

SPEED CHECK

Calibrating Australia's
broadband speeds

OCTOBER 2019

Prepared by AlphaBeta
for NBN Co

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strategy x economics

This report has been prepared by AlphaBeta for **nbnco**. AlphaBeta is a strategy, economics and data analytics firm with offices in Sydney, Singapore, Canberra and Melbourne. AlphaBeta specialises in combining advanced analytical techniques and innovative data to generate new insights and fresh perspectives on the challenges facing business and government.

For further information on this report contact sydney@alphabeta.com

αlphaβeta

strategy x economics

AlphaBeta is a strategy and economic advisory business serving clients across Australia and Asia from offices in Singapore, Sydney, Melbourne and Canberra

Sydney
Tel: +61 2 9221 5612
Sydney@alphabeta.com

Singapore
Tel: +65 6443 6480
Singapore@alphabeta.com

Canberra
Canberra@alphabeta.com

Melbourne
Melbourne@alphabeta.com

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EXECUTIVE SUMMARY

Australia is close to completing one of the world's most ambitious infrastructure projects, connecting 8 million homes and businesses to a high-speed national broadband network.¹

The nbn has improved internet speeds and accessibility throughout the country, underpinning real, tangible benefits in the education and small business sectors.² This study provides a holistic view of national broadband speed and performance that shows Australian fixed line broadband speeds have increased rapidly and are comparable with those of its international peers, and are also more evenly distributed across the population.

The analysis uses representative, government-validated subscription speed data, adjusts for household broadband access and analyses national distributions of internet access and speed.³ It has four major conclusions:

- Australian speeds have more than doubled from an average speed of 16Mbps in 2014 to 37Mbps in 2019 and much of this increase is attributable to the rollout of the nbn.
- International speed comparisons are challenging and many global 'speed test' rankings present a misleading comparison of international broadband speeds. These rankings are problematic as speed test samples are typically small, unrepresentative, and highly volatile. Rankings also do not account for cross-country differences in broadband availability, population and geography.
- Australia's average broadband speed is comparable to those of peer countries. This report finds that Australia ranks 17th among comparable economies based on data representative of all broadband users and accounting for significant cross-country differences in the share of households with access to fixed line broadband. Projecting forward to the full rollout of the nbn, Australia's rank would rise to 13th among comparable countries.
- The nbn rollout has ensured that Australia has among the most equitable access to high speed broadband. Australia's broadband speed and access is more equitable and evenly distributed than in many peer countries. After the nbn is complete, Australia would rank 10th among OECD countries in terms of internet equality.⁴

EXHIBIT

Australia's current average broadband speed ranks 17th among comparable economies; at full nbn rollout, Australia is projected to rank 10th for internet equality.



Australia ranked
59th of 178
by global speed tests

*According to Ookla's
Speedtest Global index*



Australia ranks
17th of 37
for speed ranking based on
representative data

*Ranking of current Australian subscription
speed, accounting for households
without a broadband connection*



Australia ranks
10th of 35
for ranking of internet
equality at full rollout

*Projected ranking of internet
speed distribution at full
nbn rollout*

Note: Although nbn build will be complete in June 2020, full rollout activations will continue into 2021
Source: Ookla (2019), OECD (2018), ITU (2017), ABS (2018), World Bank (2018), AlphaBeta analysis

¹ By 2020, nbn will have 11.7 million ready-to-connect premises and approximately 8.1 million home and business activations.

² AlphaBeta, Xero (2018), 'From little things, big things grow'; NBN, ideasLAB (2013), '21st Century Teaching Strategies for a Highly Connected World'.

³ Subscription speeds are the advertised speeds of a broadband plan but do not measure actual speeds experienced by end users.

⁴ This ranking uses a smaller comparison sample limited to more comparable countries i.e. major economies.

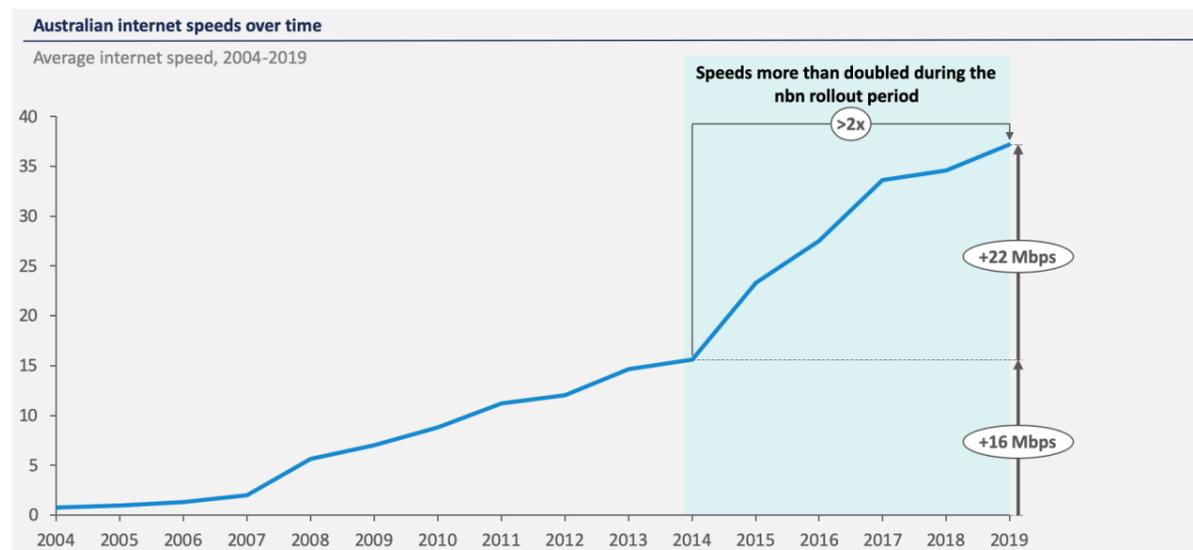
AUSTRALIANS' AVERAGE DOWNLOAD SPEEDS HAVE MORE THAN DOUBLED OVER THE LAST FIVE YEARS DURING THE PERIOD OF THE NBN ROLLOUT

The average Australian broadband download speed over the last five years has more than doubled. In 2014, the average Australian household accessed the internet via a DSL connection and had an average broadband speed of 16Mbps. Today, the average Australian household has a broadband connection with an average download speed of 37Mbps – a 138% increase in speed (see **Exhibit 1**).

Speeds are also continuing to increase. From 2016 to 2018, the share of households on plans faster than 24Mbps grew almost 10% to 65%. By 2020, 50% of fixed line nbn connections will also have the capacity to achieve 1Gbps speeds.⁵

EXHIBIT 1

Australia internet speeds have more than doubled over the past 5 years, during period of rapid nbn rollout



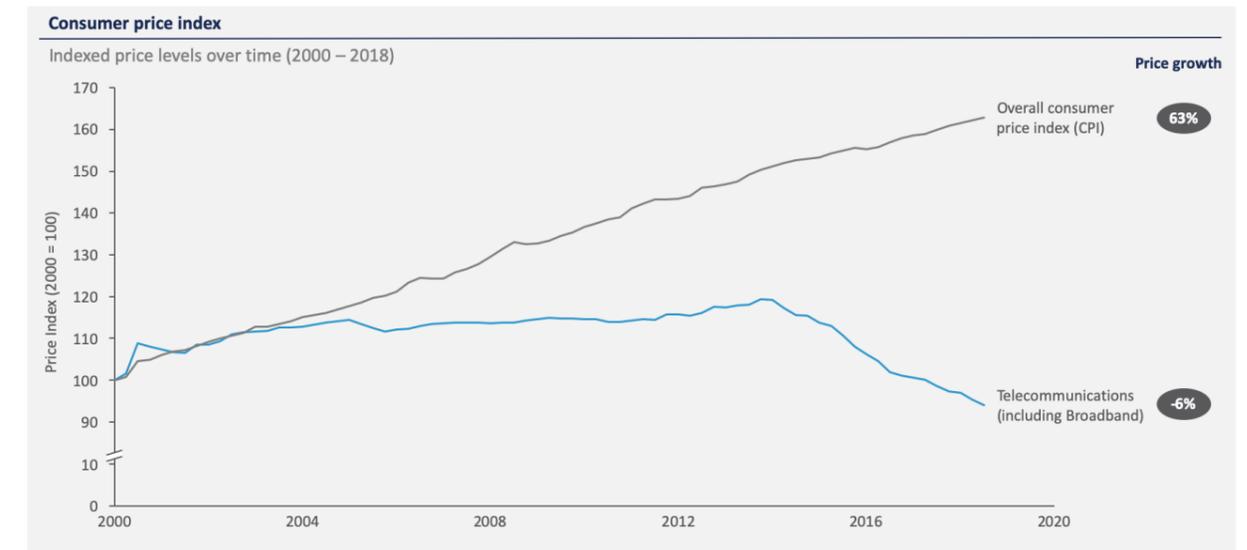
Note: Mbps are rounded up
Source: Average speed of Australian internet users, AlphaBeta analysis, 8146.0 - Household Use of Information Technology, Australia, nbn corporate plan; 8153.0 – Internet Activity, Australia.

While broadband speeds have increased, unit prices for broadband connectivity have grown more slowly than CPI inflation. The Australian Bureau of Statistics tracks prices of broadband over time in the CPI. For example, if the level of service increases (i.e. greater speed or data), and the price does not change, this will be reflected in the unit value decreasing, and a price fall being recorded. Telecommunications equipment and services have experienced much slower price growth than the overall Australian CPI. Telecommunications unit prices have fallen 6% since 2000 while the CPI has increased by 63% (see **Exhibit 2**).

This improvement in availability and speed has led to significant benefits for Australians at work and home. Previous AlphaBeta research has shown that faster internet has driven higher rates of informal and formal learning, job search, business growth, self-employment, and working from home.⁶ Today, users with fast internet are twice as likely to enrol in an online education course than those without. Faster internet has also reduced social isolation, increased the use of smart devices for wellbeing and at home, and increased the use of the internet for transactions and entertainment. For example, compared with non-fast internet households, households with faster internet spend 3 more hours a week connecting with family and friends online.

EXHIBIT 2

Broadband prices have grown more slowly than the consumer price index



Note: Broadband is a component of the CPI sub-group 'Telecommunication equipment and Services'
Source: ABS 6401.0, Consumer Price Index - September 2018, Table 7 (Group, Sub-group and expenditure class weighted average of eight capital cities)

⁵ nbn is building network capacity through increasing the availability of FTTC, exploring DOCSIS 3.1 for HFC and 5G for fixed wireless, and offering a new satellite product: Sky Muster™ Plus.

⁶ AlphaBeta, Connecting Australia: <http://www.connectingaustralia.com.au/>

INTERNATIONAL SPEED COMPARISONS ARE CHALLENGING AND MANY POPULAR ‘SPEED TEST RANKINGS’ CAN BE MISLEADING

In May 2019, speed test website Ookla ranked Australia 59th in the world for fixed line broadband speeds (**Exhibit 3**). Ookla placed Australia behind known digital leaders such as Singapore and South Korea, and also behind developing countries such as Romania, Thailand and Paraguay. Speed tests by M-Lab and Akamai have produced similar results.⁷

However, international speed comparisons are challenging because - as the United Nations' International Telecommunication Union has noted - there is no global, standardised way to assess consumers' broadband speeds.⁸ This section analyses global speed test ranking methodologies to better understand their results. It finds global speed test rankings are inaccurate and unrealistic due to three primary problems:

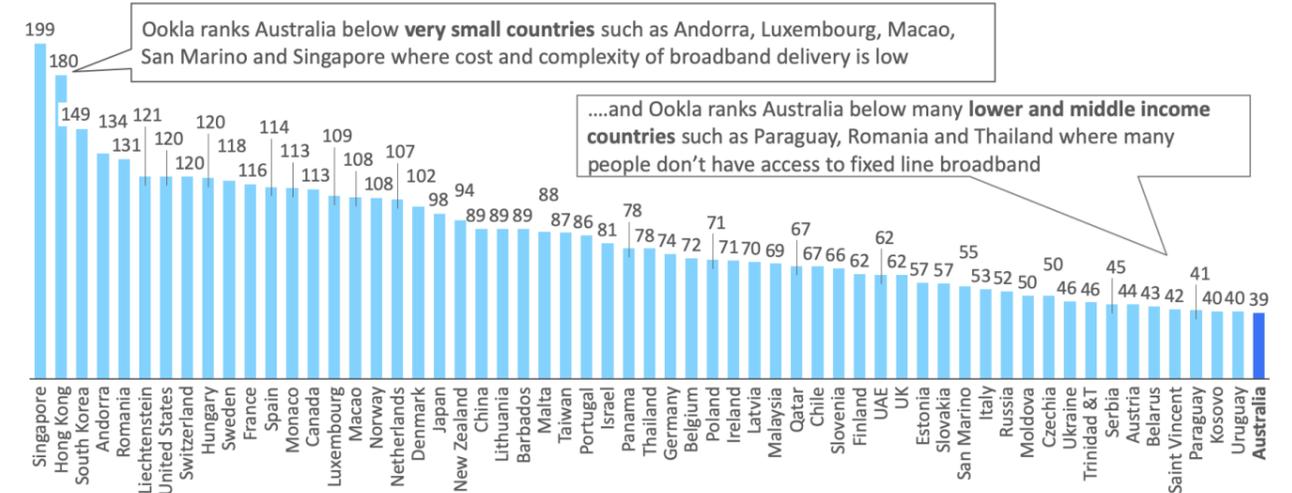
- Speed test samples are not representative of the general population, as they account only for fixed line broadband users who use speed tests. These samples are often small, highly volatile and unreliable
- Speed tests do not represent a country's true average broadband speed as they neglect the share of households without access to broadband
- Speed tests do not account for population and geographic factors that affect the cost and complexity of providing high-speed broadband

EXHIBIT 3

Australia ranks behind many small and developing countries on global broadband speed test ranking sites

Countries ranked by broadband speed (ordered by Ookla speed test ranking)

Average peak broadband speed (Mbps), 2019



Note: Other speed test sites like M-Lab and Akamai also rank Australia poorly, M-Lab 50th out of 200 (2019) and Akamai 50th out of 148 (2017)
Source: Ookla (May 2019)

⁷ This report focuses on Ookla and M-Lab speed test rankings due to popularity. However, methodological limitations apply equally to other rankings like Akamai and Netflix. Ookla and M-Lab collect data from user-generated online speed tests, while Akamai and Netflix measure the speed of software updates or video transfer to end users.
⁸ UN ITU, Internet-related performance measurements description of issue: <https://www.itu.int/en/ITU-T/C-1/Pages/IM/issues.aspx> Global speed test methodologies vary; details are available in Appendix B. Other speed test issues not analysed include an inability to account for end user activity such as in-home wiring, Wi-Fi modem/router type and location etc.

Issue 1: Speed test rankings use unrepresentative, small and highly volatile samples to report national averages

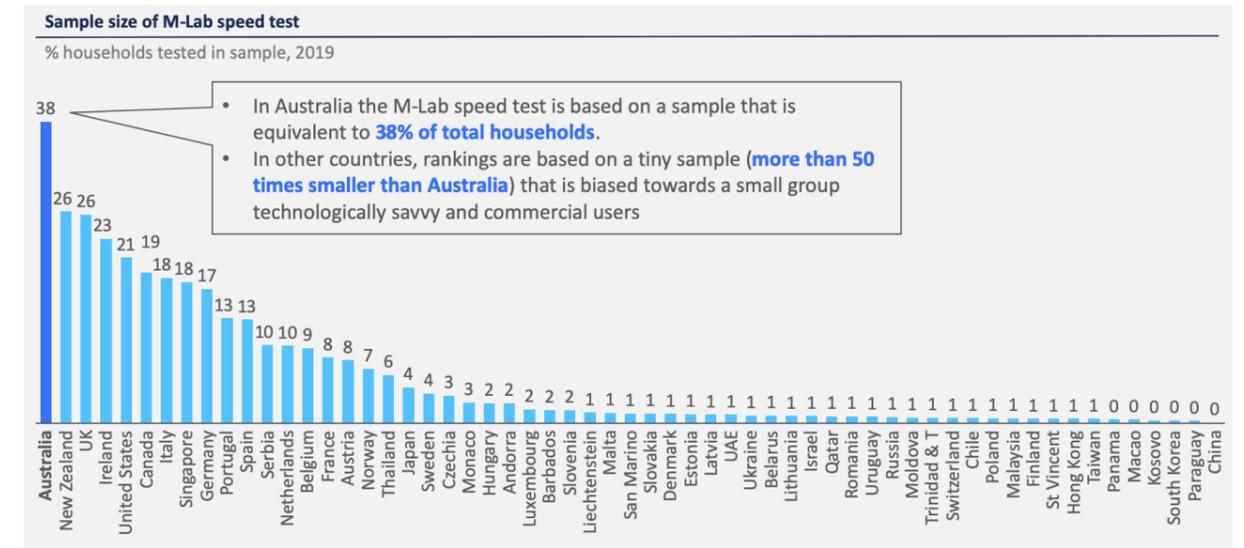
Online speed tests are typically designed as a diagnostic tool to help users measure speed, often for the purpose of finding and fixing faults. Although these tests can yield accurate individual results, they cannot be used to predict national averages for two reasons: the data does not represent all broadband users; and samples are inconsistent across different countries.

First, speed test samples are not representative of all broadband users; they simply report the average speeds achieved by users of the tests. Because speed tests by Ookla and M-Lab are primarily a diagnostic tool, user samples are biased towards technologically savvy internet users and commercial broadband operators.⁹ As such, it is misleading to aggregate these results to report national averages.¹⁰

Second, speed test samples are inconsistent and vary significantly across countries.¹¹ For example, in a 2019 published ranking, M-Lab compared the average speed of only 831 users in Macao (equivalent to only 0.4% of households) with a test sample of 3.5 million unique Australian users (equivalent to 38% of households, a sample rate 95 times larger than Macao's) (Exhibit 4).¹² Many highly ranked countries like Macao have small groups of speed test users, who are likely to be better connected than the average household. Such comparisons disadvantage countries like Australia in which speed testing is more prevalent. Larger samples are less biased by individual tests and more likely to produce lower average speeds.

EXHIBIT 4

Global speed test rankings are unrepresentative because they compare Australia with other countries where only a tiny fraction of households use speed tests



Note: Estimate infers household speed test sampling by comparing the total number of unique IP addresses with the estimated number of households per country.
Source: Cable (2019), Ookla (2019), AlphaBeta analysis

These sampling issues are reflected in the fact that speed tests can yield unreliable and inconsistent results. As such, changes in speed test rankings are often due to sampling changes instead of actual improvements in national broadband speed or quality. For instance,

- Saint Vincent and Grenadines was ranked 110th by Ookla in March 2019 and jumped to 55th just 3 months later¹³
- Spain's national average download speed in Ookla's ranking increased 43Mbps in a single year from 67Mbps in 2018 to 110Mbps in 2019

- Andorra's rank of 12th in the world (M-Lab) is based on the average speed experienced by only 547 users. Andorra is ranked 4th in the world by Ookla
- Thailand is ranked 30th by Ookla, 29 places ahead of Australia, but only 47% of Thai households have a broadband connection¹⁴

⁹ Expert interviews.

¹⁰ Although Akamai and Netflix may have more information on users, samples are not known to be adjusted for population representativeness.

¹¹ Sample sizes also vary between ranking, as different rankings have varying levels of coverage. For example, M-Lab have poor coverage in China, while Ookla has much better coverage in China.

¹² Ookla requires only 300 unique speed tests for a country to be eligible for a speed test ranking; meanwhile, 3.6 million unique Australian consumers used Ookla's speed test in a single 2017 quarter.

¹³ Average speed increased from 17Mbps in March 2019 to 40Mbps in June 2019.

¹⁴ See section: 'Australia's speed ranking improves to 17th among comparable countries after adjusting for the share of households with access to fixed line broadband' for methodological details.

Issue 2: Speed test rankings do not consider levels of household access to broadband internet

The second issue with global speed test rankings is that they account only for fixed line broadband users, and do not consider the share of households without access to broadband.

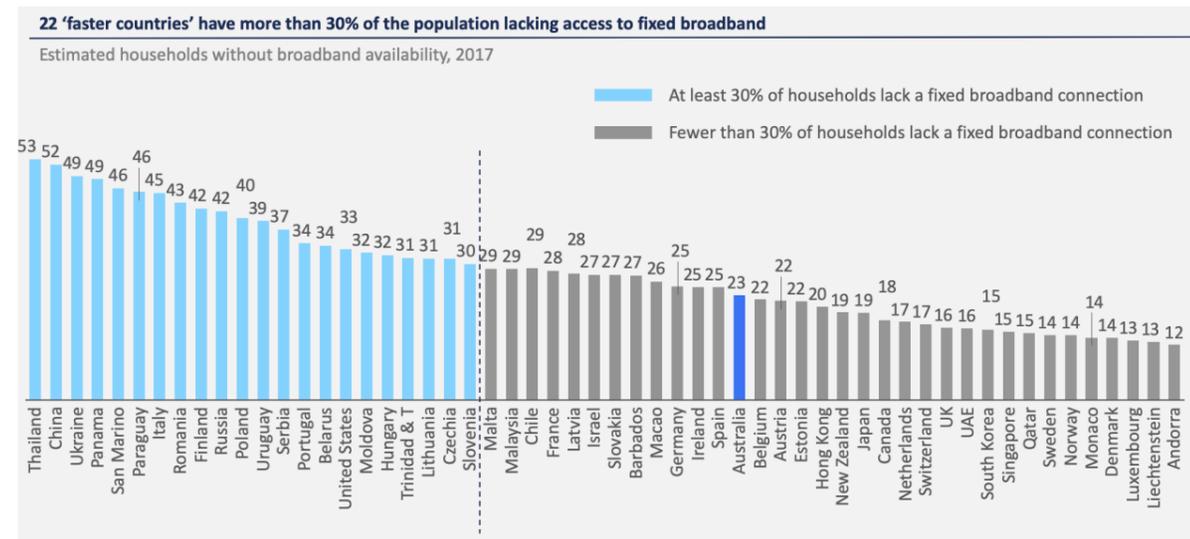
A true measure of a country's average broadband speed should reflect the realistic speeds available to every citizen. However, speed test rankings only sample people who choose to use the tests: people who have access to a broadband connection and are motivated to use a speed test.

While this would not be a problem if broadband connections were universal, in 22 of the countries ranked higher than Australia in the Ookla ranking, more than 30% of households do not have access to fixed line broadband (Exhibit 5). By not considering the extent of broadband access, these rankings overstate average speeds in countries with poor broadband equality.

Countries such as Thailand, Panama and Paraguay are found to have average speeds higher than Australia but almost half of households in these countries do not even have access to broadband. Given Australia has high broadband availability with 77% of households connected to fixed broadband, speed test rankings understate how Australia's national average broadband speed compares with those of other countries.¹⁵

EXHIBIT 5

Broadband performance should take into account households that do not have broadband access



Note: Households without broadband are estimated by scaling down the share of internet users, using the actual fixed broadband connection ratios from several European Commission countries.
 Source: ITU (2017), Ookla (May 2019), European Commission (2018), AlphaBeta analysis

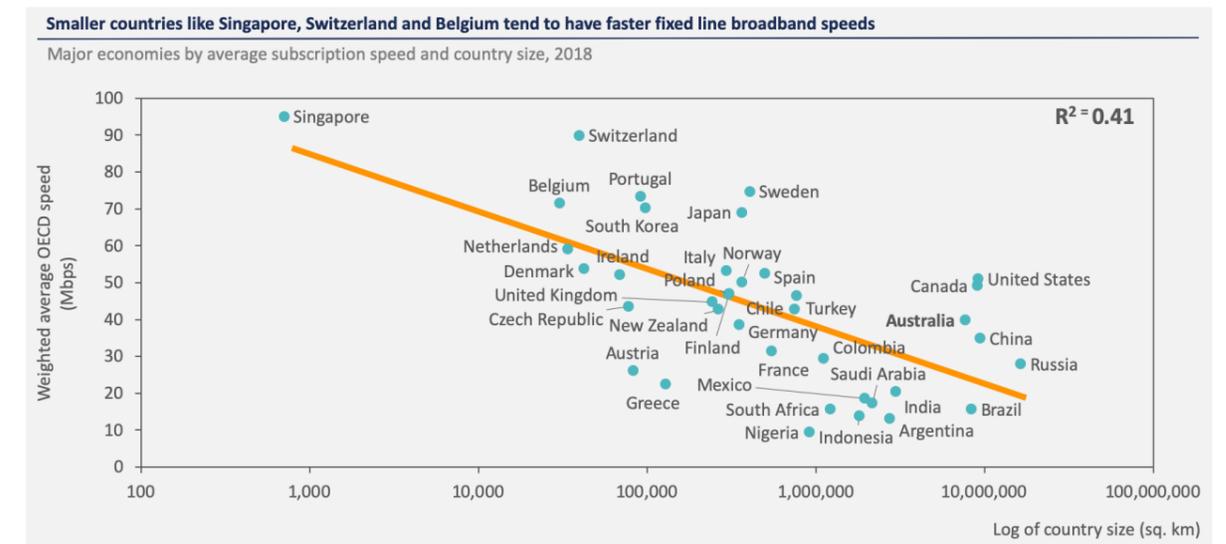
Issue 3: Speed test rankings do not account for population or geography

The final challenge for speed test rankings is that they do not account for cross-country differences in population and geography. The costs of building and operating broadband infrastructure differ significantly according to population density and country size, with high-density countries incurring a fraction of the build costs of low-density countries.¹⁶

In the Ookla rankings, Australia, with a large country area and geographically dispersed population, is compared equally to high-density city states like Macao, Monaco, Singapore, Hong Kong and San Marino, with total areas less than 1,000 square kilometres. It is no surprise that small wealthy countries with dense populations have higher average speeds than Australia, but that is not a fair comparison. Australia's performance is understated given its large geographical size and low population density (Exhibit 6).

EXHIBIT 6

Smaller countries have population and geographic advantages contributing to faster average broadband speeds



Note: Line represents fitted logarithmic line and R2 is from a linear regression. Major economies refer to OECD countries with high quality data availability and some selected comparable economies. Selected economies include India, Brazil, Russia, China, Nigeria, South Africa, Saudi Arabia, Indonesia, Argentina, South Korea, Singapore and Japan. Speeds for these countries were estimated using a combined measure of actual speeds.
 Source: OECD (2018), World Bank (2018), AlphaBeta analysis

Speed test rankings do not represent the average broadband experience in each country because they sample a biased group of speed test users and fail to consider significant differences in the levels of household access to fixed line broadband.

Speed test rankings also do not consider the geographic challenges that impact the cost and complexity of providing broadband.

¹⁵ See section: 'Australia's speed ranking improves to 17th among comparable countries after adjusting for the share of households with access to fixed line broadband' for methodological details. Australian estimate verified using previous AlphaBeta research.

¹⁶ nbn (2017), Gigabit broadband: The facts.

AUSTRALIA'S AVERAGE BROADBAND SPEED IS COMPARABLE TO THAT OF PEER COUNTRIES

While a perfect measure of national broadband speed is impossible, this study proposes to more accurately rank countries based on the average citizen's experience with broadband. This section describes a three-stage method that addresses the most significant issues with global speed test rankings. It calculates the average broadband speed in each country using government-validated subscription data and accounts for levels of household broadband access. Using this method, Australia's average broadband speed would rank 17th out of 37 peer economies – significantly higher than Ookla's suggested world ranking of 59th (see **Exhibit 9** - page 18).

Australia ranks 22nd on government-validated data of the average speeds available to all broadband users

Broadband subscription data is collected and validated by national governments of most major economies, and captures the advertised speeds available to all households with a broadband plan.¹⁷ Subscription data may therefore be used as an alternative to speed test data to create a national average speed that represents all fixed broadband users (including fixed wireless and satellite).

To produce an initial ranking of broadband speeds by country, this study proposes the following approach:

1. National subscription speed data is used to determine the average national speed available to all broadband users.¹⁸ To ensure that only high-quality representative data is used, analysis is restricted to major economies for which comprehensive subscription data is available. One consequence of this is the removal of small city states like Andorra, Macao and San Marino as well as many developing countries like Iraq or Mali, that are compared to Australia in other speed rankings.
2. As some major economies like China, Japan and Singapore do not report subscription speeds, 12 additional comparable countries have been added.¹⁹ Subscription speeds of these countries are estimated by applying a scale factor to an average of all reported speed test results.
3. Australian subscription speed data was obtained from the ABS Internet Activity (2018). This dataset was selected as it is the most reliable estimate of Australian broadband subscription speeds.²⁰
4. All 37 countries were then ranked by average subscription speed to produce a representative ranking of national subscription speeds.

As a result, in a comparison of national broadband subscription speed data, Australia ranks 22nd among comparable economies (**Exhibit 7**).

This indicates that Australia's average broadband speed is comparable to those of other major economies, based on raw subscription data alone. It also suggests that global speed test rankings unfairly elevate many small and developing countries above Australia.

EXHIBIT 7

Australia's average broadband speed ranks 22nd among comparable countries analysed using higher quality subscription speed data, representative of all broadband users



Australia ranked
59th
by global speed tests

*According to Ookla's
Speedtest Global index*



Australia ranks
22nd
using representative
broadband user data

*Ranking of broadband speed using
government-validated subscription speed data*

Note: Australia's rank of 22nd out of 37 is an improved position relative to global speed test rankings of 59th out of 178. The sample of countries with comprehensive subscription data is restricted to major economies due to the availability of high-quality representative data. This creates a fairer comparison as Australia is no longer compared to city states like Andorra, Macao and San Marino or the many developing countries like Iraq or Mali. Most excluded countries rank below Australia on other rankings.

Source: Ookla (2019), OECD (2018), ABS (2018), AlphaBeta analysis

Australia's speed ranking improves to 17th among comparable countries after adjusting for the share of households with access to fixed line broadband

Australia's rank of 22nd out of 37 reflects the speeds available to all broadband users – not the speeds available to the average person in each country. Many of the countries ranked above Australia have low levels of access to fixed line broadband: while a minority of broadband users may have access to high speeds, a large portion of the population may lack access to broadband at all.

¹⁷ Subscription speeds are equivalent to the advertised speed of a plan, different to speed test data as they do not measure actual speeds experienced by end users. Subscription speeds are not a perfect measure and have some limitations, including: their collection by different national reporting agencies; potential differences in the definition of speed tiers and broadband types; and the need for some imputation where data is unavailable. On balance, subscription speeds are the most representative national speed measure available.

¹⁸ Speeds assumptions for weighted average are as follows: >1.5/2Mbps = 5Mbps; >10Mbps = 20Mbps; >25/30Mbps = 50Mbps; >100Mbps = 100Mbps.

¹⁹ Major economies refer to OECD countries and largest 12 other world economies including Singapore, South Korea, Japan, India, Brazil, Russia, China, Nigeria, South Africa, Saudi Arabia, Indonesia and Argentina. Speeds for these countries were estimated using a combined measure of actual speeds.

²⁰ International and ABS speed tiers are not perfectly aligned, allocation as follows: >1.5/2Mbps = >8Mbps; >10Mbps = 8<24Mbps; >25/30Mbps = 24<100Mbps; >100Mbps = equal or >100Mbps. Due to poor data availability of mobile speed distributions, dataset contains some mobile broadband connections using cellular networks. Although some dongles and mobile wireless routers have high speeds, there are a high number of home wireless and mobile backup connections with restricted speeds

This section accounts for levels of access to fixed broadband as follows:

- 1. Determine the share of internet users in each country:** National data on the share of internet users in each country was obtained. This data was available for all countries and included both fixed line broadband and mobile internet connections.
- 2. Determine the share of fixed broadband users in each country:** While not all countries had data on the share of households with fixed broadband specifically, data was available for several countries in the EU. Data from these EU countries on the “households using internet” and “households with a fixed broadband connection” were used to calculate a scaling factor. The scaling factor was applied to the share of internet users in each country from step one, above, to control for mobile internet connections.

- 3. Adjust subscription speed rankings:** A weighted average speed of connected and unconnected households was calculated by assuming households without broadband had a speed of zero and households with fixed line broadband had the same subscription speeds from the previous section. The product of this calculation is an average speed for each country, adjusted for broadband availability.

Adjusting for the proportion of households with access to fixed line broadband improves Australia's rank 5 places, from 22nd to 17th (**Exhibit 8**). This is because Australia has a high level of household connectivity (77%) compared to peer countries like Italy and the United States, which have a high share of households without a broadband connection (45% and 33% respectively). This implies that global speed test rankings understate Australia's average broadband speeds.

Australia's speed ranking improves to 13th among comparable countries after projecting likely average speeds at full nbn rollout

Australia's rank of 17th of 37 reflects the current speeds available to the average person in each country. However, as the nbn rolls out across Australia, broadband speeds are increasing at a rapid rate. In the past year, the share of nbn users on fast plans (50Mbps or higher) grew from 45% to 64% and the number of users on ultra-fast plans (100Mbps or higher) has also grown to represent almost 9% of all users.²²

At full rollout, the nbn will connect 8 million homes and businesses to the wholesale network. Half of fixed line nbn connections will have the capacity to achieve 1Gbps speeds.²³ For comparison, 5.5 million homes and businesses were connected to the nbn network as of June 2019, and just 4 million were connected in June 2018.

This section accounts for nbn full rollout speeds as follows:

- 1. Calculate a weighted average of broadband speed after the completion of the nbn.** Australia's average post-rollout speed was calculated using nbn's internal forecasts of the number of households subscribed to 12/25/50 and 100Mbps speed tiers, divided by ABS estimates of the total number of households in 2021.
- 2. Adjust Australia's international ranking.** Australia's average post-rollout speed was compared with international speeds from the previous section. This improved its rank to 13th of 37.²⁴

Using the average projected broadband speed post nbn rollout improves Australia's rank 4 places from 17th to 13th. This assumption is based on current information for each ranked market and does not account for market trends that either improve or worsen access in Australia, nor factors that affect speed and access in other countries.

Australia's ranking would rise even further if the maximum technical capacity of the broadband technology were accounted for. In this case, Australia's ranking would rise as high as 3rd compared to major economies.

The average fixed line broadband download speed available in Australia ranks 22nd using representative data and 17th after accounting for the proportion of households with access to fixed line broadband. At full nbn rollout, Australia's average fixed broadband download speed is projected to be the 13th fastest out of 37 major economies. This is 46 places higher than Ookla's suggested speed ranking of 59th, highlighting the limitations of the global speed test rankings.

While the 3-stage method presented is not perfect, it is the most representative review of Australia's relative broadband performance currently available. Importantly, it takes into account all broadband users as well as broadband availability which are significant considerations in ensuring fair, equitable internet access to all Australians.

None of these calculations adjust for population or geographic differences which would also improve Australia's ranking significantly.

EXHIBIT 8

Australia's average broadband speed ranks 17th among comparable countries using data that accounts for the entire population



Australia ranked
59th
by global speed tests

According to Ookla's
Speedtest Global index



Australia ranks
22nd
using representative
broadband user data

Ranking of broadband speed
using government-validated
subscription speed data



Australia ranks
17th
using data more representative
of entire population

Ranking of subscription speed
accounting for households
without a broadband connection

Note: Ranking adjusted for broadband connection is based on the weighted average of subscription speeds where households without a broadband connection receive an average broadband speed of zero.
Source: Ookla (2019), OECD (2018), ITU (2017), World Bank (2018), AlphaBeta analysis

²¹ This method was used due to the lack reliable data on fixed line broadband connections by household. Estimates are likely conservative for many countries due to the use of a scaling factor from developed European Commission countries.

²² Considerable improvement from 16% in June 2017. Fast plans include 25Mbps to 50Mbps and 50Mbps or higher.

²³ nbn is building network capacity through increasing the availability of FTTC, exploring DOCSIS 3.1 for HFC and 5G for fixed wireless, and offering a new satellite product: Sky Muster™ Plus.

²⁴ This analysis assumes that other countries' average speeds remain the same but many countries are currently upgrading their own broadband infrastructure, so Australia's ranking may improve by a smaller amount.

EXHIBIT 9

Australia's average broadband speed ranks 17th among comparable countries analysed using higher quality subscription speed data representative of all households

Australia is ranked 59 th of 178 by global speed tests		Australia ranks 22 nd using representative broadband user data		Australia ranks 17 th using data representative of entire population		At full rollout, Australia is forecast to rank 13 th using this methodology	
1	Singapore	1	Singapore	1	Singapore	1	Singapore
3	South Korea	2	Switzerland	2	Switzerland	2	Switzerland
5	<i>Romania</i>	3	Sweden	3	Sweden	3	Sweden
7	United States	4	Belgium	4	South Korea	4	South Korea
8	Switzerland	5	South Korea	5	Japan	5	Japan
10	Sweden	6	Japan	6	Belgium	6	Belgium
11	France	7	Netherlands	7	Netherlands	7	Netherlands
12	Spain	8	Denmark	8	Denmark	8	Denmark
14	Canada	9	Italy	9	Norway	9	Norway
17	Norway	10	Spain	10	Canada	10	Canada
18	Netherlands	11	Ireland	11	Spain	11	Spain
19	Denmark	12	United States	12	Ireland	12	Ireland
20	Japan	13	Norway	13	United Kingdom	13	AUSTRALIA
21	New Zealand	14	Canada	14	Finland	14	United Kingdom
22	China	15	Poland	15	New Zealand	15	Finland
25	<i>Malta</i>	16	Finland	16	United States	16	New Zealand
27	Portugal	17	Turkey	17	AUSTRALIA	17	United States
31	Germany	18	United Kingdom	18	Germany	18	Germany
32	Belgium	19	Czech Republic	19	France	20	France
33	Poland	20	Chile	20	Chile	21	Chile
34	Ireland	21	New Zealand	21	Czech Republic	21	Czech Republic
36	<i>Malaysia</i>	22	AUSTRALIA	22	Italy	22	Italy
38	Chile	23	Germany	23	Poland	23	Poland
40	Finland	24	China	24	Slovenia	24	Slovenia
42	United Kingdom	25	France	25	Austria	25	Austria
43	Estonia	26	Colombia	26	China	26	China
46	Italy	27	Russia	27	Russia	27	Russia
47	Russia	28	Austria	28	Colombia	28	Colombia
49	Czech Republic	29	Greece	29	Greece	29	Greece
50	<i>Ukraine</i>	30	India	30	Saudi Arabia	30	Saudi Arabia
52	<i>Serbia</i>	31	Mexico	31	Mexico	31	Mexico
53	Austria	32	Saudi Arabia	32	Brazil	32	Brazil
54	<i>Belarus</i>	33	Brazil	33	Argentina	33	Argentina
59 ¹	AUSTRALIA	34	South Africa	34	South Africa	34	South Africa
65	Brazil	35	Indonesia	35	India	35	India
66	Saudi Arabia	36	Argentina	36	Indonesia	36	Indonesia
71	India	37	Nigeria	37	Nigeria	37	Nigeria

Note: Full rollout capacity estimate is based on nbn wholesale peak speed capability in 2020. Italics represent countries not in subsequent steps due to lacking data. 1. Ookla ranking is out of 178 countries. Most of the countries below Australia in Ookla are small or developing countries for which subscription speed data is not available, so the rank of 22 out of 37 is an improved position relative to 59 out of 178. Comparable countries refer to major OECD economies with a population larger than 3 million and high quality data available. Some selected comparable economies were added to the rankings, including: India, Brazil, Russia, China, Nigeria, South Africa, Saudi Arabia, Indonesia, Argentina, South Korea, Singapore and Japan. Speeds for these countries were estimated using a combined measure of actual speeds. Source: Ookla (2019), OECD (2018), ITU (2017), ABS (2018), World Bank (2018), AlphaBeta analysis

AUSTRALIA HAS AMONG THE MOST EQUAL ACCESS TO HIGH SPEED BROADBAND

Although average broadband speeds and rankings are important, they are a narrow view of what broadband should achieve for countries, their citizens and economies. In a fair and equitable society, the distribution of internet speeds across households is as important as absolute average speeds. This short section considers how Australia compares on an internet equality basis.

Speed distributions are also an important measure of internet performance

Fast, reliable internet connections underpin many aspects of modern lives, including jobs, education, society and government services. It is therefore not enough to judge a nation by speed alone. High-performing connected countries should have high broadband speeds that are also available to all citizens. A true measure of performance should assess how speeds are distributed across the population.

This speed distribution may be described by a Gini coefficient, which is typically used by economists to represent income inequality. A Gini coefficient of 1 indicates that one person receives all of a nation's income, while a Gini coefficient of zero indicates that all citizens receive the same income.

This model can be adapted to describe internet inequality by comparing a country's actual distribution of internet speeds to a "line of equality", which represents speeds that are evenly spread. The Gini coefficient indicates the difference between the line of equality and a country's actual speeds. The lower the Gini coefficient, the fairer the internet speed distribution. The higher the coefficient, the more unequal.

The nbn rollout is expected to move Australia into the top 10 OECD countries for internet equality

Due to the nbn, a large proportion of Australians now have access to fast, reliable internet connections. Based on OECD subscription speed data and Australian government statistics, Australia ranked among the bottom 10 of OECD countries in terms of internet equality in 2012, but has since improved to the middle of the pack as the nbn project progresses. This is reflected in improvements to Australia's Gini coefficient from 2012 to 2016. After the nbn is rolled out, Australia is expected to rank 10th out of 35 OECD countries for internet equality (**Exhibit 10**).

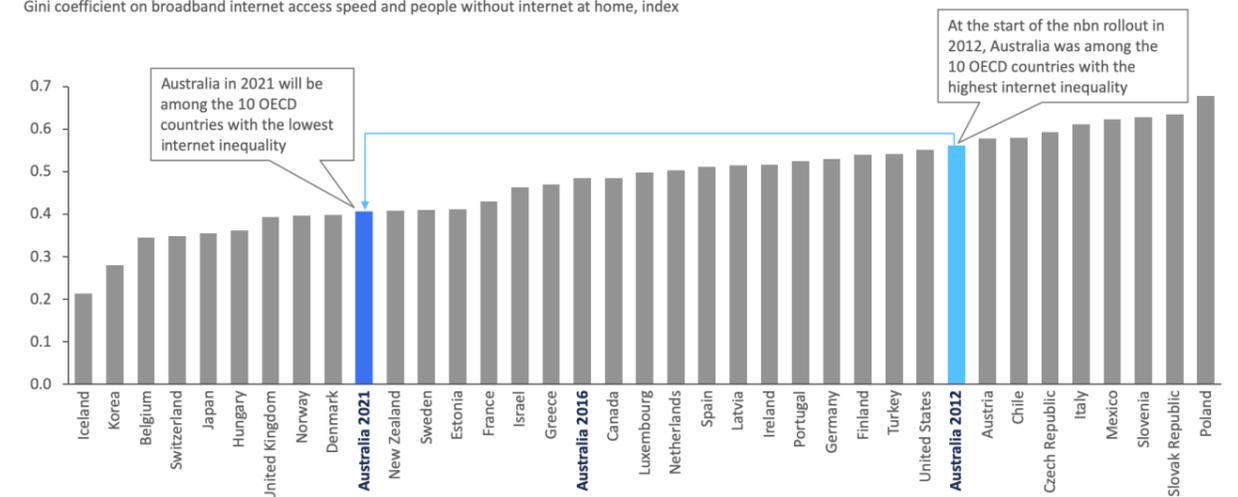
The nbn's commitment to increasing regional and remote internet access is a key reason for this improvement. In 2011, only 61% of rural, regional and remote Australians had access to the internet at home, compared to 71% of those in major capital cities. By 2015, this had improved to 80% and 89% respectively.²⁵ The nbn rollout promotes digital fairness and will likely propel Australia to a global leadership position in internet equality.

EXHIBIT 10

The nbn rollout is expected to move Australia from the bottom 10 OECD countries in terms of internet equality to the top 10

Inequality in internet access and speed in OECD countries¹

Gini coefficient on broadband internet access speed and people without internet at home, index



Note: The Gini coefficient for the OECD countries (excluding Australia) is calculated using the mean speeds of the speed tiers reported in the OECD Digital Economy Outlook 2017, and the proportion of the population in each speed tier, as well as proportion of people using internet at home. Australia's Gini coefficient in 2012 and 2016 is calculated using ABS data on speed tiers and proportion of subscribers. Australia's Gini coefficient in 2021 is calculated using projected speeds from nbn's Corporate Plan 2018-21 and extrapolating the rate of reduction in share of people without internet at home in Australia from ITU 2012-16. All countries excluding Australia are held constant at 2016 OECD distribution and speed tiers. Future changes in the distribution of internet access and speed quality in other countries may change this distribution and Australia's relative ranking. Source: OECD Digital Economy Outlook 2017, ABS (8153 – Internet Activity June 2017), International Telecommunication Union (ITU), ABS Business use of IT, ABS Household use of internet, AlphaBeta analysis

A true measure of national broadband performance must assess not only absolute average speeds, but also how speeds are distributed across the population. By 2021, the nbn rollout is expected to move Australia from the bottom 10 OECD countries to the top 10 in terms of internet equality. This will help ensure all Australians have fair, equitable access to the internet and the social and economic opportunities it enables.

²⁵ Australian Communications and Media Authority (2016), 'Regional Australians Online'. Available at: <https://www.acma.gov.au/theACMA/engage-blogs/engage-blogs/Research-snapshots/Regional-Australians-online>

CONCLUSION

This study offers a holistic assessment of global broadband connections. It ranks countries based on the average broadband speeds available to all citizens, as an alternative to online speed tests whose unrepresentative samples tend to produce unreliable and unrealistic results. By this measure, Australia ranks 17th among 37 comparable countries.

The ranking methodology proposed in this report differs from that of online speed tests in two key ways. First, it uses government-validated subscription speed data to consistently represent the maximum speeds available to all broadband users within each country, instead of accounting only for users of a particular speed test website.

Second, it accounts for the vast differences in broadband availability across countries, presenting a more accurate view of average speed rankings.

In addition to showing that Australian internet speeds are comparable to other major economies, this report finds that Australia's internet will be more equally distributed than in peer countries. After the nbn rolls out, Australia's internet equality could rank 10th best among OECD countries, delivering a fair and equitable network for all Australians.

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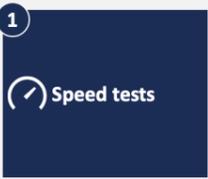
APPENDIX A - OVERVIEW OF DIFFERENT BROADBAND SPEED MEASURES

Speed test metrics generally fall into two categories: speed tests and subscription speeds. Below is a summary of the two key metrics.

EXHIBIT 11

Speed tests and subscription speeds are the main metrics covered in this report.

There are two main measures of internet speeds: speed tests and subscription speeds

	Speed definition	Measurement	Examples
 <p>1 Speed tests</p>	Real-world speed experienced by an end user	Measure of real-time data transfer either through speed test application or hardware attached to modem/router	<ul style="list-style-type: none"> Ookla M-Lab Akamai SamKnows ACCC Monitoring Broadband Performance
 <p>2 Subscription speed</p>	Advertised speed or theoretical maximum network performance	ISPs and other agencies record the number of customer subscriptions at each different speed tier	<ul style="list-style-type: none"> OECD ABS Ovum

Note: Speed tests are a combination of end user application and device measurement. Further detail on speed test types and methods are available in appendix.
 Source: OECD (2014), MIT (2010), Expert interviews, Desktop research

APPENDIX B: OVERVIEW OF MAIN GLOBAL SPEED TEST RANKINGS

There are numerous global broadband speed test rankings, each with different data sources, methodologies and results. This report has focused on several of the best-known ranking sites, including: Ookla's Speedtest Global Index, Cable's Worldwide Broadband Speed League, Akamai's State of the Internet ranking and Netflix's ISP Speed Index.

Ookla and M-Lab measure speed through self-initiated speed tests and Akamai and Netflix measure speed through monitoring the pace of data transfer during software updates and content streaming.

EXHIBIT 12

This reports refers to four different global speed test rankings

Data source	Ookla	Cable (M-Lab)	Akamai	Netflix
Australian ranking (total)	59/178	50/200	50/148	14/59
Average speed (Mbps)	39.3	12.7	11.1	4.3
Calculation	Average data transfer from user-initiated speed test, over fixed time		Average time taken to transfer fixed data amount through software update or streaming	
Method notes	<ul style="list-style-type: none"> Measures peak average speed with nearest server (135 around Australia) Each individual test omits the slowest 30% and fastest 10% of the sample Standardises user results to reduce bias from repeated tests over a short time 	<ul style="list-style-type: none"> Measures average speed between user and M-Lab server (Sydney only location in Australia) 	<ul style="list-style-type: none"> Measures average speed between user and Akamai server (in Sydney and Melbourne) Likely underreporting speed due to parallel request, small files and IP sharing 	<ul style="list-style-type: none"> Measures average primetime speed by ISP Lower speed due to measuring the streaming speed of Netflix content only

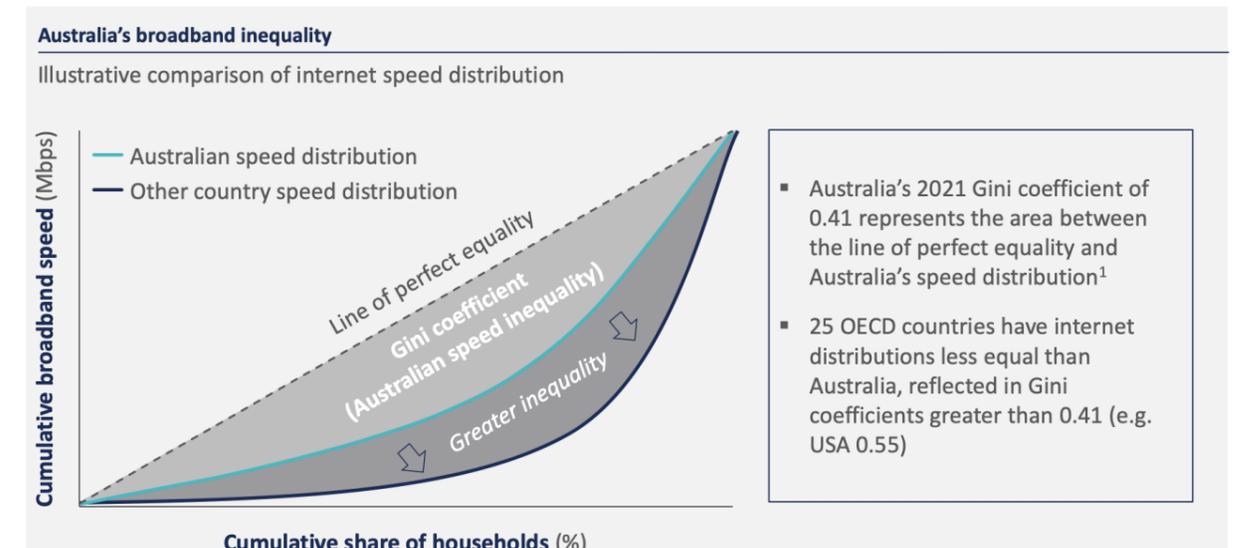
Source: Ookla (May), Cable (2019), Akamai (2017), Netflix (2019), Desktop research, Expert interviews, AlphaBeta analysis

APPENDIX C: VISUAL EXPLANATION OF GINI COEFFICIENT

EXHIBIT 13

Australia's broadband inequality can be measured using a Gini coefficient

Broadband inequality is represented by a Gini coefficient that ranges from zero to one. The lower the Gini coefficient, the more fairly internet speeds are distributed across a population: A Gini coefficient of zero indicates that all households have equal access to broadband speeds."



Note: 1. The Gini coefficient is the area between the line of perfect equality and Australia's speed distribution divided by the total area between the line of perfect equality. Where there is no difference to the line, the Gini coefficient is 0 and everyone has the same speed

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