

Mobile Telecommunications Performance Study

Digital Inclusion in First Nations Communities and Towns in
Regional and Remote Western Australia

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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 study focused on first nations communities and towns in regional and remote Western Australia. The study was carried out between 24 January and 3 April 2022 between Sydney, New South Wales and Kununurra, Western Australia.

This report provides 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.

The towns in New South Wales and Queensland were studied at a point in history when it was uncertain whether it would be possible to complete the original intent of 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	7
Module configuration	8
Data Analysis.....	8
Filter value range	8
Measurements	9
Value range guidance	9
Fitzroy Crossing, Western Australia	10
Halls Creek, Western Australia.....	12
Kununurra, Western Australia	14
Laverton, Western Australia	16
Leonora, Western Australia	18
Meekatharra, Western Australia	20
Cunnamulla, Queensland.....	22
Bourke, New South Wales	24
Expectations.....	26
Ookla Speedtest measurements.....	26
Analysis commentary	27
Conclusion.....	28
Acknowledgements	29

Figures

Figure 1 Data collection route.....	7
Figure 2 (a) Vehicle (b) Data collection equipment.....	8
Figure 3 Fitzroy Crossing	10
Figure 4 Halls Creek.....	12
Figure 5 Kununurra	14
Figure 6 Laverton	16
Figure 7 Leonora	18
Figure 8 Meekatharra	20
Figure 9 Cunnamulla.....	22
Figure 10 Bourke.....	24

Tables

Table 1 Fitzroy Crossing 750m.....	10
Table 2 Fitzroy Crossing 1500m.....	11
Table 3 Halls Creek 750m	12
Table 4 Halls Creek 1500m.....	13
Table 5 Kununurra 750m.....	14
Table 6 Kununurra 1500m.....	15
Table 7 Laverton 750m.....	16
Table 8 Laverton 1500m	17
Table 9 Leonora 750m	18
Table 10 Leonora 1500m	19
Table 11 Meekatharra 750m.....	20
Table 12 Meekatharra 1500m.....	21
Table 13 Cunnamulla 750m	22
Table 14 Cunnamulla 1500m.....	23
Table 15 Bourke 750m	24
Table 16 Bourke 1500m	25
Table 17 Q1-Q2 Ookla speedtest comparison.....	26

Introduction

A mobile performance study was completed in regional and remote Western Australia with a particular focus on first nations communities and towns with a large first nations population. 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.

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 will be included in future publications.

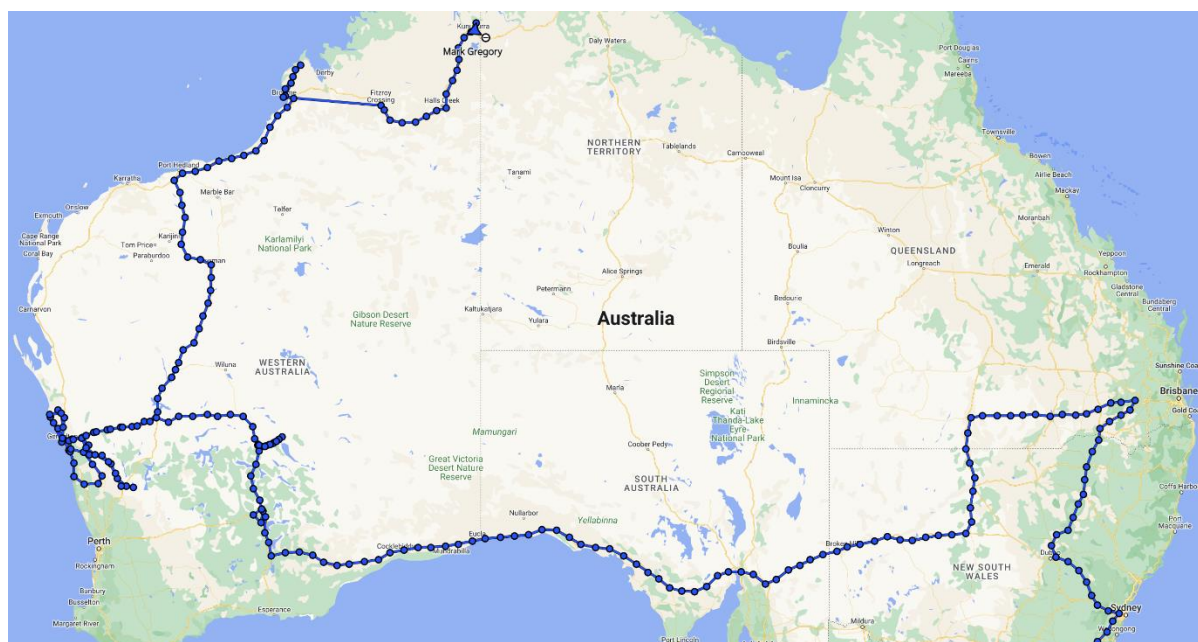


FIGURE 1 DATA COLLECTION ROUTE

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.

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 was 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. In each location a minimum of four 60 to 90 minute data measurement activities were carried out with the vehicle moving along streets at a speed between 30 to 40 km/hr using a grid pattern. This approach would not be dissimilar to the path taken by a postie vehicle delivering letters to premises.

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 7 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

Fitzroy Crossing, Western Australia

Fitzroy Crossing is a small town in the Kimberley region of Western Australia with a first nations population that is about 60% of the estimated 2,000 residents that is located on the Great Northern Highway 391 kilometres east of Broome and 647 kilometres south west of Kununurra. Study occurred between 24 to 27 March 2022.

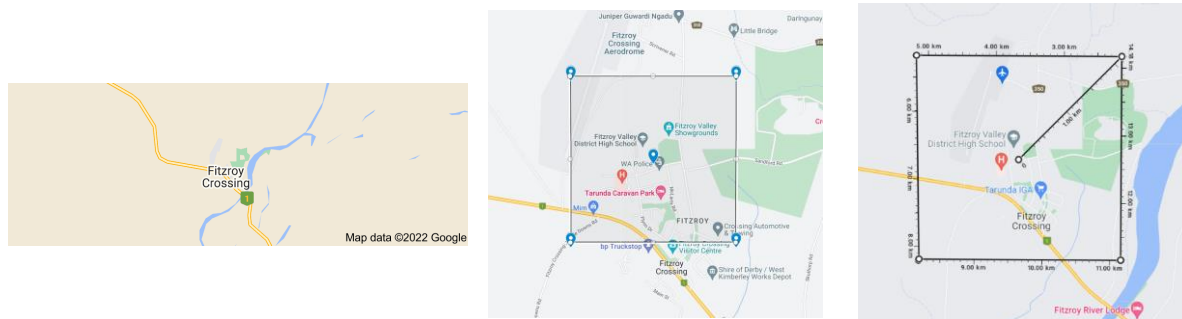


FIGURE 3 FITZROY CROSSING

TABLE 1 FITZROY CROSSING 750M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Fitzroy Crossing	125.5654865, -18.1895374	750	(125.572576,-18.182761) (125.572576,-18.196313) (125.558397,-18.196313) (125.558397,-18.182761)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	5187	0	0	0	0	0	0	0	0
Telstra	5195	0	38133	8126	241	0	42445	7876	136
Vodafone	5196	0	0	0	0	0	0	0	0

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	14318	-16.8	28.4	12.0857	14.2
Telstra	106395	-18.9	30.0	11.314409	13.65
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

TABLE 2 FITZROY CROSSING 1500M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Fitzroy Crossing	-18.1895374, 125.5654865	1500	(125.579664,-18.175985) (125.579666,-18.203089) (125.551306,-18.203089) (125.551309,-18.175985)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	11056	0	0	0	0	0	0	0	0
Telstra	10998	0	38384	7409	152	0	42445	7195	136.5
Vodafone	11079	0	0	0	0	0	0	0	0

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	31828	-16.8	28.4	12.97	14.3
Telstra	223026	-18.9	30.0	10.88	13.3
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

Halls Creek, Western Australia

Halls Creek is a small town in the Kimberley region of Western Australia with a first nations population that is about 75% of the estimated 4,100 residents that is located on the Great Northern Highway 685 kilometres east of Broome and 358 kilometres south west of Kununurra. Study occurred between 27 to 31 March 2022.

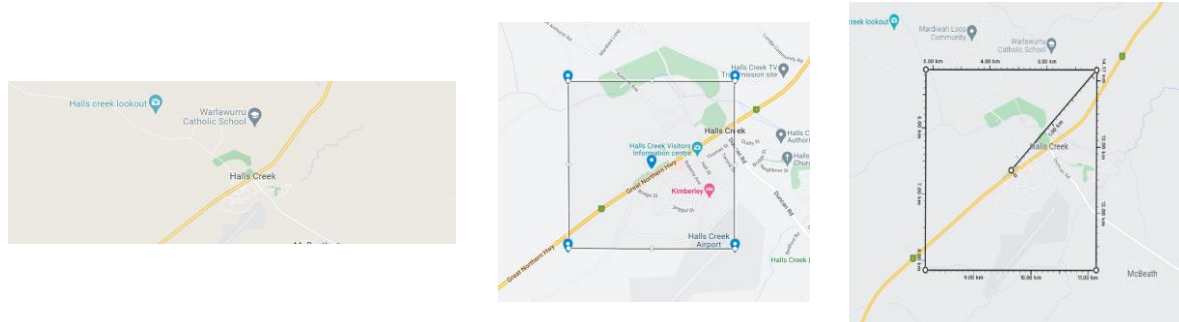


FIGURE 4 HALLS CREEK

TABLE 3 HALLS CREEK 750M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Halls Creek	-18.22611465, 127.6638203	750	(127.670911,-18.219338) (127.670911,-18.232891) (127.656729,-18.232891) (127.656730,-18.219338)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	17129	0	0	0	0	0	0	0	0
Telstra	16980	0	37961	2557	131	0	38547	6444	23
Vodafone	17060	0	0	0	0	0	0	0	0

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	34010	-20	28.5	12.76419	14.1
Telstra	230878	-17.1	27.3	14.20496	13.5
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

TABLE 4 HALLS CREEK 1500M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Halls Creek	-18.22611465, 127.6638203	1500	(127.678001,-18.212562) (127.678003,-18.239666) (127.649637,-18.239666) (127.649640,-18.212562)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	23179	0	0	0	0	0	0	0	0
Telstra	23023	0	37961	2283	119	0	38547	5945	18
Vodafone	23121	0	0	0	0	0	0	0	0

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	58607	-20	28.5	13.162	14.9
Telstra	419269	-17.1	27.3	12.73062	13.2
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

Kununurra, Western Australia

Kununurra is a small town in the Kimberley region of Western Australia with a first nations population that is about 35% of the estimated 5,000 residents and is located on the Great Northern Highway 1043 kilometres east of Broome. Study occurred between 31 March to 3 April 2022.

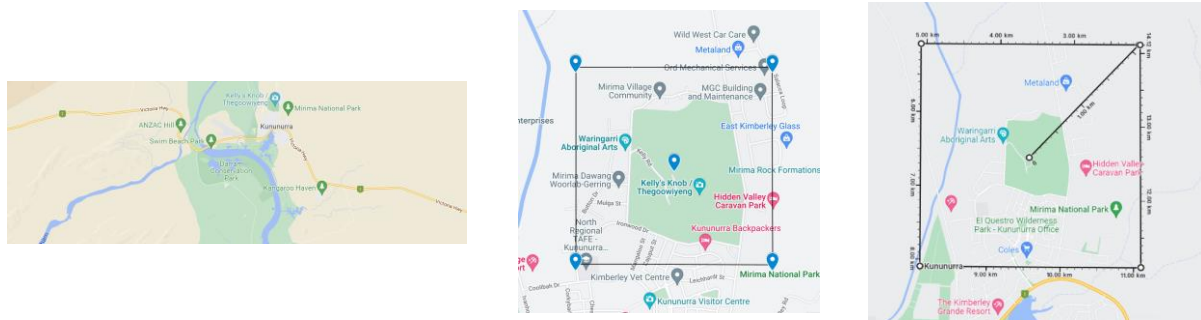


FIGURE 5 KUNUNURRA

TABLE 5 KUNUNURRA 750M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Kununurra	-15.76327985, 128.7407371	750	(128.747736,-15.756502) (128.747736,-15.770057) (128.733738,-15.770057) (128.733738,-15.756502)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	690	0	38396	5780	23	0	44235	5765	19
Telstra	992	0	29965	5254	48	0	26642	3478	112
Vodafone	691	0	14079	1068	24	0	17504	1385	12

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	33276	-15.8	28.1	9.835732	11.8
Telstra	38337	-19	27.3	10.84224	12.9
Vodafone	39700	-16	29.2	9.865758	12.05

Operator (UMTS)	Number of Records	UMTS RSCP			
		Min	Max	Mean	Median
Optus	4844	-111.24	0	-81.0321	-81.135
Telstra	NIL	NIL	NIL	NIL	NIL
Vodafone	NIL	NIL	NIL	NIL	NIL

TABLE 6 KUNUNURRA 1500M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Kununurra	-15.76327985, 128.7407371	1500	(128.754734,-15.749724) (128.754736,-15.776835) (128.726738,-15.776835) (128.726740,-15.749724)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	3112	0	38882	9025	24	0	44235	4549	33
Telstra	3936	0	32257	4674	23	0	29202	3393	33
Vodafone	3115	0	14874	1218	0	0	18430	1793	4

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	119960	-18.9	30	13.35106	13.9
Telstra	121076	-19.1	30	9.027716	11.8
Vodafone	141167	-16	30	11.43266	11.8

Operator (UMTS)	Number of Records	UMTS RSCP			
		Min	Max	Mean	Median
Optus	13080	-121.34	0	-82.2663	-82.5025
Telstra	NIL	NIL	NIL	NIL	NIL
Vodafone	NIL	NIL	NIL	NIL	NIL

Laverton, Western Australia

Laverton is a small town in the Northern Goldfields region of Western Australia with a first nations population that is about 40% of the estimated 1,000 residents and is located 359 kilometres north of Kalgoorlie and 124 kilometres east of Leonora. Study occurred between 19 to 23 February 2022.

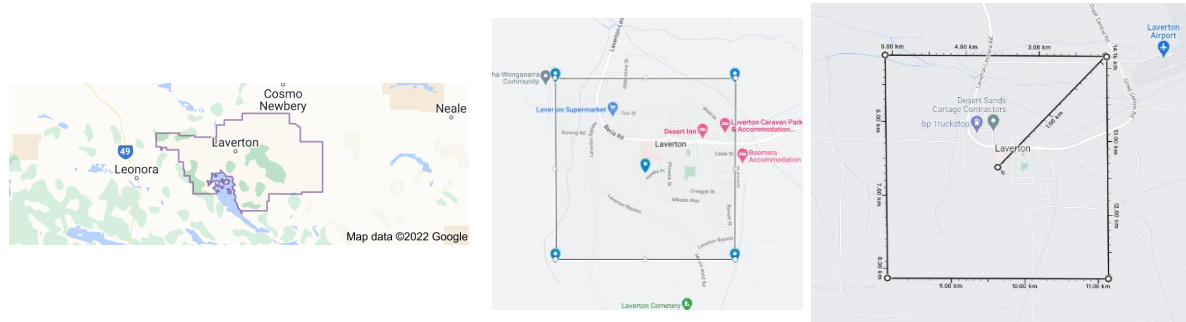


FIGURE 6 LAVERTON

TABLE 7 LAVERTON 750M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Laverton	-28.62810147, 122.3992711	750	(122.406940,-28.621334) (122.406941,-28.634868) (122.391601,-28.634868) (122.391602,-28.621334)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	2772	0	0	0	0	0	0	0	0
Telstra	2773	0	39787	1857	0	0	37155	3240	0
Vodafone	2771	0	0	0	0	0	0	0	0

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	10497	-3.5	30	20.19054	22.2
Telstra	22164	-9	30	14.77741	15.8
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

TABLE 8 LAVERTON 1500M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Laverton	-28.62810147, 122.3992711	1500	(122.414609,-28.614566) (122.414613,-28.641635) (122.383929,-28.641635) (122.383933,-28.614566)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	4522	0	0	0	0	0	0	0	0
Telstra	4521	0	39787	2243	0	0	39810	3785	0
Vodafone	4522	0	0	0	0	0	0	0	0

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	16164	-3.5	30	20.1526	21.3
Telstra	37075	-9	30	14.53272	14.5
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

Leonora, Western Australia

Leonora is a small town in the Northern Goldfields region of Western Australia with a first nations population that is about 30% of the estimated 1,500 residents and is located 235 kilometres north of Kalgoorlie. Study occurred between 19 to 23 February 2022.

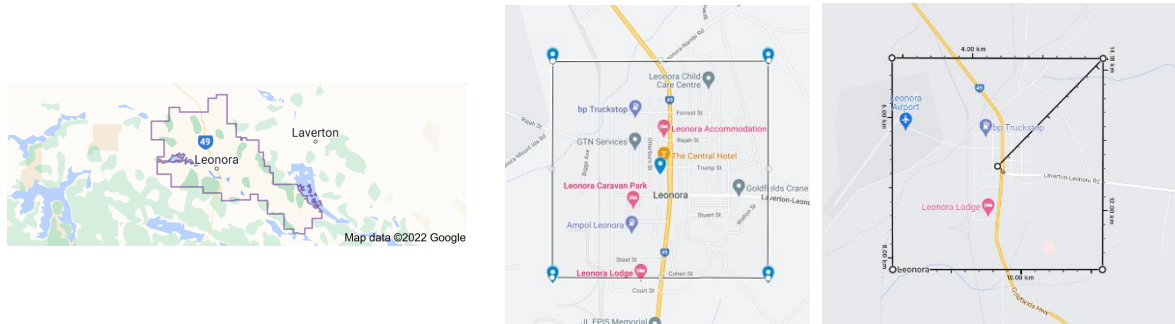


FIGURE 7 LEONORA

TABLE 9 LEONORA 750M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Leonora	-28.88370573, 121.3301439	750	(121.337832,-28.876939) (121.337833,-28.890472) (121.322455,-28.890472) (121.322456,-28.876939)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	13624	0	0	0	0	0	0	0	0
Telstra	13675	0	40299	2583	0	0	42521	6776	0
Vodafone	13534	0	0	0	0	0	0	0	0

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	28421	-17.4	27.1	8.852413	12
Telstra	57623	-15.9	30	9.610334	12.1
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

TABLE 10 LEONORA 1500M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Leonora	-28.88370573, 121.3301439	1500	(121.345519,-28.870171) (121.345523,-28.897239) (121.314765,-28.897239) (121.314769,-28.870171)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	18967	0	0	0	0	0	0	0	0
Telstra	19014	0	41803	2317	0	0	42521	5883	0
Vodafone	18879	0	0	0	0	0	0	0	0

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	48398	-17.4	27.1	8.93585	11.7
Telstra	108532	-15.9	30	8.958697	10.6
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

Meekatharra, Western Australia

Meekatharra is a small town on the Great Northern Highway in the Mid-West region of Western Australia with a first nations population that is about 50% of the estimated 1,000 residents and is located 757 kilometres north east of Perth, 535 kilometres east of Geraldton and 715 kilometres north west of Kalgoorlie. Study occurred between 10 to 13 March 2022.

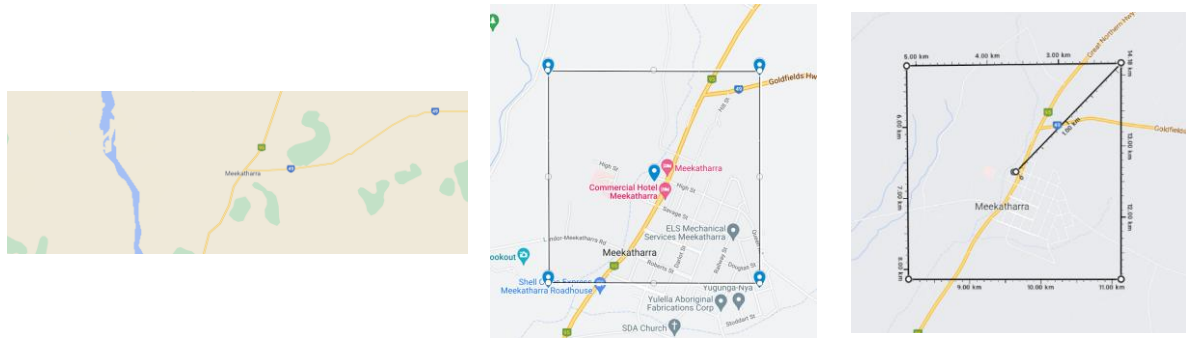


FIGURE 8 MEEKATHARRA

TABLE 11 MEEKATHARRA 750M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Meekatharra	-26.59117956, 118.4952955	750	(118.502824,-26.584410) (118.502825,-26.597948) (118.487766,-26.597948) (118.487767,-26.584410)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	14040	0	0	0	0	0	0	0	0
Telstra	14048	0	38773	4360	367.5	0	43859	12998	65
Vodafone	14439	0	0	0	0	0	0	0	0

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	23513	-18.2	27.1	10.26355	11.7
Telstra	106180	-19.5	28.9	11.06956	11.4
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

TABLE 12 MEEKATHARRA 1500M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Meekatharra	-26.59117956, 118.4952955	1500	(118.510352,-26.577640) (118.510356,-26.604717) (118.480235,-26.604717) (118.480239,-26.577640)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	19304	0	0	0	0	0	0	0	0
Telstra	19310	0	38773	4520	281	0	44295	12083	58
Vodafone	19708	0	0	0	0	0	0	0	0

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	38707	-19	27.1	10.05612	11.3
Telstra	181210	-19.5	28.9	10.85867	11.5
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

Cunnamulla, Queensland

Cunnamulla is a small town in the Shire of Paroo, Queensland with a first nations population that is about 45% of the estimated 1,250 residents and is located 750 kilometres west of Brisbane and 256 kilometres north of Bourke. Study occurred between 31 January to 2 February 2022.

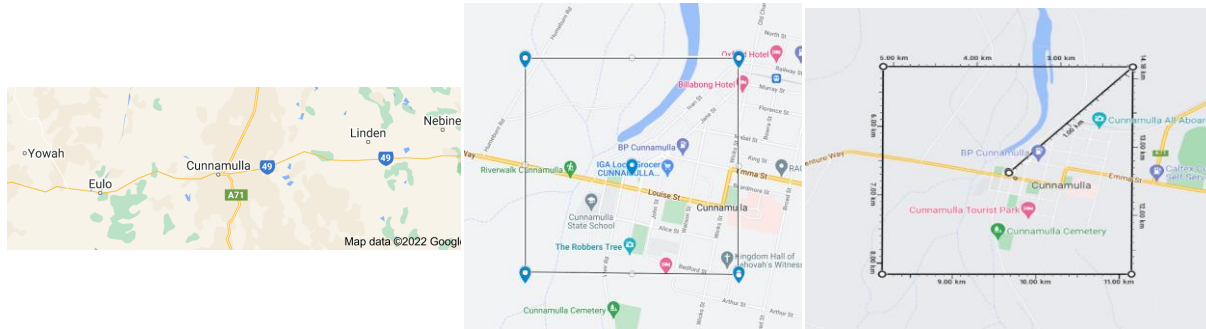


FIGURE 9 CUNNAMULLA

TABLE 13 CUNNAMULLA 750M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Cunnamulla	-28.06902844, 145.6817207	750	(145.689350,-28.062260) (145.689351,-28.075796) (145.674090,-28.075796) (145.674091,-28.062260)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	4817	0	78009	14764	0	0	58384	7736	0
Telstra	4829	0	53843	5341	0	0	47769	6611	0
Vodafone	6665	0	0	0	0	0	0	0	0

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	32549	-16.1	30	19.46053	20.8
Telstra	35723	-2.3	27.2	14.0743	15.3
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

TABLE 14 CUNNAMULLA 1500M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Cunnamulla	-28.06902844, 145.6817207	1500	(145.696978,-28.055492) (145.696982,-28.082563) (145.666459,-28.082563) (145.666463,-28.055492)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	8526	0	78009	13658	0	0	58384	7435	0
Telstra	8495	0	53843	4404	0	0	47769	6180	0
Vodafone	11463	0	0	0	0	0	0	0	0

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	55663	-16.1	30	19.50346	20.7
Telstra	63256	-7.1	27.2	13.10485	13.7
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

Bourke, New South Wales

Bourke is a town in the Bourke Shire, New South Wales with a first nations population that is about 35% of the estimated 2,500 residents and is located 800 kilometres north west of Sydney and 256 kilometres south of Cunnamulla. Study occurred between 2 to 4 February 2022.

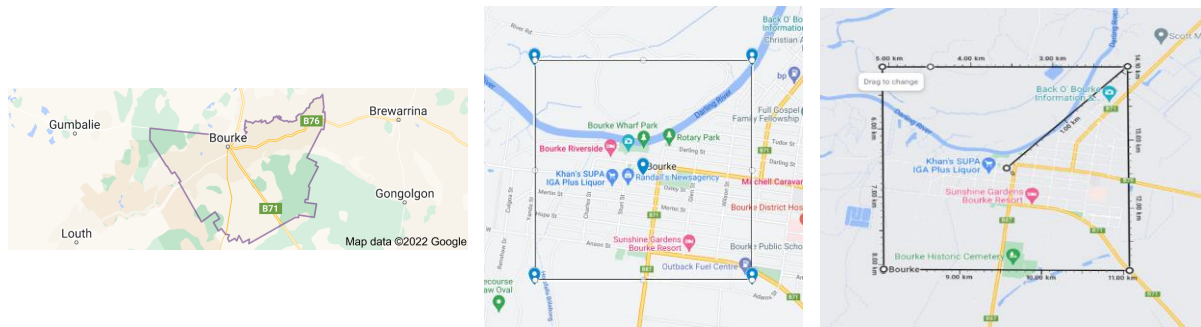


FIGURE 10 BOURKE

TABLE 15 BOURKE 750M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Bourke	-30.08939728, 145.9364217	750	(145.944201,-30.082631) (145.944202,-30.096163) (145.928641,-30.096163) (145.928642,-30.082631)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	5377	0	70518	7278	0	0	28534	3518	0
Telstra	5381	0	81521	9804	0	0	56442	8293	0
Vodafone	5379	0	0	0	0	0	0	0	0

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	54698	-15.7	30	17.74836	18.3
Telstra	49849	-17.8	30	14.78529	15.9
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

TABLE 16 BOURKE 1500M

Location	Central Coordinates (CC)	Distance from CC (m)	Bounding Polygon
Bourke	-30.08939728, 145.9364217	1500	(145.951980,-30.075865) (145.951984,-30.102928) (145.920859,-30.102928) (145.920864,-30.075865)

Operator	Number of Records	Download (Kbps)				Upload (Kbps)			
		Min	Max	Mean	Median	Min	Max	Mean	Median
Optus	17570	0	71142	5543	0	0	32701	2185	0
Telstra	17479	0	81521	10891	0	0	56442	7274	0
Vodafone	17571	0	0	0	0	0	0	0	0

Operator (LTE)	Number of Records	LTE SINR			
		Min	Max	Mean	Median
Optus	176539	-15.7	30	16.93182	17.4
Telstra	159682	-17.9	30	12.59268	14.7
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

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 17 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 18 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 Bourke median values were 0, it is possibly helpful to reflect on the Ookla median values and the Bourke 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 18 CITY COUNTRY

	Ookla		Bourke	
	Median Download Speed, Mbps	Median Upload Speed, Mbps	Mean Download Speed, Mbps	Mean Upload Speed, Mbps
Overall	75.95	10.46	5478	3153
Telstra	81.57	11.38	5543	2185
Optus	75.27	9.08	10891	7274
Vodafone	59.15	9.71	0	0

Analysis commentary

There is a large differential between the performance values reported by Ookla Speedtest 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 eight first nations towns and communities 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.

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.

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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>

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^{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>

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