## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Executive summary</td>
<td>3</td>
</tr>
<tr>
<td>Wired telecommunications at a glance</td>
<td>4</td>
</tr>
<tr>
<td>Wired telecommunications</td>
<td>5</td>
</tr>
<tr>
<td>National Broadband Network</td>
<td>5</td>
</tr>
<tr>
<td>Legacy fixed networks</td>
<td>8</td>
</tr>
<tr>
<td>Fibre</td>
<td>10</td>
</tr>
<tr>
<td>Submarine cables</td>
<td>11</td>
</tr>
<tr>
<td>Wireless telecommunications at a glance</td>
<td>12</td>
</tr>
<tr>
<td>Wireless telecommunications</td>
<td>13</td>
</tr>
<tr>
<td>Australia’s mobile networks</td>
<td>13</td>
</tr>
<tr>
<td>Mobile spectrum</td>
<td>14</td>
</tr>
<tr>
<td>Developments in 2020–21</td>
<td>14</td>
</tr>
<tr>
<td>Wireless broadband (mobile and fixed)</td>
<td>15</td>
</tr>
<tr>
<td>Satellite services</td>
<td>16</td>
</tr>
<tr>
<td>Access to communications services at a glance</td>
<td>18</td>
</tr>
<tr>
<td>How Australians access communication services</td>
<td>19</td>
</tr>
<tr>
<td>Data traffic is at an all-time high</td>
<td>19</td>
</tr>
<tr>
<td>Fixed broadband carries the majority of download traffic</td>
<td>19</td>
</tr>
<tr>
<td>Australians’ online activities in 2021</td>
<td>19</td>
</tr>
<tr>
<td>Spotlight: Online shopping</td>
<td>20</td>
</tr>
<tr>
<td>How Australians connected to the internet in 2020–21</td>
<td>21</td>
</tr>
<tr>
<td>Mobile phone is the dominant voice communication device</td>
<td>22</td>
</tr>
<tr>
<td>Smart devices are taking off</td>
<td>22</td>
</tr>
<tr>
<td>Spotlight: Cybercrime – the dark side of the internet</td>
<td>22</td>
</tr>
<tr>
<td>Consumer satisfaction with telecommunications services</td>
<td>23</td>
</tr>
<tr>
<td>Market performance</td>
<td>24</td>
</tr>
<tr>
<td>Revenue</td>
<td>25</td>
</tr>
<tr>
<td>Market activity</td>
<td>25</td>
</tr>
<tr>
<td>Future outlook</td>
<td>26</td>
</tr>
<tr>
<td>Glossary</td>
<td>26</td>
</tr>
<tr>
<td>Notes</td>
<td>29</td>
</tr>
</tbody>
</table>
Introduction

The purpose of the Australian Communications and Media Authority (ACMA) is to maximise the economic and social benefits of communications infrastructure, services and content for all Australia. We do this by:

> maintaining, enforcing and improving regulation to drive industry performance and protect consumers
> managing public resources to enable industry to deliver existing and new services
> understanding the changing communications sector to inform decision-making.

The Communications in Australia: Trends and developments in telecommunications 2020–21 report provides an overview of the Australian telecommunications sector during the 2020–21 financial year. Drawing on a combination of industry data and primary consumer research, the report describes key developments in the provision, take-up and use of telecommunications infrastructure and services, and considers drivers that underpin and shape the adoption of technology.

This report fulfills multiple legislative obligations under the Australian Communications and Media Authority Act 2005. These include requirements to:

> report to and advise the Minister of Communications, Urban Infrastructure, Cities and the Arts in relation to the telecommunications industry
> make available to the public information about matters relating to the telecommunications industry
> inform ourselves and advise the minister on technological advances and service trends in the broadcasting, internet and datacasting industries.
Executive summary

Telecommunications services have become more important than ever during the COVID-19 pandemic.

Ongoing restrictions such as lockdowns and social distancing have prevented many Australians from seeing one another, with virtual channels such as instant messaging, as well as phone and video calls becoming the primary means of communication. Remote working and education have also become commonplace over the pandemic period, with around 2 in 3 full-time employed Australian adults reporting working from home in the 6 months to June 2021.¹

The shift towards digital communications through this time has resulted in unprecedented reliance on wired telecommunications, which includes fixed-line internet connections such as fibre-to-the-home or fibre-to-the-node. At the same time, increasing use has seen pressure on network infrastructure. The completion of the National Broadband Network’s (NBN) rollout at the end of 2020 has done much to increase access to fast and reliable internet for all, connecting over 8 million homes and businesses. However, network outages are more likely to be felt, and the ability to maintain both reasonable network uptime and connectivity has become increasingly difficult. Some businesses have invested in alternative services such as dark fibre to gain greater control over their networks. Despite the ongoing challenges, overall network satisfaction has remained stable, with the major operators so far appearing to meet the challenges of maintaining their networks under heavier loads.

Wireless services have become increasingly popular over the pandemic period, with almost all Australians now owning some form of mobile device, and internet-enabled ‘smart’ devices are prevalent in nearly all Australian households. Telcos offering mobile services continue to upgrade their networks, expanding their 4G services and continuing to roll out 5G networks. Telcos have also expanded fixed wireless offerings over the year, using 5G to significantly enhance these services, making them comparable to higher speed NBN connections. Low earth orbit (LEO) satellite services have also started to enter the market, with SpaceX’s Starlink offering broadband services delivered via LEO satellite services for Australian consumers.

The telecommunications sector is showing positive signs of recovery, spurred on by business transformation, consumer take-up and economic activity.

Overall consumer use of communication services has increased over the year, with the effects of the pandemic continuing to encourage a shift towards online services. For example, online shopping has grown considerably, with over a million more Australians shopping online this year, and online retail trade now accounting for over 10% of total retail sales. 2021 saw data traffic at an all-time high, with data-thirsty activities such as video streaming and remote working on the rise. Many Australians sought to increase their internet speed and upgrade to unlimited data plans.

Despite the increasing demand for telecommunications, Australia’s 3 largest telcos, Telstra, Optus and TPG Telecom, have seen revenue declines associated with the COVID-19 pandemic.² This has been driven by a combination of factors, including a loss of mobile revenue from lower international roaming charges, weaker demand for handsets, and the ongoing migration to NBN services.

Many telcos are embarking on multi-year company transformations aimed at addressing challenges and positioning for future growth. They are increasingly looking for 5G, expansion in the enterprise market (such as dark fibre) and adoption of new services such as edge/cloud computing to drive revenue growth.
Wired telecommunications at a glance

Over 9 in 10 of us had access to fixed-line internet

We downloaded 9.8 million terabytes over the 3 months to June 2021

17% of NBN connections were 100 Mbps or higher (up from 10% in 2020)

There were 8.2 million active NBN services (up from 7.4 million in 2020)

Telstra had the highest number of NBN subscribers

TPG Telecom had the highest number of 100+ Mbps NBN subscribers

Less than 1 in 4 of us used a fixed-line phone at home

There were just under 15,000 public payphones across Australia

14 submarine fibre cables connected Australia with the rest of the world
Wired telecommunications

The fixed telecommunications industry is an important part of Australia’s telecommunications environment and is responsible for most data transmissions sent across the country and internationally. Wired telecommunications cover a variety of different fixed-line technologies, ranging from legacy copper wire connections to more modern technology such as fibre optics. The COVID-19 pandemic has reinforced the importance of home-based internet services, with lockdowns and border closures necessitating a reliance on fixed-line internet services for everyday activities such as work and study.

National Broadband Network

The National Broadband Network (NBN), maintained by NBN Co Limited (NBN Co), is the primary wholesale network for carrying Australia’s fixed-line voice and data services.

The NBN was designed to replace Australia’s former fixed telecommunications networks and ensure that Australians can easily and fairly participate in the digital economy. On 23 December 2020, the Minister for Communications, Urban Infrastructure, Cities and the Arts formally announced that the NBN should be treated as built and fully operational.3

Over 12 million homes and businesses are now ready to connect on the NBN, with 8.2 million services connected as of June 2021.4 This includes nearly 800,000 new connections, allowing more Australians access to superfast broadband.5

Internet speeds

Expanded access to the NBN combined with increased demand for higher-tier services has contributed to faster internet speeds across Australia.

This has been further supported by measures introduced by NBN Co in October 2020 supporting telcos to manage higher data volumes and encouraging more users to upgrade to higher-tier plans.6

The increased take-up of higher-tier services has resulted in greater average speeds across the network (Figure 1), with fixed-line services reporting network-wide average download speeds of almost 80 Mbps in June 2021 (Figure 2).7

National data consumption also continued to rise, with 8.2 million terabytes of data downloaded across the NBN in the June quarter of 2021.8

Figure 1: NBN speed tier mix, FY2018, FY2021, Mbps (%)

Source: NBN Co.

Figure 2: Average fixed-line connection speed, Mbps (%)

Source: Speedtest.org
**Technology mix**

Despite the NBN being formally announced as completed, the process of switching consumers over to the network is ongoing, with around 1 in 3 connections yet to be activated.\(^9\)

NBN uses a range of technologies to provide services to consumers. Fibre-to-the-node (FTTN) remains the most common type of NBN connection, with almost 30% of total NBN connections classified as FTTN as of June 2021 (Figure 3).

Fibre-to-the-curb (FTTC) has been a relatively recent NBN offering, first emerging in the 2018 financial year as an alternative to FTTN. FTTC provides numerous performance benefits over FTTN connections, shortening the distance between a home connection and an NBN hub, and increasing speed and reliability.\(^10\)

---

**Figure 3: NBN connections by technology type (%)**

- **Fibre-to-the-node (FTTN)**: 37%
- **Fibre-to-the-curb (FTTC)**: 23%
- **Fibre-to-the-building (FTTB)**: 13%
- **Hybrid fibre coaxial (HFC)**: 19%
- **Satellite**: 4%
- **Fixed wireless**: 1%
- **Other**: 3%

Source: ACCC, NBN Wholesale Market Indicators report June Qtr 2021.

---

75% of homes are expected to have access to 500 Mbps internet plans or higher by 2023.

As part of its 2021 corporate plan, NBN Co announced further investment in the capabilities of the network\(^11\), with the intent of having 75% of homes on the network able to access services over 500 Mbps by 2023. In addition, some FTTN connections will be eligible for a fibre-to-the-premises (FTTP) upgrade if they subscribe to a 100 Mbps or faster plan.
NBN market share

While NBN provides fibre services to Australians, it does not do so directly. Retail service providers (RSPs) are responsible for setting up the final link between consumers and the NBN. RSPs are required to have a carriage service provider (CSP) licence to legally provide services to consumers.

Telstra was the dominant NBN retail service provider in 2021, with over 3.7 million subscriptions or approximately 45% of total subscribers (Figure 4). Telstra has been the market leader for broadband services for many years. However, additional incentives to upgrade service plans to higher speeds and the increased internet needs of end-users during the COVID-19 pandemic have significantly increased competition, particularly in the 100+ Mbps market.

In June 2021, TPG Telecom was the dominant operator in the 100+ Mbps market, with approximately 43% of the high-speed market (Figure 5).

45% of total NBN subscribers use Telstra as a retail service provider. However, 43% of total 100+ Mbps NBN subscribers use TPG Telecom.
Legacy fixed networks

While the NBN rollout has incorporated both the former copper and hybrid fibre-coaxial (HFC) fixed-line networks, these older networks currently remain in operation for some Australians. For regional and remote Australia, which is reliant on alternate technologies such as satellite and fixed wireless infrastructure, copper services will remain the primary fixed-line service.\(^{12}\)

The NBN rollout has slowly phased out older connection types, with fewer than 400,000 household digital subscriber line (DSL) connections in operation as of June 2021 (Figure 6).\(^{13}\)

Telstra operates and maintains Australia’s copper telecommunications network but has progressively sold portions of its network to NBN Co. This is part of an ongoing agreement for NBN Co to acquire portions of Telstra’s copper network to service FTTN and FTTC NBN connections. Since September 2007, Australia’s copper network connections have fallen nearly 90%.\(^{14}\)

Businesses have been slower to connect to the NBN than consumers. Two in 5 (41%) businesses reported still having an ADSL connection as of June 2020 (Figure 7)\(^{15}\), compared to 7% of Australian adults with an ADSL connection at home.\(^{16}\)

The remainder of the network still under the control of Telstra is bound by obligations outlined under the Universal Service Guarantee (USG) until 2032. This includes:

> guaranteed access to a fixed-line voice service upon reasonable request
> connection and repair requests met within a reasonable timeframe
> priority assistance for people with life-threatening medical conditions
> reasonable access to payphones.\(^{17}\)
**Fixed-line voice services**

Analyst firm GlobalData has reported that in 2020, there were 9.5 million fixed-line phone services in Australia, 71% of which were voice over internet protocol (VoIP) services. Telstra remained the dominant provider of fixed-line services, accounting for over three-quarters of the analog market (Figure 8), and 2 in 5 VoIP services (Figure 9).

Australians continue to abandon fixed-line home phones. Only a quarter of adults (24%) made fixed-line home phone calls in 2021 – a sharp fall from 40% in 2020. ACMA 2019 telco consumer experience research shows that while 6 in 10 (59%) Australian households had a home fixed-line voice service, only 44% had a home phone that they used, and 15% had a home phone service connected but not in use.

**Payphones**

Under the USG, Telstra is responsible for ensuring reasonable access to a working payphone for all Australians on an equitable basis, regardless of where they live or work.

Over 11 million calls are made each year from payphones, a number that has been steadily declining with the widespread adoption of mobile phones. Even so, payphones provide a key back-up service to Australians who are unable to access an alternative communications service. They remain particularly important during emergencies and in regional areas where mobile phone coverage may not be available. In March 2021, for example, Telstra provided free calls and wireless internet from payphones to communities affected by severe storms and major flooding in New South Wales.

However, the number of public payphones in Australia continues to decrease. At 30 June 2021, there were 14,956 public Telstra payphones, 539 fewer than 30 June 2019.

**Free calls from Telstra payphones**

In August 2021, Telstra announced that texts, and local and national calls made from public payphones to Australian numbers would be free.

By October 2021, Telstra public phones no longer accepted coins, as the emptying and repair of coin collection mechanisms was costing more than the call costs.
Fibre

While the NBN, along with legacy copper and HFC networks, makes up the majority of Australia’s fixed communication network, other fibre-optics operations, such as dark fibre and submarine cables, also play an important role in transmitting voice and data services, both here and overseas.

Dark fibre

Dark fibre is a cover-all term for fibre networks that have been constructed but are not currently active.

While NBN Co is the primary wholesaler for retail services, other network providers may build and market wholesale fibre services for business purposes. Dark fibre services allow businesses to have a dedicated fibre connection between points that is not shared between other users, offering greater security, privacy and faster performance (Figure 11).

Any business leasing dark fibre is responsible for maintaining an operable network, including any necessary equipment and staff. These requirements make dark fibre networks expensive to operate and are typically only used by entities with specific needs, such as government organisations and large commercial enterprises. Dark fibre is not regulated as a transmission service as it does not come with the components necessary to operate a network.24

However, any business that leases a dark fibre network may be subject to regulations if they allow other businesses access to their leased dark fibre network.25

Businesses providing dark fibre services include major telecom operators such as Telstra InfraCo, TPG Telecom and Vocus, as well as smaller operators such as Superloop and 5G Networks.26 Demand for dark fibre is predicted to increase, with Telstra InfraCo expanding its dark fibre footprint by 25% in the 5 months to June 2021.27

Figure 11: How dark fibre works – managed services

![Diagram of dark fibre network](https://example.com/dark_fibre_diagram.png)
**Submarine cables**

Submarine cables are a vital part of Australia’s fixed-line communications infrastructure, carrying vast amounts of voice and data traffic both interstate and internationally.

Without these cables, the existing level of global interconnectivity would not be available in Australia. Both wired networks, such as the NBN, and most wireless networks, such as mobile networks, connect into these submarine cables to send data internationally. The exception to this is satellite networks, which can independently transmit data across the globe.

The ACMA has numerous responsibilities in relation to submarine cables, including issuing submarine cable installation permits, and declaring protection zones to prohibit or restrict potentially damaging activities near cable installations. Information about which activities are restricted or prohibited in each of the 3 declared protection zones, is available on our website.

Businesses seeking to explore and extract resources in a protection zone must consult with cable owners before beginning operations.

At the end of June 2021, there were 14 submarine cables connecting Australia with the rest of the world (Figure 12). In addition, 3 further cables were under construction:

- **Southern Cross NEXT cable (SCN)**, due for completion by January 2022, will connect Australia to New Zealand, Fiji, Samoa, Tokelau, Kiribati and California.

- **Sub.CO is building the Oman Australia Cable (OAC)** from Perth to Muscat, Oman. Due for completion by mid-2022, it will be the only express cable connecting Australia to the Middle East region.

- **Vocus Communications was building Darwin–Jakarta–Singapore Cable (DJSC)**, linking the Australia–Singapore Cable (ASC) to the Northwest Cable System (NCWS) in Port Hedland. This was completed in August 2021.

---

**Figure 12: Australia region international submarine cables, 2020–21**

Source: cable data: ACMA; map data: snazzy.com.
Over 1,200 functional space objects were registered last year, a more than threefold increase from 2019.

Low-earth orbit (LEO) satellite services started to be offered in Australia.

The United States Federal Communications Commission (FCC) has so far approved over 15,000 LEO satellites.
Wireless telecommunications

Wireless telecommunications are a vital part of the Australian communications landscape.

Mobile phones have largely supplanted fixed-line communications for voice-only services (excluding internet-based communications). Although the COVID-19 pandemic has been a significant catalyst for change in the telecommunications market, mobile phones remain the primary way Australians stay connected.

Australia’s mobile networks

Australia’s 3 major mobile network operators (MNOs) – Telstra, Optus and TPG Telecom – own and operate mobile network infrastructure, offering services, both direct to consumers and via resellers. Telstra is the largest provider of mobile services, with 48.7% market share, followed by Optus (26.3%) and TPG Telecom (15.3%) (Figure 13).

Mobile virtual network operators (MVNOs) provide just under one in 10 mobile services in Australia. MVNOs provide services to customers by paying MNOs to use a portion of their networks. MVNOs often differentiate themselves from MNOs by offering lower prices or larger data allowances than MNOs, however, are bound by wholesale contracts that give them weaker guarantees of quality and stability due to their lack of network control.31

There are also other businesses that own mobile infrastructure but do not sell mobile services to consumers. Those businesses lease towers to telcos to supplement their mobile networks.

In December 2020, there were over 30 million mobile services in operation (Figure 14).

![Figure 13: Mobile market share (%)](image-url)

![Figure 14: Mobile voice and broadband services in operation by product category (millions)](image-url)
Mobile spectrum

The ACMA has an extensive work program to support making spectrum available for mobile broadband and other uses.

5G millimetre wave spectrum in the 26 GHz and 28 GHz bands was also allocated under a new flexible licensing arrangement – the area wide licence. Successful applicants included existing and new service providers entering the Australian market to provide fixed wireless and fixed satellite services. The ACMA has allocated around 80 licences.

3G mobile networks

3G is the oldest form of mobile technology still in service in Australia. In the process of being phased out by MNOs, 3G is still used to provide services to some remote and regional areas, with 0.3% of the Australian population receiving 3G-only mobile coverage.\(^{32}\)

4G mobile networks

4G is the most common form of mobile network across Australia. Most Australians using mobile networks, particularly in metropolitan areas, are connected to a 4G network. In June 2021, 4G reached 99.5% of the Australian population.\(^{33}\)

5G mobile networks

The latest iteration of broadband mobile technology, 5G uses high-frequency radio spectrum to provide faster data speeds and lower latency than previous 4G and 3G technologies. 5G networks are still being rolled out by the major mobile network operators. As at June 2021, the 5G network covered 75% of the Australian population, with over 2 million 5G connections.\(^{34}\)

Developments in 2020–21

Continuing investment in mobile networks

All 3 mobile carriers are progressively reducing 3G services while expanding network and service offerings on 4G and 5G networks. All 3 carriers are continuing to offer 3G services using lower frequency spectrum in the interim, with Telstra’s 3G network slated for closure in 2024.

Five companies won spectrum in the ACMA’s 2021 26 GHz band auction, including Australia’s major telcos. Both Telstra and Optus announced that they had multiple mmWave (millimetre waves; short-range, high-frequency network technology) sites in major cities on the eastern seaboard of Australia, while TPG Telecom flagged plans to launch a superfast 5G service using mmWave spectrum in the near future.\(^{35}\) Pentanet and Dense Air were also awarded spectrum in this allocation.

Mobile Black Spot Program

While Australia’s mobile 4G coverage reaches over 99% of the population, some regional, rural and remote areas have sparse or no mobile access. The Australian Government has committed $380 million toward improving mobile coverage and competition across regional areas through its Mobile Black Spot Program.

To date, the program has generated a total investment of more than $875 million, to deliver more than 1,270 new mobile base stations across Australia.\(^{36}\) In July 2021, 67 new planned sites were announced, including:

- 48 from Telstra
- 4 from Optus
- 15 from Field Solutions Group.\(^{37}\)

In addition, 3 trials will be conducted to test ways mobile network operators can roll out shared infrastructure to reduce cost and provide new coverage for more than one carrier.\(^{38}\)
Tower asset divestment

Australia’s major telcos have chosen to either begin, or consider, divesting their tower assets. Telstra announced in June 2021 that it would sell a 49% stake in its towers business to a consortium comprising the Future Fund, Commonwealth Superannuation Corporation and Sunsuper, renaming the new entity Amplitel. Optus announced that it had entered an agreement to sell a 70% stake in Australian Tower Network (a wholly-owned subsidiary) to AustralianSuper. TPG Telecom is reportedly undergoing a strategic review of its infrastructure assets.

The emergence of budget brands

All 3 mobile operators now have brands that target the ‘lower’ end of the market, such as Belong (Telstra), GOMO (Optus) and Felix (TPG Telecom).

The budget brands provide an avenue for telcos to compete against the MVNOs, while offering opportunities for customers to upgrade to the premium services that Telstra, Optus and Vodafone offer.

Optus acquired MVNO amaysim in February 2021 for $250 million, further expanding its presence in the budget mobile market.

Wireless broadband (mobile and fixed)

In Australia, spectrum supports multiple categories of wireless broadband use and deployments in practice may reflect combinations of these categories.

One category of wireless broadband service is the wide-area subscriber network, with an extensive base station infrastructure serving large geographic areas. This category is characterised by telecommunication carrier mobile broadband operations.

Fixed wireless access and private mobile networks, often serving smaller, localised areas, are another category. Services provided by wireless internet service providers (WISPs) are a good example of this type of small and medium enterprise (SME) that often provide these services.
Satellite services

Australia’s vast size means that even the furthest reaching mobile communications networks are unable to reach all Australians. Satellite communications supplement mobile and fixed line communication services to ensure that even the most remote locations can be connected.

Satellite communications are experiencing a significant period of technological innovation and disruption in the provision and delivery of services.

We continue to engage internationally on the coordination, development and implementation of measures to enhance spectrum use for satellite communications.

Low earth orbit satellites

New technology innovations have considerably shrunk satellite size and power compared to older models. Combined with falling launch costs, this has created opportunities for satellite operators to develop low earth orbit (LEO) satellite constellations, an emerging trend in modern satellite communications. LEO satellites differ from traditional geosynchronous orbit (GEO) satellites in how they orbit the earth (see Figure 16). GEO satellites orbit at the same rotational speed as the earth, allowing them to remain above the earth in the same position at all times. In contrast, LEO satellites orbit much lower and do not remain in a fixed position. To resolve this issue, LEO satellites use an interlinked constellation of satellites to provide services.

Figure 16: Satellite orbit characteristics

<table>
<thead>
<tr>
<th>Orbits</th>
<th>Altitude (km)</th>
<th>Orbital period</th>
<th>Latency (ms)</th>
<th>Cost per satellite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geostationary (GEO)</td>
<td>35,786</td>
<td>24 hours</td>
<td>477</td>
<td>US$100–$400 million</td>
</tr>
<tr>
<td>Medium-earth (MEO)</td>
<td>2,000–35,786</td>
<td>2–24 hours</td>
<td>27–477</td>
<td>US$80–$100 million</td>
</tr>
<tr>
<td>Low-earth (LEO)</td>
<td>160–2,000</td>
<td>88–127 mins</td>
<td>2–27</td>
<td>US$0.5–$45 million</td>
</tr>
</tbody>
</table>

Source: Digital Connectivity and Low Earth Orbit Satellite Constellations: Opportunities for Asia and the Pacific (SDWP No. 76) (adb.org)
The primary advantage of LEO satellites is latency, as they are closer to the earth (160–2,000 km) than geostationary satellites (approximately 36,000 km). Ground stations for LEO satellite networks are also cheaper to operate.

There are a number of emerging LEO satellite services on the horizon. Most LEO satellite services are still in the construction phase, with only SpaceX’s Starlink commercially available in a limited capacity to Australians.43

The ACMA observes proposed LEO constellations have been generally growing in number, with several start-up ventures in the process of obtaining regulatory approvals to operate on a global scale (for example, Starlink via its parent Space Exploration Technologies (SpaceX)). Most of these providers are seeking to provide high-speed internet to parts of the world where traditional broadband is too costly to provide.

These businesses are largely being led by either consortia or technology companies. It is too early at this stage to tell which provider will emerge as successful, with announcements being released on a weekly, or in some cases daily, basis. Due to the COVID-19 pandemic and the significant capital costs involved in launching satellites, some of these businesses have had to restructure their finances or have been taken over by investment consortia. The more successful start-up businesses to date are supported by either government entities, multi-billion-dollar parent companies or billions of dollars in venture capital.

Like any satellite, LEO satellites require spectrum to communicate. Satellite systems that provide communication services, such as the other large non-geostationary satellite orbit (NGSO) systems of today, operate as fixed satellite services utilising Ku band and Ka band. Due to directional antennas and different orbital characteristics, it may be possible via coordination for a number of satellite systems to operate in the same spectrum.

For more information about recent developments in satellite communications in the Australian context, see the ACMA’s Market study: Australian space sector.

Other information on licences and holders is available on the ACMA’s Register of Radiocommunications Licences.

---

**Figure 17: Number of registered functional space objects, by year**

<table>
<thead>
<tr>
<th>Year</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>229</td>
</tr>
<tr>
<td>2019</td>
<td>357</td>
</tr>
<tr>
<td>2020</td>
<td>1,260</td>
</tr>
</tbody>
</table>

Note: Functional space objects include satellites, probes, crewed spacecraft and space station flight elements. Source: United Nations Office of Outer Space Affairs Annual Reports.
### Access to communications services at a glance

<table>
<thead>
<tr>
<th>Device</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smartphone</td>
<td>94% of us owned a smartphone</td>
</tr>
<tr>
<td>Smart TV</td>
<td>7 in 10 of us had a smart TV</td>
</tr>
<tr>
<td>Connected smart device</td>
<td>8 in 10 of us had at least one connected smart device</td>
</tr>
</tbody>
</table>

- **9 in 10 of us used the internet on our mobile phone.**

- **61% of employed Australians worked online from home.**

- **45% of those who upgraded their NBN plan did so to support working from home.**

- **8 in 10 NBN connections had an unlimited data allowance in June 2021.**

- **92% of us banked online.**

- **90% of us watched video content online.**

- **85% of us bought goods and services online.**

- **74% of us listened to audio content online.**
How Australians access communication services

With social distancing and travel restrictions in place across much of the country, 2020–21 saw significant changes in the way many Australians lived their lives.

Scores of us shifted to working or studying from home, while businesses were forced to innovate and adapt, or risk being left behind in a rapidly changing commercial environment.

The internet formed a crucial part of daily life for most Australians in 2020–21. Since the onset of COVID-19 pandemic restrictions in early 2020, we’ve seen significant increases in many online activities, with data consumption rising accordingly.

Data traffic is at an all-time high

Aligned with our increasing reliance on the internet, 2020–21 saw considerable growth in data downloads (Figure 18). Total downloads over 3 months rose by 20% in the year to June 2021, to 9.8 million terabytes.44

Fixed broadband carries the majority of download traffic

While mobile phones remain the most popular way to go online in Australia, fixed broadband infrastructure carries the majority of data-download traffic by a considerable margin. Nearly 90% of data downloaded in June 2021 was via fixed broadband networks45, while mobile data carried around 10%. Satellite and wireless accounted for 0.1% of downloads. Over 9 in 10 (91%) Australians had a home broadband connection in 202146, with the vast majority of services in operation (93%) now connected to the NBN.47

Australians’ online activities in 2021

With COVID-19 restrictions in force for much of 2020–21, more Australians went online to do routine activities such as working, banking and shopping (Figure 19).

With data-thirsty activities such as video streaming and remote working on the rise, many Australians sought to increase their internet speed in 2020–21. In June 2021, 80% of NBN fixed retail services were provided with no data limit, an increase of 4% compared with the same period last year.48 NBN reports that among its users, 45% of plan upgrades in 2020–21 were to better support working from home.49

For many of us, working from home became a hallmark of the COVID-19 lockdown. ACMA-commissioned research in June 2021 found that 45% of adult internet users worked online from home in the first half of 2021, with those in full-time employment most likely to work from home.50

Online banking use rose significantly in the 2 years to 2021, to over 9 in 10 online adults (92%) in the 6 months to June 2021 (from 86% in 2019), a shift that will likely be maintained well beyond the pandemic.
The Australian Banking Association reports that in 2021, more than 80% of Australians said they prefer to check account balances, pay bills and transfer funds online, compared to doing these functions in bank branches. Less than 20% indicated they preferred attending a branch for any banking activity.\(^51\)

Similarly, content streaming has boomed since 2019, with 90% of online adults having viewed online video in the 6 months to June 2021 (from 83% in 2019). During this period, online audio content access also increased to 74% of online adults (from 65% in 2019).\(^52\)

Online shopping also took off during the pandemic lockdowns, with 1.3 million Australians shopping online for the first time in 2020. In the 6 months to June 2021, internet users aged 65 and over, were the age group with the highest level of growth in online shopping, rising from 47% in 2019, to 69% in 2021 (Figure 19).

**Figure 19: Activities performed online by internet users in the past 6 months (%)**

<table>
<thead>
<tr>
<th>Activity</th>
<th>May-19</th>
<th>Jun-20</th>
<th>Jun-21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Email</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Banking</td>
<td>98</td>
<td>92</td>
<td>98</td>
</tr>
<tr>
<td>Watch videos</td>
<td>83</td>
<td>89</td>
<td>90</td>
</tr>
<tr>
<td>Shopping</td>
<td>78</td>
<td>83</td>
<td>85</td>
</tr>
<tr>
<td>Audio content</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work from home</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Worked from home</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full-time</td>
<td>65</td>
<td>69</td>
<td>74</td>
</tr>
<tr>
<td>Part-time</td>
<td>42</td>
<td>45</td>
<td></td>
</tr>
</tbody>
</table>

\(\updownarrow\) Significantly different to prior year at the 95% confidence level.

See ACMA annual consumer survey questionnaire for full description of each category.

Base: Australians aged 18 and over who accessed the internet in the past 6 months: 2019 \(n=1,991\), 2020 \(n=1,984\), 2021 \(n=3,549\).

Source: ACMA annual consumer survey. QD8 Please indicate whether you have done any of the following in the past 6 months at home or elsewhere.

**Spotlight: Online shopping**

With many retail premises closed due to COVID-19 restrictions, the popularity of e-commerce substantially increased during 2020–21.

More consumers and businesses engaged with online shopping services than ever before, creating $48.6 billion in revenue in the year to June 2021.\(^53\) The online share of total retail spend grew by 16.3% in the year to June 2021, up from 11.3% in 2019.\(^54\)

Not surprisingly, those Australian states that were placed under tougher restrictions during this period saw higher growth in online purchases, with Victoria’s online commerce activity rising by 78% in 2020, while the ACT (49%) and New South Wales (46%) saw less dramatic increases.\(^55\)
How Australians connected to the internet in 2020–21

Mobile phones are now used by almost all Australian adults to communicate (99%), with 93% of online adults accessing the internet via their mobile phone in the first half of 2021, up from 87% in 2019. Smartphones are owned by nearly every adult in Australia, providing easy access to voice and internet services for most of the population (Figures 20 and 21).

One driver for the rise in mobile phone internet access may be the soaring popularity of communication apps during the COVID-19 pandemic. Between 2019 and 2021, the proportion of online Australian adults using a message or calling app in the previous 6 months to June, rose from 67% to 78%, with especially strong growth in use of apps for video calls (41% to 55%) and messaging (58% to 72%).

While sizeable proportions of online Australians also connected to the internet via laptop computers, televisions, tablets, and desktop computers in the first half of 2021, usage declined for most of these devices, reversing the COVID-19 driven gains made in 2020. The only devices to show continued growth in usage since pre-pandemic levels in 2019 were mobile phones, laptops and TVs (see Figure 21).96

---

**Figure 20: Mobile phone ownership (%)**

<table>
<thead>
<tr>
<th></th>
<th>May-19</th>
<th>Jun-20</th>
<th>Jun-21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smartphone</td>
<td>83</td>
<td>93</td>
<td>94</td>
</tr>
<tr>
<td>Not a smartphone</td>
<td>11</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

△▼ Significantly different to prior year at the 95% confidence level.

Base: Australians aged 18 and over: 2019 (n=2,067), 2020 (n=2,009), 2021 (n=3,586). Data may not sum to reported totals due to rounding. Don’t know and refused responses not shown in chart.

Source: ACMA annual consumer survey. QC1: Is your main mobile phone a smartphone?

**Figure 21: Internet access device (%)**

<table>
<thead>
<tr>
<th>Device</th>
<th>May-19</th>
<th>Jun-20</th>
<th>Jun-21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile phone</td>
<td>93</td>
<td>91</td>
<td>87</td>
</tr>
<tr>
<td>Laptop</td>
<td>73</td>
<td>76</td>
<td>69</td>
</tr>
<tr>
<td>TV*</td>
<td>56</td>
<td>56</td>
<td>56</td>
</tr>
<tr>
<td>Tablet</td>
<td>55</td>
<td>61</td>
<td>61</td>
</tr>
<tr>
<td>Desktop PC</td>
<td>49</td>
<td>49</td>
<td>49</td>
</tr>
<tr>
<td>Digital media player</td>
<td>25</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Gaming console</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

△▼ Significantly different to prior year at the 95% confidence level.

* Includes smart and non-smart TVs.

Base: Australians aged 18 and over who accessed the internet in the past 6 months: 2019 (n=1,991), 2020 (n=1,984), 2021 (n=3,548).

Source: ACMA annual consumer survey. QD5: Which of the following devices have you used to access the internet in the past 6 months, for personal purposes?
Mobile phone is the dominant voice communication device

In addition to the growing use of mobile phones to connect to the internet, 2021 also saw increasing use of mobile functionality for voice calls and texts.\(^{57}\)

- 98% used mobile voice calls (up from 94% in 2019)
- 99% accessed the internet (up from 90% in 2019)

Smart devices are taking off

Smart devices also grew in popularity in Australian households in 2020–21, with 79% of adults reporting that they had a smart device connected to the internet, up from 50% in 2019.\(^{58}\) During COVID-19 restrictions, more than half (51%) of those Australians already with connected smart devices invested in additional devices.\(^{59}\)

Smart TVs were the most common internet-accessible smart device in Australian households, with 7 in 10 (70%) reporting they had a smart TV connected to the internet (Figure 22).

Figure 22: Smart device take-up by Australian adults (%)

![Figure 22: Smart device take-up by Australian adults (%)](image)

▲▼ Significantly different to prior year at the 95% confidence level.

Note: In 2020, the description of Smart TV was expanded to include additional details and may have contributed to an increase. Comparisons with 2020 data should be made with caution.

Base: Australians aged 18 and over: 2019 (n=2,067), 2020 (n=2,009), 2021 (n=3,586).

Source: ACMA consumer survey. QD7: Which of the following smart devices, if any, do you have connected to the internet?

Spotlight: Cybercrime – the dark side of the internet

While the many facets of the internet have provided a way for Australians to connect during the COVID-19 pandemic, some malicious cybercriminals have attempted to take advantage of the increased online activity.

According to the Australian Cyber Security Centre, more than 67,500 cybercrimes were reported in 2020–21.\(^{60}\) Reported cybercrimes ranged from fraud, through online shopping scams, to investment scams.

Consumers and businesses collectively reported over $33 billion in financial losses due to cybercrime in 2020–21.\(^{61}\) The ACMA monitors cybersecurity and cybercrime issues through its membership of ReportCyber and provides consumer alerts, warnings and advice via its website.\(^{62}\)
Consumer satisfaction with telecommunications services

Customer satisfaction levels provide a valuable measure of how effectively telecommunications providers (telcos) are meeting the needs of Australians. The ACMA monitors customer satisfaction through a range of activities, including legislated industry reporting, complaint statistics and consumer surveys.

Despite COVID-19 restrictions placing telcos under greater pressure to deliver reliable services to customers, Australia’s consumer satisfaction levels with their telcos mostly stayed the same or increased during 2020–21 compared to pre-pandemic years, suggesting a high level of resilience in the sector (Figure 23).

On average, Australian consumers were most content with their mobile phone service, with almost 7 in 10 expressing satisfaction with the service.

Among home internet users, those using an NBN connection were marginally more satisfied than non-NBN users, who, along with fixed-line phone users, were among the least satisfied at 53%.

---

**Figure 23: Consumer satisfaction with communication services overall, 2019 to 2021 (%)**

<table>
<thead>
<tr>
<th>Service</th>
<th>May-19</th>
<th>Jun-20</th>
<th>Jun-21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed-line phone</td>
<td>55</td>
<td>61</td>
<td>57</td>
</tr>
<tr>
<td>Mobile phone service</td>
<td>64</td>
<td>71</td>
<td>68</td>
</tr>
<tr>
<td>NBN home internet</td>
<td>53</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Non-NBN home internet</td>
<td>39</td>
<td>52</td>
<td>53</td>
</tr>
</tbody>
</table>

Note: Level of satisfaction or dissatisfaction was measured on a scale of 1 to 5, where 1 is very dissatisfied and 5 is very satisfied. A rating of 4 or 5 has been reported as overall satisfied.

Base: Fixed-line phone: 2019 (n=997), 2020 (n=788), 2021 (n=1,108); Mobile phone service: 2019 (n=2,033), 2020 (n=1,982), 2021 (n=3,541); NBN home internet: 2019 (n=975), 2020 (n=1,522), 2021 (n=2,667); Non-NBN home internet: 2019 (n=975), 2020 (n=365), 2021 (n=522).

Source: ACMA annual consumer survey. QB1: How satisfied or dissatisfied are you with … your household’s fixed-line telephone service [overall]?; QC8: How satisfied or dissatisfied are you with … your mobile phone service [overall]?; QD1: Which of the following is your main household internet connection?; QD10: How satisfied or dissatisfied are you with … your household internet service [overall]?
Market performance

While the normalisation of working from home and remote education over the pandemic period significantly increased demand for broadband services, traditional revenue streams have been disrupted. Ongoing lockdowns across Australia have also resulted in higher consumer use of broadband for leisure purposes, such as video-on-demand services. Telcos have benefited from this trend, with increased revenue resulting from higher numbers of broadband subscriptions and high-speed services.

Revenue

Major telcos

Despite growing demand for broadband services, the major telcos all reported falls in revenue over the 2020–21 financial year (Table 1). This was reportedly due to a reduction in international roaming charges, falling handset sales and ongoing headwinds from NBN migration.¹⁶

Mid-tier telcos

While larger telcos struggled to post revenue gains in the 2020–21 financial year, some smaller telcos have grown over the same period.

Smaller telcos are typically less diversified, which can work as either a positive or a negative depending on market conditions. Over the pandemic period, a significant decline in demand for mobile services was a key contributor to declining revenue for the major telcos. However, the mid-tier telcos in Table 2 all specialise in telecommunication services, such as broadband and cloud storage, which have seen strong demand due to factors such as remote working and education. Higher demand from general use during lockdown, such as on-demand video streaming, has also contributed to higher demand for broadband and cloud services. In some cases, smaller telcos have grown through merger and acquisitions.

---

Table 1: Revenues by Australia’s largest service providers

<table>
<thead>
<tr>
<th></th>
<th>FY20 $b</th>
<th>FY21 $b</th>
<th>Change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telstra</td>
<td>23.71</td>
<td>21.56</td>
<td>–9.1</td>
</tr>
<tr>
<td>Optus*</td>
<td>8.95</td>
<td>8.32</td>
<td>–7.0</td>
</tr>
<tr>
<td>TPG Telecom†</td>
<td>5.52</td>
<td>2.63</td>
<td>–3.0</td>
</tr>
</tbody>
</table>

* Year-end March.
† Year-end December; pro forma results.²⁴
‡ HY21 results.
§ Change based on HY20 to HY21 results.
Source: Industry reporting²⁵

Table 2: Revenues by select mid-tier Australian service providers

<table>
<thead>
<tr>
<th></th>
<th>FY20 $m</th>
<th>FY21 $m</th>
<th>Change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aussie Broadband</td>
<td>190.5</td>
<td>350.3</td>
<td>83.9</td>
</tr>
<tr>
<td>Macquarie Telecom</td>
<td>266.2</td>
<td>285.1</td>
<td>7.1</td>
</tr>
<tr>
<td>Uniti Group</td>
<td>58.2</td>
<td>159.9</td>
<td>174.7</td>
</tr>
<tr>
<td>Superloop</td>
<td>107.6</td>
<td>110.7</td>
<td>2.9</td>
</tr>
<tr>
<td>Spirit Technology</td>
<td>34.9</td>
<td>104.5</td>
<td>203.8</td>
</tr>
</tbody>
</table>

Source: Industry reporting²⁶
**Market activity**

The telecommunications market has shifted over the past several years, with a variety of acquisition and mergers resulting in higher market concentration. The merger between TPG Telecom and Vodafone Hutchison, completed in July 2020, has been the highest-profile merger over the period. This was in part due to the media attention on the Australian Competition and Consumer Commission’s legal case, initially brought against this merger on anti-competitive grounds.

**Future outlook**

Telcos have focused on digital transformation, with the demand for digital services from both consumers and businesses only increasing over time. Telcos, both large and small, have responded by diversifying their market strategy, branching into new sectors such as energy, and through acquisition of businesses, which may benefit from integration into their wider business. Software solutions, dark fibre, cloud and edge computing and cloud storage solutions have become popular businesses for acquisition and are being incorporated into new product and service offerings.

Telcos have also invested in 5G as a path for future revenue growth, with the 3 major telcos all continuing to invest in expanding their 5G mobile network coverage. Telstra aims to expand their 5G coverage to 95% of the population by FY25. Investment in 5G fixed wireless services has also become a potential path for telco growth, with these services becoming a direct competitor to NBN services in some regions.
Glossary

3G: third-generation mobile telecommunications
Broadband mobile telecommunications services with improved data rates over their 2G predecessors, providing for applications such as web-browsing, videoconferencing and location-based services.

4G: fourth-generation mobile telecommunications
Enhanced broadband mobile telecommunications services that provide increased bandwidth to support voice, video, data and high-quality streaming multimedia content over an all-IP network. See also LTE.

5G: fifth-generation mobile telecommunications
The next iteration of broadband mobile telecommunications services, 5G provides increased data rates and reduced latency to support greater connectivity and enables M2M services and the IoT. 5G became commercially available in 2019.

ACCC: Australian Competition and Consumer Commission
Commonwealth regulatory body with responsibilities derived from the Competition and Consumer Act 2010.

ACMA: Australian Communications and Media Authority

ACMA annual consumer survey
Quantitative consumer research commissioned by the ACMA that provides time-series tracking of patterns of consumer communications and media use. This research considers consumer behaviour, adoption of and attitudes towards media and communications services and emerging issues.

ADSL: asymmetric digital subscriber line
Transmission technology that enables high-speed data services to be delivered over a twisted-pair copper line. ADSL2+ is an enhanced ADSL technology that adds new features and functionality that may provide higher data rates.

broadband
A class of high-speed internet access technologies, such as ADSL, ADSL2+, HFC cable and wi-fi, offering a data rate significantly higher than dial-up internet services.

cable: hybrid fibre coaxial (HFC) cable
Transmission links consisting of optical fibre on main routes, supplemented by coaxial cable closer to the end user’s premises.

carrier
The holder of a telecommunications carrier licence in force under the Telecommunications Act.

CSP: carriage service provider
Person supplying or proposing to supply certain carriage services to a customer, including a commercial entity acquiring telecommunications capacity or services from a carrier for resale to a third party. Under the Telecommunications Act, internet and subscription TV service providers fall within the definition of CSPs.

DITRDC: Department of Infrastructure, Transport, Regional Development and Communications
Department of the Australian Government responsible for managing infrastructure and regional development policy, communicating policy and programs, cultural affairs, and arts. The ACMA is a statutory authority within the department.

fixed-line phone service
Covers the delivery of voice services over a copper pair-based PSTN access network or fixed-line broadband networks. Includes fixed VoIP services.
FCC: Federal Communications Commission
Independent agency of the United States federal government that regulates communications by radio, television, wire, satellite, and cable across the US.

FTTB: fibre-to-the-building
A type of broadband access network deployment where optical fibre is deployed to a communications cabinet in the basement of each building, which is typically a multi-dwelling unit. The final connection to each individual premises within the building is made by alternative technologies, typically using the building’s existing copper cabling.

FTTC: fibre-to-the-curb
A type of broadband access network deployment where optical fibre is extended close to premises, connecting to a small Distribution Point Unit (DPU), generally located inside a pit on the street. From here, the existing copper network is connected to the fibre to form the final connection.

FTTN: fibre-to-the-node
A type of broadband access network deployment where the optical fibre line runs to a node (cabinet) located in the street. From this street cabinet, individual premises are connected via existing copper cabling networks.

FTTP: fibre-to-the-premises
A type of broadband access network deployment where the fibre-optic line extends directly to individual premises. Compared to other fibre-optic connection types, this type of connection results in the fibre-optic line running as close as possible to the end-user and subsequently results in the least reliance on existing copper cabling networks.

GB: gigabyte
One billion bytes; a unit of information. Each byte is 8 bits.

GHz: gigahertz
One billion hertz; a unit of frequency.

GEO satellite: geosynchronous satellite
A satellite with an orbital period the same as Earth’s rotation period.

HFC – see cable

MB: megabyte(s)
One million bytes; a unit of information.

MHz: megahertz
One million hertz; a unit of frequency.

LEO satellite: low earth orbit satellite
A satellite that has an orbit below 1,000 kilometres above Earth.

Minister: Minister for Communications, Urban Infrastructure, Cities and the Arts (previously Minister for Communications, Cyber Safety and the Arts)
Minister responsible for the ACMA and its governing legislation, and the legislation that the ACMA administers.

MVNO: mobile virtual network operator
A mobile service operator that does not have its own licensed spectrum and does not own the wireless network infrastructure over which it provides services to its customers.

NBN: National Broadband Network
The national wholesale-only open-access data network in Australia offering high-speed broadband to all Australian premises using a multi-technology mix.

NBN Co: NBN Co Limited
Wholly-owned Australian Government company established to design, build and operate the NBN.

NCD: nominated carrier declaration
Declaration made by the owner of a telecommunications network unit (facilities or infrastructure for delivery of telecommunications services) nominating a licensed carrier that will be responsible for the specified network unit.

payphone
A public phone where calls may be paid for with coins, phone cards, credit cards or reverse charge facilities. In August 2021, calls were made free.
**postpaid**
A telecommunications contract under which a user is charged on a periodic basis, depending on service use during the previous billing period.

**prepaid**
A telecommunications contract system where users pay an amount upfront to buy a certain amount of use or credit.

**PSTN: public switched telecommunications network**
Public telecommunications network to provide traditional fixed-line phone services to subscribers.

**smartphone**
A mobile phone built on a mobile operating system, with more advanced computing capability and connectivity. It has a touchscreen and can assess access the internet and run apps. For example, an Apple iPhone, Samsung Galaxy or similar device.

**TB: terabyte**
One thousand gigabytes; a unit of information.

**VoIP: voice over internet protocol**
Delivery of voice communications over the internet or some other connected network, instead of the PSTN.

**wi-fi**
A type of wireless local area network (WLAN) technology that uses radio waves to provide wireless high-speed internet and network connections using specifications in the IEEE 802.11 series of standards for WLAN.
Notes

2. TPG Telecom reporting based on June HY21 pro forma results.
5. Superfast is defined as a connection that can provide an internet speed of at least 25 Mbps or higher.
6. NBN Co, NBN Co launches new Focus on Fast campaign [media release], NBN Co website, 22 October 2021, accessed 23 November 2021. NBN Co’s ‘Focus on Fast’ campaign offered incentives and rebates for retail service providers to allow them to provide higher tier connections at a discount.
7. Speedtest.org
13. DITRDC, Universal Service Guarantee for telecommunications.
34. Telstra, Financial results for the full year ended 30 June 2021; Company reports.
At the time of writing included Round 1, Round 2, the Priority Locations Round, Round 4, Round 5 and Round 5A; DITRDC, 'Mobile Black Spot Program', DITRDC website, n.d., accessed 13 October 2021.

Under Round 5a of the Mobile Black Spot Program.

Telstra, Telstra sells 49 per cent of Towers business for $2.8 billion and announces returns for shareholders [media release], Telstra website, 30 June 2021, accessed 24 November 2021; Telstra, Telstra finalises $2.8 billion InfraCo Towers sale [media release], Telstra website, 1 September 2021, accessed 23 November 2021.

Optus, Optus announces sale to Australian Super [media release], Optus website, 1 October 2021, accessed 23 November 2021.


ACCC, Internet Activity Report for the period ending 30 June 2021.


ACCC, Internet Activity Report for the period ending 30 June 2021.

ACMA, ACMA annual consumer survey, June 2021, ACMA, Australian Government, unpublished, accessed 7 December 2021. Full-time employees are defined as those who work 35 hours or more per week.


Australia Post, Inside Australian Online Shopping, eCommerce update [PDF].


ACMA, ACMA annual consumer survey.

ACMA, ACMA annual consumer survey.


TPG telecom results are calculated on assumption of a merged entity between TPG Corporation Limited and Vodafone Hutchison Australia Pty Limited from FY19 onwards.


TPG telecom results are calculated on assumption of a merged entity between TPG Corporation Limited and Vodafone Hutchison Australia Pty Limited from FY19 onwards.

