

2021 Benchmark Measurements of 5G performance in Sydney and Melbourne



December 2021

Summary of the Results

In a survey of 5G mobile networks conducted by Systemics-PAB in Sydney and Melbourne, we found excellent performance from both Optus and Telstra. While 5G of Telstra has the widest geographical reach in two largest cities of Australia, it is Optus that is number one in most 5G performance metrics. It achieves higher average download throughput, top throughputs are also highest for Optus for both upload and download. Latency which is a key element of 5G is also lowest for Optus. Compared to a similar test we performed in 2020 both Telstra and Optus improved their 5G performance. 5G of Vodafone has a smaller coverage compared to two other operators, but its 5G network has grown considerably in recent 12 months.

Table 1 – 5G top level results



% of tests using 5G	54%	84%	34%
5G download average throughput [Mbps]	480	406	193
5G download 90 percentile throughput [Mbps]	914	734	383
Highest download throughput achieved in a single test	1 454	1 138	617
5G upload average throughput [Mbps]	43.1	44.7	28.6
5G upload 90 percentile throughput [Mbps]	103	86.4	57.3
Highest upload throughput achieved in a single test	160	123	89.7
Ping average [ms]	13.6	16.1	18.3

The highest throughput achieved by Optus is a really impressive figure. 1 454 Mbps of download throughput in a drivetest is higher than the result achieved in 2020 and it is the highest result we have recorded in 5G testing so far.

Geographical coverage of the measurements

In our 5G network performance comparison we decided to conduct our test in two largest cities of Australia – Sydney and Melbourne. We wanted to do a comprehensive test covering large sections of both cities. Measurements were done as a drivetest and our driveroute covered more than 2200 km in both cities combined. The driveroute is shown in the pictures below.

Picture 1. Driveroute covered in Sydney



Picture 2. Driveroute covered in Melbourne



How the survey was conducted

The measurements were conducted by a measurement car equipped with a Rohde & Schwarz Smart Benchmarker System. As the test terminal we used Samsung Galaxy S21+. Terminals and SIM cards had all radio technologies enabled and would freely select 5G where available or use 4G when 5G would not be an optimal technology choice. Test system also included TSME-6 radio scanner from Rohde & Schwarz.

Ookla Speed Test was used to measure 5G performance. This is the same test as can be performed from Ookla mobile application, however it is executed in an automated way by the measurement system.

Measurements were performed from 19.10.2021 till 12.11.2021. In both Sydney and Melbourne the measurements were performed after Covid-19 lockdown had been lifted.

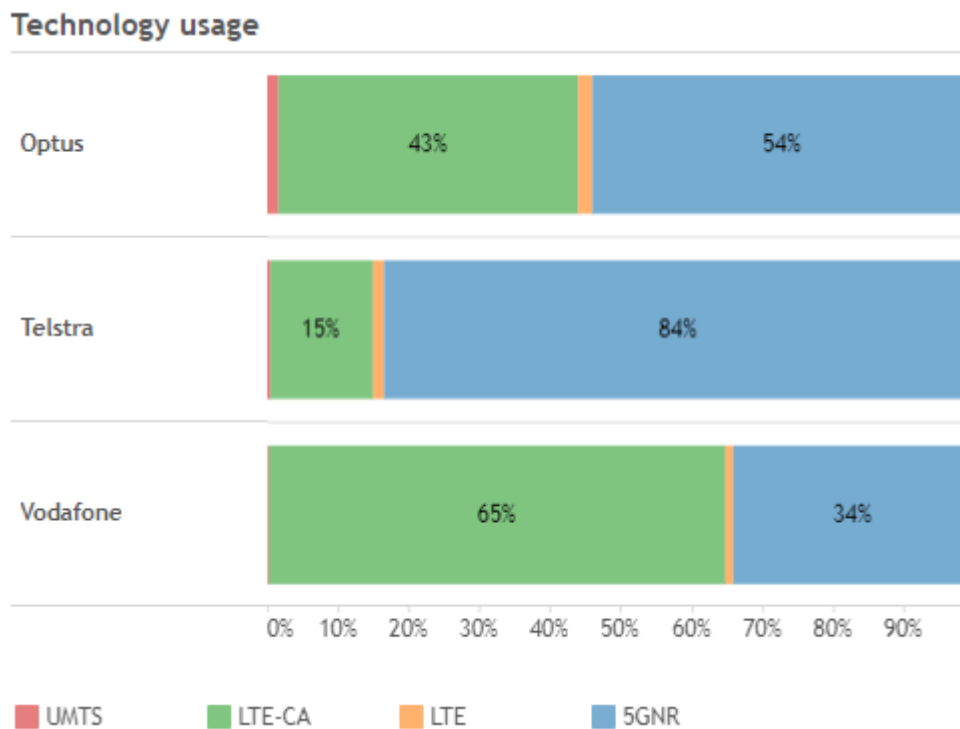


Test results

5G usage

Sydney and Melbourne are both very extensive cities. The driveroute that we selected for the test covered not only city centres but also included large sections of residential areas. Ookla speed test used in our survey was executed in the highest available radio technology. In Sydney and Melbourne Telstra achieved an impressive 84% of tests where 5G technology was used. 54% of Optus is a respectable achievement given wide area of cities that our measurement car covered. 34% of 5G coverage for Vodafone shows a gap of 5G deployment compared to Optus and Telstra, but it is a significant improvement compared to 2020.

Picture 3. 5G vs 4G usage



Overall results

This section shows overall results that aggregate all tests performed in 3G/4G/5G technologies. Average download and upload throughputs are highest for Telstra and the results for Optus are not far behind. Vodafone results show a gap to Optus and Telstra due to its lower usage of 5G. 90 percentile is an indicator of what throughput can be expected in most favourable radio conditions. The value of 765 Mbps in case of Optus means that top 10% of tests achieved the download throughput of 765 Mbps or more. Optus has an advantage over Telstra in top 10% of download tests, while Telstra has an advantage in top 10% of upload

tests (85.3 Mbps). Highest values achieved in a single test are not the most important of throughput metrics, however they tend to indicate certain technical advantages that an operator might have. We added an additional section in this report to explain the technical background of highest throughput differences between operators.

Last important element tested in Ookla test is the data transmission latency as measured by ping value. 15.2 ms achieved by Optus is a very good result and approximately 8% advantage (1.2 ms) over Telstra has an impact on latency sensitive services.

Table 2 – Overall results, including all tests performed



Download average throughput [Mbps]	315	360	120
Download 90 percentile throughput [Mbps]	765	691	277
Highest download throughput achieved in a single test [Mbps]	1 454	1 138	617
Upload average throughput [Mbps]	34.2	41.4	26.6
Upload 90 percentile throughput [Mbps]	78.6	85.3	50.3
Highest upload throughput achieved in a single test [Mbps]	160	123	89.7
Ping average [ms]	15.2	16.4	17

5G results

Our survey shows 5G coverage advantage of Telstra over Optus, but when we compare 5G only results we see almost all KPIs show a considerable 5G performance advantage of Optus over Telstra.

Table 3 – 5G results, tests without 5G are excluded

	OPTUS	Telstra	vodafone
Download average throughput [Mbps]	480	406	193
Download 90 percentile throughput [Mbps]	914	734	383
Highest throughput achieved in a single test	1 454	1 138	617
Upload average throughput [Mbps]	43.1	44.7	28.6
Upload 90 percentile throughput [Mbps]	103	86.4	57
Highest upload throughput achieved in a single test	160	123	90
Ping average [ms]	13.6	16.1	18.3




5G average download throughput and top 10% download results (90 percentile) are highest for Optus and there is a significant advantage of close to 20% in both of those metrics. In 5G average upload throughput Telstra has a slight advantage over Optus, however in top 10% upload results (90 percentile) Optus is clearly ahead of Telstra.

Latency values for 5G only tests show a larger advantage of Optus over Telstra – 2.5 ms difference. Single digit latency values which is one of the goals of 5G will be achievable when 5G stand alone networks are deployed and there are terminals compatible with stand alone networks. At the moment 5G network utilises common core network which is the same for both 4G and 5G connections, therefore the latency differences in 5G tests are relatively small compared with overall latency values presented in Table 2.

Top throughput tests – technical explanation

When comparing the best download throughput tests for Optus, Telstra and Vodafone we can see most significant 5G radio differences between those networks. There is a huge difference between top values achieved in a single test, and the reasons behind this difference comes down mainly to 5G and 4G radio resources available in the networks.

Table 4 – Best download tests comparisons

			
Highest throughput achieved in a single test [Mbps]	1 454	1 138	617
5G bandwidth used in 3500 MHz band [MHz]	100	80	60
5G bandwidth used in 2300 MHz band [MHz]	40		
4G bandwidth used in all available bands [MHz]	40	85	35
Total 5G bandwidth used during the test [MHz]	140	80	60
Combined 4G and 5G bandwidth used during the test [MHz]	180	165	95

5G carrier bandwidth is directly linked with the throughput that can be carried over 5G radio network. In case of Optus 5G is available in two bands – 3500 MHz and 2300 MHz and an ability to aggregate carriers in those two bands means that in a single data transfer a combined 140 MHz of 5G spectrum is utilised. Adding 40 MHz of 4G spectrum we end up with a staggering 180 MHz bandwidth used by a single user. As a reference point 4G technology when launched in Australia in 2011 used up to 20 MHz carriers for data transmission.

In case of Telstra the bandwidth available in 5G 3500 MHz band is 80 MHz, but combined with 85 MHz of 4G spectrum it offers 165 MHz of bandwidth to a single user, which is also a very significant amount of radio spectrum. Vodafone aggregates 60 Mhz of 5G with 35 Mhz of 4G hence its top speed is significantly lower than what we recorded for Optus.

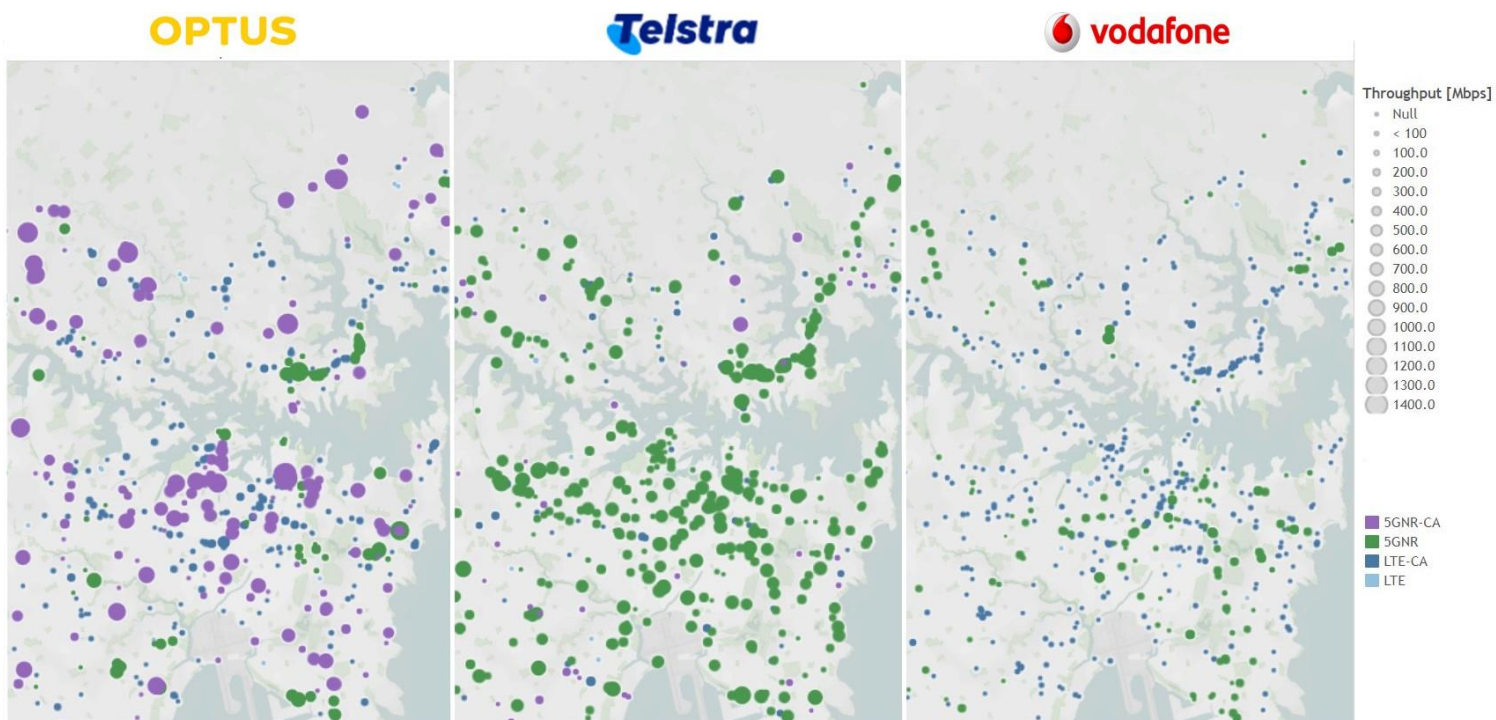
Please note the above comparisons are for 3 tests with the highest download throughput in each network. Bandwidth aggregations described refer to those individual tests and they are not available in all the tested locations.

Geographical coverage of 5G and dual band 5G

Compared with 2020 survey that Systemics performed a year ago we could see significant improvements in 5G coverage from all three operators. For Telstra most of the tests that we performed in city centres of Sydney and Melbourne were done in 5G technology, with very limited usage of LTE. For Optus the total 5G coverage was lower compared to Telstra, however in almost all locations where 5G was available this was dual band 5G offering extra throughput compared with standard 5G. For Vodafone 5G coverage has grown in the last 12 months from few 5G spots in 2020 to a reasonable continuous coverage in 2021.

Maps below show breakdown of radio technologies used in data download tests. Color of a dot represents radio technology, while the size of the dot corresponds to average throughput in that location. Purple denotes dual carrier 5G, green – standard 5G and blue - LTE

Picture 4 Sydney centre – radio technology and throughput

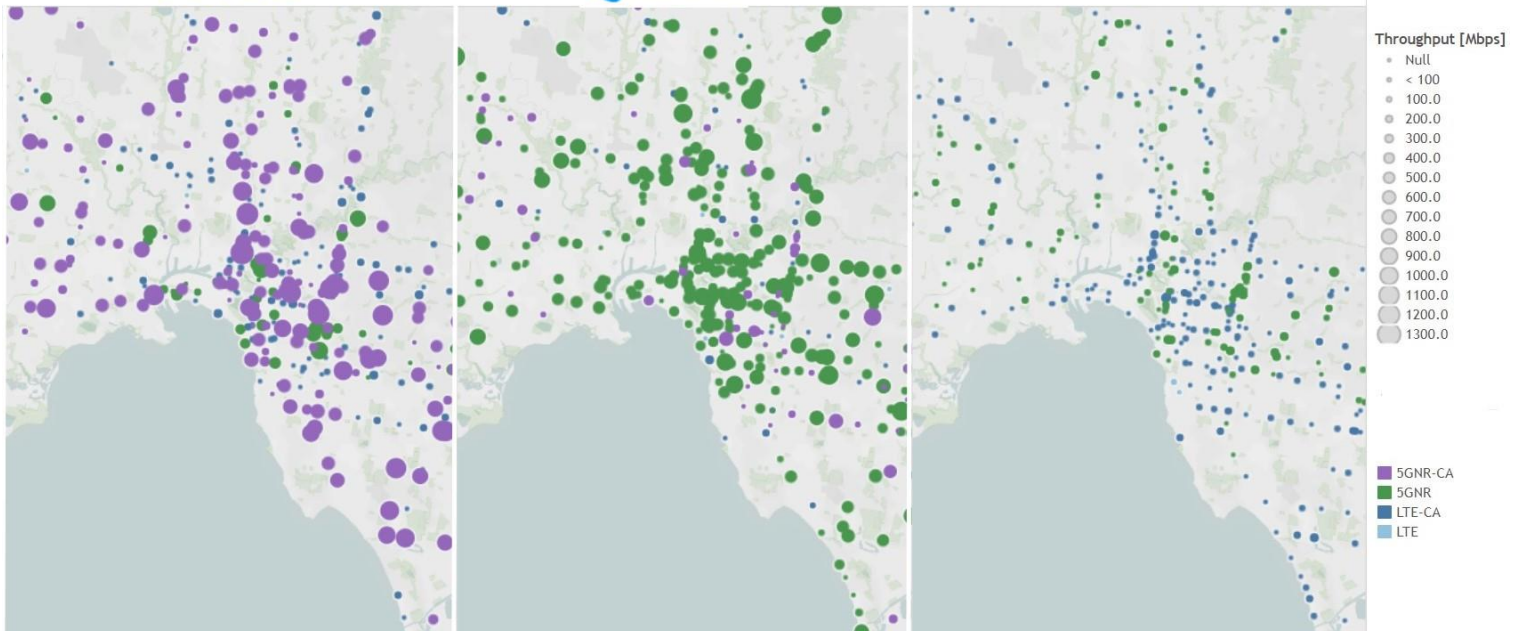


Picture 5 Melbourne centre – radio technology and throughput

OPTUS

Telstra

vodafone



Conclusions

Both Optus and Telstra offer excellent 5G networks in Sydney and Melbourne. In both cities Telstra has the widest geographical coverage and all three networks have expanded its 5G footprint in the last 12 months.

In terms of available 5G bandwidth Optus has an advantage in primary 3500 MHz band, where it offers 100 MHz bandwidth compared to 80 MHz of Telstra. On top of that in most areas where Optus 5G is available, a second 5G band in 2300 MHz frequencies can be used. In most places it adds additional 40 MHz of 5G bandwidth and in few locations we could use 60 MHz of additional bandwidth. The two carrier 5G network of Optus has significantly grown its coverage in the last 12 months and now in most places where 5G from Optus can be used it is the two carrier variant. Today it offers 140 MHz of combined 5G bandwidth and since in few locations we encountered 160 MHz we can expect over time 160 MHz will become more widely available further increasing possible throughputs.

Technical advantage of Optus over Telstra in terms of available 5G bandwidth translates into higher 5G average download throughput and higher top speed throughputs. Telstra has a slight edge over Optus in average upload throughput, however more importantly for 5G services Optus has an advantage over Telstra in shorter latency as measured by ping test.

Choice of 5G operator in Sydney and Melbourne is not straight forward. 5G of Telstra is more widely available in two largest cities of Australia, in terms of coverage this is the 5G

network to choose. If top download and upload speeds and lowest possible latency are your priority Optus, thanks to its widely deployed two carrier 5G network is a better choice. It is the fastest 5G network available in Sydney and Melbourne.

Systemics-PAB

Systemics-PAB is a leading provider of independent Quality of Experience benchmarking services for mobile operators and regulators. We have conducted various benchmarking campaigns of mobile networks in more than 50 countries in Europe, Middle East, Australia, Asia and Africa.

Our mission is to assist customers to understand and address the variety of issues affecting quality in mobile and fixed telecommunication networks. Expert know-how developed over many years, combined with large-scale operations and efficient cloud-based data post processing, gives us an unparalleled flexibility in conducting high-quality and complex projects in multiple countries worldwide. From 2017 Systemics-PAB is a certified partner of Rohde & Schwarz in the mobile networks testing domain. Systemics-PAB has also been a contributing member of ETSI working group developing guidance for Quality of Services testing in mobile networks.

