TUTELA

Australia and New Zealand

State of Mobile Networks

Analysts
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Annual Report

OCTOBER 2019

www.tutela.com

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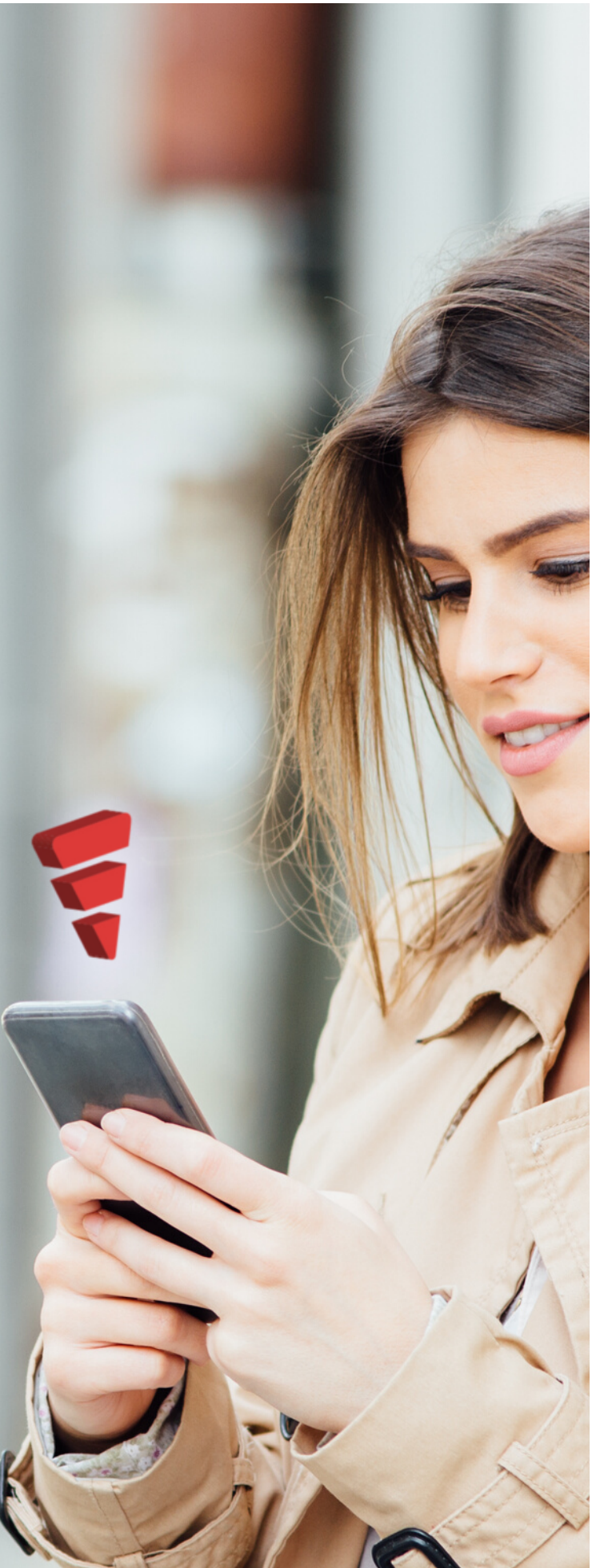


2019 has been a busy year for mobile networks in both New Zealand and Australia, not just with the advent of 5G networks(1), but also as users continue to expect more from, and do more using their mobile devices.

Within the region, there are also broader conversations about market competition and mobile pricing. A recent report from New Zealand's Commerce Commission concluded that no fourth network was needed to improve competition in New Zealand(2), while the Australian regulator continues to oppose the merger of TPG and Vodafone AU(3) on the grounds that TPG's value as a fourth MNO in the country would be critical for maintaining market competition.

(1) Mobile World Live, Spark, Vodafone NZ introduce 5G service
https://www.mobileworldlive.com/asia/asia-news/spark-vodafone-nz-introduce-5g-service/
Retrieved 17 October 2019

(2) Commerce Commission NZ, Mobile market study - findings
https://comcom.govt.nz/__data/assets/pdf_file/0022/177331/Mobile-Market-Study-Findings-report-26-September-2019.PDF
Retrieved 17 October 2019

(3) The Guardian, TPG, Vodafone merger would snuff out competition in Australia, ACCC tells court
https://www.theguardian.com/technology/2019/sep/10/tpg-vodafone-merger-would-snuff-out-competition-accc-tells-court
Retrieved 17 October 2019

At the same time, Australia is navigating the shutdown of 3G networks in the coming years to free up spectrum(4). With this in mind, it will be interesting over the years ahead to see how 3G spectrum is refarmed for 4G and 5G, particularly when it comes to ensuring mobile networks in more rural areas are part of the Mobile Black Spot Program which remains an ongoing priority for all operators and the Australian government(5).

As both countries work towards 5G implementations and continue to evaluate the shape of the telecoms industry within each nation, one thing remains evident -- we are living in dynamic times when it comes to the potential of mobile networks in the Oceania region.

(4) News.com.au, Telstra announces 3G mobile network will be switched off in 2024 to free up spectrum
https://www.news.com.au/technology/gadgets/mobile-phones/telstra-announces-3g-mobile-network-will-be-switched-off-in-2024-to-free-up-spectrum/news-story/39ec5edf73d1a1fd313d2f592d202c4c
Retrieved 17 October 2019

(5) Australian Government, Mobile Black Spot Program
https://www.communications.gov.au/what-we-do/phone/mobile-services-and-coverage/mobile-black-spot-program
Retrieved 17 October 2019

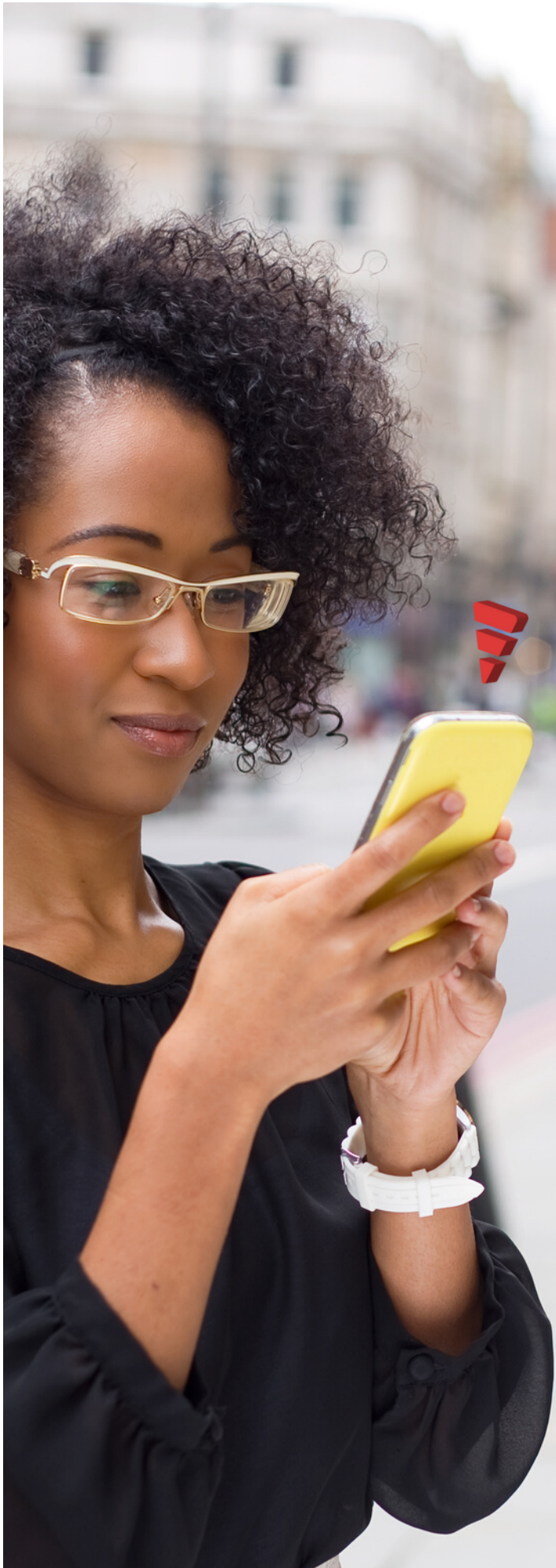
Key findings

- Australia outperformed New Zealand not just on Excellent Consistent Quality, but across every metric tested including median download throughput and latency

- In Australia, Telstra led for Excellent Consistent Quality and median upload throughput, The mobile operator drew with Optus for the top spot for both Core Consistent Quality and median download throughput, while Vodafone Australia led for latency

- In New Zealand, 2degrees proved a dominant force in Tutela's testing. The newest entry into the New Zealand MNO space had the top result for both Excellent and Core Consistent Quality, as well as median upload throughput and latency.

- Meanwhile, Vodafone New Zealand proved to be the fastest network in terms of median download throughput



Results overview

TUTELA

Mobile experience results

Australia, October 2019

	Telstra	Vodafone	Optus
Excellent Consistent Quality	★ Winner		
Core Consistent Quality	★ Draw		★ Draw
Download throughput	★ Draw		★ Draw
Upload throughput	★ Winner		
Latency		★ Winner	

Results from 74,718,510,850 measurements taken in Common Coverage Areas between April 1st to September 30th 2019.

"Telstra delivered the highest percentage of Excellent Consistent Quality in Tutela's tests"

TUTELA

Best Mobile Network Experience

OCTOBER 2019

Based on the highest Excellent Consistent Quality in Common Coverage Areas.

Results overview

TUTELA

Mobile experience results

New Zealand, October 2019

Excellent Consistent Quality		★ Winner	
Core Consistent Quality		★ Winner	
Download throughput	★ Winner		
Upload throughput		★ Winner	
Latency		★ Winner	

Results from 8,482,510,992 measurements taken in Common Coverage Areas between April 1st to September 30th 2019.

"2degrees delivered the highest percentage of Excellent Consistent Quality in Tutela's tests"

TUTELA
Best Mobile Network Experience
OCTOBER 2019

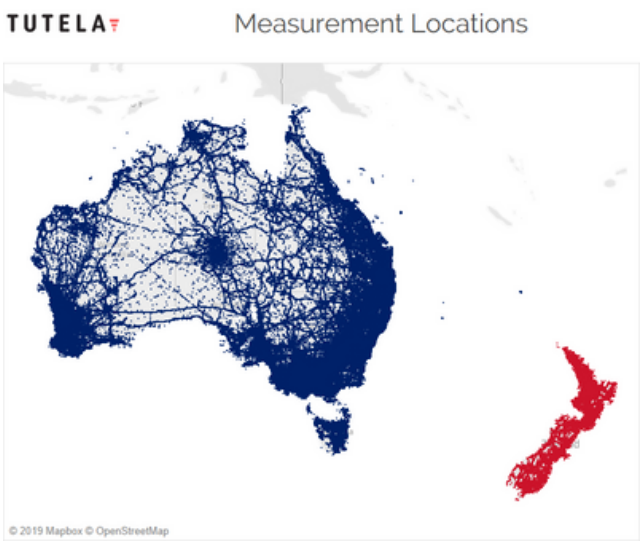
Based on the highest Excellent Consistent Quality in Common Coverage Areas.

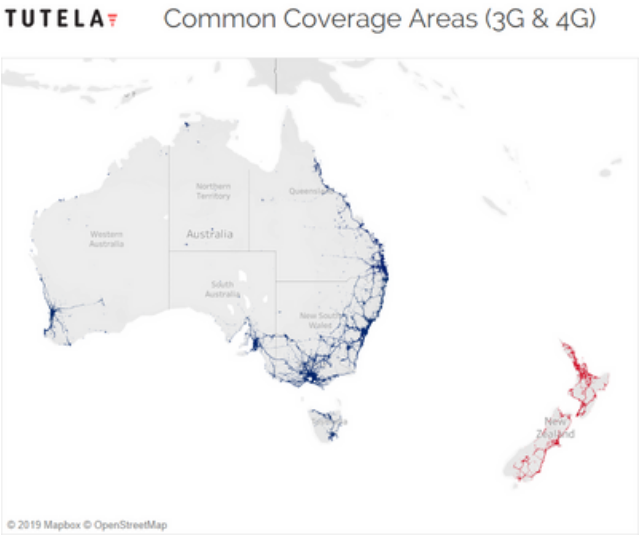
Understanding this report

Tutela uses two key methodological components to best compare user experience across operators: Consistent Quality and Common Coverage Areas. Consistent Quality is a set of metrics that Tutela has developed to objectively evaluate when networks are (and are not) enabling users to do almost everything that they want to do on their smartphones.

The methodology is covered in detail at the end of this report and on our website, but simply put, there are two sets of thresholds, Excellent and Core. A connection that hits the Excellent threshold is sufficient for use-cases like 1080p video streaming or multiplayer gaming, while a Core connection will stream standard-definition video or handle things like web browsing or uploading photos to social media. The percentages you see in this report represent the percentage of tests on a given operator that were above the Excellent or Core thresholds. These were most recently re-assessed and updated September 1st, 2019.

Common Coverage Areas are parts of the country where the majority of operators offer service. In this report, we present results nationally and from Common Coverage Areas, which helps present both a full national picture, as well as highlighting network conditions wherever operators are directly in competition.





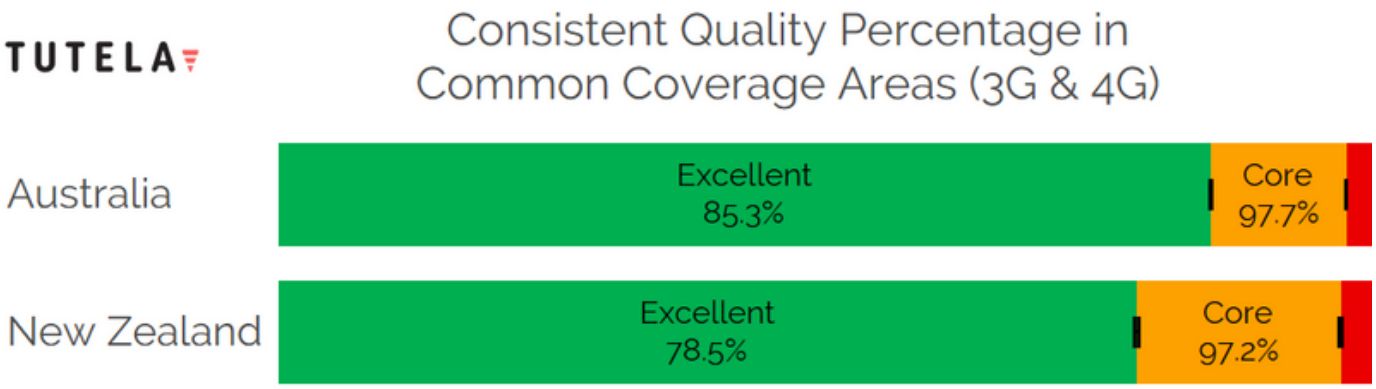
Consistent Quality

Country comparison Common Coverage Areas

Australia demonstrates a clear lead over New Zealand for Excellent Consistent Quality at 85.3% compared to 78.5%, however the gap between the two for Core Consistent Quality was far smaller: just 0.5%.

All three operators in Australia have an Excellent Consistent Quality in Common Coverage areas above that of those in New Zealand, however, the results for Core Consistent Quality are largely comparable across all operators in both countries.

"All three operators in Australia have an Excellent Consistent Quality in Common Coverage areas above that of those in New Zealand"



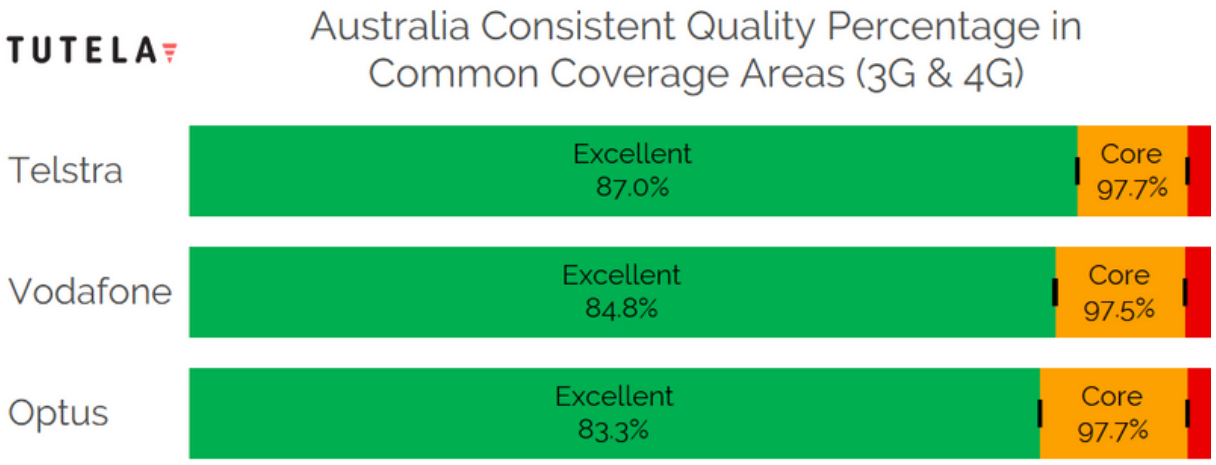
Consistent Quality

Australian operators Common Coverage Areas vs. Nationwide

In Common Coverage Areas across Australia, Telstra had the highest Excellent Consistent Quality at 87.0%. However, the gap between all operators was relatively small - just 3.7% separated third-place Optus from first-place Telstra.

For Core Consistent Quality, Optus's network drew even with Telstra to draw for the top spot when it comes to uses such as VOIP calls, standard definition video streaming, or social media usage. Outside of Common Coverage Areas, Telstra is still the network with the best overall Excellent Consistent Quality, although the results are slightly closer.

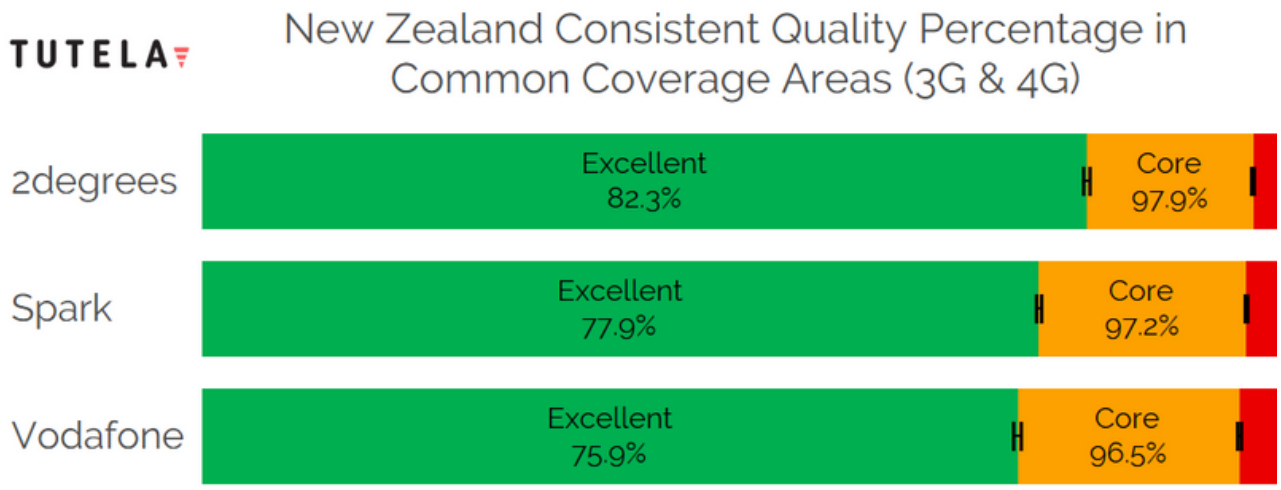
Telstra's result is 1.1% lower -- due, most likely, of the challenges of providing high-quality coverage in highly rural areas.

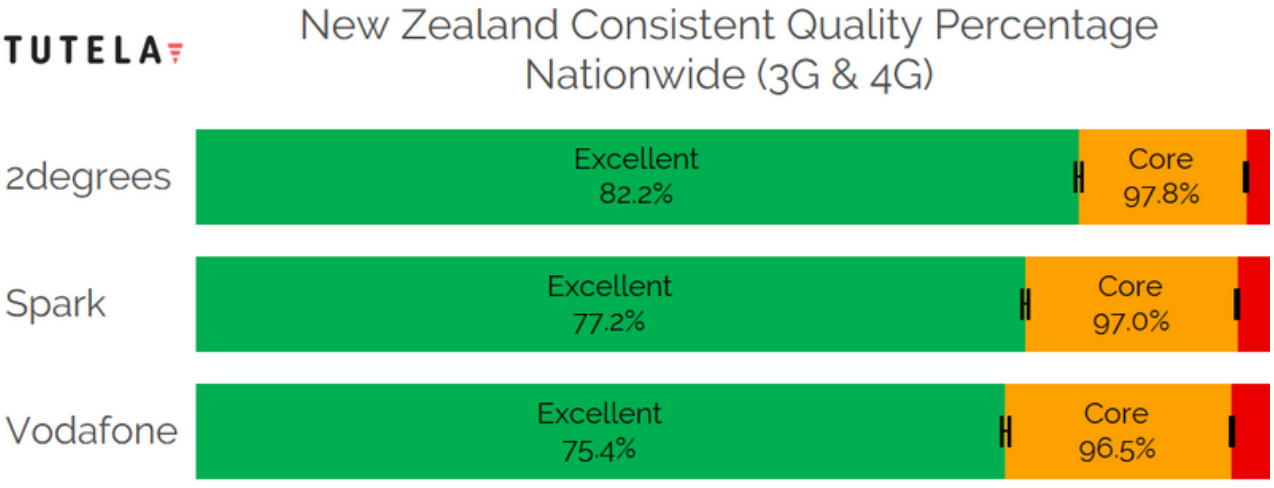


Consistent Quality

New Zealand operators Common Coverage Areas vs. Nationwide

In New Zealand, 2degrees has a compelling lead for Excellent Consistent Quality in Common Coverage Areas at 82.3%, 4.4% more than second-place Spark. Meanwhile, second and third place was separated by just 2%. 2degrees retained this lead on a nationwide level, however all operators' scores are a few fractions of a percentage point lower due to more rural conditions.

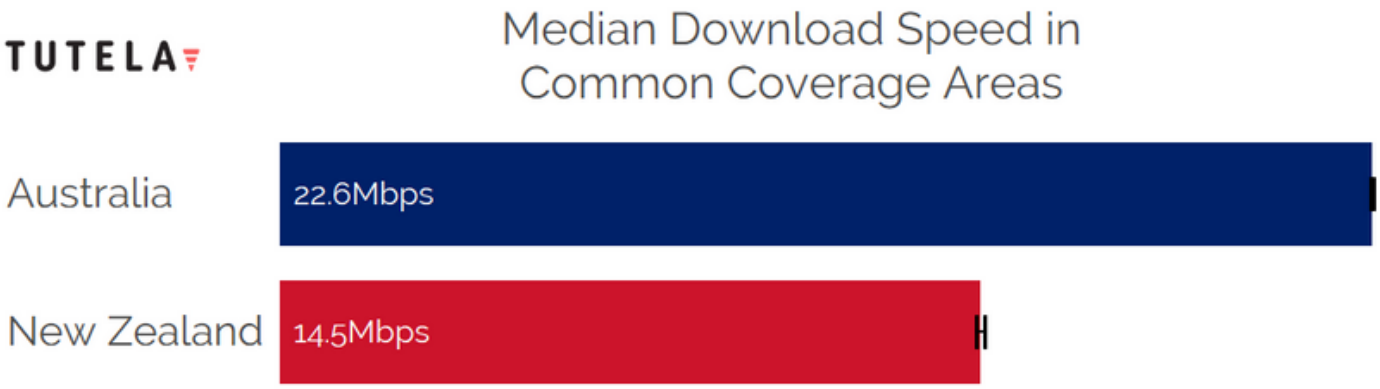




Download throughput

Country comparison Common Coverage Areas

Australia's lead over New Zealand in mobile networks is even clearer when looking at median download speeds. The difference here is 8.1 Mbps, a significant margin. While it's important to note that download speeds are not a proxy for a "good" network (a faster network does not lead to an appreciable improvement in performance for many use cases, above a certain threshold), the difference indicates that Australia's networks are capable of supporting even highly intensive use-cases from a raw speed perspective.

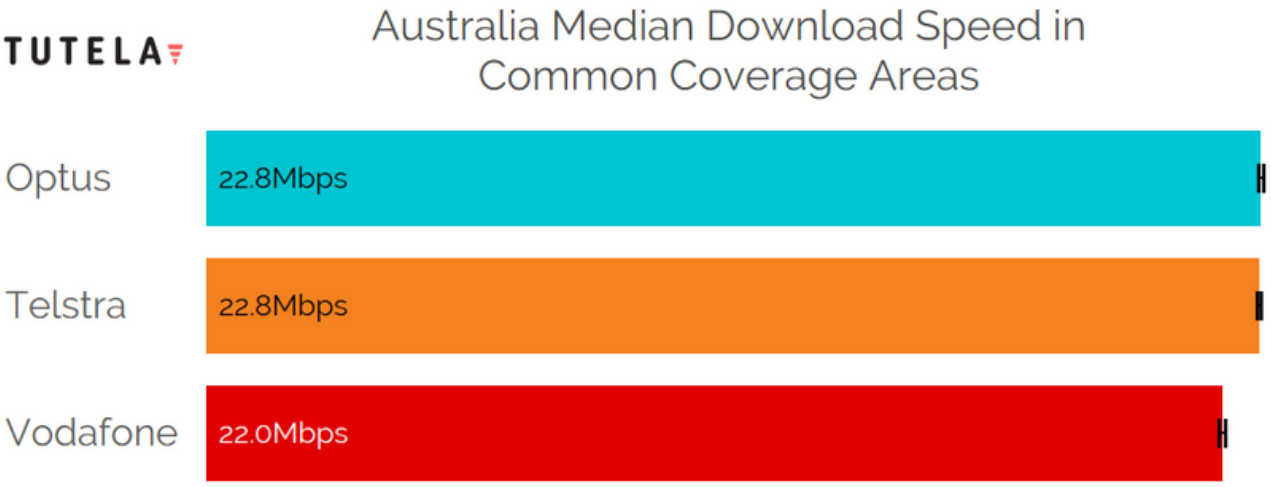


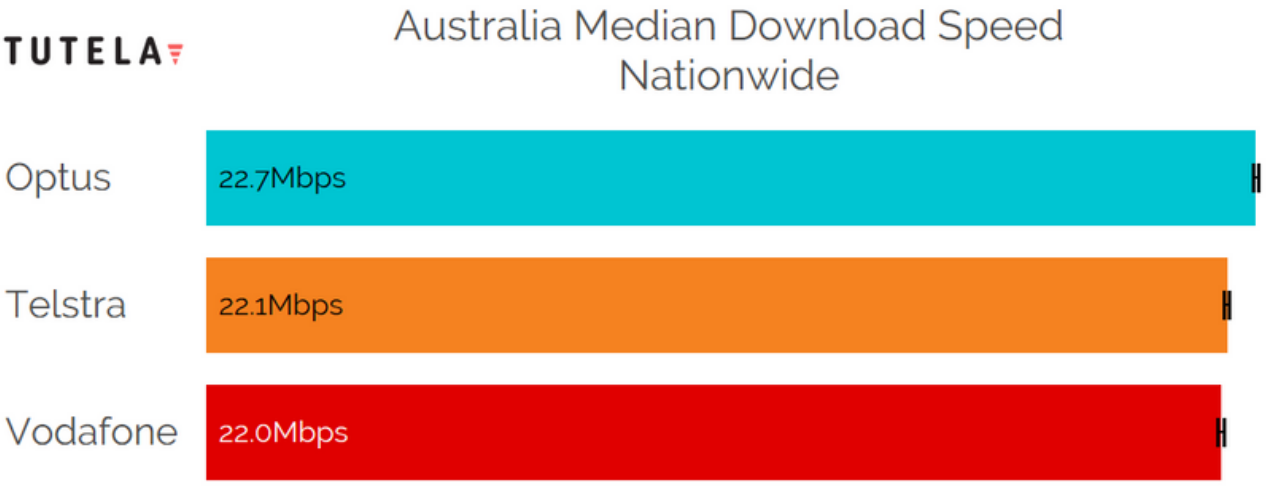
Download throughput

Australian operators Common Coverage Areas vs. Nationwide

Within Australia's Common Coverage Areas, Optus and Telstra drew for the top spot at 22.8 Mbps as the median performance. However, the rankings were extremely close with Vodafone just slightly behind at 22.0 Mbps.

Both Optus and Telstra display slightly slower performance when looking on a full national level. Optus's nationwide median download speed is 0.1 Mbps lower, while Telstra's is 0.7 Mbps lower. Vodafone stayed the same.

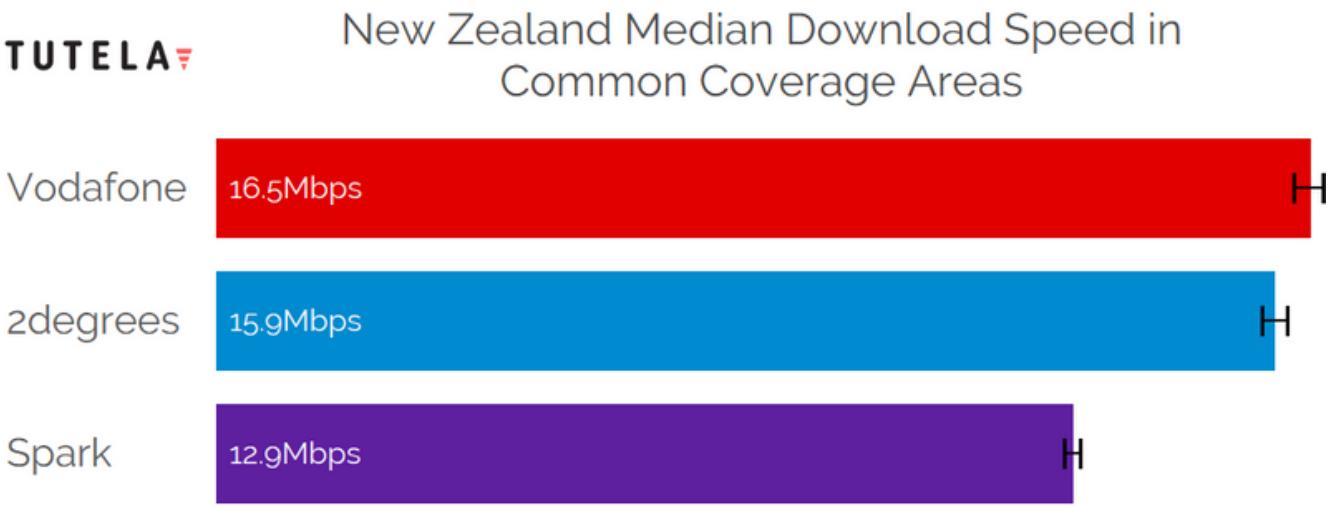


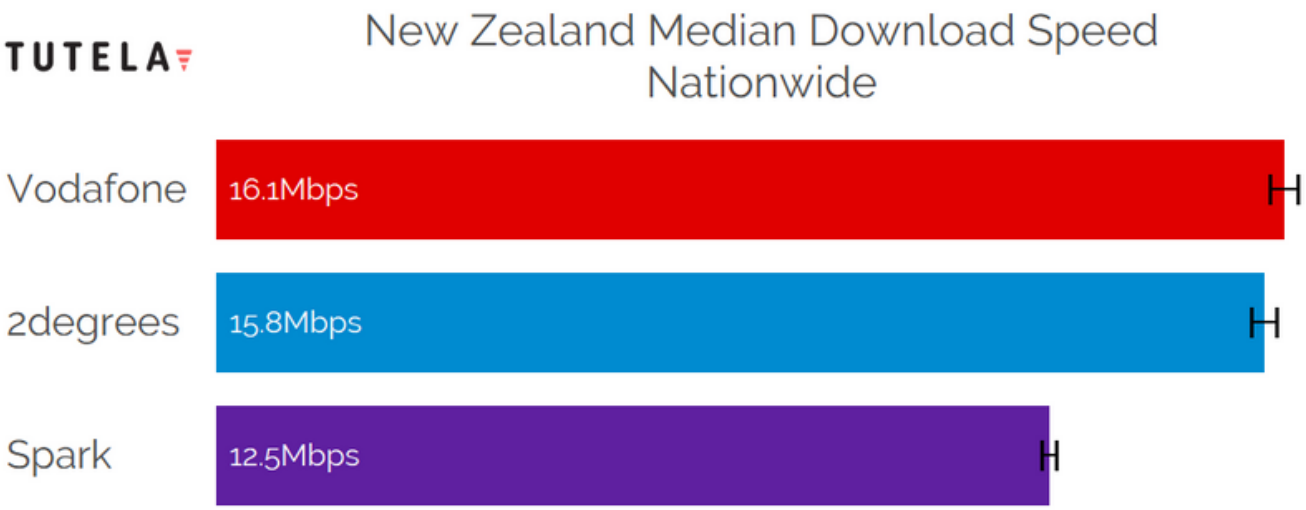


Download throughput

New Zealand operators Common Coverage Areas vs. Nationwide

In New Zealand, Vodafone had a clear advantage in terms of median download speed, with an average of 16.5 Mbps. This was 0.6 Mbps faster than 2degrees, and notably faster than third-place Spark, which had a median of 12.9 Mbps -- the slowest among the six operators in this report. All operators saw an appreciable decline in median download speed outside of Common Coverage Areas, with Spark seeing the greatest decline of 0.4 Mbps.



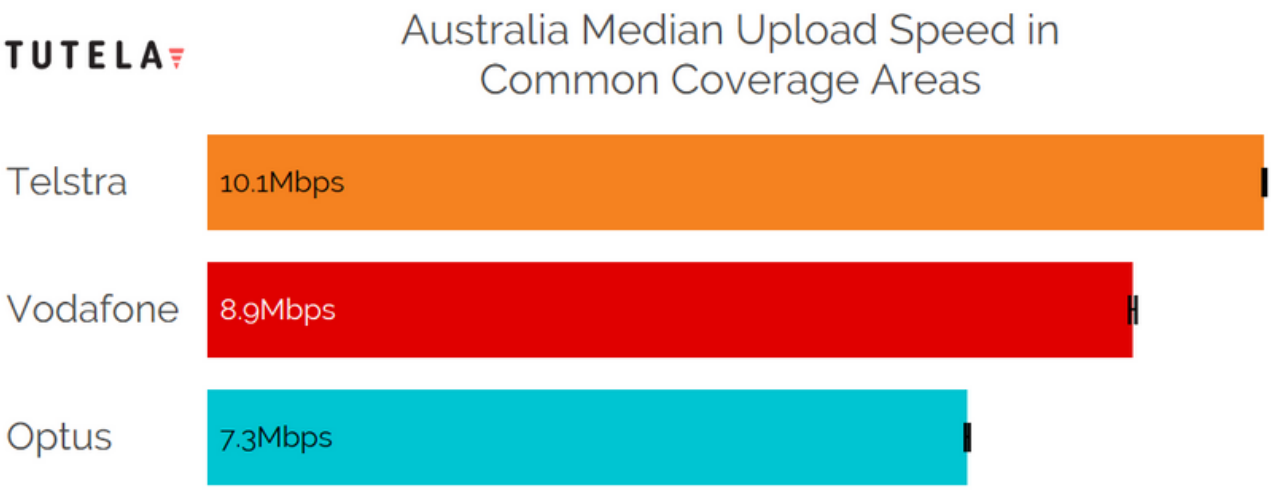


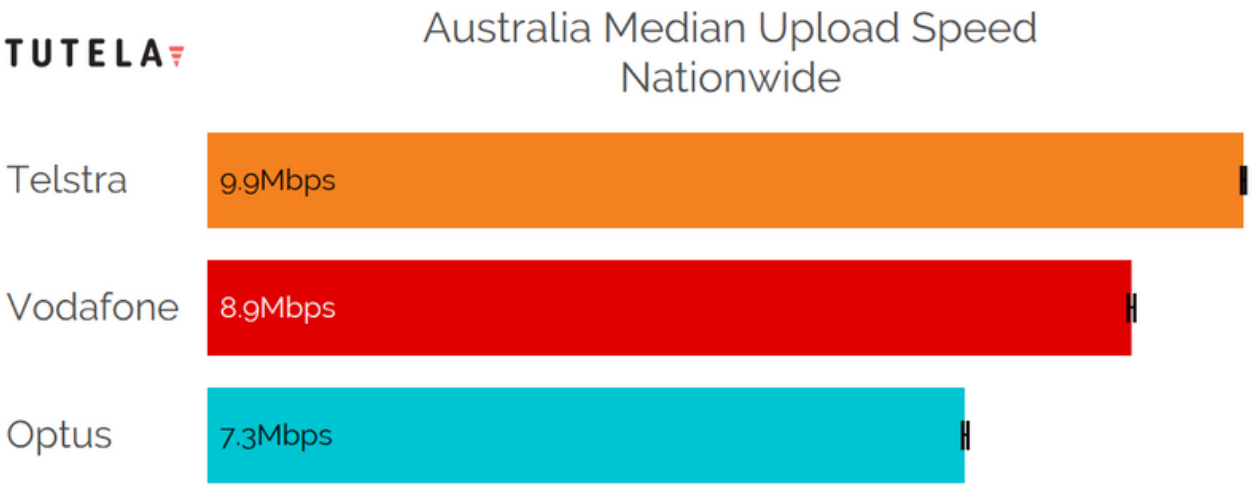
Upload throughput

Australian operators Common Coverage Areas vs. Nationwide

As with download throughput, median upload speeds in Australia were about 50% faster than those in New Zealand. However, the median upload speeds of both countries were notably high -- on average far above the 1.5 Mbps threshold Tutela uses as part of its Excellent Consistent Quality threshold.

Telstra had the fastest median upload throughput at 10.1 Mbps, while Optus, which had the fastest median download speed came third for upload at 7.3 Mbps. The picture remains constant at the national level, although Telstra's median upload speed is a little lower (9.9 Mbps)

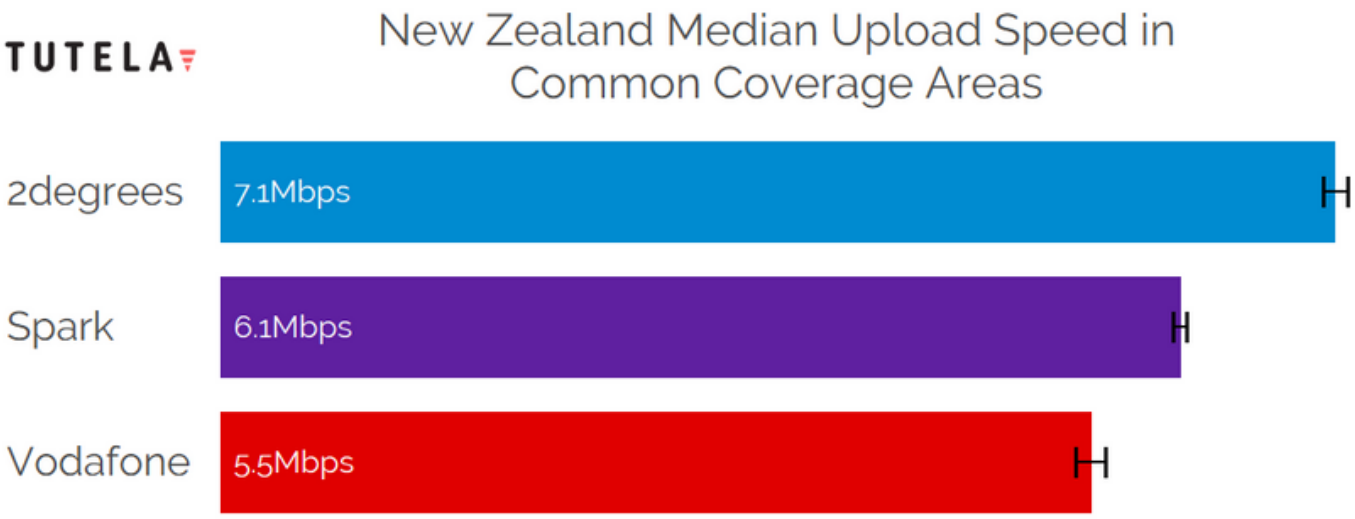


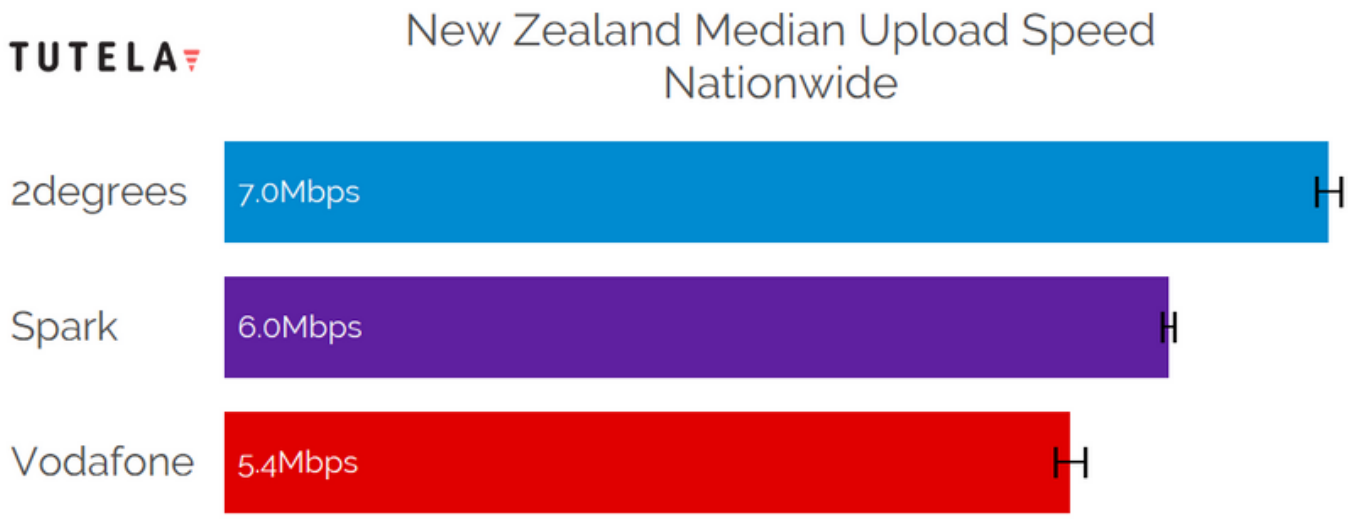


Upload throughput

New Zealand operators Common Coverage Areas vs. Nationwide

In New Zealand, the results were much closer. However, 2degrees still had a clear lead at 7.1 Mbps. Spark comes second at 6.1 Mbps, with Vodafone, the fastest network in New Zealand in terms median download speed, at 5.5 Mbps. On average, all operators remained comfortably above the 1.5 Mbps upload throughput threshold for uses such as HD group video calling.

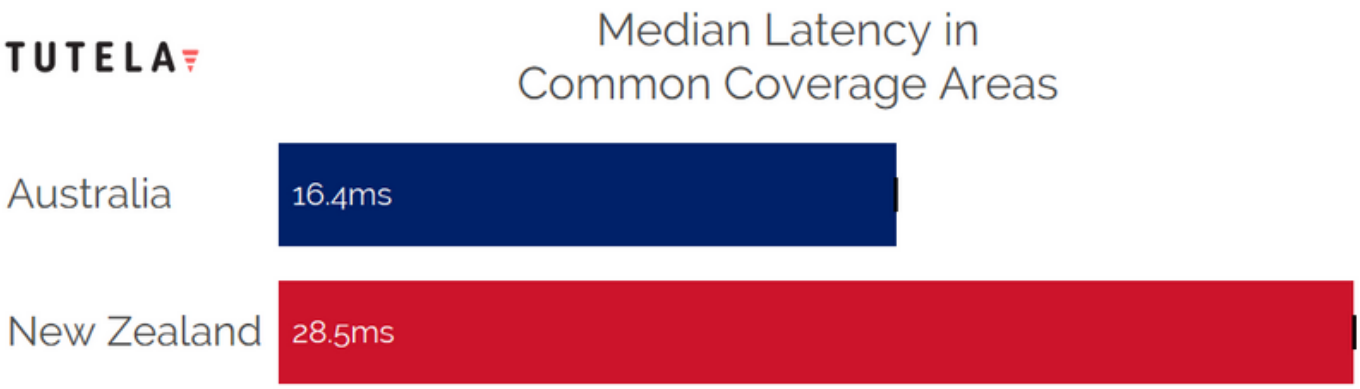




Latency

Australia & New Zealand operators Common Coverage Areas

Australia also had the lower latency when compared with New Zealand, with a median one-way delay that was 12.1 ms less than the median for New Zealand.

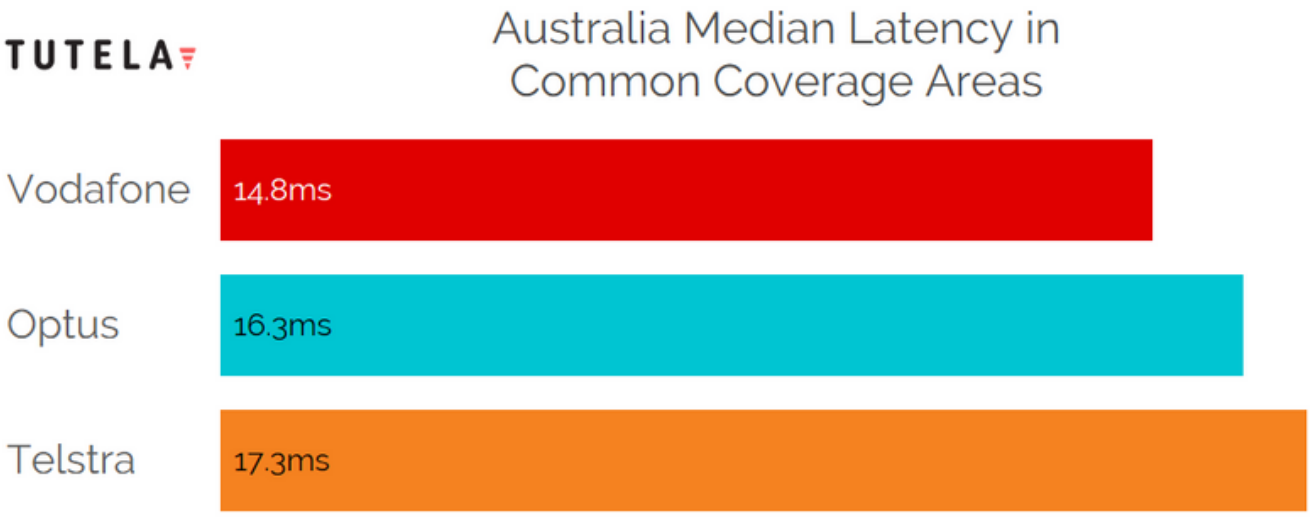


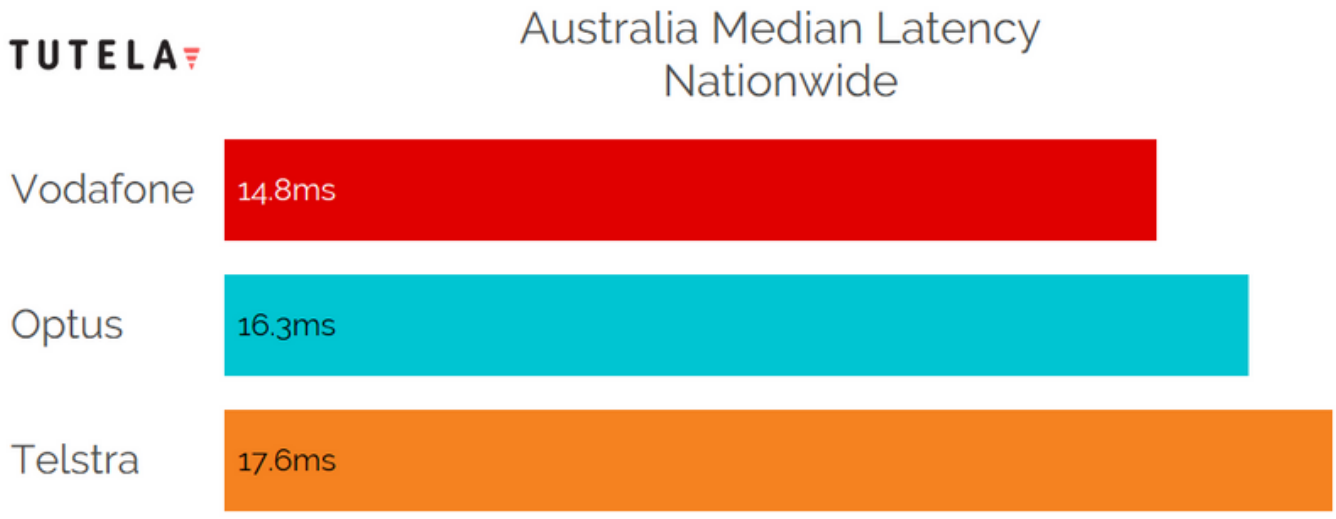
Latency

Australian operators Common Coverage Areas vs. Nationwide

In Australia, Vodafone had the lowest latency at just 14.8 ms, with Optus in second at 16.3ms and all three operators comfortably under the 50ms one-way latency threshold that Tutela uses as part of Excellent Consistent Quality.

Lower latency is particularly important for the likes of real-time online mobile gaming, or HD group video calling where delays can be both a noticeable and significant irritation.



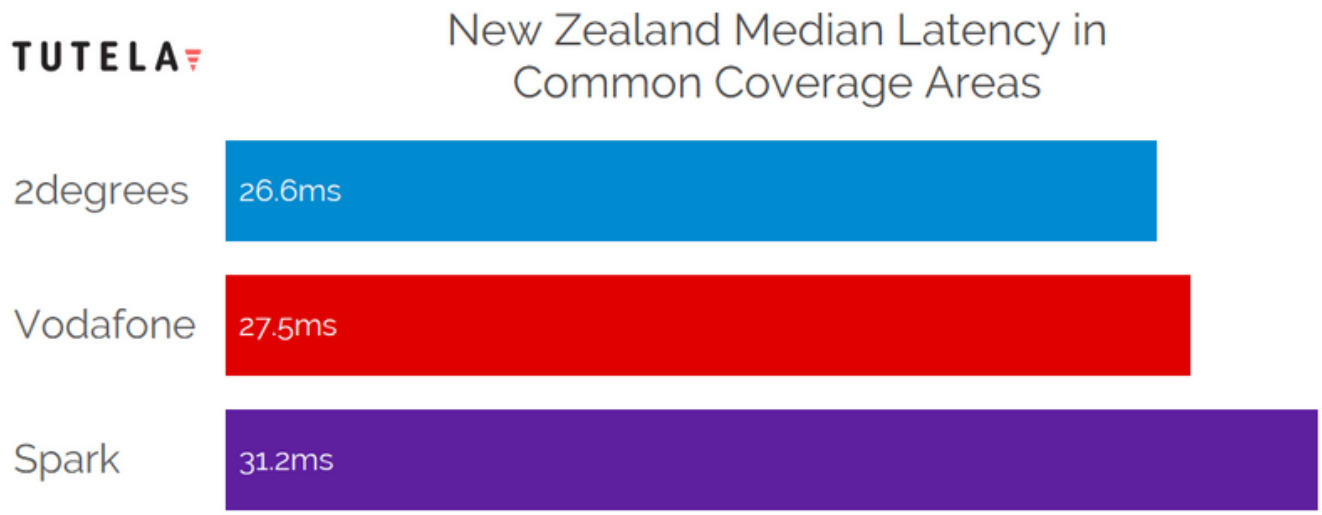


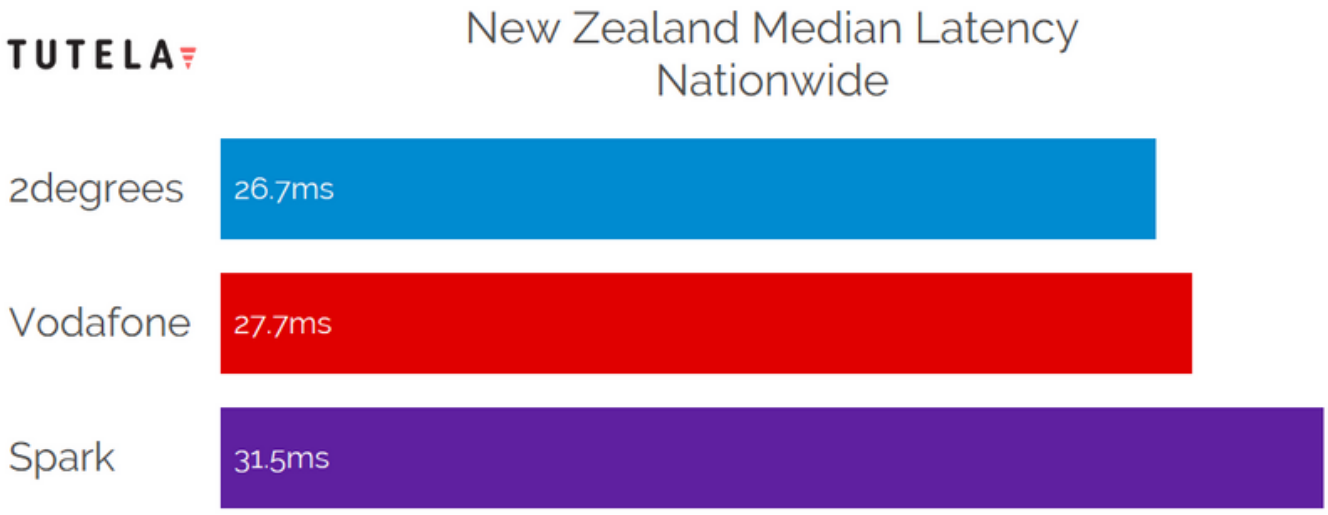
Latency

New Zealand operators Common Coverage Areas vs. Nationwide

In New Zealand, median one-way latency was much closer between operators. 2degrees had the lowest median latency in Common Coverage Areas, at 26.6ms, but just 4.6ms separated first and third place.

While all operators had higher latency than their Australian counterparts, all three still had a median performance again better than Tutela's 50ms threshold.

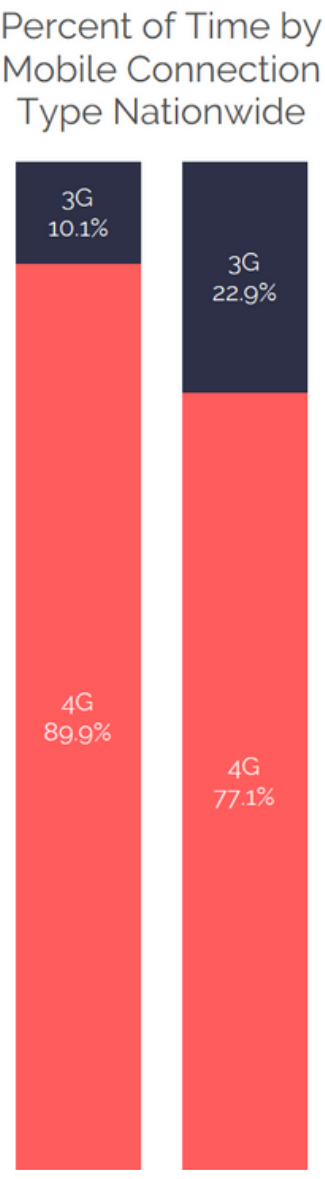


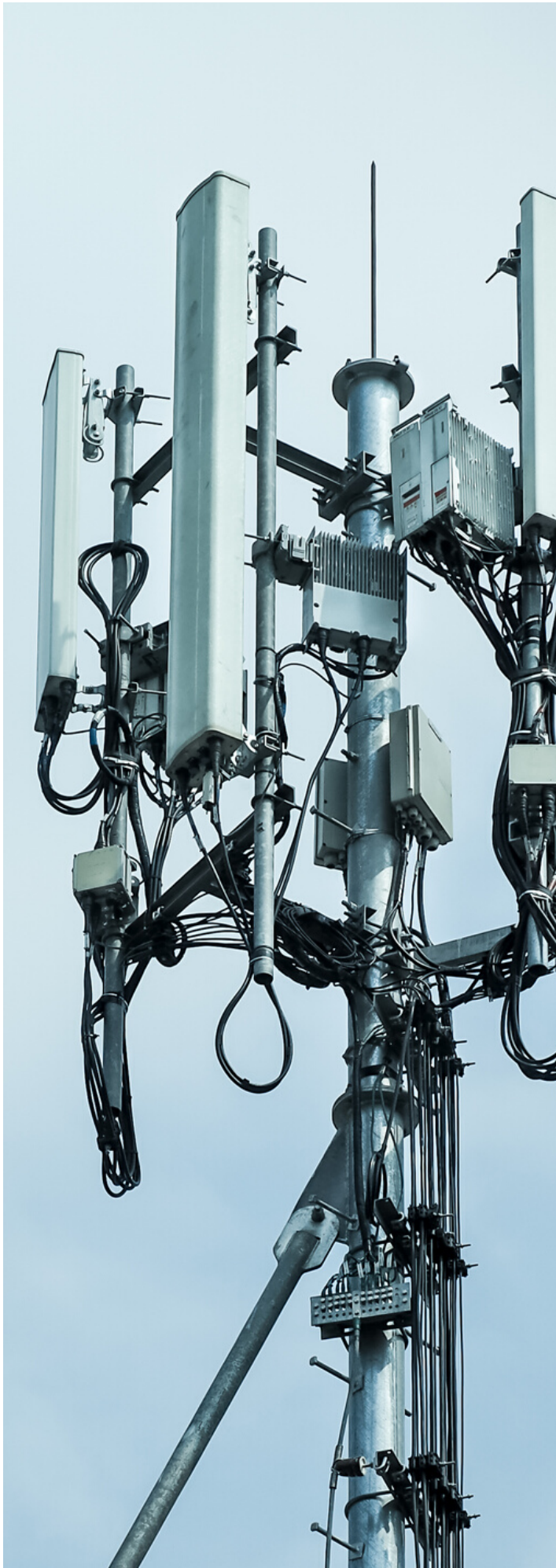


Data and spectrum usage

Australian mobile users spend just under 90% of their time on a 4G connection, indicating the maturity of the technology as mobile operators look ahead to phasing out 3G altogether.

Meanwhile, New Zealand users still end up on a 3G connection nearly a quarter of the time when they have a signal.

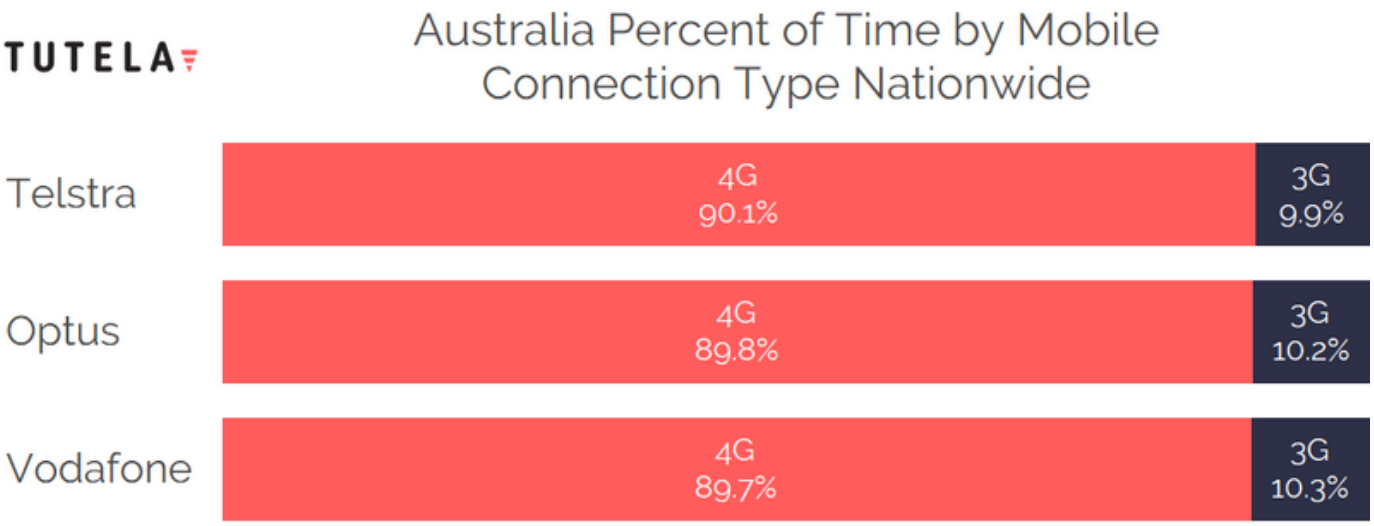


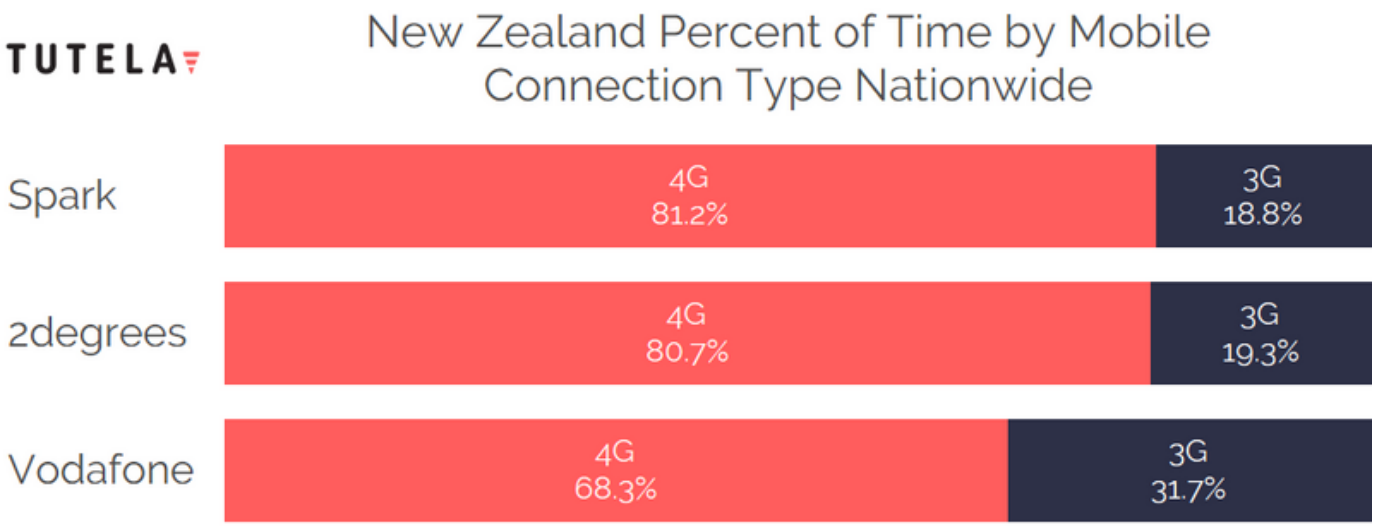


Data and spectrum usage

Australia and New Zealand operators nationwide

In Australia, all three operators offer extremely comparable levels of 4G, with users on all three networks spending about 90% of their time when they had a connection on 4G. Meanwhile, in New Zealand, the picture is much less homogenous. New Zealand's overall lower percentage of time spend on 4G suggests there is more work still to be done on broadening 4G availability across the country.





Data and spectrum usage

Australia and New Zealand operators nationwide

This is in part due to Vodafone New Zealand users spending significantly less time on 4G than any of the other operators at just 68.3%.

Given this, Vodafone's first place finish for median download throughput is particularly impressive, as 3G networks historically tend to be notably slower than 4G ones.

Meanwhile, users on both Spark and 2degrees spend more than 80% of their time on 4G, which likely contributes to the pair's higher Excellent Consistent Quality -- it is far harder to consistently reach the thresholds Tutela uses to represent a network suitable for HD video streaming, group HD video calling, real-time mobile gaming and more over a 3G connection.

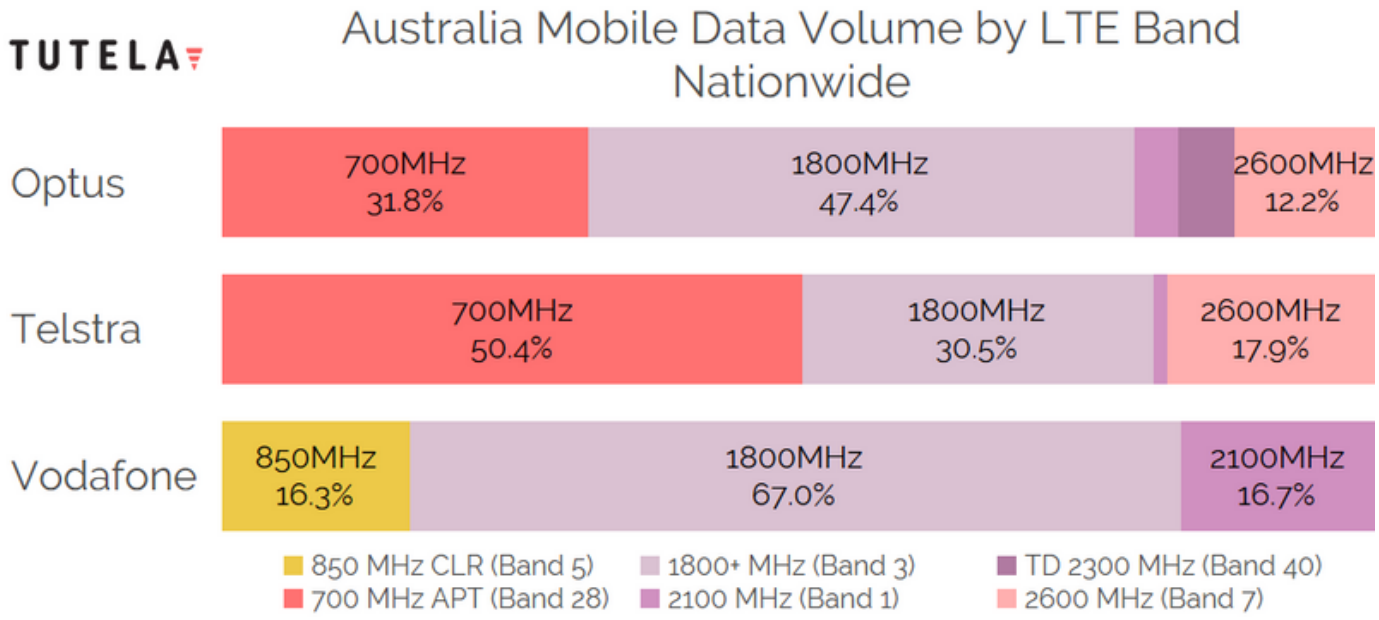
Data and spectrum usage

Australia operators

Telstra's heavy usage of 700 MHz spectrum stands out among Australian operators. Low-band radio waves (like 700 MHz) travel further and penetrate obstacles better than mid-band or high-band spectrum, which helps with coverage, especially in rural areas or inside buildings.

Typically, operators use a mix of low-band spectrum for coverage and mid-band and high-band for capacity, to prevent the low-band spectrum from being congested. In the case of Telstra, the operator owns a total of 40 MHz (uplink and downlink combined) in the 700 MHz band. Tutela's data shows that Telstra is deploying a 20 MHz-wide chunk in 700 MHz virtually nationwide, the maximum size allowed by the LTE protocol.

Owning (and deploying) such a wide spectrum chunk means that Telstra can have the best of both worlds -- coverage and capacity -- and goes some way to explaining Telstra's leading network performance.



Data and spectrum usage

Australia operators

One disruption on the horizon will be the wider rollout of 3.6 GHz spectrum for 5G, the auction for which concluded at the end of 2018.

Early deployments of the similar 3.5 GHz spectrum in Europe have shown that beamforming can deliver comparable coverage for 5G over 3.5 GHz as for current 1800 MHz LTE deployments.

Vodafone relies heavily on 1800 MHz for its existing LTE network, and it will be interesting to see if the similarities between 1800 MHz LTE and 3.6 GHz 5G (primarily, the density of existing cell sites) provides an advantage in building out 5G coverage.

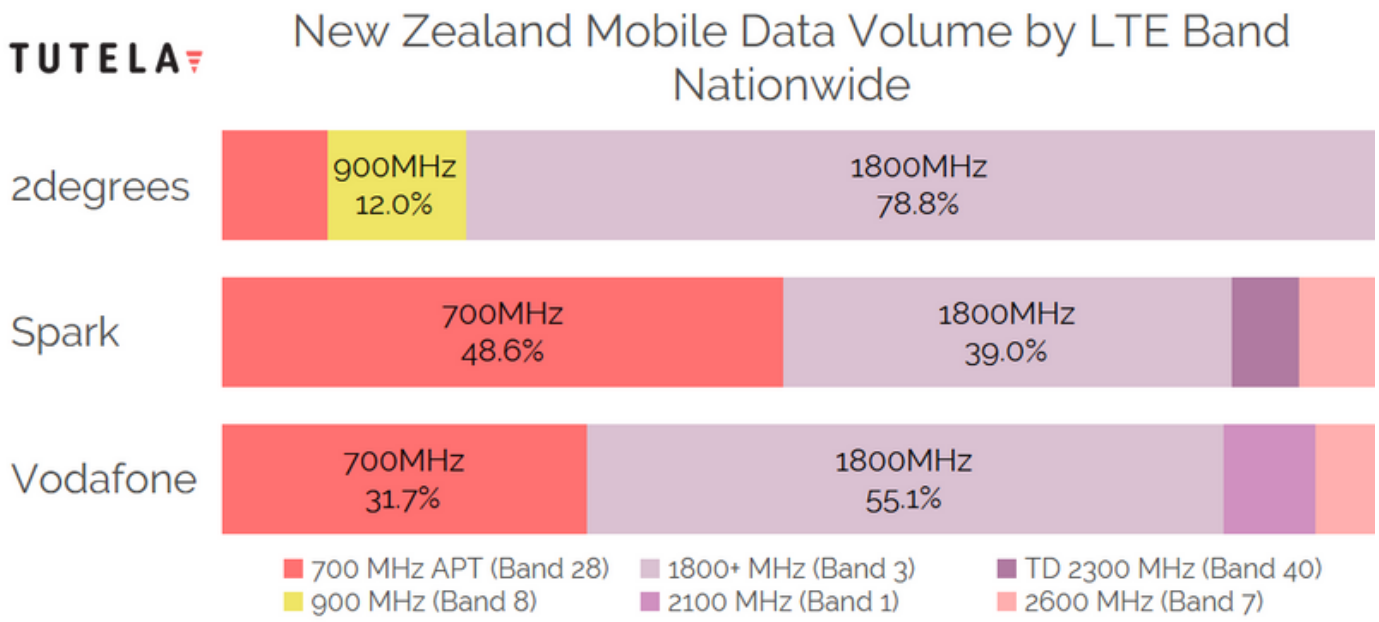
Data and spectrum usage

New Zealand operators

All three operators use a mix of 700 MHz and 1800 MHz for the bulk of their data traffic, with some variations between operators.

Although both 2degrees and Vodafone own spectrum in the 900 MHz band, Vodafone is still using that spectrum for its 3G network, while 2degrees has refarmed it to LTE.

Like Telstra in Australia, Spark holds a 40 MHz block of 700 MHz low-band spectrum, which accounts for nearly half of its data traffic.



Methodology

Tutela is an independent crowdsourced data company with a global panel of over 300 million smartphone users. We gather information on mobile infrastructure and test wireless experience, helping organisations in the mobile industry to understand and improve the world's networks.

Tutela collects data and runs network tests via software embedded in a diverse range of over 3000 consumer applications, which enable the measurement of real-world quality of experience for mobile users, 24/7. For this report, we gathered 83,201,021,842 measurements, including over 16 million speed tests and 215 million latency tests between April 1st and September 30th 2019.

Tutela measures network quality based on the real-world performance of actual network subscribers, inclusive of occasions when a network or tariff may be throttled or congested. Results in this report are based on a testing configuration designed to represent the typical (rather than maximum) performance that users experience. We use a 2 MB file to perform our download testing and a 1 MB file to perform our upload testing. Latency performance in this report reflects one-way UDP latency. Tests are conducted against the same content delivery networks that power many of the world's most popular consumer applications, and as such reflect the end-to-end performance of the network.

Consistent Quality

Download speed is most often used as a proxy for network quality, but while download throughput is important, it's just one of several crucial requirements for a "good" connection.

As operators have upgraded 3G networks to LTE-Advanced technology, theoretical (and even real-world) peak throughput speeds have increased to where they vastly outstrip the maximum needed for any current use-case. Real-world speeds above 100 Mbps are now common in parts of the world, and with a 4K video stream -- which itself is rarely something smartphone users need -- using a fifth of that, average download speed has lost some of its relevance as the dominant statistic used to measure the quality of wireless networks.

At its most basic, a good connection is one that doesn't get in the way of users doing what they want to do. In the real world, smartphone users aren't running speed tests all day -- they're browsing the web, using apps, voice calling their friends, streaming Netflix and YouTube, or making video calls.

Consistent Quality

To more objectively evaluate when networks are (and are not) enabling users to do those things, Tutela has developed a standard called consistent quality. Simply put, it's two sets of thresholds, called Excellent and Core. If a connection hits the Excellent standard, it's sufficient for the most demanding mobile use-cases, like HD group video calling or 1080p video streaming. A Core connection is good enough for SD video streaming, web browsing, emails, and VOIP calling, but users are more likely to experience delays or buffering when trying to use more demanding apps. Tutela bases the threshold values on the minimum performance requirements published by popular apps. We most recently updated our Consistent Quality thresholds on September 1st, 2019.

Tutela's consistent quality metric, as used in our reports, simply measures the percentage of time that users can hit the thresholds. The higher the number, the more often users have a Core or Excellent quality connection.

Excellent Quality

KPI	Download throughput	Upload throughput	Latency	Jitter	Packet loss
Minimum acceptable value	5 Mbps	1.5 Mbps	50 ms	30 ms	1%

Core Quality

KPI	Download throughput	Upload throughput	Latency	Jitter	Packet loss
Minimum acceptable value	1.5 Mbps	500 Kbps	100 ms	50 ms	5%

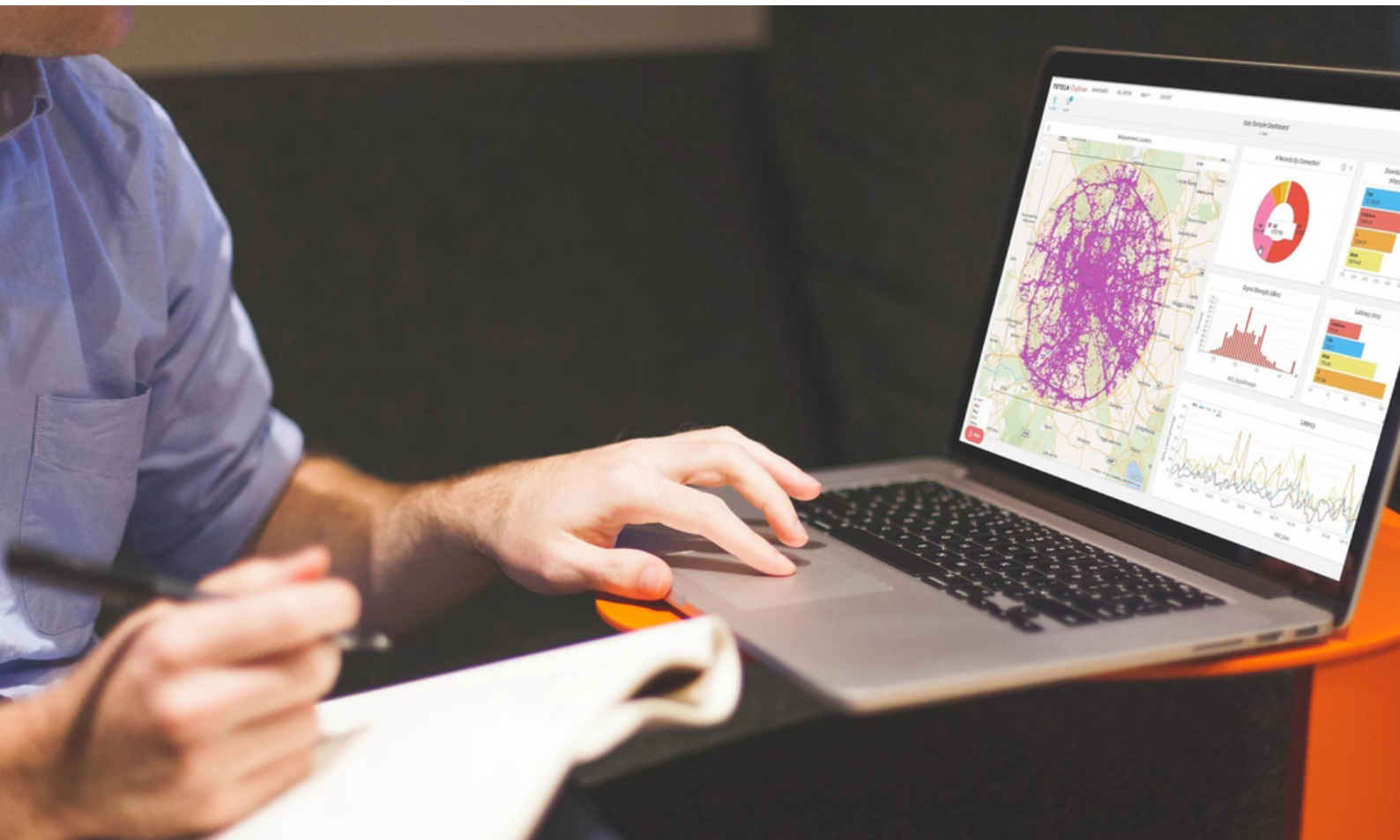
Discover Tutela Explorer

Tutela Explorer is a powerful cloud-based solution for real-time analysis of crowdsourced data. Using the platform, mobile operators can:

- Create coverage and quality maps
- Benchmark network quality and coverage across all operators
- Drill down to any KPI at city, street or even building level
- Analyse spectrum utilisation, performance and more

Visit www.tutela.com/explorer to learn more

Learn more



Appendix

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Error Margins

			Download Median	Upload Median	Latency Median	Excellent CQ	Core CQ
Common Coverage Areas	Australia	Optus	±0.06Mbps	±0.02Mbps	±0.00ms	±0.1%	±0.0%
		Telstra	±0.05Mbps	±0.02Mbps	±0.00ms	±0.1%	±0.0%
		Vodafone	±0.07Mbps	±0.03Mbps	±0.00ms	±0.1%	±0.0%
	New Zealand	2degrees	±0.19Mbps	±0.08Mbps	±0.01ms	±0.3%	±0.1%
		Spark	±0.12Mbps	±0.04Mbps	±0.01ms	±0.3%	±0.1%
		Vodafone	±0.23Mbps	±0.10Mbps	±0.01ms	±0.3%	±0.1%
National	Australia	Optus	±0.06Mbps	±0.02Mbps	±0.00ms	±0.1%	±0.0%
		Telstra	±0.05Mbps	±0.02Mbps	±0.00ms	±0.1%	±0.0%
		Vodafone	±0.06Mbps	±0.03Mbps	±0.00ms	±0.1%	±0.0%
	New Zealand	2degrees	±0.19Mbps	±0.08Mbps	±0.01ms	±0.3%	±0.1%
		Spark	±0.12Mbps	±0.04Mbps	±0.01ms	±0.3%	±0.1%
		Vodafone	±0.22Mbps	±0.10Mbps	±0.02ms	±0.3%	±0.1%

		Download Median	Upload Median	Latency Median	Excellent CQ	Core CQ
Common Coverage Areas	Australia	±0.03Mbps	±0.01Mbps	±0.00ms	±0.0%	±0.0%
	New Zealand	±0.09Mbps	±0.04Mbps	±0.01ms	±0.2%	±0.1%

About Tutela

Tutela Technologies, Ltd., is an independent crowdsourced data company with a global panel of over 300 million smartphone users. It gathers information on mobile infrastructure and tests wireless experience, helping organizations in the mobile industry to understand and improve the world's networks. Data and insights provided by Tutela are trusted by the engineering teams at mobile network operators and network equipment manufacturers around the world and used to compare operators as well as inform decisions in network and infrastructure planning and optimisation. The organization is headquartered in Victoria, British Columbia.

Tutela does not collect any sensitive personal data and is compliant with international privacy regulations including GDPR.

For further information about the methodology, data and tools used to create this report, please contact analysis@tutela.com or visit www.tutela.com.

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