

Mobile Telecommunications Performance Study

Mid West Western Australia

Disclaimer

The material in this report is of a general nature and should not be regarded as legal advice or relied on for the assistance of any particular circumstances or emergency situation. In any important matter, you should seek appropriate independent professional advice in relation to your own circumstances.

RMIT University and auDA Foundation accept no responsibility or liability for any damage, loss or expense incurred as result of the reliance on information contained in this report.

Copyright



© RMIT University 2022

The material in this report is licensed under a Creative Commons Attribution—4.0 International license, with the exception of:

- RMIT University and auDA Foundation logos;
- any third party material;
- any material protected by a trademark; and
- any images and/or photographs.

More information on this CC BY licence is set out as follows:

- Creative Commons website—www.creativecommons.org
- Attribution 4.0 international (CC by 4.0)—www.creativecommons.org/licenses/by/4.0.

Third party copyright

RMIT University has made all reasonable efforts to clearly identify material where the copyright is owned by a third party. Permission may need to be obtained from third parties to re-use their material.

Attribution

The CC BY licence is a standard form licence agreement that allows you to copy and redistribute the material in any medium or format, as well as remix, transform, and build upon the material, on the condition that you provide a link to the licence, you indicate if changes were made, and you attribute the material as follows:

Licensed from RMIT University under a Creative Commons Attribution 4.0 International licence.

Enquiries about the use of any material in this publication can be sent to RMIT University.

Executive Summary

Mobile telecommunications is vital for the health and wellbeing of individuals and communities. The Regional Telecommunications Reviews carried out by the Commonwealth Government of Australia over the past decade have called for the measurement of mobile telecommunications performance in regional and remote areas; providing the motivation for this study. Earlier work carried out identified the need for quantifiable information about mobile performance in regional and remote areas¹. This report covers the period 23 February to 13 March when the study occurred in the Mid West region of Western Australia. The full study was carried out between 24 January and 3 April 2022 between Sydney, New South Wales and Kununurra, Western Australia.

This report provides a study of mobile telecommunications performance within Mid West towns, suburbs and the entire Mid West region of Western Australia based on the data collected within the study area. This is in contrast with the Australian Competition and Consumer Commission's *Measuring Broadband Australia* monitoring program that only provides aggregated national performance measures for retail service providers that connect customers over the National Broadband Network.

Whilst national figures are important, it is considered important that customers are provided with telecommunication performance outcomes for their individual communities and regions.

Included in this report are details of the study, how data was collected with a Cerno™ v2 radio frequency measurement device that was mounted on top of a vehicle, the data analysis methodology and performance values found in eight selected first nations towns located in New South Wales, Queensland and Western Australia. The study outcomes include information about coverage, signal strength and quality, and available network capacity, data download and upload speeds. Measurements were taken throughout the journey and future publications will examine the performance values in other locations. It is important to note that, except along highways, all areas in this report were measured at least twice on different days with the vehicle passing through the areas.

The Mid West region of Western Australia was studied at a point in history when it was uncertain whether it would be possible to complete the study. The timely support for the study during this difficult period in history is acknowledged and appreciated.

Contents

Executive Summary	3
Introduction	6
Regional Telecommunications Review	6
Mobile Coverage Audit	6
Methodology	8
Module configuration	9
Data Analysis.....	9
Filter value range.....	9
Measurements.....	10
Performance.....	10
Range guidance.....	10
Geraldton, Western Australia	11
Bluff Point, Western Australia	13
Dongara, Western Australia.....	14
Goodlands, Western Australia.....	15
Green Head, Western Australia.....	16
Kalbarri, Western Australia.....	17
Mullewa, Western Australia.....	18
Northampton, Western Australia	19
Mid West, Western Australia	20
Mid West (North West), Western Australia	21
Mid West (South West), Western Australia	22
Mid West (North East), Western Australia.....	23
Mid West (South East), Western Australia	24
Expectations.....	25
Ookla Speedtest measurements.....	25
Comparison.....	25
Analysis commentary	26
Conclusion.....	27
Acknowledgements	28

Figures

Figure 1 Data collection route.....	8
Figure 2 (a) Vehicle (b) Data collection equipment.....	9
Figure 3 Geraldton	11
Figure 4 Bluff Point.....	13
Figure 5 Dongara.....	14
Figure 6 Goodlands.....	15
Figure 7 Green Head.....	16
Figure 8 Kalbarri.....	17
Figure 9 Mullewa.....	18
Figure 10 Northampton.....	19
Figure 11 Mid West.....	20
Figure 12 Mid West (North West).....	21
Figure 13 Mid West (South West).....	22
Figure 14 Mid West (North East).....	23
Figure 15 Mid West (South East).....	24

Tables

Table 1 Geraldton 750m.....	11
Table 2 Geraldton 2000m.....	12
Table 3 Bluff Point 2000m.....	13
Table 4 Dongara 2000m.....	14
Table 5 Goodlands 60000m.....	15
Table 6 Green Head 1500m.....	16
Table 7 Kalbarri 2000m.....	17
Table 8 Mullewa 2000m.....	18
Table 9 Northampton 1500m.....	19
Table 10 Mid West 250000m.....	20
Table 11 Mid West (North West) 125000m.....	21
Table 12 Mid West (South West) 125000m.....	22
Table 13 Mid West (North East) 125000m.....	23
Table 14 Mid West (South East) 125000m.....	24
Table 15 Q1-Q2 Ookla speedtest comparison.....	25
Table 16 City Country.....	26

Introduction

A mobile performance study was completed in regional and remote Western Australia and this report covers the period 23 February to 13 March 2022 when the study occurred in the Mid West region of Western Australia. The study was carried out between 24 January and 3 April 2022 utilising vehicle mounted measurement equipment.

This study has collected and analysed data that provides guidance as to the state of mobile telecommunications in regional and remote Western Australia. The data provides a foundation to understand the utility of mobile telecommunications in regional and remote Western Australia and how the performance found fundamentally affects the capability of individuals or groups to enjoy the benefits of being online and use technology in these communities.

This report provides a study of mobile telecommunications performance within Mid West towns, suburbs and Mid West region of Western Australia based on the data collected within the study area. This is in contrast with the Australian Competition and Consumer Commission's *Measuring Broadband Australia* monitoring program that only provides aggregated national performance measures for retail service providers that connect customers over the National Broadband Network.

Whilst national figures are important, it is considered important that customers are provided with telecommunication performance outcomes for their community and region.

Regional Telecommunications Review

This project was motivated by submissions made to the 2021 Regional Telecommunications Reviewⁱⁱ and to previous reviews calling for mobile performance data to be collected. The 2021 Regional Telecommunications Review Reportⁱⁱⁱ Recommendation 9 Mobile Services states:

The Committee recommends that the Government ensures measures are undertaken to increase the accuracy and transparency of mobile network quality and coverage information, including network congestion. This includes measures to collect and standardise mobile network coverage information and develop a tool to empower consumers to compare network performance and service availability.

The Committee further recommends that:

- the Government provides funding to undertake an investigation and audit to collect and report mobile coverage performance across regional Australia, including congestion; and
- the Government undertakes a feasibility study to consider the capability for mobile roaming to be deployed in emergency circumstances.

Mobile Coverage Audit

The 2022-23 Federal Budget sets aside \$20 million for an independent audit of mobile coverage over five years to assist with identifying mobile black spots and investment priorities. The audit is a key component of the *Better Connectivity for Regional and Rural Australia Plan*^{iv}.

A key feature of the audit will be the collaboration with Australia Post to utilise its transport assets for data collection. A partner organisation will be selected through a competitive tender to provide, fit and operate mobile signal measurement devices that are mounted on the Australia Post transport assets.

The methodology and outcomes identified in this report provides learning points for the Government's audit that is expected to commence in 2023.

Methodology

The data collection commenced in Sydney, New South Wales on 24 January 2022 and ended on 4 April 2022 in Kununurra, Western Australia. Figure 1 provides a GPS track of the route. Data collected in towns and regions not included in this report or earlier reports will be included in future publications.

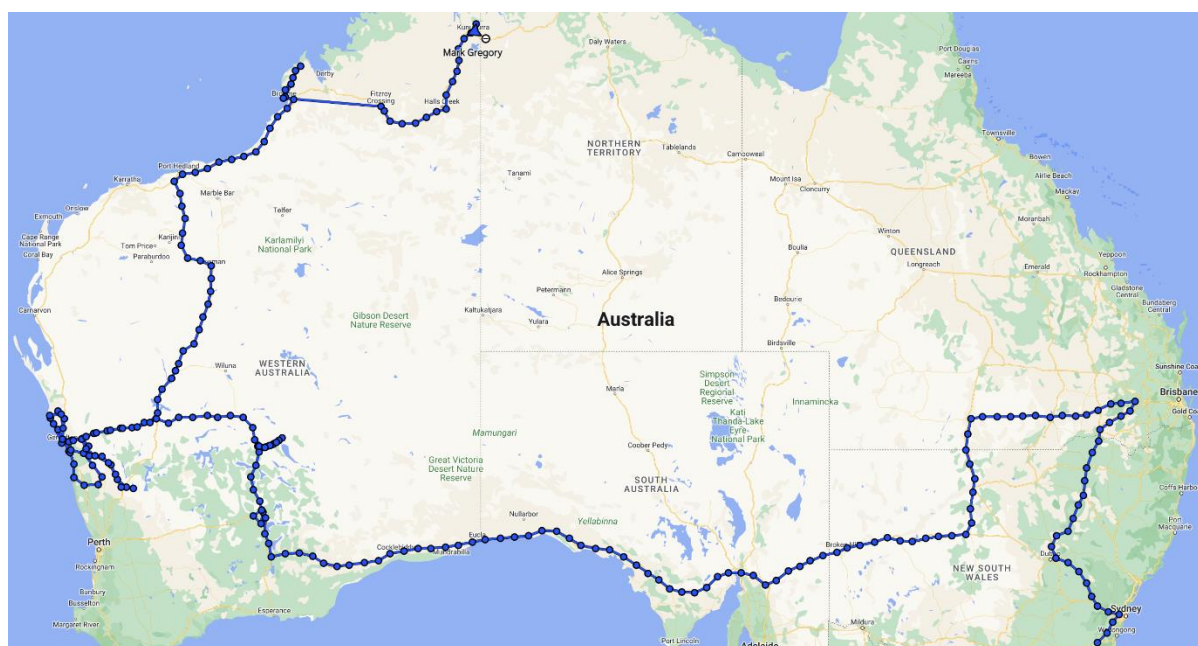


FIGURE 1 DATA COLLECTION ROUTE

The data collection equipment was a Cerno™ v2 loaned from Ranlytics Pty Ltd, a Sydney based RF monitoring, measurement and analysis company. The Cerno™ v2 has been used by Ranlytics to carry out studies for mobile network operators and industry. The Cerno™ incorporated six modules that could be independently configured, as shown in Figure 2(b). The equipment was mounted on the roof of a vehicle, as shown in Figure 2(a), with an external GPS and power was provided by the vehicle. Four Cerno™ modules were configured for the Telstra mobile network, one for the Optus mobile network and one for the Vodafone mobile network.

The first module was fitted with a Telstra SIM and configured for the Telstra spectrum bands, to measure signal on the currently connected band and to carry out data upload and download speed testing to a server operated by Telstra. The second module was fitted with an Optus SIM and configured for the Optus spectrum bands, to measure signal on the currently connected band and to carry out data upload and download speed testing to a server operated by Optus. The third module was fitted with a Vodafone SIM and configured for the Vodafone spectrum bands, to measure signal on the currently connected band and to carry out data upload and download speed testing to a server operated by Vodafone. The fourth, fifth and sixth modules were fitted with Telstra SIMs and configured to measure the signal on separate Telstra spectrum bands: 700 MHz, 1800 MHz and 2600 MHz. These additional modules were not included in the results published in this report to provide a focus on the modules set to operate as handset equivalents.

Module configuration

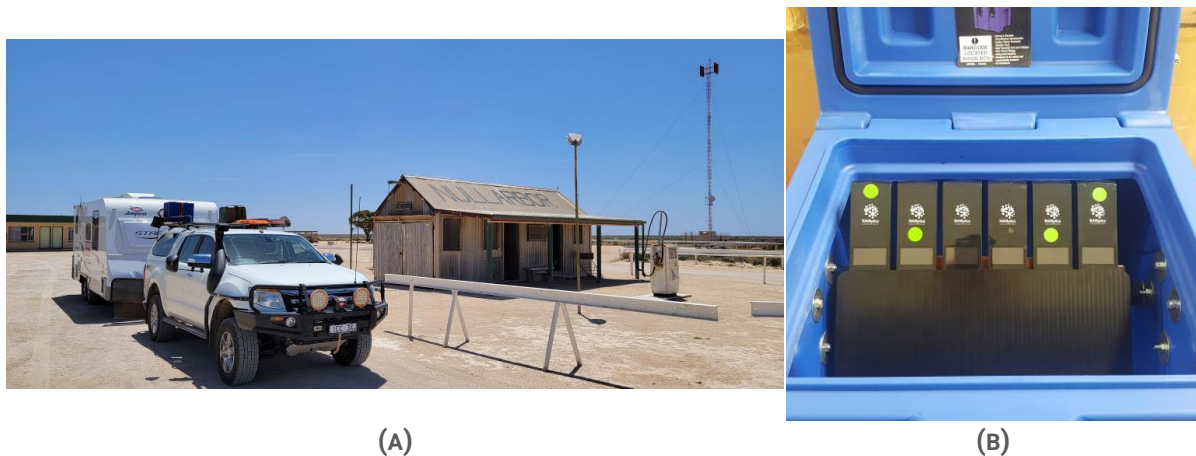


FIGURE 2 (A) VEHICLE (B) DATA COLLECTION EQUIPMENT

Data Analysis

The data was filtered to remove data elements that had invalid GPS, datetime or values outside the expected range for the parameter, e.g., negative download or upload values. It is estimated that less than half a per cent of the data elements captured in the regions included in this report were filtered during this process. The remaining data was analysed to identify mean and median values for the data elements within the selected regions. A box, with a mobile phone tower in the centre, was used to simplify the identification of the data elements to include.

Filter value range

- Data download and upload: 0-100 Mbps
- Reference Signals Received Power (RSRP)(dBm): lower than -180 was set to -180. RSRP is a measure of signal level for LTE networks.
- Signal to Interference Plus Noise Ratio (SINR)(dB): lower than -50 was set to -50. SINR is a measure of signal quality of wireless connections.
- Reference Signal Received Quality (RSRQ)(dB): less than -50 was set to -50. RSRQ is a measure of signal quality for modern LTE networks.
- Received Signal Code Power (RSCP)(dBm): lower than -125 was set to -125. This parameter is used to measure the strength of the received signal, especially in UMTS networks (3G).
- Downlink carrier-to-interference ratio (E_c/I_o)(dB): between 0 and -40. E_c/I_o is a measure of signal quality (3G).
- Received Signal Strength Indication (RSSI)(dBm): between 0 and -180. RSSI is a measure of the power of a received signal.

Measurements

In this section selected aggregated values of the filtered data are presented. The Mid West region of Western Australia was broken down into segments and each segment was visited two or three times during the study. The distances involved meant that the vehicle speed was 30 to 40 km/hr when travelling through towns and close to the speed limit when moving between towns.

Performance

The Internet performance required to utilise online services varies depending on the number of services being accessed at the same time and what the services are. For example, Netflix guidance states that “recommended internet download speeds for playing TV shows and movies on Netflix” are: High definition (HD): 720p 3 Mbps, Full high definition (FHD): 1080p 5 Mbps, and 4K/Ultra HD (UHD): 4K: 15 Mbps. Typical download requirements:

- Up to 25 Mbps: Email, social media, moderate video, web browsing
- 50 – 100 Mbps: add gaming and 4K streaming
- 150 to 200 Mbps: add sharing large files, virtual and augmented reality and live streaming video

The ratio of 10 (download) to 4 (upload), e.g, 100/40 Mbps, is a minimum recommended when backups, video conferencing, or interactive gaming are services routinely accessed.

Range guidance

Typical download speeds

Telstra 4GX category 6 devices 2 Mbps to 100 Mbps. Telstra 4GX category 4 devices 2 Mbps to 75 Mbps. Telstra 4G 2-50 Mbps. 3G 1.1 Mbps to 20 Mbps. 3.5G 1.1 Mbps to 42 Mbps.

4G signal strength values

	RSRP (dBm)	RSRQ (dB)	SINR (dB)	RSSI (dBm)
Excellent	>= 80	>= -10	>= 20	>= -65
Good	-80 to -90	-10 to -15	13 to 20	-65 to -75
Fair to Poor	-90 to -100	-15 to -20	0 to 13	-75 to -85
Poor				-85 to -95
No Signal	<= -100	<= -20	<= 0	<= -95

3G signal strength values

	RSCP (dBm)	Ec/Io (dBm)	RSSI (dBm)
Excellent	>= -60	>= -6	>= -75
Good	-60 to -75	-6 to -10	-75 to -80
Fair to Poor	-75 to -85	-10 to -15	-80 to -90
Poor	-85 to -125	-15 to -20	-90 to -112
No Signal	<= -125	<= -20	<= -112

Geraldton, Western Australia

Geraldton is the regional hub for the Mid West region of Western Australia and it is located about 424 kilometres north of Perth. The population of Geraldton is about 40,000.

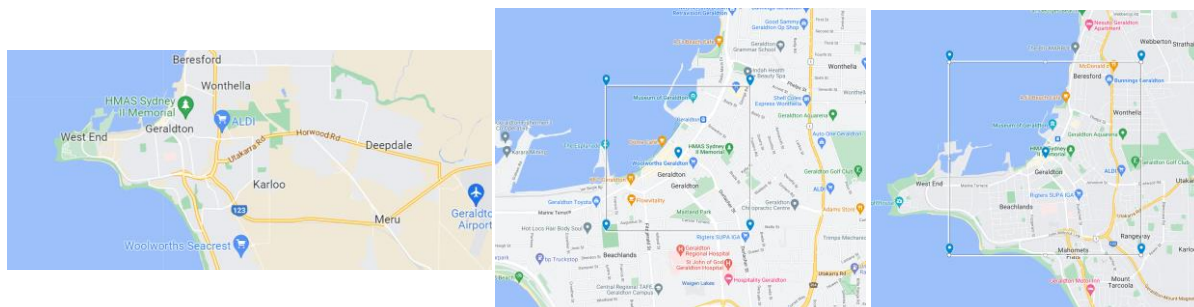


FIGURE 3 GERALDTON

TABLE 1 GERALDTON 750M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Geraldton	114.610552668, -28.773604673	750	(114.6182326,-28.76683746),(114.6182336,-28.78037145) (114.6028717,-28.78037145),(114.6028717,-28.76683746)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	18314	0	56699	15430	0	0	53079	14640	0
Telstra	18308	0	42534	3617	0	0	42464	4285	0
Vodafone	18325	0	26163	2384	0	0	18942	2246	0

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	32200	-13.8	30	14.59811	15.55
Telstra	33754	-20	21.4	6.507209	7
Vodafone	32198	-12.3	30	13.44149	13.4

Operator (UMTS)	Number of Records	UMTS RSCP			
		Min	Max	Mean	Median
Optus	NIL	NIL	NIL	NIL	NIL
Telstra	NIL	NIL	NIL	NIL	NIL
Vodafone	NIL	NIL	NIL	NIL	NIL

TABLE 2 GERALDTON 2000M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Geraldton	114.610552668, -28.773604673	2000	(114.6310304,-28.75555777),(114.6310374,-28.79164842) (114.5900679,-28.79164842),(114.590075,-28.75555777)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	33143	0	56699	13226	0	0	53079	12137	0
Telstra	33139	0	48445	5513	0	0	43448	4970	0
Vodafone	33164	0	26163	2261	0	0	20501	1961	0

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	189327	-20	30	9.757031	10.95
Telstra	184620	-20	29.9	5.702281	6.2
Vodafone	201667	-12.3	30	10.50608	11.1

Operator (UMTS)	Number of Records	UMTS RSCP			
		Min	Max	Mean	Median
Optus	2194	-112.63	0	-93.2389	-92.45
Telstra	NIL	NIL	NIL	NIL	NIL
Vodafone	NIL	NIL	NIL	NIL	NIL

Bluff Point, Western Australia

Bluff Point is a northern suburb of Geraldton Western Australia. Bluff Point is located about 5 km from central Geraldton and is located adjacent to the Chapman River.

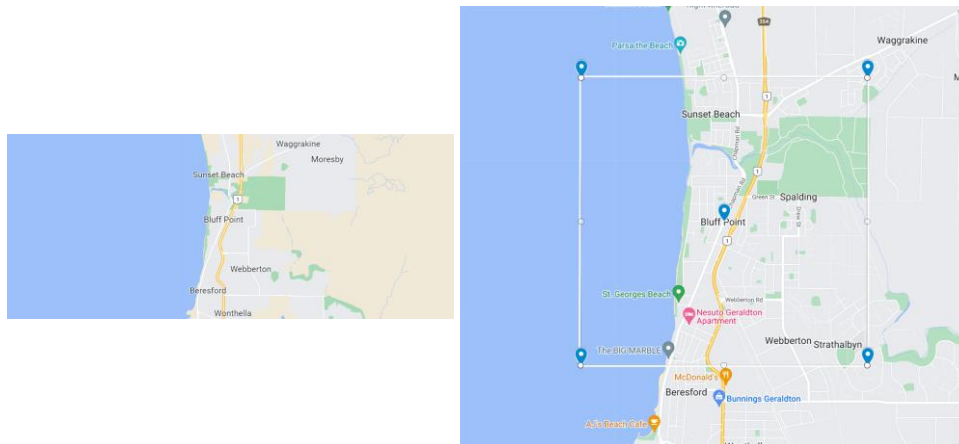


FIGURE 4 BLUFF POINT

TABLE 3 BLUFF POINT 2000M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Bluff Point	114.624914, -28.736727	2000	(114.6453845, -28.71868), (114.6453915, -28.75477085), (114.6044365, -28.75477085), (114.6044435, -28.71868)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	12860	0	51535	3420	0	0	45524	3508	2
Telstra	12869	0	42987	4111	13	0	41933	10479	2
Vodafone	12862	0	25422	201	0	0	19152	126	0

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	76888	-17.8	27.2	6.171436	5.95
Telstra	75425	-19.4	30	7.542885	6.8
Vodafone	71715	-17.2	29	4.959513	5.4

Operator (UMTS)	Number of Records	UMTS RSCP			
		Min	Max	Mean	Median
Optus	1783	-118.03	0	-93.3861	-93.25
Telstra	NIL	NIL	NIL	NIL	NIL
Vodafone	NIL	NIL	NIL	NIL	NIL

Dongara, Western Australia

Dongara is a beachside community about 73 km south of Geraldton Western Australia. Dongara is situated on the Brand Highway and located at the mouth of the Irwin River.

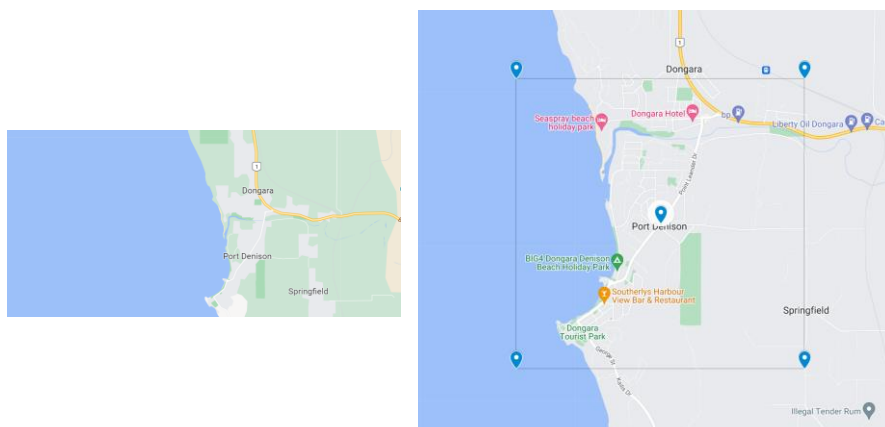


FIGURE 5 DONGARA

TABLE 4 DONGARA 2000M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Dongara	114.929152, -29.264412	2000	(114.9497267, -29.24636639), (114.9497339, -29.2824544), (114.9085701, -29.2824544), (114.9085773, -29.24636639)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	6442	0	56033	14510	71	0	53077	10613	138
Telstra	6457	0	46073	5974	134	0	48376	10477	14
Vodafone	6447	0	32765	4730	227	0	23882	3386	73.5

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	71620	-13.1	30	17.9834	18.85
Telstra	68114	-19.9	30	13.73526	14.5
Vodafone	79408	-9.5	30	22.05541	23.3

Operator (UMTS)	Number of Records	UMTS RSCP			
		Min	Max	Mean	Median
Optus	NIL	NIL	NIL	NIL	NIL
Telstra	NIL	NIL	NIL	NIL	NIL
Vodafone	NIL	NIL	NIL	NIL	NIL

Goodlands, Western Australia

Goodlands is a rural area bordering Lake Moore in the Shire of Dalwallinu on the border of the south eastern fringe of the Mid West and the region known as the Wheatbelt.

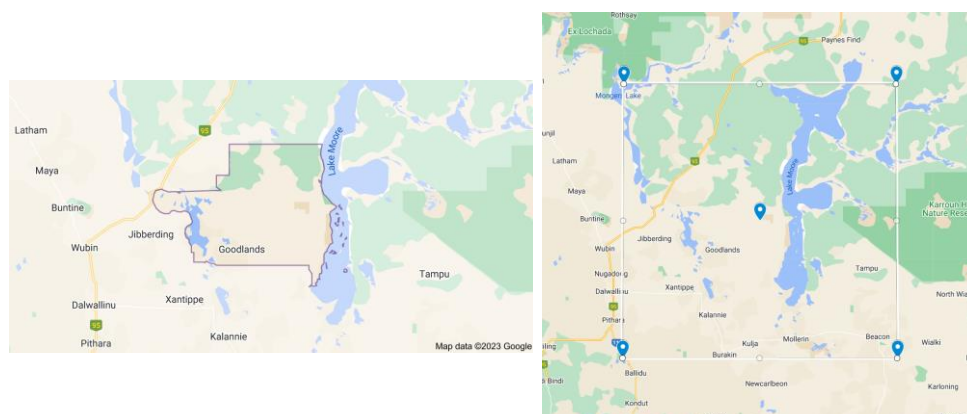


FIGURE 6 GOODLANDS

TABLE 5 GOODLANDS 60000M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Goodlands	117.335045, -29.995707	60000	(117.953525,-29.45297178),(117.9602729,-30.53546074) (116.7098171,-30.53546074),(116.716565,-29.45297178)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	4711	0	9860	17	0	0	4388	9	0
Telstra	4718	0	33175	2988	0	0	40732	4433	0
Vodafone	4722	0	0	0	0	0	0	0	0

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	7925	-20	20	-2.35885	-4.35
Telstra	34826	-20	15.3	-5.39938	-6.4
Vodafone	NIL	NIL	NIL	NIL	NIL

Operator (UMTS)	Number of Records	UMTS RSCP			
		Min	Max	Mean	Median
Optus	13266	-124.97	0	-107.886	-109.25
Telstra	NIL	NIL	NIL	NIL	NIL
Vodafone	NIL	NIL	NIL	NIL	NIL

Green Head, Western Australia

Green Head is a small coastal town about 136 km south of Geraldton on the southern fringe of the Mid West of Western Australia.

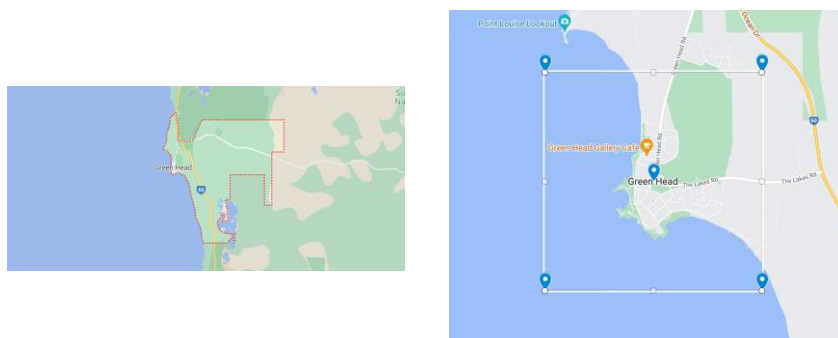


FIGURE 7 GREEN HEAD

TABLE 6 GREEN HEAD 1500M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Green Head	114.967973, -30.067471	1500	(114.9835277,-30.0539387),(114.9835319,-30.08100143) (114.9524141,-30.08100143),(114.9524183,-30.0539387)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	1256	0	52160	13141	103	0	50422	7221	177
Telstra	1256	0	40422	5943	89	0	41486	8471	81
Vodafone	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	19225	-11.4	30	21.36105	22.3
Telstra	18556	-4.4	30	18.55089	18.7
Vodafone	NIL	NIL	NIL	NIL	NIL

Operator (UMTS)	Number of Records	UMTS RSCP			
		Min	Max	Mean	Median
Optus	NIL	NIL	NIL	NIL	NIL
Telstra	NIL	NIL	NIL	NIL	NIL
Vodafone	NIL	NIL	NIL	NIL	NIL

Kalbarri, Western Australia

Kalbarri is a small coastal town located on the mouth of the Murchison River about 168 km north of Geraldton on the northern fringe of the Mid West of Western Australia.

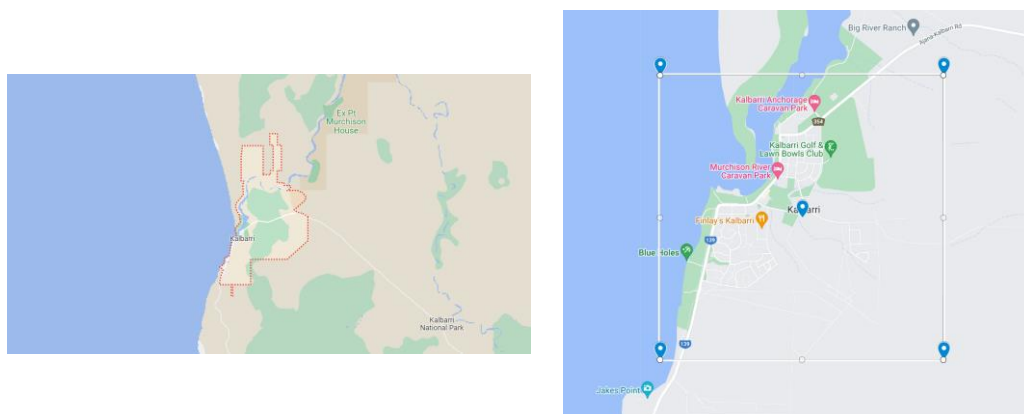


FIGURE 8 KALBARRI

TABLE 7 KALBARRI 2000M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Kalbarri	114.171089, -27.712549	2000	(114.1913652,-27.69449937),(114.1913719,-27.73059562) (114.1508061,-27.73059562),(114.1508128,-27.69449937)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	4414	0	52772	14713	207.5	0	51082	8905	144
Telstra	4404	0	42571	7295	228	0	47919	10709	46
Vodafone	4420	0	32995	5292	284	0	19626	3356	84

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	58769	-10.3	30	23.14706	23.45
Telstra	55504	-18.7	30	16.73144	18.7
Vodafone	73008	-11.8	30	14.22655	16.6

Operator (UMTS)	Number of Records	UMTS RSCP			
		Min	Max	Mean	Median
Optus	NIL	NIL	NIL	NIL	NIL
Telstra	NIL	NIL	NIL	NIL	NIL
Vodafone	NIL	NIL	NIL	NIL	NIL

Mullewa, Western Australia

Mullewa is a small farming town located about 98 km east-northeast of Geraldton in the Mid West of Western Australia.

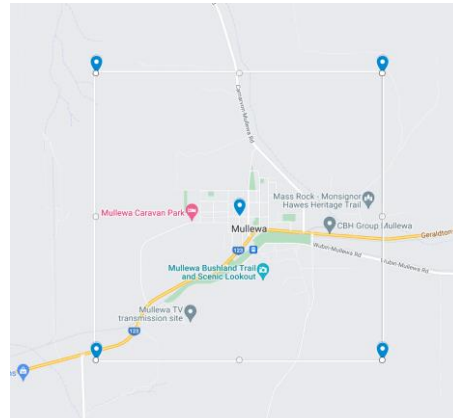


FIGURE 9 MULLEWA

TABLE 8 MULLEWA 2000M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Mullewa	115.510729, -28.53793	2000	(115.531161,-28.51988249),(115.5311679,-28.55597439) (115.4902901,-28.55597439),(115.490297,-28.51988249)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	4467	0	51026	8683	0	0	50030	5314	0
Telstra	4464	0	41975	7982	0	0	42591	8231	0
Vodafone	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	29182	-18.4	30	19.23626	19.95
Telstra	31836	-16.3	27.1	9.397122	8.4
Vodafone	NIL	NIL	NIL	NIL	NIL

Operator (UMTS)	Number of Records	UMTS RSCP			
		Min	Max	Mean	Median
Optus	1669	-90.84	0	-67.8107	-66.79
Telstra	NIL	NIL	NIL	NIL	NIL
Vodafone	NIL	NIL	NIL	NIL	NIL

Northampton, Western Australia

Northampton is a small town located on the North West Coastal Highway about 52 km north of Geraldton in the Mid West region of Western Australia.

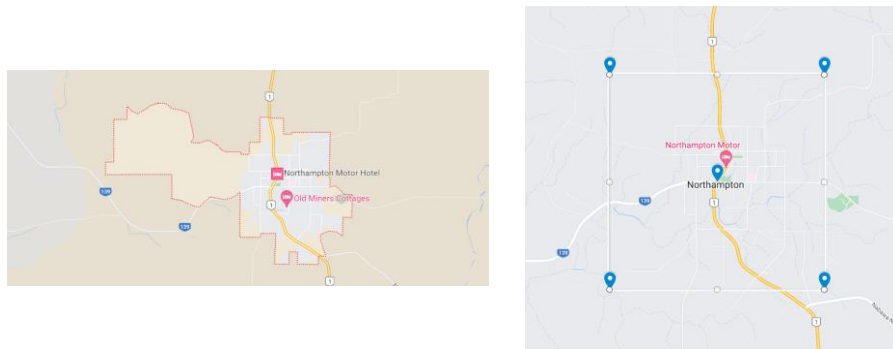


FIGURE 10 NORTHAMPTON

TABLE 9 NORTHAMPTON 1500M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Northampton	114.630202 -28.351969	1500	(114.6454999,-28.33843329),(114.6455038,-28.36550296) (114.6149002,-28.36550296),(114.6149041,-28.33843329)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	2175	0	54856	10743	99	0	51368	6134	248
Telstra	2163	0	40686	4609	215	0	34505	6062	69
Vodafone	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	48778	-7.7	30	16.13495	19.25
Telstra	43776	-18.1	25.4	9.013116	11
Vodafone	NIL	NIL	NIL	NIL	NIL

Operator (UMTS)	Number of Records	UMTS RSCP			
		Min	Max	Mean	Median
Optus	NIL	NIL	NIL	NIL	NIL
Telstra	NIL	NIL	NIL	NIL	NIL
Vodafone	NIL	NIL	NIL	NIL	NIL

Mid West, Western Australia

The Mid West region of Western Australia a geographic region north of Perth that borders the Wheatbelt, Goldfields – Esperance, Gascoyne and Pilbara regions of Western Australia. The Mid West showcases a space precinct, fishing, mining, agriculture and tourism in the region includes wild flowers, and outstanding natural sites.

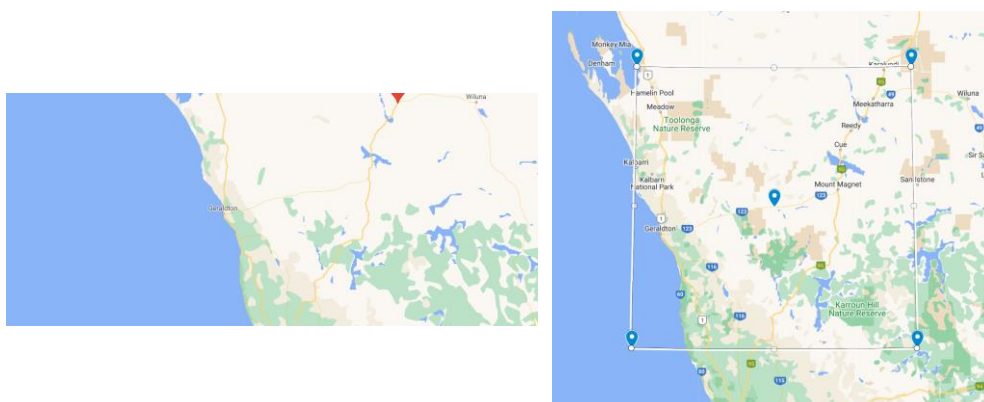


FIGURE 11 MID WEST

TABLE 10 MID WEST 250000M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Mid West	116.68287, -28.346174	250000	(119.1808644,-26.06721465),(119.2886746,-30.57666464) (114.0770654,-30.57666464),(114.1848756,-26.06721465)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	269385	0	56699	4469	0	0	53111	3282	0
Telstra	270957	0	48445	3739	0	0	49377	6421	0
Vodafone	270751	0	32995	717	0	0	24188	565	0

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	2245614	-20	30	8.862699	9.4
Telstra	3608801	-20	30	3.970383	3.8
Vodafone	830458	-20	30	7.840947	8.9

Operator (UMTS)	Number of Records	UMTS RSCP			
		Min	Max	Mean	Median
Optus	463631	-124.99	0	-103.036	-105.56
Telstra	NIL	NIL	NIL	NIL	NIL
Vodafone	NIL	NIL	NIL	NIL	NIL

Mid West (North West), Western Australia

The Mid West region of Western Australia a geographic region north of Perth that borders the Wheatbelt, Goldfields – Esperance, Gascoyne and Pilbara regions of Western Australia. The north west region showcases the square kilometer array telescope, fishing, agriculture, farming and tourism in the north west includes wild flowers, stromatolites, national parks and outstanding natural sites. The coastal areas include historical ship wrecks from the 17th century.

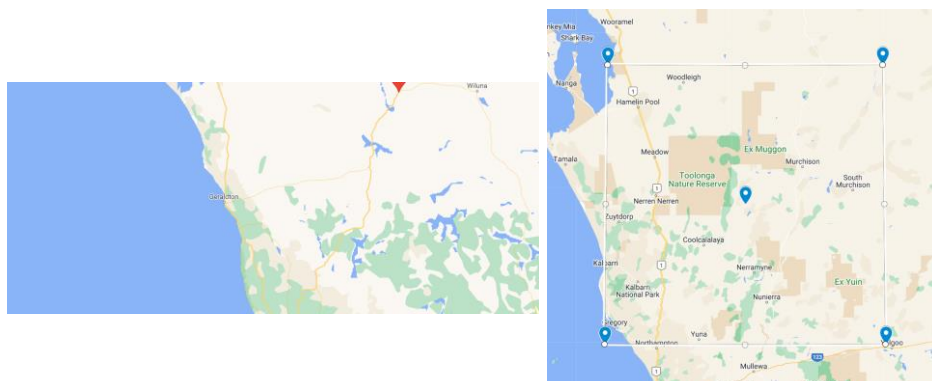


FIGURE 12 MID WEST (NORTH WEST)

TABLE 11 MID WEST (NORTH WEST) 125000M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Mid West (North West)	115.433872798, -27.1945771428	125000	(116.6829861,-26.06084667),(116.7083789,-28.31677106) (114.1593667,-28.31677106),(114.1847595,-26.06084667)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	17279	0	52772	4225	0	0	51082	2380	0
Telstra	17279	0	42571	3640	0	0	47919	5358	0
Vodafone	17301	0	32995	1341	0	0	24188	822	0

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	141011	-19.1	30	7.37625	5.4
Telstra	213864	-20	30	7.058792	1.85
Vodafone	67590	-17.7	30	7.453227	18.7

Operator (UMTS)	Number of Records	UMTS RSCP			
		Min	Max	Mean	Median
Optus	62827	-124.81	0	-106.996	-106.47
Telstra	NIL	NIL	NIL	NIL	NIL
Vodafone	NIL	NIL	NIL	NIL	NIL

Mid West (South West), Western Australia

The Mid West region of Western Australia a geographic region north of Perth that borders the Wheatbelt, Goldfields – Esperance, Gascoyne and Pilbara regions of Western Australia. The south west showcases fishing, rock lobster industry, a space precinct, mining, natural gas fields, agriculture and tourism in the region includes wild flowers, and coastal tourism.

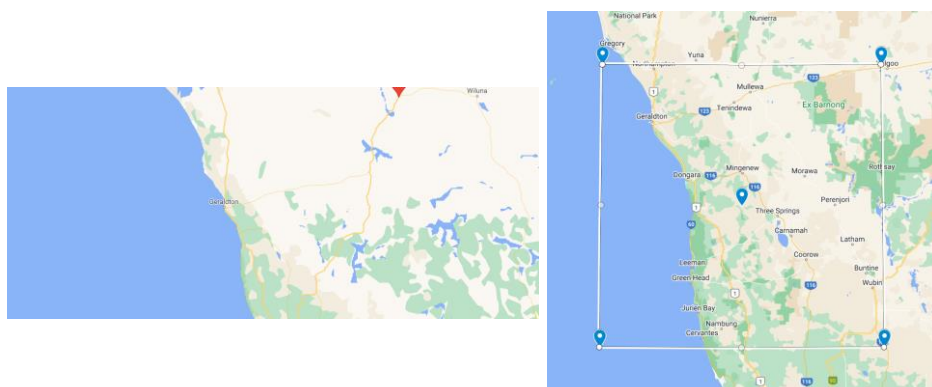


FIGURE 13 MID WEST (SOUTH WEST)

TABLE 12 MID WEST (SOUTH WEST) 125000M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Mid West (South West)	115.433872798, -29.4493021405	125000	(116.7083624,-28.31539252),(116.7368574,-30.57054837) (114.1308882,-30.57054837),(114.1593832,-28.31539252)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	191136	0	56699	5820	0	0	53111	4375	0
Telstra	192693	0	48445	4029	0	0	49377	6553	0
Vodafone	192004	0	32765	862	0	0	23882	701	0

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	1928535	-20	30	9.081701	9.6
Telstra	2809112	-20	30	3.785785	3.2
Vodafone	699078	-20	30	7.254025	8

Operator (UMTS)	Number of Records	UMTS RSCP			
		Min	Max	Mean	Median
Optus	384652	-124.99	0	-101.903	-105.165
Telstra	NIL	NIL	NIL	NIL	NIL
Vodafone	NIL	NIL	NIL	NIL	NIL

Mid West (North East), Western Australia

The Mid West region of Western Australia a geographic region north of Perth that borders the Wheatbelt, Goldfields – Esperance, Gascoyne and Pilbara regions of Western Australia. The north east showcases gold mining, farming and tourism in the region includes a historical townsite and natural sites.

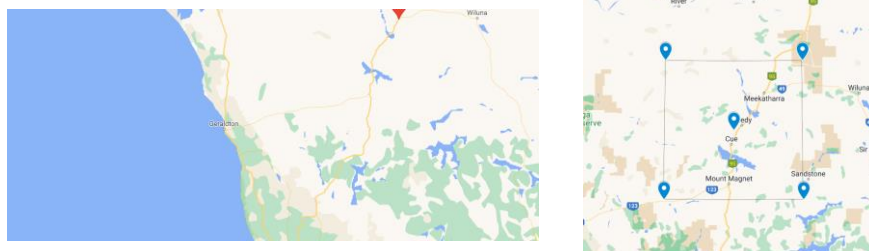


FIGURE 14 MID WEST (NORTH EAST)

TABLE 13 MID WEST (NORTH EAST) 125000M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Mid West (North East)	117.931867201, -27.1945771484	125000	(119.1809805,-26.06084667),(119.2063733,-28.31677106) (116.6573611,-28.31677106),(116.6827539,-26.06084667)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Telstra	51415	0	38773	2907	0	0	44295	6836	0
Vodafone	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	110749	-20	30	4.087014	7.8
Telstra	491916	-20	29.6	4.992753	7.9
Vodafone	NIL	NIL	NIL	NIL	NIL

Operator (UMTS)	Number of Records	UMTS RSCP			
		Min	Max	Mean	Median
Optus	NIL	NIL	NIL	NIL	NIL
Telstra	NIL	NIL	NIL	NIL	NIL
Vodafone	NIL	NIL	NIL	NIL	NIL

Mid West (South East), Western Australia

The Mid West region of Western Australia a geographic region north of Perth that borders the Wheatbelt, Goldfields – Esperance, Gascoyne and Pilbara regions of Western Australia. The south east showcases fossicking for gold, gold mining, agriculture, farming and tourism in the region includes national parks, wild flowers, and natural sites.

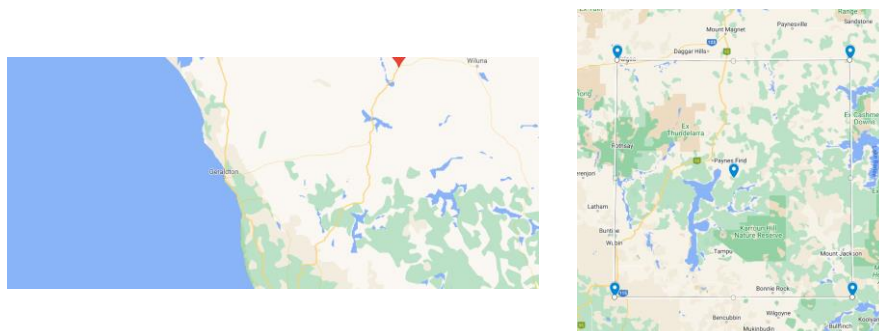


FIGURE 15 MID WEST (SOUTH EAST)

TABLE 14 MID WEST (SOUTH EAST) 125000M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Mid West (South East)	117.931867201, -29.4493021405	125000	(119.2063568, -28.31539252), (119.2348518, -30.57054837), (116.6288826, -30.57054837), (116.6573776, -28.31539252)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	10111	0	9860	8	0	0	4388	4	0
Telstra	10129	0	38712	3860	0	0	45122	4963	0
Vodafone	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	14767	-20	30	7.37901	2.4
Telstra	57949	-20	28.9	4.663359	-2.7
Vodafone	NIL	NIL	NIL	NIL	NIL

Operator (UMTS)	Number of Records	UMTS RSCP			
		Min	Max	Mean	Median
Optus	14059	-124.97	0	-107.891	-109.27
Telstra	NIL	NIL	NIL	NIL	NIL
Vodafone	NIL	NIL	NIL	NIL	NIL

Expectations

The mobile performance measurements presented in this report were for towns and communities in regional and remote regions. The study commenced with the expectation that mobile telecommunications performance in regional and remote areas, particularly within town boundaries, would be similar to that for urban areas. There are factors affecting mobile telecommunications performance, and it might be reasonable for a small performance differential between customer experience across the nation.

Ookla Speedtest measurements

The Ookla Speedtest measurements for the first half of 2022 are shown in Table 1. The comparison of 1,338,193 user-initiated tests identifies that over 98 per cent of the tests were carried out in Brisbane, Melbourne, and Sydney – locations with 5G, 4G and 3G. The Ookla Speedtest utilises a methodology provided on the Ookla website^v.

TABLE 15 Q1-Q2 OOKLA SPEEDTEST COMPARISON

	Median Download Speed, Mbps	Median Upload Speed, Mbps	Median Latency, ms
Overall	75.95	10.46	22
Telstra	81.57	11.38	23
Optus	75.27	9.08	21
Vodafone	59.15	9.71	22

In 2021, Ookla announced a move to utilise median values “because median is a better measure of everyday experience^{vi}. Median is less likely to be influenced by outlier values, and the introduction of 5G and gigabit internet can “mask the fact that not everyone’s internet is improving.”

The Ookla speedtest utilises a speedtest methodology that was designed to provide a measure of customer experience. The speedtest measures can be affected by the device and software used, the test server location and other factors.

The Q1-Q2 Ookla speedtest comparison is provided here as an indication of Australia’s mobile performance for the first half of 2022 and should not be used for a direct comparison with the speedtest values found during this study as the methodologies used to capture and analyse the speedtest data are not consistent and the study did not occur in areas with 5G.

Comparison

Table 16 provides the Ookla values, which are indicative of urban connection speeds and the Geraldton values, which are indicative of a major rural community. It should be noted that the Geraldton values only represent measurements taken near a mobile tower in the centre of Geraldton. The other point that should be noted is that the Ookla figures are median and the Geraldton figures are mean values. Normally the median values are more representative of user experience, however, as the aggregated Geraldton median values were 0, it is possibly helpful to reflect on the Ookla median values and the Geraldton median values. The process used by Ookla to collect and aggregate data is not available to the project team. It is possibly helpful to mention

that it is likely that most of Ookla’s speed tests were carried out by people who were stationary thus providing a better opportunity for the speed test to occur without the possible changes in signal experienced by a moving device. The greater majority of our speed tests were carried out with the vehicle moving at speeds above 30km/hr.

TABLE 16 CITY COUNTRY

	Ookla		Geraldton	
	Median Download Speed, Mbps	Median Upload Speed, Mbps	Mean Download Speed, Mbps	Mean Upload Speed, Mbps
Overall	75.95	10.46	7.14	7.06
Telstra	81.57	11.38	3.62	4.29
Optus	75.27	9.08	15.43	14.64
Vodafone	59.15	9.71	2.38	2.25

Analysis commentary

There is a large differential between the performance values reported by Ookla Speedtest (overwhelmingly urban) and the performance values identified for the eight selected towns and communities included in this report. The gap is significant and consistent. It is reasonable therefore to identify that the mobile telecommunications performance found in the eight towns and communities is significantly lower than what might be expected within town boundaries. The mobile telecommunications performance further diminished as the vehicle moved away from the town centres.

Conclusion

Mobile telecommunications is a fundamental requirement for an inclusive and connected society. In regional and remote areas, mobile telecommunications provides a vital role in connecting people and business with government services, particularly health and education. This study was motivated by the need to monitor mobile telecommunications performance in regional and remote areas, particularly in first nations towns and communities. This report provides aggregated mobile telecommunications performance values derived from data that was collected between 24 January to 3 April 2022 utilising a vehicle mounted measurement device.

This report includes a summary of the Ookla Speedtest measurements for the Australian mobile network operators for the first half of 2022. About 98 per cent of the Ookla Speedtests were carried out in major urban areas. A significant difference exists between the measurements taken during this study and the Ookla Speedtest measurements.

The mobile telecommunications performance within the town boundaries of the Mid West towns and suburbs included in this report was found to be far lower than what is experienced in urban areas. This outcome highlights that the digital divide remains a factor that negatively affects digital inclusion within the eight first nations towns and communities included in this report.

There is more work to do to bring mobile telecommunications performance in regional and remote areas closer to what is experienced in urban areas. It is recommended that the Government consider a minimum performance standard, especially for upload and download speeds, for telecommunications within town and community boundaries in regional and remote areas.

This report provides a study of mobile telecommunications performance within Mid West towns, suburbs and the entire Mid West region of Western Australia based on the data collected within the study area. This is in contrast with the Australian Competition and Consumer Commission's *Measuring Broadband Australia* monitoring program that only provides national aggregated performance measures for retail service providers that connect customers over the National Broadband Network.

Whilst national figures are important, it is considered important that customers are provided with telecommunication performance outcomes for their community and region.

The Government should consider funding the development of a low-cost mobile performance measurement solution that can be deployed by regions, towns and communities. The Government should also consider funding a national GIS based mobile performance data analysis system that is open to the public and can be used by regions, towns and communities to upload and analyse collected data would be a major national and international resource.

Acknowledgements

The Chief Investigator Associate Professor Mark Gregory would like to thank the other members of the team: Dr Khandakar Ahmed and Dr Syed Shah.



The study team wish to acknowledge the grant funding received from the auDA Foundation.

Public donations were received through the RMIT University philanthropic body and this support was appreciated by the study team.

The study was carried out in Western Australia during COVID-19. Support for the study to occur was timely and vital. The study team acknowledges and appreciates the support provided by:

Hon. Sandra Anne Carr MLC, Member for Agricultural Region, Western Australia

Goldfields Esperance Development Commission, Western Australia

Kimberley Development Commission, Western Australia

Mid West Development Commission, Western Australia

Department of Primary Industries and Regional Development, Western Australia

This study was supported by the Ranlytics CEO Mr Keith Sheridan with the loan of the Cerno™ RF measurement equipment, and access to the Ranlytics RF measurement data processing and reporting system. We wish to especially thank Mr Bradley Shapter, who provided guidance on how to configure and use the Cerno™ and liaised with the Ranlytics support and engineering teams.

ⁱ Regional Mobile Telecommunications Performance, 2021, Mark A Gregory, Journal of Telecommunications and the Digital Economy, Vol. 9 No. 3, pp. 170-185, <https://doi.org/10.18080/jtde.v9n3.444>

ⁱⁱ 2021 Regional Telecommunications Review, Australian Government, Accessed online at <https://www.rtirc.gov.au/>

ⁱⁱⁱ 2021 Regional Telecommunications Review Report, Australian Government, Accessed online at <https://www.infrastructure.gov.au/sites/default/files/documents/2021-rtirc-report-a-step-change-in-demand.pdf>

^{iv} Better Connectivity Plan for Regional and Rural Australia, Australian Government, Accessed online at <https://www.infrastructure.gov.au/media-communications-arts/better-connectivity-plan-regional-and-rural-australia>

^v Speedtest Awards™ Methodology, Ookla, Accessed online at <https://www.speedtest.net/awards/methodology>

^{vi} Improving the Speedtest Global Index with Data on Median Speeds, Ookla, Accessed online at <https://www.ookla.com/articles/global-index-median-announcement-2021>