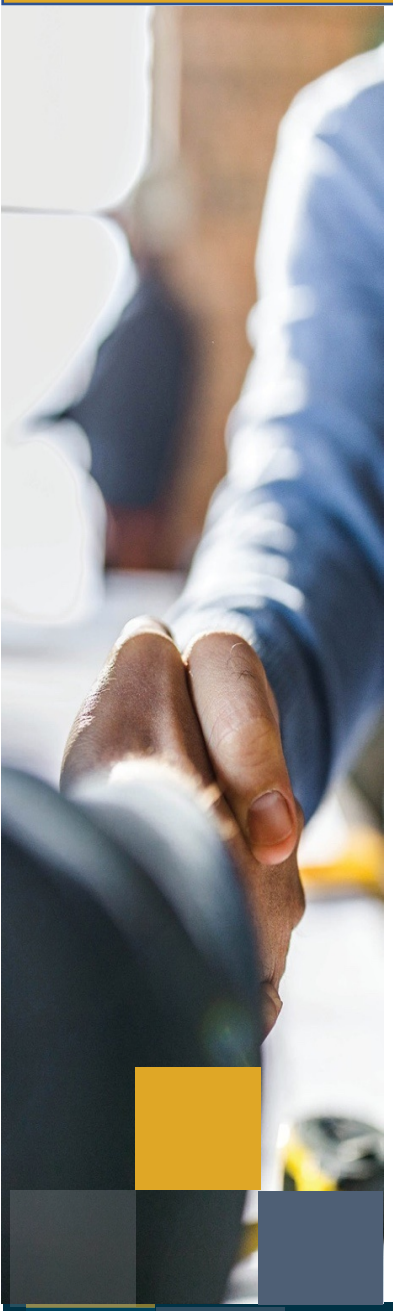


Mallee Region
Digital Infrastructure Advancement, Investment and Action Plan

What you'll find inside

1. Digital Connectivity Infrastructure Overview

Overview

All Australians deserve access to high-quality telecommunications networks.

Over the past 50 years, advances in telecommunications have transformed Australians' lives. Cashless payments, digital collaboration and videoconferencing are used so much that digital connectivity is now essential for everyday life and Australia's economic growth. Technological advances have turned homes into workplaces for millions of Australians.

Access to digital technology is a defining factor in people's ability to connect with friends, family, work and institutions, but there is a large gap across places and groups that must be addressed.

During the COVID-19 pandemic, Australia's digital infrastructure kept most people consistently connected, despite unprecedented network demand. Australia's telecommunications providers, regulators and governments acted decisively and effectively to ensure Australia could stay connected during the national lockdown that began in March 2020. At the height of the pandemic in 2020, digital services enabled businesses to continue operating and virtual alternatives to working in the office flourished.

While digital connectivity can unlock economic growth and connect people socially, the pandemic has highlighted significant challenges because of the nation's growing reliance on telecommunications.

Providing widespread terrestrial mobile coverage to regions is inherently difficult because Australia is so geographically vast. Over 99% of the population can receive a terrestrial mobile signal in their homes and neighbourhoods, but staying connected across Australia's regional places and remote roads remains a challenge.

The pandemic has had a considerable financial impact on the sector for reasons such as lost roaming revenues and accommodating customer hardship. Also, the ongoing costs of building new 5G networks in areas outside cities and towns mean funding for sites in remote areas is less certain. All levels of government need to consider how base stations in regional areas can be sustainably funded, approved and rented in the long term.

Why are rural and remote regions at risk? The possibilities enabled by 5G and IoT require significantly more capital than was the case for the moves to 4G from 3G, or 2G to 3G, principally because 5G cell density is much greater than previous mobile generations. With declining capital returns, telecommunications carriers in Australia have redoubled their focus on high density areas such as CBDs and inner-city as the target for profitable new network investment. By contrast, many lower density areas such as outer metropolitan Cities and regions still lack basic coverage. Federal policy has not been able to sufficiently drive market behavior to address these challenges, meaning in our view, that intervention is often needed, through advocacy, funding subsidies and streamlined access arrangements by state government and larger local governments.

A "digital divide" in outer-metro and regional Australia is a real risk, and will limit thousands of households, farms, small to medium businesses (SMBs) and communities, dilute new job creation and hamper "regionalisation" at a time when all CBDs face decline post COVID, and public safety and security services have

been recently challenged by natural disasters and pandemics.

We are also seeing the **emergence of innovations to connect cities and regions**, such as through network sharing and community-led initiatives, including new communication technologies and energy solutions.

Significant investment is required to provide the required digital connectivity infrastructure in rural and remote regions such as the Mallee Region. Other States have recognised that State Government funding support is required for digital connectivity co-investment, especially in rural and remote areas where government funding intervention is the only method that allows for infrastructure improvements in non-commercial environments.

Mobile Networks

Building and maintaining mobile network infrastructure is capital intensive and Mobile Network Operators (MNOs) face an ongoing infrastructure investment challenge. Mobile Networks involve capital investment and fixed operating costs which represent a significant proportion of the total costs to be borne by the industry and its customers.

As referenced by the ACCC, the high costs involved in expanding mobile network coverage and service quality is correlated to Australia's highly urbanised population, where revenues from the provision of mobile services to regional and rural customers diminish as population density decreases. These costs are further exacerbated by the need for MNOs to continually deploy new network technologies to market quickly, such as 5G, while earlier network investments become redundant (e.g. 3G).

The investment decision of expanding mobile network infrastructure is typically a function of –

1. The level of utilisation of mobile network infrastructure which impacts the business case for infrastructure investment and the ongoing cost of mobile service provision to recover such investment,
2. The nature of mobile service provision which requires MNOs to offer services and maintain network infrastructure across a wide coverage area that is inconsistent with customer utilisation of the network. Increasingly, customers expect to be able to access mobile services in rural and regional areas, including where they travel from urban areas to rural and regional areas,
3. Increased consumption of data as newer generations of mobile technology support more data intensive apps and services consume more bandwidth, meaning MNOs face continuing network investment demands after the initial deployment of new generations of mobile technology to address these capacity constraints.

Due to the low returns from building network infrastructure in sparsely populated regional and rural areas, the commercial incentives to roll out network infrastructure in these areas are typically lower than in metropolitan areas. Consequently, co-contribution funding is likely to be a key driver for MNOs when considering expanding mobile coverage. As a result, local, state and federal governments have developed co-contribution programs from time to time to provide subsidies to network operators to roll out infrastructure in these areas.

Co-contribution programs, like the Federal Mobile Black Spot Program (MBSP), provide incentives to invest in areas where there is either inadequate or no mobile coverage. However, the design of these programs often means that governments are generally subsidising the capital component of individual commercial entities without requiring broader benefits to be shared by consumers.

Mobile Network Operators

Telstra

Telstra supplies fixed and mobile voice and broadband services in Australia. Telstra also owns and operates its own mobile network, which covers around 99.5% of the Australian population.

Telstra plans to deliver 95% population coverage for 5G by FY25, which includes a 100,000 km2 increase in its 4G / 5G mobile footprint. This coverage will be supported by Telstra's continued 5G rollout and the doubling of metro cells to increase density for greater capacity and speed. As a result, Telstra expects 80% of all mobile traffic to be on 5G by FY25.

Telstra will extend its 4G coverage to 100% of its mobile network by June 2024, enabling it to lead in composite coverage, speed and performance for 4G and 5G as it closes the 3G network.

Optus

Optus supplies fixed and mobile voice and broadband services over its wholly owned and operated network. Optus has the second largest number of subscribers in mobile services and covers around 98.8% of the Australian population.

Optus planned to commence a network refresh from April 2022, under which it will reallocate its 2100 MHz spectrum assets (currently used to support 3G technology) to provide a better 4G network experience and provide for the growth of 5G.

TPG Telecom (Vodafone)

TPG merged with Vodafone on 13 July 2020 to be the third largest telecommunications provider in Australia, through the provision of fixed and mobile voice and broadband services.

TPG owns and operates its own 3G / 4G network in major metropolitan areas. Its coverage of 3G / 4G in regional and urban fringe Australia comprises approximately 725 sites and a 3G roaming agreement with Optus. TPG has made limited investments in regional Australia in recent years, focusing more on the 5G roll out in the metropolitan areas.

Spectrum Types Deployed

An MNO typically uses a range of radiofrequency spectrum bands for the purpose of providing mobile services. The spectrum an MNO deploys at each of its mobile sites is one of the factors that may impact end-user experience. Radiofrequency spectrum can be used across a variety of technologies including 3G, 4G and 5G and can also be repurposed or re-farmed over time to support a different technology. Generally, spectrum is classified into three categories – low band, mid-band and high band. Each band serves a different purpose in the MNOs' networks and the equipment at a mobile site can support the use of multiple bands at the same time.

Low band

- Radiofrequency bands less than 1 Gigahertz (GHz) or 1,000 Megahertz (MHz).
- Typically used by a mobile network to provide the primary coverage layer and also provides capacity.
- Can transmit information over greater distances and through obstacles such as buildings and trees more easily than higher frequencies. This means it is ideal for providing mobile services in

sparsely populated regional and remote areas. It also allows for the deployment of a smaller number of sites, as a given site provides coverage over a greater geographical area.

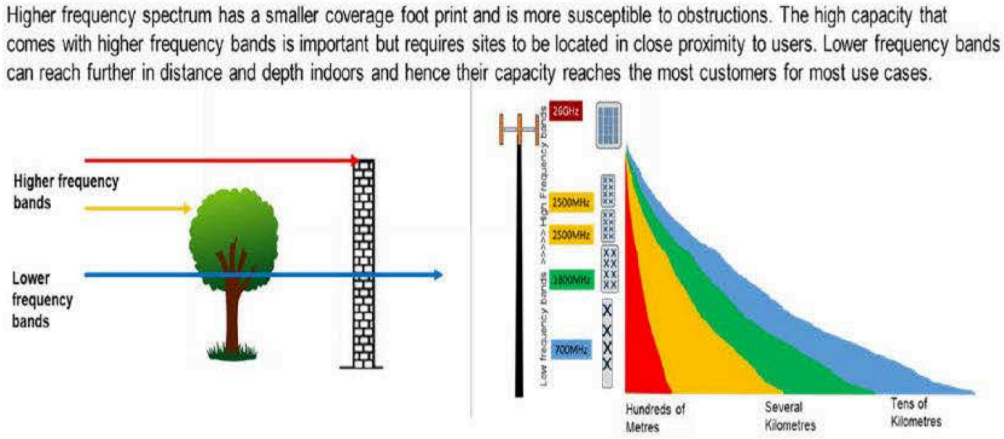
Mid-band

- Refers to radiofrequency bands between 1 GHz and 6 GHz.
- Typically deployed to supplement low-band spectrum.
- Information sent and received through mid-band spectrum can only occur over shorter distances than that of low band spectrum, meaning an MNO may need to build more sites when using this spectrum compared to low-band, to cover areas of the same size.
- Is likely to have a larger amount of spectrum available than in the low band, and hence a higher capacity, which makes it very useful in more populated and congested areas.

High band

- High band spectrum generally refers to radiofrequency bands greater than 6 GHz.
- The distances information can travel using high band spectrum is less than both low band and mid-band spectrum. The notable characteristic of this frequency band is that it delivers very short range, mainly line of sight coverage. This is combined with significant capacity, due the large amount of spectrum available, for very high-speed data transmission, making it ideal for use in heavy-traffic areas.

The capacity of a network depends on the quantity of spectrum available in a band, not on the frequency of that band. That is, the same quanta of spectrum in the low band can provide the same capacity as the same quanta of spectrum in the mid or high band. However, because larger amounts of spectrum are available in the higher bands those bands are likely to have greater capacity. As shown in the diagram below, low band spectrum is more important in regional and rural areas because its signal carries further and can penetrate obstacles, such as trees.



Each of the three MNOs have spectrum in the low band and mid band ranges in regional Australia, including parts of the Mallee Region, shown below

Spectrum Band	Telstra (MHz)	Optus (MHz)	TPG (MHz)
700 MHz	2 x 20	2 x 10	2 x 15
850 MHz	2 x 25	0	2 x 5
900 MHz (from July 2024)	0	2 x 25	0
1800 MHz	2 x 35 to 2 x 40	2 x 20 – 2 x 25	2 x 10 – 2 x 20
2100 MHz	2 x 10	2 x 5	2 x 5
2300 MHz	0	0	0
2600 MHz	2 x 40	2 x 20	0
3600 MHz	50 – 82.5	30 – 67.5	20 – 45
26000 MHz	1000	800	600

Telstra and TPG no longer offer 3G on their 2100 MHZ spectrum, while Optus has announced it will redeploy its 2100 MHz for use with 4G and 5G services in April 2022. Whilst focusing on expanding network and service offerings on the 4G and 5G networks, all three MNOs will continue to offer 3G services using lower frequency spectrum (such as 900 MHz). Telstra has announced that it plans to switch off its 3G services in June 2024. The spectrum that TPG uses for 3G services expires in June 2024.

Telstra TPG Network Sharing Agreement

Telstra and TPG Telecom have announced a ten-year regional Multi-Operator Core Network (MOCN) commercial agreement, which will provide TPG Telecom subscribers with 4G and 5G services within a defined coverage zone across regional and urban fringe areas.

Under the deal TPG Telecom will gain access to around 3,700 of Telstra's mobile network assets, increasing TPG Telecom's current 4G coverage from around 96 per cent to 98.8 per cent of the population.

Telstra will gain access to TPG Telecom's spectrum across 4G and 5G, which will allow it to grow its network, increase capacity and continue to provide the country's largest and fastest network.

Under the MOCN arrangement Telstra will share its Radio Access Network (RAN) for 4G and subsequently 5G services in the defined coverage zone, however both carriers will continue to operate their own core network where key differentiating functionality resides.

Telstra will also obtain access to and deploy infrastructure on up to 169 TPG Telecom existing mobile sites, improving coverage for TPG and Telstra customers in the zone.

The three mobile providers (Telstra, Optus and TPG Telecom (Vodafone)) are operating in a competitive and profitable part of the telecommunications market and they invest more in their mobile technology than in any other area since the advent of the NBN. This market changes technology platforms increasingly often (3G, 4G and now 5G) to meet market demand for data driven services for smart phones and tablets. The current significant investment in the rollout of 5G technology from 2019 will deliver significantly faster download speeds (greater than 200Mb/s) to mobile devices. Many in the industry consider the advent of 5G services will support many broadband demand requirements and reduce the demand for fixed services such as those delivered by the NBN.

While this potential competition with the NBN is speculative, it will be a potentially valuable alternative to NBN services, especially where they offer limited access technology options.

In order to deliver 5G services, many more base stations are needed due to propagation limitations and to conserve radio spectrum and this expensive development of service providers' networks will probably not be economic in some regional areas due to the poor economies of scale.

National Broadband Network

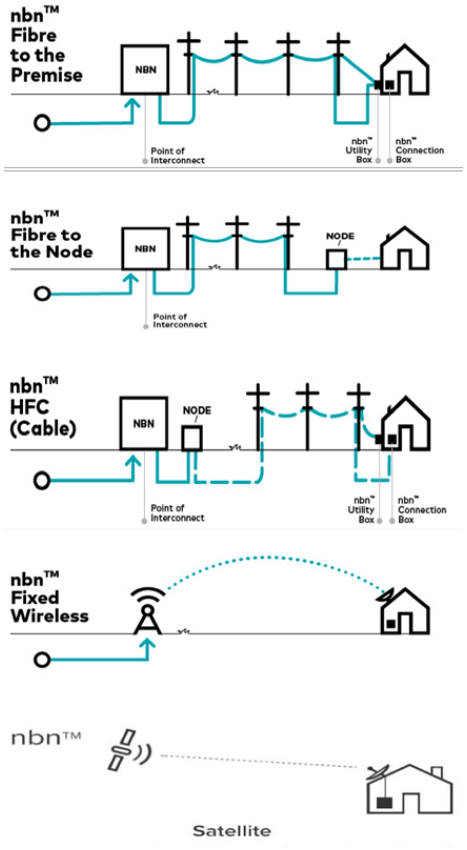
The NBN offers a range of connectivity technology to residential and business premises in Australia. Fibre to the Premise (FttP) offers the highest speed connection and is deployed in several select areas within the Mallee Region. Fibre to the Basement (FttB), Fibre to the Curb (FttC) and Fibre to the Node utilises existing copper cables to connect into the residential and business premises to save the cost of lead-in fibre cabling and as a result have some limitation on connection speed. For broad areas of the Mallee region, fixed wireless connections to premises will be used to avoid cabling costs to or near the premises. For the more remote areas of the region, the NBN satellite service will be the only available connection option.

As part its 2021–2024 Corporate Plan, NBN Co announced a $4.5 billion investment package. It allocated $3.5 billion to network upgrades, $700 million to improve business-grade fibre broadband and $300 million to improve fixed broadband in regional Australia.

Under the plan, the highest NBN wholesale speed tier of up to 1 Gbps will be made available to around 75% of homes and businesses on the fixed-line network by 2023.
NBN Co will enable further upgrades in many communities that are already serviced by Fibre to the Node (FTTN) technology. This will enable customers in these communities to upgrade to a Fibre to the Premises (FTTP) connection allowing them to access faster service speeds when they order a higher- speed plan.

NBN Co expects to extend fibre past around two million FTTN premises by the end of 2023. It will also invest in newer technologies in its Hybrid Fibre Coaxial (HFC) and Fibre to the Curb (FTTC) networks that will enable premises on these networks to order speeds of up to 1 Gbps.

The NBN fixed wireless network now comprises 2,200 towers and 13,000 cells, providing coverage to 250,000 km2. This is 3% of Australia's total geographic landmass and covers 610,000 premises.
To complement this coverage, two Sky Muster satellites cover more than 7 million km2, providing access for around 400,000 premises



Fibre Infrastructure (Backhaul)

Backhaul refers to the connections from the region to the rest of Australia, and a lack of competition in backhaul choice has in the past been a major contributor to the higher cost of telecommunications services in regional areas in Australia, however this situation has largely been eliminated by the National Broadband Network. However, backhaul is still important for increasing choice and access to non NBN connectivity especially for 'last mile' telecommunications options.

In Mallee region there is predominantly only one backhaul provider able to connect the region to Melbourne, Adelaide and Sydney, being Telstra InfraCo.

Adequate and competitive backhaul will become more crucial for the future of the NBN and 5G and for ensuring growing regional communities are well served with telecommunication services.

2. Current State Digital Infrastructure

Current State Analysis

The following tables and maps show the telecommunications infrastructure as currently available for major townships in each of the Council areas within the Mallee region.
Where any infrastructure is either not available or not fit for purpose, this constitutes the gaps in telecommunications and connectivity that impacts the economic capability and social fabric of that particular area of the Mallee.

Community	nbn	TELSTRA	OPTUS	tpg TELECOM	Telstra InfraCo	VOCUS	VicTrack		LoRaWAN	sigfox
Mildura	Fibre to the Premise Fibre to the Curb Fibre to the Node Fixed WIreless	5G 3600MHz 4G 700MHz 1800MHz 2100MHz 2600MHz 3G 850MHz	4G 900MHz 1800MHz 2100MHz 2600MHz 3G 900MHz 2100MHz	4G 850MHz 2100MHz 3G 900MHz	☑	☑	-	☑	-	☑
Swan Hill	Fibre to the Premise Fibre to the Node	5G 3600MHz 4G 700MHz 1800MHz 2100MHz 2600MHz 3G 850MHz	4G 900MHz 1800MHz 2100MHz 2600MHz 3G 900MHz 2100MHz	4G 850MHz 3G 900MHz 2100MHz	☑	☑	-	☑	-	-
Kerang	Fibre to the Premise Fibre to the Node Fixed Wireless	4G 700MHz 1800MHz 3G 850MHz	4G 900 MHz 1800MHz 2600MHz 3G 900MHz 2100MHz	4G 850MHz 3G 900MHz	☑	☑	-	☑	-	-

Community	nbn	TELSTRA	OPTUS	tpg TELECOM	Telstra InfraCo	VOCUS	VicTrack		LoRaWAN	sigfox
Red Cliffs	Fibre to the Premise Fibre to the Node Fixed Wireless	5G 3600MHz 4G 700MHz 1800MHz 2100MHz 2600MHz 3G 850MHz	4G 900MHz 1800MHz 2600MHz 3G 900MHz 2100MHz	4G 850MHz 3G 900MHz	☑	-	-	☑	-	-
Robin Vale	Fibre to the Node Fixed Wireless	4G 700MHz 2600MHz 3G 850MHz	4G 900MHz 2100MHz 2600MHz 3G 900MHz 2100MHz	4G 850MHz 3G 900MHz	☑	-	-		-	-
Cohuna	Fibre to the Curb Fibre to the Node Fixed Wireless	4G 700MHz 1800MHz 3G 850MHz	4G 900Mhz 2600MHz 3G 900MHz 2100MHz	3G 900MHz	☑	-	-		-	-
Donald	Fibre to the Curb Fixed Wireless	4G 700MHz 3G 850MHz	4G 900Mhz 2600MHz 3G 900MHz	-	☑	-	-		-	-
Ouyen	Fibre to the Curb Fibre to the Node Satellite	4G 700MHz 3G 850MHz	4G 900Mhz 1800MHz 2600MHz 3G 900MHz	-	☑					

Community	nbn	TELSTRA	OPTUS	tpg TELECOM	Telstra InfraCo	VOCUS	VicTrack		LoRaWAN	sigfox
Charlton	Fibre to the Node Satellite	4G 700MHz 1800MHz 3G 850MHz	3G 900MHz	-	☑					
Lake Boga	Fixed Wireless	5G 3600MHz 4G 700MHz 1800MHz 2100MHz 2600MHz 3G 850MHz	4G 900MHz 1800MHz 2600MHz 3G 900MHz 2100MHz	4G 850MHz 3G 900MHz	☑					
Sea Lake	Satellite	4G 700MHz 3G 850MHz	4G 900MHz 2600MHz 3G 900MHz	-	☑					
Birchup	Fixed Wireless	4G 700MHz 3G 850MHz	3G 900MHz	-	☑					
Wycheproof	Fixed Wireless	4G 700MHz 1800MHz 3G 850MHz	4G 900MHz 2600MHz 3G 900MHz	-	☑					
Leitchville	Fixed Wireless	4G 700MHz 3G 850MHz	3G 900MHz 2100MHz	-	☑					

Mildura

In relation to NBN coverage, the City of Mildura (approx. population of 33,000) is predominantly serviced by NBN fibre to the curb and fibre to the node technologies. This level of NBN infrastructure will not be fit for purpose in the coming decade, which has been confirmed by NBN as Mildura has been announced for an upgrade to fibre to the premise infrastructure.
An initial LEO Satellite service from Starlink is available, albeit at a high access cost.
The city is serviced by Telstra 5G / 4G / 3G, Optus 4G / 3G and TPG Telecom (Vodafone) 4G/ 3G. Due to high visitor numbers and potentially other factors, network congestion is often experienced resulting in diminished levels of service quality and experience on all mobile networks.
In relation to Fibre Backhaul network access and Low Powered Wireless Access Networks (LPWANs), the city has access to a number of alternative choices to Telstra.

Swan Hill

In relation to NBN coverage, the City of Swan Hill (approx. population of 11,000) is predominantly serviced by NBN fibre to the node technology. This level of NBN infrastructure will not be fit for purpose in the coming decade as fibre to the premise technology provides a future proof and scalable outcome.
An initial LEO Satellite service from Starlink is available, albeit at a high access cost.
The city is serviced by Telstra 5G / 4G / 3G, Optus 4G / 3G and TPG Telecom (Vodafone) 4G/ 3G. Due to high visitor numbers and potentially other factors, network congestion is often experienced resulting in diminished levels of service quality and experience on all mobile networks.
In relation to Fibre Backhaul network access and Low Powered Wireless Access Networks (LPWANs), the city has access to a number of alternative choices to Telstra.

Kerang

In relation to NBN coverage, the township of Kerang (approx. population of 4,000) is predominantly serviced by NBN fibre to the node technology. This level of NBN infrastructure will not be fit for purpose in the coming decade as fibre to the premise technology provides a future proof and scalable outcome.
An initial LEO Satellite service from Starlink is available, albeit at a high access cost.
The township is serviced by Telstra 4G / 3G, Optus 4G / 3G and TPG Telecom (Vodafone) 4G / 3G. Due to high visitor numbers and potentially other factors, network congestion is often experienced resulting in diminished levels of service quality and experience on all mobile networks.
In relation to Fibre Backhaul network access and Low Powered Wireless Access Networks (LPWANs), the township has access to a number of alternative choices to Telstra.

Red Cliffs

In relation to NBN coverage, the township of Red Cliffs (approx. population of 5,000) is predominantly serviced by NBN fibre to the node technology. This level of NBN infrastructure will not be fit for purpose in the coming decade as fibre to the premise technology provides a future proof and scalable outcome.
An initial LEO Satellite service from Starlink is available, albeit at a high access cost.
The township is serviced by Telstra 5G / 4G / 3G, Optus 4G / 3G and TPG Telecom (Vodafone) 4G/ 3G. Due to high visitor numbers and potentially other factors, network congestion is often experienced resulting in diminished levels of service quality and experience on all mobile networks.
In relation to Fibre Backhaul network access and Low Powered Wireless Access Networks (LPWANs), the township does not have direct access to alternative choices to Telstra.

Robin Vale

In relation to NBN coverage, the township of Robin Vale (approx. population of 3,300) is predominantly serviced by NBN fibre to the node technology. This level of NBN infrastructure will not be fit for purpose in the coming decade as fibre to the premise technology provides a future proof and scalable outcome.
An initial LEO Satellite service from Starlink is available, albeit at a high access cost.
The township is serviced by Telstra 4G / 3G, Optus 4G / 3G and TPG Telecom (Vodafone) 4G/ 3G. Due to high visitor numbers and potentially other factors, network congestion is often experienced resulting in diminished levels of service quality and experience on all mobile networks.
In relation to Fibre Backhaul network access and Low Powered Wireless Access Networks (LPWANs), the township does not have direct access to alternative choices to Telstra.

Cohuna

In relation to NBN coverage, the township of Cohuna (approx. population of 2,500) is predominantly serviced by NBN fibre to the curb and fibre to the node technologies. This level of NBN infrastructure will not be fit for purpose in the coming decade as fibre to the premise technology provides a future proof and scalable outcome.
An initial LEO Satellite service from Starlink is available, albeit at a high access cost.
The township is serviced by Telstra 4G / 3G, Optus 4G / 3G and TPG Telecom (Vodafone) 3G only. Due to a range of factors, network congestion is often experienced resulting in diminished levels of service quality and experience on all mobile networks.
In relation to Fibre Backhaul network access and Low Powered Wireless Access Networks (LPWANs), the city does not have direct access to alternative choices to Telstra.

Donald

In relation to NBN coverage, the township of Donald (approx. population of 1,500) is predominantly serviced by NBN fibre to the curb technology. This level of NBN infrastructure will not be fit for purpose in the coming decade as fibre to the premise technology provides a future proof and scalable outcome.
An initial LEO Satellite service from Starlink is available, albeit at a high access cost.
The township is serviced by Telstra 4G / 3G, Optus 4G / 3G and no TPG Telecom (Vodafone) network access. Due to a range of factors, network congestion is often experienced resulting in diminished levels of service quality and experience on all mobile networks.
In relation to Fibre Backhaul network access and Low Powered Wireless Access Networks (LPWANs), the township does not have direct access to alternative choices to Telstra.

Ouyen

In relation to NBN coverage, the township of Ouyen (approx. population of 1,200) is predominantly serviced by NBN fibre to the curb and fibre to the node technologies. This level of NBN infrastructure will not be fit for purpose in the coming decade which has been confirmed by Connecting Victoria as Ouyen has been announced for an upgrade to fibre to the premise infrastructure.
An initial LEO Satellite service from Starlink is available, albeit at a high access cost.
The township is serviced by Telstra 4G / 3G, Optus 4G / 3G and no TPG Telecom (Vodafone) network access. Due to high visitor numbers and potentially other factors, network congestion is often experienced resulting in diminished levels of service quality and experience on all mobile networks.
In relation to Fibre Backhaul network access and Low Powered Wireless Access Networks (LPWANs), the township does not have direct access to alternative choices to Telstra.

Charlton

In relation to NBN coverage, the township of Charlton (approx. population of 1,000) is predominantly serviced by NBN fibre to the node technology. This level of NBN infrastructure will not be fit for purpose in the coming decade as fibre to the premise technology provides a future proof and scalable outcome.
An initial LEO Satellite service from Starlink is available, albeit at a high access cost.
The township is serviced by Telstra 4G / 3G, Optus 4G / 3G and no TPG Telecom (Vodafone) network access. Due to a range of factors, network congestion is often experienced resulting in diminished levels of service quality and experience on all mobile networks.
In relation to Fibre Backhaul network access and Low Powered Wireless Access Networks (LPWANs), the township does not have direct access to alternative choices to Telstra.

Lake Boga

In relation to NBN coverage, the township of Kerang (approx. population of 1,000) is serviced by NBN fixed wireless technology. This level of NBN infrastructure will not be fit for purpose in the coming decade as fibre to the premise technology provides a future proof and scalable outcome.
An initial LEO Satellite service from Starlink is available, albeit at a high access cost.
The city is serviced by Telstra 5G / 4G / 3G, Optus 4G / 3G and TPG Telecom (Vodafone) 4G/ 3G. Due to high visitor numbers and potentially other factors, network congestion is often experienced resulting in diminished levels of service quality and experience on all mobile networks.
In relation to Fibre Backhaul network access and Low Powered Wireless Access Networks (LPWANs), the city does not have direct access to alternative choices to Telstra.

Sea Lake

In relation to NBN coverage, the township of Kerang (approx. population of 650) is predominantly serviced by NBN satellite technology. This level of NBN infrastructure will not be fit for purpose in the coming decade which has been confirmed by the Commonwealth Government as Sea Lake has been announced for an upgrade to fibre to the premise infrastructure.
An initial LEO Satellite service from Starlink is available, albeit at a high access cost.
The township is serviced by Telstra 4G / 3G, Optus 4G / 3G and no TPG Telecom (Vodafone) network access. Due to a range of factors, network congestion is often experienced resulting in diminished levels of service quality and experience on all mobile networks.
In relation to Fibre Backhaul network access and Low Powered Wireless Access Networks (LPWANs), the township does not have direct access to alternative choices to Telstra.

Birchup

In relation to NBN coverage, the township of Birchup (approx. population of 700) is predominantly serviced by NBN fixed wireless technology. This level of NBN infrastructure will not be fit for purpose in the coming decade as fibre to the premise technology provides a future proof and scalable outcome.
An initial LEO Satellite service from Starlink is available, albeit at a high access cost.
The township is serviced by Telstra 4G / 3G, Optus 4G / 3G and no TPG Telecom (Vodafone) network access. Due to a range of factors, network congestion is often experienced resulting in diminished levels of service quality and experience on all mobile networks.
In relation to Fibre Backhaul network access and Low Powered Wireless Access Networks (LPWANs), the township does not have direct access to alternative choices to Telstra.

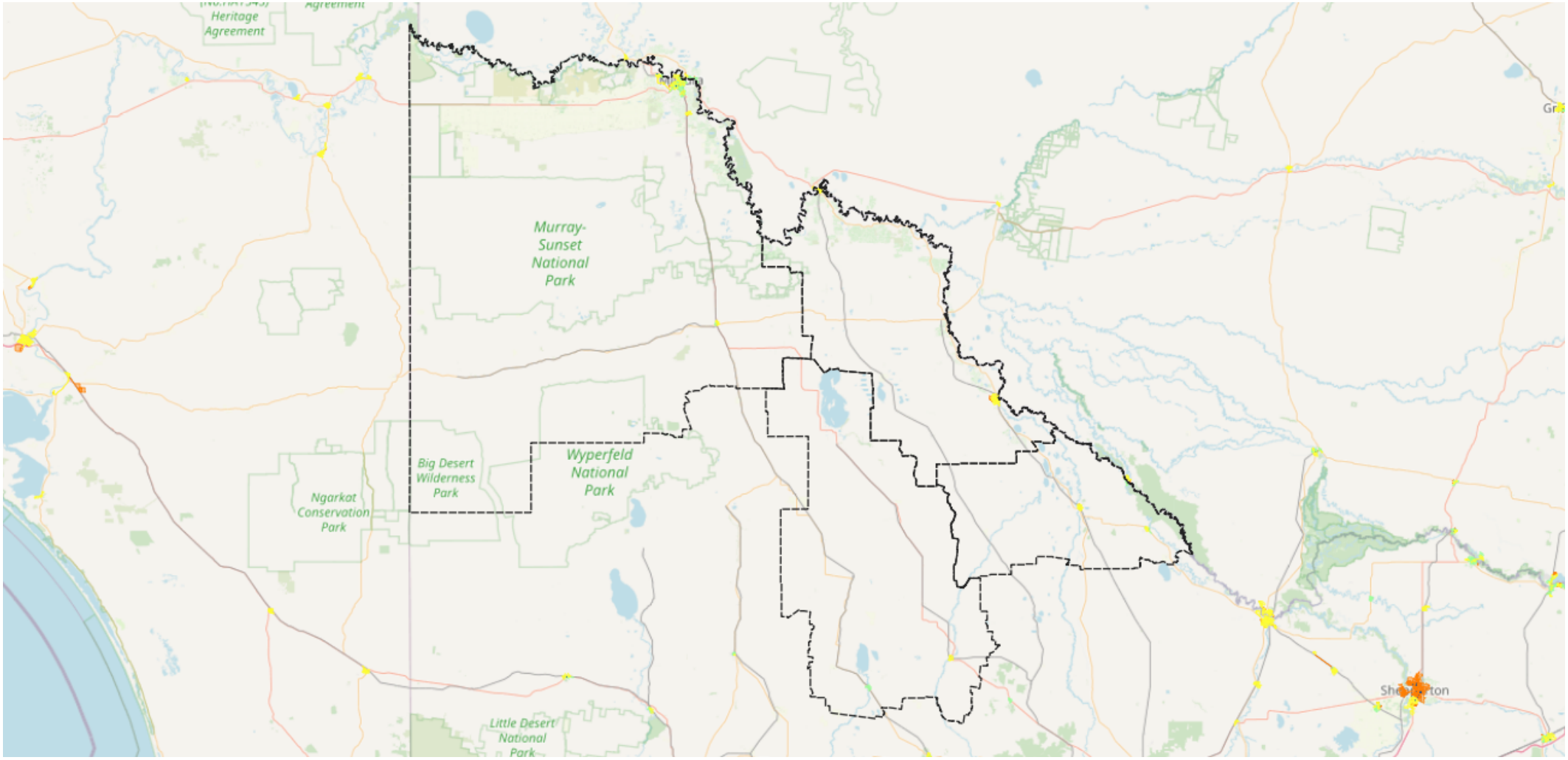
Wycheproof

In relation to NBN coverage, the township of Wycheproof (approx. population of 650) is predominantly serviced by NBN fixed wireless technology. This level of NBN infrastructure will not be fit for purpose in the coming decade as fibre to the premise technology provides a future proof and scalable outcome.
An initial LEO Satellite service from Starlink is available, albeit at a high access cost.
The township is serviced by Telstra 4G / 3G, Optus 4G / 3G and no TPG Telecom (Vodafone) network access. Due to a range of factors, network congestion is often experienced resulting in diminished levels of service quality and experience on all mobile networks.
In relation to Fibre Backhaul network access and Low Powered Wireless Access Networks (LPWANs), the township does not have direct access to alternative choices to Telstra.

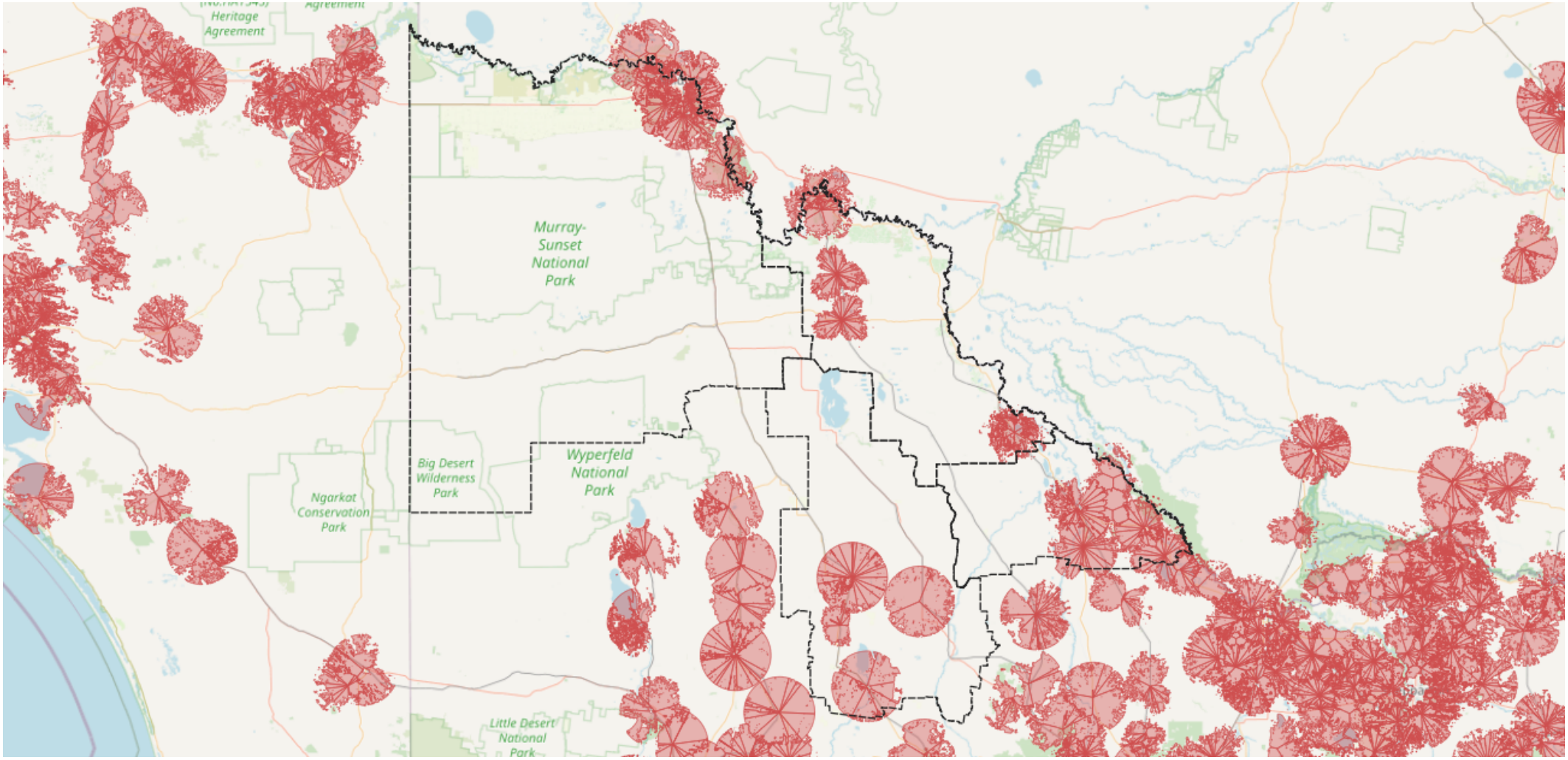
Leitchville

In relation to NBN coverage, the township of Leitchville (approx. population of 600) is predominantly serviced by NBN fixed wireless technology. This level of NBN infrastructure will not be fit for purpose in the coming decade as fibre to the premise technology provides a future proof and scalable outcome.
An initial LEO Satellite service from Starlink is available, albeit at a high access cost.
The township is serviced by Telstra 4G / 3G, Optus 4G / 3G and no TPG Telecom (Vodafone) network access. Due to a range of factors, network congestion is often experienced resulting in diminished levels of service quality and experience on all mobile networks.
In relation to Fibre Backhaul network access and Low Powered Wireless Access Networks (LPWANs), the township does not have direct access to alternative choices to Telstra.

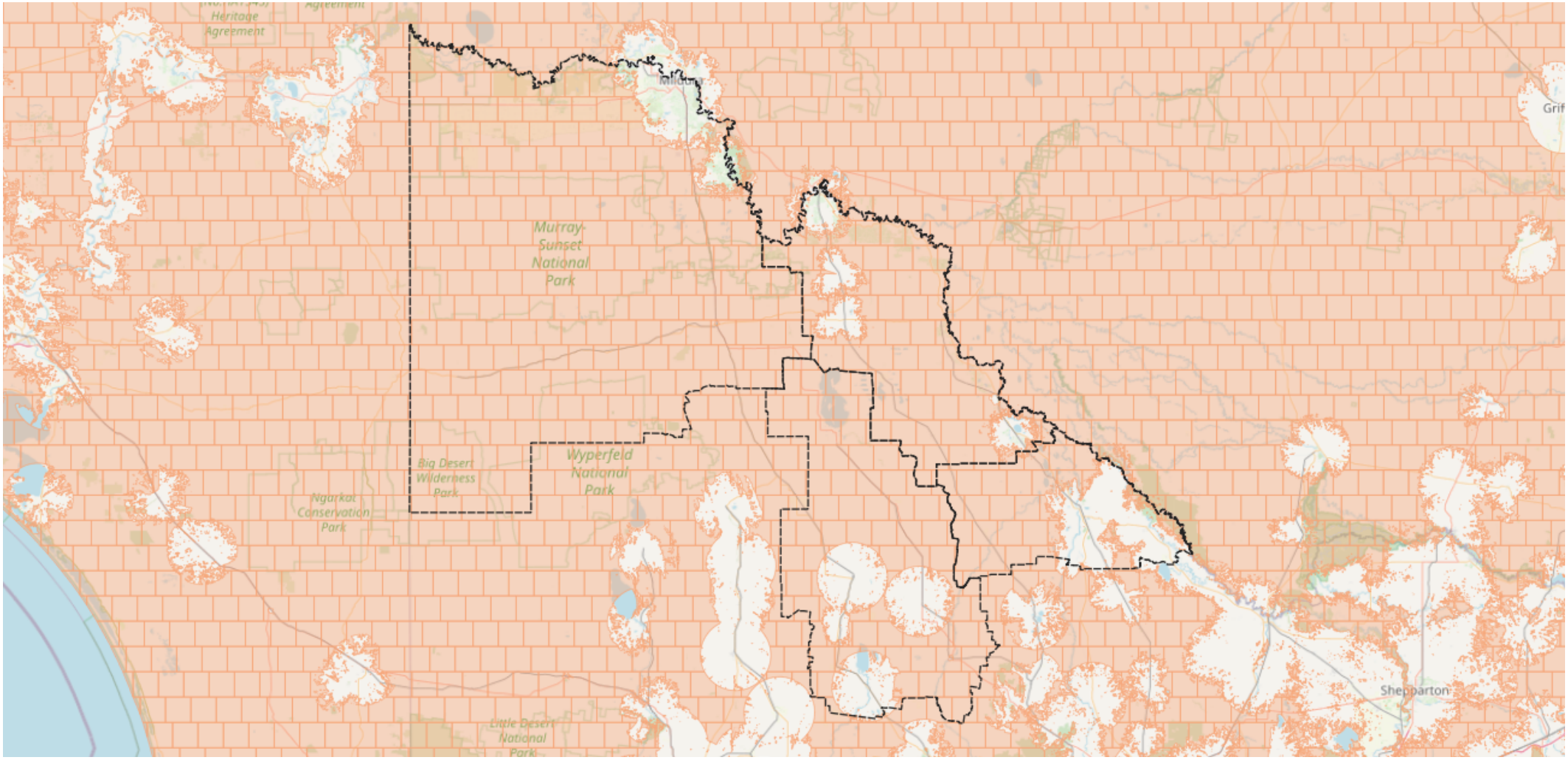
NBN Fibre to the (Premise, Kerb, Node, Building)



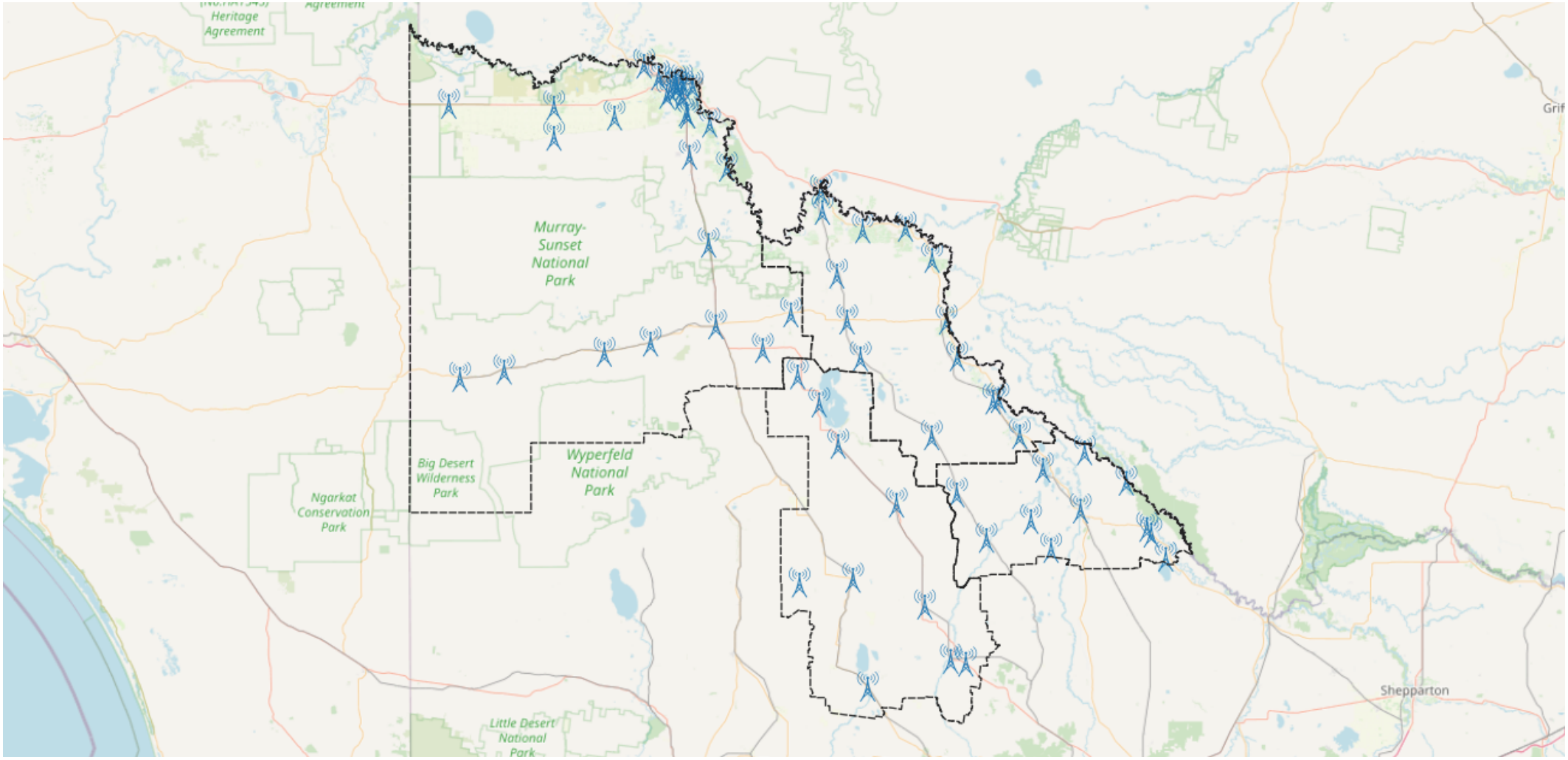
NBN Fixed Wireless



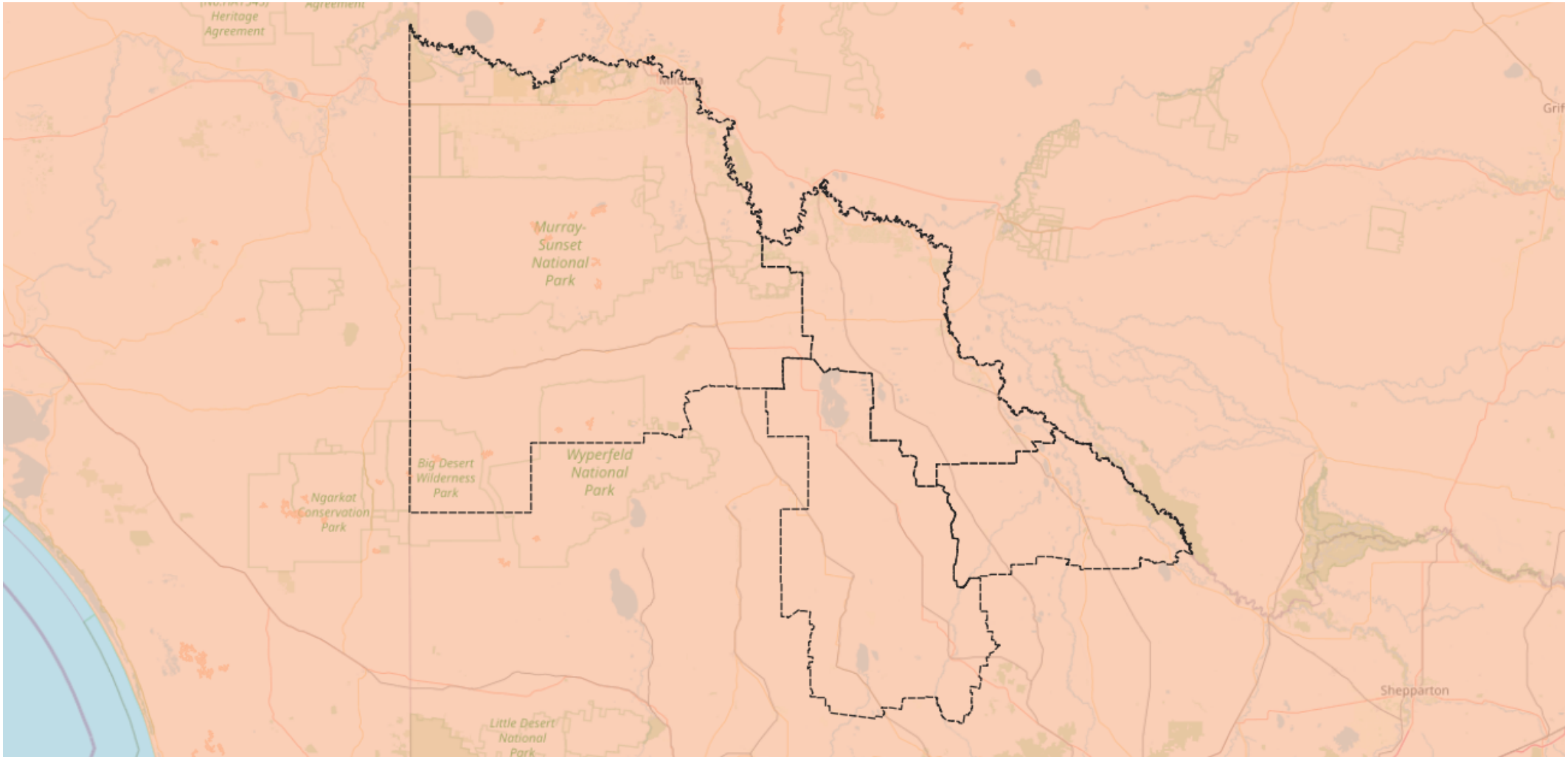
NBN Satellite



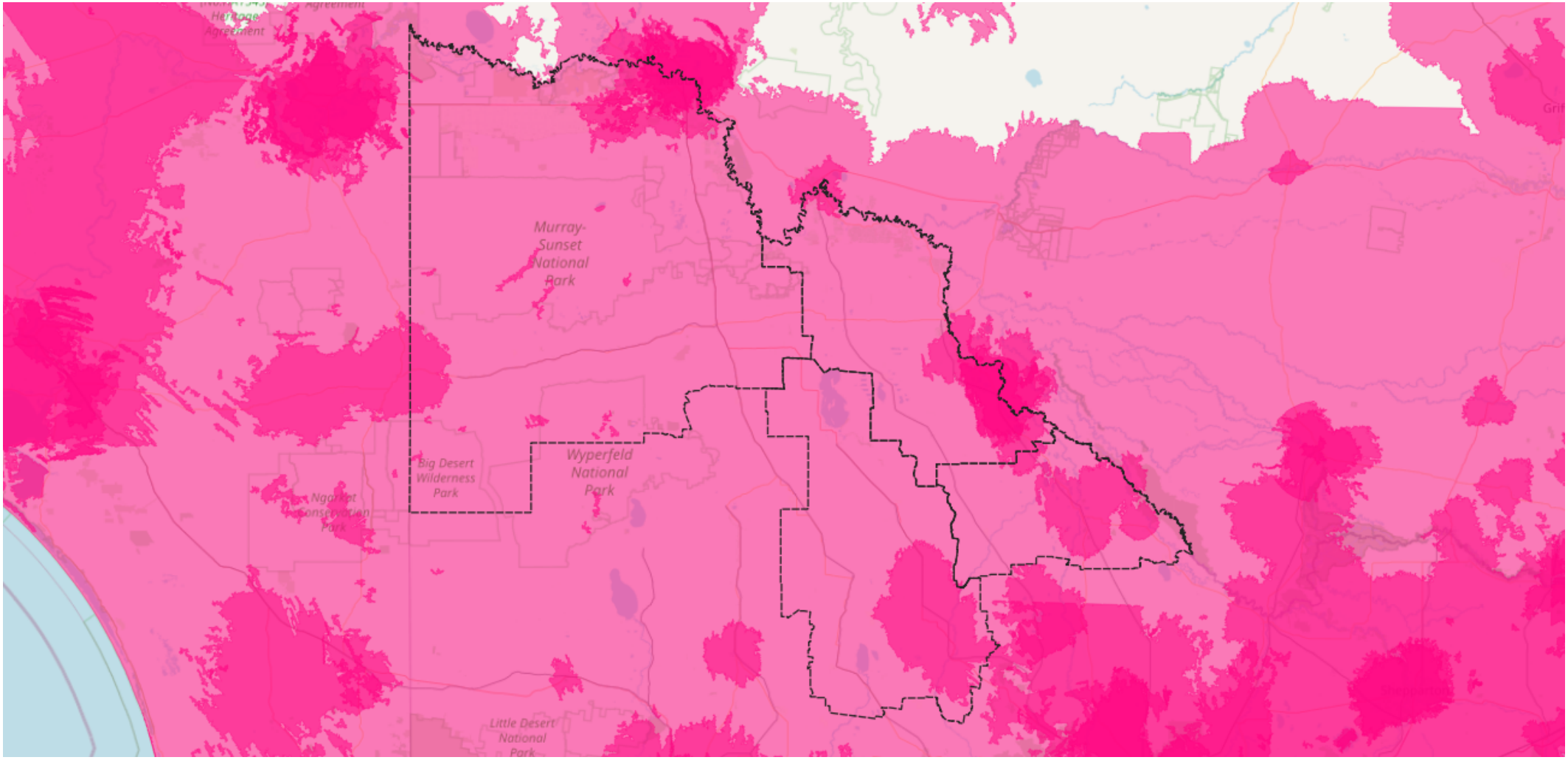
Telstra Mobile Sites



Telstra 3G Coverage



Telstra 4G Coverage



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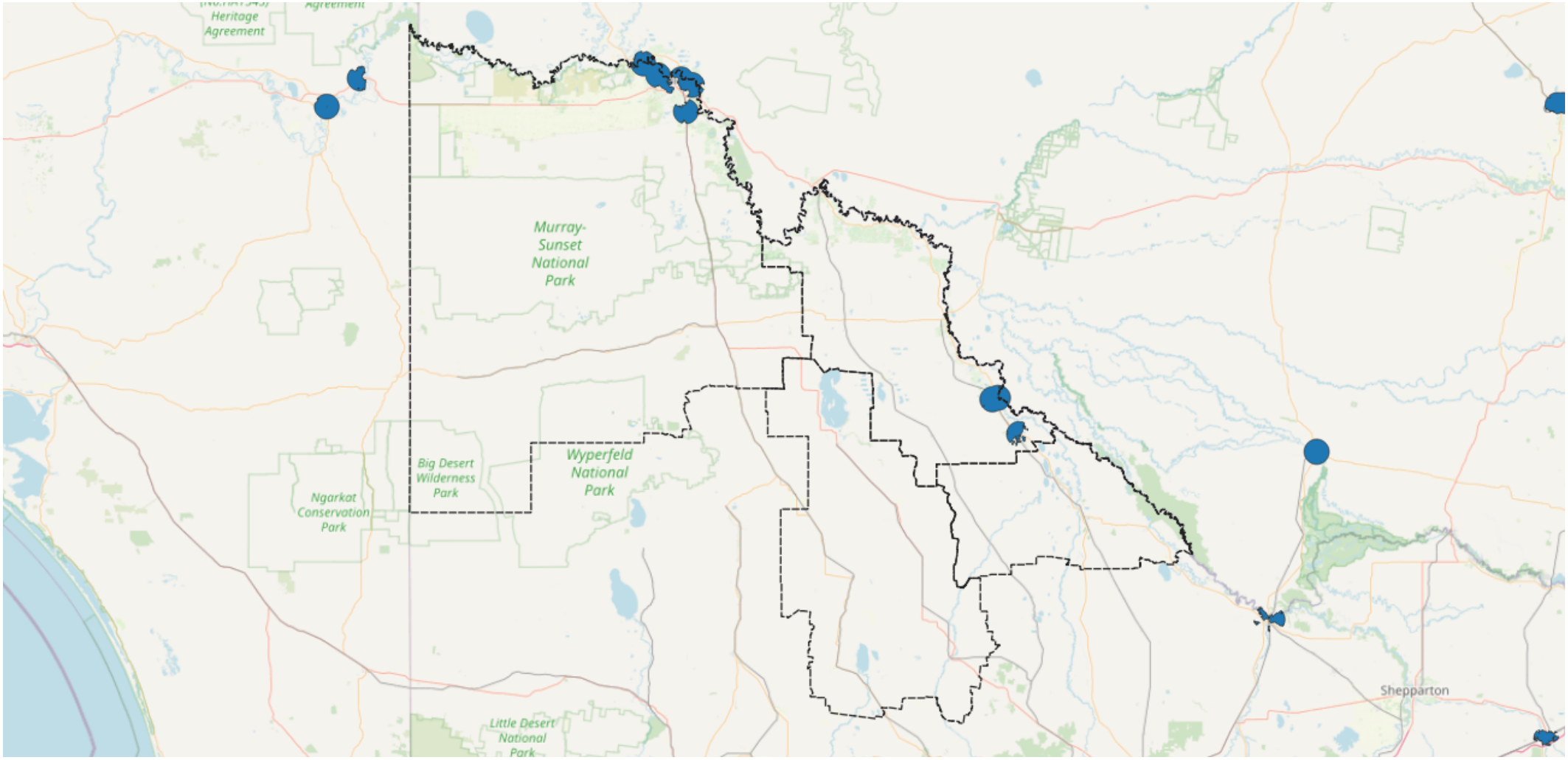
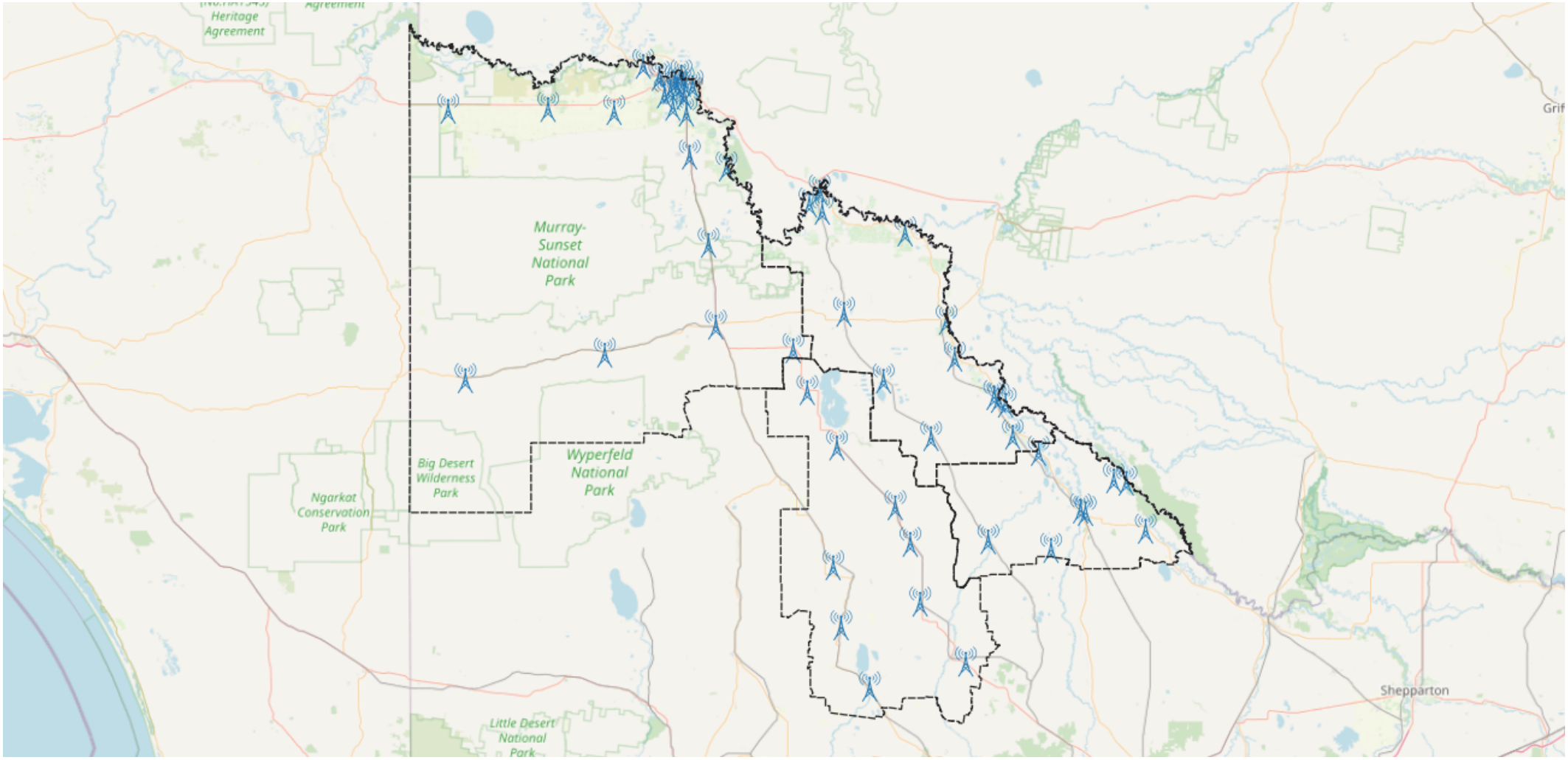


Optus Mobile Sites



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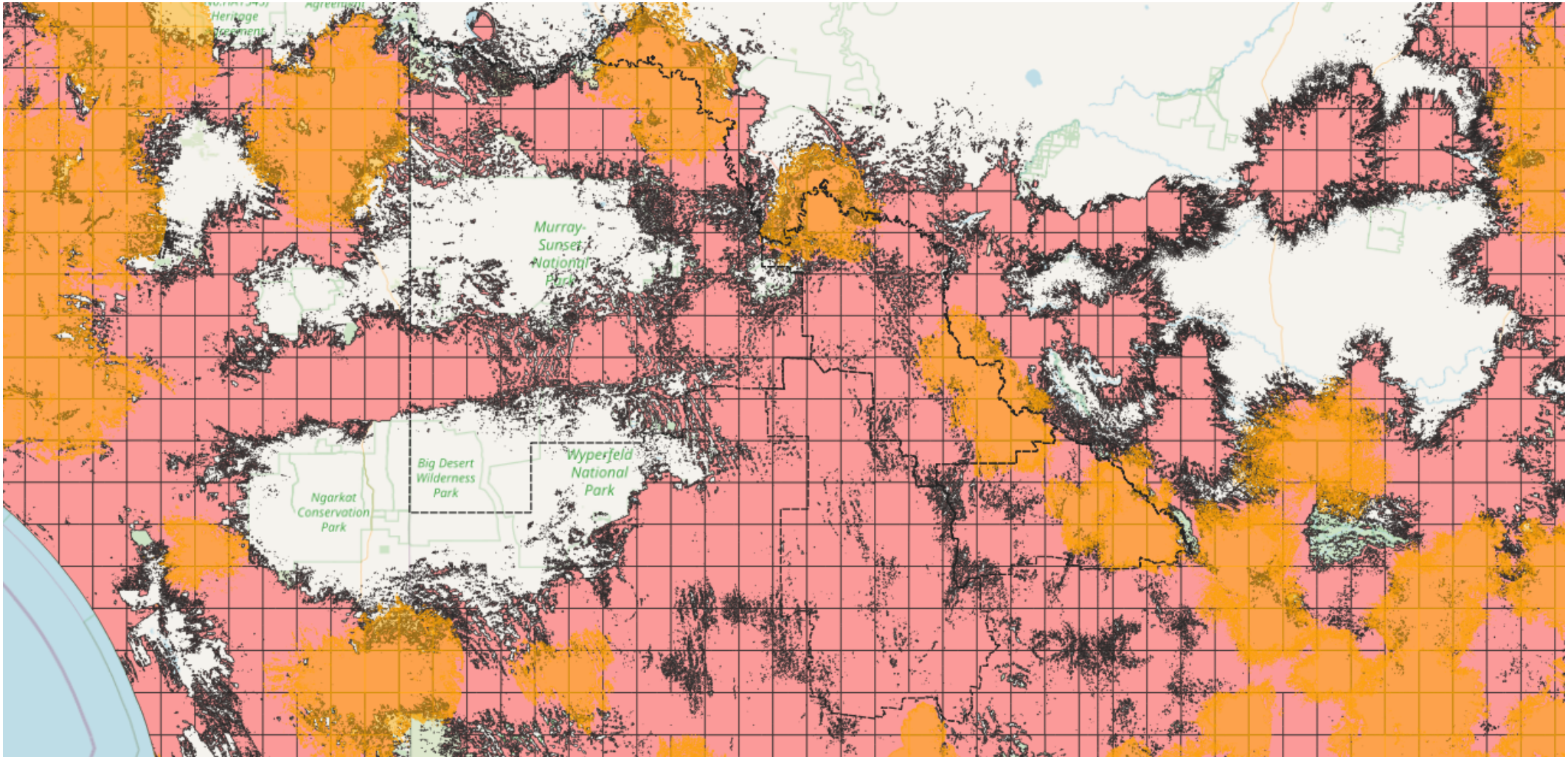

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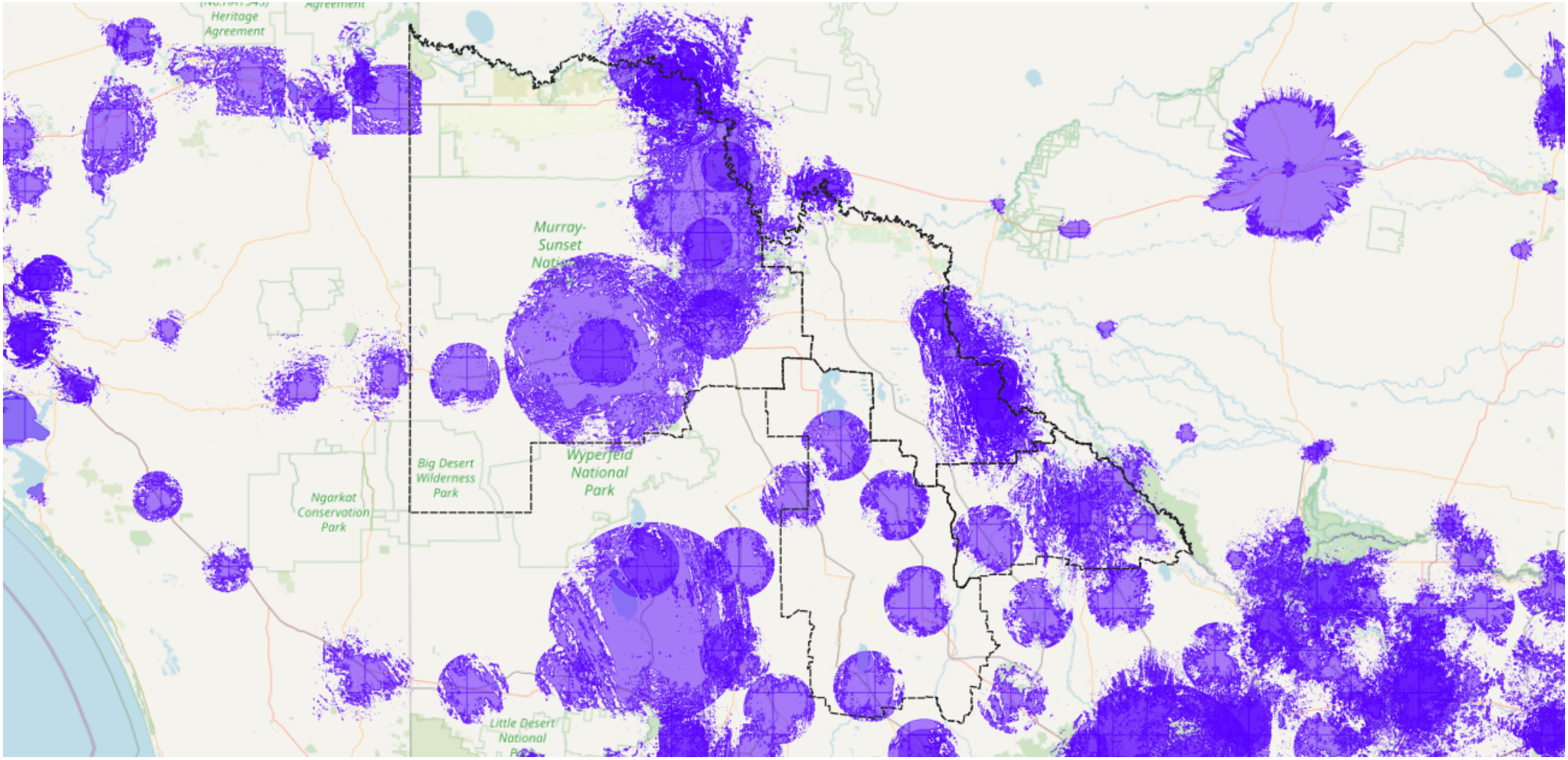
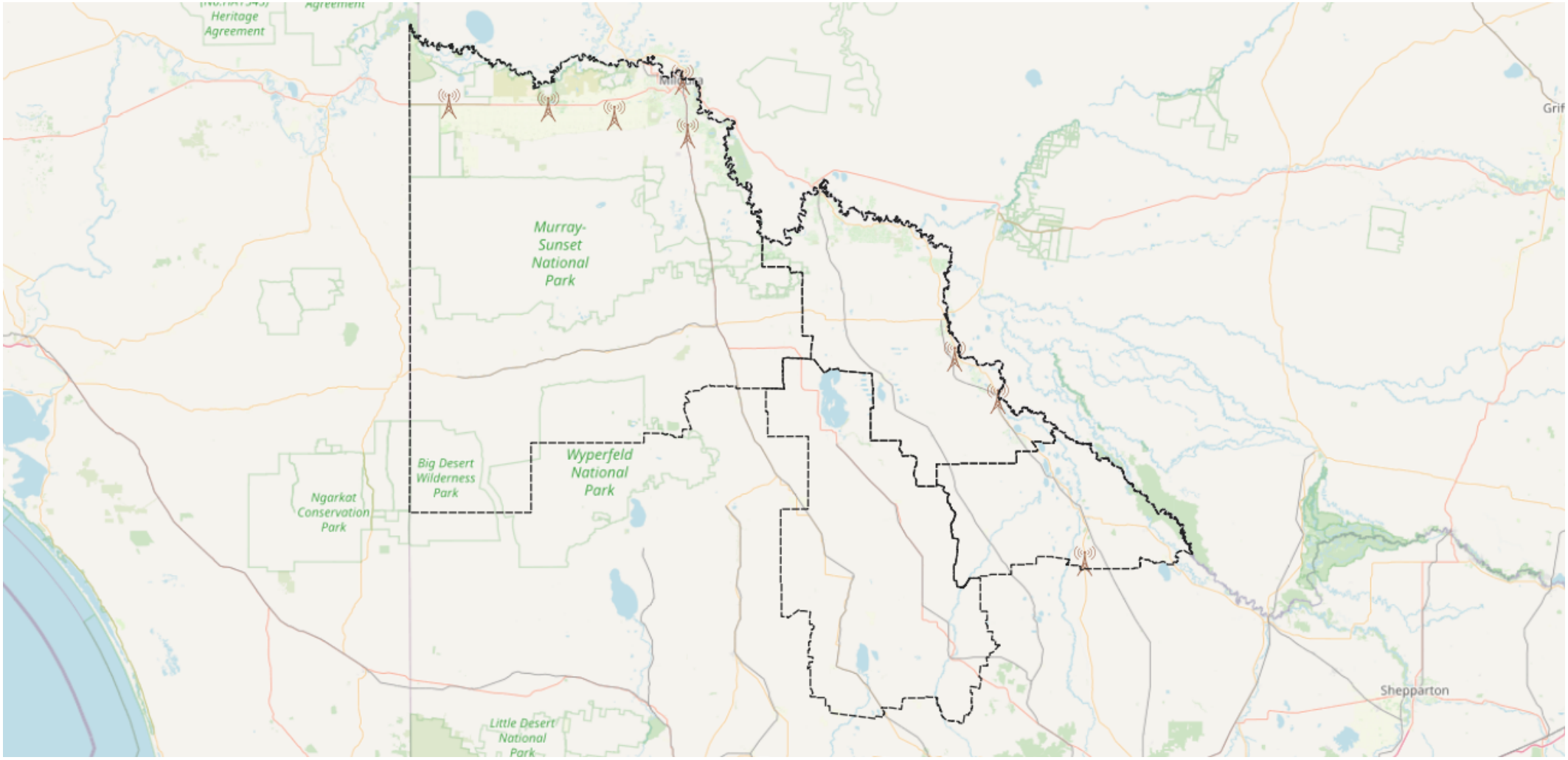


TPG Telecom / Vodafone Mobile Sites



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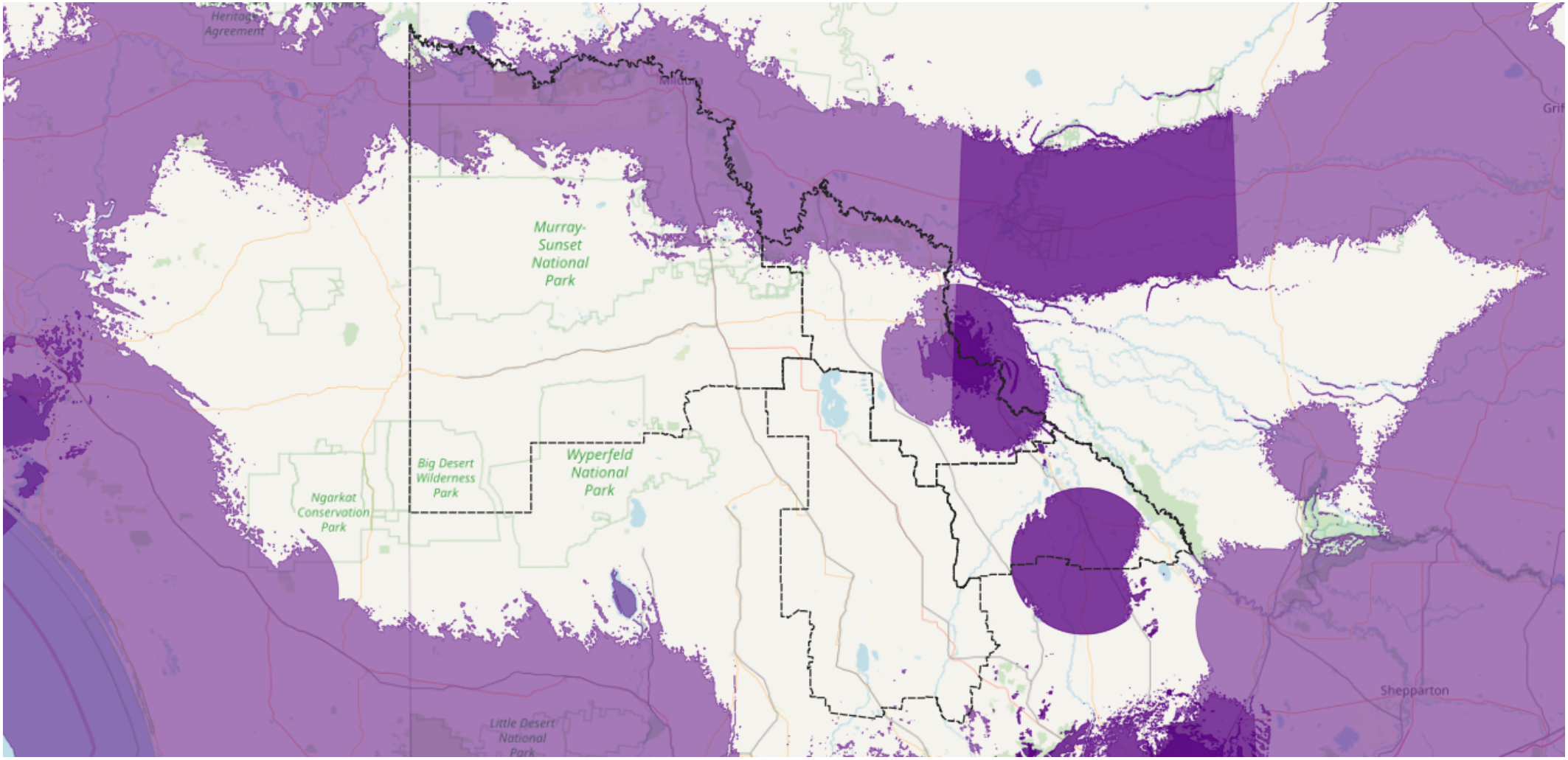

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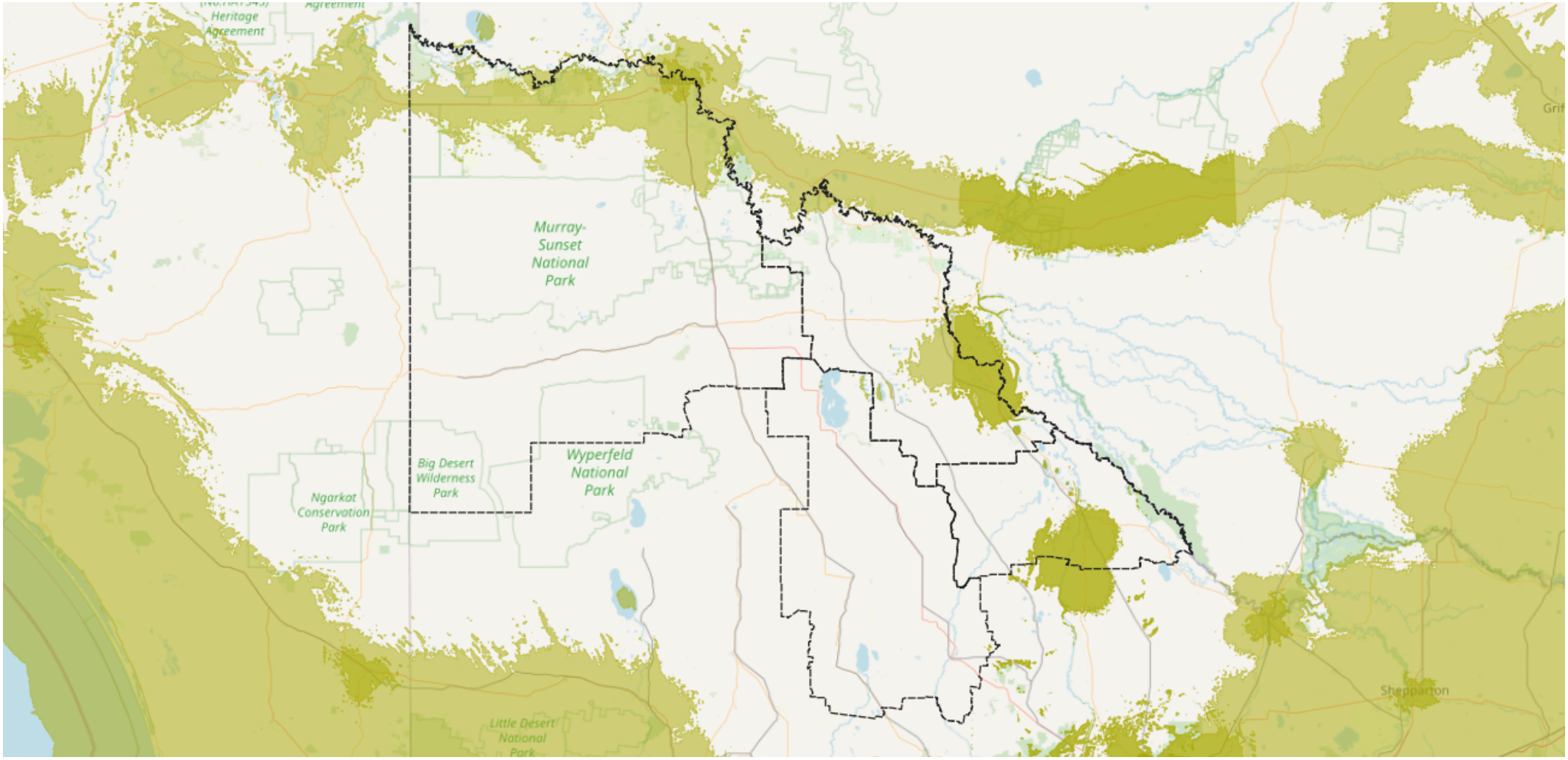


3. Mobile Network Testing

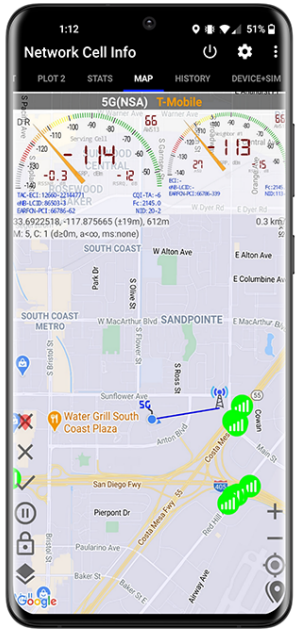
Mobile Network Testing

By using independent mobile testing technology, Gravelroad Group provides impartial user experience-based reports and recommendations. The methodology used by us to independently test mobile network performance and identify carrier blackspots has been developed over the last 10 years to provide results that describe the 'user experience'.

We used three Google Pixel 4a 5G handsets, as commonly used by members of the public, to capture information about signal strength and network performance for each of the national carriers - Telstra, Optus & Vodafone. This benchmarking process provides a rich methodology that has been acknowledged and respected by all major wireless service providers.

Other local governments have typically used the report and specific recommendations to advocate for increased funding by Federal, State governments together with each of the three national carriers – often through the Mobile Black Spot Program.

We have employed the only independent 3G, 4G and 5G Mobile Network coverage and capacity testing solution in the Australian Advisory market to collect rich and granular mobile network signal level readings (taken every 100 metres) to demonstrate both coverage and capacity across the Telstra, Optus and TPG Telecom (Vodafone) networks.



By providing the GPS location and current results in real time, testers can monitor and authenticate the testing accuracy in real time.

There are six simple principles used to inform our testing methodology:

- User experience based – we use handsets commonly owned by users rather than other more technical and theoretical approaches.
- Same handset, same settings – this provides an equitable basis for bench marking network performance.

- Simultaneous testing – all tests are carried out in the same vehicle – spaced to remove interference and completed at the same time in that location.
- Signal Strength – for 3G, 4G & 5G
- Network Performance Test – download, upload and latency
- Our testing mimics the user experience based on a descending hierarchy from 5G to 4G to 3G

Signal Strength

We have tested mobile signal strength for each of the three mobile network operators (Telstra, Optus and Vodafone) in both 3G, 4G and 5G modes at approx. every 100m as per the maps in this report. This methodology will comprehensively demonstrate the quality of coverage by carriers in each area tested.

The contrast between Black Spots and hotspots of coverage is clearly shown in both the 3G, 4G and 5G tables and maps below.
Signal strength by itself is not the best indicator of a network performance as it only shows where local access is possible. The signal strength information combined with the network performance testing provides a clear assessment on the networks in the region of study.

3G Signal Strength explained

The following indicators are used to determine the quality of a 3G signal. The table below indicate guidelines as to what constitutes a particular level of quality, ranging from excellent to unusable (poor or no usable signal). White in the map indicates no signal collected at all.

Signal	Quality	Description
>= -75dbm	Excellent	Strong signal enabling maximum data capacity
>= -80dbm	Good	Good signal and speeds with no dropouts expected
>= -90dbm	Fair	Fair/usable signal with possibility of dropouts and slowdowns
>= -112dbm	No / Poor / Unusable	No usable signal - expect frequent disconnections and sluggish performance

4G Signal Strength explained

The following indicators are used to determine the quality of a 4G signal. The table below indicate guidelines as to what constitutes a particular level of quality, ranging from excellent to unusable (poor or no usable signal). White in the map indicates no signal collected at all.

Signal	Quality	Description
>= -80dbm	Excellent	Strong signal enabling maximum data capacity
>= -90dbm	Good	Good signal and speeds with no dropouts expected

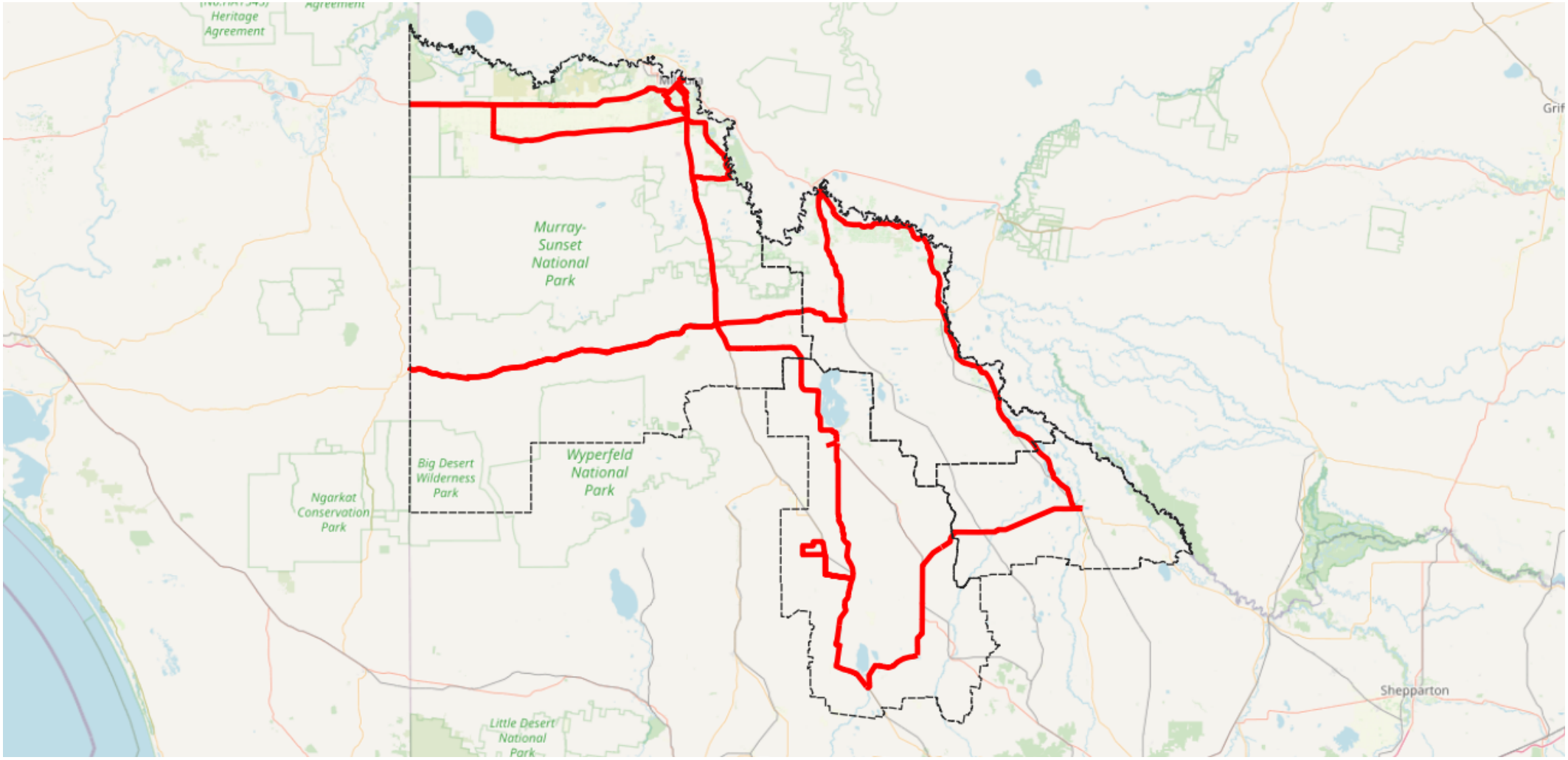
>= -110dbm	Fair	Fair/usable signal with possibility of dropouts and slowdowns
>= -120dbm	No / Poor / Unusable	No usable signal - expect frequent disconnections and sluggish performance

5G Signal Strength explained

The following indicators are used to determine the quality of a 4G signal. The table below indicate guidelines as to what constitutes a particular level of quality.

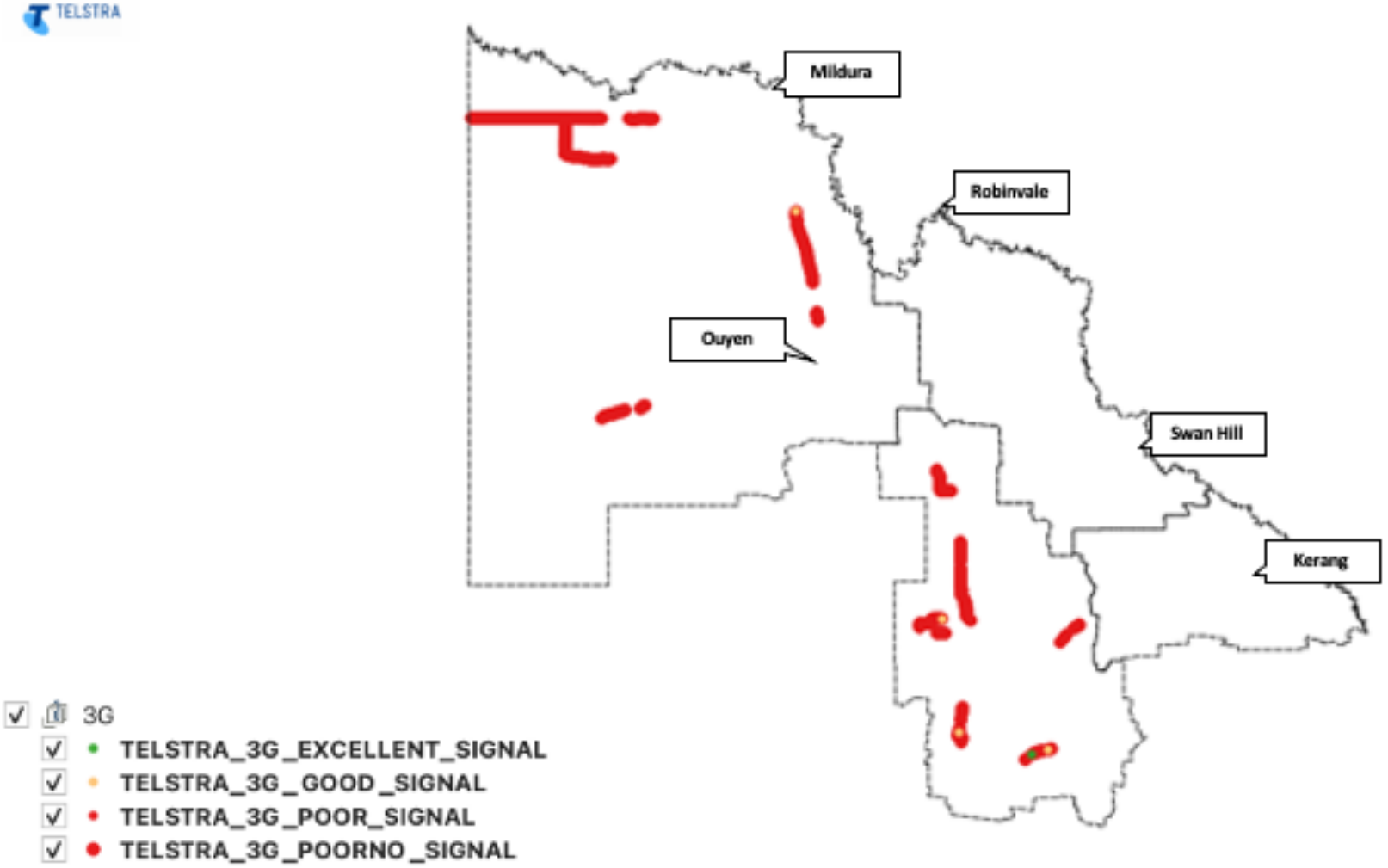
Signal	Quality	Description
>= -80dbm	Excellent	Strong signal enabling maximum data capacity
>= -80 to -90dbm	Good	Good signal and speeds with no dropouts expected
>= -90 to -100dbm	Fair	Mid Cell
<= -100dbm	No / Poor / Unusable	Cell Edge

Drive Testing Route

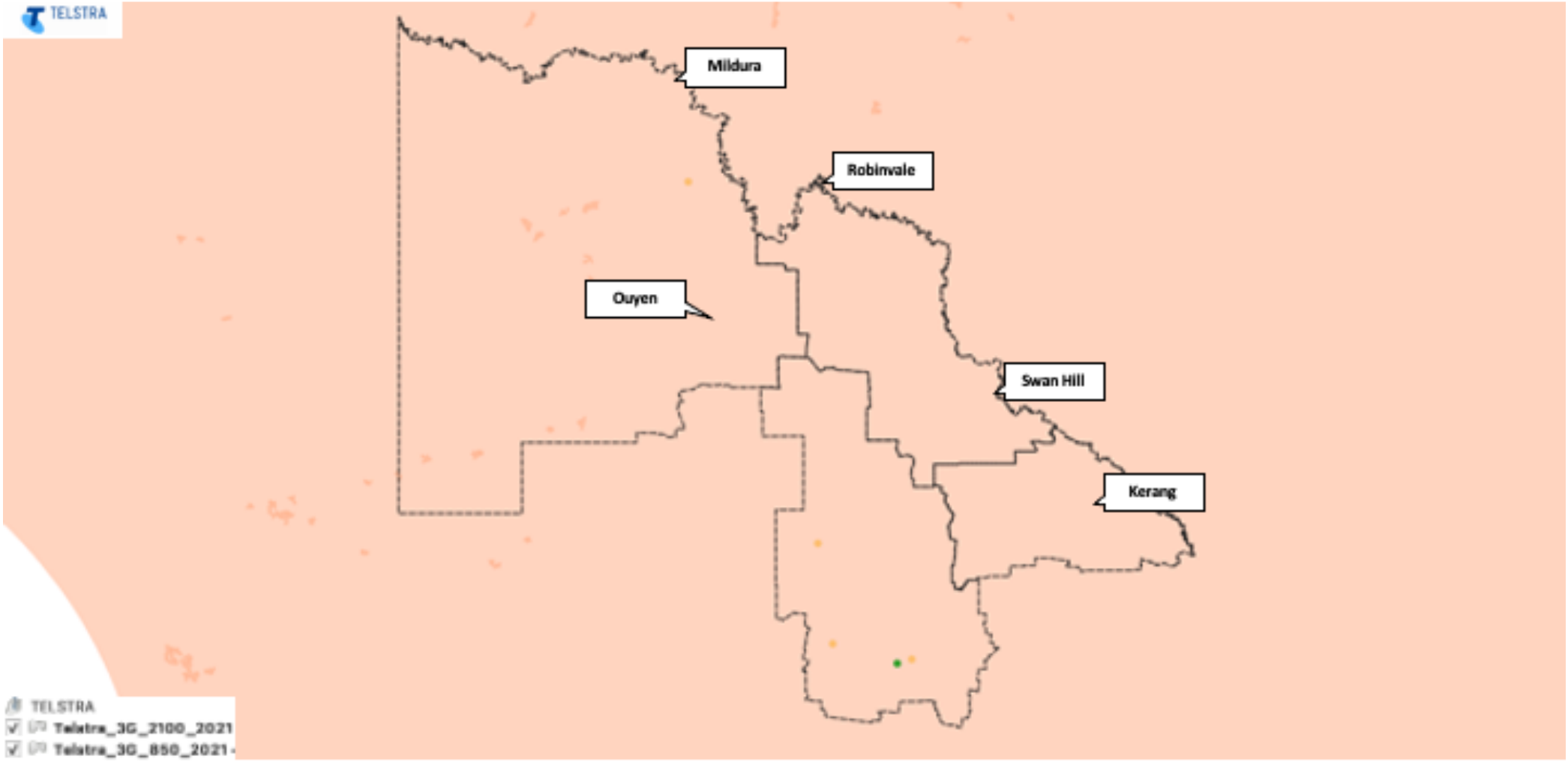


Summary of 3G Signals collected

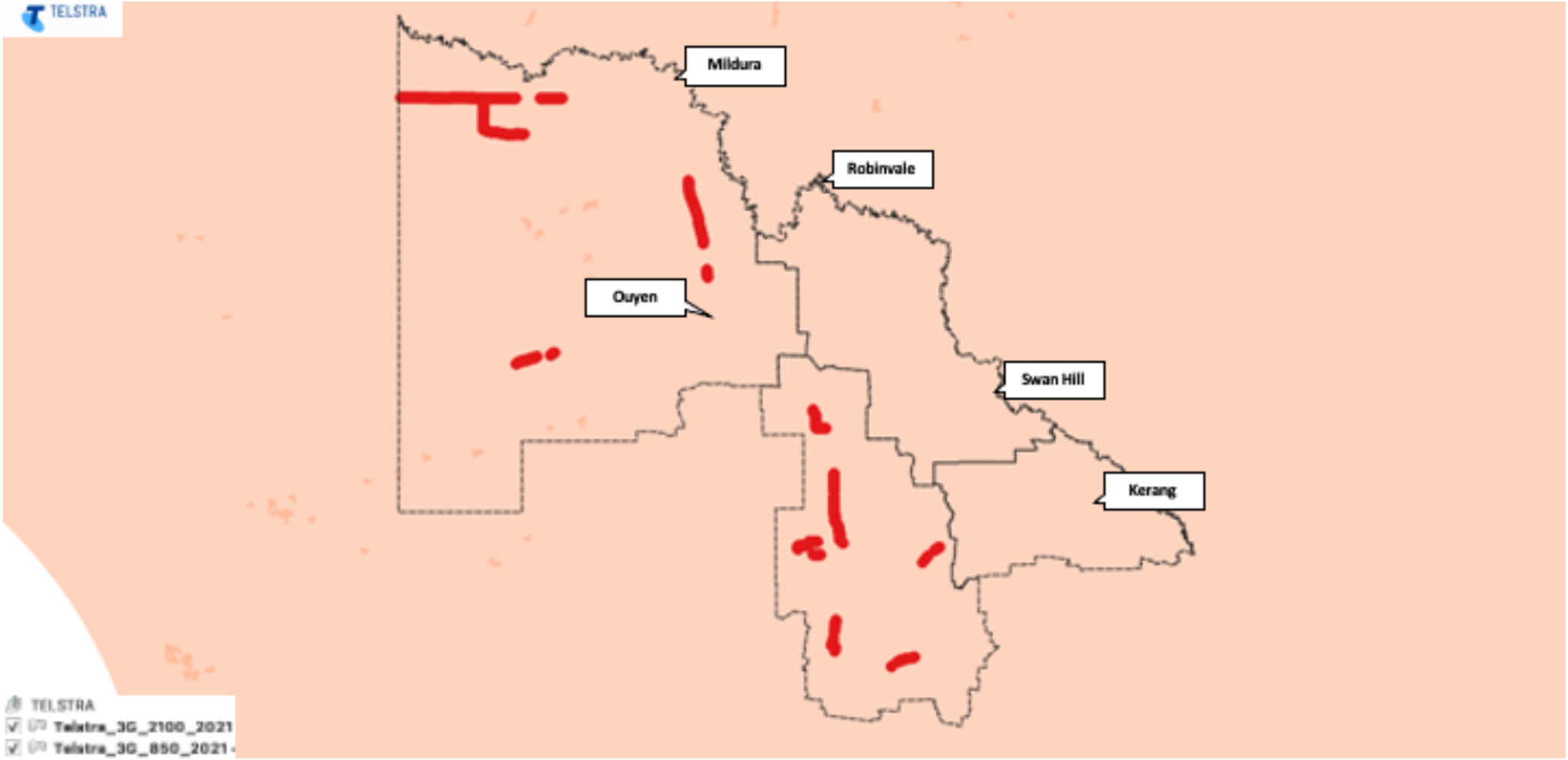
Telstra 3G Signal collected



Telstra 3G Excellent, Good & Fair Signal vs 3G coverage map

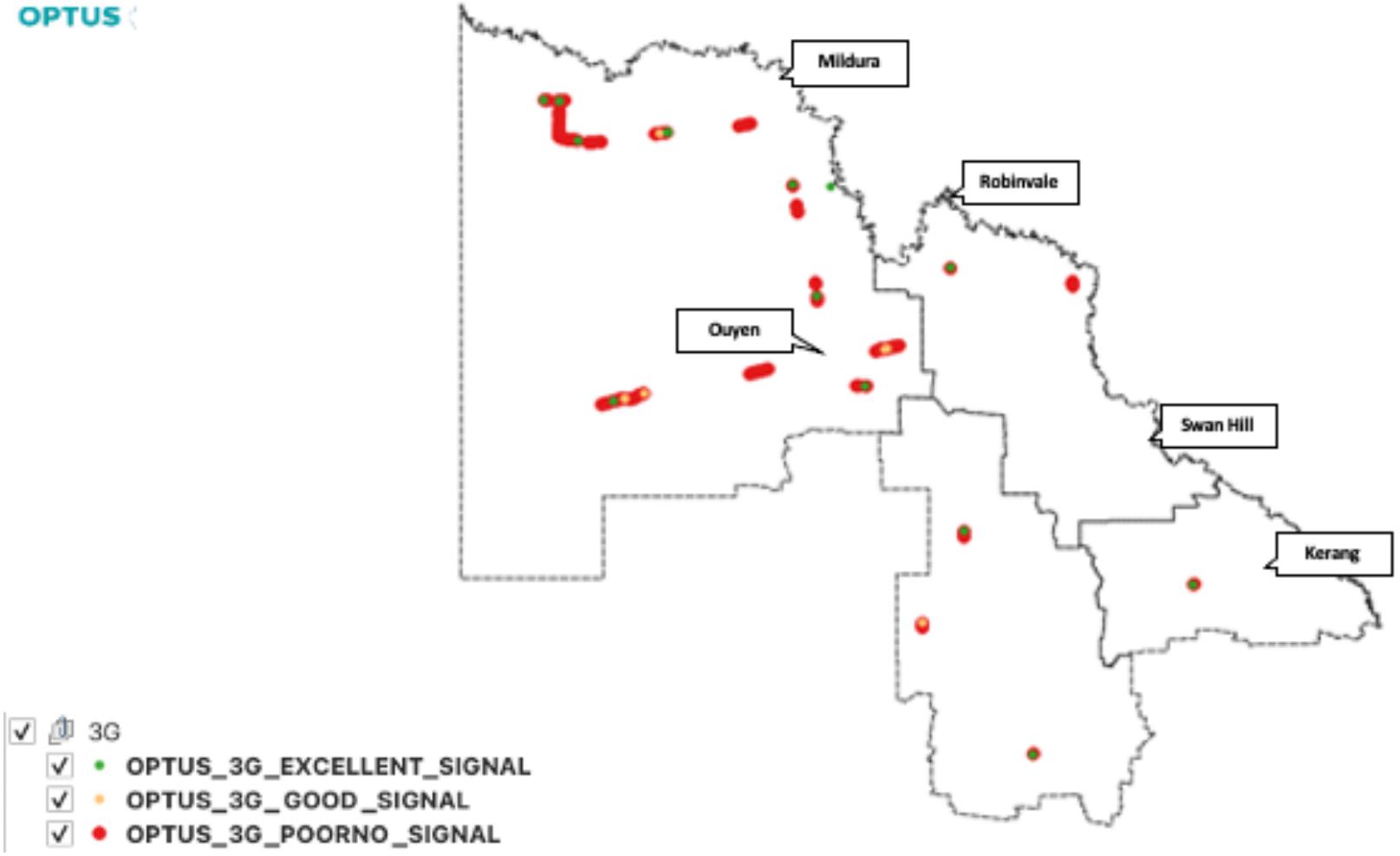


Telstra 3G Poor & No Signal vs 3G coverage map

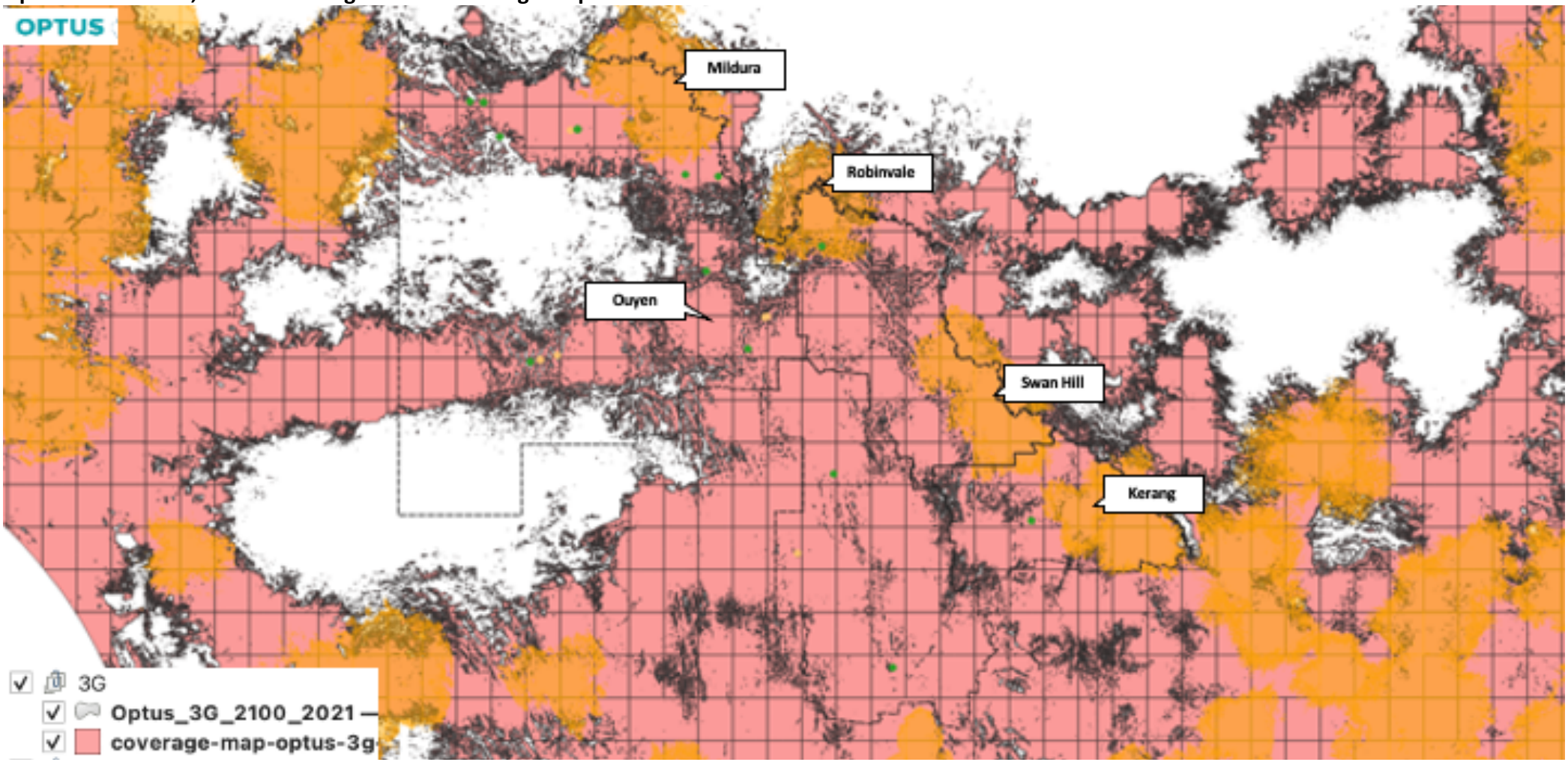


Optus 3G Signal collected

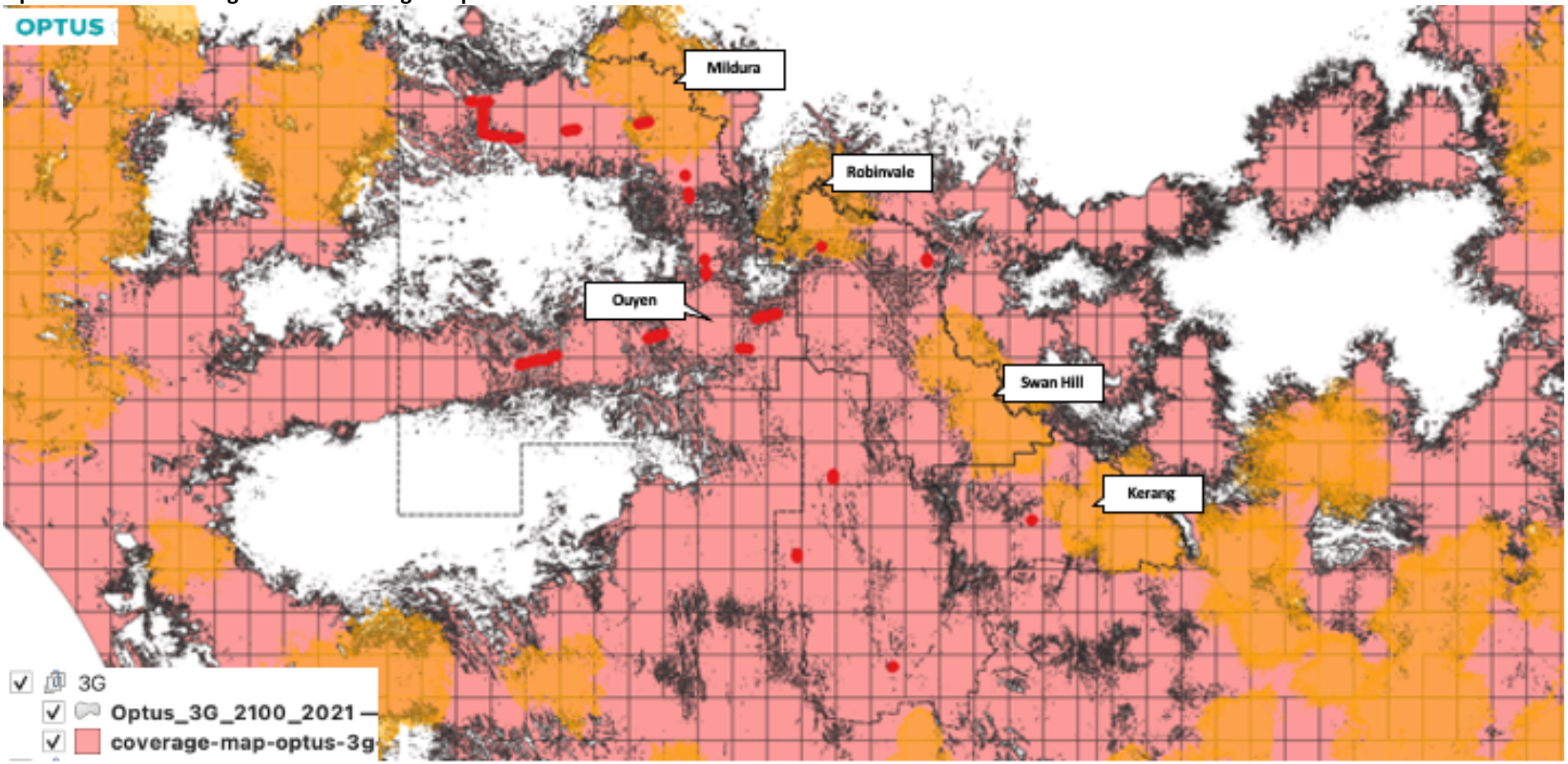
OPTUS



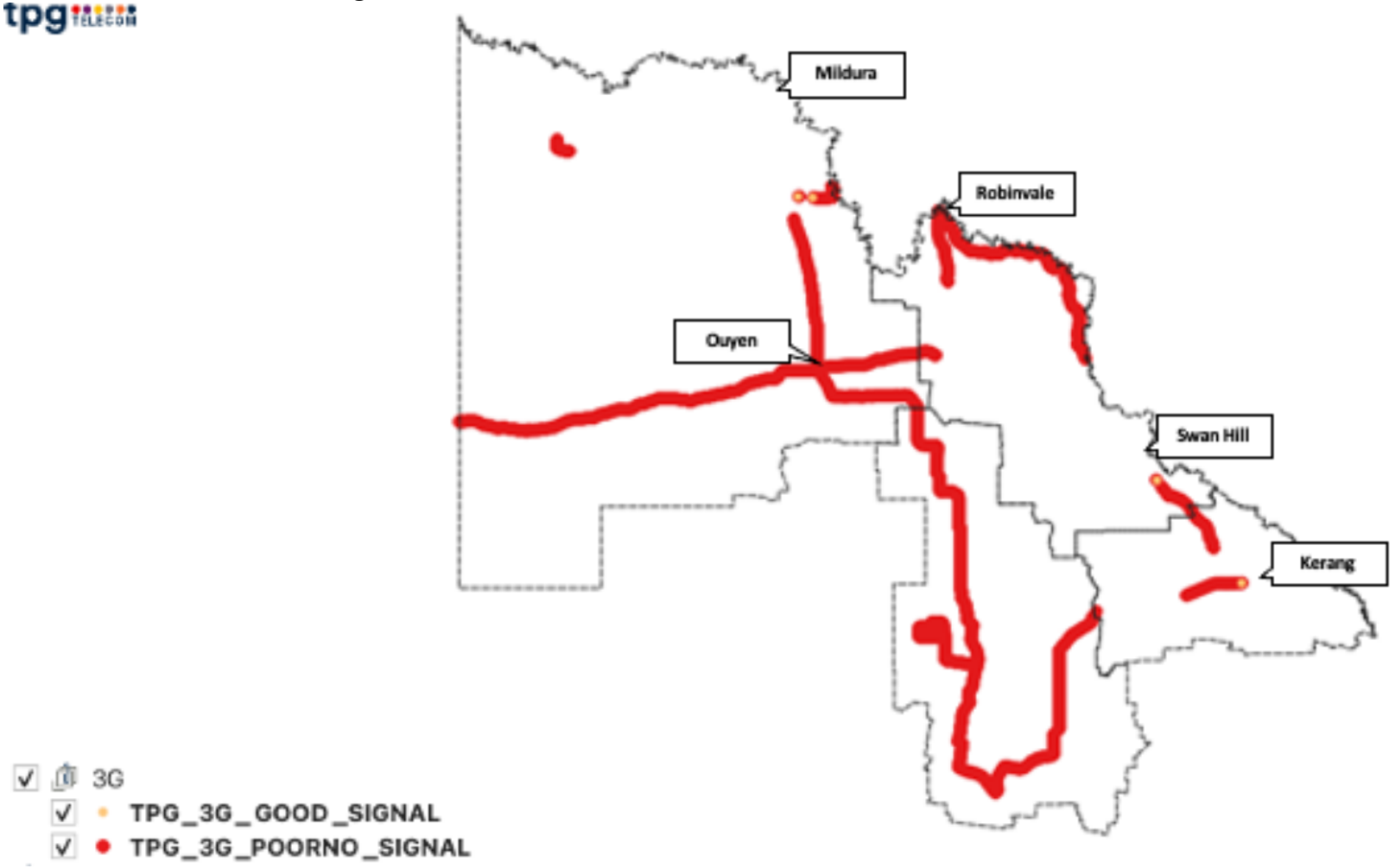
Optus 3G Excellent, Good & Fair Signal vs 3G coverage map



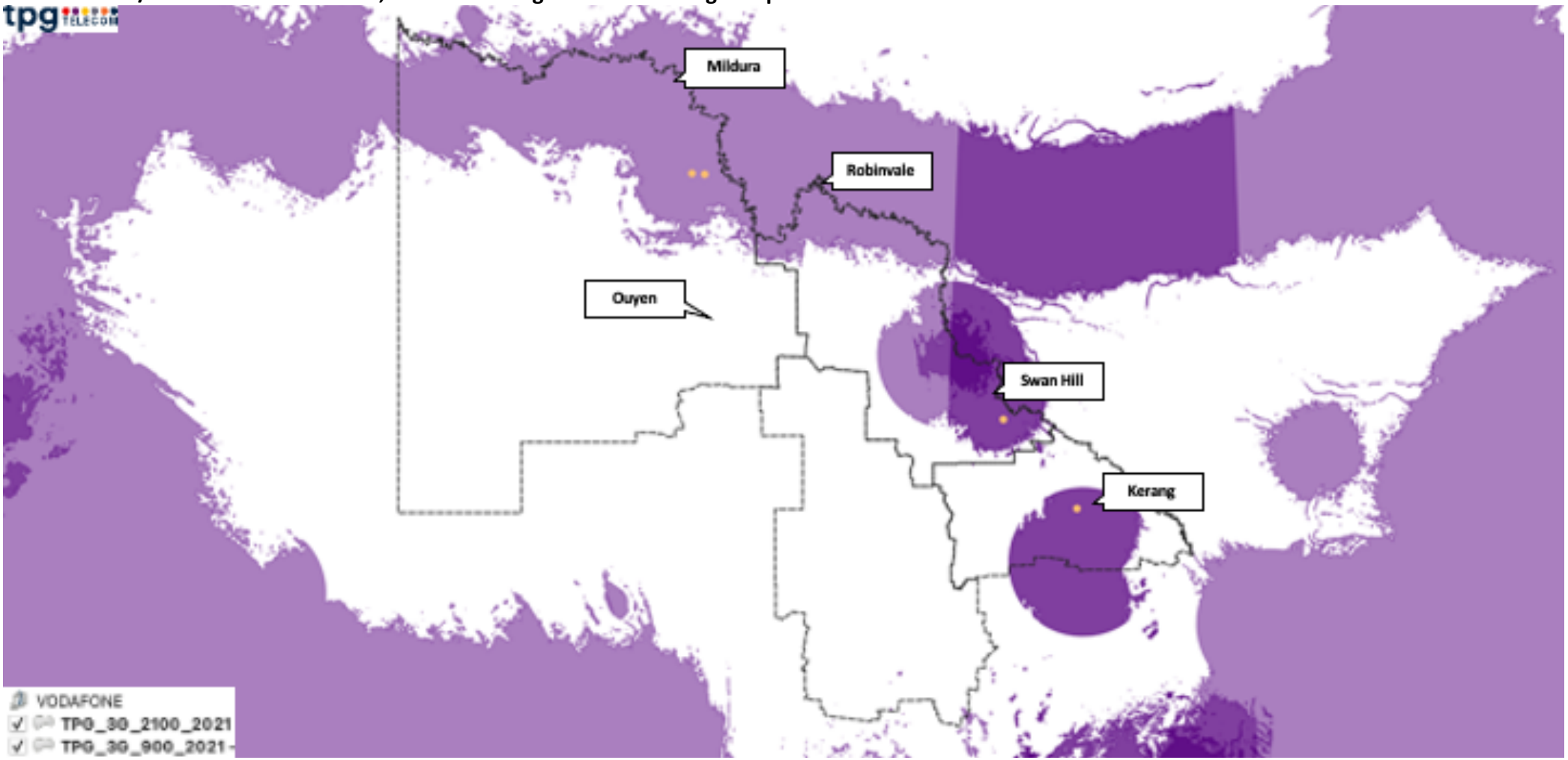
Optus 3G Poor & No Signal vs 3G coverage map



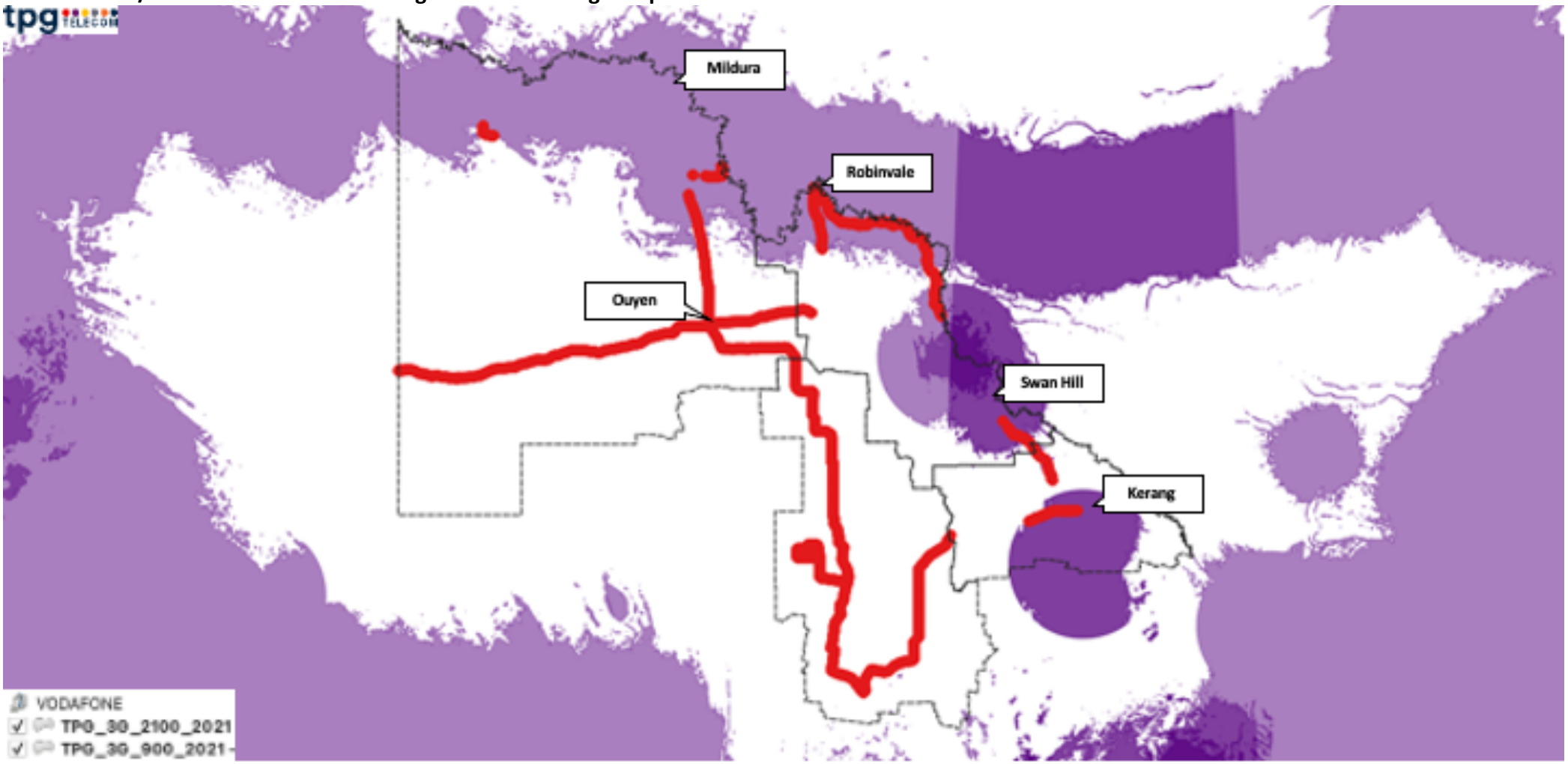
TPG Telecom / Vodafone 3G Signal collected



TPG Telecom / Vodafone 3G Excellent, Good & Fair Signal vs 3G coverage map

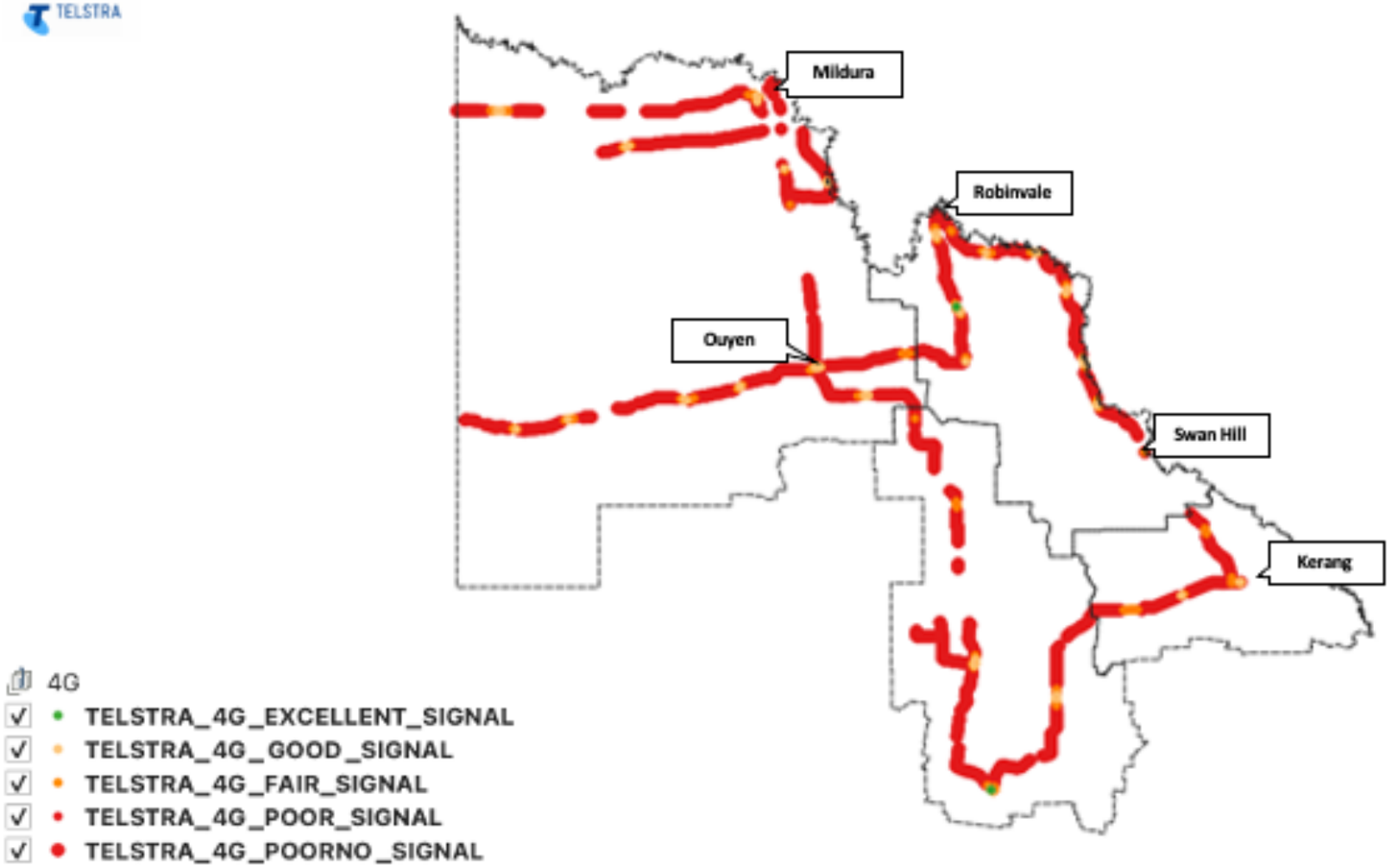


TPG Telecom / Vodafone 3G Poor & No Signal vs 3G coverage map

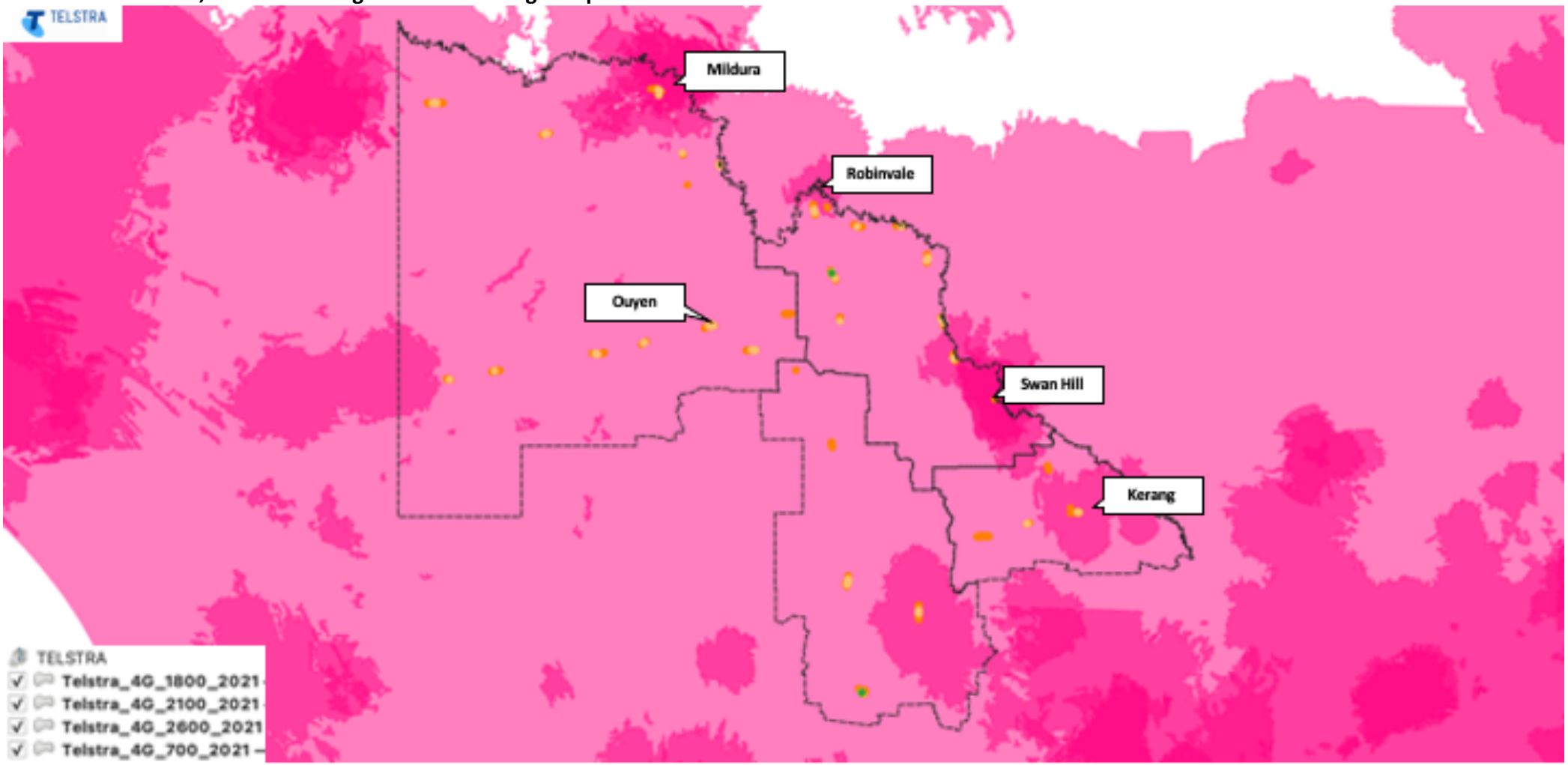


Summary of 4G signal

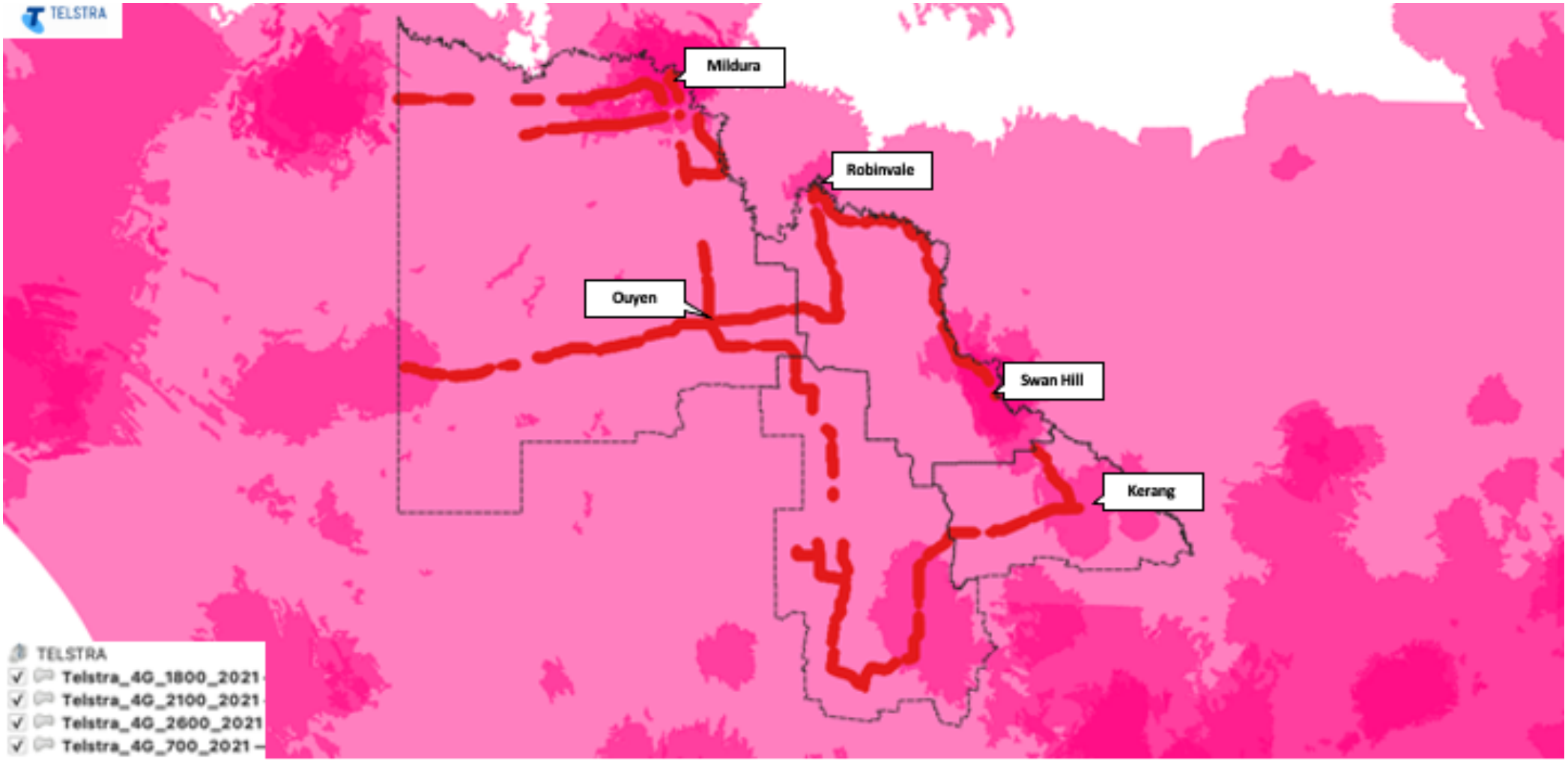
Telstra 4G Signal collected



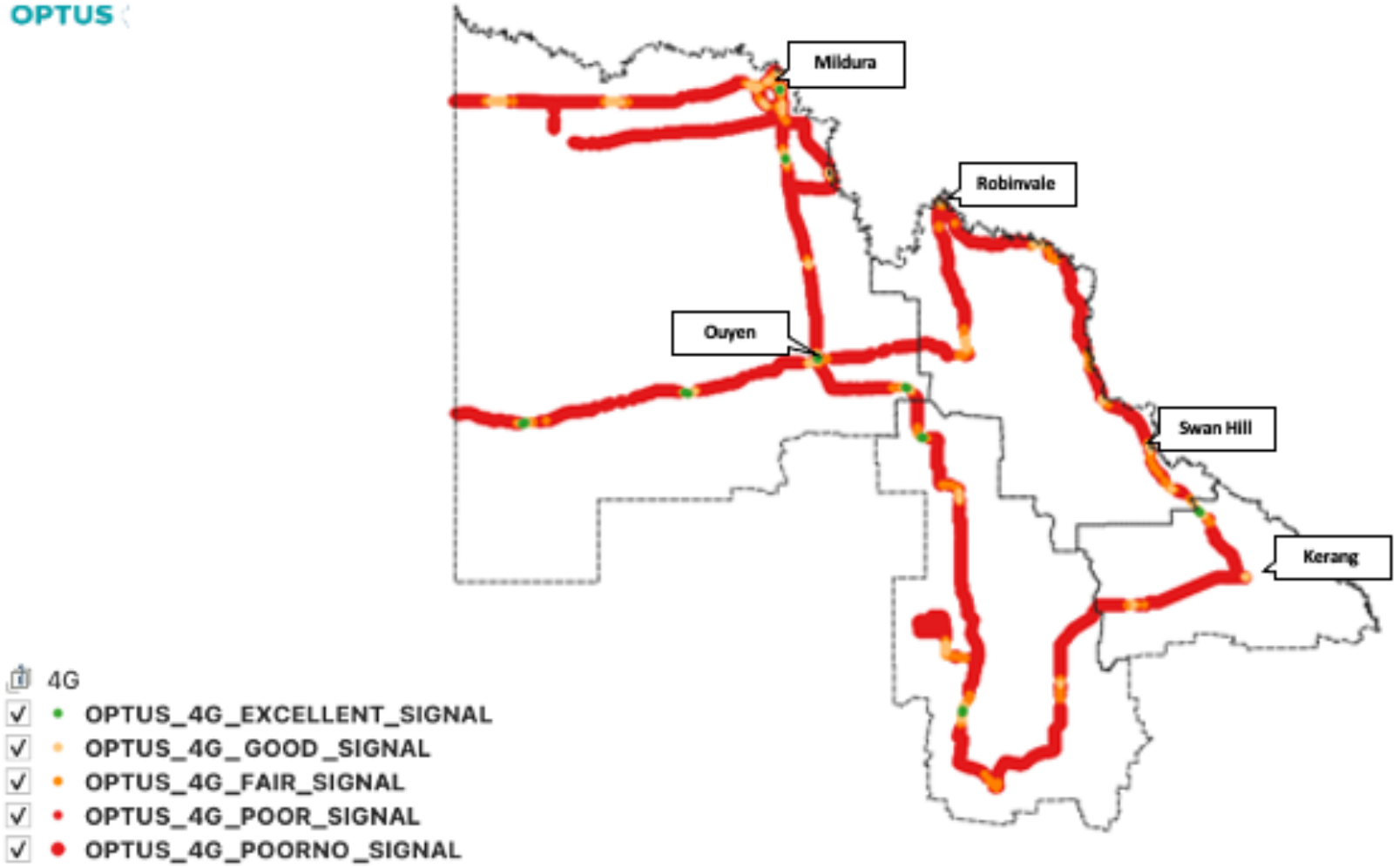
Telstra 4G Excellent, Good & Fair Signal vs 4G coverage map



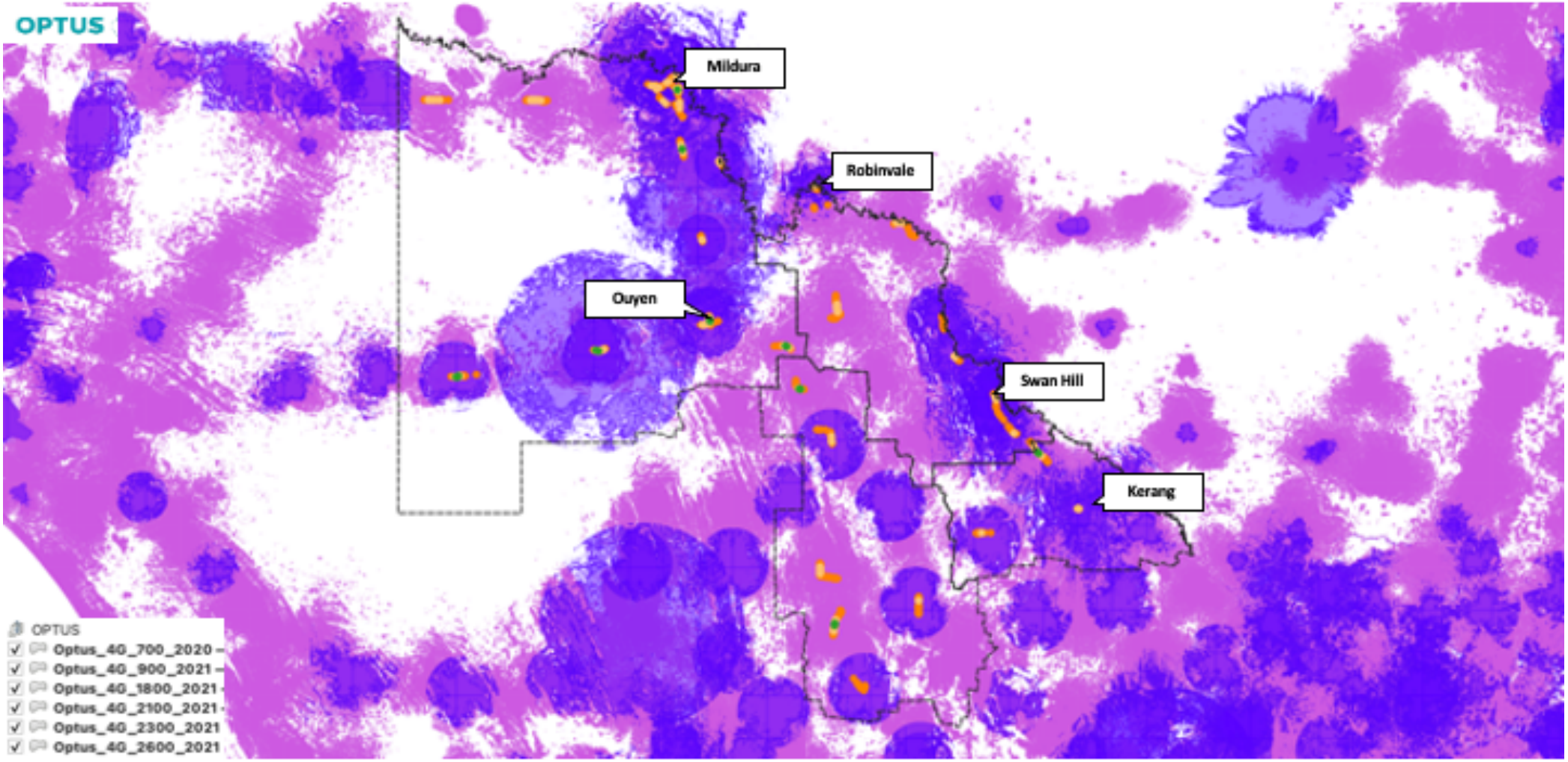
Telstra 4G Poor & No Signal vs 4G coverage map



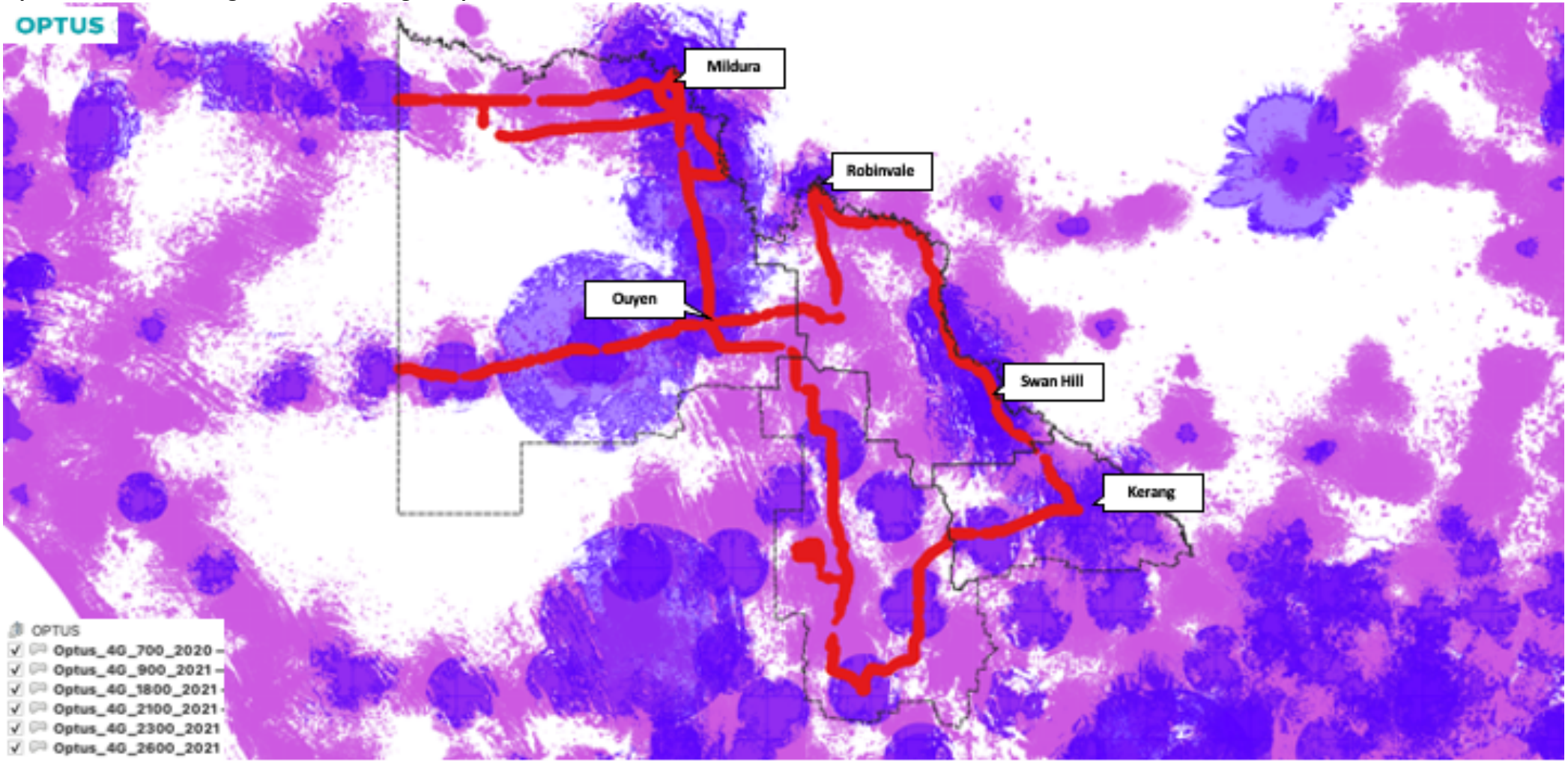
Optus 4G Signal collected



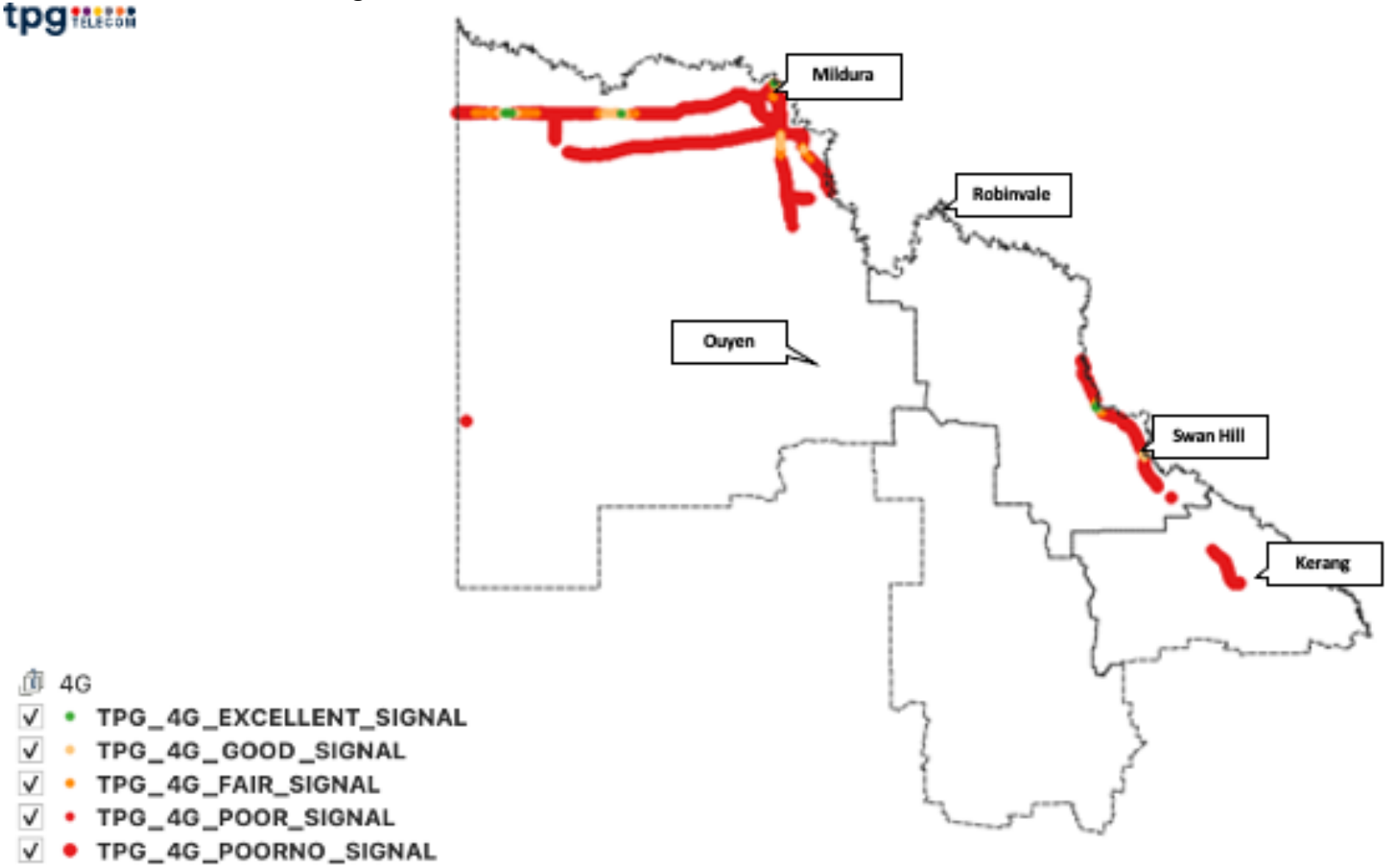
Optus 4G Excellent, Good & Fair Signal vs 4G coverage map



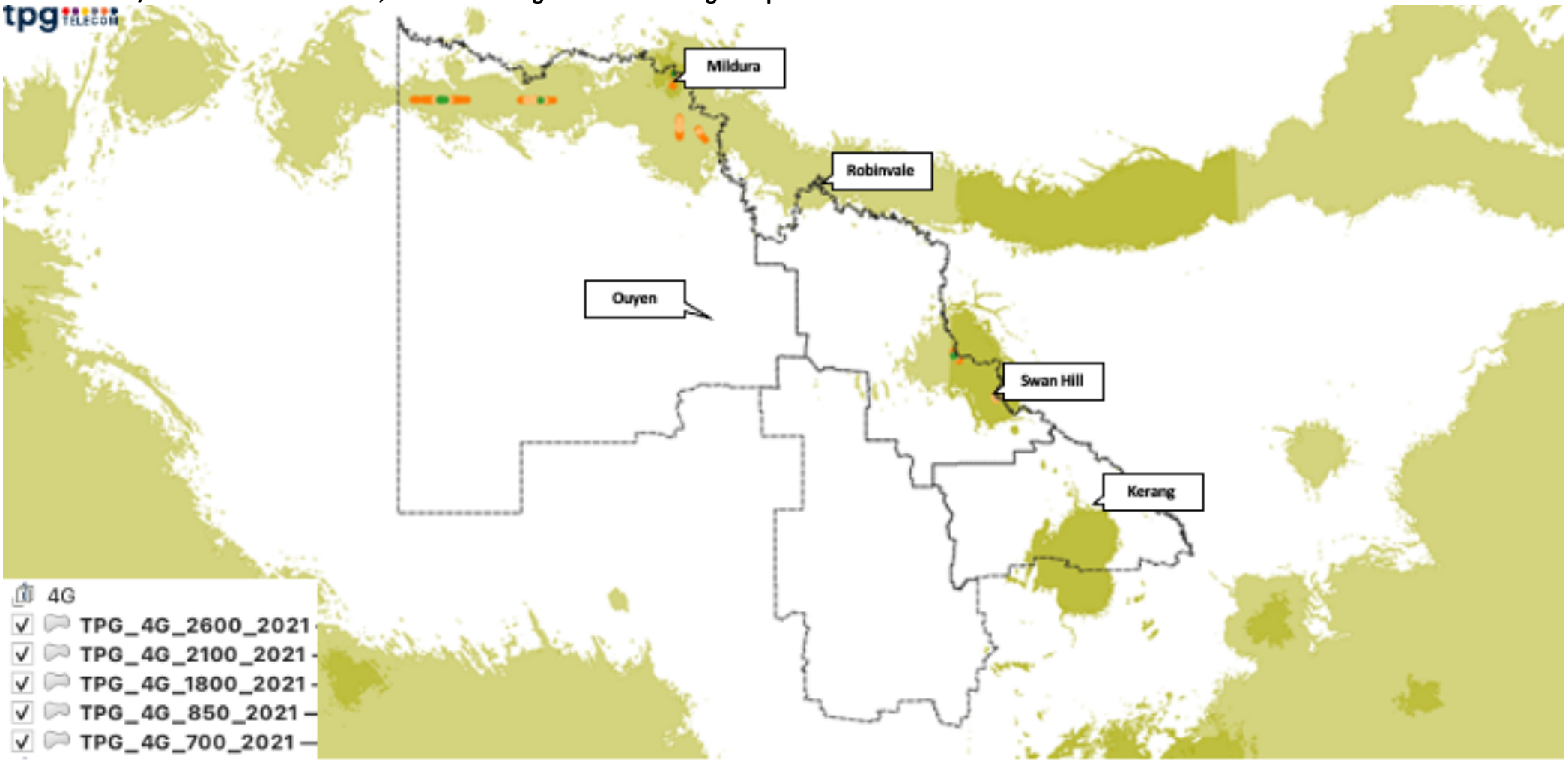
Optus 4G Poor & No Signal vs 4G coverage map



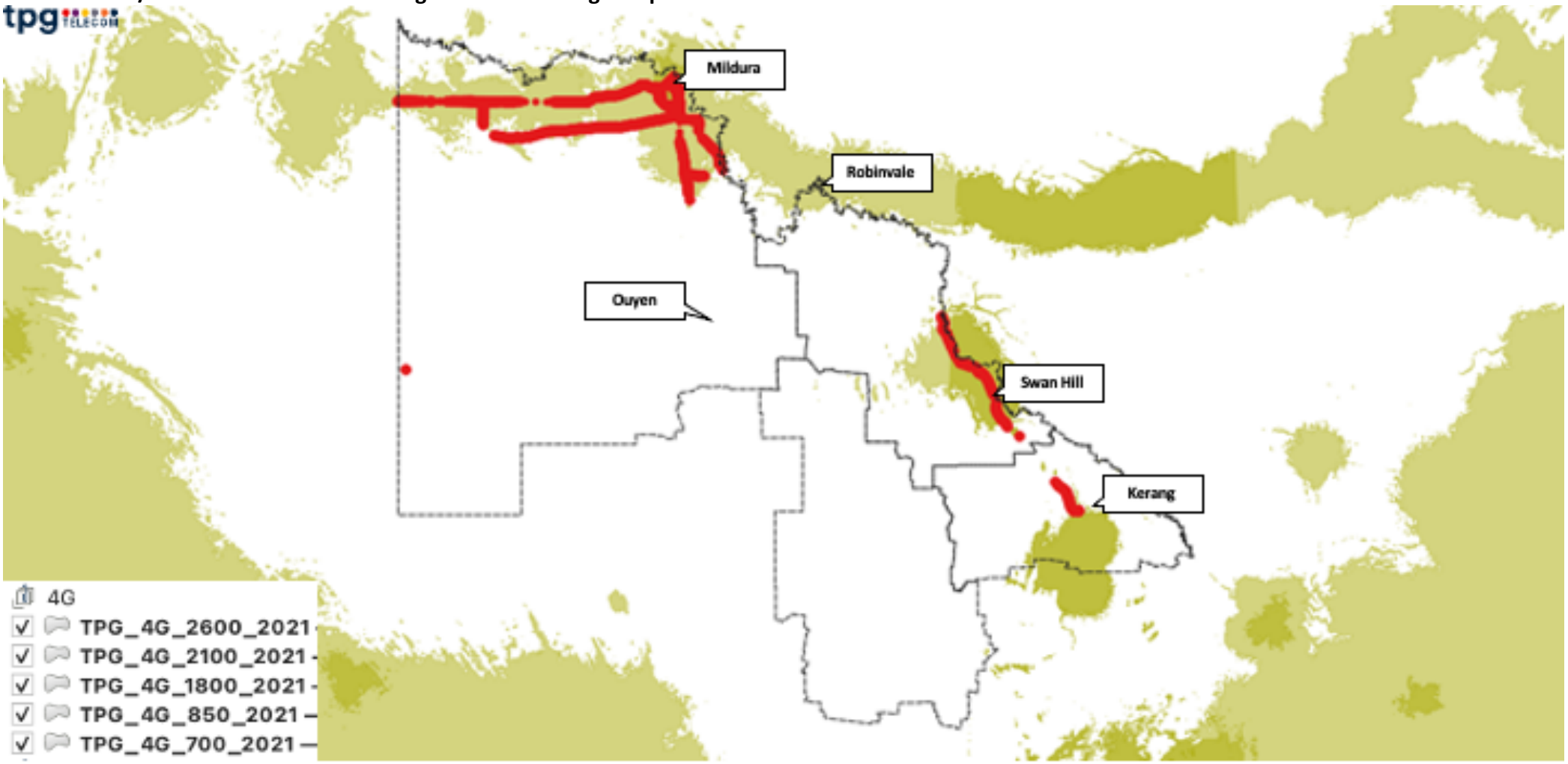
TPG Telecom / Vodafone 4G Signal collected



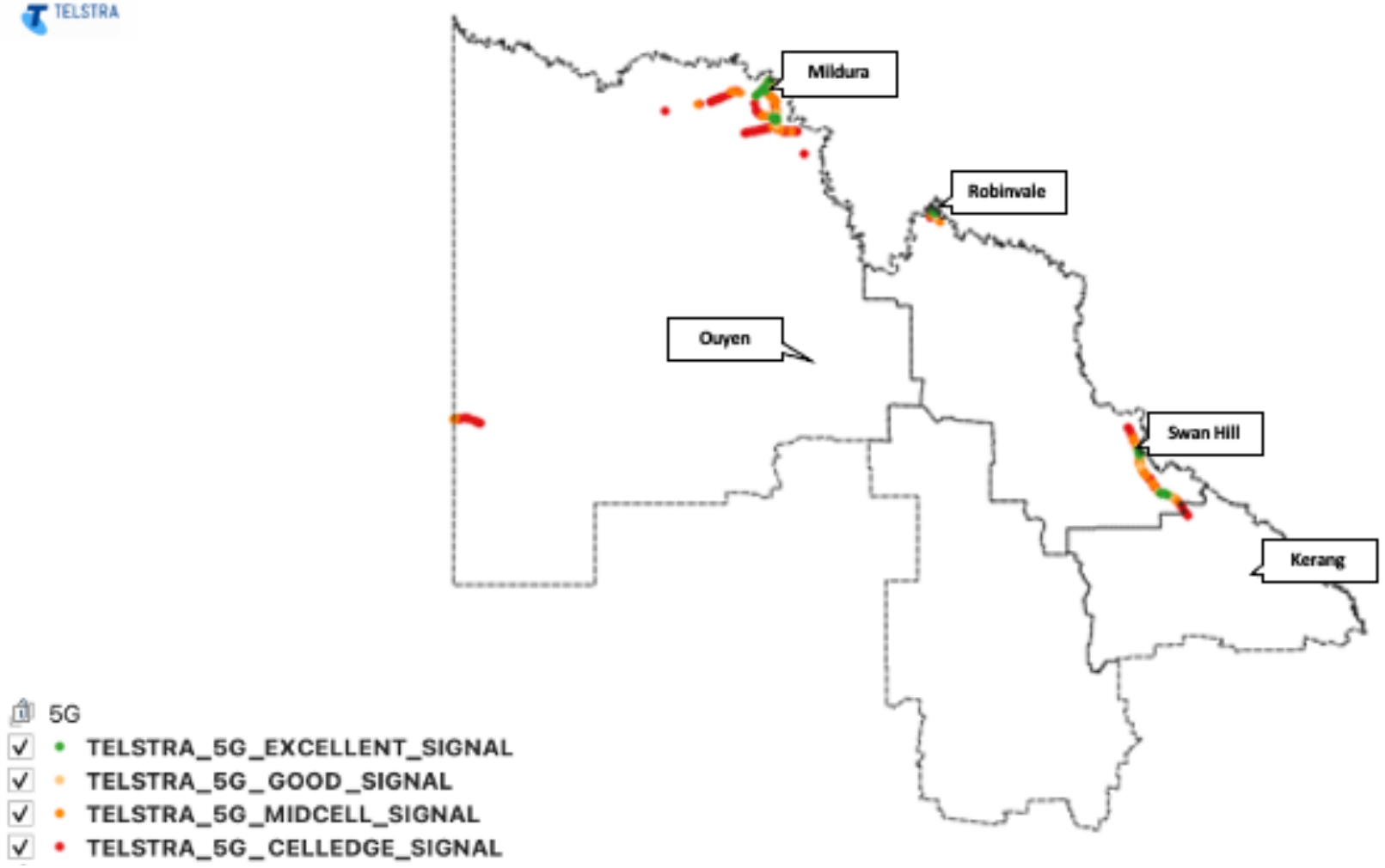
TPG Telecom / Vodafone 4G Excellent, Good & Fair Signal vs 4G coverage map



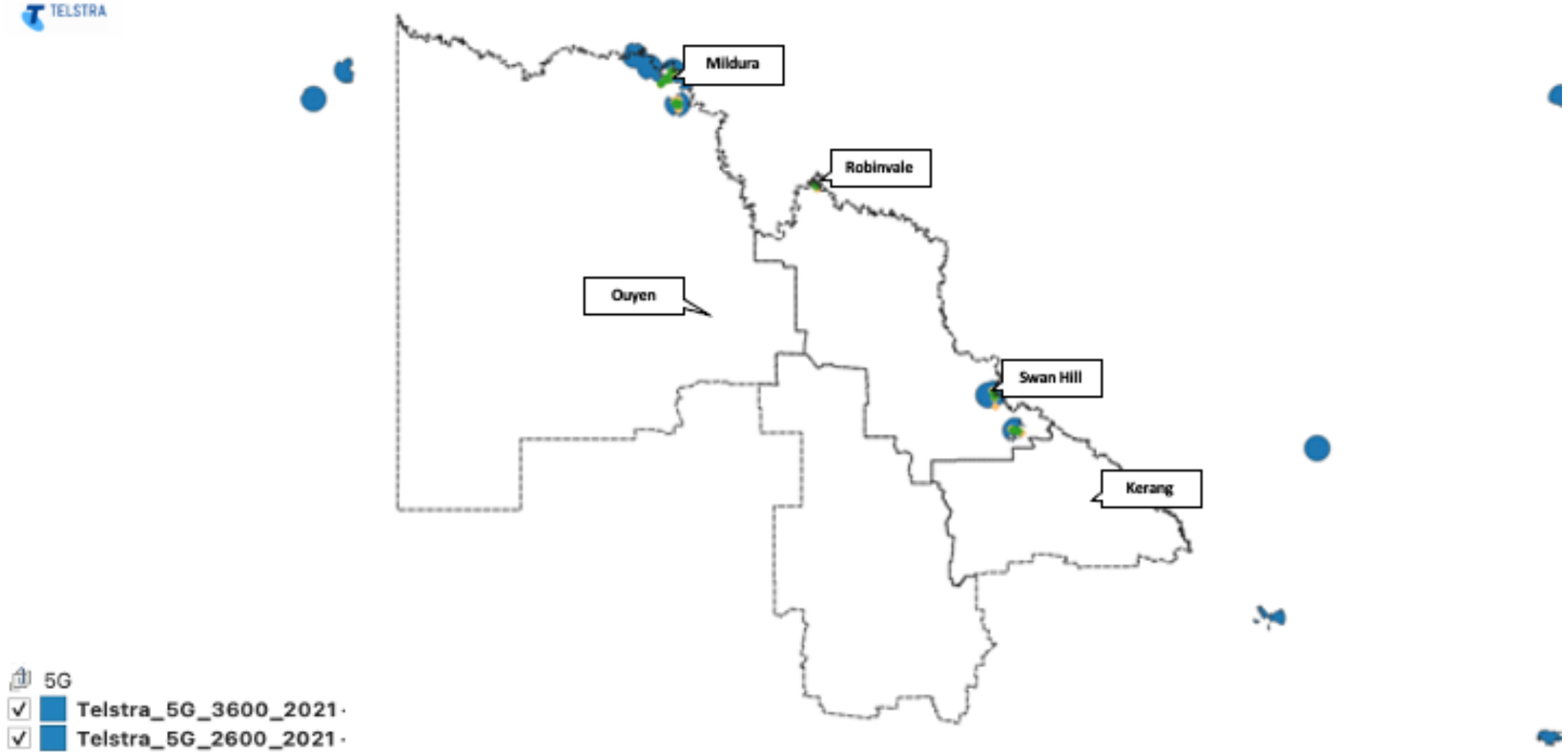
TPG Telecom / Vodafone 4G Poor & No Signal vs 4G coverage map



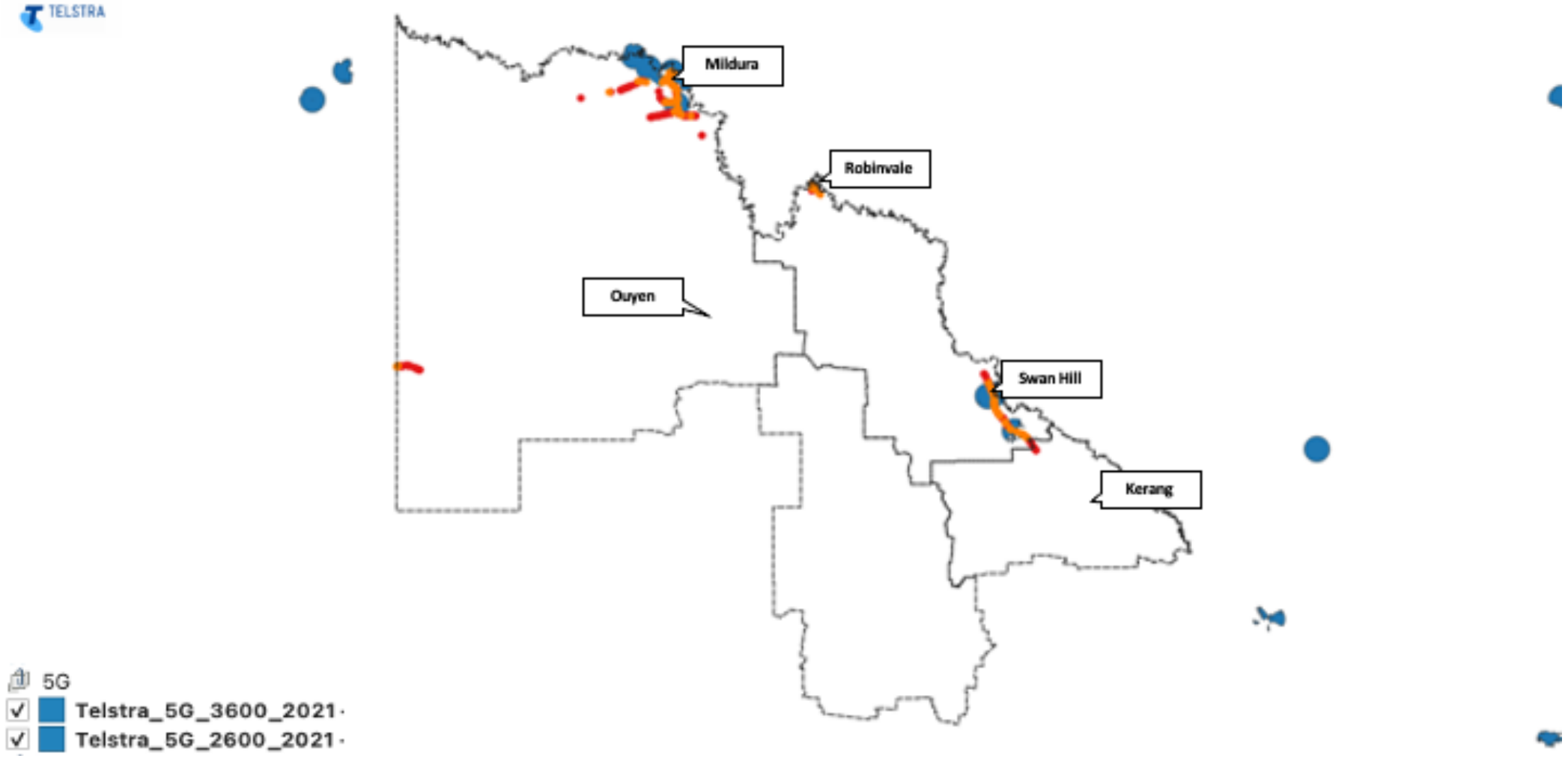
Summary of 5G mobile coverage
Telstra 5G Signal collected



Telstra 5G Excellent, Good & Fair Signal vs 5G coverage map



Telstra 5G Poor & No Signal vs 5G coverage map



4. Issues, Challenges & Advocacy

Key Issues

Current Challenges

The following challenges have been identified:

The importance of highly connected service centres

In the Mallee Region, there are several very important 'service centre' townships with a growing resident population that provide the local areas with essential services. It is essential that advocacy and prioritisation efforts are concentrated on the provision of better connectivity to these centre's than towns with higher populations that are easier to reach due to their geographic proximity and more attractive for investment by telecommunication providers.

Mobile Network Coverage, Capacity and Choice

Due to the nature of the Mobile Network Operator market, it is not commercially feasible for these operators to build ubiquitous mobile networks across any region in Australia including the Mallee region. Whilst some lower populated areas are not expected to have access to 4G networks for the foreseeable future, several higher population growth locations have been recommended for prioritisation to improve mobile network coverage, capacity and choice.

NBN Infrastructure access & suitability

Several key townships in the Mallee Region are currently only served by NBN Fixed Wireless and Satellite. Additionally, other key centres are currently served by Fibre to the Node (FttN) infrastructure. Whilst these technologies are essentially fit for purpose for 2022, it is arguable that by 2030 and the subsequent decade that Fixed Wireless, Satellite and Fibre to the Node technologies will not serve the capacity demands of households, businesses and other connectivity requirements such as growing Internet of Things connections.

Solving 'Last Mile' connectivity alternatives

The NBN enjoys a near monopoly position as the last mile fixed line network provider in Australia. However, in many areas there is evidence of frustration with service delivery and connection issues that result in either a diminished outcome or the inability to access an NBN service outright. More populated areas are seeing the introduction of alternatives to NBN such as high-speed wireless services and 5G Fixed Wireless.

Improvements to Satellite access

For rural and remote Australia, satellite networks have the attraction of offering additional bandwidth to connect these regions to international destinations. Satellite broadband services provide 100 per cent coverage of Australia's land area. However, the high costs and low speeds of satellite technologies have relegated them to be truly a last-option broadband technology. New low-earth orbit (LEO) satellites could potentially offer significant speed, performance and latency improvements towards the middle of the coming decade. Early LEOSat services such as Starlink are becoming available now as a high cost 'beta' service but will need to be accessible at lower pricing in the future.

Lack of access to LPWAN networks

Low-power wide area networks (LPWAN) is a wireless wide area network technology that interconnects low-bandwidth, battery-powered devices with low data rates over long ranges. Created for internet of things (IoT) networks, LPWANs operate at a lower cost with greater power efficiency than

traditional mobile networks. They are also able to support a greater number of connected devices over a larger area.

Ensuring future connectivity is fit for purpose

As digital connectivity continues to embed itself as an essential 21st century utility, the importance of ensuring connectivity infrastructure is fit for purpose for not just now but for coming decades in the most efficient way possible is paramount. Policies such as 'Dig Once' can ensure that the required passive infrastructure such as Ducts and Pits are installed in new development areas and construction projects enabling easier and cheaper installation of effective and competitive telecommunication infrastructure.

Advocacy Priorities

In the area of Telecommunications and Digital Connectivity, there are several key Federal and State Government Departments, Telecommunications Carriers and Service Providers and Industry Organisations that all regional stakeholders should maintain regular contact with to advocate for improvements and funding opportunities.

It is recommended that regional stakeholders should prioritise their finite resources for advocacy in accordance with the following section:

National Broadband Network

Areas for Mallee Region advocacy include specific items outlined in the Action Plans later in this strategy and generally the following:

- **NBN infrastructure improvements and extensions**
- **Business grade NBN access**
- **Satellite technology improvements**

Stakeholder	Frequency
NBN (Vic Stakeholder Relations representative)	Bi-annually
Federal Local Members	Annually
Department of Infrastructure, Transports, Regional Development and Communications	Annually
DJPR (Victorian State Government)	Annually

In relation to advocacy for improvements to NBN Satellite capacity and service levels, we recommend that the Mallee Region concentrates on advocating for longer term improvements by NBN and the Federal Government in the potential use of LEO Sat technologies as any immediate improvements by NBN in this area would be of incremental benefit at best.

Mobile Network coverage, capacity and choice

Areas for Mallee Region advocacy include specific items outlined in the Action Plans later in this strategy and generally the following:

- **Mobile network blackspots and Commonwealth Mobile Coverage Blackspot program funding**
- **Uplift of Mobile network capacity in key centres**
- **Shared infrastructure opportunities**
- **Low Power Wireless Networks for Sensors delivered by mobile networks**

Stakeholder	Frequency
Mobile Carriers Forum	Annually
Telstra	Annually
Optus	Annually
TPG Telecom	Annually
Federal Local Members	Annually
Department of Infrastructure, Transports, Regional Development and Communications	Annually
DJPR (Victorian State Government)	Annually

Last mile connectivity alternatives and Fibre Backhaul

Areas for Mallee Region advocacy include specific items outlined in the Action Plans later in this strategy and generally the following:

- **High speed Network alternatives to NBN (Fixed Wireless, Microwave etc.)**
- **Low Power Wireless Networks for Sensors delivered by non-mobile networks**
- **Increased opportunities for Fibre Backhaul connectivity**

Stakeholder	Frequency
VicTrack	Annually
LPWAN vendor(s)	Annually
Federal Local Members	Annually
Department of Infrastructure, Transports, Regional Development and Communications	Annually
DJPR (Victorian State Government)	Annually

In relation to advocacy with Fibre Backhaul providers such as Telstra and others, we recommend that Mallee Region prioritises its finite advocacy efforts on “Last Mile Connectivity” like NBN uplift and Mobile Network coverage, capacity and choice improvements, which will provide the most benefit for the region.

5. Future State Digital Infrastructure

Digital Infrastructure technologies are rapidly evolving

The days of dial-up, when the internet moved at a glacial pace, are now a distant memory. Today technology heeds our commands at the touch of a button. But even in urban areas, the digital world is not as fast and responsive as it could be. Calls still drop, connections go down, large files fail to download, and videos freeze for buffering.

All that is about to change, and quickly, thanks to the next generations of fixed and mobile connectivity as well as the proliferation of some existing technologies. More than any single advance on its own, it is the convergence of these developments that could enable new capabilities and create a more connected world.

In the coming years, connections could be 10 times faster, with a new level of reliability and stability. As latency improves by up to 50 times, applications will respond seamlessly to commands. Consumers could enjoy instant high-definition video streaming and even new types of immersive experiences with augmented and virtual reality.

Connectivity Technologies towards 2030

Connectivity Technology	Description	Applicability & timeline for Mallee Region
 Low to mid band 5G	High-speed, low-latency cellular connectivity overlay on existing 4G infrastructure	• Highly applicable upgrade to all current 4G and 3G networks • By 2025 for all Towns in Mallee Region
 Fibre to the Premise	High-speed, low-latency fixed networks that support other connectivity	• Highly applicable upgrade to all current NBN in township areas • By 2030 for all Towns in Mallee Region
 LPWAN	Low-power and low-maintenance networks that support high densities of connected devices	• Highly applicable to Agricultural areas
 LEO Satellite	Global coverage with significantly reduced latency vs. existing satellite offerings	• Highly applicable upgrade to NBN Satellite • Dependent on NBN upgrading to LEO Satellite technology or alternative provider (i.e., Starlink)
 High band 5G	Highest speed, low latency, and highly secure cellular connectivity	• Highly applicable enhancement to 5G networks • By 2030 for all Towns in Mallee Region

Mobile (Cellular)

5G

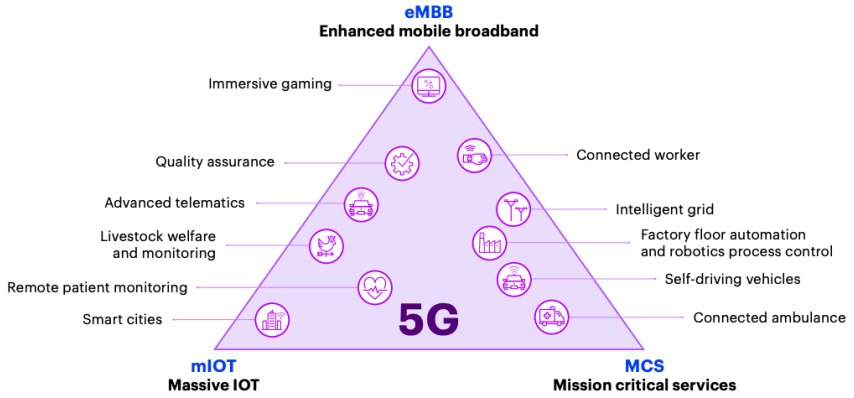
In terms of mobile coverage, providers are upgrading existing 4G infrastructure with low- to mid-band 5G network overlay. The end results of these upgrades will vary depending on the spectrum used and tower density. But in general, these low- to mid-frequency 5G networks can offer significant improvements in speed and latency, all while supporting a greater density of connected devices.

High-band (also known as millimetre-wave or standalone) 5G networks represent a step change in performance. Designed to be the most ultra-fast mobile option, high-band 5G promises to put the speed, latency, reliability, and security of fibre in the air, expanding what mobile devices can do. Because this requires a highly densified radio access network, an upgraded 5G core network, and upgraded network support systems, these networks are highly capital-intensive to build. Users will also need to upgrade to 5G-capable devices in order to experience the full benefits. Some companies will connect to commercially available services, while others may opt to build their own private 5G networks.

5G will lay the platform for the anticipated surge in connected devices and sensors by making more efficient use of spectrum and core networks than 3G and 4G technologies.

The improved connectivity offered by 5G will enable the potential of emerging technologies including augmented and virtual reality, autonomous vehicles, machine learning and robotics to be explored.

5G can better handle the increasing number of wireless devices being used simultaneously, so it will also facilitate greater use of Internet of Things (IoT).



IoT is currently enabled by 4G and other networks and in 2017 its adoption in the Australian consumer market rose by 55 per cent. In addition, government investment in and use of sensor technologies is becoming more compelling as they are capable of gathering more information and data, become self-powering and cheaper.

Business and industry use of IoT solutions is driving exponential growth and it is predicted that the existing 4G network will be unable to cope with the projected growth in data and devices - driving the need for 5G.

5G will require more sites than 2G, 3G or 4G because the radio spectrum used for 5G in metropolitan areas is generally higher frequency and less able to travel long distances than that used for earlier generations. 5G can be combined with other technologies such as ‘edge computing’ to deliver its potential. Edge computing is a distributed computing framework that brings enterprise applications closer to data sources (such as IoT devices or local edge servers), delivering faster insights, improved response times and better bandwidth availability.

	Low-band 5G 'Blanket' range	Mid-band 5G Sub 6 range	High-band 5G mmWave range
Spectrum used in Australia	**850 MHz / 900 MHz**	**3.6 GHz**	**26 GHz**
Sites required to fully cover a typical suburb with 5G	**A couple** Big, macro sites	**A few** Mix of macro sites and small cells	**A few dozen** A couple of macro sites and many small cells
Maximum **reach**	**A few kilometres**	**Up to a kilometre**	**A few hundred metres**
Coverage and wall penetration	**Great** Excellent propagation	**Good** Gets through walls	**Poor** Struggles to penetrate brick walls
Maximum **speeds** and latency	**Fast** Similar to 4G	**Faster** About 5–10 times faster than 4G	**Lightning fast** Up to 20–30 times faster than 4G
Ideal **areas for deployment**	**Outer metro** and **regional**	**Metro** and **suburban**	**High-density urban** and **CBDs**

Comparing 5G to other Technologies

	Wi-Fi 6	4G	5G
Latency	Several seconds	~55 milliseconds	<10 milliseconds
Mobility	Low	High	High
Coverage	10m (30 feet)	100m to km[1]*	100m to km[1]*
Bandwidth	High bandwidth[2]	Up to 20MHz band[3]	Up to 400 MHz[3]
Security	Reasonably secured[4]	Very secure[5]	Very secure[6]

With 4G, consumers can already stream media with fast download rates, but 5G takes this a step further. 5G has faster bi-directional connectivity and enhanced latency that can unlock many use cases across industries that 4G could not, such as augmented or virtual reality. 5G also offers several important benefits compared to WiFi-6. While WiFi-6 offers low cost and high speed, it lacks wireless mobility, reliability over wide-area coverage and the low latency benefits of 5G.

Fibre Optic

On the fixed line side, fibre optic networks continue to expand.
There are a few types of fibre connections:

- Fibre to the Premises (FTTP) – fibre optic cable is laid all the way to a home or business premises. High capacity services for businesses can be installed using a Point to Point architecture as compared to the NBN Fibre to the Premise which uses a Passive Optical Network architecture.
- Fibre to the Curb (FTTC) – fibre optic cable is laid to your kerb or driveway, and then connects to an existing copper phone line.
- Fibre to the Node (FTTN) – fibre optic cable is laid to a central point in a locality, and then connects to the existing copper phone line for each premise.
- Fibre to the Building (FTTB) – in an apartment building, fibre optic cable is laid to a central point, and then connects to the existing copper phone line for each apartment or office premises.
- Cable (aka Hybrid Fibre-Coaxial, or HFC) is a broadband technology that uses the sort of cable used by pay TV to connect you to the world wide web.

WIFI 6

Once a location is wired with fibre, the next generation of Wi-Fi (Wi-Fi 6) will improve speeds while supporting many more connected devices. Wi-Fi 6 will make the biggest difference in crowded environments such as airports, apartment buildings, theatres, stadiums, public spaces, and homes with multiple internet users and smart gadgets.
It also extends the battery life of smart devices and IoT sensors by employing "target wake time," which recognizes higher data transmission times instead of continuously scanning for signals. Users need to have Wi-Fi 6-ready devices, however.

LPWAN

Low-power wide-area networks (LPWANs) provide connectivity over broader areas and longer ranges. Different protocols, such as LoRa, NB-IoT, and Sigfox, compete in this realm, with no clear winner at this stage. Since LPWANs require less power from the devices they connect, they could enable batteries in those devices to last 10 years or more. This could set the stage for billions of additional battery-powered devices and sensors to come online. Beyond network developments, IoT sensors themselves are becoming more sophisticated and robust. They can perform more complex tasks, from location tracking and temperature measurement to small-scale processing. Even as they gain capabilities, unit prices are rapidly declining.

LEO Satellites

Like 5G, Low Earth Orbit (LEO) satellites enable other technologies, but their viability is less certain. If successful, they could deliver a breakthrough—not necessarily in network performance but in breadth of coverage. They could cover parts of the world where the economics do not work for laying fiber or building networks of towers (although providing coverage requires a constellation of many satellites orbiting at once). LEO satellite constellations could potentially substitute for mobile backhaul in disadvantaged or remote areas, essentially beaming broadband down from above, and providing coverage to those who lack connectivity today. The next generation of LEO satellite constellations promise substantial improvements over versions launched in the 1990s. However, OneWeb and SpaceX are the only companies to launch test satellites (as of this writing), and no commercial services are yet available.

6. High Level Investment & Action Plan

Recommended Options

Digital connectivity – or 'smart infrastructure' or 'digital infrastructure' – is the utility of the twenty-first century, underpinning every aspect of the modern economy and all aspects of smart cities. This includes cellular wireless – 2G, 3G, 4G, and 5G – and Wi-Fi, wired (including full-fibre) technologies, Internet of Things (IoT), and emerging non-terrestrial networks such as low-earth orbit satellites.

A further description of some of these opportunities are presented below –

NBN Business Fibre Zones

In mid 2020, NBN announced the expansion of business fibre zones to key regional areas within Australia to provide business grade Fibre to the Premise services to more areas at metropolitan pricing. This initiative would also provide the potential for extension of enterprise grade broadband to service local agribusinesses and industry clusters, many of whom are located in areas that could be prioritised.

NBN Fibre to the Premise upgrade

As outlined in the current state assessment, a number of Mallee Region townships are currently served with NBN Fibre to the Curb / Node, Fixed Wireless and Satellite. These towns should be advocated for by the Mallee Region and implemented by NBN for upgrade to Fibre to the Premise (FttP) as a minimum fit for purpose fixed line infrastructure before the end of the decade.

Next Step for Mallee Region

Advocate with the Commonwealth Government for NBN to

- implement NBN business fibre zones and NBN FttP upgrades as outlined in the table below

Mobile Network Infrastructure

Regional Australians rely on mobile and broadband networks for real-time information, access to emergency services, contact with loved ones, and resources to support post disaster recovery. However, gaps in coverage, particularly on mobile networks, continue to be a key barrier to telecommunications reliability in regional areas. Given current technology limitations and cost, there will be some gaps. However, despite significant government and industry investment in new mobile infrastructure across Australia, many priority areas, including major transport corridors, disaster-prone communities, tourist areas, and facilities like schools, hospitals and halls, do not have adequate coverage.

Next Step for Mallee Region

Advocate with the Commonwealth Government, Telstra, Optus and TPG Telecom to

- implement specific 5G and 4G Mobile Network upgrades as outlined in the table below

Fibre Backhaul Networks

The delivery of wholesale transmission services or fibre backhaul networks in regional Australia is vitally important, as this availability and access to these fibre backbone networks carry aggregated data over long distances and provide capacity for mobile and broadband networks. These services are predominantly supplied by large, vertically integrated providers like Telstra, although other wholesalers (like Vocus), government agencies, utilities providers, education facilities and rail companies also maintain quantities of fibre for their own communications needs and can also provide commercial access.

Next Step for Mallee Region

Advocate with the Commonwealth Government and the Telecommunications Carriers to

- implement specific Fibre Backhaul network investments as outlined in the table below

Low Powered Wireless Area Networks (LPWAN)

Unlike prior wireless technologies, LPWAN provides battery-efficient, ubiquitous wide-area connectivity, enabling more sensor and Internet of Things based applications that were previously prohibitive due to cost. The agricultural industry stands to benefit greatly from IoT initiatives and LPWAN can provide essential connectivity.

Next Step for Mallee Region

Advocate with the Commonwealth Government, Local Government and the Telecommunications Carriers to

- implement specific LPWAN network investments as outlined in the table below

Community	Fixed Broadband	Mobile Network	Mobile Network	Mobile Network[1]	Fibre Backhaul	LPWAN
Mildura	NBN business fibre zone & Fibre to the Premise upgrade has been announced by NBN[2]	5G 2600MHz 26000 MHz Sought by 2024	5G 2100Mhz 3500Mhz Sought by 2024 26000MHz Sought by 2026	5G 700Mhz 3600Mhz Sought by 2024 26000Mhz Sought by 2026 4G 2100Mhz Sought by 2023	Potential VicTrack Fibre Backhaul extension from Ballarat to Mildura TOTAL CAPEX ~$65M Sought by 2025	LoRaWAN network overlay TOTAL CAPEX ~$2M
Swan Hill	NBN business fibre zone & Fibre to the Node to Fibre to the Premise upgrade sought by 2025 TOTAL CAPEX ~$7.5M	5G 2600MHz 26000 MHz Sought by 2024	5G 2100Mhz 3500Mhz Sought by 2024 26000MHz Sought by 2026	5G 700Mhz 3600Mhz Sought by 2024 26000Mhz Sought by 2026 4G 2100Mhz Sought by 2023	Potential VicTrack Fibre Backhaul extension from Bendigo to Swan Hill TOTAL CAPEX ~$30M Sought by 2025	LoRaWAN network overlay TOTAL CAPEX ~$1.5M
Kerang	NBN business fibre zone & Fibre to the Node to Fibre to the Premise upgrade sought by 2025 TOTAL CAPEX ~$3M	5G 2600MHz 3600MHz Sought by 2024 26000Mhz Sought by 2026 4G 2100MHz & 2600Mhz Sought by 2024	5G 2100Mhz 3500Mhz Sought by 2024 26000MHz Sought by 2026 4G 2100Mhz Sought by 2023	5G 700Mhz 3600Mhz Sought by 2024 26000Mhz Sought by 2026 4G 2100Mhz Sought by 2023	Potential VicTrack Fibre Backhaul extension from Bendigo to Kerang TOTAL CAPEX ~$20M (if Swan Hill isn't delivered) Sought by 2025	LoRaWAN network overlay TOTAL CAPEX ~$0.75M

[1] Upgrades outlined may not be required if the Telstra TPG Network Sharing agreement is approved by the ACCC

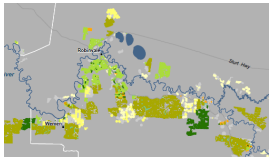
[2] https://www.nbnco.com.au/corporate-information/media-centre/media-statements/nbnco-announces-suburbs-and-towns-where-an-additional-ninty-thousand-homes-and-businesses-will-become-eligible-for-fibre-upgrades

Community	Fixed Broadband	Mobile Network	Mobile Network	Mobile Network[1]	Fibre Backhaul	LPWAN
Red Cliffs	NBN business fibre zone & Fibre to the Node to Fibre to the Premise upgrade sought by 2025 TOTAL CAPEX ~$3.5M	5G 2600MHz 26000 MHz Sought by 2024	5G 2100Mhz 3500Mhz Sought by 2024 26000MHz Sought by 2026	5G 700Mhz 3600Mhz Sought by 2024 26000Mhz Sought by 2026 4G 2100Mhz Sought by 2023	Potential VicTrack Fibre Backhaul extension from Ballarat to Red Cliffs TOTAL CAPEX ~$60M	LoRaWAN network overlay TOTAL CAPEX ~$0.5M
Robin Vale	NBN business fibre zone & Fibre to the Node to Fibre to the Premise upgrade sought by 2025 TOTAL CAPEX ~$5M	5G 2600MHz 3600MHz Sought by 2024 26000Mhz Sought by 2026 4G 1800MHz & 2100MHz Sought by 2024	5G 2100Mhz 3500Mhz Sought by 2024 26000MHz Sought by 2026 4G 1800Mhz Sought by 2023	5G 700Mhz 3600Mhz Sought by 2024 26000Mhz Sought by 2028 4G 2100Mhz Sought by 2023		LoRaWAN network overlay TOTAL CAPEX ~$0.5M
Cohuna	Fibre to the Node to Fibre to the Premise upgrade sought by 2026 TOTAL CAPEX ~$4M	5G 2600MHz 3600MHz Sought by 2024 26000Mhz Sought by 2028 4G 2100MHz & 2600MHz Sought by 2023	5G 2100Mhz 3500Mhz Sought by 2024 26000MHz Sought by 2028 4G 1800Mhz Sought by 2023	5G 700Mhz 3600Mhz Sought by 2024 26000Mhz Sought by 2028 4G 850MHz & 2100Mhz Sought by 2023		LoRaWAN network overlay TOTAL CAPEX ~$0.25M
Donald	Fibre to the Node to Fibre to the Premise upgrade sought by 2026 TOTAL CAPEX ~$5M	5G 2600MHz 3600MHz Sought by 2024 26000Mhz Sought by 2028 4G 2100MHz & 2600MHz Sought by 2023	5G 2100Mhz 3500Mhz Sought by 2024 26000MHz Sought by 2028 4G 1800Mhz Sought by 2023	5G 700Mhz 3600Mhz Sought by 2024 26000Mhz Sought by 2028 4G 850MHz & 2100Mhz Sought by 2023		LoRaWAN network overlay TOTAL CAPEX ~$0.25M

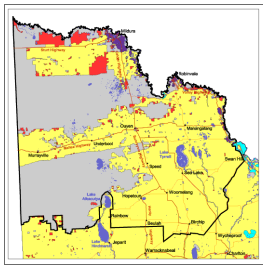
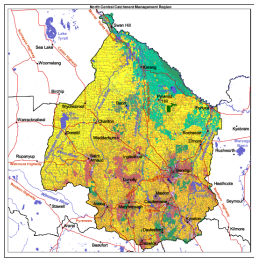
Community	nbn Fixed Broadband	TELSTRA Mobile Network	OPTUS Mobile Network	tpg TELECOM Mobile Network[1]	Fibre Backhaul	LPWAN
Ouyen	Fibre to the Premise upgrade has been announced by Connecting Victoria[3]	5G 2600MHz 3600MHz Sought by 2024 26000Mhz Sought by 2028 4G 2100MHz & 2600MHz Sought by 2023	5G 2100Mhz 3500Mhz Sought by 2024 26000MHz Sought by 2028	5G 700Mhz 3600Mhz Sought by 2024 26000Mhz Sought by 2028 4G 850MHz & 2100Mhz Sought by 2023	Potential VicTrack Fibre Backhaul extension from Ballarat to Ouyen TOTAL CAPEX ~$50M Sought by 2025	LoRaWAN network overlay TOTAL CAPEX ~$0.25M
Charlton	Fibre to the Node to Fibre to the Premise upgrade sought by 2026 TOTAL CAPEX ~$5M	5G 2600MHz 3600MHz Sought by 2024 26000Mhz Sought by 2028 4G 2100MHz & 2600MHz Sought by 2023	5G 2100Mhz 3500Mhz Sought by 2024 26000MHz Sought by 2028 4G 900MHz, 1800Mhz & 2100MHz Sought by 2023	5G 700Mhz 3600Mhz Sought by 2024 26000Mhz Sought by 2028 4G 850MHz & 2100Mhz Sought by 2023		LoRaWAN network overlay TOTAL CAPEX ~$0.25M
Lake Boga	Fibre to the Node to Fibre to the Premise upgrade sought by 2026 TOTAL CAPEX ~$5M	5G 2600MHz 26000 MHz Sought by 2024	5G 2100Mhz 3500Mhz Sought by 2024 26000MHz Sought by 2026	5G 700Mhz 3600Mhz Sought by 2024 26000Mhz Sought by 2026 4G 2100Mhz Sought by 2023		LoRaWAN network overlay TOTAL CAPEX ~$0.25M
Sea Lake	Fibre to the Premise upgrade has been announced[4]	5G 2600MHz 3600MHz Sought by 2024 26000Mhz	5G 2100Mhz 3500Mhz Sought by 2024 26000MHz	5G 700Mhz 3600Mhz Sought by 2024 26000Mhz	Potential VicTrack Fibre Backhaul extension from Bendigo to Sea Lake	LoRaWAN network overlay

[3] https://djpr.vic.gov.au/connecting-victoria/projects
[4] https://nationals.org.au/victoria-gets-telecommunications-boost/

Community	nbn Fixed Broadband	TELSTRA Mobile Network	OPTUS Mobile Network	tpg TELECOM Mobile Network[1]	Fibre Backhaul	LPWAN
		Sought by 2028 4G 2100MHz & 2600MHz Sought by 2023	Sought by 2028 4G 1800MHz Sought by 2023	Sought by 2028 4G 850MHz & 2100Mhz Sought by 2023	TOTAL CAPEX ~$30M Sought by 2028	TOTAL CAPEX ~$0.25M
Birchup	Fibre to the Node to Fibre to the Premise upgrade sought by 2028 TOTAL CAPEX ~$5M	5G 2600MHz 3600MHz Sought by 2024 26000Mhz Sought by 2028 4G 1800MHz, 2100MHz & 2600MHz Sought by 2023	5G 2100Mhz 3500Mhz Sought by 2024 26000MHz Sought by 2028 4G 900MHz, 1800Mhz & 2100MHz Sought by 2023	5G 700Mhz 3600Mhz Sought by 2024 26000Mhz Sought by 2028 4G 850MHz & 2100Mhz Sought by 2023		LoRaWAN network overlay TOTAL CAPEX ~$0.25M
Wycheproof	Fibre to the Node to Fibre to the Premise upgrade sought by 2028 TOTAL CAPEX ~$5M	5G 2600MHz 3600MHz Sought by 2024 26000Mhz Sought by 2028 4G 2100MHz & 2600MHz Sought by 2023	5G 2100Mhz 3500Mhz Sought by 2024 26000MHz Sought by 2028 4G 1800Mhz Sought by 2023	5G 700Mhz 3600Mhz Sought by 2024 26000Mhz Sought by 2028 4G 850MHz & 2100Mhz Sought by 2023		LoRaWAN network overlay TOTAL CAPEX ~$0.25M
Leitchville	Fibre to the Node to Fibre to the Premise upgrade sought by 2028 TOTAL CAPEX ~$5M	5G 2600MHz 3600MHz Sought by 2024 26000Mhz Sought by 2028 4G 1800MHz, 2100MHz & 2600MHz Sought by 2023	5G 2100Mhz 3500Mhz Sought by 2024 26000MHz Sought by 2028 4G 900MHz, 1800Mhz & 2100MHz Sought by 2023	5G 700Mhz 3600Mhz Sought by 2024 26000Mhz Sought by 2028 4G 850MHz & 2100Mhz Sought by 2023		LoRaWAN network overlay TOTAL CAPEX ~$0.25M

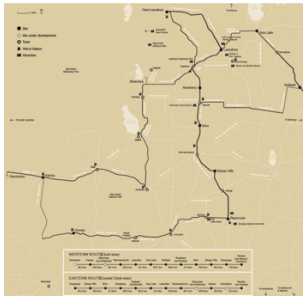
Community	Fixed Broadband	Mobile Network	Mobile Network	Mobile Network[5]	Fibre Backhaul	LPWAN
Industry Priority – Horticulture 	Advocate for increased choice in LEO Satellite services via Starlink, OneWeb and NBN	Widespread access to 5G 2600MHz 3600MHz Sought by 2026 4G 1800MHz, 2100MHz & 2600MHz Sought by 2024	Widespread access to 5G 2100Mhz 3500Mhz Sought by 2026 4G 900MHz, 1800Mhz & 2100MHz Sought by 2024	Widespread access to 5G 700Mhz 3600Mhz Sought by 2026 4G 850Mhz & 2100Mhz Sought by 2024	Refer to Fibre Backhaul improvements above for Robin Vale	LoRaWAN network overlay TOTAL CAPEX ~$5M

[5] Upgrades outlined may not be required if the Telstra TPG Network Sharing agreement is approved by the ACCC

Community	Fixed Broadband	Mobile Network	Mobile Network	Mobile Network[6]	Fibre Backhaul	LPWAN
Industry Priority – Cropping  	Advocate for increased choice in LEO Satellite services via Starlink, OneWeb and NBN	Widespread access to 5G 2600MHz 3600MHz Sought by 2026 4G 1800MHz, 2100MHz & 2600MHz Sought by 2024	Widespread access to 5G 2100Mhz 3500Mhz Sought by 2026 4G 900MHz, 1800Mhz & 2100MHz Sought by 2024	Widespread access to 5G 700Mhz 3600Mhz Sought by 2026 4G 850Mhz & 2100Mhz Sought by 2024	Refer to Fibre Backhaul improvements above for Mildura, Robin Vale, Ouyen etc	LoRaWAN network overlay TOTAL CAPEX ~$10M

[6] Upgrades outlined may not be required if the Telstra TPG Network Sharing agreement is approved by the ACCC

Community	Fixed Broadband	Mobile Network	Mobile Network	Mobile Network[7]	Fibre Backhaul	LPWAN

Industry Priority – Tourism
 	
• Highways including
  ○ Sunraysia Hwy;
  ○ Calder Hwy;
  ○ Murray Valley Hwy;
  ○ Sturt Hwy and
  ○ Mallee Highway
 	
• Visitor centre at Lake Tyrrell
• Western part of Silo Trail
 	
 
	Advocate for increased choice in LEO Satellite services via Starlink, OneWeb and NBN	Widespread access to
		5G
		2600MHz
		3600MHz
		Sought by 2026
		4G
		1800MHz, 2100MHz & 2600MHz
		Sought by 2024
			Widespread access to
			5G
			2100Mhz
			3500Mhz
			Sought by 2026
			4G
			900MHz, 1800Mhz & 2100MHz
			Sought by 2024
				Widespread access to
				5G
				700Mhz
				3600Mhz
				Sought by 2026
				4G
				850Mhz & 2100Mhz
				Sought by 2024
					Refer to Fibre Backhaul improvements above	LoRaWAN network overlay
						TOTAL CAPEX ~$5M

[7] Upgrades outlined may not be required if the Telstra TPG Network Sharing agreement is approved by the ACCC

Upgrades to Mobile Networks using Shared Radio Access Networks

Increasingly, the ability to deliver increased 4G and 5G coverage, capacity and choice of provider through shared infrastructure deployment are becoming more viable. Passive and Active sharing of enabling infrastructure and Radio Access Networks (RAN) is being proven overseas and this has been recognised by the Commonwealth Government through the recent changes to the Mobile Blackspot Program guidelines that promote these architectures. The Alpine Shire would provide an opportunity for at minimum, a Proof of Concept with other Government Partners and Mobile Network operators to deploy shared mobile infrastructure for regional Victoria.

Next step for Mallee Region

Engage assistance to develop the Proof of Concept Scope, Engagement Procedure, Request for Information documents and seek funding as a Covid Recovery Telecommunications Infrastructure project.

Approximate investment: $30K to $50K

Open Access Duct investment in key centres

There are viable opportunities to install open access duct infrastructure in key centres as part of Streetscape projects. The increment extra cost of installation when trenches are open is the cheapest way to install appropriately designed passive infrastructure that can attract outcomes including NBN infrastructure uplift, the introduction of additional Telecommunications providers and the ability to attract access revenues to offset some of the cost of deployment, operations and maintenance.

Next Step for Mallee Region

Engage assistance to review current designs to ensure that appropriate telecommunications pit and pipe and associated infrastructure is correctly dimensioned and develop a commercial and facilities access framework to promote open and equitable access.

Approximate investment $20K to $30K

Whole of Region Policy – Common Telco Facilities Access and New Duct in New Development and Construction projects

An important way that local government can enable long term telecommunications and connectivity outcomes is to develop a common Facilities Access Framework across all Council owned assets that can house telecommunications equipment in the region. This can include Land, Buildings, Water Reservoirs, Poles and other Street level assets such as Bus Shelters. A common framework that allows for timely access, approvals and appropriate lease rental costs can position the region as attractive for accelerated investment in both fixed and mobile networks. In addition, the adoption of a 'Dig Once' policy for the introduction of Council owned duct and smartpoles in new developments and construction projects such as new roads and road upgrades can contribute to important passive assets that can be leveraged to encourage future connectivity access.

Next Step for Mallee Region

Engage assistance to develop the Policy based on best practice and engage with relevant stakeholders

Approximate investment: $30K to $50K

7. Funding Opportunities

Funding Opportunities to close gaps

In order to proceed with any of the identified options, there may be value in exploring funding options from government sources as set out below:

Commonwealth Government

Regional Connectivity Program

The Regional Connectivity Program (the RCP) is a grants program funding the delivery of 'place-based' telecommunications infrastructure projects to improve digital connectivity across regional, rural and remote Australia.
https://www.infrastructure.gov.au/media-technology-communications/internet/regional-connectivity-program

Mobile Black Spot Program

The Australian Government is improving mobile phone coverage and competition in regional and remote Australia through the Mobile Black Spot Program. The Government has committed $380 million to the Mobile Black Spot Program (the Program) to invest in telecommunications infrastructure to improve mobile coverage and competition across Australia. The Program is supported by co-contributions from state and local governments, mobile network operators (Optus, Telstra, TPG Telecom Ltd (formerly Vodafone) and Field Solutions Group), businesses and local communities.
https://www.communications.gov.au/what-we-do/phone/mobile-services-and-coverage/mobile-black-spot-program

Peri-urban Mobile Program

The Peri-Urban Mobile Program (PUMP) is a grants program that provides funding to improve mobile connectivity in bushfire priority areas along the edges of Australia's major cities.
https://www.infrastructure.gov.au/media-technology-communications/phone/mobile-services-coverage/peri-urban-mobile-program

5G Innovation Initiative

The Australian 5G Innovation Initiative will test technologies that make use of 5G to drive productivity and growth across Australia in key sectors. The 5G Innovation Initiative will fund trials demonstrating different future 5G uses, including Internet of Things applications, which will help build Australia's 5G ecosystem. The Initiative will support the rigorous, commercial and replicable testing of 5G uses and showcase the productivity boosting applications of the technology. The Initiative is an open, competitive grants program with two rounds of funding over three years to encourage private sector investment.
https://www.communications.gov.au/what-we-do/spectrum/australian-5g-innovation-initiative

NBN Regional Co-investment Fund

NBN Co has also allocated $300 million to co-invest with councils, state, territory and federal governments in programs to boost regional connectivity. The co-investment fund is expected to assist in expanding fixed line services to more regional areas.
https://www.nbnco.com.au/content/dam/nbn/documents/about-nbn/reports/reports-and-publications/nbn-rcif-guidelines.pdf

Mobile Network Hardening Program

The purpose of the Mobile Network Hardening Program (the Program) is to increase the resilience of (i.e. to harden) Australia's mobile telecommunication networks to help prevent, mitigate and manage outages during bushfires and other Natural Disasters.
https://www.infrastructure.gov.au/media-communications-arts/phone/improving-resilience-australias-telco-networks

State Government

Connecting Victoria

The Victorian Government is fast-tracking better mobile coverage and broadband across the state through the $550 million Connecting Victoria program.
The program will focus on getting more Victorians access to business-grade broadband and upgrading mobile coverage, improving 4G mobile coverage, helping more places become 5G ready, and improving access to safety information during bushfires and other emergencies.
https://djpr.vic.gov.au/connecting-victoria

Local Government

It has been noted previously that the Councils within the Mallee Region could contribute to the advancement of telecommunications throughout the region by investing cash, budgeted on the basis of it being utility infrastructure, necessary for the development of the economy, community and safety for the region. Council could also make available, some of its existing infrastructure, such as water towers, buildings, etc. where transmission devices could be located.

Private Investment

There is also the possibility that private organisations, or individuals could be willing to contribute. Service providers might be encouraged to invest in the expansion of their networks if critical demand mass could be aggregated, or potential users willing to meet or offset some of the capital cost involved in delivering the necessary infrastructure.

8. Conclusion

Conclusion

The Mallee Region Digital Advancement Investment Action Plan has identified that there is a significant requirement to improve digital connectivity within the Mallee Region. We have outlined a number of near, medium and long term initiatives that will require significant levels of investment which will be beyond the funding capabilities of local government alone.

Investment priorities for all relevant programs need to ensure multiple service provider outcomes as much as possible, require little to no matching funding contributions for remote locations and should always prioritise towns based on their service provider status, not necessarily in population ranking.

Other jurisdictions such as the Australian Government and New South Wales[8] have recognised that State Government funding support is required for digital connectivity co-investment, especially in rural and remote areas where government funding intervention is the only method that allows for infrastructure improvements in non-commercial environments.

Our strong recommendation is that Mallee Regional Partnership, advocate to the Commonwealth and Victorian State Governments for significant amounts of co-investment funding that can be leveraged with Telecommunication Provider co-investment to implement 21st century digital connectivity infrastructure in the Mallee region.

[8] https://www.nsw.gov.au/snowy-hydro-legacy-fund/regional-digital-connectivity-program/gig-state

9. Glossary

Glossary of Terms	
Backhaul	Backhaul typically refers to the mid to long-distance transport of data from a series of disparate locations back to a more centralised location. The backhaul portion of the network comprises the intermediate links between the core, or backbone, of the network and the small sub-networks at the 'edge' of the entire hierarchical network. In the context of the NBN, backhaul services are the data carriage services provided over highspeed, high-capacity fibre lines, which carry aggregated network traffic between a Point of Interconnect (PoI) and a centralised or 'core' part of the network, for example an Internet Service Provider's data centre.
Bandwidth	Refers to the capacity and rate of data transfer over a network, usually measured in kilobits, megabits or gigabits per second.
Blackspot	An under-served premises, or area, usually in remote or rural locations and sometimes on the edges of cities, which is unable to obtain adequate, metro-comparable broadband or other communications services. Reasons for blackspots are normally related to the limitations of technologies, geography or a lack of investment.
Broadband	Broadband is a term used to refer to 'always on' high speed Internet or other network access. In the past, broadband services and technologies were defined in terms of a capability to transfer information at higher rates than traditional dial-up services.
Cloud Computing	Cloud computing is an Internet-based technology which stores information in servers and provides that information as an on demand service. Under cloud computing consumers can access all of their documents and data from any device with internet access such as a home or work PC, a mobile phone or other mobile internet enabled device.
Dark Fibre	It is the equipment at either end that dictates what capacity can be delivered over an optical fibre— ranging upwards from about 100 Mbit/s (at the low end). The term 'dark fibre' simply refers to optical fibre that is available for use and is provided without any equipment at either end. The term was originally used when talking about the potential network capacity of telecommunication infrastructure, but now also refers to the increasingly common practice of leasing fibre optic cables from a network service provider.
Digital Divide	The gap between people with effective access to digital and information technology and services, and those with very limited or no access at all. It refers both to a person's physical access to technology and the resources and skills available to effectively use the technology. Often used in Australia to describe the different levels of communications service available between metropolitan and regional areas.

Fibre Optic	Also known as optical fibre, fibre-optic cable is made up of thin threads of glass that carry beams of light. In telecommunications, data is translated into pulses of laser light that can be transmitted along the fibre cables. Fibre-optic technology is less susceptible to 'noise' and 'interference' than other data-transfer mediums such as standard copper telephone lines and can be used more reliably over longer distances without loss of speed or quality. Fibre is used extensively in backbone and international submarine networks, and to connect the base stations of mobile and wireless networks. It is increasingly being used for the last mile connection to home and business premises in FTTX networks.
Fibre to the Curb (FttC)	Refers to networks in which fibre connections are provided to a kerb-side equipment cabinet, in which the fibre's optical signal is converted to an electrical signal and delivered to premises over copper wires— typically over a maximum distance of 100 metres or less.
Fibre to the Node (FttN)	Similar to FTTC but using a neighbourhood node that serves more premises rather than a kerb-side node. Copper distances are typically up to around 1 km.
Fibre to the Premise (FttP)	Similar to Fibre to the Home, but a more neutral term that includes non-residential premises, such as schools, hospitals, and workplaces, as well as households. Fibre connections are provided all the way to premises, including individual units in multi-dwelling buildings
Fixed Line	Fixed line refers to technologies that use physical infrastructure, such as copper wires, rather than wireless infrastructure to deliver data connections. Traditional voice services, dial-up internet, xDSL, HFC cable and FTTP are all forms of fixed line services
Fixed Wireless Broadband	A family of wireless technologies that, as opposed to mobile wireless, delivers broadband services to a particular premises or fixed location. These services are sometimes called 'point-to point' or 'point-to-multi-point' and require an antenna that is generally permanently attached to the user's building. Fixed wireless can be used for backhauling in certain cases but also as an access technology, particularly in rugged or remote terrain and areas with low population densities that may make a fixed line alternative impossible or uneconomic. Wireless technologies are limited by the availability of wireless spectrum, the number of concurrent users, distance from the cell antenna and physical impediments such as hills and valleys interrupting signals.
Gigabit per second (Gbit/s)	A measure of communications speed equal to 1 000 000 000 bits per second. Also expressed as Gbps and Gb/s.

Greenfield	A term used to describe a piece of undeveloped land, either currently used for agriculture or completely unused.
Internet	A worldwide, publicly accessible series of interconnected computer networks that transmit data using the standard Internet Protocol (IP). It is a 'network of networks' that consists of millions of smaller domestic, academic, business, and government networks, which together carry various information and services, such as electronic mail, online chat, file transfer, and the interlinked web pages and other resources of the World Wide Web (www).
Internet Service Provider (ISP)	Also known as a Retail Service Provider (RSP), an organisation that offers access to the Internet to its customers. ISPs generally also provide other services such as electronic mail accounts, data storage and web hosting to their customers. ISPs may employ a combination of their own and third party infrastructure, or simply resell services provided by a wholesale carrier.
Last mile infrastructure	Infrastructure used to provide the link from a customer's premises to the provider's nearest point of aggregation. For example, a provider offering a wireless broadband service to the customer would be providing last-mile infrastructure using wireless broadband technology. The "digital divide" is attributed to the lack of suitable "Last mile infrastructure' in lower population density areas.
Latency	The delay in data transmission caused by the time it takes for data to get from one designated point to another.
Megabits per second (Mbit/s)	A measure of communications speed equal to 1 000 000 bits per second. Also expressed as Mbps, mbps, Mb/s and mb/s.
Mobile Wireless and Mobile Broadband	Broadband services supported by mobile networks, such as '3G' and '4G' networks, offering mobility and flexibility for users of handheld and laptop devices. Wireless technologies are limited by the availability of wireless spectrum, the number of concurrent users, distance from the cell antenna and physical impediments such as hills and valleys interrupting signals.
Point of Interconnect	The connection point that allows Retail Service Providers (RSPs) and Wholesale Service Providers (WSPs) to connect to NBN Co network infrastructure.

(PoI)	
Quality of Service (QoS)	The use of a range of networking technologies and techniques to provide guarantees on the ability of a network to deliver predictable results. Network performance within the scope of QoS can include availability, bandwidth, latency and error rate.
Satellite Broadband	Satellite broadband uses a radio dish to bounce a signal off a satellite and down to an earth station. It is common in rural and remote areas with low population densities, where fixed line alternatives are uneconomic. One-way satellite connections utilise a satellite link to download data to the broadband user and a standard telephone connection for uploading data back to the Internet. Two–way satellite connections use the satellite link to both upload and download information. The suitability of satellite broadband for some applications is impacted by the large physical distances between satellites and the earth's surface, which results in latency (delay) in the sending and receipt of data. Quality may also be affected by the number of simultaneous users and adverse weather conditions.
Smart Infrastructure	The application of communications technologies to infrastructure to make better, more efficient use of resources. Smart infrastructure can be used within the transport, energy, communications and water sectors.
Wholesale Service Provider (WSP)	A provider of infrastructure and services that deals only with other providers and does not have a commercial relationship with end-users or consumers. In telecommunications, a wholesale service provider allows other companies to lease access to equipment and services and avoid the expense of building their own infrastructure.
Wireless Broadband	Wireless broadband uses radio frequencies to transmit and receive data between customers and a local transmission point. Normally, this requires a number of base stations, similar to mobile phone towers, which transmit to customers who have a small transmitter/receiver connected to their computers or other digital devices. Wireless technologies are limited by the availability of wireless spectrum, the number of concurrent users, distance from the cell antenna and physical impediments such as hills and valleys interrupting signals.
Wireless Spectrum	Often referred to as the Radio-Frequency Spectrum, this is the array of electromagnetic radio frequencies used for communications, including mobile broadband, television, AM and FM radio, defence and any other service employing a wireless technology. The spectrum is divided into many frequency ranges, or bands, and usually allocated for a specific technology, device, use or service. Wireless Spectrum is a finite and regulated public asset, and in Australia is administered by the Australian Communications and Media Authority (ACMA), often through a licensing regime.