average download and upload speeds are higher for mobile compared to fixed line connections.**
- **There is little data available comparing the reliability of fixed line and mobile services. Surveys by Choice suggest fixed line customers experience more connection problems than mobile customers.**
- **Comparisons of these characteristics across the entire population will not account for individual differences in location and other factors that can significantly impact the speed, reliability and performance of fixed line and mobile services.**

Customer choices between fixed and mobile services depend on the price of these services, in addition to other characteristics such as the:

- amount of included data usage per month
- connection speed
- reliability
- latency, and
- compatibility with existing devices.

The level of substitution between fixed line and mobile services depends on how they compare in terms of these characteristics. If non-price characteristics of these plans are very different, then they would be poor substitutes, while if these characteristics are similar it suggests they would be close substitutes. The perception of the relative strengths and weaknesses of each access type can also be different depending on the user. As our survey has shown, there is a subset of users of both fixed line and mobile-only that report a willingness to switch based on characteristics such as speed and reliability.

Data allowances and prices per GB

Consumers are downloading increasing amounts of data, mainly associated with video streaming, cloud services and having more connected devices. This means that the download allowance of broadband plans is a very important characteristic to consumers.

The price of data under fixed line and mobile plans

The data allowance of mobile and fixed line plans is one of the most important characteristics in determining the price of the plan. The cost of data can be measured by decomposing the price of broadband plans into separate components related to their included features. Appendix A describes the hedonic modelling approach we have used to break down the price of plans into the value of included data, the premium for different providers, and value of other characteristics. The relationship between price and data inclusions in broadband plans can be measured in terms of the price per GB of data download allowance.

Fixed line price of data

It is difficult to estimate the price per GB for fixed line plans, given that these plans often have unlimited download allowances. Where the data allowance is unlimited, the price of data (in $ per GB) is not defined. This suggests that the price per GB has fallen to almost zero, given that customers are not generally charged higher prices per month for higher data allowances.[10]

Some providers do have plans with limited data allowances (such as 10GB, 100GB or 1000GB allowances). However, all providers now offer plans with unlimited data allowances, and some providers only offer unlimited allowances.

Mobile price of data

In contrast to fixed line plans, mobile plans often have limited data allowances. The price per GB for mobile plans can therefore be estimated using the hedonic modelling. The price of data is not constant with respect to the amount of data included, with the price per GB of plans with low allowances being lower than the price per GB for plans with high allowances.

As part of this current project and in previous work, The CIE has collected a database of mobile plans each year from 2014-2017, as well as more recently for early 2020. Over time the upper limit of data allowances available has been increasing significantly, up to 240GB in early 2020 (chart 3.1). This does not include the unlimited data plans now available from some mobile providers.

The increase in maximum data allowances available under mobile plans means that mobile is increasingly able to meet consumer demand for higher downloads. That is, the difference between data allowances of fixed line and mobile plans is getting smaller.

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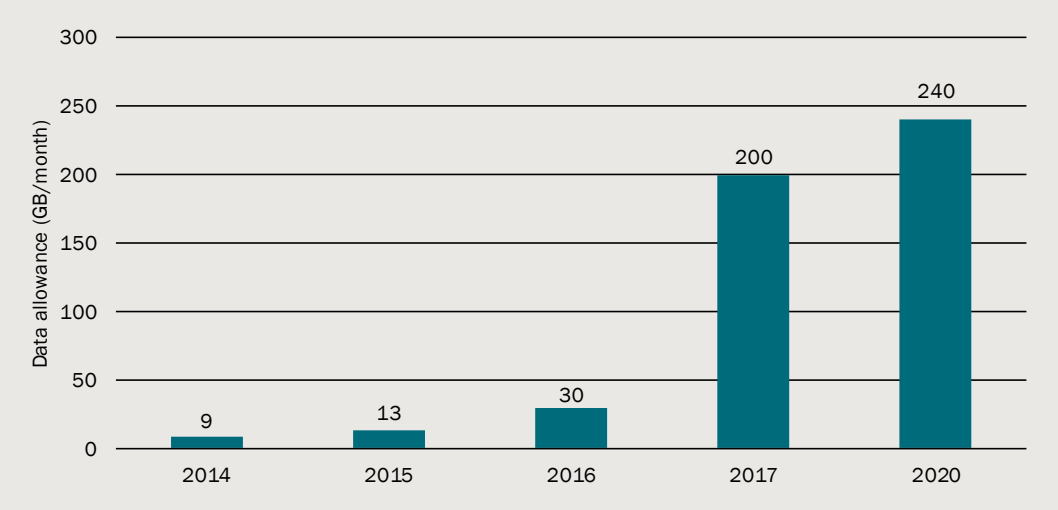
10 Instead of charging users based on their usage, providers may recover the costs of providing more usage capacity through fixed costs charged to all users. If this were the case, it would suggest that the cost of data is low. If the price of data was high this would be an unsustainable equilibrium, because competitors would be able to supply the same service to low-usage customers at lower prices than to high-usage customers.

3.1 Highest mobile data allowances available over time



Note: This does not include the Vivid Wireless (now owned by Optus) unlimited data plans for wireless in the home. These plans have been available since at least 2014, but speeds are low meaning that high data usage may not be possible.

Data source: CIE databases of mobile plans 2014-2017.

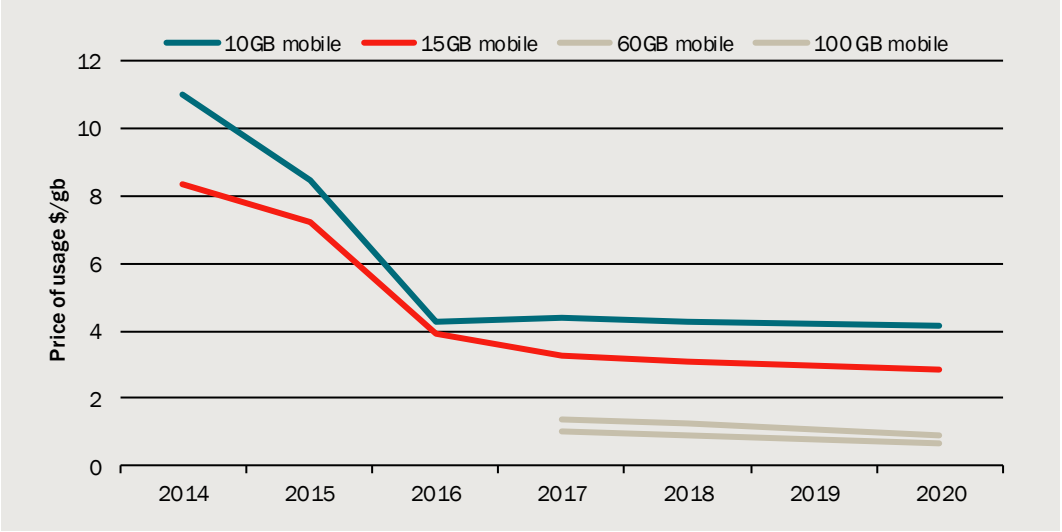
It is apparent from chart 3.1 that data allowances for mobile are increasing at a much faster rate than prices, suggesting that the price of data is falling.

Hedonic modelling of the price of data for mobile shows that it has fallen dramatically over time (chart 3.2). For example, the price of a data allowance of 15GB (not including the base price of mobile plans without a data allowance) has fallen from over $8/GB in 2014 to around $3/GB in 2020. In more recent years plans with larger data inclusions have become available, including unlimited data. The price per GB is lower compared to plans with smaller allowances. For instance, the price per GB for a 100GB a month plan is under a dollar per GB. Because these plans are new, there are less data points available to track their price over time.

These estimates of the price of data are based on looking across a wide range of plans with different data (and other) inclusions. This finds that the price of data falls as plans get bigger — going from a 10 GB/month to 15GB/month has a higher cost than going from 50GB to 55GB.

The estimates of the price of data for individual data limits (e.g. 10 GB/month) has stabilised somewhat from 2017 to 2020. However, the overall price of data will have fallen by more than this, as more customers have moved to higher data plans.

3.2 Price of data for mobile plans over time



Note: The values for 60GBand 100GB mobile were imputed in a straight-line fashion between 2017 and 2020 as observations were not collected in this year.

Data source: CIE hedonic modelling.

International developments in mobile

Internationally, more mobile providers are beginning to offer unlimited mobile plans. This includes major carriers in the United States such as AT&T and T-Mobile, as well as Vodafone in the UK (table 3.3). Plans in the US throttle speeds above a certain data download limit or while downloading different types of content, while in the UK speed is capped depending on the plan type.

3.3 Example mobile plans in the US and the UK

	AT&T Unlimited Elite	T-Mobile - Magenta	Vodafone UK
Data allowance	Unlimited (throttled past 100GB)	Unlimited (throttled past 50GB)	Unlimited
Streaming quality	HD	SD	HD
5G access	Yes	Yes	Yes
Inclusions	na	Netflix	na
Speed limitation	Yes	Yes	Yes - always restricted to 2 Mbps or 10 Mbps depending on plan

Source: AT&T: https://www.att.com/buy/wireless/deviceconfig, T-Mobile: https://www.t-mobile.com/cell-phone-plans/magenta-plus, Vodafone UK https://www.vodafone.co.uk/mobile/best-sim-only-deals

Use of mobile networks to provide broadband to the home

There have also been developments in the use of 5G mobile networks to provide broadband in the home. A key example is Verizon in the US, which provides fixed-

wireless broadband to '5G ready' households that are within its 5G footprint[11]. Verizon offers a $70 a month unlimited data plan with typical speeds of around 300 Mbps and a maximum speed of up to 940 Mbps. Other inclusions include discounts if the customer already has a mobile service (bringing the monthly price down to $50) as well as entertainment bundles such as Apple TV.

In New Zealand, Spark made 4G fixed wireless broadband options available towards the end of 2019 to select areas in Auckland as part of its 'Unplan Metro' service, which has a range of price points for different download allowances including $85 a month for usage up to 600GB[12]. Similarly, in Australia, Optus has begun offering a 5G home broadband service for $70 per month with a "50 Mbps Guarantee" on speed and unlimited download[13]

Speeds of services

Connection speed is another key characteristic of fixed line and mobile services. Consumers prefer faster connections, particularly with the proliferation of bandwidth-intensive applications such as video streaming.

Factors that affect connection speeds

The connection speed that a consumer receives is dependent on a number of factors, such as the following:

- **Network technology**: whether the service is provided via the fixed line or mobile network. If the service is provided on a fixed line network, speeds will also vary between Fibre, ADSL2+, NBN Fixed Wireless, NBN Satellite or other network technologies.
- **Geographic location**: fixed line connection speeds are higher for households located closer to certain parts of the network infrastructure (such as exchanges or nodes). The type of fixed line connection (NBN Fibre-To-The-Home, ADSL2+, etc.) available to a household depends on their location, with households outside metropolitan areas often only having access to relatively slower NBN Fixed Wireless or NBN Satellite services. Mobile connection speeds depend on location and topography as well as distance from network infrastructure, in particular mobile towers.
- **Time-of-day and competing users**: the number of competing users of fixed line and mobile networks at a given time will affect speeds. In particular, speeds are lower during peak times in the evening, when many households are using the internet at the same time.

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11 See https://www.verizonwireless.com/5g/learn-5g-home-internet/

12 See https://www.sparknz.co.nz/news/Spark-unveils-Unplan-Metro-Wireless-Broadband/ and https://www.nzherald.co.nz/business/news/article.cfm?c_id=3&objectid=12284056

13 See https://www.optus.com.au/broadband-nbn/5g-home-broadband/5g-home-broadband-plan#emailDetails.

- **Capacity provisioning**: the difference between peak and average speeds experienced by customers can depend on capacity provisioning. Fixed line customers receiving services on the NBN will be allocated a certain amount of capacity based on the amount of Connectivity Virtual Circuit (CVC) acquired by their retailer.

Comparison of average connection speeds between fixed line and mobile

With the NBN rollout all but complete, most fixed line broadband users are on an NBN service. Around 32 per cent of fixed line users stated that they are on a 50 Mbps plan, compared to 15 per cent on 100 Mbps and 19 per cent on 25 Mbps. A sizeable proportion (27 per cent) are not aware of their speed tier (table 3.4). These speed tiers can also be compared against the measured average download speed in busy periods, which is reported by the ACCC as part of its broadband performance statistics. For most customers, the average speed they experience in busy period will be below their plans maximum (e.g. a 100 Mbps plan will typically yield speeds of 84.9 Mbps during busy periods).

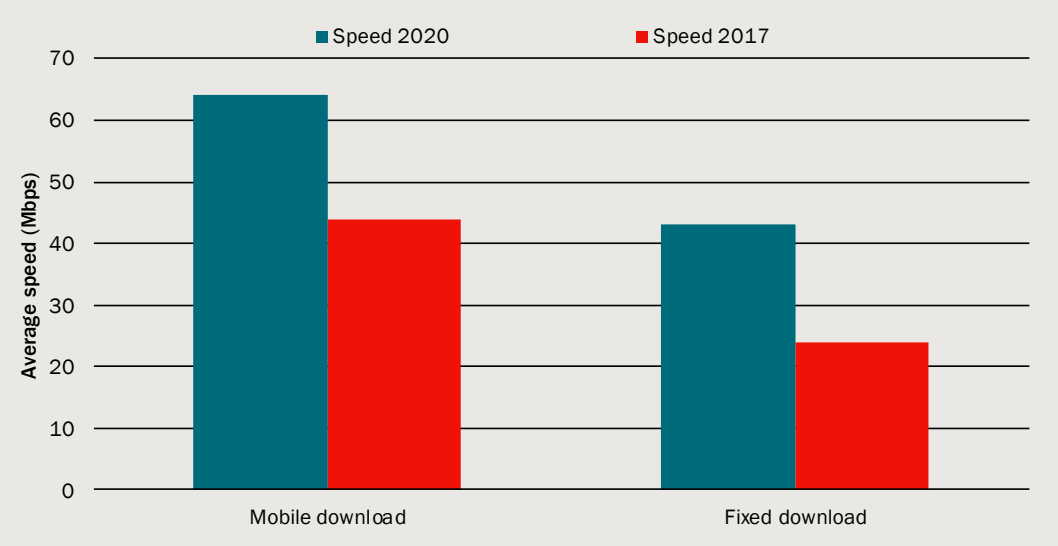
3.4 Average speed and proportion of users on NBN plans

Speed tier	Proportion of fixed users – survey (Sep-20)	Proportion of fixed users – survey (Mar-20)	Proportion of fixed users – ACCC	Average speed during busy hours
		Per cent	Per cent	Mbps
NBN 12 Mbps	6	8	18	na
NBN 25 Mbps	19	17	15	22.2
NBN 50 Mbps	32	38	56	42.4
NBN 100 Mbps	15	13	8	84.9
Don't know	27	23	na	na
Other (please specify)	1	1	2	na

Source: Survey data from Woolcott Research (commissioned by the CIE) (n=1011), ACCC Broadband performance data, accessible at https://www.accc.gov.au/consumers/internet-landline-services/broadband-performance-data (2/04/2020), ACCC, NBN Wholesale market indicators report December 2019, https://www.accc.gov.au/regulated-infrastructure/communications/national-broadband-network-nbn/nbn-wholesale-market-indicators-report/december-quarter-2019-report.

On average, mobile internet speed is higher than fixed line in Australia, although speeds on both access types have increased over time (chart 3.5). Fixed line speeds have increased from 24 Mbps on average in 2017 to 43 Mbps currently. Mobile speeds in contrast have increased from 44 Mbps to 64 Mbps over the same period. This gap may widen as 5G services deploy more widely in Australia over the coming years.

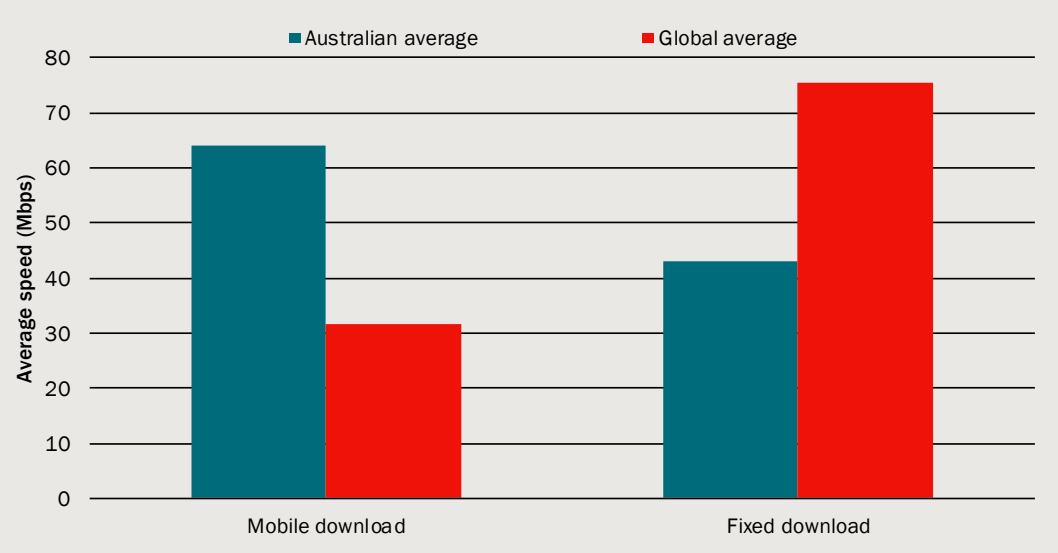
3.5 Comparing fixed line and mobile speed in Australia over time



Data source: Speed Test Global index, available at https://www.speedtest.net/global-index#mobile

In terms of international comparisons (chart 3.6), Australia has lower than the global average speed on fixed line services (43 Mbps compared to 75 Mbps), however outperforms in terms of mobile speeds (64 Mbps compared to 32 Mbps).

3.6 Comparing Australian download speeds to international averages



Data source: Speed Test Global index, available at https://www.speedtest.net/global-index#mobile

It should be noted that the average speeds measured by this speed test may be biased estimates of average speeds across all users and times. It is likely that users perform speed tests at times when they have just started receiving a new service, or when they are experiencing connection problems and slow speeds. These and other unknown factors have an uncertain net effect on the estimates. The results of the Ookla Speedtest are the largest data sample available to assess the relative speeds of fixed line and mobile customers.

Reliability

Reliability can have two main meanings in the context of home internet services, either relating to the:

- variability of speeds, or
- frequency of service interruptions.

Customers may interpret 'reliability' to relate to speeds and may describe a connection which experiences long loading times as being 'unreliable', even if this is attributable to low average speeds. Having already addressed average speeds, in this section we focus on the variability of speeds and the frequency of disconnections and drop-outs.

Customers value connections which have consistent speeds. Highly variable speeds can result in unexpected delays in videos while files are downloading, inability to quickly access downloadable files when desired or reductions in the resolution of streaming videos when speeds fall.

Fixed line reliability

The Choice *Internet Service Provider Satisfaction Survey 2019* found that 23 per cent of users experience disconnections, dropouts or variables speed performance on their fixed-line connection[14]. This has not changed materially over the past few years, with 17 per cent of ADSL2+ customers and 25 per cent of NBN customers experiencing the same issues in 2017[15]. This is further supported by results from our survey, in which 40 per cent of fixed-line internet users reported switching to a mobile service within the home due to experiencing a dropout or outage on their fixed line connection.

While there is little quantitative evidence about the variability of speeds for fixed line services, our survey information has shown that 31 per cent of fixed-line users rely on a mobile service within the home due to experiencing slow speeds on their fixed line connection.

Mobile reliability

The reliability of service on mobile networks can be measured by the proportion of times that users have access to a connection. The OpenSignal *State of Mobile Networks* report 2019 for example measures how often users can access a 4G network rather than a lower speed network. As at May 2019, the report states that depending on the mobile network

14 Internet service provider satisfaction survey 2019, available at :https://www.choice.com.au/electronics-and-technology/internet/connecting-to-the-internet/articles/internet-service-provider-satisfaction-survey

15 *Internet Service Provider Satisfaction Survey 2017*, July 2017, available at: https://www.choice.com.au/electronics-and-technology/internet/connecting-to-the-internet/articles/internet-service-provider-satisfaction-survey-2017

the customer uses, a 4G connection is available around 90 per cent of the time.[16] This is up from 75 per cent since our previous report on mobile substitution in 2017, which suggests the reliability of mobile connections as increased over time.

In terms of reliability of mobile speed, the P3 connect Mobile Benchmark Study examines the performance and quality of mobile networks in Australia, with a particular focus on comparing this performance across locations and providers. The study's methodology involves walking and driving around large Australian cities, regional towns and regional roads and measuring download speeds, upload speeds and other performance and quality indicators.

The P3 connect Mobile Benchmark results exhibit considerable variation in download speeds across locations (table 3.7). The average speed in large cities of 92 Mbps while driving, which is higher than the previous year. Speeds while driving in cities are around 37 per cent higher than in towns (slightly higher than the 35 per cent difference the year earlier). The speeds experienced while driving are not ideal measures for assessing the speeds likely to be experienced by mobile users at home, but this illustrates the significant difference in speeds between towns and cities.

The average speed while walking in large cities was 61 Mbps, which is lower than the 74 Mbps experienced a year earlier. This illustrates the wide variation in speeds that can be experienced on mobile networks. However, testing was conducted between 8am and 10pm, meaning that average speeds may not reflect those experienced by households using their mobile network during peak hours. Additionally, because testers were walking during the test, which means they may walk between areas of lower or higher connection strength, the amount of speed variation may not be reflective of speed variation experienced during stationary use at home. Despite these qualifications, the results provide an illustration of the variability in speeds experienced by mobile network users.

3.7 P3 connect Mobile Benchmark variability in speeds by location (7 second download test) 2018

Percentile	Cities - drive test	Cities walk test	Towns drive test	Data on roads test
	Mbps	Mbps	Mbps	Mbps
90th percentile	19	14	71	4
50th percentile	92	61	67	43
10th percentile	195	118	139	103
50th percentile in 2017	65	74	47	35

Note: The 10th-50th percentiles and 50th-90th percentiles have been calculated using the tables on pages 9-10 of the P3 connect Mobile Benchmark in 2018. These tables report the speed (in Mbps) threshold that speeds exceed 90 per cent of the time, and that speeds exceed 10 per cent of time. These are interpreted as 10th and 90th percentiles of the distribution of speeds during testing.

Data source: The 2018 P3 connect Mobile Benchmark in Australia 2018, CIE.

16 Open Signal: the state of mobile experience may 2019, available at https://www.opensignal.com/sites/opensignal-com/files/data/reports/global/data-2019-05/the_state_of_mobile_experience_may_2019_0.pdf

Latency

Latency refers to the time taken for a signal to be sent from your computer or device to another and then a response to be received. This can be interpreted as the delay in an internet connection.

Latency can be important for certain applications such as videoconferencing, gaming and live streaming.[17]. For example, video-calls using a connection with high latency will have a noticeable delay between when one person says something and the other person hears it, much like the delay experienced with long-distance phone calls.

Information on the actual latency experienced by Australian fixed line and/or mobile users is sparse. The OpenSignal *State of Mobile Networks* report presents metrics for latency on 4G mobile networks. As at May 2019, latency on 4G networks was around 37.6 ms on average. This is lower than the average latency of 51-57 ms from the previous 2017 report. Lower scores for latency show that the network is more responsive, and that users will experience shorter delays as data makes a round trip through the network.

The OpenSignal data does not provide a comparison between these latency estimates and latency of fixed line connections. However, latency is highly dependent on the hardware used by the customer. For example, Wi-Fi connections experience higher latency than ethernet connections.[18] Thus, while latency may be an important factor for households considering fixed line and mobile connections, because of the individual-specific factors (such as hardware) that affect latency, there is insufficient evidence to determine whether fixed line or mobile connections offer lower latency.

Other factors that will affect preferences for mobile or fixed line

A number of other reasons may exist for customers preferring mobile or fixed line services:

- **Many devices or a single device**: there are few mobile services available that cope with multiple devices. That is, most mobile services have one SIM associated with that service, which is in one device (such as a mobile handset or tablet). While technology (such as Wi-Fi routers with a SIM) is available, these may be unfamiliar to customers, thus presenting a barrier to switching from fixed line to mobile.
- **Regular changes of address or no fixed address**: these customers may prefer mobile services over fixed line services in order to avoid the longer contract durations and initial/setup costs of fixed line subscriptions, which may be prohibitively expensive for those who regularly change address.
- **Location of premises**: some premises do not have a fixed line connection available or would experience poor fixed line connection performance due to their distance from network infrastructure (such as exchanges or nodes). This may relate to more than just speed.

17 Latency refers to the time taken for data to travel between its source and destination.

18 See https://www.NBNco.com.au/blog/connected-homes/wifi-vs-ethernet-cables-pros-and-cons.html

4 Technology changes in fixed line and mobile services

Key points:

- **Technological advancement is enabling a growing number of households to access the internet without using a fixed-line connection.**
- **5G technology will continue to erode the barrier between fixed line and mobile internet, with vastly superior speeds and reliability ushering in a new era of digital connectivity through the 'Internet of Things'.**
- **5G technology is showing early signs of being able to compete with fibre based fixed line networks. The NBN may have a role to play in facilitating the deployment of 5G infrastructure.**
- **Consumers are increasingly turning to mobile devices as their first point of online access. Many digital business strategies are geared towards 'mobile-first' and consumers have grown accustomed to focusing on services rather than infrastructure, forcing telecommunications providers to adapt to remain relevant.**
- **Like mobile technology, fixed line technology will continue to evolve and improve. This will require technology-neutral policy settings.**

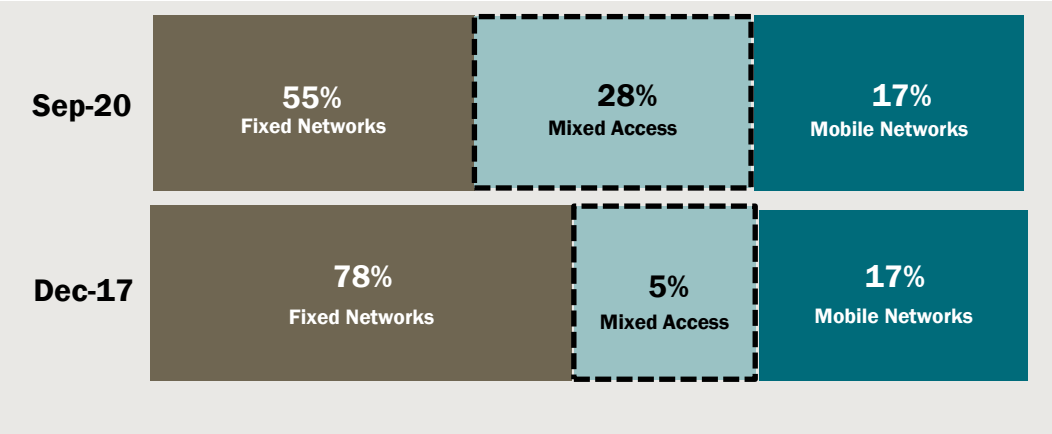
Evolution in broadband access

The growing capabilities of telecommunications technology is empowering customers with new ways to access the internet. Since the introduction of 4G LTE mobile networks, a subset of households has found it favourable to bypass conventional fixed line broadband and have their needs met by a mobile-only connection. To date, fixed line and mobile internet connections, although enabling very similar use cases, are still different with respect to a few key characteristics, bringing about a unique set of advantages and limitations for users. As has been previously explored, these differences mainly lie in the fact that fixed line connections typically provide large download allowances at a relatively lower cost per GB, whilst mobile connections provide a more modest download allowance at a higher cost per GB in exchange for faster speed and mobility.

In some applications, advancements in telecommunications technology has also begun to blur the lines between fixed and mobile broadband, with increasing convergence leading to mixed broadband access types such as home wireless and 4G back-up modems. The rapid pace of growth in wireless technology has the potential to disrupt the future of household broadband and this is already being seen, with over 28 per cent of households

accessing the internet through alternatives to conventional fixed line connections[19] (chart 4.2).

4.1 Internet access by technology type in Australia



Note: Graphic is for illustrative purposes and is not to scale

Data source: CIE & Woolcott Research Survey.

Convergence in broadband technologies

Convergence in broadband technologies leads to less emphasis on the customer choosing access types and instead allows the service provider to determine the optimal connection depending on the context. This is a form of supplier-led substitution between fixed line and mobile internet connections. Convergence has the role of bridging the gap between the advantages and limitations of fixed line and mobile connections to provide a superior service to the customer and this is currently achieved by:

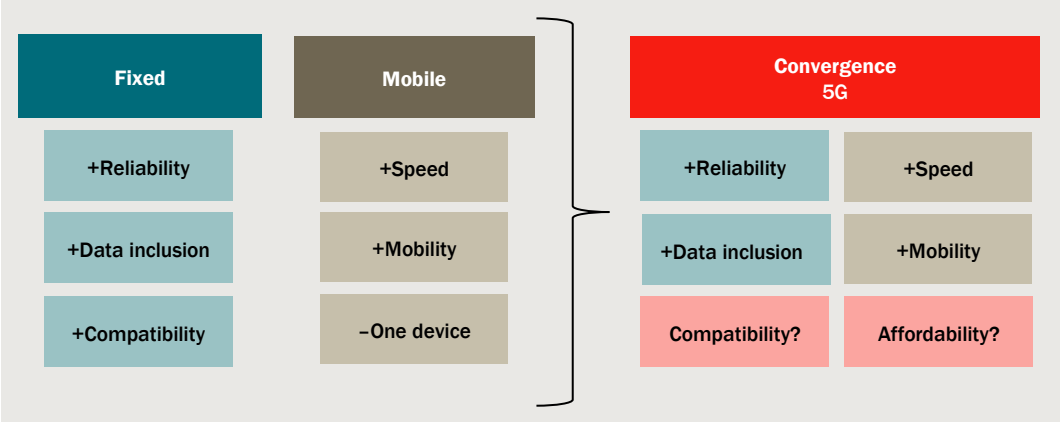
- **Enabling higher data usage on mobile** – current efforts involve the use of hybrid cellular networks which uses automatic switching between cellular connections and local Wi-Fi hotspots to reduce contention on the mobile network and enable non-metered data usage (such as Telstra Air in Australia and Google's Project Fi overseas).
- **Increasing speed and performance on fixed line** – this is possible through modems which include an in-built 4G SIM and antenna that enables connection to the mobile network, such as the Vodafone Wi-Fi Hub. This provides customers with instant access to Vodafone's 4G mobile network while they wait for the NBN to be connected, or if there is a fault on the NBN.
- New service offerings are made possible due to the rapidly accelerating pace advancement in wireless technologies. Whilst it is technically possible to 'cut the cord' entirely today and use mobile and wireless connections, many internet users have so far not made the trade-offs associated with switching technologies due to either cost or

19 Of this 28 per cent of all internet users (mobile-only and fixed line), 11 per cent are households on a home wireless (NBN Fixed Wireless) connection, while 17 per cent are users which have a fixed line connection with a 4G back-up smart modem.

limits of technological capability in servicing large volumes of customers in urban areas. This pattern is set to change however, as 5G is deployed.

5G is capable of combining the features of mobile networks such as ultra-fast speeds and mobility with the high capacity and reliability users typically experience on fixed line connections[20] (chart 4.2). Whilst unknowns remain with respect to the affordability of future 5G services and how compatible it will be with common household devices (compared to fixed/Wi-Fi), the widespread adoption of 5G will certainly provide new opportunities for connectivity and enhance the user experience by unlocking new use cases.

4.2 Convergence between fixed line and mobile



Data source: CIE.

The next generation of mobile broadband – 5G

GSMA figures as of September 2020 indicate that worldwide there have been 106 commercial 5G launches, 7 per cent of the population has access and by 2025 it is expected that 20 per cent of connections will be 5G.[21]. 5G will pave the way for a dramatic growth in capacity compared to 4G, allowing a much higher density of concurrent mobile users and enabling superior device-to-device and massive machine communications. In Australia, the Government has recently declared that 2.4 GHz of essential spectrum in the 26 GHz band will be available for licensing to facilitate the rollout of 5G across the country.[22]

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20 GSA: 5G vision, characteristics and requirements 2016 (accessed at https://www.gsma.com/spectrum/wp-content/uploads/2016/08/GSA-5G-Spectrum-update.pdf), NGMN 5G White Paper 2015, page 9

21 GSMA website, accessed 19 October 2020, https://www.gsma.com/futurenetworks/ip_services/understanding-5g/

22 Australian Government Department of Infrastructure, Transport, Regional Development and Communications website, accessed 4 June 2020, https://www.communications.gov.au/departmental-news/spectrum-released-5g-rollout

Unlocking new use cases with 5G

The growth in capacity of 5G is expected to pave the way for a new paradigm in internet usage. The combination of high speed (bandwidth) and low latency is expected to enable a variety of use cases[23]:

1 **Fast broadband access in dense areas**
   - providing access to thousands of people and devices per square kilometre
   - data rates in the hundreds of megabits per second, enabling pervasive use of always-connected applications and high-fidelity visual content, including augmented and virtual reality

2 **High user mobility and reliability**
   - enhanced connectivity for in-vehicle internet usage, including high speed transport such as trains and aircraft
   - more precise navigation capabilities
   - seamless usage whilst traveling, with no dropout when moving between cell sites

3 **Massive Internet of Things**
   - high capacity networks can facilitate many connected devices simultaneously
   - pervasive sensor networks in urban areas with applications in smart cities for dynamic traffic management, metering and surveillance

4 **Extreme real-time communications and 'tactile internet'**
   - extremely low latency will enable mobile real-time interactions including remotely controlling real and virtual objects with instant or 'tactile' feedback
   - network connected devices such as autonomous vehicles can respond to each other in real time, leading to more reliable and safer experiences.

More recent thinking is seeing a particular focus on enterprise use and ways to provide higher reliability and performance for some users (network slicing).[24]

Role of the NBN and 5G in providing superfast broadband

Parallel to the rollout of 5G mobile networks is the imminent completion of the NBN. While there has been a significant increase in internet speeds in Australia as a result of the NBN, Australia has lower than the global average speed on fixed line services (43 Mbps compared to 75 Mbps)[25].

The mostly fixed line NBN can offer superfast speeds, however its ability to deliver and ultimately compete with alternate technologies such as 5G depends a great deal on its pricing.

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23 NGMN White Paper, 2015

24 GSMA website, https://www.gsma.com/futurenetworks/technology/understanding-5g/, GSMA 2020, *Network economics annual report,* https://www.gsma.com/futurenetworks/wp-content/uploads/2020/03/Final_GSMA-Network-Economic-Report-2020.pdf.

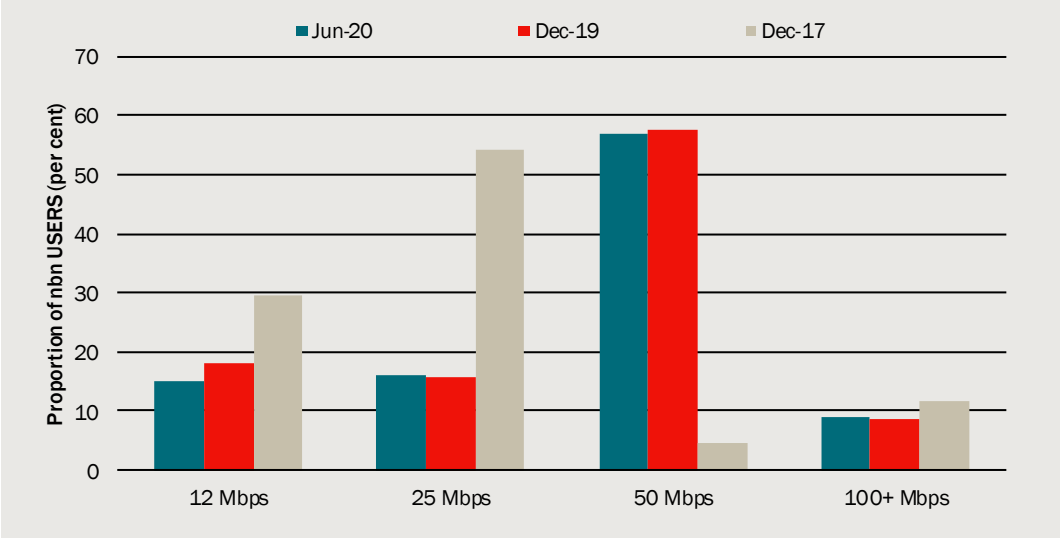
25 Speed Test Global index, available at https://www.speedtest.net/global-index#mobile

Retail speed offerings on the NBN are directly related to the cost retailers must pay to transfer data on the NBN (also known as connectivity virtual circuit or CVC). There has been a significant reticence amongst NBN retailers to promote the higher speed services that the NBN offers in large part due to the industry's concern that higher speeds result in more data usage and therefore uneconomic costs for retailers.

The prohibitive costs of providing higher speed broadband services on the NBN have been reflected in the low initial take up rate for speeds faster than 25 Mbps (which is still available on non-NBN packages such as ADSL2+).

Changes in pricing by the NBN in the past couple of years have led to a significant shift in users from lower speed bands to the 50 Mbps speed package, with a smaller share of users moving to the 100 Mbps speed package (chart 4.3). However, NBN retailers have been advocating for the removal of the CVC charge and the adoption of a flat rate charge for each of the speed packages to make it more attractive for retailers to offer faster speeds on the NBN.

4.3 Take-up rate of speed packages on NBN



Notes: Excludes Wireless Plus and take up of >100 Mbps plans.
Data source: ACCC, NBN Wholesale market indicators report December 2017, 2019 and June 2020, https://www.accc.gov.au/regulated-infrastructure/communications/national-broadband-network-nbn/nbn-wholesale-market-indicators-report/june-quarter-2020-report

Fibre-based fixed line networks can offer superfast speeds, although their ability to deliver and ultimately compete with alternate technologies such as 5G depends a great deal on cost and pricing. The other significant advantage of fixed connections lies primarily in offering large data download inclusions as opposed to speed.

5G 'fixed wireless' services

Given NBN retailers' concerns regarding the costs of providing higher speed broadband services on the NBN, it is expected that the industry will increasingly focus its attention on 5G to meet the increasing consumer demand for fast broadband services in future.

The use of higher frequency spectrum and new technologies such as massive multiple-input, multiple output (known as MIMO) on 5G will enable larger scale fixed-wireless deployments in urban areas with vastly reduced congestion[26]. Early 5G fixed-wireless deployments for household broadband and this is being used in the US[27] and Australia. Point to point transmission on 5G fixed wireless is expected to provide extremely fast speeds and ultra-low latency, competing with the current speed offerings on the NBN.

The trend towards 'mobile-first'

Underlying technological advancement in broadband technology are fundamental changes in the way consumers are interacting with digital content. Mobile is increasingly the first and preferred means of connecting to the internet. This is reflected in the fact that mobile sales (as indicated by global shipments) have consistently exceeded the sale of PCs since 2010 (chart 4.4). The high market penetration of smartphones is reflected in the fact that people are using mobile exclusively for certain activities such as social media and web browsing, and over half of the average user's online time is now spent on mobile[28].

Global smartphone shipments, while vastly exceeding that of PCs do appear to have plateaued and even decreased in recent years. This suggests a degree of saturation in the market for smartphones. The next wave of mobile capable devices is likely to be smart home appliances and smart goods. Cisco estimates that connected home appliances and smart goods will represent half of all machine to machine connections in 2023. These connections will require greater bandwidth and lower latency[29]As the role and capabilities of mobile devices grows, there is greater potential for consumer-led substitution towards mobile-only internet.

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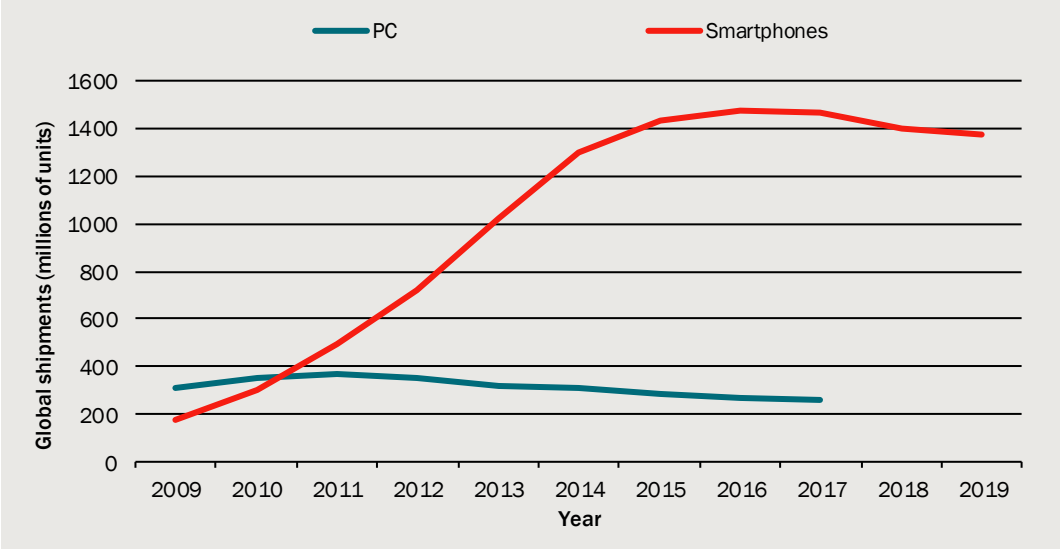
26 Qualcomm OEM Netcom Wireless sees tipping point for urban fixed wireless substitution, Communications Day Issue 5554, 9 February 2018.

27 Verizon Relaunches Fixed Wireless Service With 5G NR, DIY Installs, https://www.lightreading.com/mobile/5g/verizon-relaunches-fixed-wireless-service-with-5g-nr-diy-installs/d/d-id/755026

28 Communications Chambers - Mobile first, fibre as required: The case for 'fibre to the 5G (FT5G)", January 2017

29 Cisco Annual Internet Report 2018-2023 white paper, available at: https://www.cisco.com/c/en/us/solutions/collateral/executive-perspectives/annual-internet-report/white-paper-c11-741490.html

4.4 PC and Smartphone global shipments 2009-2019



Data source: Statistica.

Customers care about services, not infrastructure

The appeal of mobile is in being able to perform any action on any device, anywhere and at any time. This ease of access has been enabled by app developers and digital businesses adopting 'mobile first' strategies as the best way to engage the customer.[30]

The ubiquity of such services is a powerful disruptor to the way in which customers perceive the role of their telecommunications provider. Increasingly, the focus of the customer is on the service being not the infrastructure delivering the service. The effects of this behaviour area already visible with the rise of OTT services such as Facebook and WhatsApp and Apple iMessage. Consumers are bypassing traditional mobile voice and SMS services in favour of OTT services, in much the same way that mobile cannibalised fixed line voice services only decades earlier.[31]

Changing consumer behaviour places greater pressure on telecommunications providers to remain relevant to the customer. In an era where the last leg of internet access to the device is wireless, telecommunications providers will have a larger role to play in utilising the mix of technologies at their disposal to provide seamless connectivity solutions for their customers.

30 Mckinsey, The economic essentials of digital strategy, July 2015

31 Mckinsey, Overwhelming OTT: Telecommunications' growth strategy in a digital world, January 2017

5 Current and future levels of substitution

KEY POINTS

- **Currently, 17 per cent of households that use the internet at home have a mobile service and no fixed line service (i.e. are 'mobile-only').**
- **There is considerable scope for an increase in the share of households that are mobile-only as mobile data allowances increase and prices drop.**
- **Households with higher data usage are more likely to choose fixed line over mobile. We modelled the household choice between fixed line and mobile-only services and find that:**
  - **If the price of mobile plans remained the same compared to fixed line plans, increasing data usage over time will result in the share of households that are mobile-only falling to 8 per cent in 2025.**
  - **If the price of data under mobile plans falls to near zero, the share of households that are mobile-only could rise to 34 per cent in 2025.**
  - **Other factors such as the speed and reliability of mobile networks are expected to improve over time, which would likely lead to a higher mobile share than under the scenarios above. However, this may be countered to an extent by improvements in the speed and reliability experienced by fixed broadband consumers as the NBN is completed and pricing issues addressed.**

There are two main types of substitution between fixed line and mobile services:

- Consumers may be able to use a fixed line or a mobile service to deliver their needs
- Service providers may be able to substitute between networks to provide services

This report focusses on substitution by consumers between fixed line and mobile services.

The substitutability of fixed line for mobile services is a matter of degree. A greater share of households choosing to access the internet at home only with mobile services (the 'mobile-only' share) would imply that fixed line and mobile are closer substitutes. There will likely always be some customers for which fixed line and mobile services are not substitutes, either because of their particular characteristics or their location and service availability.

In this chapter we:

- present estimates of the current share of households which are mobile-only
- assess the scope for potential future substitution based on survey responses about what it would take for users to substitute between these services
- model the extent to which households substitute between fixed line and mobile services based on measurable factors such as usage preferences. This model enables

projection of the mobile-only share under different scenarios of data demand and costs of mobile relative to fixed line.

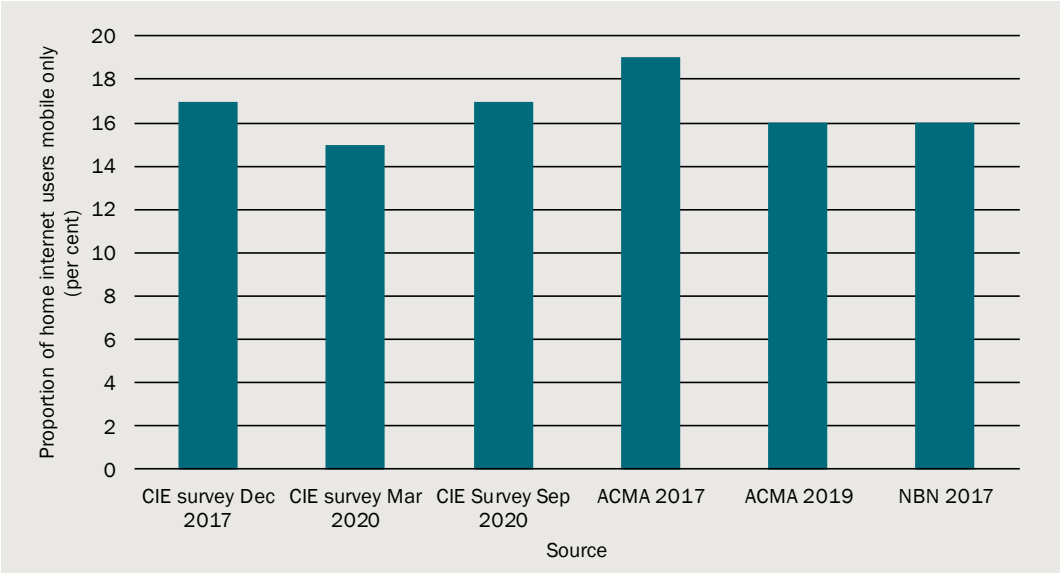
There is also likely to be an increase in situations where households maintain both fixed line and mobile services to the home (either by choice or through their provider), to reduce reliability issues on either. In fact, this trend may well be stronger than any changes in mobile-only usage.

NBN Fixed Wireless and NBN Sky Muster are considered fixed line technologies for the purposes of this study. From a customer's perspective, this does not result in differences in mobility, but only in differences in other quality and price characteristics of a fixed line service. Analysis of the survey conducted by The CIE and Woolcott Research, however, suggests that NBN Fixed Wireless users experience very similar levels of quality and satisfaction across key service characteristics such as price, speed and reliability.

Current levels of substitution

Currently, 17 per cent of households that use the internet at home have a mobile service and no fixed line service (i.e. are 'mobile only'). This estimate is based on the survey conducted by The CIE and Woolcott Research and Engagement. This estimate is slightly higher compared to the same survey conducted in March, and the same level as the December 2017 survey (chart 5.1). This means there is no clear upward or downward trend in the share of mobile only users over the past few years.

5.1 Estimates of the proportion of households that are mobile-only

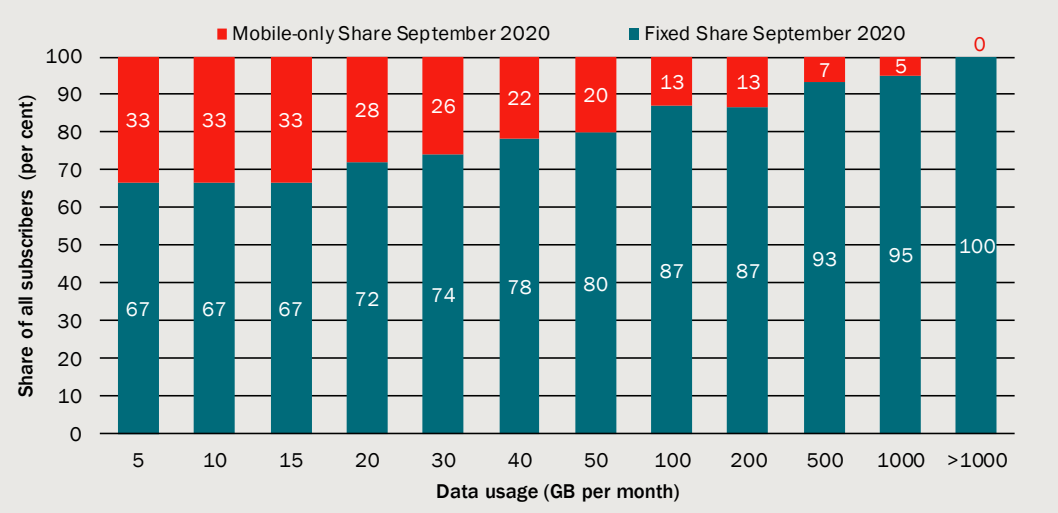


Data source: NBN *Corporate Plan 2017* p.39, ACMA research ACMA snapshot, available at: https://www.acma.gov.au/publications/2019-10/report/mobile-only-australia-living-without-fixed-line-home, CIE and Woolcott Research and Engagement survey 2017 and 2020.

A greater share of households with lower data use are mobile-only (chart 5.2). For example, the mobile-only share of households with usage up to 30GB or less is around 26 per cent. In contrast, 13 per cent of households with usage of 200GB or greater are mobile-only (which is up from 5 per cent in March).

The primary reason that households with higher usage are more likely to choose fixed line is because the price of data is lower for fixed line, and mobile plans with high data allowances such as 1000GB and unlimited plans may be significantly more expensive than fixed line plans with the same data allowance.

5.2 Substitution and data allowance



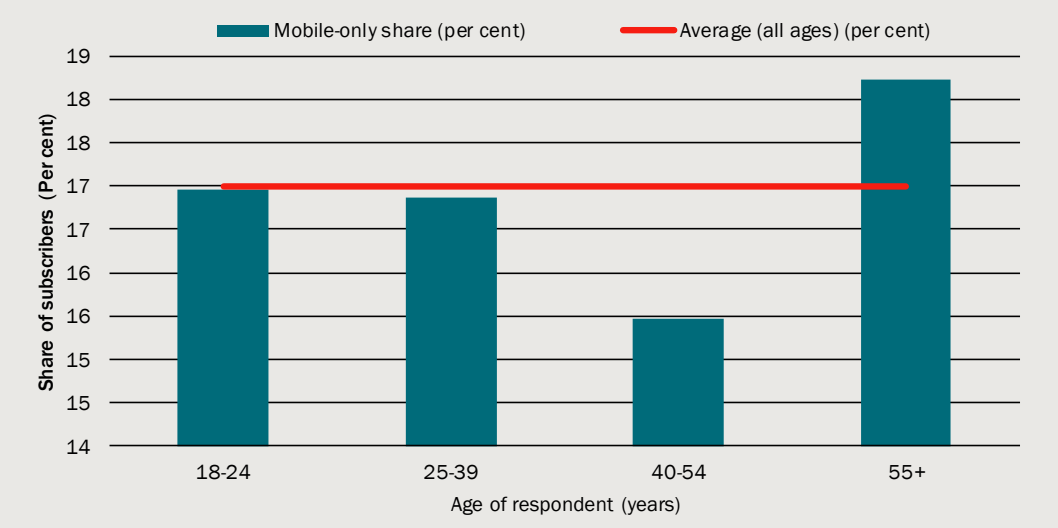
Data source: Woolcott Research and Engagement survey (commissioned by the CIE) (n=1011).

Current substitution by age group

Substitution also varies by age group. The cohort which has the highest share of mobile only are those aged 55 and over, with around 18.5 per cent reported as being mobile-only. It is important to distinguish however, that this does not mean that out of the share of all mobile only users that over 55s make up a higher share than other age groups (since there may be fewer people in this age group using the internet as a proportion of all users), rather this refers to the proportion within a cohort (chart 5.3).

The higher prevalence of mobile only usage within the over 55s age bracket could be explained due the fact that over 55s may use less data overall and find a mobile plan sufficient to cover their needs. Also, younger age groups are more likely to be part of larger households and families and may use fixed line connections due to higher data needs and the use of more devices.

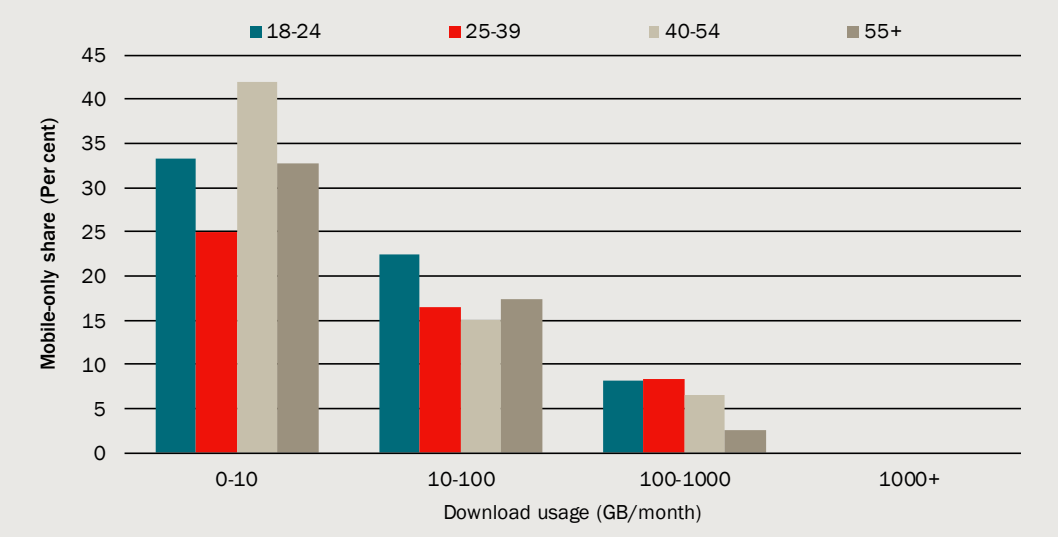
5.3 Average share of mobile-only subscribers by age



Data source: CIE and Woolcott Research and Engagement survey n=1011.

A portion of the variation in the mobile-only share by age may be explained by differences in data usage. However, there are also differences in the mobile-only share of each age group within a given tier of usage (chart 5.4). For example, in the 0-10GB usage tier, the 40-54-year age group has the highest mobile-only share, compared to the 10-100GB tier which in which the youngest cohort has the highest mobile-only shares. The mobile-only share among households with usage over 1000GB per month is zero per cent across all age groups.

5.4 Share of mobile-only subscribers by age and data usage



Data source: CIE and Woolcott Research and Engagement survey n=1011

Scope for future substitution

Because there is a lack of evidence suggesting a clear trend in the share of households that are mobile-only, we assess the potential for substitution between fixed line and mobile services using opinions of households about whether they would switch between fixed line and mobile, and their reasons for why or why not.

In chapter 2 of this report we assessed that a significant proportion of households with usage at or below 200GB month may have their needs met by a mobile-only service based on data allowance. Among households receiving fixed line services and with usage at or below 200GB per month, 27 per cent indicate they would switch to mobile if they were offered a plan with the same data allowance and price compared to 26 per cent for users of 100GB and 33 per cent for users of 100GB in March (table 5.5). Additionally, a further 40 per cent indicate that they would switch if the price of mobile plans fell below fixed line plans by $10–40 (which would represent halving the price of many mobile plans) for the same data allowance (this is the same as users of up to 100GB in September and very similar to the March result).

The remaining 33 per cent of this group of households indicated they would never choose mobile-only even if it was as much as $40 per month cheaper and had the same data allowance as their fixed line plan (compared to 35 per cent of users on 100GB epr month and 26 per cent of users on 100GB in March). These customers do not view fixed line and mobile as substitutes with their current speed, reliability and other characteristics.

5.5 Fixed line customers who might switch to mobile only

	Respondents in September 2020 with usage up to 200GB	Respondents in September 2020 with usage up to 100GB	Respondents in March 2020 with usage up to 100GB	Respondents in December 2017 with usage up to 100GB
	Per cent	Per cent	Per cent	Per cent
Same price and allowance	27	26	33	35
$10/month	5	5	6	6
$20/month	20	20	20	12
$40/month	15	15	15	16
Would never choose mobile only	33	35	26	31
Total that would change	67	65	74	69

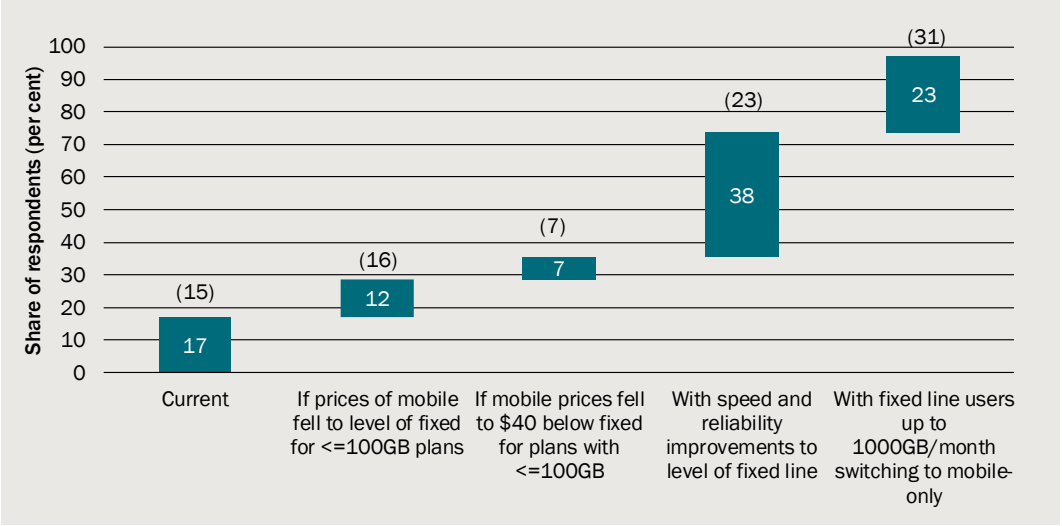
Data source: Woolcott Research and Engagement survey (commissioned by the CIE) (n=1011).

Chart 5.6 shows that there is considerable scope for an increase in the share of households that are mobile-only in future. In addition to the 17 per cent of mobile only households:

- 12 per cent of households would shift if the prices of mobile services fell to the level offered on fixed line for usage up to and including 100GB per month
- 7 per cent of households would change for the same reason if mobile prices fell to $40 below fixed line for the same usage
- 38 per cent of households would change to mobile-only if speed and reliability were on par with users who believe fixed line to be superior to mobile. This is up from 23 per cent of users from the March survey.
- 23 per cent of households with usage up to 1000GB would change to mobile if the price of mobile plans with usage up to 1000GB fell significantly below the price of fixed line plans and speeds and reliability improved (down from 31 per cent in March)

The remaining 3 per cent of users would not be willing to switch to mobile-only because their usage is above 1000GB per month or because of compatibility/other reasons. The scope for mobile substitution therefore depends heavily on price as well as capability (speed, reliability and download allowances).

5.6 Scope for future substitution if mobile plans improve



Data source: Woolcott Research and Engagement survey (commissioned by the CIE) (n=1011).

Estimating the future mobile-only share

In order to better understand the decision between fixed line and mobile only, we used the survey dataset to model substitution between these two services. This involved constructing a model of household choices between fixed line and mobile services, which enables for prediction of the mobile-only share under different usage and cost scenarios. Note that these scenarios do not cover many other factors that will affect fixed line and mobile substitution. Importantly, changes in speed and reliability cannot be modelled in this way, since we cannot incorporate speed and reliability into the model.

Methodology

We estimate a model that seeks to predict the choice of individual households between two options: fixed line or mobile-only. Consumers are assumed to purchase the option that gives them the greatest utility/benefit.[32] The model we have estimated is a logit model, which is used where the aim is to predict a choice between options.

This model accounts for the following individual and usage characteristics that affect the probability of choosing fixed line compared to mobile services:

- Data usage of an individual household (in GB/month)
- Whether the household is in a capital city or not
- The composition of the household, including the number of adults, children under the age of 5 and children over the age of 5
- The sex of the person responding to the survey (who is a member of the household),
- The income of the household, and
- The highest qualification level among household members (e.g. High School, Certificate level, etc).

This model allows us to estimate the share of households which are mobile-only under different scenarios for these characteristics such as usage.

Each age group is modelled separately. That is, respondents are segmented by their age group, and separate effects of these characteristics on the probability of choosing fixed line or mobile are estimated for each. This approach has been taken because different age groups are expected to have different relationships between usage and their choice of fixed line or mobile. For example, younger cohorts are expected to switch between fixed lineand mobile more easily than older cohorts.

Other studies have modelled the choice between types of broadband services in overseas telecommunication markets. The most relevant studies are summarised in box 5.7.

5.7 Other studies modelling the choice between broadband services

A number of studies have estimated logit models to analyse consumer choices between broadband service options, including the following:

- Srinuan, Srinuan & Bohlin (2012) found that mobile services are a substitute to fixed line services in Sweden. This study used survey data to estimate nested choice models, whereby consumers choose between options in stages. That is, firstly, consumers choose whether to purchase internet access services, then choose whether to purchase fixed or mobile services, then choose between various fixed line technologies that are available in their geographic area. This study estimated the price of each alternative decision in each stage (e.g. the price of mobile and

32 Cardona et al. (2007) explain how utility maximisation is the basis for these types of logit models: Cardona, M., Schwarz, A., Yurtoglu, B.B. and Zulehner, C., 2007, 'Demand estimation and market definition for broadband internet services', Working paper, available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1081261

fixed line services) and estimated the own-price and cross-price elasticities of demand for each option.

- A previous study using similar methods is Cardona et al. (2007), which estimated nested logit models using survey data from Austria. This study likewise included price estimates for each option to estimate price elasticities. The modelling approach allowed for the authors to conclude the cable network s are likely to be in the same market as DSL connections, illustrating that substitutability of goods/services is a key component to defining separate markets.

Srinuan, Srinuan & Bohlin (2012) is particularly relevant because it presents empirical evidence from Sweden about substitution between fixed line and mobile broadband services. However, the extent of substitution between fixed line and mobile is expected to be highly dependent on the infrastructure, regulatory environment, demand prices and competition levels of each country. This suggests that their results will not necessarily hold in Australia. Additionally, the authors do not make predictions about the future path of prices or the level of substitutability between fixed line and mobile broadband.

Our approach is distinct from the approach of these studies in two key ways:

- We do not estimate the price of each alternative or include this as a variable in the decision between broadband service options.
- We have data concerning usage of fixed line and mobile subscribers and use this variable as a predictor in our model. Note that using usage as a predictor variable in the model implicitly assumes that the choice between fixed line and mobile-only does not affect usage.

Maintaining current mobile technology under different demand scenarios

We use the model to predict the impacts on the mobile-only share of increasing data usage if mobile technology does not improve relative to fixed line technology. This is equivalent to assuming that the cost of data under mobile plans does not reduce relative to the cost of data under fixed line plans.

We have modelled the level of substitution under three projections of data usage/demand (chart 5.8), which are based on:

1 A growth forecast of 25 per cent CAGR. This is based on recently reported data growth by NBN to the year ending 2019[33].

2 The Cisco Visual Networking Index, which forecasts a CAGR for usage (across fixed line and mobile) of 27 per cent.[34]

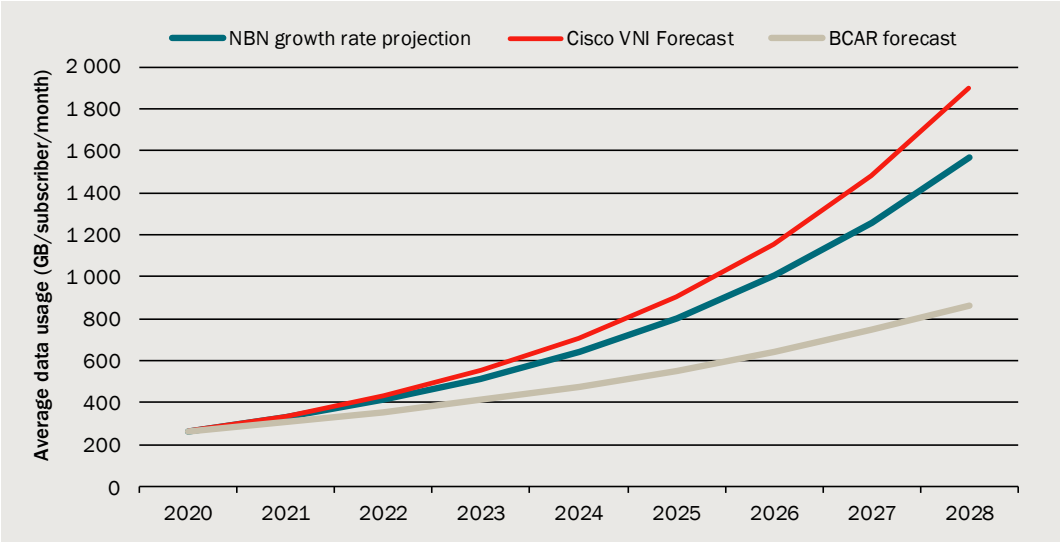
[33] See https://www.nbnco.com.au/corporate-information/media-centre/media-statements/data-usage-surges

[34] See the 'consumer internet traffic' forecast at the bottom of table 8. We have chosen to use a constant CAGR for simplicity, and because year-to-year variation in growth rates may reflect country-specific factors. Additionally, the 'Asia Pacific' projections likely reflect factors affecting other countries in this region, moreso than factors affecting Australia, thus, we have chosen to use the global forecast:

3 The Bureau of Communications and Arts Research (BCAR)[35] forecast that usage will increase from 95GB in 2016 to 420GB in 2026, implying a CAGR of 16 per cent.

These growth rates are applied to a survey average data usage of 263GB per month.

5.8 Projections of data demand



Note: The NBN growth rate is based on historical growth rate of 25 per cent to the year ending 2019. The Cisco VNI forecast is based on a CAGR of 27 per cent. The Bureau of Communications and Arts Research project is based on a CAGR of 16 per cent. All projections use the same starting point of 263GB average usage based on the results of the 2020 CIE survey.

Data source: CIE calculations using historical compound annual growth rates from NBN, the Cisco VNI Forecast and the BCAR forecast.

Data usage is variable across households. We have projected growth in usage that is equal in percentage terms across the distribution. This has been implemented according to the following steps, followed separately for the separate models for each age group:

1 The population of households is split into tiers of usage based on the share of survey respondents in each tier.
2 The average usage of each tier in 2020 is estimated based on survey data.
3 The ratio of average usage for each tier to average usage across all tiers is calculated.
4 The average usage across all tiers is projected according to the specified CAGR for each scenario.
5 Holding the ratio of average usage for each tier to average usage across all tiers constant, the usage for each tier in forecast years is estimated.

The final step makes clear that we assume the ratio of average usage in each tier remains in constant proportion to the average usage across all tiers as average usage increases. An alternative assumption is that the entire distribution of usage shifts by an amount (in GB) equal to the change in average usage. This is clearly less plausible, since an annual

https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/complete-white-paper-c11-481360.html#_Toc484813985

35 Bureau of Communications and Arts Research, 2018, 'Demand for fixed-line broadband in Australia', working paper, February 2018, accessed on 28 February 2018, available at: https://www.communications.gov.au/publications/demand-fixed-line-broadband-australia

increase in usage of 50GB may plausible for a household using 200GB or 1000GB, but clearly not plausible for a household using 1GB in the previous year.

Table 5.9 presents the usage projections for age group as an example (the 18-24 year-old cohort). It shows that the usage of each tier increases by around 200 per cent between 2020 and 2025, which is equal to the average increase in usage projected by the ACCC Market study (CAGR of 25 per cent). This means that the usage of each tier increases by a different level in absolute terms, with usage in the bottom tier (0-1GB) increasing by 0.6GB while usage in the top tier (2000-9000GB) increases by around 9 600GB.

Note that there is no usage growth for the 'unlimited usage' tier. This small (0.2 per cent of 18-24 year-old users) group consists of entirely fixed line customers, and under all scenarios we project that these household continue to receive fixed line rather than mobile services. 'Unlimited' usage is not possible, and survey respondents may have erroneously entered that they had unlimited usage because their actual usage exceeded the maximum allowed in the survey (9999GB), they could not determine their actual usage[36], or because they misunderstood the question and have an unlimited download allowance.

5.9 Usage tiers and projections of average usage to 2020 – 18-24 cohort

Usage tiers	Proportion of users	Average usage of tier in 2020	Average usage of tier in 2025
	Per cent	GB	GB
0-1	0.2	0.4	1.1
1-5	0.8	3.3	10.0
5-10	0.5	7.6	23.1
10-20	0.8	15.5	47.2
20-50	2.2	35.9	109.6
50-100	1.9	74.3	226.8
100-200	1.9	141.1	430.5
200-500	2.1	321.2	980.4
500-1000	0.9	674.4	2058.1
1000-2000	0.0	1198.8	3658.4
2000-9000	0.3	4678.8	14278.6
Unlimited	0.2		
Average across all excluding unlimited		**275.2**	**839.8**

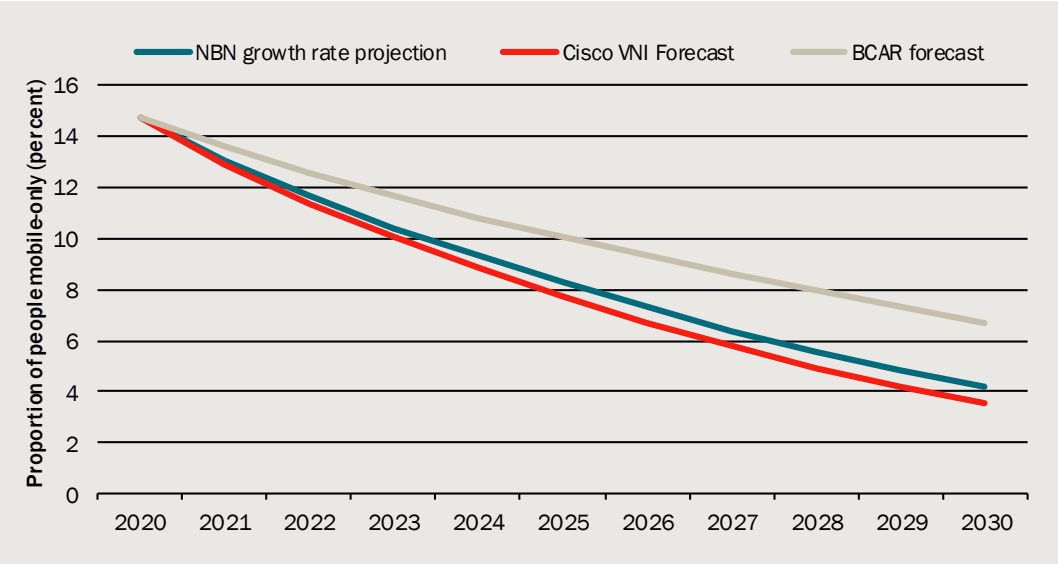
Note: The average usage projections shown in the table assume a 25 per cent CAGR based on the ACCC Market study projections.
Source: CIE.

As usage increases and mobile technology does not improve relative to fixed line technology, we project that the mobile-only share falls to 4.4 per cent by 2030 and around 3.8 per cent by 2030 under the ACCC and Cisco usage projections (chart 5.10). Under the BCAR scenario, the mobile-only share falls to 6.8 per cent in 2030. The fall in the

36 For example, TPG customers with unlimited download allowances cannot view their actual usage for their account. Survey respondents with such plans may have responded that they have unlimited usage because they have an unlimited download allowance.

mobile-only share under these scenarios is initially larger, but the rate of decrease slows down despite a constant CAGR under both scenarios. This occurs because we model different age profiles and usage segments separately, with some segments reaching saturation (zero per cent mobile-only) quickly. A declining proportional response in the dependent variable to changes in the independent variables is also a feature of logistic models.

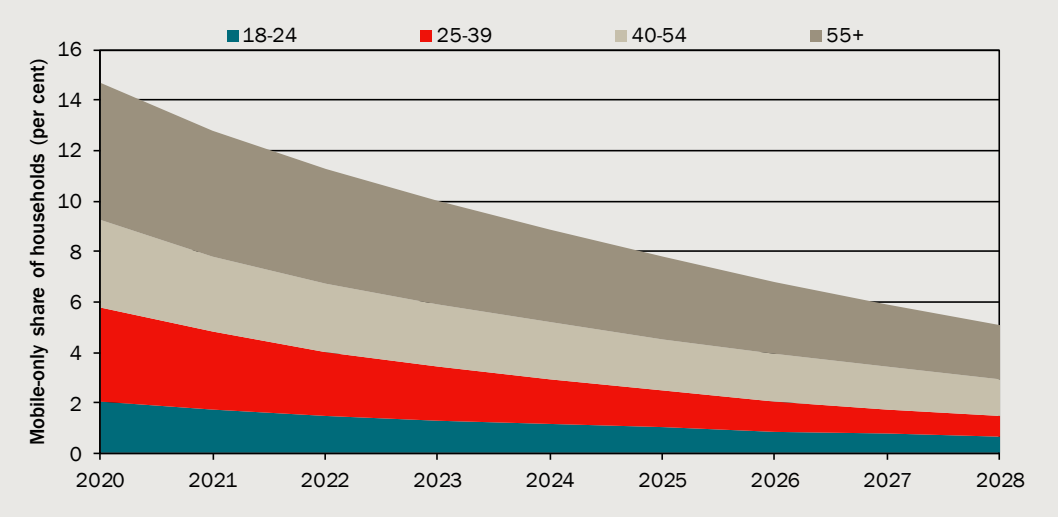
5.10 Predicted substitution assuming current mobile technology level is maintained



Data source: CIE.

The saturation of some age group/usage tier segments can be seen particularly in the 18-24 year-old cohort (chart 5.11). The 18-24 cohort is the most responsive to changes in usage (in terms of their choice of fixed line or mobile), and usage tiers in this group 'saturate', entirely choosing fixed line services over mobile as their usage increases. In contrast, the other age groups experience more gradual and smooth changes in the mobile-only share as usage increases.

5.11 Mobile-only share by age group under ACCC market study usage scenario



Data source: CIE.

Falling price of mobile data scenario

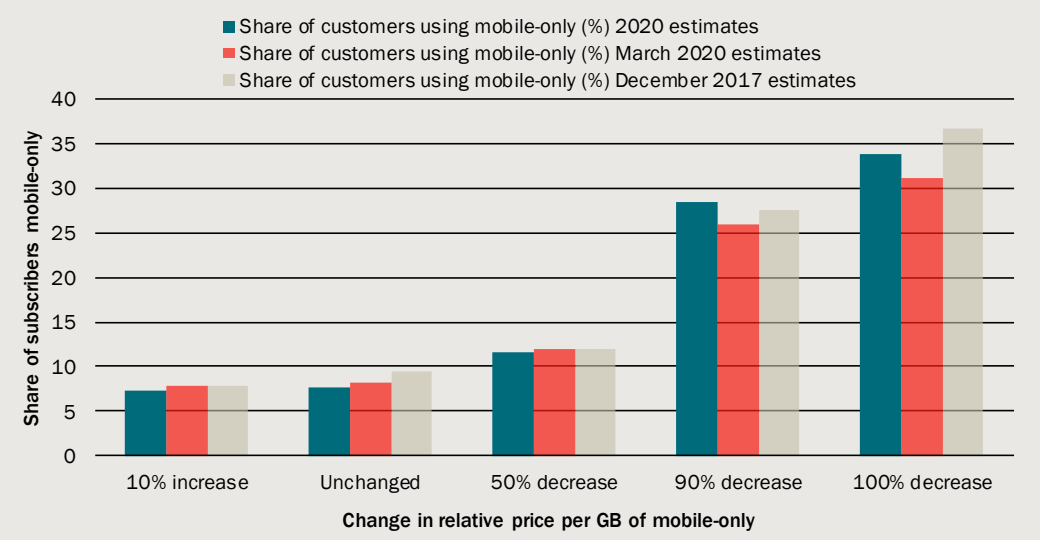
One of the key changes for fixed line and mobile markets is the roll-out of 5G mobile technology. This technology will dramatically improve speeds, latency, and data capacity of mobile networks. Given that the price of data for fixed line services is already near zero, the price of data for mobile relative to fixed is likely to fall significantly.

We have modelled the impact of this fall in the price of data by adjusting the magnitude of the assumed relationship between usage and the probability of choosing fixed line rather than mobile (see Appendix B). At an extreme, if the price of mobile data fell to almost zero, data usage would no longer be expected to affect the choice between fixed and mobile. As with modelling the usage scenarios, we have modelled each tier of the usage distribution separately to account for 'saturation' of the mobile-only share among low-usage households.

Chart 5.12 presents the predicted mobile-only shares under different mobile price scenarios using survey data from our most recent September 2020 survey as well as the results from the 2017 survey[37]. If the price of mobile-only data were unchanged in 2025, the share of mobile-only households is estimated to fall to 8 per cent from the current 17 per cent. In contrast, if the price of mobile-only were to fall to almost zero, the share would increase to 34 per cent.

These patterns of substitution estimated using the September survey compared to March and December 2017 surveys are similar, if not slightly lower for some of the scenarios. It is difficult to ascertain whether this is due to an overall trend reduction in propensity of households to be mobile-only (potentially due to non-price and qualitative factors) or whether this is simply due to sample variation.

5.12 Estimated mobile-only share in 2025 under mobile price scenarios



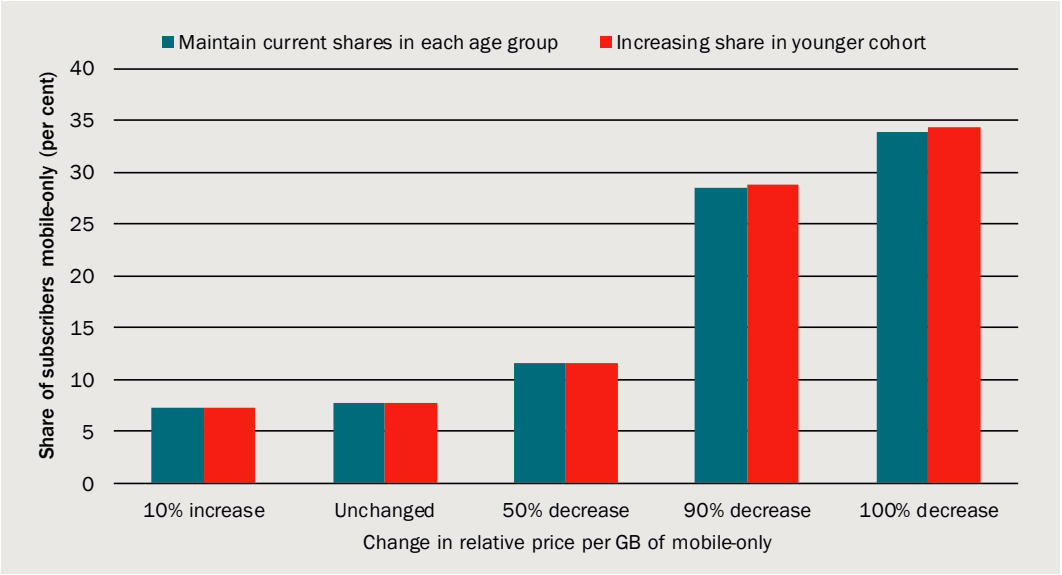
Note: These results assume that data usage grows at 25 per cent CAGR (the ACCC Market study scenario).

Data source: CIE.

37 We have made slight adjustments to the scenario methodology since 2017 and have updated our 2017 estimate in line with these changes to make the results comparable. The effect is a slightly lower rate of substitution using the 2017 data compared to our previous report.

Chart 5.13 also presents modelling results when changing age composition of households (the younger cohorts within the age bracket 18-24 year today who are more familiar with technology will become part of the older cohort in future, replacing older people in those same cohorts who are familiar with technology today). This feature has been incorporated to reflect a decrease in customer inertia over time, whereby each year more people become familiar with technology and able to switch between fixed and mobile more easily. This does not appear to drive the results materially, however.

5.13 Estimated mobile-only share in 2025 under mobile price scenarios



Note: These results assume that data usage grows at 25 per cent CAGR (the ACCC Market study scenario).

Data source: CIE.

6 Policy settings and how they should adapt to change

KEY POINTS

- **Convergence between mobile and fixed line technologies will require technology-neutral policy settings.**
- **Policymakers should not respond by protecting the NBN from competition, even where convergence becomes a partial commercial threat to the NBN. Instead, the NBN remit should evolve to enhance the performance of both fixed line and mobile technologies.**
- **The optimal policy pathway would see technologies competing on the service they offer to consumers. Government's role would be to ensure a level playing field and ensure regulatory decisions do not increase costs and reduce competition.**
- **The worst policy pathway would see restrictions on non-NBN technologies or competitors and policies to favour the NBN.**

General policy principles

As mobile and fixed line services converge, from the perspective of being able to provide more similar services to the home, then there are a number of relevant general policy principles:

1 **Policy settings should aim to be technology neutral.**
   - As mobile and fixed line services converge, the costs of different policy settings for each will become larger. This will be particularly important to manage given the government ownership of the NBN which has supported, and will likely continue to support, the NBN at a rate of return below what would be acceptable to a private operator.

2 **The outcome sought from government policies should be to maximise the welfare of the Australian people, not the financial outcome for government.**
   - Policymakers should embrace the opportunity for the NBN to be an enabler of all broadband services.
   - Government revenue from the NBN and spectrum sales should not be the drivers of policy decisions.[38]

38 Hazlett, T. W., Muñoz, R. E., and Avanzini, D. B., 2012, "What really matters in spectrum allocation design" *Northwestern Journal of Technology and Intellectual Property*, Volume 3, Issue 3: Article 2.

- Maximising the welfare of the Australian people will require policies that do not add to costs, support competition and allow for rapid deployment of whichever new technologies are considered to best meet the needs of consumers.

3 **Government policy should promote economically efficient use of, and investment in, broadband infrastructure.**

- Pricing of the NBN involves a trade-off between additional usage of the network and revenue recovery. The optimal pricing strategy for NBN should maximise consumer benefits for a given amount of revenue and sunk costs should not prevent infrastructure from being put to its highest use for the benefit of end-users.

4 **Regulation should promote competition and a level playing field.**

- The importance of technology-neutrality has been recognised by Australian policymakers. For example, the objective of the Vertigan Panel in conducting a cost-benefit analysis of the NBN was: *To identify the market structure and regulatory arrangements that will deliver affordable and reliable communications services to all Australians, including fast broadband services, in the most economically efficient way*[39]
- This objective is technology neutral, in that it does not specify what technology or combination of technologies would provide services most efficiently.
- Internationally, the OECD has highlighted the following general principles to guide regulatory reform in the light of convergence:[40]
  - Simplify rules and procedures to ease costs of transactions and reduce barriers to new entrants and new services.
  - Uphold technology neutral regulation where possible, including not tying scarce resources such as spectrum to specific networks, technologies or devices.
  - Promote investment along the whole value chain for broadband access services.
  - Promote competition and innovation without favouring particular platforms or participants, and promote a level playing field.

5G spectrum set aside for the NBN

The NBN currently has large holdings of spectrum that could be used for the deployment of 5G services. Spectrum policy should be technology-neutral so that allocations are made based on the highest value use.

The official international 5G spectrum band 'n78' covers the 3.3 to 3.8 GHz (3300 to 3800 MHz) frequency range although it is commonly allocated as 3.4 to 3.8 GHz (3400 to 3800 MHz) due to incumbent use in the lower part of the band. In Australia, it is accepted that at least 300MHz of spectrum in this band will be required by the mobile

39 Vertigan Panel, 2014, 'Independent cost-benefit analysis of broadband and review of regulation: Volume I', p. 45, available at: https://www.communications.gov.au/sites/g/files/net301/f/NBN-Market-and-Regulatory-Report.pdf

40 OECD, 2016, *Broadband policies for Latin America and the Caribbean: a digital economy toolkit*, p.213, available at: http://www.oecd-ilibrary.org/science-and-technology/broadband-policies-for-latin-america-and-the-caribbean_9789264251823-en

industry to meet the projected demand for 5G services, in addition to spectrum from adjacent bands where possible.

To date, the ACMA has allocated 225MHz of spectrum in this band. A further 75MHz was set aside for the NBN in metropolitan areas despite 5G mobile services progressively being rolled out.

In 2014 the ACMA, at the direction of the Minister for Communications, administratively allocated this 75 MHz nationally to the NBN for fixed wireless services. This includes metropolitan areas where there is no plan for the NBN to rollout fixed wireless services.

Further, the NBN. does not pay for its option to acquire these licences. The NBN only pays if, and when, it takes up individual licences and then only at a rate of $0.03/MHz/pop, which is around 10 percent of the price of the 125 MHz of spectrum sold at the 2018 3.6GHz band auction ($0.29/MHz/pop).

Given the NBN is a public monopoly, there is a higher standard of care on the part of the ACMA to ensure that its approach to these spectrum holdings does not result in explicit or implicit discrimination. The retention of this spectrum by NBN may also have significant consequences for deployment of 5G and competition in the mobile market. In metropolitan areas, Optus holds up to 100 MHz of the total 300MHz of spectrum in the 3.4 to 3.8 GHz range as a result of the acquisition of Vivid Wireless in 2012. Telstra has up to 63MHz in metropolitan areas and TPG Telecom has 60MHz.

Competitive neutrality and subsidy arrangements

The NBN pricing model and the Regional Broadband Scheme (RBS) levy raise potential competitive neutrality issues. If the 'commercial' part of the NBN is not earning a rate of return required by a private company, then this is a competitive neutrality issue.

There is also considerable duplication of subsidy mechanisms to provide telecommunications services in regional and remote Australia. In addition to the RBS, there is the Universal Service Obligation (USO) and the Mobile Black Spot Program, for example.

Policymakers should consider the competitive implications of the RBS in addition to these other measures. A more efficient outcome would be to consolidate these arrangements into a broader technology neutral framework. Additionally, universal service obligations should be contestable to promote competition.

Regional Broadband Scheme (RBS)

As a Government Business Enterprise which is currently required to ensure that its wholesale prices recover its full costs there may be an incentive for policymakers to constrain competition with the NBN. A clear example of this is the Regional Broadband Scheme (RBS).

The RBS is a $7.10 per premises-per month levy on other fixed line suppliers of high-speed broadband services to assist in the funding of NBN non-commercial services in regional areas.

The RBS is premised on two key assumptions, neither of which appear to survive scrutiny:

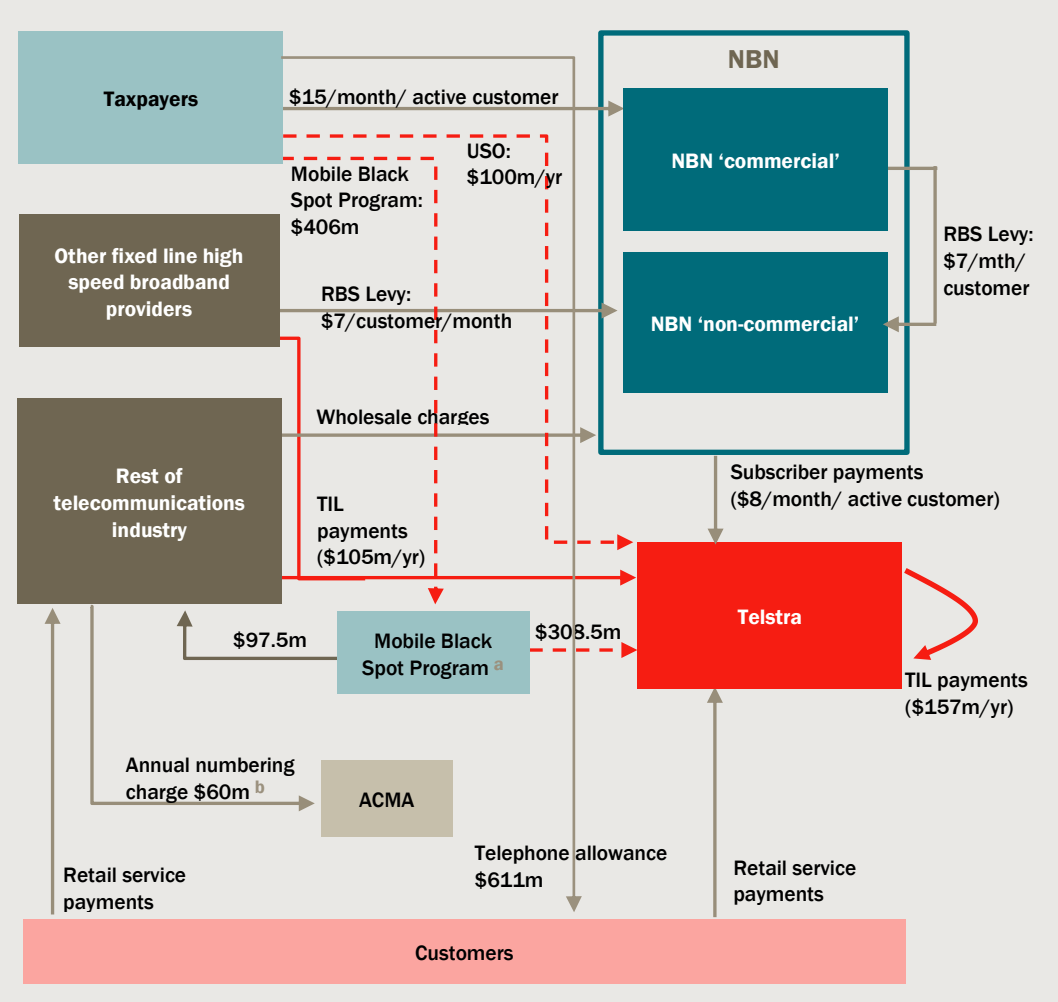
- that NBN's 'commercial' operations are cross subsidising its 'non-commercial' operations, and
- that a levy on other competitors to NBN therefore "levels the playing field" between the commercial arm of NBN and other network providers.

In reality, the NBN's own corporate plan does not show any cross-subsidy – only a subsidy from the taxpayer to both arms of the NBN since both are in fact loss making and therefore non-commercial. This makes the RBS levy distortionary and anti-competitive, especially since NBN is actively competing with the independent network providers that are forced to cover its losses. These effects would be further exacerbated should the Government decide in the future to extend the RBS levy to fixed wireless and/or mobile broadband services.

Technology convergence offers the potential to reconsider a range of overlapping policies and programs, including the up to $1 billion[41] of industry and taxpayer funding each year for the provision of universal telecommunications services. This is in addition to the $51 billion taxpayer funded NBN. The complexity and duplication of current arrangements is illustrated by Chart 6.1.

41 Productivity Commission 2017, *Telecommunications universal services obligation,* Inquiry report, p.7

6.1 Where the money flows



a based on available information on funding from Department of Communications, Telstra, Optus and Vodafone websites and CIE analysis. Telstra received funding for 797 of the 1,047 total base stations funded under rounds 1-4 (or 76 percent). b based on ACMA fee revenue target for 2019 https://www.acma.gov.au/annual-fee-phone-numbers

Note: $/customer/month figures are based on the present value of the cost or revenue items divided by the present value of active customers. For example, subscriber payments are actually front-loaded, so will be very high initially and then decline to zero.

Data sources: Regional Broadband Scheme factsheet, available at: https://www.communications.gov.au/documents/regional-broadband-scheme; TIL amounts for 2018/19 see https://www.acma.gov.au/sites/default/files/2019-11/Telecommunications%20Indutry%20Levy%20Assessment%202018-19.pdf; See Appendix A for NBN subsidies. Telephone allowance amounts based on Productivity Commission 2017, *Telecommunications universal services obligation,* Inquiry report, p.7 Table 1.

Universal Service Obligation (USO)

With a baseline level of broadband service to all premises in Australia enabled by the NBN, it is logical to reform the USO in combination with the RBS as part of a broader technology neutral framework.

The Government asked the Productivity Commission to undertake an inquiry into the future direction of telecommunication universal service obligations, given the evolving telecommunications market.[42]

The Productivity Commission found that: [43]

- For the vast majority (more than 99 per cent) of premises, the combination of the NBN and mobile networks is likely to meet or exceed minimum standards for universal voice and broadband service delivery.
- The USO can therefore be terminated once the NBN is fully rolled out and replaced by a set of targeted policy responses for premises in pockets of the NBN satellite footprint without adequate mobile coverage and cohorts of users with particular needs.
- Telstra's contractual obligations under the agreement with the Government lack transparency and accountability.

In response to this, the Productivity Commission recommended that:[44]

- The Government should commence negotiations with Telstra to terminate the USO shortly after the NBN is rolled out and remove Telstra's statutory obligations to provide the standard telephone service.
- As a replacement for the standard telephone service, the Government should introduce a competitive tendering process for the delivery of 'baseline' voice services within the NBN satellite footprint where there is inadequate coverage and it is unviable to provide such coverage.
- The Government (in consultation with the States and Territories) should rationalise the telecommunications programs that share a universal service obligation to improve efficiency and cost effectiveness.

In line with the Productivity Commissions' report, the Government is assessing cost and delivery options to provide for a future Universal Service Guarantee (USG) and is currently consulting with industry and regional stakeholders. According to the government, a future USG will need to meet the following requirements:

- broadband services are available to 100 per cent of Australian premises, on request, at the completion of the NBN rollout in 2020
- voice services are available to 100 per cent of Australian premises on request;
- any proposed new service delivery arrangements are cost effective compared to existing the USO contract (including any transitional costs), and
- a new consumer safeguards framework is in place following a review and associated public consultation process.

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42 Australian Government (2017), *Telecommunications universal service obligation Productivity Commission Inquiry Report No. 83,* Productivity Commission, p. iv, viewed 12 July 2017, http://www.pc.gov.au/inquiries/completed/telecommunications/report

43 Ibid, pp. 19 - 28

44 Ibid, pp. 19 - 28

The growing relevance of broadband in communications, including voice (such as VoIP) highlights the redundancies of multiple policies duplicating funding for telecommunications in regional Australia. A clear example of such duplication is continuing to subsidise Telstra to maintain copper lines for voice services in areas covered by the NBN Fixed Wireless footprint which can deliver high quality voice services.

NBN products and pricing

A key potential benefit of the NBN for consumers is higher speeds. However, average speeds currently experienced on fixed line services are generally below those of mobile as result of barriers caused by the NBN pricing model, which is prohibitively costly for both retailers and their customers at higher speed tiers.

Conceptually, given that the costs of NBN are largely fixed, an efficient pricing structure would be similar to a Ramsay optimal tax. This leads to charging more for the pricing components to which consumers are least responsive.[45]

The optimal pricing structure of the NBN will depend on factors such as the following:

- *Price sensitivity* — if customers are highly price sensitive, then higher prices will be associated with greater than proportional decreases in usage of the NBN. Customers are more sensitive to prices in the presence of alternatives, such as 5G. Optimal prices will therefore aim to achieve a level whereby prices will minimise substitution to alternatives and increase usage of the NBN. Different segments of customers respond differently to price. Customers with lower data usage would be likely candidates to switch to mobile broadband if it were to offer comparable speed to today's NBN at a lower price.
- *Willingness to pay for speed* — the apparent lack of demand for higher speed tiers on NBN by customers has shown that prices have been too high. Recent AVC and CVC bundling packages offered by NBN have enabled retailers such as Vodafone to offer discounts on higher speed tiers, resulting in a higher take up of faster NBN plans. Similar measures would need to be implemented for higher speed tiers in order to maximise the potential of NBN.
  - Customers may also have difficulty in understanding the current pricing strategy around speed. This lack of understanding may not provide retail service providers with sufficient incentives to purchase enough CVC to guarantee adequate quality levels (this has prompted the ACCC to ensure that retailers provide information regarding typical evening speeds on different NBN packages46).

The pricing structures that are most efficient will need to understand these issues in detail.

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45 Ramsey, Frank (1927). "A Contribution to the Theory of Taxation". *Economic Journal*, Vol. 37: pp. 47–61.

46 ACCC: Broadband Speed Claims, Industry guidance August 2017

Access to NBN infrastructure

NBN pricing is regulated because of the natural monopoly characteristics of its infrastructure. The regulatory framework used seeks to cap NBN from earning a return greater than its costs, with costs including its operating expenditure, return on its assets, depreciation and tax expenses. Its costs in total are called building block costs. However, the regulatory arrangements also apply price caps, which currently are below its building block costs[47].

Access to the NBN is regulated via the Special Access Undertaking (SAU)[48]. The SAU stipulates maximum prices for a selection of pre-specified wholesale services provided using the NBN. These services connect NBN Points of Interconnect (POIs) to customer premises using fibre, fixed wireless and other technologies.

The high costs of NBN could, if there is sufficient competition from other fixed line and 5G providers, mean that NBN pricing never recovers the building block costs. If there is sufficient competition, then the importance of regulation of wholesale prices at the premise will fall.

If 5G services provide a mechanism for reaching the premises but would use other infrastructure of NBN's further from the premises, then the regulatory arrangements and NBN's commercial arrangements may need to evolve to focus on this role. Currently, mobile operators will typically have their own arrangements for transmitting information from mobile sites to other parts of their network and other networks. However, there will be many more 5G sites compared to 4G sites, which will make this component of costs more critical for efficient service delivery and confer greater benefits from using NBN infrastructure.[49]

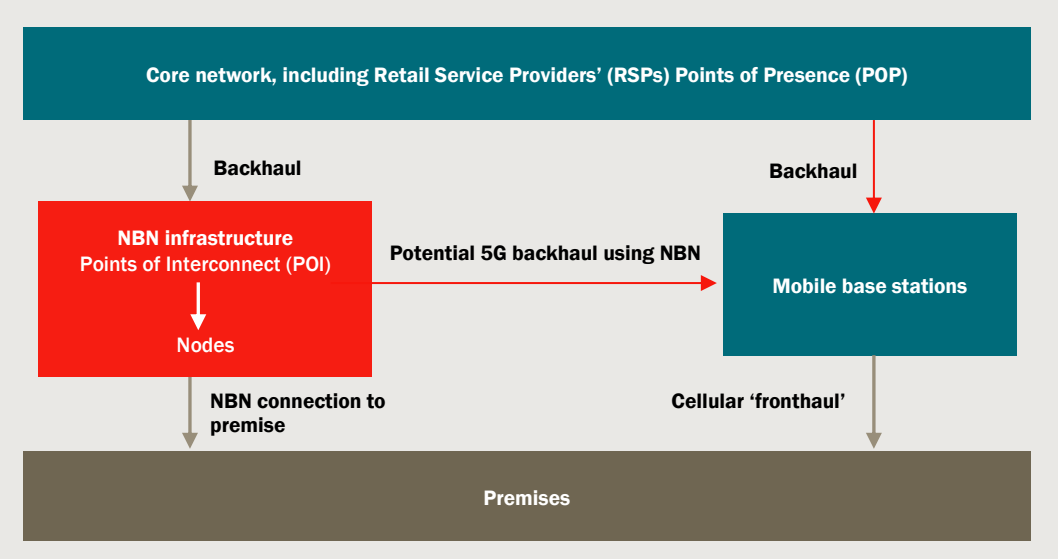
For example, a mobile base station may link to NBN infrastructure for the provision of mobile backhaul (transmission) services, as shown in chart 6.2.

47 ACCC Communications sector market study draft report, October 2017 p129-176

48 https://www.NBNco.com.au/content/dam/NBNco/documents/NBN%20Co%20SAU%20-%20Varied%20on%2018%20November%202013%20(clean%20version).pdf

49 Ciena, 2016, *5G wireless needs fiber, and lots of it*, available at: http://www.ciena.com/insights/articles/5G-wireless-needs-fiber-and-lots-of-it_prx.html

6.2 NBN provision of backhaul for 5G services



Data source: CIE.

There are a number of points in the telecommunications network where the NBN could be involved in the market, such as providing backhaul to mobile cell sites, including small cells. If the NBN was a non-monopolist competitor, it would have a greater incentive to seek out these opportunities to earn revenue from infrastructure with sunk costs, given the incremental costs of doing so would be very low. However, its position as a monopolist facing increased competition from 5G means that it has a disincentive to provide these services, thus potentially warranting a role for regulation of these services.

Costs of a poor policy pathway

The worst policy pathway would see restrictions on non-NBN technologies or competitors and policies to favour NBN. There are two potential impacts from such a pathway:

- the market structure for mobile broadband becomes more concentrated; and
- mobile technology is delayed or rolled-out at higher cost.

Both impacts would increase the prices of mobile technology to Australian consumers.

A more concentrated market for mobile services

Policy responses to 5G can have direct impacts on the state of competition in both the fixed line and mobile broadband markets. Depending on the motive of government with respect to the competitiveness of the NBN, possible responses might include:

- **Changing policy to reduce NBN prices** — this would primarily impact on the NBN's market share to the home and would reduce the extent to which mobile technologies and other infrastructure providers were taken up in the home. While this would be a competitive distortion, in that the NBN would likely be pricing below cost, it would not be likely to materially alter the market structure of the mobile sector itself

- **Hindering competitors to NBN in the home** — the three main tools government could use to either help or hinder competitors are: (i) access to spectrum; (ii) access to NBN infrastructure; and (iii) levies for regional broadband provision. The first issue - spectrum - could materially alter the market structure of mobile broadband. The second and third may also make some impact on market structure. For example, government may prevent the re-allocation of the NBN's spectrum holdings within the 3.4 – 3.8 GHz band. This could reduce competition in the mobile market.

Delays or higher costs for 5G roll-out

Government policies could impact on the cost of providing mobile services or delay mobile technologies. Possible examples of this could include:

- the timing of spectrum releases, and
- access to NBN infrastructure for mobile operators.

A two-year delay could, if benefits from 5G match past benefits from mobile broadband, reduce future Australian economic activity by around $11 billion each year, and reduce economic growth by 0.5 per cent.[50] This would occur by delaying:

- new uses of mobile networks such as IoT
- falling prices of mobile data and a wider variety of applications for consumers, and
- productivity improvements realised by industrial applications such as autonomous vehicles, pervasive sensor networks and smart factories.

Rewards from technology neutrality

Technology-neutral policymaking would provide:

- **Better outcomes for consumers:** policies that promote competition and enable new technologies such as 5G will result in lower prices, greater innovation and higher quality services for consumers.
- **Adaptability to technological change:** the capabilities and costs of fixed line and mobile technologies will continue to evolve, likely in line with the trend of convergence. Technology-neutral policy will promote the efficient use of and investment in infrastructure, particularly in ensuring that consumer benefits from the NBN are maximised.
- **Adaptability to changing preferences:** consumer preferences over speed, mobility, reliability and other preferences are changing over time, and policies that do not lock in dominance of a particular technology will ensure that the technology mix in the

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50 This assumes GDP of $1.9 trillion: ABS, *Australian National Accounts: National Income, Expenditure and Product, Mar 2020*, Cat no. 5206.0, series A2304755F (Gross domestic product: Chain volume measures).

The Centre for International Economics, 2014, *The economic impacts of mobile broadband on the Australian economy, from 2006 to 2013*, prepared for the ACMA

market can respond. For example, if demand for data usage increases by more than expected, an adaptable and competitive NBN can respond with additional investments or changed pricing strategies

A Hedonic modelling of fixed-line and mobile plans

The price that consumers pay for purchasing mobile and fixed line services can be broken down into the price of the subcomponents of each plan.

The formal method for comparing similar plans is called 'hedonic pricing'. The hedonic pricing method assumes that the value of a product is based on the value consumers place on the characteristics of the product. For example, in the context of mobile phones, the value of a phone plan is dependent on characteristics such as:

- number of included call minutes
- amount of included data usage
- entertainment content included, and
- mobile network providing the service.

This breaks up the overall price of a plan into the prices of sub-components, such as voice minutes, provider and data allowances. It does so using statistical models to decompose the price paid for products into the value of each characteristic. It has been used to determine the value placed on various characteristics of real estate, automobiles and other products such as personal computers.[51] We have used this method in the past for the valuation of characteristics of mobile and fixed line plans and estimation of Telstra's market premium.[52]

We have collected data on 81 different post-paid phone plans and 45 fixed line plans in order to determine the extra amount consumers are willing to pay for each characteristic. For example, it estimates the price consumers are willing to pay for an extra GB of included data usage.

Fixed line

We have collected data on plans from Telstra, Optus, TPG and iiNet. These providers together comprised 81 per cent of market share in June 2018.[53]

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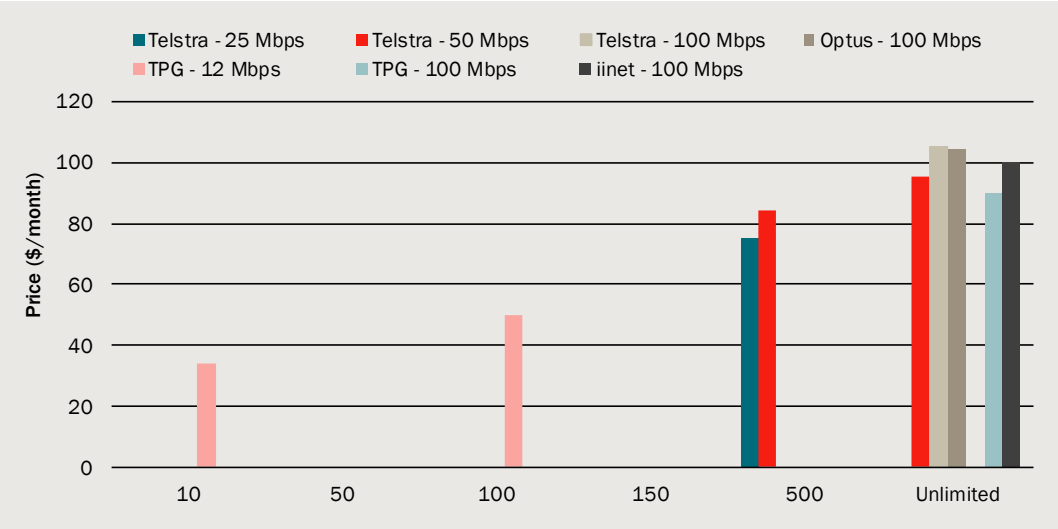
51 Triplett, J. (2004), *Handbook on Hedonic Indexes and Quality Adjustments in Price Indexes – Special Application to Information Technology Products*, Organisation for Economic Cooperation and Development, Paris. http://browse.oecdbookshop.org/oecd/pdfs/free/9306081e.pdf

52 The CIE, 2016, *Telstra's price premium: the premium paid by consumers for fixed and mobile services*, prepared for Vodafone Hutchison Australia, available at: http://www.thecie.com.au/wp-content/uploads/2017/03/CIE-Report_VHA_Price-Premium-Update-VHA-01122016.pdf

53 *ACCC Telecommunications Report 2015–16*, published February 2019, https://www.accc.gov.au/system/files/ACCC%20Communications%20Market%20Report%202017%E2%80%9318%E2%80%94February%202019.pdf

It is difficult to estimate the price of data (in $/GB) for fixed line plans due to the proliferation of unlimited data plans. Some providers such as Telstra and TPG have plans with and without unlimited data allowances (chart A.1). Plans from these major providers have 10GB, 100GB, 500GB or unlimited options for data allowances as shown. There is variation in the price of plans that offer unlimited data and this could be due to a range of factors such as speed differences and other content inclusions.

A.1 Prices and data allowances of example fixed line plans

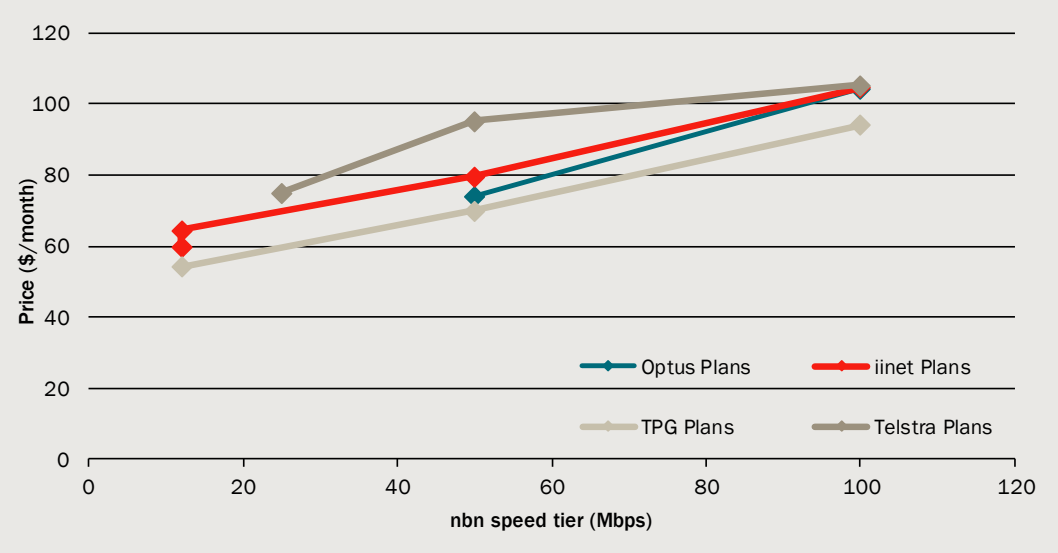


Data source: TPG, iiNet and Telstra websites, CIE.

Other providers, such as Optus, only have plans with unlimited data allowances. For example, Optus offers a plan with an unlimited allowance for $70 per month. Where the data allowance is unlimited, the price of data (in $ per GB) is not defined.

Among unlimited data plans, the main determinants of price are speed and which telecommunications company is providing the service. Plans on higher speed tiers cost more, although among the cheapest offerings on 100 Mbps, most carriers offer around the same price with the exception of TPG, which is lower (chart A.2).

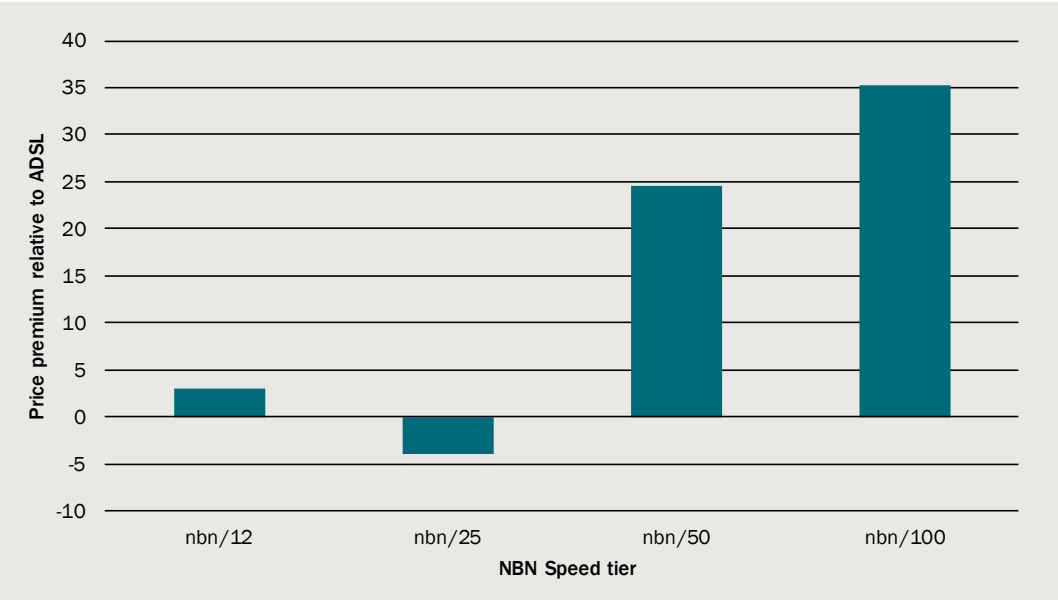
A.2 Prices and speeds of selected cheapest NBN plans



Data source: CIE.

Chart A.3 shows the price premiums for NBN plans of varying speeds relative to ADSL plans. A price premium of $25 for 50 Mbps plans on the NBN means that prices for these plans are, on average, $25 more expensive than ADSL plans, controlling for other variables such as the included data allowance. NBN plans with 12 Mbps speeds have a smaller price premium relative to ADSL of around $3 while the premium for 100 Mbps plans is $35. There is a negative premium associated with 25 Mbps of around $5, which would mean that these plans are slightly cheaper on average compared to ADSL plans. These plans are much rarer as most carriers off 50 Mbps as their minimum.

A.3 Price of fixed line technologies and speed tiers relative to ADSL/HFC



Note: Price premiums shown in the chart are the price premiums relative to ADSL/cable plans.

Data source: CIE.

We estimated the following main model specification for fixed line plans:

$$Price_t = \beta_0 + \beta_1 \times unlimited\ data_t + \beta_2 \times data_t + \beta_3 \times data_t^2 + \sum_i^3 \beta_i \times provider_t + \sum_{s=1}^{6} \beta_s \times technology_t + \beta_{13} \times line\ rental_t + \beta_{14} \times local\ calls_t + \beta_{15} \times mobile\ calls_t + contract\ length_t + \varepsilon_t$$

which estimates the price of plan t for providers i, and technology types s. The technology dummy variables specify both the technology used and the speed. For example, a separate price effect for NBN (12Mbps maximum speed) and NBN (25Mbps maximum speed) is estimated. The *line rental*, *local calls* and *mobile calls* variables are indicator variables for whether these features are included in the plan (e.g. are calls to Australian mobiles included in the plan, or do they cost extra). Each plan observation is weighted by the market share of the provider (based on ACCC, 2018) multiplied by the reciprocal of the number of plans from that provider in the dataset. Table A.4 presents the estimated coefficients from this model.

A.4 Fixed line plans hedonic model

Variable	Coefficient	P-value
	$/month	
Data	0.07	0.331
Data-squared	-0.00004	0.774
Unlimited data	27.1	0.000
Carriers		
TPG	-12.5	0.001
Telstra	6.7	0.027
iiNet	-5.7	0.047
Technology and speed		
NBN/100	35.3	0.000
NBN/12	3.0	0.538
NBN/25	-4.0	0.467
NBN/50	24.5	0
Line rental	-1.9	0.455
Local calls	15.9	0
Contract length		
18	-4.2	0.259
24	-7.9	0.012
Constant	44.0	0.000

Note: The excluded value of 'technology' is ADSL/Cable and the excluded carrier is Optus. The coefficients for each technology and carrier reflect the price premium relative to these excluded values.

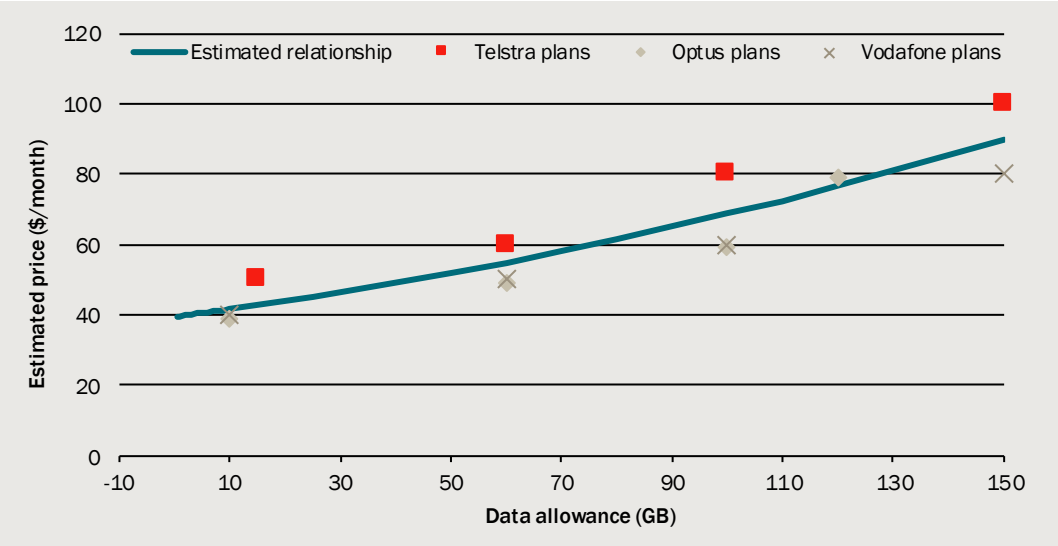
Source: CIE.

Mobile plans

We have collated data on post-paid mobile plans provided by Telstra, Optus, Vodafone, TPG, iiNet and Amaysim, which together represent between 90–100 per cent of market share.

Chart A.5 shows the data allowance and price of mobile plans from Telstra, Optus and Vodafone. It also shows the estimated relationship between data allowance and price. It is clear that the relationship between data allowance and price is steeper for Telstra plans than for Optus or Vodafone plans. We have estimated only a single relationship between data demand and price, because the focus is on obtaining the average price of data across all providers.

A.5 Prices and data allowances of selected mobile plans



Data source: Telstra, Optus and Vodafone websites, CIE.

We estimated the following main model specification for post-paid plans:

$$Price_t = \beta_0 + \beta_1 \times data_t + \beta_2 \times data_t^2 + \beta_3 \times unlimited\ data_t + \sum_{h=1}^{2} \beta_t \times handset_t + \beta_6 \times Unlimited\ International\ minutes_t + \beta_7 \times month - to - month_t + \beta_8 \times Music\ subscription_t + Extra\ credot_t + \varepsilon_t$$

which estimates the price of plan t for handsets h. The $Unlimited\ International\ minutes$ variable is an indicator variable measuring the whether a plan includes unlimited international minutes or not[54]. The $month - to - month$ variable indicates whether the plan has no lock-in contract. The

54 In our previous report this was a continuous variable which specified the number of included international minutes. In our recent overview of mobile plans, those plans which included international calls were typically unlimited. Those with a metered service generally offered 1000 minutes. This variable was therefore changed to an indicator variable due to reduced variation in the number of international minutes included.

Music subscription variable indicates whether a music subscription service is included in the plan (such as Apple Music). Each plan observation is weighted by the market share of the provider (based on ACCC, 2018) multiplied by the reciprocal of the number of plans from that provider in the dataset.

Table A.6 presents the coefficient estimates which relate each of these variables with the monthly price of a plan.

A.6 Mobile plans hedonic model

Variable	Coefficient	P-value
	$/month	
Data	0.21	0
Data-squared	0.001	0.001
Unlimited data	na	na
Handsets		
Samsung Galaxy S20 5G	44.6	0
iPhone XR 64GB	35.6	0
Carriers		
Optus	15.0	0
TPG	2.1	0.559
Telstra	23.4	0
Vodafone	16.3	0
iiNet	2.4	0.503
International minutes	na	na
Month-to-month	na	na
Extra credit	0.10	0
Music subscription	-1.78	0.479
Constant	22.39	0

Note: The excluded carrier is Amaysim. The coefficients for each carrier reflect the price premium relative to Amaysim. Variables for unlimited data, international minutes and month-to-month were omitted from the regression model due to insufficient variation amongst the plans.

Source: CIE.

B Modelling choices between fixed line and mobile

In order to better understand the decision between fixed line and mobile-only, we use the survey dataset to model substitution between these two services. This appendix provides more detail about the modelling methodology, estimated coefficients and measurement of the impacts of the falling price of data.

Methodology

We estimate a logit model that seeks to predict the choice of individual households between two options: fixed line or mobile-only. Logit models are a type of regression model where the dependent variable can take two values; in this case, either fixed or mobile-only. Consumers are assumed to purchase the option that gives them the greatest utility/benefit.[55]

The logit model we estimate has the following form:

$$\text{logit}\, P(fixed) = \log \frac{P(fixed)}{P(mobile)} = \beta_0 + \beta_1 data + \beta_2 data^2 + \sum_{k=1}^{K} \beta_k x_k$$

where:

- $\text{logit}\, P(fixed)$ is the log-odds of a customer choosing to purchase fixed line services rather than mobile services
- $data$ is the data usage of an individual household (in GB/month)
- x_k are a series of individual characteristics including the following:
  - an indicator variable for whether the household is in a capital city or not
  - variables for the number of adults, the number of children under 5 years-old
  - the number of children between 5 and 18 years-old in the household
  - an indicator variable for the sex of the respondent[56]

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55 Cardona et al. (2007) explain how utility maximisation is the basis for these types of logit models: Cardona, M., Schwarz, A., Yurtoglu, B.B. and Zulehner, C., 2007, 'Demand estimation and market definition for broadband internet services', Working paper, available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1081261

56 This variable is particularly important for the 25-34 year-old cohort, and excluding this variable has a noticeable impact on the estimated coefficients of interest (β_1 and β_2). The relationship between sex of the respondent and the choice between fixed and mobile is statistically significant at the 5 per cent level for 25-34 year-olds. While it is not statistically significant for other age cohorts, estimated coefficients and model fit are negligibly affected by inclusion/exclusion of this variable in models for other age cohorts.

  - indicator variables for the annual income band of the household ($18 200 or less, $18 201–37 000, $37 001–87 000, $87 001–120 000, $120 001–$180 000, $180 000 or more), and
  - indicator variables for the highest qualification level of a household member (including High school level, Certificate level, Advanced diploma and diploma, Bachelor degree and above).
- β_0, β_1, β_2 and β_k are coefficient estimates, which can be interpreted as the estimated change in logit $P(fixed)$ resulting from a one-unit change in the respective dependent variables such as $data$.

This model allows us to estimate the share of households which are mobile-only under different scenarios for the explanatory variables.

We estimate separate models for each age cohort. That is, respondents are segmented by their age group, and separate models (and, therefore, coefficients) are estimated for each. This approach has been taken because different age groups are expected to have different relationships between usage and their choice of fixed or mobile. For example, younger cohorts are expected to switch between fixed and mobile more easily than older cohorts.

Estimated model

Table B.1 presents the estimated coefficients of usage and usage-squared for each age group. The coefficient of usage is positive, while the coefficient of usage-squared is negative. This suggests a positive but decreasing relationship between usage and the probability of choosing fixed-line.[57]

These coefficient estimates are difficult to interpret because they measure the impact of one-unit changes in usage and usage-squared on the *log-odds* of choosing fixed line. As a result, the impact of a one-unit change in usage on the *probability* of choosing fixed line will depend on both the starting point for usage and the starting point of the probability of choosing fixed line. The table shows a simple calculation of the mobile-only share that would be implied if usage increased from the current average of 266GB to 316GB. The current mobile-only share for each age group is used as a starting point (shown in the column corresponding to 266GB average usage). This calculation illustrates how sensitive the mobile-only share is to changes in usage, showing that the 18-24 age group responds most to changes in usage.[58]

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57 At very high levels of usage such as 8000GB or more depending on the age group, the model predicts that the probability of choosing fixed line falls as usage increase. This level of usage is not commonly observed in the dataset or projections of data usage, and thus this feature of the coefficients has at most a trivial effect on model predictions.

58 This calculation does not account for deviation between actual usage of individuals and the average usage across each age group (i.e. the distribution of usage). Therefore, it implicitly assumes that all households in each age group have usage equal to average usage, and all households experienced the same 50GB increase in usage. The change in the mobile-only share is generally lower (for a given change in average usage) once the distribution of usage is accounted for.

Table B.1 also shows the proportion of internet-using households in each age group based on the survey.[59] These shares are used to convert estimates of the mobile-only share for each age group into estimates of the mobile-only share across all households.

B.1 Estimated coefficients of choice model by age group

Age group	Usage coefficient	Usage-square coefficient	Mobile-only share with 266GB average usage	Mobile-only share with 316GB average usage	Share of internet-using households in age group
			Per cent	Per cent	Per cent
18-24	0.00815	-0.00000092	17.5	12.7	12.1
25-39	0.00989	-0.00000113	13.3	8.8	28.3
40-54	0.00523	-0.00000055	14.4	11.6	24.3
55+	0.02642	-0.00000502	15.0	5.2	35.3

Source: CIE.

Modelling the impact of the falling price of data scenarios

We have modelled the impact of this fall in the price of data by modifying the coefficients β_1 and β_2 from the logit model (shown in table B.1). That is, to model the impacts of a 50 per cent reduction in the cost of data for mobile relative to fixed line plans, we reduce the magnitude of β_1 and β_2 each by 50 per cent for each age group. This is an appropriate to reflect changes in the price of mobile data because the estimated coefficients reflect the relationship between data usage and the choice of fixed line or mobile. At an extreme, if the price of mobile data fell to almost zero, data usage would no longer be expected to affect the choice between fixed line and mobile.

This assertion relies on the assumption that data usage is positively related to the probability of choosing fixed line only because data usage is costly for mobile but almost costless for fixed line. This assumption is approximately true, as shown by the proliferation of unlimited data allowances among fixed line plans and the fact that the marginal cost to the network owner of additional fixed line network traffic is almost 0.

The impact of changing the logit model coefficients can be represented by the following equation:

$$\frac{P(fixed_{p1})}{P(mobile_{p1})} \Bigg/ \frac{P(fixed_{p0})}{P(mobile_{p0})} = \frac{e^{\beta_{1,p1} data} + e^{\beta_{2,p1} data^2}}{e^{\beta_{1,p0} data} + e^{\beta_{2,p0} data^2}}$$

where $p1$ and $p0$ refer to the current price ($p0$) and increased/reduced price ($p1$) scenarios and e refers to the exponential function.

59 These estimated proportions of internet users by age group closely align to population shares by age group (based on ABS Census 2016 data).

This function is derived by exponentiating the original logit model equation, and then taking the ratio between the odds of the equation with coefficients $p1$ and the equation with coefficients $p0$ (assuming that the other coefficients and independent variables are unchanged). As with modelling the usage scenarios, we have modelled each tier of the usage distribution separately to account for 'saturation' of the mobile-only share among low-usage households.

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