DSSN Region Digital Connectivity Business Case

Phase 1 Deliverable:

- LGA Regions Telecommunications Infrastructure Review
- Future Population and Visitor Demands on Telecommunications Infrastructure
- Telecommunications Infrastructure Options Analysis
- Scenario Planning for Future Connectivity Demand

February 2024

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Structure and Limitations to this report

Limitations

The review of telecommunications infrastructure and any data analysed in this report has been conducted utilising public information from reputable sources such as the ACCC and ABS. Datasets have been provided to such sources directly by telecommunications providers and census data, all of which are in the public domain.

Where specific data has not been public, proxy numbers have been used based on assumptions made from existing data sets and highlighted accordingly.

Structure

Due to the detailed modelling and amount of data used to determine the current and future state of telecommunications infrastructure and digital connectivity access across the DSSN region (ten Local Government Areas), this report is laid out in the following structure:

1. **Chapter Summary:** The four outputs of this deliverable are presented in succinct chapters summarising the high-level approach taken and the key outcomes of the research and modelling conducted.
2. **Appendices:** The detailed methodologies and findings behind the report chapters and outcomes.

This report can be navigated using the chapter titles listed across the top of the main body pages. Appendix chapters use the main four chapter headings for ease of navigation and to inform the reader as to which chapter the appendix refers to.

Scope of this Report

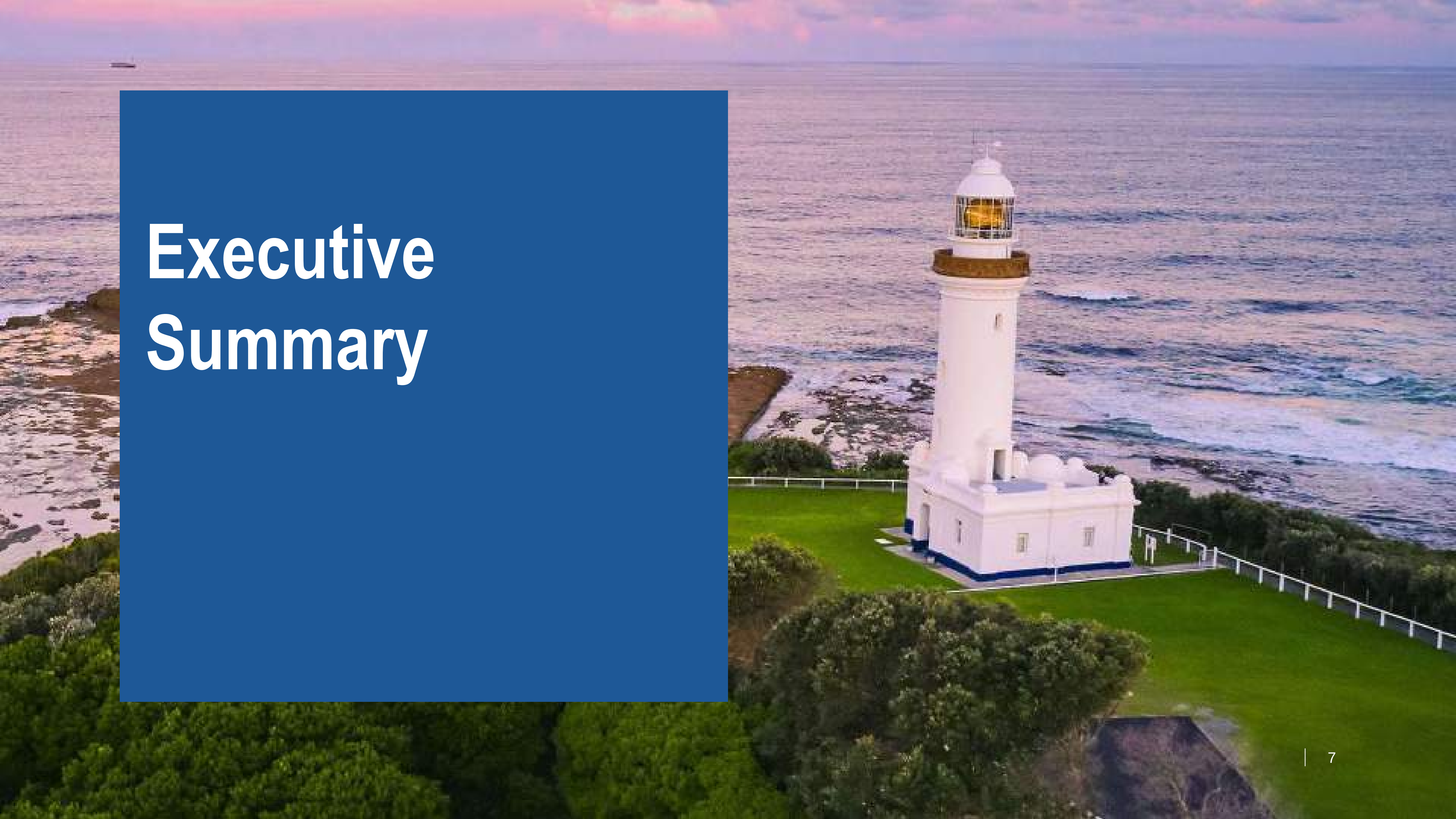
Phase 1 Outcomes	Phase 1 Deliverables	Phase 1 Deliverables – Report Navigation	Page Numbers
1) Deep Dive Audit	• The production of LGA Regions Telecommunications Infrastructure Heat Map	• Chapter 1: LGA Regions Telecommunications Infrastructure Review • Appendix 5.1	14 – 32 128 - 172
	• The production of Technology Gap Analysis	• Chapter 3: Future Demand Model Scenarios (Includes ‘Future population and visitor demand on telecommunications infrastructure’ and ‘Scenario planning (e.g. low, baseline, high) that fulfils future connectivity demand’) • Appendix 5.2 – 5.3	46 – 66 173 - 224
2) Tourism and Visitor Economy Use Cases	• Five (5) Use case reports	• Chapter 4: Telecommunications Infrastructure Options Analysis: Case Studies	67 - 112
3) Executive Summary of Potential Technology Solutions	• Executive Summary of Potential Technology Solutions	• Chapter 4: Telecommunications Options Analysis • Appendix 5.4	67 – 126 225 - 268
4) Business Case Briefing Paper	• Outline of Business Case Methodology	• Provided in the Business Case final deliverable, *The Case for Improved Digital Connectivity in the Hunter and Central Coast Regions*	

Glossary

TERM	DEFINITION
3G	The third generation in mobile technology standards prepared by the 3GPP global partnership.
3GPP	The 3rd Generation Partnership Project is an umbrella term for a consortium of mobile operators, vendors and international standards organisations that develop protocols and interfaces for mobile telecommunications, including 3G, 4G, and 5G standards.
4G	The fourth generation in mobile technology standards prepared by the 3GPP global partnership.
5G	The fifth generation in mobile technology standards prepared by the 3GPP global partnership.
Busy hour	Period of time during a day when network usage or traffic is at its highest level. It is a specific one-hour timeframe within a 24-hour day when the demand for network resources, such as bandwidth and connectivity, is most intensive.
Contention Ratio	Represents the relationship between the total available bandwidth and the bandwidth allocated to a specific group of users.
Co-location	A form of passive infrastructure sharing where a mobile network operator deploys its active equipment on the same passive infrastructure as another mobile network operator.
Digital Connectivity Index	A measure of the quality and effectiveness of digital connectivity in a selected area that indicates the capability of a location to support various digital activities such as remote work, online learning, or mobile internet usage.
Gbps	"Gigabits per second". Represents the number of gigabits (one billion bits) that can be transmitted or processed in one second.
Headroom Extra Capacity	Additional capacity deliberately built into a system or network beyond the anticipated peak demand or regular usage.
IoT	The Internet of Things (IoT) describes physical objects (or groups of such objects) with sensors, processing ability, software and other technologies that connect and exchange data with other devices and systems over the Internet or other communications networks.
Mbps	"Megabits per second". Represents the number of megabits (one million bits) that can be transmitted or processed in one second.

Glossary

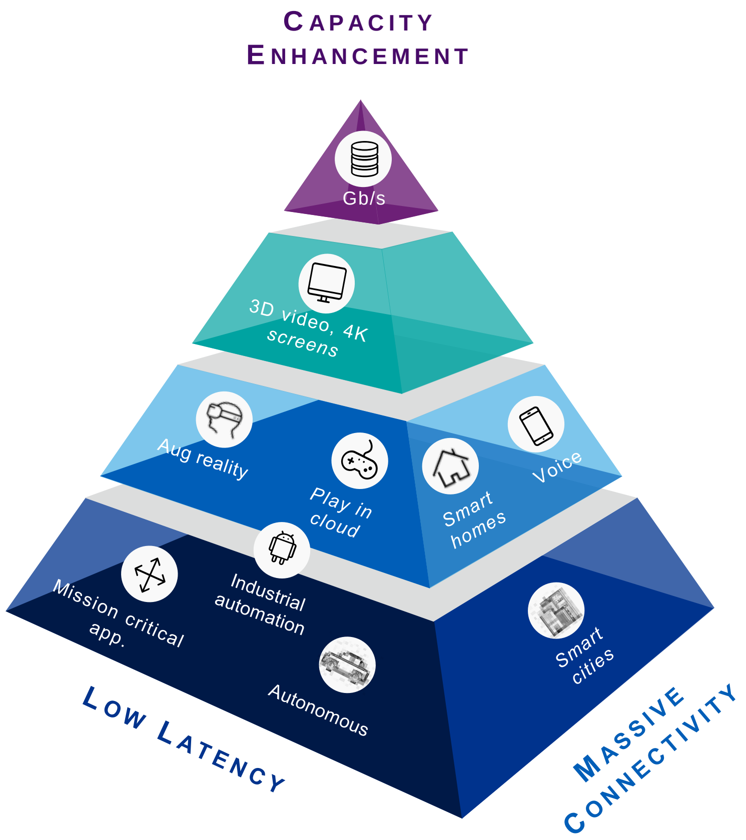
TERM	DEFINITION
Mobile network operator	A mobile network operator supplies mobile services to customers at the retail level. Examples include Telstra, Optus and TPG Telecom.
Non-IoT	Connections that are not associated with IoT. These connections are associated with a private connection of a user, such as a resident's mobile phone to an antenna or a personal computer at internet home.
Passive infrastructure	Assets and equipment which are not part of the active layer of a telecommunications network (the signal path), including but not limited to sites, buildings, shelters, towers, masts, poles, ducts, trenches, electric power supply/generators and air conditioning.
Passive sharing	Passive infrastructure sharing is where mobile network operators share non-electronic infrastructure, such as tower, land, power and other physical elements.
Spectrum	The radio spectrum is part of the electromagnetic spectrum with frequencies from 3 Hz to 3,000 GHz (3 THz). Active equipment uses radiofrequency spectrum to provide connectivity to mobile devices.
Throughput	Speed at which data is successfully transmitted or processed through a system or network.
Tower	A structure on which a radio base station equipment can be installed. It includes telecommunications towers that are part of the National Broadband Network, radio and television broadcasting towers and other suitable towers or similar structures that could be used to improve mobile telecommunications coverage or can be used in the supply of mobile telecommunications and other radiocommunications services, including rooftops or utility masts.
LGAs	Local Government Areas. Each LGA is governed by a local Council, which is responsible for the Area.
Busy Hour	Period of time during a day when network usage or traffic is at its highest level. It is a specific one-hour time frame within a 24-hour day when the demand for network resources, such as bandwidth and connectivity, is most intensive.
Contention Ratio	Represents the relationship between the total available bandwidth and the bandwidth allocated to a specific group of users.
Headroom Extra Capacity	Additional capacity deliberately built into a system or network beyond the anticipated peak demand or regular usage.



Executive Summary

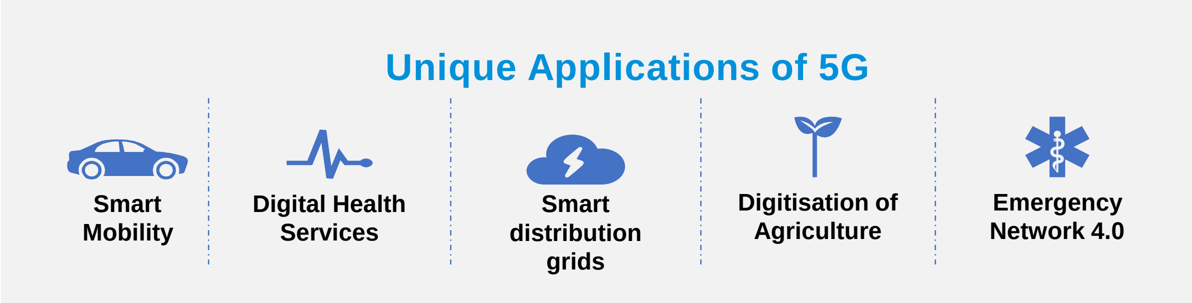
Framing the Connectivity Challenge – devices drive demand

This study has been conducted using the high-level approach of ***devices driving connectivity demand***. The number of devices used by our population, including residents, businesses and visitors to the region, are expected to increase gradually over time. Digital devices include smart phones, computers, smart appliances such as televisions, mobile GPS devices used in cars, and anything else that requires the user to be connected to fixed or wireless telecommunications infrastructure.



The Digital Connectivity Challenge is framed according to the following:

- New demand for capacity, connectivity and low latency will stress the current connectivity infrastructure.
- Investing in the appropriate infrastructure is essential for countries and regions that want to be successful in a digital future.
- To support the wide range of digital and connectivity use cases and guarantee the quality of those services, the network will have to assure the connection of a large number of devices simultaneously, processing an immense volume of data in real time.
- **Key network performance measures are higher capacity, higher connectivity and lower latency.**



High Level Approach to Digital Connectivity Challenge

Assessing the region's telecommunications infrastructure provides insights into the capacity to meet current digital connectivity demand, identify areas for improvement, and enable informed decision-making for future demand needs. The high-level approach taken to conducting this study included the following:

Estimation of Future Population & Visitor Demand

Compile the latest demographic data and population growth projections.
Compile the latest visitor numbers to project peak connectivity demand from visitors and the local population combined.

Estimation of Future Number of Devices

Calculate the average number of devices per capita, estimating total IoT and non-IoT connections, using industry-specific employment rates to project industrial and individual devices.

Connectivity Demand Model

Estimate demand on the network based on the projected future connectivity demand through to 2030.

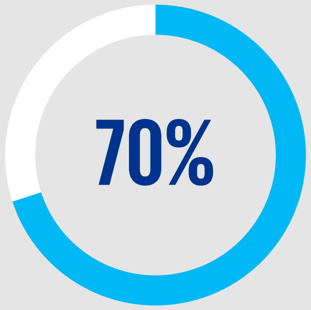
Analysis of Existing Telecommunications Infrastructure

Examine the deployed network access types across mobile, fibre, fixed, wireless and satellite from the three major telecommunications operators (Telstra, Optus, and TPG) and the National Broadband Network (nbn).

Key Findings: The Digital Connectivity Index for the DSSN Region

The NSW Digital Connectivity Index is a visualisation tool that measures the quality of digital connectivity across NSW and is based on metrics such as coverage, speeds, choice and performance. It is measured at a granular level by suburb and LGA, based on public and commercial datasets with more than 200 million data points. The Index helps to identify areas where better connectivity is required and should be leveraged by different levels of government and industry to develop solutions.

Metropolitan suburbs in NSW have an average Digital Connectivity Index score of 64 (Above Average connectivity), with inner Sydney being as high as 100 (Excellent connectivity). **By comparison, regional suburbs have an average score of just 16 (Poor connectivity)**.



Of LGAs have 'average' or 'below average' digital connectivity

- The poorest connectivity ('below average' digital connectivity index rating) are in Upper Hunter, Muswellbrook, Singleton and Cessnock.
- The three LGAs with 'above average' connectivity are Newcastle, Lake Macquarie and Maitland.

Stationary

(Fibre, Fixed Wireless, Satellite connectivity)

- **No LGAs** in the DSSN region have an '**Excellent**' connectivity rating (a score of between 81-100) for Stationary digital connectivity
- **Four LGAs** have an '**Above Average**' connectivity index rating (61-80): Central Coast, Lake Macquarie, Maitland and Newcastle.
- **Five LGAs** have an '**Average**' connectivity index rating (41-60): Cessnock, Dungog, Muswellbrook, Port Stephens and Singleton.
- The Upper Hunter is the **only LGA** that has a '**Below Average**' (21-40) digital connectivity index rating.
- **No LGAs** in the DSSN region have a '**Poor**' (0-20) rating.

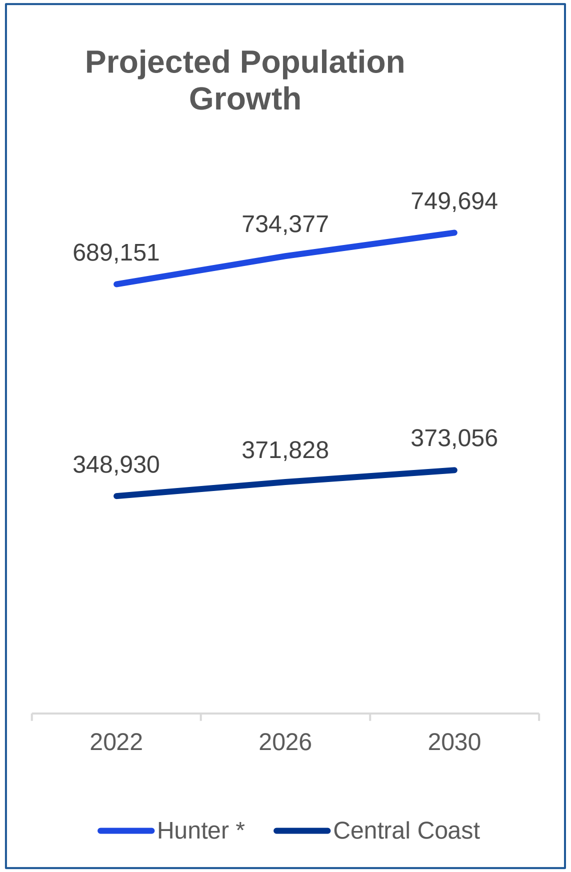
On the Move

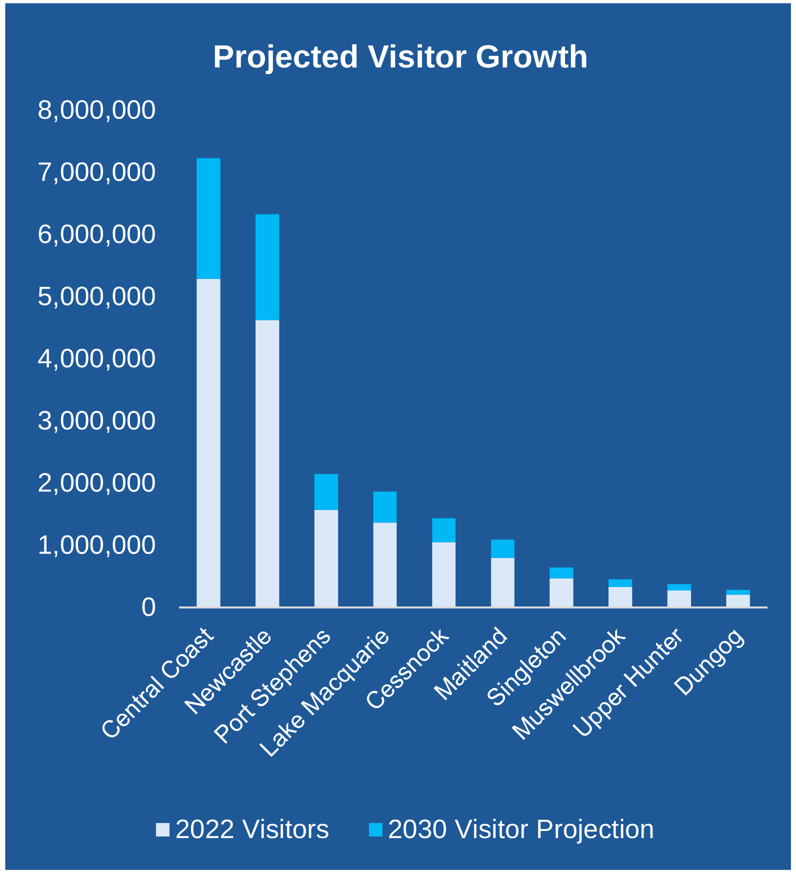
(3G, 4G and 5G mobile connectivity)

- **No LGAs** in the DSSN region have an '**Excellent**' connectivity rating (a score of between 81-100) for 'On the Move' digital connectivity
- **Newcastle** is the **only LGA that has an 'Above Average connectivity index rating** (61-80)
- **Four LGAs** have an '**Average**' connectivity index rating (41-60): Central Coast, Lake Macquarie, Maitland and Port Stephens
- **Five LGAs** have a '**Below Average**' connectivity index rating (21-40): Cessnock, Dungog, Muswellbrook, Singleton and Upper Hunter.
- **No LGAs** in the DSSN region have a '**Poor**' (0-20) rating.

Key Findings: Future Connectivity Demand

The future digital connectivity demand on telecommunications infrastructure is driven by an increasing population of local residents, businesses, and visitors to the area. By 2030, the population across the Hunter and Central Coast are expected to increase by 8 per cent, and visitor numbers by 37 per cent. The number of devices projected to be in use by 2030 is driven by the increase in the number people – both residents and visitors, at home, work and whilst travelling – using stationary and mobile devices to connect to digital infrastructure. This increase in the number of expected devices to be in use puts additional demand on the existing infrastructure.





Projected Increase in Devices by 2030

The number of digital devices calculated to be in use in 2023, and projected to be in use by 2025 and 2030, are based on the current and forecasted population and visitor numbers, multiplied by the average number of devices per person based on three scenarios: Low, Baseline and High.

Scenario	Total Number of Devices		
	2023	2025	2030
Low	6.9M	8.3M	14.1M
Baseline	9.9M	12M	20.4M
High	14.3M	17.2M	29.3M

Destination Sydney Surrounds North

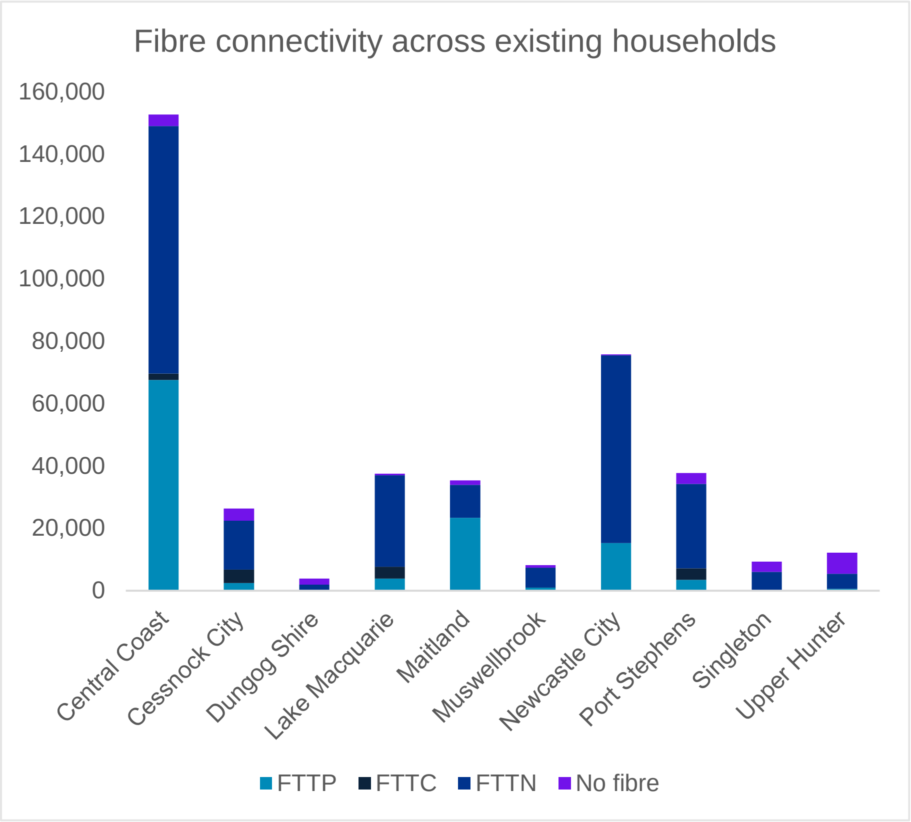
- *The DSSN Region includes all LGAs within the Hunter and Central goes region, excluding Mid-Coast LGA.*
- **Population is sourced from 2022 ABS, Forecast Percentage Growth:* Population Projections - Australian Bureau of Statistics

Key Findings: The Digital Connectivity Gap

Wireless

	Low Scenario			Baseline Scenario			High Scenario		
	2023	2025	2030	2023	2025	2030	2023	2025	2030
Central Coast	Green	Green	Yellow	Green	Green	Red	Yellow	Red	Red
Cessnock City	Green	Green	Green	Green	Yellow	Red	Red	Red	Red
Dungog Shire	Green	Green	Green	Green	Yellow	Red	Red	Red	Red
Lake Macquarie	Green	Green	Yellow	Green	Yellow	Red	Red	Red	Red
Maitland	Green	Green	Red	Red	Red	Red	Red	Red	Red
Muswellbrook	Green	Green	Green	Green	Green	Green	Green	Green	Red
Newcastle City	Green	Green	Green	Green	Green	Red	Red	Red	Red
Port Stephens	Green	Green	Green	Green	Green	Red	Red	Red	Red
Singleton	Green	Green	Green	Green	Green	Green	Green	Green	Red
Upper Hunter	Green	Green	Green	Green	Green	Green	Green	Green	Red

Wireline



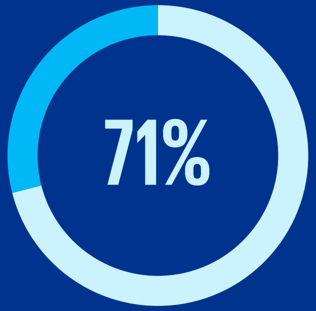
Key Findings: The Digital Connectivity Gap

This report outlines the key findings of expected future demand from devices used by residents, businesses and visitors to the DSSN region, the current state of telecommunications infrastructure, gaps in the projected supply and demand based on that infrastructure, and how the projected demand may be met.

782

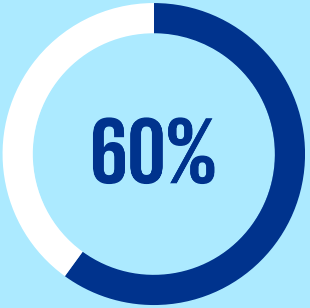
Total number of existing mobile sites across the DSSN region.

- Central Coast has the highest number of existing mobile sites (265), with majority being Optus (104).
- Dungog has the lowest number of mobile sites (13), with 0 TPG sites.



The percentage of private dwellings that require FTTP upgrades.

- 6.6 per cent of the total dwellings across the DSSN region (a total of 26,180) do not have fibre access.
- 71 per cent of the region's private dwellings (281,472 in total) require FTTP upgrades from FTTC, FTTN or no fibre.
- 52 per cent of Dungog Shire's private dwellings have no fibre access, with the remaining 48 per cent having only FTTN.



Of LGAs not have sufficient infrastructure to meet the future demand.

- Based on the simulations in this report, the projection is that there is a capacity issue in 2025 and 2030 for six of the ten LGAs across the DSSN region, meaning they are unlikely to have sufficient telecommunications infrastructure to meet the expected 'baseline' increase in demand (devices in use) by 2030.
- Not only will the digital gap occur because of population and visitor growth, but the real challenge is exemplified by cases of peak visitation. In this report we analyse five case studies for major planned events and peak visitation periods in Pokolbin (Hunter Valley), Morisset (Lake Macquarie), The Entrance (Central Coast) and Nelson Bay (Port Stephens).
  Given the significant network capacity gap for these peak visitation events, this report considers several technical options that can be pursued to address these peak visitor events.

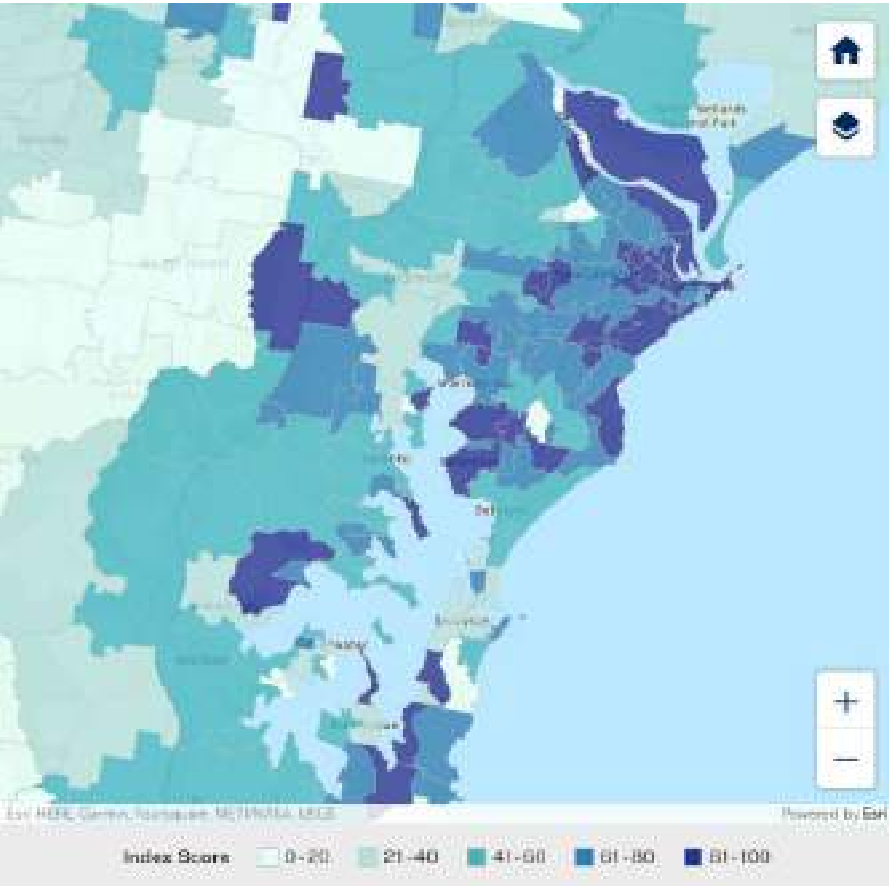
1.
LGA Regions Telecommunications Infrastructure Review

Refer to Appendix 5.1 for detailed analysis

The Digital Connectivity Index

Digital Connectivity Index

The Connectivity Index is a visualisation tool that measures the quality of digital connectivity across NSW and is based on metrics such as coverage, speeds, choice and performance. It is measured at a granular level by suburb and LGA, based on public and commercial datasets with more than 200 million data points.



High level insights

- Metro suburbs in NSW have an average index score of 64, inner Sydney as high as 100 and by comparison regional suburbs have an average of just 16.
- The NSW Digital Connectivity Index helps to identify areas where better connectivity is required and should be leveraged by different levels of government and industry to develop solutions.

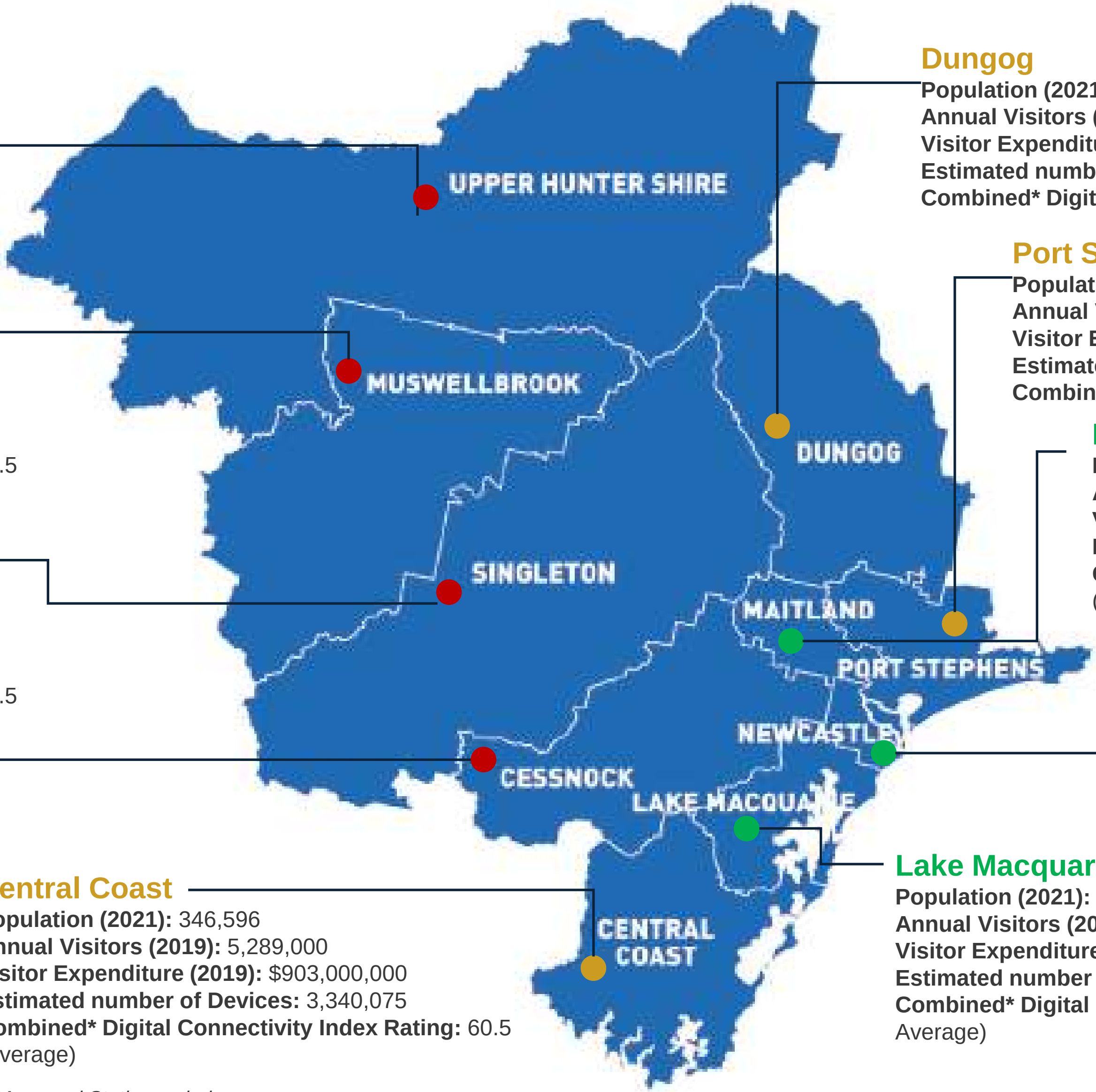
Score	Rating	What does this score mean?
81-100	Excellent	Communities with these scores are highly likely to be able to meaningfully conduct digital activities such as working, video conferencing and accessing telehealth
61-80	Above Average	Communities with these scores are likely able to meaningfully conduct digital activities such as working, video conferencing and accessing telehealth
41-60	Average	Communities with these scores are less likely to be able to meaningfully conduct digital activities such as working, video conferencing and accessing telehealth
21-40	Below Average	Communities with these scores are unlikely to be able to meaningfully conduct digital activities such as working, video conferencing and accessing telehealth
0-20	Poor	Communities with these scores are highly unlikely to be able to meaningfully conduct digital activities such as working from home, video conferencing, gaming and online streaming

NSW Digital Connectivity Index | NSW Government

The DSSN Region's Digital Connectivity Current State

Key
- Below average connectivity
- Average connectivity
- Above average connectivity

70 per cent of the region is experiencing average or below average digital connectivity, impacting local residents, businesses and visitors.



Upper Hunter Region Shire
Population (2021): 14,229
Annual Visitors (2019): 279,000
Visitor Expenditure (2019): $52,000,000
Estimated number of Devices: 137,471
Combined* Digital Connectivity Index Rating: 27 (Below Average)

Muswellbrook
Population (2021): 16,357
Annual Visitors (2019): 335,000
Visitor Expenditure (2019): $59,000,000
Estimated number of Devices: 159,036
Combined* Digital Connectivity Index Rating: 37.5 (Below Average)

Singleton
Population (2021): 24,577
Annual Visitors (2019): 473,000
Visitor Expenditure (2019): $123,000,000
Estimated number of Devices: 241,071
Combined* Digital Connectivity Index Rating: 40.5 (Below Average)

Cessnock
Population (2021): 63,632
Annual Visitors (2019): 1,053,000
Visitor Expenditure (2019): $328,000,000
Estimated number of Devices: 630,315
Combined* Digital Connectivity Index Rating: 38.5 (Below Average)

Central Coast
Population (2021): 346,596
Annual Visitors (2019): 5,289,000
Visitor Expenditure (2019): $903,000,000
Estimated number of Devices: 3,340,075
Combined* Digital Connectivity Index Rating: 60.5 (Average)

Dungog
Population (2021): 9,541
Annual Visitors (2019): 211,000
Visitor Expenditure (2019): $28,000,000
Estimated number of Devices: 93,662
Combined* Digital Connectivity Index Rating: 42 (Average)

Port Stephens
Population (2021): 75,276
Annual Visitors (2019): 1,573,000
Visitor Expenditure (2019): $563,000,000
Estimated number of Devices: 737,349
Combined* Digital Connectivity Index Rating: 46 (Average)

Maitland
Population (2021): 90,226
Annual Visitors (2019): 801,000
Visitor Expenditure (2019): 1,610,370
Estimated number of Devices: 887,979
Combined* Digital Connectivity Index Rating: 62 (Above Average)

Newcastle
Population (2021): 168,873
Annual Visitors (2019): 4,627,000
Visitor Expenditure (2019): $1,056,000,000
Estimated number of Devices: 1,662,988
Combined* Digital Connectivity Index Rating: 75 (Above Average)

Lake Macquarie
Population (2021): 213,845
Annual Visitors (2019): 1,365,000
Visitor Expenditure (2019): $210,000,000
Estimated number of Devices: 2,049,942
Combined* Digital Connectivity Index Rating: 64.5 (Above Average)

**Combined Digital Connectivity Index Rating is the average of On the Move and Stationary index*

Technology Review Approach

Technology Review - Approach

In the diagram below, the different steps completed for the review of existing mobile and fixed access technology for various Local Government Areas are illustrated.

Mobile Network

1

Analysis of the existing Mobile Technologies (3G, 4G, 5G)

2

Mapping the different sites by the three major Operators

3

Analysis of coverage maps and Identification of Connectivity Issues

Fixed Network (NBN Services)

4

Analysis of different types of technology provided by the NBN

5

Analysis of NBN coverage maps (different regions) and identification of connectivity issues.

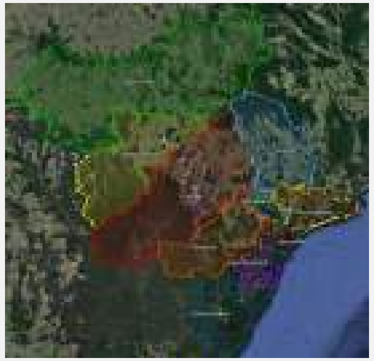
Technology Review Findings

To understand how demand growth affects network infrastructure, it's essential to assess the current deployment status of various network access types. An evaluation was conducted on the deployment of Mobile, Fibre, Fixed Wireless, and Satellite access, focusing on the three major operators (Telstra, Optus, and TPG) and the National Broadband Network (NBN).

Analysis of Current Network Mobile State

- Collected data on **radio sites** operated by **Telstra**, **Optus**, and **TPG** in various regions
- Conducted **coverage** assessment by mapping sites using **geographic coordinates** and **operator-provided maps**
- Examination of **3G**, **4G** and **5G** technologies

Disclaimer: the operators are planning to **discontinue 3G** technology in **2024.**



Existing Number of Mobile Sites for each DSSN Region:

Region	Telstra	Optus	TPG	Total
Central Coast	100	104	61	265
Newcastle	43	41	30	114
Lake Macquarie	40	39	32	111
Port Stephens	28	31	20	79
Cessnock	24	22	13	59
Maitland	22	18	10	50
Singleton	25	9	5	39
Muswellbrook	18	7	3	28
Upper Hunter	12	8	4	24
Dungog	10	3	0	13

Sources: ACCC Mobile Infrastructure Report | Telstra Coverage Maps | Optus Coverage Maps | TPG Coverage Maps

Analysis of nbn Types of Technology

To analyze the current **fixed/fibre network infrastructure** for each region, the assessment focused on the deployment status of the **NBN network**.

The coverage maps for each region were scrutinized, considering **Fibre to the Premises** (FTTP), **Fibre to the Node** (FTTN), and **Fixed Wireless** and **Satellite** as the predominant access types. The following are the connection types provided by the NBN:

Wired Connections

Fibre to the Premises (FTTP) - used in circumstances where direct fibre optic line is extended from the nearest available fibre node directly to population premises.

Fibre to the Building (FTTB) - is typically employed by NBN when connecting apartment blocks or similar structures. It involves running a fibre optic line to the fibre node in the building's communications room and utilizing the existing connection technology within the building.

Fibre to the Curb (FTTC) - used in circumstances where fibre is extended close to habitational premises, connecting to a small Distribution Point Unit (DPU), generally located inside a pit on the street**.**

Fibre to the Node (FTTN) - used where the existing copper phone and internet network from a nearby fibre node is used to make the final part of the connection to the NBN network

Wireless Connections

Fixed Wireless - typically used in circumstances where the distance between premises can be many kilometres.

Satellite - used in remote and residential areas that do not have access to the NBN network through wired/fibre connections or fixed wireless

Source: NBN National Map Datasets | NBN Australia

Technology Review by LGA: Radio Access (mobile)

Technology Review – Summary of Radio Access

The below summarises for each LGA the digital connectivity index, types mobile services that are available from the key operators and current state connectivity insights.

#	Region	Digital Connectivity Index (On the Move)	Type of Access	Relevant Insights
Local Government Area	Central Coast	NSW Digital Connectivity Index 55 Access 83 Affordability 86 Demographics 59	Telstra: 3G ✓, 4G ✓, 5G ✓ Optus: 3G ✓, 4G ✓, 5G ✓ TPG: 3G ✓, 4G ✓, 5G ✓	• High Digital Connectivity Index, reflected by complete 3G and 4G coverage in residential areas. • Average Download Speed of 76.06 Mbps and Upload Speed of 7.35 Mbps.* • Presence of 5G in major suburbs. Connectivity gaps in 5G observed in suburbs such as Wamberal and Matcham. • Remote area of Dharug National Park lacks any site infrastructure, naturally resulting in no coverage.
Local Government Area	Cessnock	NSW Digital Connectivity Index 34 Access 77 Affordability 85 Demographics 36	Telstra: 3G ✓, 4G ✓, 5G ✓ Optus: 3G ✓, 4G ✓, 5G ✗ TPG: 3G ✓, 4G ✓, 5G ✓	• Complete 3G and 4G coverage in inhabited and industrial zones of the region. • Coverage gaps identified Pokolbin State Forest and Yengo National Park. • Digital connectivity index below average, attributed not to access issues but to the demographic characteristics of the region. • Presence of 5G coverage in the central part of Cessnock. • Absence of 5G coverage by Optus.
Local Government Area	Dungog	NSW Digital Connectivity Index 31 Access 49 Affordability 81 Demographics 59	Telstra: 3G ✓, 4G ✓, 5G ✗ Optus: 3G ✓, 4G ✓, 5G ✗ TPG: 3G ✗, 4G ✗, 5G ✗	• TPG has not deployed any radio sites in the region. • No 5G coverage is available. • Majority of residential areas are covered, although there may be some connectivity gaps in the northern part of the region, which is highly rural.

***Source:** Speedtest - Internet Providers in New South Wales

Technology Review – Summary of Radio Access

The below summarises for each LGA the digital connectivity index, types mobile services that are available from the key operators and current state connectivity insights.

#	Region	Digital Connectivity Index (On the Move)	Type of Access	Relevant Insights
Local Government Area	Lake Macquarie	NSW Digital Connectivity Index: 60 Access: 86 Affordability: 87 Demographics: 60	Telstra: 3G ✓, 4G ✓, 5G ✓ Optus: 3G ✓, 4G ✓, 5G ✓ TPG: 3G ✓, 4G ✓, 5G ✓	• 3G and 4G connectivity available throughout the entire region. • A significantly high Digital Connectivity Index, ensuring robust access. • Well-developed 5G infrastructure in areas with high population density and associated industry.
Local Government Area	Maitland	NSW Digital Connectivity Index: 58 Access: 90 Affordability: 91 Demographics: 56	Telstra: 3G ✓, 4G ✓, 5G ✓ Optus: 3G ✓, 4G ✓, 5G ✓ TPG: 3G ✓, 4G ✓, 5G ✓	• Download speed of 86.40 Mbps and upload speed of 8.55 Mbps.* • Region with the highest index in terms of access. • Complete 3G and 4G coverage for the Maitland region. The absence of extensive forested and remote areas allows for coverage throughout the region. • A strong presence of 5G in the residential areas of the region.
Local Government Area	Muswellbrook	NSW Digital Connectivity Index: 33 Access: 68 Affordability: 79 Demographics: 34	Telstra: 3G ✓, 4G ✓, 5G ✓ Optus: 3G ✓, 4G ✓, 5G ✗ TPG: 3G ✓, 4G ✓, 5G ✗	• 3G and 4G coverage available in residential and industrial zones. • 5G coverage is limited to the central area of Muswellbrook. • No 5G coverage provided by Optus and TPG for the Muswellbrook region.

***Source:** Speedtest - Internet Providers in New South Wales

Technology Review – Summary of Radio Access

The below summarises for each LGA the digital connectivity index, types mobile services that are available from the key operators and current state connectivity insights.

#	Region	Digital Connectivity Index (On the Move)	Type of Access	Relevant Insights
Local Government Area	**Newcastle**	NSW Digital Connectivity Index: 70 Access 89 Affordability 90 Demographics 76	Telstra: 3G ✓, 4G ✓, 5G ✓ Optus: 3G ✓, 4G ✓, 5G ✓ TPG: 3G ✓, 4G ✓, 5G ✓	• 3G and 4G available throughout the region. • Average download speed of 110.39 Mbps and upload speed of 8.55 Mbps.* • The area has the highest digital connectivity index. • Widespread implementation of 5G in the area by all three operators, with few coverage gaps.
Local Government Area	**Port Stephens**	NSW Digital Connectivity Index: 41 Access 77 Affordability 79 Demographics 46	Telstra: 3G ✓, 4G ✓, 5G ✓ Optus: 3G ✓, 4G ✓, 5G ✓ TPG: 3G ✓, 4G ✓, 5G ✓	• 3G and 4G connectivity available throughout the Port Stephens region with no notable coverage issues. • 5G is accessible in the main residential and tourist-interest areas of the region, provided by Telstra and Optus.
Local Government Area	**Singleton**	NSW Digital Connectivity Index: 37 Access 59 Affordability 87 Demographics 54	Telstra: 3G ✓, 4G ✓, 5G ✓ Optus: 3G ✓, 4G ✓, 5G ✓ TPG: 3G ✓, 4G ✓, 5G ✗	• 3G and 4G connectivity available throughout the inhabited region. • Outlying areas such as Putty and Garland Valley, away from the central region, have 3G and 4G coverage provided by Telstra. • The region has a below-average digital connectivity index. • Limited 5G access is available only in the populated area of Singleton. • TPG does not have any 5G base stations in the region.

***Source:** Speedtest - Internet Providers in New South Wales

Technology Review – Summary of Radio Access

The below summarises for each LGA and selected suburbs/clusters the digital connectivity index, types mobile services that are available from the key operators and current state connectivity insights.

#	Region	Digital Connectivity Index (On the Move)	Type of Access	Relevant Insights
Local Government Area	**Upper Hunter**	NSW Digital Connectivity Index: 23 ●●○○○ Access 51 ●●●○○ Affordability 74 ●●●●○ Demographics 40 ●●○○○	Telstra: 3G ✓, 4G ✓, 5G ✓ Optus: 3G ✓, 4G ✓, 5G ✓ TPG: 3G ✓, 4G ✓, 5G ✗	• The region has the lowest digital connectivity index among the top DSSN regions. • It is an extremely rural area where 3G and 4G coverage is limited to populated areas, including residences and industry. • 5G is only available in the more populated areas such as Scone and Aberdeen. • TPG lacks 5G coverage in the region.
Suburb/Cluster	**Pokolbin**	NSW Digital Connectivity Index: 31 ●●○○○ Access 38 ●●○○○ Affordability 74 ●●●●○ Demographics 100 ●●●●●	Telstra: 3G ✓, 4G ✓, 5G ✓ Optus: 3G ✓, 4G ✓, 5G ✗ TPG: 3G ✓, 4G ✓, 5G ✗	• The area has a total of 10 base stations distributed among the three operators. • The region does not have connectivity gaps in terms of 3G and 4G in the populated zone. However, given the extent of the suburb, there may be a need to install base stations to ensure continuous coverage throughout. • There is a co-located site (with antennas from all three operators) in the mountainous area, ensuring good coverage to the west. • There is only one radio site with 5G technology, in the residential area.
Suburb/Cluster	**Cedar Mill (Morisset)**	NSW Digital Connectivity Index: 55 ●●●○○ Access 84 ●●●●● Affordability 78 ●●●●○ Demographics 32 ●●○○○	Telstra: 3G ✓, 4G ✓, 5G ✓ Optus: 3G ✓, 4G ✓, 5G ✓ TPG: 3G ✓, 4G ✓, 5G ✓	• A total of five base stations distributed among the three operators. • 3G and 4G connectivity ensured for the entire region without apparent gaps in the residential zone. • 5G is well-developed in the Morisset region with the presence of five base stations offering this technology. • The Cedar Mill project's expansion may necessitate the deployment of new base stations to ensure continuous capacity in terms of network demand.

Technology Review – Summary of Radio Access

The below summarises for each LGA and selected suburbs/clusters the digital connectivity index, types mobile services that are available from the key operators and current state connectivity insights.

#	Region	Digital Connectivity Index (On the Move)	Type of Access	Relevant Insights
Suburb/Cluster	Nelson Bay / Shoal Bay	NSW Digital Connectivity Index: 49 ●●●○○ Access 86 ●●●●● Affordability 70 ●●●●○ Demographics 53 ●●●○○	Telstra: 3G ✓, 4G ✓, 5G ✓ Optus: 3G ✓, 4G ✓, 5G ✓ TPG: 3G ✓, 4G ✓, 5G ✓	• A total of seven base stations in Nelson Bay, with no apparent coverage issues in terms of 3G and 4G connectivity. • No base stations in the Shoal Bay area. The installation of a base station in this zone may be necessary to ensure 3G and 4G mobile connectivity. • 5G coverage is ensured in the majority of the Nelson Bay area.
Suburb/Cluster	The Entrance	NSW Digital Connectivity Index: 36 ●●○○○ Access 80 ●●●●○ Affordability 76 ●●●●○ Demographics 26 ●●○○○	Telstra: 3G ✓, 4G ✓, 5G ✓ Optus: 3G ✓, 4G ✓, 5G ✓ TPG: 3G ✓, 4G ✓, 5G ✓	• The suburb has a total of three mobile sites co-located, one for each operator. • The Entrance is a densely populated suburb where 3G and 4G connectivity are available throughout the region, • 5G coverage is available throughout the entire suburb without any coverage gaps.

Technology Review by LGA: Stationary (nbn access)

Technology Review – Summary of nbn Service Access

The below summarises for each LGA the digital connectivity index, nbn services types available from service providers and current state connectivity insights.

#	Region	Digital Connectivity Index (Stationary)	Type of Access	Relevant Insights
Local Government Area	Central Coast	NSW Digital Connectivity Index 66 Access 96 Affordability 90 Demographics 59	Fibre to the Premises ✓ Fibre to the Building ✓ Fibre to the Curb ✓ Fibre to the Node ✓ Fixed Wireless ✓ Satellite ✓	• Access via Fibre to the Premises is available for the Gosford and The Entrance regions. • Fibre to the Node is provided for the remaining densely populated areas. • Rural areas with some population density, such as Mangrove or Somersby, have access via fixed wireless. The remaining mountainous areas have access via satellite.
Local Government Area	Cessnock	NSW Digital Connectivity Index 43 Access 88 Affordability 90 Demographics 36	Fibre to the Premises ✓ Fibre to the Building ✗ Fibre to the Curb ✓ Fibre to the Node ✓ Fixed Wireless ✓ Satellite ✓	• Fibre to the Premises is significantly limited throughout the entire region, available only for a small part of Cessnock City. • Access via Fibre to the Node is available for the remaining residential areas. • Due to the rural nature of the Cessnock region, remote areas with occasional housing have access via Fixed Wireless.
Local Government Area	Dungog	NSW Digital Connectivity Index 53 Access 76 Affordability 88 Demographics 59	Fibre to the Premises ✗ Fibre to the Building ✗ Fibre to the Curb ✗ Fibre to the Node ✓ Fixed Wireless ✓ Satellite ✓	• In terms of fibre, only Fibre to the Node is available for the central area of Dungog and the residential area of Clarence Town. • The remaining areas with housing have access via Fixed Wireless. • Satellite access is provided for remote areas.

Technology Review – Summary of nbn Service Access

The below summarises for each LGA the digital connectivity index, nbn services types available from service providers and current state connectivity insights.

#	Region	Digital Connectivity Index (Stationary)	Type of Access	Relevant Insights
Local Government Area	Lake Macquarie	NSW Digital Connectivity Index: 69 Access 97 Affordability 91 Demographics 60	Fibre to the Premises ✔ Fibre to the Building ✔ Fibre to the Curb ✔ Fibre to the Node ✔ Fixed Wireless ✔ Satellite ✔	• Access via Fibre to the Premises is available only in certain residential areas of West Wall and North Cooranbong. • Access via Fibre to the Node is provided for the area around the lake, where the most densely populated part of the region is located. • Remote areas of the region have access via Fixed Wireless and satellite.
Local Government Area	Maitland	NSW Digital Connectivity Index: 66 Access 99 Affordability 94 Demographics 56	Fibre to the Premises ✔ Fibre to the Building ✔ Fibre to the Curb ✘ Fibre to the Node ✔ Fixed Wireless ✔ Satellite ✔	• Average download speeds of 54.18 Mbps and upload speeds of 18 Mbps for fixed access. • A considerably extensive area has access via Fibre to the Premises, with the majority of the southern region using this type of access. The remaining residential areas have access via Fibre to the Node. • Fixed Wireless and Satellite options are available for more remote areas.
Local Government Area	Muswellbrook	NSW Digital Connectivity Index: 42 Access 86 Affordability 83 Demographics 34	Fibre to the Premises ✔ Fibre to the Building ✘ Fibre to the Curb ✔ Fibre to the Node ✔ Fixed Wireless ✔ Satellite ✔	• Access via Fibre to the Premises is available only for part of the residential area in the region. The remaining residential zone is served by Fibre to the Node and Fixed Wireless. • Given the extremely rural nature of the region, the non-residential areas have access via satellite.

Technology Review – Summary of nbn Service Access

The below summarises for each LGA the digital connectivity index, nbn services types available from service providers and current state connectivity insights.

#	Region	Digital Connectivity Index (Stationary)	Type of Access	Relevant Insights
Local Government Area	**Newcastle**	**NSW Digital Connectivity Index** 80 **Access** 99 **Affordability** 92 **Demographics** 76	**Fibre to the Premises** ✓ **Fibre to the Building** ✓ **Fibre to the Curb** ✗ **Fibre to the Node** ✓ **Fixed Wireless** ✓ **Satellite** ✓	• Average download speeds of 51.45 Mbps and upload speeds of 18.09 Mbps for fixed access.* • The Newcastle area is highly urbanised, with the entire residential zone having access via fibre. • Only the area around the Hunter Wetlands National Park relies on fixed wireless. • The region has the highest digital connectivity index
Local Government Area	**Port Stephens**	**NSW Digital Connectivity Index** 51 **Access** 91 **Affordability** 85 **Demographics** 46	**Fibre to the Premises** ✓ **Fibre to the Building** ✓ **Fibre to the Curb** ✓ **Fibre to the Node** ✓ **Fixed Wireless** ✓ **Satellite** ✓	• The residential area of Port Stephens primarily has access via fibre, with Corlette and Eagleton enjoying the best access through Fibre to the Premises. • More remote areas of the region, such as Wallaroo and Medowie Park, have access via fixed wireless and satellite.
Local Government Area	**Singleton**	**NSW Digital Connectivity Index** 44 **Access** 72 **Affordability** 90 **Demographics** 54	**Fibre to the Premises** ✓ **Fibre to the Building** ✓ **Fibre to the Curb** ✗ **Fibre to the Node** ✓ **Fixed Wireless** ✓ **Satellite** ✓	• Due to Singleton being an extremely rural area, including the Wollemi National Park, the region is predominantly covered via fixed wireless and satellite. • Access via fibre is only available in the central part of Singleton city.

***Source:** Speedtest - Internet Providers in New South Wales

Technology Review – Summary of nbn Service Access

The below summarises for each LGA and selected suburbs/clusters the digital connectivity index, nbn services types available from service providers and current state connectivity insights.

#	Region	Digital Connectivity Index (Stationary)	Type of Access	Relevant Insights
Local Government Area	**Upper Hunter**	NSW Digital Connectivity Index 31 **Access** **61** **Affordability** **83** **Demographics** **40**	**Fibre to the Premises** ✗ **Fibre to the Building** ✗ **Fibre to the Curb** ✗ **Fibre to the Node** ✓ **Fixed Wireless** ✓ **Satellite** ✓	• The area has the lowest stationary digital connectivity index. • Access via fibre is only available in the form of Fibre to the Node for the cities of Scone, Murrurundi, and Aberdeen.
Suburb/Cluster	**Pokolbin**	NSW Digital Connectivity Index 69 **Access** **69** **Affordability** **89** **Demographics** **100**	**Fibre to the Premises** ✓ **Fibre to the Building** ✗ **Fibre to the Curb** ✓ **Fibre to the Node** ✓ **Fixed Wireless** ✓ **Satellite** ✓	• As Pokolbin is a rural region characterised by extensive vineyards and a distributed population across various areas without a distinct population centre, the existing fibre access is mainly provided via Fibre to the Curb. There is a small area with access via Fibre to the Premises and Fibre to the Node.
Suburb/Cluster	**Cedar Mill (Morisset)**	NSW Digital Connectivity Index 62 **Access** **95** **Affordability** **86** **Demographics** **32**	**Fibre to the Premises** ✓ **Fibre to the Building** ✓ **Fibre to the Curb** ✗ **Fibre to the Node** ✓ **Fixed Wireless** ✓ **Satellite** ✓	• The Morisset area provides complete fibre access to the residential zone, with the majority of the population having access via Fibre to the Node. • Some residential clusters have access via Fibre to the Premises and Fibre to the Building.

Technology Review – Summary of nbn Service Access

The below summarises for each LGA and selected suburbs/clusters the digital connectivity index, nbn services types available from service providers and current state connectivity insights.

#	Region	Digital Connectivity Index (Stationary)	Type of Access	Relevant Insights
Suburb/Cluster	Nelson Bay/ Shoal Bay	NSW Digital Connectivity Index: 60 Access: 99 Affordability: 78 Demographics: 53	Fibre to the Premises: ✓ Fibre to the Building: ✗ Fibre to the Curb: ✗ Fibre to the Node: ✓ Fixed Wireless: ✓ Satellite: ✓	• The Nelson Bay/Shoal Bay area provides fibre access for the entire residential zone of the region, with this access primarily through Fibre to the Node. • The more remote areas, without permanent housing or any type of industry, have access via satellite.
Suburb/Cluster	The Entrance	NSW Digital Connectivity Index: 46 Access: 98 Affordability: 77 Demographics: 26	Fibre to the Premises: ✓ Fibre to the Building: ✓ Fibre to the Curb: ✗ Fibre to the Node: ✗ Fixed Wireless: ✗ Satellite: ✗	• Access to NBN services is exclusively provided through fibre. • The Entrance is a highly densely populated area, with the majority of dwellings having access to Fibre to the Premises. • Commercial spaces and buildings with a higher number of floors have access via Fibre to the Building.

2.
Future population and visitor demands on telecommunications infrastructure

Refer to Appendix 5.2 for detailed methodology used to determine findings in this chapter

Methodology for calculating visitor numbers

To obtain the peak number of visitors across the different LGAs and thereby estimate the number of devices associated with visitor demand, it was necessary to formulate a methodology, which is presented below.

Step-by-Step Methodology

1. Obtain the number of commercial rooms for overnight visitors. This number includes rooms in hotels, motels, apartments, villas, houses, and caravan parks.
   Source: DSSN Accommodation Audit

2. Calculation of the number of overnight visitors staying in commercial accommodation. It was considered 1.5 people per room.
   Source: DSSN Assumption

3. Calculation of the additional number of overnight visitors who visit the regions to be with friends and family. To obtain this value, it was assumed a percentage of 33% of these visitors compared to overnight visitors. In the case of Central Coast, the value was 66%.
   Source: NSW Regional Data

4. Obtain the number of day trip visitors. To obtain this number, a ratio of 59% for day trip visitors and 41% for overnight visitors was considered, in accordance with the Hunter Valley Destination Management Plan.
   Source: Hunter Valley Destination Management Plan

5. Definition of the number of visitors for the different scenarios:
   - **High Scenario:** 100% of max. accommodation (day visitors + overnight visitors)
   - **Baseline Scenario:** 75% of max. accommodation (day visitors + overnight visitors)
   - **Low Scenario:** 50% of max. accommodation (day visitors + overnight visitors)

DSSN Peak Visitor Numbers according to the accommodation for the different LGAs

Region	Total Visitors (Low-50% of max. accommodation)	Total Visitors (Baseline-75% of max. accommodation)	Total Visitors (High-100% of max. accommodation)
Central Coast	6,631	9,947	13,263
Cessnock	6,216	9,324	12,432
Dungog	966	1,449	1,932
Lake Macquarie	3,041	4,562	6,082
Maitland	1,903	2,854	3,805
Muswellbrook	1,126	1,690	2,253
Newcastle	5,068	7,602	10,136
Port Stephens	7,097	10,645	14,194
Singleton	2,214	3,321	4,428
Upper Hunter	978	1,467	1,956
DSSN Region	**35,240**	**52,861**	**70,481**

Summary: Total Number of Connections per Region (IoT & Non-IoT)

The total number of devices for each region for Industrial/IoT devices & Individual/Non-IoT devices is 9.9 million (in 2023). This has been calculated using the assumption that 9.4 devices per capita will be in use, a figure aligned with Cisco's projection for **Western Europe**, in lieu of an existing per capita prediction for the Australian market.

Regions	Number of IoT Devices	Number of Non-IoT Individual Devices	Number of Non-IoT Visitor Devices	Total
Central Coast	1,831,941	1,448,001	41,278	3,321,220
Cessnock	345,356	272,976	38,320	656,652
Dungog	50,963	40,282	6,013	97,259
Lake Macquarie	1,136,283	898,140	18,932	2,053,355
Maitland	490,875	387,997	11,844	890,715
Muswellbrook	86,712	68,539	7,013	162,264
Newcastle	899,438	710,993	31,547	1,641,917
Port Stephens	401,848	317,628	44,175	763,651
Singleton	131,648	104,057	13,782	249,487
Upper Hunter	75,035	59,309	13,782	140,433
DSSN Region	5,450,099	4,307,863	218,991	9,976,952

DSSN's Region Characterisation - Central Coast

The below tables summarise all the data such as population, demographics, number of devices, visitor demand, and other aspects that characterise a specific region. The steps taken to determine these figures are presented in the Appendix of this report. This is the characterisation for the Central Coast region.

Population and Demographic Aspects

Total Area
1,682 km^2

Urban vs Rural Split	
Urban	98.8%
Rural	1.2%

Total Population	
2023	355,654
2025	366,611
2030	390,743

Visitor Demand (per day)

Year	Total Visitors (Low-50% of max. accommodation)	Total Visitors (Baseline-75% of max. accommodation)	Total Visitors (High-100% of max. accommodation)
2023	6,631	9,947	13,263
2025	7,241	10,862	14,484
2030	9,024	13,536	18,049

Main Events and Touristic Points

Annual Central Coast highlights include Flavours by the Sea in Terrigal held in March, ChromeFest in The Entrance held in October with over 50,000 visitors, and New Year's Eve festivities at The Entrance and Gosford. The region has 41 beaches along its 80km coastline, great walks in Bouddi National Park, and popular coastal towns such as Terrigal and The Entrance.

Number of Devices (Baseline Scenario)

Sectors	2023	2025	2030
Agriculture, Forestry, Fishing, Mining, Quarrying, Oil & Gas	23,815	32,046	67,307
Utilities	18,319	24,651	51,775
Construction	210,673	283,482	595,409
Manufacturing	108,085	145,439	305,471
Wholesale and Retail Trade	227,161	305,667	642,006
Transportation & Warehousing	67,782	91,207	191,566
Finance, Insurance, Real Estate, Rental & Leasing	89,765	120,788	253,696
Professional, Scientific & Technical Services	109,916	147,904	310,648
Business, Building & other support services	60,454	81,347	170,856
Educational services	150,219	202,135	424,552
Health care and social assistance	326,085	438,781	921,589
Arts, Information, Culture & Recreation	54,958	73,952	155,324
Accommodation and food services	128,236	172,554	362,423
Other services (excluding public administration)	69,614	93,672	196,744
Public administration	111,748	150,369	315,826
Households & Consumer Goods (Individual Devices)	1,448,001	1,492,613	1,590,864
Visitor Demand (Visitor Devices)	41,278	45,077	56,443

DSSN's Region Characterisation - Cessnock

The below tables summarise all the data such as population, demographics, number of devices, visitor demand, and other aspects that characterise a specific region. The steps taken to determine these figures are presented in the Appendix of this report. This is the characterisation for the Cessnock region.

Population and Demographic Aspects

Total Area
1,966 km²

Urban vs Rural Split	
Urban	0.0%
Rural	100.0%

Total Population	
2023	67,048
2025	69,113
2030	73,663

Visitor Demand (per day)

Year	Total Visitors (Low-50% of max. accommodation)	Total Visitors (Baseline-75% of max. accommodation)	Total Visitors (High-100% of max. accommodation)
2023	6,216	9,324	12,432
2025	6,788	10,084	13,576
2030	8,459	12,566	16,918

Main Events and Touristic Points

The vineyards in Pokolbin and Lovedale are at the heart of Australia's oldest wine region. Major draws for tourists include music events at Bimbadgen and Hope Estate, and the Lovedale Long Lunch, a food and wine highlight every May. The Kurri Kurri Nostalgia Fest brings over 30,000 visitors for three days of vintage charm every March.

Number of Devices (Baseline Scenario)

Sectors	2023	2025	2030
Agriculture, Forestry, Fishing, Mining, Quarrying, Oil & Gas	34,536	46,471	97,605
Utilities	4,490	6,041	12,689
Construction	31,773	42,753	89,797
Manufacturing	25,902	34,853	73,204
Wholesale and Retail Trade	41,788	56,230	118,102
Transportation & Warehousing	14,160	19,053	40,018
Finance, Insurance, Real Estate, Rental & Leasing	10,361	13,941	29,282
Professional, Scientific & Technical Services	12,433	16,730	35,138
Business, Building & other support services	16,232	21,841	45,874
Educational services	20,721	27,883	58,563
Health care and social assistance	49,386	66,454	139,575
Arts, Information, Culture & Recreation	5,180	6,971	14,641
Accommodation and food services	30,391	40,895	85,893
Other services (excluding public administration)	15,886	21,377	44,898
Public administration	17,268	23,236	48,803
Households & Consumer Goods (Individual Devices)	272,976	281,386	299,908
Visitor Demand (Visitor Devices)	38,320	41,846	52,398

DSSN's Region Characterisation - Dungog

The below tables summarise all the data such as population, demographics, number of devices, visitor demand, and other aspects that characterise a specific region. The steps taken to determine these figures are presented in the Appendix of this report. This is the characterisation for the Dungog region.

Population and Demographic Aspects

Total Area
2,250 km²

Urban vs Rural Split	
Urban	0.0%
Rural	100.0%

Total Population	
2023	9,894
2025	10,199
2030	10,870

Visitor Demand (per day)

Year	Total Visitors (Low-50% of max. accommodation)	Total Visitors (Baseline-75% of max. accommodation)	Total Visitors (High-100% of max. accommodation)
2023	966	1,449	1,932
2025	1,055	1,582	2,110
2030	1,315	1,972	2,629

Main Events and Touristic Points

Dungog is known for its country charm and nature, featuring the Barrington Tops National Park and the Williams River. Visitors frequent the region for extensive bike trails, camping adventures, the annual Dungog Show, and the popular Dungog Rodeo held in April with over 6,000 attendees in 2023.

Number of Devices (Baseline Scenario)

Sectors	2023	2025	2030
Agriculture, Forestry, Fishing, Mining, Quarrying, Oil & Gas	6,982	9,395	19,733
Utilities	764	1,029	2,161
Construction	6,268	8,435	17,716
Manufacturing	3,007	4,046	8,498
Wholesale and Retail Trade	5,402	7,269	15,268
Transportation & Warehousing	2,395	3,223	6,770
Finance, Insurance, Real Estate, Rental & Leasing	1,580	2,126	4,465
Professional, Scientific & Technical Services	2,650	3,556	7,490
Business, Building & other support services	1,631	2,194	4,609
Educational services	4,230	5,692	11,955
Health care and social assistance	6,218	8,366	17,572
Arts, Information, Culture & Recreation	663	891	1,872
Accommodation and food services	2,242	3,017	6,337
Other services (excluding public administration)	2,344	3,155	6,626
Public administration	2,446	3,292	6,914
Households & Consumer Goods (Individual Devices)	40,282	41,523	44,257
Visitor Demand (Visitor Devices)	6,013	6,566	8,222

DSSN's Region Characterisation - Lake Macquarie

The below tables summarise all the data such as population, demographics, number of devices, visitor demand, and other aspects that characterise a specific region. The steps taken to determine these figures are presented in the Appendix of this report. This is the characterisation for the Lake Macquarie region.

Population and Demographic Aspects

Total Area
649 km^2

Urban vs Rural Split	
Urban	91.5%
Rural	8.5%

Total Population	
2023	220,598
2025	227,395
2030	242,363

Visitor Demand (per day)

Year	Total Visitors (Low-50% of max. accommodation)	Total Visitors (Baseline-75% of max. accommodation)	Total Visitors (High-100% of max. accommodation)
2023	3,041	4,562	6,082
2025	3,321	4,982	6,642
2030	4,138	6,208	8,277

Main Events and Touristic Points

Lake Macquarie is centred around the vast lake, with scenic walking trails and a selection of beaches, including the popular Naru Beach. The annual Fast and Loud Festival attracts over 40,000 visitors, while the Lake Macquarie Food & Wine Festival provides a gourmet experience with local produce.

Number of Devices (Baseline Scenario)

Sectors	2023	2025	2030
Agriculture, Forestry, Fishing, Mining, Quarrying, Oil & Gas	34,088	45,869	96,342
Utilities	15,908	21,406	44,959
Construction	127,264	171,246	359,675
Manufacturing	65,904	88,681	186,260
Wholesale and Retail Trade	131,809	177,362	372,521
Transportation & Warehousing	43,179	58,101	122,033
Finance, Insurance, Real Estate, Rental & Leasing	51,133	68,804	144,512
Professional, Scientific & Technical Services	64,768	87,152	183,049
Business, Building & other support services	35,225	47,398	99,553
Educational services	104,538	140,666	295,448
Health care and social assistance	217,030	292,036	613,375
Arts, Information, Culture & Recreation	20,453	27,522	57,085
Accommodation and food services	71,586	96,326	202,317
Other services (excluding public administration)	46,588	62,688	131,667
Public administration	63,632	85,623	179,838
Households & Consumer Goods (Individual Devices)	898,140	925,811	986,752
Visitor Demand (Visitor Devices)	18,932	20,674	25,887

DSSN's Region Characterisation - Maitland

The below tables summarise all the data such as population, demographics, number of devices, visitor demand, and other aspects that characterise a specific region. The steps taken to determine these figures are presented in the Appendix of this report. This is the characterisation for the Maitland region.

Population and Demographic Aspects

Total Area
392 km²

Urban vs Rural Split	
Urban	64.0%
Rural	36.0%

Total Population	
2023	95,299
2025	98,235
2030	104,701

Visitor Demand (per day)

Year	Total Visitors (Low-50% of max. accommodation)	Total Visitors (Baseline-75% of max. accommodation)	Total Visitors (High-100% of max. accommodation)
2023	1,903	2,854	3,805
2025	2,078	3,117	4,155
2030	2,590	3,884	5,178

Main Events and Touristic Points

Maitland is a vibrant region rich in heritage and cultural events, drawing thousands to its annual festivals. Some popular events in the region are the annual Steamfest, Aroma festival highlighting coffee and chocolate in August with 15,000 attendees, the culturally diverse Riverlights, and the three-day Taste festival for local flavours with 15,000 attendees.

Number of Devices (Baseline Scenario)

Sectors	2023	2025	2030
Agriculture, Forestry, Fishing, Mining, Quarrying, Oil & Gas	35,834	48,218	101,274
Utilities	6,872	9,247	19,422
Construction	44,179	59,447	124,859
Manufacturing	32,889	44,255	92,950
Wholesale and Retail Trade	62,341	83,886	176,190
Transportation & Warehousing	21,108	28,402	59,655
Finance, Insurance, Real Estate, Rental & Leasing	17,181	23,118	48,556
Professional, Scientific & Technical Services	23,071	31,044	65,204
Business, Building & other support services	18,162	24,439	51,331
Educational services	38,288	51,521	108,211
Health care and social assistance	79,522	107,004	224,746
Arts, Information, Culture & Recreation	6,872	9,247	19,422
Accommodation and food services	33,379	44,915	94,338
Other services (excluding public administration)	21,108	28,402	59,655
Public administration	31,907	42,934	90,176
Households & Consumer Goods (Individual Devices)	387,997	399,951	426,277
Visitor Demand (Visitor Devices)	11,844	12,934	16,195

DSSN's Region Characterisation - Muswellbrook

The below tables summarise all the data such as population, demographics, number of devices, visitor demand, and other aspects that characterise a specific region. The steps taken to determine these figures are presented in the Appendix of this report. This is the characterisation for the Muswellbrook region.

Population and Demographic Aspects

Total Area
3,405 km^2

Urban vs Rural Split	
Urban	0.0%
Rural	100.0%

Total Population	
2023	16,834
2025	17,353
2030	18,495

Visitor Demand (per day)

Year	Total Visitors (Low-50% of max. accommodation)	Total Visitors (Baseline-75% of max. accommodation)	Total Visitors (High-100% of max. accommodation)
2023	1,126	1,690	2,253
2025	1,230	1,846	2,460
2030	1,532	2,300	3,066

Main Events and Touristic Points

Muswellbrook LGA, at the heart of the Hunter Valley's mining region, boasts a rich blend of industry and culture. Key events include the Upper Hunter Show and the Muswellbrook Gold Cup in March, the Great Cattle Dog Muster in September, and the Upper Hunter Wine and Food Affair, highlighting the food and wine of the region including Pukara Estate.

Number of Devices (Baseline Scenario)

Sectors	2023	2025	2030
Agriculture, Forestry, Fishing, Mining, Quarrying, Oil & Gas	24,800	33,370	70,089
Utilities	3,295	4,434	9,313
Construction	4,943	6,651	13,969
Manufacturing	3,295	4,434	9,313
Wholesale and Retail Trade	9,105	12,251	25,732
Transportation & Warehousing	2,515	3,384	7,107
Finance, Insurance, Real Estate, Rental & Leasing	1,734	2,234	4,901
Professional, Scientific & Technical Services	2,168	2,917	6,127
Business, Building & other support services	4,336	5,834	12,253
Educational services	5,463	7,351	15,439
Health care and social assistance	7,804	10,501	22,056
Arts, Information, Culture & Recreation	1,214	1,634	3,431
Accommodation and food services	5,896	7,934	16,665
Other services (excluding public administration)	3,555	4,784	10,048
Public administration	3,382	4,550	9,558
Households & Consumer Goods (Individual Devices)	68,539	70,650	75,301
Visitor Demand (Visitor Devices)	7,013	7,659	9,590

DSSN's Region Characterisation - Newcastle

The below tables summarise all the data such as population, demographics, number of devices, visitor demand, and other aspects that characterise a specific region. The steps taken to determine these figures are presented in the Appendix of this report. This is the characterisation for the Newcastle region.

Population and Demographic Aspects

Total Area
187 km^2

Urban vs Rural Split	
Urban	100.0%
Rural	0.0%

Total Population	
2023	174,617
2025	179,997
2030	191,845

Visitor Demand (per day)

Year	Total Visitors (Low-50% of max. accommodation)	Total Visitors (Baseline-75% of max. accommodation)	Total Visitors (High-100% of max. accommodation)
2023	5,068	7,602	10,136
2025	5,534	8,302	11,069
2030	6,897	10,345	13,794

Main Events and Touristic Points

Newcastle is a coastal hub with rich culture and a vibrant events calendar. New Annual arts festival is held over 10 days, beginning in September, with over 40,000 attendees in 2022. Major concerts are being held at the McDonald Jones Stadium, including Elton John with over 50,000 tickets sold for two performances that injected over $12 million into the visitor economy.

Number of Devices (Baseline Scenario)

Sectors	2023	2025	2030
Agriculture, Forestry, Fishing, Mining, Quarrying, Oil & Gas	20,687	27,837	58,466
Utilities	10,793	14,523	30,504
Construction	70,156	94,402	198,277
Manufacturing	43,173	58,094	122,016
Wholesale and Retail Trade	93,542	125,869	264,369
Transportation & Warehousing	31,480	42,360	88,970
Finance, Insurance, Real Estate, Rental & Leasing	41,374	55,673	116,932
Professional, Scientific & Technical Services	69,257	93,192	195,735
Business, Building & other support services	26,084	35,098	73,718
Educational services	91,743	123,449	259,285
Health care and social assistance	185,284	249,318	523,654
Arts, Information, Culture & Recreation	21,587	29,047	61,008
Accommodation and food services	74,653	100,454	210,987
Other services (excluding public administration)	29,681	39,939	83,886
Public administration	57,564	77,458	162,689
Households & Consumer Goods (Individual Devices)	710,933	732,836	781,075
Visitor Demand (Visitor Devices)	31,547	34,450	43,137

DSSN's Region Characterisation - Port Stephens

The below tables summarise all the data such as population, demographics, number of devices, visitor demand, and other aspects that characterise a specific region. The steps taken to determine these figures are presented in the Appendix of this report. This is the characterisation for the Port Stephens region.

Population and Demographic Aspects

Total Area
858 km^2

Urban vs Rural Split	
Urban	17.4%
Rural	82.6%

Total Population	
2023	78,015
2025	80,418
2030	85,712

Visitor Demand (per day)

Year	Total Visitors (Low-50% of max. accommodation)	Total Visitors (Baseline-75% of max. accommodation)	Total Visitors (High-100% of max. accommodation)
2023	7,097	10,645	14,194
2025	7,750	11,625	15,500
2030	9,658	14,486	19,316

Main Events and Touristic Points

Port Stephens is well-known for its stunning beaches, wildlife experiences, and nature, with Shoal Bay being a popular holiday destination. Diverse nature experiences include the Stockton Sand Dunes, Tomaree Head Summit with 250,000 visitors per annum, and the 27km Tomaree Coastal Walk. Sail Port Stephens is an annual event that injected over $2 million into the visitor economy in 2022.

Number of Devices (Baseline Scenario)

Sectors	2023	2025	2030
Agriculture, Forestry, Fishing, Mining, Quarrying, Oil & Gas	12,859	17,303	36,343
Utilities	4,018	5,407	11,357
Construction	43,400	58,398	122,657
Manufacturing	24,915	33,525	70,414
Wholesale and Retail Trade	48,222	64,887	136,285
Transportation & Warehousing	19,691	26,496	55,650
Finance, Insurance, Real Estate, Rental & Leasing	13,663	18,385	38,614
Professional, Scientific & Technical Services	20,896	28,118	59,057
Business, Building & other support services	15,270	20,548	43,157
Educational services	29,737	40,014	84,043
Health care and social assistance	58,268	78,405	164,678
Arts, Information, Culture & Recreation	6,831	9,192	19,307
Accommodation and food services	36,568	49,206	103,350
Other services (excluding public administration)	17,279	23,251	48,836
Public administration	33,755	45,421	95,400
Households & Consumer Goods (Individual Devices)	317,628	327,414	348,966
Visitor Demand (Visitor Devices)	44,175	48,240	60,404

DSSN's Region Characterisation - Singleton

The below tables summarise all the data such as population, demographics, number of devices, visitor demand, and other aspects that characterise a specific region. The steps taken to determine these figures are presented in the Appendix of this report. This is the characterisation for the Singleton region.

Population and Demographic Aspects

Total Area
4,893 km²

Urban vs Rural Split	
Urban	1.7%
Rural	98.3%

Total Population	
2023	25,558
2025	26,346
2030	28,080

Visitor Demand (per day)

Year	Total Visitors (Low-50% of max. accommodation)	Total Visitors (Baseline-75% of max. accommodation)	Total Visitors (High-100% of max. accommodation)
2023	2,214	3,321	4,428
2025	2,418	3,627	4,835
2030	3,013	4,519	6,026

Main Events and Touristic Points

The Singleton LGA is a prominent mining hub in the heart of Hunter Valley's wine region. The annual Singleton Firelight Festival held each May showcases the area's community spirit and distinct identity. As part of the community strategic plan, Singleton LGA commits to initiatives aimed at reinforcing Singleton's brand.

Number of Devices (Baseline Scenario)

Sectors	2023	2025	2030
Agriculture, Forestry, Fishing, Mining, Quarrying, Oil & Gas	33,439	44,995	94,505
Utilities	3,160	4,251	8,930
Construction	9,479	12,754	26,789
Manufacturing	5,529	7,440	15,627
Wholesale and Retail Trade	14,086	18,955	39,811
Transportation & Warehousing	3,818	5,137	10,790
Finance, Insurance, Real Estate, Rental & Leasing	2,633	3,543	7,441
Professional, Scientific & Technical Services	3,949	5,314	11,162
Business, Building & other support services	5,924	7,972	16,743
Educational services	7,636	10,274	21,580
Health care and social assistance	11,585	15,589	32,742
Arts, Information, Culture & Recreation	1,448	1,949	4,093
Accommodation and food services	8,952	12,046	25,300
Other services (excluding public administration)	5,793	7,794	16,371
Public administration	9,215	12,400	26,045
Households & Consumer Goods (Individual Devices)	104,057	107,263	114,324
Visitor Demand (Visitor Devices)	13,782	15,050	18,845

DSSN's Region Characterisation - Upper Hunter

The below tables summarise all the data such as population, demographics, number of devices, visitor demand, and other aspects that characterise a specific region. The steps taken to determine these figures are presented in the Appendix of this report. This is the characterisation for the Upper Hunter region.

Population and Demographic Aspects

Total Area
8,096 km^2

Urban vs Rural Split	
Urban	0.0%
Rural	100.0%

Total Population	
2023	14,567
2025	15,016
2030	16,005

Visitor Demand (per day)

Year	Total Visitors (Low-50% of max. accommodation)	Total Visitors (Baseline-75% of max. accommodation)	Total Visitors (High-100% of max. accommodation)
2023	978	1,467	1,956
2025	1,068	1,602	2,136
2030	1,331	1,996	2,662

Main Events and Touristic Points

Upper Hunter hosts the Scone Horse Festival in May, celebrating its equine heritage with 10,000 visitors over 10 days. The Aberdeen Highland Games are held annually in July, with the Rosto Festival of the Fleeces held in Merriwa every June with over 6,000 visitors. Warbirds over Scone attracts a loyal crowd with 8,000 attendees, injecting an estimated $2.4 million into the local economy.

Number of Devices (Baseline Scenario)

Sectors	2023	2025	2030
Agriculture, Forestry, Fishing, Mining, Quarrying, Oil & Gas	21,685	29,180	61,287
Utilities	1,126	1,515	3,181
Construction	5,252	7,068	14,845
Manufacturing	4,727	6,361	13,360
Wholesale and Retail Trade	6,378	8,582	18,026
Transportation & Warehousing	2,101	2,827	5,938
Finance, Insurance, Real Estate, Rental & Leasing	1,276	1,716	3,605
Professional, Scientific & Technical Services	3,001	4,039	8,483
Business, Building & other support services	2,326	3,130	6,574
Educational services	5,553	7,472	15,693
Health care and social assistance	6,828	9,188	19,298
Arts, Information, Culture & Recreation	2,026	2,726	5,726
Accommodation and food services	4,202	5,654	11,876
Other services (excluding public administration)	2,626	3,534	7,422
Public administration	3,302	4,443	9,331
Households & Consumer Goods (Individual Devices)	59,309	61,137	65,161
Visitor Demand (Visitor Devices)	6,088	6,648	8,324

3. Future Demand Model Scenarios

Refer to Appendices:

5.3.1 Future Demand: Methodology for the Estimation of Future Number of Devices
5.3.2 Future Demand: Methodology and Analysis of Demand based on Sector Characteristics

Scenario inputs and outputs

Scenario 1 - Low Demand

Obtain a conservative scenario where the number of devices per capita is lower and assumes a lower population growth rate.

Low Demand Scenario

Assumptions

1 - Average Number of Devices per Capita:

- **6.58**

Source: Cisco IBSG Group

2 - IoT vs Non-IoT Connections Ratio

- **56% vs 44%**

Source: IoT Analytics

3 - Industrial Devices vs Individual Devices per inhabitant

- Industrial Devices: **3.68**
- Individual/Visitor Devices: **2.90**

4 - Total Population (2023)

- **1,038,081**

5 - Total Industrial Devices (2023)

- **3,815,069** (1,038,081 * 3.68)

6 - Total Individual Devices (2023)

- **3,015,504** (1,038,081 * 2.90)

7 - Annual Growth of Industrial Devices

- **16%** (**Source**: Ericsson)

8 - Annual Growth of Individual Devices

- Follow the annual growth of population (table on the right)

9 - Annual Growth of Visitor Demand

- **4.5% per year**

10 - Total Visitor Devices

- Visitor Numbers (50% of max. accommodation) * **2.90**

11 - Population Growth Rate:

- Population growth for the DSSN Regions based on the lower projection from the ABS for New South Wales.

Year	Population for New South Wales	Annual Growth
2022	8,166,525	-
2023	8,308,795	1.74%
2024	8,426,235	1.41%
2025	8,538,190	1.33%
2026	8,644,507	1.25%
2027	8,746,490	1.18%
2028	8,841,657	1.09%
2029	8,931,668	1.02%
2030	9,015,876	0.94%

Source: Population Projections - ABS

Regions	2023				2025				2030			
	Industrial Devices	Individual Devices	Visitor Devices	Total	Industrial Devices	Individual Devices	Visitor Devices	Total	Industrial Devices	Individual Devices	Visitor Devices	Total
Central Coast	1,282,359	1,013,601	19,262	2,315,222	1,725,542	1,041,585	21,035	2,788,162	3,624,227	1,099,859	26,213	4,750,299
Cessnock City	241,749	191,083	18,057	450,889	325,298	196,359	19,718	541,375	683,236	207,344	24,573	915,154
Dungog Shire	35,674	28,198	2,806	66,678	48,003	28,976	3,064	80,044	100,824	30,597	3,819	135,240
Lake Macquarie	795,398	628,698	8,834	1,432,930	1,070,288	646,056	9,647	1,725,990	2,247,970	682,200	12,022	2,942,192
Maitland	343,612	271,598	5,528	620,738	462,365	279,096	6,037	747,498	971,124	294,711	7,523	1,273,358
Muswellbrook	60,698	47,977	3,271	111,946	81,676	49,302	3,572	134,549	171,547	52,060	4,451	228,058
Newcastle City	629,606	497,653	14,722	1,141,981	847,198	511,392	16,077	1,374,668	1,779,406	540,003	20,035	2,339,444
Port Stephens	281,293	222,340	20,616	524,249	378,508	228,478	22,513	629,500	794,997	241,261	28,055	1,064,314
Singleton	92,154	72,840	6,431	171,425	124,002	74,851	7,023	205,876	260,446	79,039	8,752	348,237
Upper Hunter	52,525	41,517	2,841	96,882	70,677	42,663	3,102	116,443	148,447	45,050	3,866	197,362
DSSN Region	**3,815,069**	**3,015,504**	**102,368**	**6,932,941**	**5,133,557**	**3,098,758**	**111,788**	**8,344,104**	**10,782,224**	**3,272,124**	**139,309**	**14,193,657**

Scenario 2 - Baseline Demand

Obtain a baseline scenario where the number of devices per capita is most likely and assumes a medium population growth rate.

Baseline Demand Scenario

Assumptions

1 - Average Number of Devices per Capita:

- 9.4

Source: Cisco Annual Internet Report

2 - IoT vs Non-IoT Connections Ratio

- **56% vs 44%**

Source: IoT Analytics

3 - Industrial Devices vs Individual Devices per inhabitant

- Industrial Devices: **5.25**
- Individual/Visitor Devices: **4.15**

4 - Total Population (2023)

- **1,038,081**

5 - Total Industrial Devices (2023)

- **5,450.099** (1,038,081 * 5.25)

6 - Total Individual Devices (2023)

- **4,307,863** (1,038,081 * 4.15)

7 - Annual Growth of Industrial Devices

- **16%** (**Source**: Ericsson)

8 - Annual Growth of Individual Devices

- Follow the annual growth of population (table on the right)

9 - Annual Growth of Visitor Demand

- **4.5% per year**

10 - Total Visitor Devices

- Visitor Numbers (75% of max. accommodation) * 4.15

11 - Population Growth Rate:

- Population growth for the DSSN Regions based on the lower projection from the ABS for New South Wales.

Year	Population for New South Wales	Annual Growth
2022	8,166,525	-
2023	8,323,889	1.93%
2024	8,453,902	1.56%
2025	8,580,341	1.50%
2026	8,702,446	1.42%
2027	8,820,393	1.36%
2028	8,933,348	1.28%
2029	9,041,818	1.21%
2030	9,145,140	1.14%

Source: Population Projections - ABS

Regions	2023				2025				2030			
	Industrial Devices	Individual Devices	Visitor Devices	Total	Industrial Devices	Individual Devices	Visitor Devices	Total	Industrial Devices	Individual Devices	Visitor Devices	Total
Central Coast	1,831,941	1,448,001	41,278	3,321,220	2,465,060	1,492,613	45,077	4,002,749	5,177,467	1,590,864	56,443	6,824,775
Cessnock City	345,356	272,976	38,320	656,652	464,711	281,386	41,846	787,943	976,052	299,908	52,398	1,328,358
Dungog Shire	50,963	40,282	6,013	97,259	68,576	41,523	6,566	116,666	144,034	44,257	8,222	196,513
Lake Macquarie	1,136,283	898,140	18,932	2,053,355	1,528,983	925,811	20,674	2,475,467	3,211,386	986,752	25,887	4,224,025
Maitland	490,875	387,997	11,844	890,715	660,521	399,951	12,934	1,073,406	1,387,320	426,277	16,195	1,829,793
Muswellbrook	86,712	68,539	7,013	162,264	116,679	70,650	7,659	194,988	245,066	75,301	9,590	329,957
Newcastle City	899,438	710,933	31,547	1,641,917	1,210,283	732,836	34,450	1,977,569	2,542,008	781,075	43,137	3,366,220
Port Stephens	401,848	317,628	44,175	763,651	540,726	327,414	48,240	916,381	1,135,710	348,966	60,404	1,545,080
Singleton	131,648	104,057	13,782	249,487	177,145	107,263	15,050	299,458	372,066	114,324	18,845	505,234
Upper Hunter	75,035	59,309	6,088	140,433	100,968	61,137	6,648	168,752	212,066	65,161	8,324	285,552
DSSN Region	**5,450,099**	**4,307,863**	**218,991**	**9,976,952**	**7,333,653**	**4,440,584**	**239,143**	**12,013,381**	**15,403,177**	**4,732,885**	**299,445**	**20,435,506**

Scenario 3- High Demand

Obtain a disruptive scenario where the number of devices per capita is high and assumes a high population growth rate.

High Demand Scenario

Assumptions

1 - Average Number of Devices per Capita:

- 13.4

Source: Cisco Annual Internet Report

2 - IoT vs Non-IoT Connections Ratio

- **56% vs 44%**

Source: IoT Analytics

3 - Industrial Devices vs Individual Devices per inhabitant

- Industrial Devices: **7.48**
- Individual/Visitor Devices: **5.92**

4 - Total Population (2023)

- **1,038,081**

5 - Total Industrial Devices (2023)

- **7,769,290** (1,038,081 * 7.48)

6 - Total Individual Devices (2023)

- **6,140,996** (1,038,081 * 5.92)

7 - Annual Growth of Industrial Devices

- **16%** (**Source**: Ericsson)

8 - Annual Growth of Individual Devices

- Follow the annual growth of population (table on the right)

9 - Annual Growth of Visitor Demand

- **4.5% per year**

10 - Total Visitor Devices

- Visitor Numbers (100% of max. accommodation) * 5.92

11 - Population Growth Rate:

- Population growth for the DSSN Regions based on the lower projection from the ABS for New South Wales.

Year	Population for New South Wales	Annual Growth
2022	8,166,525	-
2023	8,341,073	2.14%
2024	8,491,447	1.80%
2025	8,638,413	1.73%
2026	8,781,199	1.65%
2027	8,920,424	1.59%
2028	9,055,666	1.52%
2029	9,186,911	1.45%
2030	9,313,449	1.38%

Source: Population Projections - ABS

Regions	2023				2025				2030			
	Industrial Devices	Individual Devices	Visitor Devices	Total	Industrial Devices	Individual Devices	Visitor Devices	Total	Industrial Devices	Individual Devices	Visitor Devices	Total
Central Coast	2,611,490	2,064,172	78,460	4,754,122	3,514,021	2,137,755	85,680	5,737,456	7,380,645	2,304,807	106,773	9,792,225
Cessnock City	492,316	389,136	73,544	954,996	662,460	403,008	80,312	1,145,780	1,391,393	434,500	100,084	1,925,977
Dungog Shire	72,650	57,424	11,429	141,503	97,758	59,471	12,481	169,710	205,325	64,118	15,554	284,996
Lake Macquarie	1,619,808	1,280,327	35,979	2,936,115	2,179,614	1,325,968	39,290	3,544,872	4,577,933	1,429,584	48,963	6,056,480
Maitland	699,758	553,102	22,509	1,275,369	941,594	572,819	24,581	1,538,994	1,977,669	617,581	30,632	2,625,882
Muswellbrook	123,610	97,704	13,328	234,643	166,330	101,187	14,555	282,072	349,350	109,094	18,138	476,582
Newcastle City	1,282,177	1,013,457	59,962	2,355,596	1,725,297	1,049,585	65,480	2,840,362	3,623,714	1,131,603	81,600	4,836,917
Port Stephens	572,847	452,789	83,968	1,109,604	770,823	468,930	91,695	1,331,448	1,618,991	505,574	114,268	2,238,833
Singleton	187,668	148,337	26,195	362,200	252,527	153,625	28,605	434,756	530,392	165,629	35,648	731,669
Upper Hunter	106,965	84,547	11,571	203,084	143,933	87,561	12,636	244,130	302,308	94,404	15,747	412,458
DSSN Region	7,769,290	6,140,996	416,946	14,327,231	10,454,356	6,359,908	455,315	17,269,580	21,957,720	6,856,893	567,406	29,382,019

Wireless infrastructure capacity modelling approach and assumptions

Wireless - Modelling Approach Overview

The below steps have been undertaken in the wireless modelling to determine new telecommunications infrastructure requirements and the associated cost estimates.

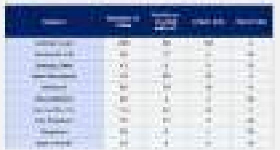
1 Assess existing radio mobile site profiles

- Analysis of emission frequencies for the various radio technologies used by the three major Australian mobile operators.
- Define radio mobile site profiles and their technical characteristics.

Specifications	3G/4G co-located with 5G	Urban Site	Rural Site
Maximum throughput downlink per site (Mbps)	630	290	250
Maximum throughput uplink per site (Mbps)	120	60	55
Maximum Simultaneously Active Users per site	2300	1700	1400

2 Model the topology / profile of mobile sites per LGA

- Analysis of the current number of radio sites for the DSSN regions.
- Distribution of the number of sites across the different topologies/profiles defined according to the urban vs rural split by LGA.



3 Determine new equipment / infrastructure needed per LGA

- Execute the wireless model to understand the current state in terms of capacity requirements and new infrastructure that's needed to accommodate the new demand.
- Analysis of capacity in terms of transmission, reception, and simultaneous number of active devices across the different LGAs according to their existing mobile sites and the distribution of the number of devices across the three defined scenarios (Low, Medium, and High).

Projected Years	Required Mbps - Downlink as % of RAN Capacity	Required Mbps - Uplink as % of RAN Capacity	Required SAUs as % of RAN Capacity
2023	97.6%	98.6%	69,6%
2025	108.2%	109.2%	95.9%
2030	141.6%	142.9%	162.7%

Projected Years	Required Mbps - Downlink as % of RAN Capacity	Required Mbps - Uplink as % of RAN Capacity	Required SAUs as % of RAN Capacity
2023	97.6%	98.6%	79.8%
2025	96.2%	97.5%	76.2%
2030	90.8%	93.0%	98.5%

4 Cost estimation for the new equipment / infrastructure

- Obtain average costs related to the installation of new macro sites based on tower types and areas. Note that the average cost assumptions in Australia are based on the ACCC regional mobile enquiry report from July 2023.
- Define assumptions to estimate a cost range, area where the macro site will be built, and current mobile site co-location arrangement for the different radio sites.
- Calculate the wireless network costs for each of the three demand scenarios, in line with the number of new macro sites that will need to be added for each region.

Wireless - Mobile Site Profiles

Understanding the mobile site technologies, frequencies and characteristics across co-located, urban and rural sites is important to establish mobile site throughput assumptions.

Existing technologies & frequencies in use for radio access

- According to ACCC data for mobile sites for the three main operators, the existing 3G, 4G and 5G technologies and radio frequencies are currently in use.

Technology	Frequency [Mhz]	Operator		
		Telstra	OPTUS	TPG
3G	850	x		
	900		x	x
	2100	x	x	x
4G	700	x	x	x
	800			x
	900	x	x	
	1800	x	x	x
	2100	x	x	x
	2300		x	
	2600	x	x	
5G	700	x		x
	900		x	
	2100	x	x	x
	2300		x	
	2600	x		
	3500		x	
	3600	x		x
	26000	x	x	x

Lower frequencies ensure lower capacity but greater coverage.

Higher frequencies ensure greater capacity but lower coverage.

Sources: ACCC Mobile Infrastructure Report - Datasets of Mobile Sites for the three operators (2023)

Mobile sites profiles

- To estimate the current network capacity for different regions, three site profiles were considered:

  1) **4G co-located sites with 5G** - sites incorporating all technologies, providing high capacity.
  2) **Urban Sites** - 3G/4G standalone sites using high frequencies (e.g., LTE 1800, 2100, 2300, 2600).
  3) **Rural Sites** - 3G/4G standalone sites using lower frequencies (e.g., LTE 700, 800, 900).

- The definition of maximum transmission capabilities in terms of transmission, reception, and devices per mobile site depends on many factors, including channel bandwidth, modulation and coding scheme, number of MIMO streams, among others. The values in the table below are average values, considering a starting point of a 4G radio site with a 20MHz bandwidth, modulation at 64-QAM, and the use of multiple 2x2 antennas (MIMO). This type of calculation is theoretical and based on the 3GPP communication standards.

Specifications	4G co-located with 5G	Urban Site	Rural Site
Maximum transmission link capacity per site (Mbps)	510	290	250
Maximum reception link capacity per site (Mbps)	105	60	55
Maximum Simultaneously Active Users per site	1,800	1,400	1,200

Wireless - Existing Mobile Sites per LGA

Understanding the existing mobile sites and technologies currently deployed in each LGA, across urban vs rural areas, is an important input assumption for the capacity modelling.

Existing mobile sites per LGA

Region	Number of Sites	3G Radio Access	4G Radio Access	5G Radio Access
Central Coast	265	234	263	98
Cessnock City	59	55	58	17
Dungog Shire	13	10	11	0
Lake Macquarie	111	98	108	68
Maitland	50	41	49	20
Muswellbrook	28	20	25	2
Newcastle City	114	107	114	66
Port Stephens	79	69	78	27
Singleton	39	33	35	8
Upper Hunter	24	20	22	4

Urban vs rural population split by LGA

Region	Urban Population	% Urban Population	Rural Population	% Rural Population
Central Coast	343,631	98.8%	4,236	1.2%
Cessnock City	0	0.0%	65,082	100.0%
Dungog Shire	0	0.0%	8,770	100.0%
Lake Macquarie	80,750	91.5%	7,466	8.5%
Maitland	57,646	64.0%	32,358	36.0%
Muswellbrook	0	0.0%	18,154	100.0%
Newcastle City	172,820	100.0%	0	0.0%
Port Stephens	14,376	17.4%	68,161	82.6%
Singleton	378	1.7%	22,527	98.3%
Upper Hunter	0	0.0%	24,463	100.0%

Mobile sites per LGA - topology

Assumptions

- Given that there are currently no standalone 5G sites at any of the LGAs, it is assumed that any site with 5G access is co-located with an existing 4G site.
- To determine the split of the remaining mobile sites between urban and rural, the ratio between the percentage of urban vs rural population was used as a proxy.

Region	Number of Sites	4G co-located with 5G	Urban Site	Rural Site
Central Coast	265	98	165	2
Cessnock City	59	17	0	42
Dungog Shire	13	0	0	13
Lake Macquarie	111	68	39	4
Maitland	50	20	19	11
Muswellbrook	28	2	0	26
Newcastle City	114	66	48	0
Port Stephens	79	27	9	43
Singleton	39	8	1	30
Upper Hunter	24	4	0	20

Wireless - Simulated Capacity Methodology

The below steps have been undertaken in the wireless modelling to identify areas where the existing network capacity does not support the estimated future demand.

Wireless Model Methodology

1 - Model Inputs

To estimate the current state capacity, previously estimated input assumptions feed into the wireless model. These inputs are:

- **1.1 - Total Number of Devices**: Estimated total number of devices for the years 2023, 2025, and 2030, for three scenarios.
- **1.2 - Total Number of Sites:** The existing number of mobile sites in the region categorised as 4G co-located with 5G, Urban Sites (4G with higher frequencies), and Rural Sites (4G with lower frequencies).
- **1.3 - Busy Hour Traffic associated with Mobile Access Technologies**: Traffic associated with the mobile network during the busy hour.
- **1.4 - Split Urban vs Rural:** The population ratio between urban and rural areas used to determine the type of traffic and the respective number of sites allocated to each region.

2 - As-Is State

After feeding the model with the inputs mentioned in step 1, it is possible to estimate the current state in terms of RAN (Radio Access Network) capacity across three different variables. In this analysis, it is assumed that the number of sites will remain the same until 2030.

- **Required Transmission Link Capacity as % of RAN Capacity:** This parameter aims to understand the network's capacity to handle data transmissions, information, and other network parameters between the radio site and user equipment.
- **Required Receive Link Capacity as % of RAN Capacity:** This parameter aims to understand the network's capacity to handle the reception of data, information, and other network parameters between user equipment and the base station.
- **Required Simultaneous Active Users/Devices (SAUs) as % of RAN Capacity:** This parameter allows the understanding of network's capacity to handle the number of simultaneous devices/users accessing during the busy hour.

For each of these parameters, the capacity based on the simulated demand is determined as a **percentage** and is represented as:

- <90% - The existing capacity is sufficient to **support the estimated future demand** and **no deployment** of new mobile sites is necessary.
- 90%-100% - The existing capacity is sufficient **to support the estimated future demand**, **without the need to add new radio sites.** However, despite already considering a 20% extra headroom, the network may experience saturation in the case of peak demand or unexpected network congestion
- >100% - The existing capacity **does not support the estimated future demand**, which may lead to **denial of mobile network** service. Installation of **new radio sites** is recommended.

3 - Future State

Through the analysis of the current state, the future state of the network is defined, providing the number of sites that need to be implemented \in 2025 and 2030 as necessary to address the simulated connectivity demand by increasing capacity.

Projected Years	Required Mbps - Downlink as % of RAN Capacity	Required Mbps - Uplink as % of RAN Capacity	Required SAUs as % of RAN Capacity
2023	97.6%	98.6%	69.6%
2025	108.2%	109.2%	95.9%
2030	141.6%	142.9%	162.7%

Illustrative Example

Wireless Infrastructure Modelling – Future Capacity Requirements

Wireless - Summarisation: Central Coast

For a detailed analysis of the simulated capacity demand for each LGA, refer to **Appendix 5.5: Future Demand: Wireless Simulated Capacity for Each LGA**

Low Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 2,315,222
- **2025:** 2,788,162
- **2030:** 4,750,299

Current Number of Sites: **(265)**

- **4G co-located with 5G**: 98
- **Urban Sites:** 165
- **Rural Sites:** 2

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	61.6%	57.2%	43.2%
2025	68.3%	63.4%	52.1%
2030	93.2%	86.4%	88.7%

- Until 2030, the mobile network can ensure the demand

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	61.6%	57.2%	43.2%
2025	68.3%	63.4%	52.1%
2030	93.2%	86.4%	88.7%

- **Until 2025**: No need of installation of new mobile sites
- **2025-2030**: No need of installation of new mobile sites
- **Total Radio Sites by 2030**: 265

Projected Costs: $0

Baseline Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 3,321,220
- **2025:** 4,002,749
- **2030:** 6,824,775

Current Number of Sites: **(265)**

- **4G co-located with 5G**: 98
- **Urban Sites:** 165
- **Rural Sites:** 2

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	69.8%	64.7%	49.0%
2025	77.5%	71.9%	59.0%
2030	105.7%	98.0%	100.6%

- Necessary increase in network capacity in 2030

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	69.8%	64.7%	49.0%
2025	77.5%	71.9%	59.0%
2030	99.5%	92.8%	95.9%

- **Until 2025**: No need of installation of new mobile sites
- **2025-2030**: Installation of 11 new mobile sites
- **Total Radio Sites by 2030**: 276

Projected Costs: $4,235,381 - $6,442,062

High Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 4,754,122
- **2025:** 5,737,456
- **2030:** 9,792,225

Current Number of Sites: **(265)**

- **4G co-located with 5G**: 98
- **Urban Sites:** 165
- **Rural Sites:** 2

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	99.9%	92.7%	70.1%
2025	111.0%	103.0%	84.6%
2030	151.6%	140.6%	144.4%

- Necessary increase in network capacity in 2025

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	99.9%	92.7%	70.1%
2025	99.7%	93.4%	77.6%
2030	97.1%	93.3%	99.7%

- **Until 2025**: Installation of 20 new mobile sites
- **2025-2030**: Installation of 79 new mobile sites
- **Total Radio Sites by 2030**: 364

Projected Costs: $38,591,325 - $58,467,640

Wireless - Summarisation : Cessnock

For a detailed analysis of the simulated capacity demand for each LGA, refer to **Appendix 5.5: Future Demand: Wireless Simulated Capacity for Each LGA**

Low Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 450,889
- **2025:** 541,375
- **2030:** 915,154

Current Number of Sites: **(59)**

- **4G co-located with 5G**: 17
- **Urban Sites:** 0
- **Rural Sites:** 42

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	58.6%	55.1%	37.1%
2025	64.7%	60.8%	44.6%
2030	83.6%	78.6%	75.4%

- Until 2030, the mobile network can ensure the demand

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	58.6%	55.1%	37.1%
2025	64.7%	60.8%	44.6%
2030	83.6%	78.6%	75.4%

- **Until 2025**: No need of installation of new mobile sites
- **2025-2030**: No need of installation of new mobile sites
- **Total Radio Sites by 2030**: 59

Projected Costs: $0

Baseline Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 656,652
- **2025:** 787,943
- **2030:** 1,328,358

Current Number of Sites: **(59)**

- **4G co-located with 5G**: 17
- **Urban Sites:** 0
- **Rural Sites:** 42

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	83.1%	78.1%	54.1%
2025	91.4%	85.9%	64.9%
2030	121.4%	114.1%	109.4%

- Necessary increase in network capacity in 2030

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	83.1%	78.1%	54.1%
2025	91.4%	85.9%	64.9%
2030	98.0%	92.7%	93.7%

- **Until 2025**: No need of installation of new mobile sites
- **2025-2030**: Installation of 8 new mobile sites
- **Total Radio Sites by 2030**: 67

Projected Costs: $3,343,835 - $4,619,979

High Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 954,996
- **2025:** 1,145,780
- **2030:** 1,925,977

Current Number of Sites: **(59)**

- **4G co-located with 5G**: 17
- **Urban Sites:** 0
- **Rural Sites:** 42

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	120.8%	113.6%	78.6%
2025	132.9%	124.9%	94.3%
2030	176.1%	165.4%	158.6%

- Necessary increase of the network capacity at the moment.

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	89.0%	84.3%	62.9%
2025	97.8%	92.7%	75.4%
2030	94.3%	90.0%	98.8%

- **Until 2025**: Installation of 12 new mobile sites
- **2025-2030**: Installation of 17 new mobile sites
- **Total Radio Sites by 2030**: 88

Projected Costs: $12,748,370 - $17,613,669

Wireless - Summarisation : Dungog

For a detailed analysis of the simulated capacity demand for each LGA, refer to **Appendix 5.5: Future Demand: Wireless Simulated Capacity for Each LGA**

Low Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 66,678
- **2025:** 80,044
- **2030:** 135,240

Current Number of Sites: **(13)**

- **4G co-located with 5G**: 0
- **Urban Sites:** 0
- **Rural Sites:** 13

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	58.5%	53.2%	32.1%
2025	62.8%	57.1%	38.5%
2030	84.3%	76.6%	65.0%

- Until 2030, the mobile network can ensure the demand

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	58.5%	53.2%	32.1%
2025	62.8%	57.1%	38.5%
2030	84.3%	76.6%	65.0%

- **Until 2025**: No need of installation of new mobile sites
- **2025-2030**: No need of installation of new mobile sites
- **Total Radio Sites by 2030**: 13

Projected Costs: $0

Baseline Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 97,259
- **2025:** 116,666
- **2030:** 196,513

Current Number of Sites: **(13)**

- **4G co-located with 5G**: 0
- **Urban Sites:** 0
- **Rural Sites:** 13

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	85.3%	77.5%	46.8%
2025	91.5%	83.2%	56.1%
2030	122.4%	111.3%	94.5%

- Necessary increase in network capacity in 2030

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	85.3%	77.5%	46.8%
2025	91.5%	83.2%	56.1%
2030	87.9%	81.4%	76.8%

- **Until 2025**: No need of installation of new mobile sites
- **2025-2030**: Installation of 2 new mobile site
- **Total Radio Sites by 2030**: 15

Projected Costs: $835,959 - $1,154,995

High Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 141,503
- **2025:** 169,710
- **2030:** 284,996

Current Number of Sites: **(13)**

- **4G co-located with 5G**: 0
- **Urban Sites:** 0
- **Rural Sites:** 13

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	124.1%	112.8%	68.0%
2025	137.1%	124.6%	81.6%
2030	184.2%	167.4%	137.0%

- Necessary increase of the network capacity at the moment.

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	89.1%	82.5%	55.3%
2025	98.5%	91.1%	66.3%
2030	93.0%	87.3%	86.9%

- **Until 2025**: Installation of 2 new mobile sites
- **2025-2030**: Installation of 3 new mobile sites
- **Total Radio Sites by 2030**: 18

Projected Costs: $2,298,886 - $3,176,235

Wireless - Summarisation : Lake Macquarie

For a detailed analysis of the simulated capacity demand for each LGA, refer to **Appendix 5.5: Future Demand: Wireless Simulated Capacity for Each LGA**

Low Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 1,432,930
- **2025:** 1,725,990
- **2030:** 2,942,192

Current Number of Sites: **(111)**

- **4G co-located with 5G**: 68
- **Urban Sites:** 39
- **Rural Sites:** 4

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	60.6%	59.0%	47.1%
2025	67.2%	65.5%	56.7%
2030	91.7%	89.3%	96.7%

- Until 2030, the mobile network can ensure the demand

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	60.6%	59.0%	47.1%
2025	67.2%	65.5%	56.7%
2030	91.7%	89.3%	96.7%

- **Until 2025**: No need of installation of new mobile sites
- **2025-2030**: No need of installation of new mobile sites
- **Total Radio Sites by 2030**: 111

Projected Costs: $0

Baseline Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 2,053,355
- **2025:** 2,475,467
- **2030:** 4,224,025

Current Number of Sites: **(111)**

- **4G co-located with 5G**: 68
- **Urban Sites:** 39
- **Rural Sites:** 4

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	86.8%	84.6%	67.5%
2025	96.4%	94.0%	81.3%
2030	131.6%	128.3%	138.8%

- Necessary increase in network capacity in 2030

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	86.8%	84.6%	67.5%
2025	96.4%	94.0%	81.3%
2030	91.1%	90.1%	99.6%

- **Until 2025**: No need of installation of new mobile sites
- **2025-2030**: Installation of 39 new mobile sites
- **Total Radio Sites by 2030**: 150

Projected Costs: $16,016,413 - $22,749,742

High Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 2,936,115
- **2025:** 3,544,872
- **2030:** 6,056,480

Current Number of Sites: **(111)**

- **4G co-located with 5G**: 68
- **Urban Sites:** 39
- **Rural Sites:** 4

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	124.1%	121.0%	96.5%
2025	138.0%	134.5%	116.5%
2030	188.7%	183.9%	199.0%

- Necessary increase of the network capacity at the moment.

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	99.2%	97.7%	79.0%
2025	99.5%	98.3%	86.7%
2030	88.6%	88.7%	99.6%

- **Until 2025**: Installation of 34 new mobile sites (19 now; 12 in 2025)
- **2025-2030**: Installation of 65 new mobile sites
- **Total Radio Sites by 2030**: 210

Projected Costs: $32,794,470 - $57,401,140

Wireless - Summarisation : Maitland

For a detailed analysis of the simulated capacity demand for each LGA, refer to **Appendix 5.5: Future Demand: Wireless Simulated Capacity for Each LGA**

Low Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 620,738
- **2025:** 747,498
- **2030:** 1,273,358

Current Number of Sites: **(50)**

- **4G co-located with 5G**: 20
- **Urban Sites:** 19
- **Rural Sites:** 11

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	70.7%	67.2%	49.7%
2025	78.4%	74.5%	59.8%
2030	103.1%	97.9%	101.9%

- Necessary increase in network capacity in 2030

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	70.7%	67.2%	49.7%
2025	78.4%	74.5%	59.8%
2030	97.1%	92.6%	97.2%

- **Until 2025**: No need of installation of new mobile sites
- **2025-2030:** Installation of 2 new mobile sites
- **Total Radio Sites by 2030**: 52

Projected Costs: $907,059 - $1,050,393

Baseline Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 890,715
- **2025:** 1,073,406
- **2030:** 1,829,793

Current Number of Sites: **(50)**

- **4G co-located with 5G**: 20
- **Urban Sites:** 19
- **Rural Sites:** 11

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	101.5%	96.4%	71.3%
2025	112.7%	107.0%	85.9%
2030	148.1%	140.7%	146.5%

- Necessary increase of the network capacity at the moment

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	98.5%	93.7%	69.6%
2025	97.6%	93.6%	76.5%
2030	93.5%	91.3%	99.9%

- **Until 2025**: Installation of 5 new mobile sites
- **2025-2030**: Installation of 14 new mobile sites
- **Total Radio Sites by 2030**: 69

Projected Costs: $9,119,052 - $10,417,176

High Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 1,275,369
- **2025:** 1,538,994
- **2030:** 2,625,882

Current Number of Sites: **(50)**

- **4G co-located with 5G**: 20
- **Urban Sites:** 19
- **Rural Sites:** 11

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	145.3%	138.0%	102.1%
2025	161.5%	153.4%	123.2%
2030	212.6%	201.9%	210.2%

- Necessary increase of the network capacity at the moment

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	99.5%	96.7%	74.6%
2025	98.2%	96.0%	81.3%
2030	89.2%	88.5%	99.9%

- **Until 2025**: Installation of 21 new mobile sites
- **2025-2030**: Installation of 24 new mobile sites
- **Total Radio Sites by 2030**: 95

Projected Costs: $18,656,511 - $24,191,118

Wireless - Summarisation : Muswellbrook

For a detailed analysis of the simulated capacity demand for each LGA, refer to **Appendix 5.5: Future Demand: Wireless Simulated Capacity for Each LGA**

Low Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 111,946
- **2025:** 134,549
- **2030:** 228,058

Current Number of Sites: **(28)**

- **4G co-located with 5G**: 2
- **Urban Sites:** 0
- **Rural Sites:** 26

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	38.9%	35.7%	24.1%
2025	42.8%	39.4%	29.0%
2030	55.0%	50.5%	49.2%

- Until 2030, the mobile network can ensure the demand

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	38.9%	35.7%	24.1%
2025	42.8%	39.4%	29.0%
2030	55.0%	50.5%	49.2%

- **Until 2025**: No need of installation of new mobile sites
- **2025-2030**: No need of installation of new mobile sites
- **Total Radio Sites by 2030**: 28

Projected Costs: $0

Baseline Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 162,264
- **2025:** 194,988
- **2030:** 329,957

Current Number of Sites: **(28)**

- **4G co-located with 5G**: 2
- **Urban Sites:** 0
- **Rural Sites:** 26

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	56.3%	51.8%	35.0%
2025	60.2%	55.3%	42.0%
2030	79.6%	73.1%	71.1%

- Until 2030, the mobile network can ensure the demand

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	56.3%	51.8%	35.0%
2025	60.2%	55.3%	42.0%
2030	79.6%	73.1%	71.1%

- **Until 2025**: No need of installation of new mobile sites
- **2025-2030**: No need of installation of new mobile sites
- **Total Radio Sites by 2030**: 28

Projected Costs: $0

High Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 234,643
- **2025:** 282,072
- **2030:** 476,582

Current Number of Sites: **(28)**

- **4G co-located with 5G**: 2
- **Urban Sites:** 0
- **Rural Sites:** 26

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	81.5%	74.9%	50.6%
2025	89.8%	82.5%	60.8%
2030	114.9%	105.6%	102.7%

- Necessary increase in network capacity in 2030

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	81.5%	74.9%	50.6%
2025	89.8%	82.5%	60.8%
2030	98.7%	91.4%	93.1%

- **Until 2025**: No need of installation of new mobile sites
- **2025-2030**: Installation of new 2 mobile sites
- **Total Radio Sites by 2030**: 30

Projected Costs: $835,959 - $1,154,995

Wireless - Summarisation : Newcastle

For a detailed analysis of the simulated capacity demand for each LGA, refer to **Appendix 5.5: Future Demand: Wireless Simulated Capacity for Each LGA**

Low Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 1,141,981
- **2025:** 1,374,668
- **2030:** 2,339,444

Current Number of Sites: **(114)**

- **4G co-located with 5G**: 66
- **Urban Sites:** 48
- **Rural Sites:** 0

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	54.7%	53.1%	43.0%
2025	60.7%	58.9%	51.8%
2030	82.6%	80.1%	88.1%

- Until 2030, the mobile network can ensure the demand.

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	54.7%	53.1%	43.0%
2025	60.7%	58.9%	51.8%
2030	82.6%	80.1%	88.1%

- **Until 2025**: No need of installation of new mobile sites
- **2025-2030**: No need of installation of new mobile sites
- **Total Radio Sites by 2030**: 114

Projected Costs: $0

Baseline Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 1,641,917
- **2025:** 1,977,569
- **2030:** 3,366,220

Current Number of Sites: **(114)**

- **4G co-located with 5G**: 66
- **Urban Sites:** 48
- **Rural Sites:** 0

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	78.7%	76.3%	61.8%
2025	87.3%	84.7%	74.5%
2030	118.9%	115.3%	126.7%

- Necessary increase in network capacity in 2030

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	78.7%	76.3%	61.8%
2025	87.3%	84.7%	74.5%
2030	92.2%	89.4%	99.7%

- **Until 2025**: No need of installation of new mobile sites
- **2025-2030**: Installation of 27 new mobile sites
- **Total Radio Sites by 2030**: 141

Projected Costs: $10,496,379 - $15,965,111

High Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 2,324,484
- **2025:** 2,794,682
- **2030:** 4,727,428

Current Number of Sites: **(114)**

- **4G co-located with 5G**: 66
- **Urban Sites:** 48
- **Rural Sites:** 0

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	112.9%	109.5%	88.7%
2025	125.4%	121.6%	106.9%
2030	170.8%	165.7%	182.1%

- Necessary increase of the network capacity at the moment

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	99.1%	96.1%	78.5%
2025	99.7%	96.8%	86.2%
2030	90.9%	88.2%	99.9%

- **Until 2025**: Installation of 24 new mobile sites
- **2025-2030**: Installation of 58 new mobile sites
- **Total Radio Sites by 2030**: 196

Projected Costs: $25,412,286 - $48,735,602

Wireless - Summarisation : Port Stephens

For a detailed analysis of the simulated capacity demand for each LGA, refer to **Appendix 5.5: Future Demand: Wireless Simulated Capacity for Each LGA**

Low Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 524,249
- **2025:** 629,500
- **2030:** 1,064,314

Current Number of Sites: **(79)**

- **4G co-located with 5G**: 27
- **Urban Sites:** 9
- **Rural Sites:** 43

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	47.8%	45.4%	34.9%
2025	52.9%	50.2%	41.9%
2030	69.0%	65.5%	70.8%

- Until 2030, the mobile network can ensure the demand

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	47.8%	45.4%	34.9%
2025	52.9%	50.2%	41.9%
2030	69.0%	65.5%	70.8%

- **Until 2025**: No need of installation of new mobile sites
- **2025-2030**: No need of installation of new mobile sites
- **Total Radio Sites by 2030**: 79

Projected Costs: $0

Baseline Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 763,651
- **2025:** 916,381
- **2030:** 1,545,080

Current Number of Sites: **(79)**

- **4G co-located with 5G**: 27
- **Urban Sites:** 9
- **Rural Sites:** 43

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	69.7%	66.1%	50.8%
2025	77.0%	73.1%	60.9%
2030	100.2%	95.0%	102.7%

- Necessary increase in network capacity in 2030

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	69.7%	66.1%	50.8%
2025	77.0%	73.1%	60.9%
2030	96.3%	91.4%	99.6%

- **Until 2025**: No need of installation of new mobile sites
- **2025-2030**: Installation of 2 new mobile sites
- **Total Radio Sites by 2030**: 81

Projected Costs: $835,959 - $1,154,995

High Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 1,109,604
- **2025:** 1,331,448
- **2030:** 2,238,833

Current Number of Sites: **(79)**

- **4G co-located with 5G**: 27
- **Urban Sites:** 9
- **Rural Sites:** 43

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	101.3%	96.1%	73.8%
2025	111.9%	106.2%	88.5%
2030	150.6%	142.8%	148.9%

- Necessary increase of the network capacity at the moment

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	99.3%	94.2%	72.6%
2025	99.7%	94.8%	80.8%
2030	92.2%	88.3%	99.6%

- **Until 2025**: Installation of 6 new mobile sites
- **2025-2030**: Installation of 25 new mobile sites
- **Total Radio Sites by 2030**: 110

Projected Costs: $14,784,408 - $17,827,248

Wireless - Summarisation : Singleton

For a detailed analysis of the simulated capacity demand for each LGA, refer to **Appendix 5.5: Future Demand: Wireless Simulated Capacity for Each LGA**

Low Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 171,425
- **2025:** 205,876
- **2030:** 348,237

Current Number of Sites: **(39)**

- **4G co-located with 5G**: 8
- **Urban Sites:** 1
- **Rural Sites:** 30

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	35.7%	33.4%	24.8%
2025	39.3%	36.7%	29.8%
2030	50.4%	47.1%	50.5%

- Until 2030, the mobile network can ensure the demand

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	35.7%	33.4%	24.8%
2025	39.3%	36.7%	29.8%
2030	50.4%	47.1%	50.5%

- **Until 2025**: No need of installation of new mobile sites
- **2025-2030**: No need of installation of new mobile sites
- **Total Radio Sites by 2030**: 39

Projected Costs: $0

Baseline Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 249,487
- **2025:** 299,458
- **2030:** 505,234

Current Number of Sites: **(39)**

- **4G co-located with 5G**: 8
- **Urban Sites:** 1
- **Rural Sites:** 30

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	52.0%	48.5%	36.1%
2025	57.2%	53.4%	43.4%
2030	73.2%	68.3%	73.2%

- Until 2030, the mobile network can ensure the demand

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	52.0%	48.5%	36.1%
2025	57.2%	53.4%	43.4%
2030	73.2%	68.3%	73.2%

- **Until 2025**: No need of installation of new mobile sites
- **2025-2030**: No need of installation of new mobile sites
- **Total Radio Sites by 2030**: 39

Projected Costs: $0

High Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 362,200
- **2025:** 434,756
- **2030:** 731,669

Current Number of Sites: **(39)**

- **4G co-located with 5G**: 8
- **Urban Sites:** 1
- **Rural Sites:** 30

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	75.4%	70.5%	52.4%
2025	83.0%	77.6%	62.9%
2030	110.1%	102.8%	105.9%

- Necessary increase in network capacity in 2030

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	75.4%	70.5%	52.4%
2025	83.0%	77.6%	62.9%
2030	95.9%	90.1%	95.9%

- **Until 2025**: No need of installation of new mobile sites
- **2025-2030**: Installation of 3 new mobile sites
- **Total Radio Sites by 2030**: 42

Projected Costs: $1,462,928 - $2,021,241

Wireless - Summarisation : Upper Hunter

For a detailed analysis of the simulated capacity demand for each LGA, refer to **Appendix 5.5: Future Demand: Wireless Simulated Capacity for Each LGA**

Low Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 96,882
- **2025:** 116,443
- **2030:** 197,362

Current Number of Sites: **(24)**

- **4G co-located with 5G**: 4
- **Urban Sites:** 0
- **Rural Sites:** 20

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	34.6%	32.2%	23.3%
2025	38.2%	35.5%	28.0%
2030	51.0%	47.4%	47.4%

- Until 2030, the mobile network can ensure the demand

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	34.6%	32.2%	23.3%
2025	38.2%	35.5%	28.0%
2030	51.0%	47.4%	47.4%

- **Until 2025**: No need of installation of new mobile sites
- **2025-2030**: No need of installation of new mobile sites
- **Total Radio Sites by 2030**: 24

Projected Costs: $0

Baseline Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 140,433
- **2025:** 168,752
- **2030:** 285,552

Current Number of Sites: **(24)**

- **4G co-located with 5G**: 4
- **Urban Sites:** 0
- **Rural Sites:** 20

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	50.2%	46.7%	33.8%
2025	55.3%	51.4%	40.6%
2030	73.8%	68.5%	68.6%

- Until 2030, the mobile network can ensure the demand

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	50.2%	46.7%	33.8%
2025	55.3%	51.4%	40.6%
2030	73.8%	68.5%	68.6%

- **Until 2025**: No need of installation of new mobile sites
- **2025-2030**: No need of installation of new mobile sites
- **Total Radio Sites by 2030**: 24

Projected Costs: $0

High Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 203,084
- **2025:** 244,130
- **2030:** 412,458

Current Number of Sites: **(24)**

- **4G co-located with 5G**: 4
- **Urban Sites:** 0
- **Rural Sites:** 20

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	72.6%	67.5%	48.8%
2025	80.0%	74.4%	58.7%
2030	106.5%	99.0%	99.2%

- Necessary increase in network capacity in 2030

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	72.6%	67.5%	48.8%
2025	80.0%	74.4%	58.7%
2030	98.2%	91.6%	93.7%

- **Until 2025**: No need of installation of new mobile sites
- **2025-2030**: Installation of one new mobile sites
- **Total Radio Sites by 2030**: 25

Projected Costs: $626,969 - $866,246

4. Telecommunications Infrastructure Options Analysis

For a detailed analysis of the Future Demand Scenarios and infrastructure options for each LGA, refer to Appendix:

5.4 Future Demand: Wireless Simulated Capacity for Each LGA

Case Studies: Peak Visitor Demand on Telecommunications Infrastructure

Case Studies 1 & 2: Pokolbin, Cessnock - Region Characterisation

The below tables summarise all the data such as population, demographics, number of devices, visitor peak demand, and other aspects that characterise a specific region. The steps taken to determine these figures are presented in the Appendix of this report. This is the characterisation for the Pokolbin suburb.

Population and Demographic Aspects

Total Area
126.1 km^2

Urban vs Rural Split	
Urban	0.0%
Rural	100.0%

Total Population	
2023	1,069
2025	1,102
2030	1,175

Visitor Demand

Major Event	Estimated Number of Visitors
Concert at the Hope Estate	20,000
SuperCars Event	62,000

Main Assumptions

- Peak visitors of 20,000 is based on the venue capacity at Hope Estate.
- The total number of peak visitors of 62,000 people was based on Newcastle 500 event attendee numbers from 2023.
- In the case of an event at Hope Estate, only the coverage and capacity of the three mobile sites located in that area were considered to ensure more precise results.
- To obtain the total number of devices for industrial sectors, the industry employment rate for the Cessnock region was used.

Number of Devices (Baseline Scenario)

Sectors	2023	2025	2030
Agriculture, Forestry, Fishing, Mining, Quarrying, Oil & Gas	551	741	1,557
Utilities	72	96	202
Construction	507	682	1,432
Manufacturing	413	556	1,167
Wholesale and Retail Trade	666	897	1,883
Transportation & Warehousing	226	304	638
Finance, Insurance, Real Estate, Rental & Leasing	165	222	467
Professional, Scientific & Technical Services	198	267	560
Business, Building & other support services	259	348	732
Educational services	330	445	934
Health care and social assistance	788	1,060	2,226
Arts, Information, Culture & Recreation	83	111	233
Accommodation and food services	485	652	1,370
Other services (excluding public administration)	253	341	716
Public administration	275	371	778
Households & Consumer Goods (Individual Devices)	4,353	4,490	4,852
Hope Estate - Visitor Demand (Visitor Devices)	83,000	83,000	83,000
SuperCars Event - Visitor Demand (Visitor Devices)	257,290	257,290	257,290

Case Studies 1 & 2: Pokolbin, Cessnock - Technology Review

The detailed analysis of the number of sites, types of radio technology, and the evaluation of the NBN network offer insights into the current telecommunications maturity of a suburb, enabling the identification of potential gaps. This represents the current status for the suburb of Pokolbin, located in the Cessnock region.

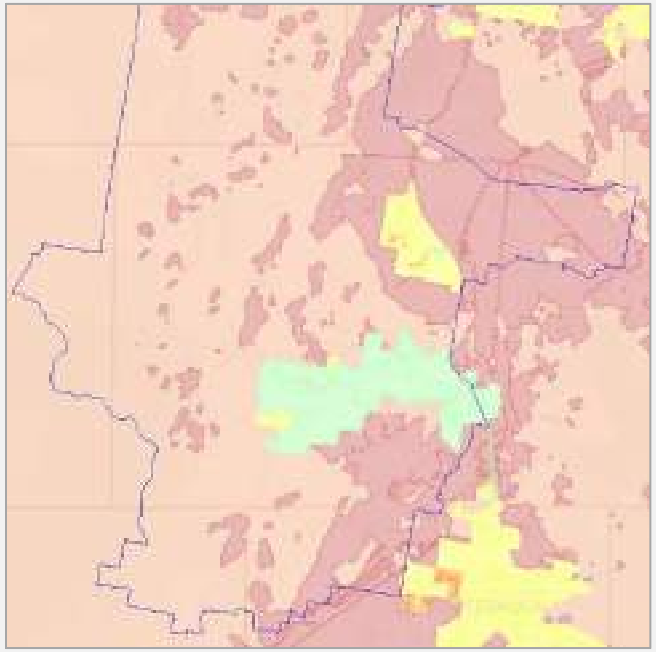
Existing Radio Mobile Sites

- Pokolbin currently has a total of 10 mobile radio sites deployed in the area (3 from Telstra, 4 from Optus, 3 from TPG). According to coverage maps, the zone does not show connectivity gaps in terms of 3G and 4G, including the more forested area due to the presence of an antenna (with radio sites from all three operators).
- Concerning 5G coverage, this technology is accessible in the residential area due to the presence of 1 Telstra radio site in the region.

Mobile Operator	# of Radio Mobile Sites	# of Sites with 3G Access	# of Sites with 4G Access	# of Sites with 5G Access
Telstra	3	3	3	1
Optus	4	4	4	0
TPG	3	3	3	0

Note: Some radio sites from different operators may be co-located on the same tower and may not be visible in the image above.

NBN Technology Types



Fibre to the Premises
Fibre to the Curb
Fibre to the Node
Fixed Wireless
Satellite

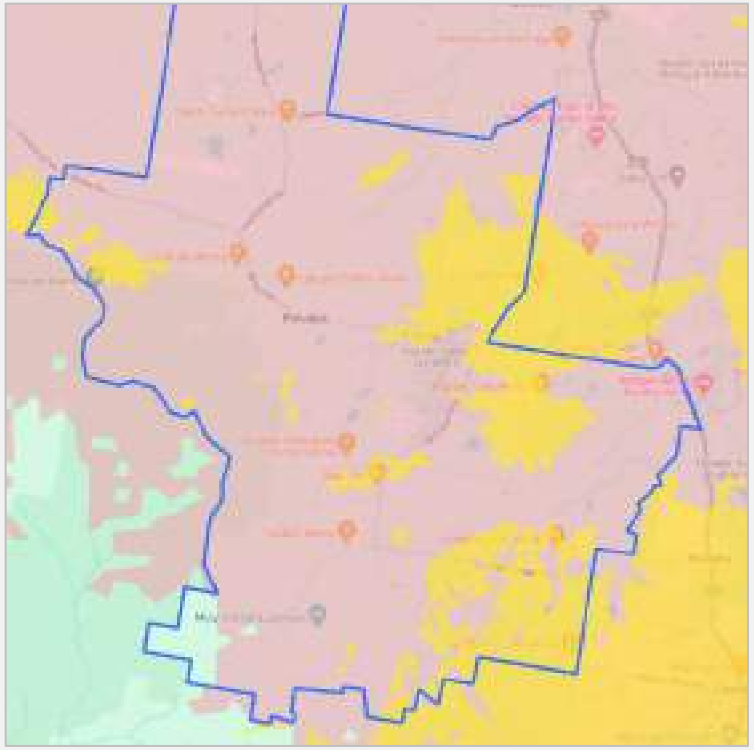
- As illustrated in the image above, Pokolbin has access to NBN services. Fibre to the premises is exclusively available to a limited residential block.
- The remaining densely populated area is connected to NBN services through fibre to the curb or fibre to the node.
- In more remote areas, access is provided through fixed wireless, and satellite serves as the final option in the most remote areas.

Case Studies 1 & 2: Pokolbin, Cessnock - Technology Review

The examination of coverage maps from the three major operators helps to understand the distribution of radio technologies across regions and identify potential connectivity challenges. In these maps, 3G is not separately detailed, as the radio sites are co-located with 4G, and considering that 3G is planned for discontinuation throughout 2024.

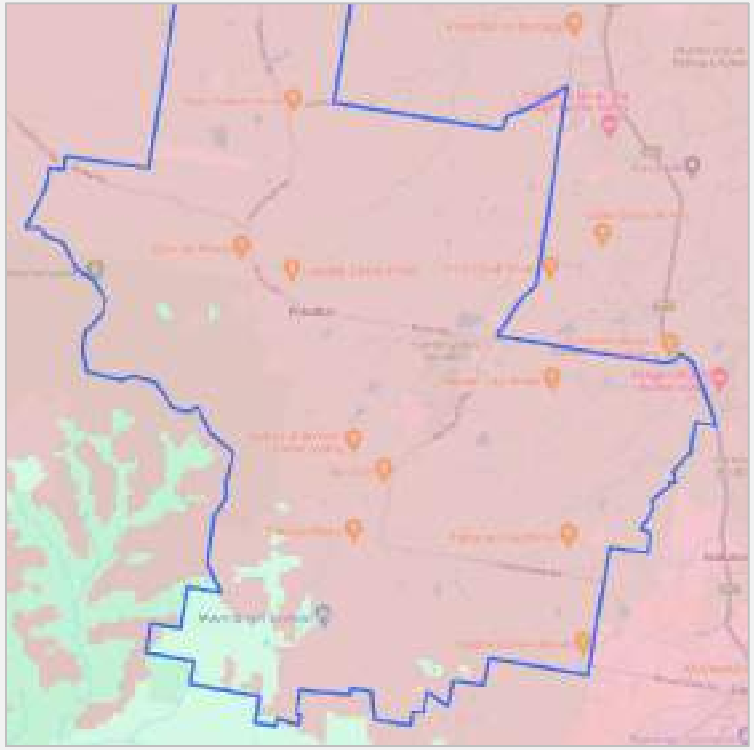
Current Mobile Coverage

Telstra Mobile Coverage



Optus Mobile Coverage

TPG Mobile Coverage



4G 5G

Sources: ACCC Mobile Infrastructure Report - Coverage Maps 2023 (KML)

Case Study 1: Pokolbin, Cessnock - Wireless Summarisation

(20,000 visitor peak demand at Hope Estate)

Below, the As-Is and Future State in terms of RAN Capacity (Downlink, Uplink, Simultaneous Active Devices) for the different scenarios are represented in a peak demand case of 20,000 visitors at Hope Estate.

Low Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 64,737
- **2025:** 66,096
- **2030:** 71,734

Current Number of Sites: **(3)**

- **4G co-located with 5G**: 1
- **Urban Sites:** 0
- **Rural Sites:** 2

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	70,4%	67,1%	105,3%
2025	71,9%	68,6%	107,5%
2030	78,1%	74,5%	116,8%

- Necessary increase of the network capacity at the moment.

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	49,2%	46,9%	73,6%
2025	50,3%	47,9%	75,1%
2030	54,6%	52,0%	81,5%

- **Until 2025:** Installation of one new mobile site
- **2025-2030:** No need of installation of new mobile sites
- **Total Radio Sites by 2030:** 4

Projected Costs: $626,969 - $866,246

Baseline Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 92,624
- **2025:** 94,582
- **2030:** 102,748

Current Number of Sites: **(3)**

- **4G co-located with 5G**: 1
- **Urban Sites:** 0
- **Rural Sites:** 2

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	109,9%	103,7%	147,8%
2025	112,3%	105,9%	150,9%
2030	121,9%	115,0%	164,0%

- Necessary increase of the network capacity at the moment.

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	51,8%	49,6%	81,7%
2025	52,9%	50,7%	83,5%
2030	57,5%	55,1%	90,7%

- **Until 2025**: Installation of two new mobile sites
- **2025-2030**: No need of installation of new mobile sites
- **Total Radio Sites by 2030**: 5

Projected Costs: $835,958 - $1,154,994

High Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 132,119
- **2025:** 134,941
- **2030:** 146,667

Current Number of Sites: **(3)**

- **4G co-located with 5G**: 1
- **Urban Sites:** 0
- **Rural Sites:** 2

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	156,8%	147,9%	210,9%
2025	160,2%	151,0%	215,3%
2030	174,1%	164,1%	234,1%

- Necessary increase of the network capacity at the moment.

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	58,5%	56,2%	95,3%
2025	59,7%	57,4%	97,3%
2030	53,7%	51,7%	89,4%

- **Until 2025**: Installation of three new mobile sites
- **2025-2030**: Installation of one new mobile site
- **Total Radio Sites by 2030**: 7

Projected Costs: $1,671,917 - $ 2,309,989

Case Study 1: Pokolbin, Cessnock - Wireless Simulated Capacity

(20,000 visitor peak demand at Hope Estate)

In the table below, the capacity status for the Pokolbin suburb under a baseline demand scenario conditions and a peak demand of 20,000 visitors is presented.

Low Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 64,737
- **2025:** 66,096
- **2030:** 71,734

Visitor Peak Demand: **20,000 Visitors** (Concert Event)

Current Number of Sites: **(3)***

- **4G co-located with 5G:** 1
- **Urban Sites:** 0
- **Rural Sites:** 2

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%****

Urban vs Rural Split:

- **Urban** - 0%
- **Rural -** 100%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	70,4%	67,1%	105,3%
2025	71,9%	68,6%	107,5%
2030	78,1%	74,5%	116,8%

<90%
90%-100%
>100%

- After running the model for the Pokolbin suburb in case of a major event with 20,000 visitors, it can be observed that there is **currently saturation** in terms of **mobile network capacity**, requiring the **deployment of new radio sites**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2025 -** Installation of **one new mobile base station until 2025** that will support the demand for Pokolbin region in case of a major event with 20,000 visitors.
- **2030 -** No need to install new mobile sites, **as the one mobile site installed by 2025 support** the demand in **2030**.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	49,2%	46,9%	73,6%
2025	50,3%	47,9%	75,1%
2030	54,6%	52,0%	81,5%

<90%
90%-100%
>100%

*For the analysis of a peak demand of 20,000 visitors at Hope Estate and to obtain more precise results, only the three mobile sites present in the area of Hope Estate were considered to estimate the mobile capacity.
****Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Case Study 1: Pokolbin, Cessnock - Wireless Simulated Capacity

(20,000 visitor peak demand at Hope Estate)

In the table below, the capacity status for the Pokolbin suburb under a low demand scenario conditions and a peak demand of 20,000 visitors is presented.

Baseline Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 92,624
- **2025:** 94,582
- **2030:** 102,748

Visitor Peak Demand: **20,000 Visitors** (Concert Event)

Current Number of Sites: **(3)***

- **4G co-located with 5G:** 1
- **Urban Sites:** 0
- **Rural Sites:** 2

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%****

Urban vs Rural Split:

- **Urban** - 0%
- **Rural -** 100%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	109,9%	103,7%	147,8%
2025	112,3%	105,9%	150,9%
2030	121,9%	115,0%	164,0%

<90%
90%-100%
>100%

- After running the model for the Pokolbin suburb in case of a major event with 20,000 visitors, it can be observed that there is **currently saturation** in terms of **mobile network capacity**, requiring the **deployment of new radio sites**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2025 -** Installation of **two new mobile base stations until 2025** that will support the demand for Pokolbin region in case of a major event with 20,000 visitors.
- **2030 -** No need to install new mobile sites, **as the two mobile sites installed by 2025 support** the demand in **2030**.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	51,8%	49,6%	81,7%
2025	52,9%	50,7%	83,5%
2030	57,5%	55,1%	90,7%

<90%
90%-100%
>100%

*For the analysis of a peak demand of 20,000 visitors at Hope Estate and to obtain more precise results, only the three sites present in the area of Hope Estate were considered to estimate the mobile capacity.
**__Important Note:__ While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Case Study 1: Pokolbin, Cessnock - Wireless Simulated Capacity

(20,000 visitor peak demand at Hope Estate)

In the table below, the capacity status for the Pokolbin suburb under a high demand scenario conditions and a peak demand of 20,000 visitors is presented.

High Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 132,119
- **2025:** 134,941
- **2030:** 146,667

Visitor Peak Demand: **20,000 Visitors** (Concert Event)

Current Number of Sites: **(3)***

- **4G co-located with 5G:** 1
- **Urban Sites:** 0
- **Rural Sites:** 2

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%****

Urban vs Rural Split:

- **Urban** - 0%
- **Rural -** 100%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	156,8%	147,9%	210,9%
2025	160,2%	151,0%	215,3%
2030	174,1%	164,1%	234,1%

<90% | 90%-100% | >100%

- After running the model for the Pokolbin suburb in case of a major event with 20,000 visitors, it can be observed that there is **currently saturation** in terms of **mobile network capacity**, requiring the **deployment of new radio sites**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2025 -** Installation of **three new mobile base stations until 2025** that will support the demand for Pokolbin region in case of a major event with 20,000 visitors.
- **2030 -** Installation of **one new mobile base station between 2025 and 2030**, resulting in a total of **7 radio mobile sites** in the Hope Estate area.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	58,5%	56,2%	95,3%
2025	59,7%	57,4%	97,3%
2030	53,7%	51,7%	89,4%

<90% | 90%-100% | >100%

*For the analysis of a peak demand of 20,000 visitors at Hope Estate and to obtain more precise results, only the three sites present in the area of Hope Estate were considered to estimate the mobile capacity.
****Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Case Study 1: Pokolbin, Cessnock – Other Technology Options

(20,000 visitor peak demand at Hope Estate)

There are alternative technologies with the potential to accommodate the demand generated by events in defined regions. We have outlined potential technology options available for the Pokolbin region in the case of 20,000 visitors.

Other Technology Options

1 - Analysis (2030):

Low Scenario

- Total Devices **- 71,734**
- Visitor Devices - **58,000**
- As-Is %RAN Capacity - **116.8%**
- No. of Devices exceeding the network capacity - **10,318**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%)**:** **10,318 * 20% * 30% = 619**

Baseline Scenario

- Total Devices **- 102,748**
- Visitor Devices - **83,000**
- As-Is %RAN Capacity - **164.0%**
- No. of Devices exceeding the network capacity - **40,097**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%)**:** **40,097 * 20% * 30% = 2,406**

High Scenario

- Total Devices **- 146,667**
- Visitor Devices - **118,400**
- As-Is %RAN Capacity - **234.1%**
- No. of Devices exceeding the network capacity - **84,016**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%)**:** **84,016 * 20% * 30% = 5,041**

Technology	Description	Projected Cost	Effectiveness
Cell on Wheels	**Cell on Wheels (CoW) are temporary infrastructures** that provide mobile coverage and capacity, supporting an average of up to **350 devices simultaneously**. Therefore, in each of the following scenarios, and to accommodate exceeding network devices, the required number of CoWs (independent of the operator) are: • **Low Scenario**: 619 exceeding devices connected during the busy hour via mobile access. Since each CoW supports 350 devices, **2 CoWs are necessary**. • **Baseline Scenario**: 2,406 exceeding devices connected during the busy hour via mobile access. Since each CoW supports 350 devices, **7 CoWs are necessary**. • **High Scenario**: 5,041 exceeding devices connected during the busy hour via mobile access. Since each CoW supports 350 devices, **15 CoWs are necessary**. Cell on Wheels can be installed during events, saving annual operational costs in terms of maintaining this infrastructure connected. The deployment of COWs by operators is specific to the respective operator (e.g., a COW implemented by Telstra is only accessible to Telstra mobile network users). The cost of this infrastructure is performed only one time, and the option of renting them is also available: • Acquisition Cost (per unit): **$500,000** • Rental Cost (per unit): **$30,000*** * Rental costs is indicative and requires a 3-4 month lead time with the provider	**Low Scenario** Acquisition Cost: **$1,000,000** Rental Cost*: **$60,000**	**Low Scenario** ✔
		Baseline Scenario Acquisition Cost: **$3,500,000** Rental Cost: **$210,000**	**Baseline Scenario** ✖
		High Scenario Acquisition Cost: **$7,500,000** Rental Cost: **$450,000**	**High Scenario** ✖

Case Study 1: Pokolbin, Cessnock – Other Technology Options
(20,000 visitor peak demand at Hope Estate)

There are alternative technologies with the potential to accommodate the demand generated by events in defined regions. We have outlined potential technology options available for the Pokolbin region in the case of 20,000 visitors.

Other Technology Options

1 - Analysis (2030):

Low Scenario

- Total Devices **- 71,734**
- Visitor Devices - **58,000**
- As-Is %RAN Capacity - **116.8%**
- No. of Devices exceeding the network capacity - **10,318**
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Baseline Scenario

- Total Devices **- 102,748**
- Visitor Devices - **83,000**
- As-Is %RAN Capacity - **164.0%**
- No. of Devices exceeding the network capacity - **40,097**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%): **40,097 * 20% * 30% = 2,406**

High Scenario

- Total Devices **- 146,667**
- Visitor Devices - **118,400**
- As-Is %RAN Capacity - **234.1%**
- No. of Devices exceeding the network capacity - **84,016**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%): **84,016 * 20% * 30% = 5,041**

Technology	Description	Projected Cost	Effectiveness
Cold Mobile Site	The **Cold Mobile Site is a pre-located site** that contains all passive infrastructure components. It is only activated during major events, requiring the installation of antennas and connections to power and backhaul. Therefore, the implementation costs associated with this solution are included in the Wireless Costing, excluding the costs related to **associated infrastructure**. For this case study #1 (Pokolbin with a peak demand of 20,000 visitors), the projected need for 2030 is to implement: • **Low Scenario:** 1 new mobile site without active infrastructure • **Baseline Scenario:** 2 new mobile sites without active infrastructure • **High Scenario:** 4 new mobile sites without active infrastructure	**Low Scenario** Min: $560,856 Max: $721,351 **Baseline Scenario** Min: $747,808 Max: $961,801 **High Scenario** Min: $1,495,616 Max: $1,923,603	**Low Scenario** ✓ **Baseline Scenario** ✓ **High Scenario** ✓
Private 5G	The deployment of a **private wireless solution based on 5G** is a technology option to adopt in **events and specific zones** where a significant demand is expected. This solution, being **private, allows only selected devices in the region of Pokolbin to access the network**, with **capabilities designed according to the expected demand.** The estimation of the number of access points depends on various factors. However, it is reasonable to assume that, given the forecast of the expected demand for the event/region and the dedicated spectrum, each access point (AP) can support an average of 100 devices. Therefore, the following number of access points would be necessary for the three scenarios: • **Low Scenario:** 619 exceeding devices connected during the busy hour via mobile access. Since each AP supports 100 devices, **7 APs are necessary** (Small Site) • **Baseline Scenario:** 2,406 exceeding devices connected during the busy hour via mobile access. Since each AP supports 100 devices, **25 APs are necessary**. (Small Site) • **High Scenario:** 5,041 exceeding devices connected during the busy hour via mobile access. Since each AP supports 100 devices, **51 APs are necessary**. (Medium Site)	**Low Scenario** Min: $976,000 Max: $987,000 **Baseline Scenario** Min: $1,478,000 Max: $1,522,000 **High Scenario** Min: $1,530,000 Max: $1,574,000	**Low Scenario** ✓ **Baseline Scenario** ✓ **High Scenario** ✓

Case Study 1: Pokolbin, Cessnock – Other Technology Options

(20,000 visitor peak demand at Hope Estate)

There are alternative technologies with the potential to accommodate the demand generated by events in defined regions. We have outlined potential technology options available for the Pokolbin region in the case of 20,000 visitors.

Other Technology Options

1 - Analysis (2030):

Low Scenario

- Total Devices **- 71,734**
- Visitor Devices - **58,000**
- As-Is %RAN Capacity - **116.8%**
- No. of Devices exceeding the network capacity - **10,318**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%)**:** **10,318 * 20% * 30% = 619**

Baseline Scenario

- Total Devices **- 102,748**
- Visitor Devices - **83,000**
- As-Is %RAN Capacity - **164.0%**
- No. of Devices exceeding the network capacity - **40,097**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%)**:** **40,097 * 20% * 30% = 2,406**

High Scenario

- Total Devices **- 146,667**
- Visitor Devices - **118,400**
- As-Is %RAN Capacity - **234.1%**
- No. of Devices exceeding the network capacity - **84,016**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%)**:** **84,016 * 20% * 30% = 5,041**

Technology	Description	Projected Cost	Effectiveness
Private Wi-Fi	The deployment of a **private Wi-Fi-based solution** is another option to consider, especially in **closed/concentrated areas** such as **Cedar Mill Venue in Morisset**. This solution, similar to those used in airports, shopping malls, being private, allows for greater control of usage and definition of **network capabilities** according to expected demand and the number of users accessing the network. A Wi-Fi-based solution requires the installation of **Wi-Fi access points or kiosks** throughout the **venue/building**, and in contrast to a private wireless network based on 5G, it does not offer as high speeds but is also a more **easily installed solution** operating on **unlicensed spectrum**. Additionally, since it is Wi-Fi-based, this solution requires **users to register/connect their devices to the respective Wi-Fi network**. This solution is only adaptable in situations where a network core is already installed, allowing for the installation of access points and access switches. In the event of an existing network core and the presence of Wi-Fi only, a **simple chip upgrade is required to convert Wi-Fi 5 terminals to Wi-Fi 6, without the need to alter the architectural design.** Therefore, the following number of access points would be necessary for the three scenarios • **Low Scenario:** 619 exceeding devices connected during the busy hour via mobile access. Since each AP supports 100 devices, **7 APs are necessary** (Small Site) • **Baseline Scenario:** 2,406 exceeding devices connected during the busy hour via mobile access. Since each AP supports 100 devices, **25 APs are necessary**. (Small Site) • **High Scenario:** 5,041 exceeding devices connected during the busy hour via mobile access. Since each AP supports 100 devices, **51 APs are necessary**. (Medium Site) For the costs associated with deploying a private Wi-Fi solution, only the Access Points and Access Switches are considered, as it is assumed that the core already exists.	**Low Scenario** Min: $36,000 Max: $47,000 **Baseline Scenario** Min: $72,000 Max: $83,000 **High Scenario** Min: $190,000 Max: $234,000	**Low Scenario** ✓ **Baseline Scenario** ✓ **High Scenario** ✓

Case Study 2: Pokolbin, Cessnock - Wireless Summarisation

(62,000 visitor peak demand)

Below, the As-Is and Future State in terms of RAN Capacity (Downlink, Uplink, Simultaneous Active Devices) for the different scenarios are represented in a peak demand case of 62,000 visitors at a SuperCars Event in Pokolbin.

Low Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 186,537
- **2025:** 187,896
- **2030:** 193,534

Current Number of Sites: **(10)**

- **4G co-located with 5G**: 1
- **Urban Sites:** 0
- **Rural Sites:** 9

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	82,4%	76,0%	96,5%
2025	83,0%	76,5%	97,2%
2030	85,5%	78,8%	100,1%

- Necessary increase of the network capacity in 2030.

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	82,4%	76,0%	96,5%
2025	83,0%	76,5%	97,2%
2030	70,0%	65,2%	88,5%

- **Until 2025**: No need of installation of new mobile sites
- **2025-2030**: Installation of one new mobile site
- **Total Radio Sites by 2030**: 11

Projected Costs: $626,969 - $866,246

Baseline Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 266,914
- **2025:** 268,872
- **2030:** 277,038

Current Number of Sites: **(10)**

- **4G co-located with 5G**: 1
- **Urban Sites:** 0
- **Rural Sites:** 9

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	117,9%	108,7%	138,1%
2025	118,7%	109,5%	139,1%
2030	122,3%	112,8%	143,3%

- Necessary increase of the network capacity at the moment.

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	70,9%	66,7%	99,1%
2025	71,4%	67,2%	99,8%
2030	65,0%	61,4%	94,0%

- **Until 2025**: Installation of three new mobile sites
- **2025-2030**: Installation of one new mobile site
- **Total Radio Sites by 2030**: 14

Projected Costs: $1,671,917 - $2,309,989

High Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 380,759
- **2025:** 383,581
- **2030:** 395,307

Current Number of Sites: **(10)**

- **4G co-located with 5G**: 1
- **Urban Sites:** 0
- **Rural Sites:** 9

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	168,1%	155,0%	196,9%
2025	169,4%	156,2%	198,4%
2030	174,6%	161,0%	204,5%

- Necessary increase of the network capacity at the moment.

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	60,8%	57,9%	96,2%
2025	61,2%	58,4%	96,9%
2030	63,1%	60,1%	99,8%

- **Until 2025**: Installation of eight new mobile sites
- **2025-2030**: No need of installation of new mobile sites
- **Total Radio Sites by 2030**: 18

Projected Costs: $3,343,835 - $4,619,979

Case Study 2: Pokolbin, Cessnock - Wireless Simulated Capacity
(62,000 visitor peak demand)

In the table below, the capacity status for the Pokolbin suburb under a low demand scenario conditions and a peak demand of 62,000 visitors is presented.

Low Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 186,537
- **2025:** 187,896
- **2030:** 193,534

Visitor Peak Demand: **62,000 Visitors** (Supercars Event)

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(10)**

- **4G co-located with 5G:** 1
- **Urban Sites:** 0
- **Rural Sites:** 9

Urban vs Rural Split:

- **Urban** - 0%
- **Rural -** 100%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	82,4%	76,0%	96,5%
2025	83,0%	76,5%	97,2%
2030	85,5%	78,8%	100,1%

<90%
90%-100%
>100%

- After running the model for the Pokolbin suburb in case of a major event with 62,000 visitors it can be observed that for the **year 2023 and 2025, the current scenario in terms of sites supports the necessary demand**. However, by the year **2030, there is already saturation in terms of network capacity**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2030 -** Installation of **one new mobile base station between 2025 and 2030**, resulting in a total of **11 radio mobile sites** in the Pokolbin.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	82,4%	76,0%	96,5%
2025	83,0%	76,5%	97,2%
2030	70,0%	65,2%	88,5%

<90%
90%-100%
>100%

*__Important Note:__ While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Case Study 2: Pokolbin, Cessnock - Wireless Simulated Capacity (62,000 visitor peak demand)

In the table below, the capacity status for the Pokolbin suburb under a baseline demand scenario conditions and a peak demand of 62,000 visitors is presented.

Baseline Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 266,914
- **2025:** 268,872
- **2030:** 277,038

Visitor Peak Demand: **62,000 Visitors** (Supercars Event)

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(10)**

- **4G co-located with 5G:** 1
- **Urban Sites:** 0
- **Rural Sites:** 9

Urban vs Rural Split:

- **Urban** - 0%
- **Rural -** 100%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	117,9%	108,7%	138,1%
2025	118,7%	109,5%	139,1%
2030	122,3%	112,8%	143,3%

<90%
90%-100%
>100%

- After running the model for the Pokolbin suburb in case of a major event with 62,000 visitors, it can be observed that there is **currently saturation** in terms of **mobile network capacity**, requiring the **deployment of new radio sites**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2025 -** Installation of **three new mobile base station until 2025** that will support the demand for Pokolbin region in case of a major event with 62,000 visitors.
- **2030 -** Installation of **one new mobile base station between 2025 and 2030**, resulting in a total of **14 radio mobile sites** in the Pokolbin.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	70,9%	66,7%	99,1%
2025	71,4%	67,2%	99,8%
2030	65,0%	61,4%	94,0%

<90%
90%-100%
>100%

*__Important Note:__ While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Case Study 2: Pokolbin, Cessnock - Wireless Simulated Capacity
(62,000 visitor peak demand)

In the table below, the capacity status for the Pokolbin suburb under an high demand scenario conditions and a peak demand of 62,000 visitors is presented.

High Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 380,759
- **2025:** 383,581
- **2030:** 395,307

Visitor Peak Demand: **62,000 Visitors** (Supercars Event)

Current Number of Sites: **(10)**

- **4G co-located with 5G:** 1
- **Urban Sites:** 0
- **Rural Sites:** 9

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Urban vs Rural Split:

- **Urban** - 0%
- **Rural -** 100%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	168,1%	155,0%	196,9%
2025	169,4%	156,2%	198,4%
2030	174,6%	161,0%	204,5%

<90%
90%-100%
>100%

- After running the model for the Pokolbin suburb in case of a major event with 62,000 visitors, it can be observed that there is **currently saturation** in terms of **mobile network capacity**, requiring the **deployment of new radio sites**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2025 -** Installation of **eight new mobile base station until 2025** that will support the demand for Pokolbin region in case of a major event with 62,000 visitors.
- **2030 -** No need to install new mobile sites, **as the eight mobile sites installed by 2025 support** the demand in **2030**.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	60,8%	57,9%	96,2%
2025	61,2%	58,4%	96,9%
2030	63,1%	60,1%	99,8%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Case Study 2: Pokolbin, Cessnock - Wireless Simulated Capacity
(62,000 visitor peak demand)

There are alternative technologies with the potential to accommodate the demand generated by events in defined regions. We have outlined potential technology options available for the Pokolbin region in the case of 62,000 visitors.

Other Technology Options

1 - Analysis (2030):

Low Scenario
- Total Devices **- 193,534**
- Visitor Devices - **179,800**
- As-Is %RAN Capacity - **100.1%**
- No. of Devices exceeding the network capacity - **193**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%)**: 193 * 20% * 30% = 11**

Baseline Scenario
- Total Devices **- 277,038**
- Visitor Devices - **257,290**
- As-Is %RAN Capacity - **143.3%**
- No. of Devices exceeding the network capacity - **83,710**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%)**: 83,710 * 20% * 30% = 5,022**

High Scenario
- Total Devices **- 395,307**
- Visitor Devices - **367,040**
- As-Is %RAN Capacity - **204.5%**
- No. of Devices exceeding the network capacity - **202,002**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%)**: 202,002 * 20% * 30% = 12,120**

Technology	Description	Projected Cost	Effectiveness
Cell on Wheels	**Cell on Wheels (CoW) are temporary infrastructures** that provide mobile coverage and capacity, supporting an average of up to **350 devices simultaneously**. Therefore, in each of the following scenarios, and to accommodate exceeding network devices, the required number of CoWs (independent of the operator) are: • Low Scenario: 11 exceeding devices connected during the busy hour via mobile access. Since each CoW supports 350 devices, 1 **CoWs are necessary**. • Baseline Scenario: 5,022 exceeding devices connected during the busy hour via mobile access. Since each CoW supports 350 devices, 15 **CoWs are necessary**. • High Scenario: 12,120 exceeding devices connected during the busy hour via mobile access. Since each CoW supports 350 devices, 35 **CoWs are necessary**. Cell on Wheels can be installed during events, saving annual operational costs in terms of maintaining this infrastructure connected. The deployment of COWs by operators is specific to the respective operator (e.g., a COW implemented by Telstra is only accessible to Telstra mobile network users). The cost of this infrastructure is performed only one time, and the option of renting them is also available: • Acquisition Cost (per unit): **$500,000** • Rental Cost (per unit): **$30,000*** *Rental Costs provided by Telstra	Low Scenario Acquisition Cost: **$500,000** Rental Cost: **$30,000**	Low Scenario ✔
		Baseline Scenario Acquisition Cost: **$7,500,000** Rental Cost: **$450,000**	Baseline Scenario ✘
		High Scenario Acquisition Cost: **$17,500,000** Rental Cost: **$1,050,000**	High Scenario ✘

Case Study 2: Pokolbin, Cessnock - Wireless Simulated Capacity

(62,000 visitor peak demand)

There are alternative technologies with the potential to accommodate the demand generated by events in defined regions. We have outlined potential technology options available for the Pokolbin region in the case of 62,000 visitors.

Other Technology Options

1 - Analysis (2030):

Low Scenario

- Total Devices **- 193,534**
- Visitor Devices - **179,800**
- As-Is %RAN Capacity - **100.1%**
- No. of Devices exceeding the network capacity - **193**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%)**: 193 * 20% * 30% = 11**

Baseline Scenario

- Total Devices **- 277,038**
- Visitor Devices - **257,290**
- As-Is %RAN Capacity - **143.3%**
- No. of Devices exceeding the network capacity - **83,710**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%): **83,710 * 20% * 30% = 5,022**

High Scenario

- Total Devices **- 395,307**
- Visitor Devices - **367,040**
- As-Is %RAN Capacity - **204.5%**
- No. of Devices exceeding the network capacity - **202,002**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%): **202,002 * 20% * 30% = 12,120**

Technology	Description	Projected Cost	Effectiveness
Cold Mobile Site	The **Cold Mobile Site is a pre-located site** that contains all passive infrastructure components. It is only activated during major events, requiring the installation of antennas and connections to power and backhaul. Therefore, the implementation costs associated with this solution are included in the Wireless Costing, excluding the costs related to **associated infrastructure**. For this case study #2 (Pokolbin with a peak demand of 62,000 visitors), the projected need for 2030 is to implement: • **Low Scenario:** 1 new mobile site without active infrastructure • **Baseline Scenario:** 4 new mobile sites without active infrastructure • **High Scenario:** 8 new mobile sites without active infrastructure	**Low Scenario** Min: $560,856 Max: $721,351 **Baseline Scenario** Min: $1,495,616 Max: $1,923,603 **High Scenario** Min: $2,991,232 Max: $3,847,205	**Low Scenario** ✔ **Baseline Scenario** ✔ **High Scenario** ✔
Private 5G	The deployment of a **private wireless solution based on 5G** is a technology option to adopt in **events and specific zones** where a significant demand is expected. This solution, being **private, allows only selected devices in the region of Pokolbin to access the network**, with **capabilities designed according to the expected demand** The estimation of the number of access points depends on various factors. However, it is reasonable to assume that, given the forecast of the expected demand for the event/region and the dedicated spectrum, each access point (AP) can support an average of 100 devices. Therefore, the following number of access points would be necessary for the three scenarios • **Low Scenario:** 193 exceeding devices connected during the busy hour via mobile access. Since each AP supports 100 devices, **2 APs are necessary** (Small Site) • **Baseline Scenario:** 5,022 exceeding devices connected during the busy hour via mobile access. Since each AP supports 100 devices, **51 APs are necessary**. (Medium Site) • **High Scenario:** 12,120 exceeding devices connected during the busy hour via mobile access. Since each AP supports 100 devices, **122 APs are necessary**. (Large Site)	**Low Scenario** Min: $966,000 Max: $977,000 **Baseline Scenario** Min: $1,530,000 Max: $1,574,000 **High Scenario** Min: $2,604,000 Max: $2,844,000	**Low Scenario** ✔ **Baseline Scenario** ✔ **High Scenario** ✔

Case Study 3: Cedar Mill (Morisset) - Region Characterisation

The below tables summarise all the data such as population, demographics, number of devices, visitor peak demand, and other aspects that characterise a specific region. The steps taken to determine these figures are presented in the Appendix of this report. This is the characterisation for the Morisset suburb.

Population and Demographic Aspects

Total Area
27.1 km²

Urban vs Rural Split	
Urban	91.5%
Rural	8.5%

Total Population	
2023	4,157
2025	4,285
2030	4,567

Visitor Demand

Major Event	Estimated Number of Visitors
Cedar Mill Venue	30,000

Main Assumptions

- Peak visitors of 30,000 is based on the venue capacity for Cedar Mill.
- To obtain the total number of devices for industrial sectors, the industry employment rate for the Cessnock region was used.

Number of Devices (Baseline Scenario)

Sectors	2023	2025	2030
Agriculture, Forestry, Fishing, Mining, Quarrying, Oil & Gas	642	864	1,815
Utilities	300	403	847
Construction	2,398	3,227	6,777
Manufacturing	1,242	1,671	3,510
Wholesale and Retail Trade	2,484	3,342	7,019
Transportation & Warehousing	814	1,095	2,299
Finance, Insurance, Real Estate, Rental & Leasing	963	1,296	2,723
Professional, Scientific & Technical Services	1,220	1,642	3,449
Business, Building & other support services	664	893	1,876
Educational services	1,970	2,650	5,567
Health care and social assistance	4,089	5,503	11,557
Arts, Information, Culture & Recreation	385	519	1,089
Accommodation and food services	1,349	1,815	3,812
Other services (excluding public administration)	878	1,181	2,481
Public administration	1,199	1,613	3,389
Households & Consumer Goods (Individual Devices)	16,923	17,456	18,862
Cedar Mill - Visitor Demand (Visitor Devices)	124,500	124,500	124,500

Case Study 3: Cedar Mill (Morisset) - Technology Review

The detailed analysis of the number of sites, types of radio technology, and the evaluation of the NBN network offer insights into the current telecommunications maturity of a suburb, enabling the identification of potential gaps. This represents the current status for the suburb of Morisset, located in the Lake Macquarie region.

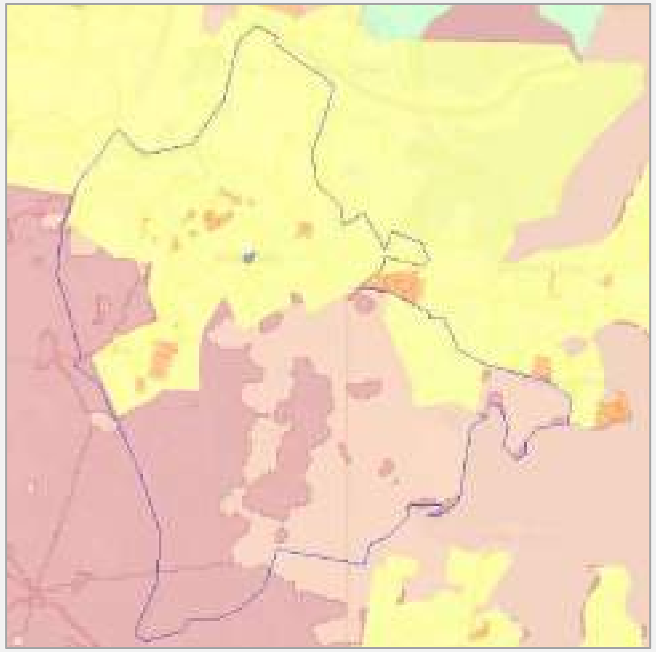
Existing Radio Mobile Sites

- The suburb of Morisset, where Cedar Mill is planned, currently has a total of 5 mobile radio sites (2 from Telstra, 2 from Optus, and 1 from TPG). Analysing the coverage maps of the three operators, there are no connectivity gaps or coverage issues for this suburb.
- Regarding 5G coverage, it is available throughout the residential and areas with industrial and commercial activity.

Mobile Operator	# of Radio Mobile Sites	# of Sites with 3G Access	# of Sites with 4G Access	# of Sites with 5G Access
Telstra	2	2	2	2
Optus	2	2	2	1
TPG	1	1	1	1

Note: Some radio sites from different operators may be co-located on the same tower and may not be visible in the image above.

NBN Technology Types



- Fibre to the Premises
- Fibre to the Building
- Fibre to the Node
- Fixed Wireless
- Satellite

- In the image above, the coverage of NBN services in the Morisset suburb is illustrated. Fibre-to-the-premises is available in residential zones, while other densely populated and industrial areas are served by fibre-to-the-building and fibre-to-the-node. In the more remote, forested zone, coverage is ensured through fixed wireless and satellite technologies

Case Study 3: Cedar Mill (Morisset) - Technology Review

The examination of coverage maps from the three major operators helps to understand the distribution of radio technologies across regions and identify potential connectivity challenges. In these maps, 3G is not separately detailed, as the radio sites are co-located with 4G, and considering that 3G is planned for discontinuation throughout 2024.

Current Mobile Coverage

Telstra Mobile Coverage

Optus Mobile Coverage

TPG Mobile Coverage

4G | 5G

Sources: ACCC Mobile Infrastructure Report - Coverage Maps 2023 (KML)

Case Study 3: Cedar Mill (Morisset) - Wireless Summarisation

Below, the As-Is and Future State in terms of RAN Capacity (Downlink, Uplink, Simultaneous Active Devices) for the different scenarios are represented in a peak demand case of 30,000 visitors event at the Morisset suburb.

Low Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 113,265
- **2025:** 118,584
- **2030:** 140,816

Current Number of Sites: **(5)**

- **4G co-located with 5G**: 4
- **Urban Sites:** 1
- **Rural Sites:** 0

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	57.6%	57.6%	86.5%
2025	60.3%	60.3%	90.6%
2030	71.6%	71.6%	107.6%

- Necessary increase of the network capacity in 2030.

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	57.6%	57.6%	86.5%
2025	60.3%	60.3%	90.6%
2030	58.5%	58.8%	88.8%

- **Until 2025**: No need of installation of new mobile sites
- **2025-2030**: Installation of one new mobile site
- **Total Radio Sites by 2030**: 6

Projected Costs: $552,441 - $840,269

Baseline Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 162,020
- **2025:** 169,671
- **2030:** 201,573

Current Number of Sites: **(5)**

- **4G co-located with 5G**: 4
- **Urban Sites:** 1
- **Rural Sites:** 0

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	74.2%	74.2%	111.5%
2025	77.7%	77.7%	116.8%
2030	92.4%	92.4%	138.7%

- Necessary increase of the network capacity at the moment.

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	60.7%	60.9%	92.1%
2025	63.5%	63.8%	96.4%
2030	63.8%	64.3%	97.5%

- **Until 2025**: Installation of one new mobile site
- **2025-2030**: Installation of one new mobile site
- **Total Radio Sites by 2030**: 7

Projected Costs: $736,588 - $1,120,359

High Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 231,085
- **2025:** 242,110
- **2030:** 287,919

Current Number of Sites: **(5)**

- **4G co-located with 5G**: 4
- **Urban Sites:** 1
- **Rural Sites:** 0

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	105.9%	105.9%	159.0%
2025	110.9%	110.9%	166.6%
2030	131.9%	131.9%	198.1%

- Necessary increase of the network capacity at the moment.

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	55.9%	56.5%	86.2%
2025	58.6%	59.2%	90.3%
2030	62.3%	63.1%	96.4%

- **Until 2025**: Installation of four new mobile sites
- **2025-2030**: Installation of one new mobile site
- **Total Radio Sites by 2030**: 10

Projected Costs: $1,657,323 - $3,080,986

Case Study 3: Cedar Mill (Morisset) - Wireless Simulated Capacity

In the table below, the capacity status for the Morisset suburb under a low demand scenario conditions and a peak demand of 30,000 visitors is presented.

Low Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 113,265
- **2025:** 118,584
- **2030:** 140,816

Visitor Peak Demand: **30,000 Visitors** (Cedar Mill Venus)

Current Number of Sites: **(5)**

- **4G co-located with 5G:** 4
- **Urban Sites:** 1
- **Rural Sites:** 0

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Urban vs Rural Split:

- **Urban** - 91.5%
- **Rural -** 8.5%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	57.6%	57.6%	86.5%
2025	60.3%	60.3%	90.6%
2030	71.6%	71.6%	107.6%

<90%
90%-100%
>100%

- After running the model for the Morisset suburb in case of a major event with 30,000 visitors it can be observed that for the **year 2023 and 2025, the current scenario in terms of sites supports the necessary demand**. However, by the year **2030, there is already saturation in terms of network capacity**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2030 -** Installation of **one new mobile base station between 2025 and 2030**, resulting in a total of **6 radio mobile sites** in the Morisset suburb.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	57.6%	57.6%	86.5%
2025	60.3%	60.3%	90.6%
2030	58.5%	58.8%	88.8%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Case Study 3: Cedar Mill (Morisset) - Wireless Simulated Capacity

In the table below, the capacity status for the Morisset suburb under a baseline demand scenario conditions and a peak demand of 30,000 visitors is presented.

Baseline Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 162,020
- **2025:** 169,671
- **2030:** 201,573

Visitor Peak Demand: **30,000 Visitors** (Cedar Mill Venus)

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(5)**

- **4G co-located with 5G:** 4
- **Urban Sites:** 1
- **Rural Sites:** 0

Urban vs Rural Split:

- **Urban** - 91.5%
- **Rural -** 8.5%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	74.2%	74.2%	111.5%
2025	77.7%	77.7%	116.8%
2030	92.4%	92.4%	138.7%

<90%
90%-100%
>100%

- After running the model for the Morisset suburb in case of a major event with 30,000 visitors, it can be observed that there is **currently saturation** in terms of **mobile network capacity**, requiring the **deployment of new radio sites**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2025 -** Installation of **one new mobile base station until 2025** that will support the demand for the Morisset suburb in case of a major event with 30,000 visitors.
- **2030 -** Installation of **one new mobile base station between 2025 and 2030**, resulting in a total of **7 radio mobile sites** in the Morisset suburb.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	60.7%	60.9%	92.1%
2025	63.5%	63.8%	96.4%
2030	63.8%	64.3%	97.5%

<90%
90%-100%
>100%

*__Important Note:__ While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Case Study 3: Cedar Mill (Morisset) - Wireless Simulated Capacity

In the table below, the capacity status for the Morisset suburb under a high demand scenario conditions and a peak demand of 30,000 visitors is presented.

High Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 231,085
- **2025:** 242,110
- **2030:** 287,919

Visitor Peak Demand: **30,000 Visitors** (Cedar Mill Venus)

Current Number of Sites: **(5)**

- **4G co-located with 5G:** 4
- **Urban Sites:** 1
- **Rural Sites:** 0

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Urban vs Rural Split:

- **Urban** - 91.5%
- **Rural -** 8.5%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	105.9%	105.9%	159.0%
2025	110.9%	110.9%	166.6%
2030	131.9%	131.9%	198.1%

<90%
90%-100%
>100%

- After running the model for the Morisset suburb in case of a major event with 30,000 visitors, it can be observed that there is **currently saturation** in terms of **mobile network capacity**, requiring the **deployment of new radio sites**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2025 -** Installation of **four new mobile base station until 2025** that will support the demand for Morisset suburb in case of a major event with 30,000 visitors.
- **2030 -** Installation of **one new mobile base station between 2025 and 2030**, resulting in a total of **10 radio mobile sites** in the Morisset suburb.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	55.9%	56.5%	86.2%
2025	58.6%	59.2%	90.3%
2030	62.3%	63.1%	96.4%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Case Study 3: Cedar Mill (Morisset) - Other Technology Options

There are alternative technologies with the potential to accommodate the demand generated by events in defined regions. We have outlined potential technology options available for the Morisset (Cedar Mill) region in the case of 30,000 visitors.

Other Technology Options

1 - Analysis (2030):

Low Scenario

- Total Devices **- 140,816**
- Visitor Devices **- 87,000**
- As-Is %RAN Capacity - **107.6%**
- No. of Devices exceeding the network capacity - **9,946**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%)**:** **9,946 * 20% * 30% = 596**

Baseline Scenario

- Total Devices **- 201,573**
- Visitor Devices **- 124,500**
- As-Is %RAN Capacity - **138.7%**
- No. of Devices exceeding the network capacity - **56,242**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%)**:** **56,242 * 20% * 30% =3,374**

High Scenario

- Total Devices **- 287,919**
- Visitor Devices **- 177,600**
- As-Is %RAN Capacity - **198.1%**
- No. of Devices exceeding the network capacity - **142,578**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%)**:** **142,578 * 20% * 30% = 8,554**

Technology	Description	Projected Cost	Effectiveness
Cell on Wheels	**Cell on Wheels (CoW) are temporary infrastructures** that provide mobile coverage and capacity, supporting an average of up to **350 devices simultaneously**. Therefore, in each of the following scenarios, and to accommodate exceeding network devices, the required number of CoWs (independent of the operator) are: • **Low Scenario**: 596 exceeding devices connected during the busy hour via mobile access. Since each CoW supports 350 devices, **2 CoWs are necessary**. • **Baseline Scenario**: 3,374 exceeding devices connected during the busy hour via mobile access. Since each CoW supports 350 devices, 10 **CoWs are necessary**. • **High Scenario**: 8,554 exceeding devices connected during the busy hour via mobile access. Since each CoW supports 350 devices, 2**5 CoWs are necessary**. Cell on Wheels can be installed during events, saving annual operational costs in terms of maintaining this infrastructure connected. The deployment of COWs by operators is specific to the respective operator (e.g., a COW implemented by Telstra is only accessible to Telstra mobile network users). The cost of this infrastructure is performed only one time, and the option of renting them is also available: • Acquisition Cost (per unit): **$500,000** • Rental Cost (per unit): **$30,000*** *Rental Costs provided by Telstra	**Low Scenario** Acquisition Cost: **$1,000,000** Rental Cost: **$60,000**	**Low Scenario** ✓
		Baseline Scenario Acquisition Cost: **$5,000,000** Rental Cost: **$300,000**	**Baseline Scenario** ✗
		High Scenario Acquisition Cost: **$12,500,000** Rental Cost: **$750,000**	**High Scenario** ✗

Case Study 3: Cedar Mill (Morisset) - Other Technology Options

There are alternative technologies with the potential to accommodate the demand generated by events in defined regions. We have outlined potential technology options available for the Morisset (Cedar Mill) region in the case of 30,000 visitors.

Other Technology Options

1 - Analysis (2030):

Low Scenario

- Total Devices **- 140,816**
- Visitor Devices - **87,000**
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Baseline Scenario

- Total Devices **- 201,573**
- Visitor Devices - **124,500**
- As-Is %RAN Capacity - **138.7%**
- No. of Devices exceeding the network capacity - **56,242**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%): **56,242 * 20% * 30% =3,374**

High Scenario

- Total Devices **- 287,919**
- Visitor Devices - **177,600**
- As-Is %RAN Capacity - **198.1%**
- No. of Devices exceeding the network capacity - **142,578**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%): **142,578 * 20% * 30% = 8,554**

Technology	Description	Projected Cost	Effectiveness
Cold Mobile Site	The **Cold Mobile Site is a pre-located site** that contains all passive infrastructure components. It is only activated during major events, requiring the installation of antennas and connections to power and backhaul. Therefore, the implementation costs associated with this solution are included in the Wireless Costing, excluding the costs related to **associated infrastructure**. For this case study #3 (Cedar Mill in Morisset with a peak demand of 30,000 visitors), the projected need for 2030 is to implement: • **Low Scenario:** 1 new mobile site without active infrastructure • **Baseline Scenario:** 2 new mobile sites without active infrastructure • **High Scenario:** 5 new mobile sites without active infrastructure	**Low Scenario** Min: $286,164 Max: $754,999 **Baseline Scenario** Min: $381,552 Max: $1,006,665 **High Scenario** Min: $858,492 Max: $2,768,330	**Low Scenario** ✔ **Baseline Scenario** ✔ **High Scenario** ✔
Private 5G	The deployment of a **private wireless solution based on 5G** is a technology option to adopt in **events and specific zones** where a significant demand is expected. This solution, being **private, allows only selected devices in the region of Morisset (Cedar Mill) to access the network**, with **capabilities designed according to the expected demand** The estimation of the number of access points depends on various factors. However, it is reasonable to assume that, given the forecast of the expected demand for the event/region and the dedicated spectrum, each access point (AP) can support an average of 100 devices. Therefore, the following number of access points would be necessary for the three scenarios • **Low Scenario:** 596 exceeding devices connected during the busy hour via mobile access. Since each AP supports 100 devices, **6 APs are necessary** (Small Site) • **Baseline Scenario:** 3,374 exceeding devices connected during the busy hour via mobile access. Since each AP supports 100 devices, **34 APs are necessary**. (Medium Site) • **High Scenario:** 8,554 exceeding devices connected during the busy hour via mobile access. Since each AP supports 100 devices, **86 APs are necessary**. (Medium Site)	**Low Scenario** Min: $974,000 Max: $985,000 **Baseline Scenario** Min: $1,496,000 Max: $1,540,000 **High Scenario** Min: $1,600,000 Max: $1,644,000	**Low Scenario** ✔ **Baseline Scenario** ✔ **High Scenario** ✔

Case Study 3: Cedar Mill (Morisset) - Other Technology Options

There are alternative technologies with the potential to accommodate the demand generated by events in defined regions. We have outlined potential technology options available for the Morisset (Cedar Mill) region in the case of 30,000 visitors.

Other Technology Options

1 - Analysis (2030):

Low Scenario

- Total Devices **- 140,816**
- Visitor Devices **- 87,000**
- As-Is %RAN Capacity - **107.6%**
- No. of Devices exceeding the network capacity - **9,946**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%)**:** **9,946 * 20% * 30% = 596**

Baseline Scenario

- Total Devices **- 201,573**
- Visitor Devices - **124,500**
- As-Is %RAN Capacity - **138.7%**
- No. of Devices exceeding the network capacity - **56,242**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%)**:** **56,242 * 20% * 30% =3,374**

High Scenario

- Total Devices **- 287,919**
- Visitor Devices - **177,600**
- As-Is %RAN Capacity - **198.1%**
- No. of Devices exceeding the network capacity - **142,578**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%)**:** **142,578 * 20% * 30% = 8,554**

Technology	Description	Projected Cost	Effectiveness
Private Wi-Fi	The deployment of a **private Wi-Fi-based solution** is another option to consider, especially in **closed/concentrated areas** such as **Cedar Mill Venue in Morisset**. This solution, similar to those used in airports, shopping malls, being private, allows for greater control of usage and definition of **network capabilities** according to expected demand and the number of users accessing the network. A Wi-Fi-based solution requires the installation of **Wi-Fi access points or kiosks** throughout the **venue/building**, and in contrast to a private wireless network based on 5G, it does not offer as high speeds but is also a more **easily installed solution** operating on **unlicensed spectrum**. Additionally, since it is Wi-Fi-based, this solution requires **users to register/connect their devices to the respective Wi-Fi network**. This solution is only adaptable in situations where a network core is already installed, allowing for the installation of access points and access switches. In the event of an existing network core and the presence of Wi-Fi only, a **simple chip upgrade is required to convert Wi-Fi 5 terminals to Wi-Fi 6, without the need to alter the architectural design.** Therefore, the following number of access points would be necessary for the three scenarios • <u>Low Scenario:</u> 596 exceeding devices connected during the busy hour via mobile access. Since each AP supports 100 devices, **6 APs are necessary** (Small Site) • <u>Baseline Scenario:</u> 3,374 exceeding devices connected during the busy hour via mobile access. Since each AP supports 100 devices, **34 APs are necessary**. (Medium Site) • <u>High Scenario:</u> 8,554 exceeding devices connected during the busy hour via mobile access. Since each AP supports 100 devices, **86 APs are necessary**. (Medium Site) For the costs associated with deploying a private Wi-Fi solution, only the Access Points and Access Switches are considered, as it is assumed that the core already exists.	<u>Low Scenario</u> Min: $34,000 Max: $45,000 <u>Baseline Scenario</u> Min: $156,000 Max: $200,000 <u>High Scenario</u> Min: $260,000 Max: $304,000	<u>Low Scenario</u> ✔ <u>Baseline Scenario</u> ✔ <u>High Scenario</u> ✔

Case Study 4: Nelson Bay/Shoal Bay - Other Technology Options

The below tables summarise all the data such as population, demographics, number of devices, visitor peak demand, and other aspects that characterise a specific region. The steps taken to determine these figures are presented in the Appendix of this report. This is the characterisation for the Nelson and Shoal Bay suburbs.

Population and Demographic Aspects

Total Area
19.6 km²

Urban vs Rural Split	
Urban	17.4%
Rural	82.6%

Total Population	
2023	8,109
2025	8,359
2030	8,909

Visitor Demand

Major Event	Estimated Number of Visitors
Food Event	15,000

Main Assumptions

- Peak visitors of 15,000 is based on a previous food event.
- To obtain the total number of devices for industrial sectors, the industry employment rate for the Port Stephens region was used.

Number of Devices (Baseline Scenario)

Sectors	2023	2025	2030
Agriculture, Forestry, Fishing, Mining, Quarrying, Oil & Gas	1,337	1,799	3,778
Utilities	418	562	1,181
Construction	4,511	6,070	12,750
Manufacturing	2,590	3,485	7,319
Wholesale and Retail Trade	5,012	6,745	14,166
Transportation & Warehousing	2,047	2,754	5,785
Finance, Insurance, Real Estate, Rental & Leasing	1,420	1,911	4,014
Professional, Scientific & Technical Services	2,172	2,923	6,139
Business, Building & other support services	1,587	2,136	4,486
Educational services	3,091	4,159	8,736
Health care and social assistance	6,057	8,150	17,118
Arts, Information, Culture & Recreation	710	956	2,007
Accommodation and food services	3,801	5,115	10,743
Other services (excluding public administration)	1,796	2,417	5,076
Public administration	3,509	4,721	9,916
Households & Consumer Goods (Individual Devices)	33,016	34,055	36,799
Cedar Mill - Visitor Demand (Visitor Devices)	62,250	62,250	62,250

Case Study 4: Nelson Bay/Shoal Bay - Technology Review

The detailed analysis of the number of sites, types of radio technology, and the evaluation of the NBN network offer insights into the current telecommunications maturity of a suburb, enabling the identification of potential gaps. This represents the current status for the suburb of Nelson and Shoal Bay, located in the Port Stephens region.

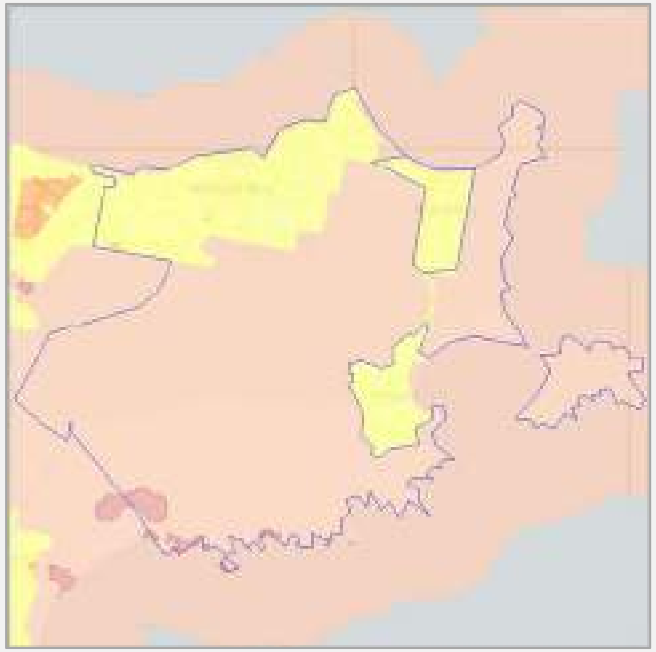
Existing Radio Mobile Sites

- The Nelson and Shoal Bay area currently has a total of 7 mobile radio sites (2 from Telstra, 3 from Optus, and 2 from TPG). Analysing the coverage maps of the operators, there are no connectivity gaps for 3G and 4G technologies.
- Regarding 5G, out of the 7 sites, 3 provide access to this technology. While Nelson Bay has access to 5G, Shoal Bay is not covered by this technology. There is no base station in the area, and due to the proximity to the water, the radio signal strength may experience some attenuation.

Mobile Operator	# of Radio Mobile Sites	# of Sites with 3G Access	# of Sites with 4G Access	# of Sites with 5G Access
Telstra	2	2	2	1
Optus	3	2	3	1
TPG	2	2	2	1

Note: Some radio sites from different operators may be co-located on the same tower and may not be visible in the image above.

NBN Technology Types



- Fibre to the Premises
- Fibre to the Node
- Fixed Wireless
- Satellite

- The Nelson Bay and Shoal Bay area utilises four different types of technology to access NBN services. Fibre to the premises is selectively available in a very limited residential zone, whereas the broader populated region relies on fibre to the node. In remote, uninhabited areas, satellite technology is predominantly utilised for NBN access.

Case Study 4: Nelson Bay/Shoal Bay - Technology Review

The examination of coverage maps from the three major operators helps to understand the distribution of radio technologies across regions and identify potential connectivity challenges. In these maps, 3G is not separately detailed, as the radio sites are co-located with 4G, and considering that 3G is planned for discontinuation throughout 2024.

Current Mobile Coverage

Telstra Mobile Coverage

Optus Mobile Coverage

TPG Mobile Coverage

4G 5G

Sources: [ACCC Mobile Infrastructure Report - Coverage Maps 2023 (KML)]

Case Study 4: Nelson Bay/Shoal Bay - Wireless Summarisation

Below, the As-Is and Future State in terms of RAN Capacity (Downlink, Uplink, Simultaneous Active Devices) for the different scenarios are represented in a peak demand case of 15,000 visitors event at Nelson and Shoal Bay suburbs.

Low Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 94,652
- **2025:** 105,000
- **2030:** 148,246

Current Number of Sites: **(7)**

- **4G co-located with 5G**: 2
- **Urban Sites:** 1
- **Rural Sites:** 4

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	80.0%	76.3%	69.6%
2025	85.5%	81.7%	77.2%
2030	107.4%	102.5%	109.0%

- Necessary increase of the network capacity in 2030.

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	80.0%	76.3%	69.6%
2025	85.5%	81.7%	77.2%
2030	84.9%	82.2%	91.4%

- **Until 2025**: No need of installation of new mobile sites
- **2025-2030**: Installation of one new mobile site
- **Total Radio Sites by 2030**: 8

Projected Costs: $626,969 - $866,246

Baseline Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 135,324
- **2025:** 150,207
- **2030:** 212,251

Current Number of Sites: **(7)**

- **4G co-located with 5G**: 2
- **Urban Sites:** 1
- **Rural Sites:** 4

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	98.0%	93.6%	85.3%
2025	104.9%	100.1%	94.7%
2030	131.7%	125.8%	133.8%

- Necessary increase of the network capacity in 2025.

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	98.0%	93.6%	85.3%
2025	82.9%	80.3%	79.3%
2030	86.1%	84.2%	96.5%

- **Until 2025**: Installation of one new mobile sites
- **2025-2030**: Installation of one new mobile site
- **Total Radio Sites by 2030**: 9

Projected Costs: $835,959 - $1,154,995

High Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 192,905
- **2025:** 214,352
- **2030:** 303,459

Current Number of Sites: **(7)**

- **4G co-located with 5G**: 2
- **Urban Sites:** 1
- **Rural Sites:** 4

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	139.7%	133.4%	121.6%
2025	149.7%	142.9%	135.1%
2030	196.2%	187.3%	191.3%

- Necessary increase of the network capacity at the moment.

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	91.3%	89.3%	87.7%
2025	97.8%	95.7%	97.4%
2030	84.4%	83.8%	97.3%

- **Until 2025**: Installation of two new mobile sites
- **2025-2030**: Installation of three new mobile sites
- **Total Radio Sites by 2030**: 12

Projected Costs: $2,512,186 - $2,862,430

Case Study 4: Nelson Bay/Shoal Bay - Wireless Simulated Capacity

In the table below, the capacity status for the Nelson and Shoal Bay suburbs under a low demand scenario conditions and a peak demand of 15,000 visitors is presented.

Low Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 94,652
- **2025:** 105,000
- **2030:** 148,246

Visitor Peak Demand: **15,000 Visitors** (Food Event)

Current Number of Sites: **(7)**

- **4G co-located with 5G:** 2
- **Urban Sites:** 1
- **Rural Sites:** 4

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Urban vs Rural Split:

- **Urban** - 17.4%
- **Rural -** 82.6%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	80.0%	76.3%	69.6%
2025	85.5%	81.7%	77.2%
2030	107.4%	102.5%	109.0%

<90%
90%-100%
>100%

- After running the model for the Nelson and Shoal Bay suburbs in case of a major event with 15,000 visitors it can be observed that for the **year 2023 and 2025, the current scenario in terms of sites supports the necessary demand**. However, by the year **2030, there is already saturation in terms of network capacity**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2030 -** Installation of **one new mobile base station between 2025 and 2030**, resulting in a total of **8 radio mobile sites** in the Nelson and Shoal Bay suburbs.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	80.0%	76.3%	69.6%
2025	85.5%	81.7%	77.2%
2030	84.9%	82.2%	91.4%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Case Study 4: Nelson Bay/Shoal Bay - Wireless Simulated Capacity

In the table below, the capacity status for the Nelson and Shoal Bay suburbs under a baseline demand scenario conditions and a peak demand of 15,000 visitors is presented.

Baseline Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 135,324
- **2025:** 150,207
- **2030:** 212,251

Visitor Peak Demand: **15,000 Visitors** (Food Event)

Current Number of Sites: **(7)**

- **4G co-located with 5G:** 2
- **Urban Sites:** 1
- **Rural Sites:** 4

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Urban vs Rural Split:

- **Urban** - 17.4%
- **Rural -** 82.6%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	98.0%	93.6%	85.3%
2025	104.9%	100.1%	94.7%
2030	131.7%	125.8%	133.8%

<90%
90%-100%
>100%

- After running the model for the Nelson and Shoal Bay suburbs, it can be observed that for the **year 2023 the current scenario in terms of sites supports the necessary demand**. However, by the year **2025, there is already saturation in terms of network capacity**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2025 -** Installation of **one new mobile base station until 2025** that will support the demand for Nelson and Shoal Bay suburbs in case of a major event with 15,000 visitors.
- **2030 -** Installation of **one new mobile base station between 2025 and 2030**, resulting in a total of **9 radio mobile sites** in the Nelson and Shoal Bay suburbs.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	98.0%	93.6%	85.3%
2025	82.9%	80.3%	79.3%
2030	86.1%	84.2%	96.5%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Case Study 4: Nelson Bay/Shoal Bay - Wireless Simulated Capacity

In the table below, the capacity status for the Nelson and Shoal Bay suburbs under a high demand scenario conditions and a peak demand of 15,000 visitors is presented.

High Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 192,905
- **2025:** 214,352
- **2030:** 303,459

Visitor Peak Demand: **15,000 Visitors** (Food Event)

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(7)**

- **4G co-located with 5G:** 2
- **Urban Sites:** 1
- **Rural Sites:** 4

Urban vs Rural Split:

- **Urban** - 17.4%
- **Rural -** 82.6%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	139.7%	133.4%	121.6%
2025	149.7%	142.9%	135.1%
2030	196.2%	187.3%	191.3%

<90%

90%-100%

>100%

- After running the model for the Nelson and Shoal Bay suburbs in case of a major event with 15,000 visitors, it can be observed that there is **currently saturation** in terms of **mobile network capacity**, requiring the **deployment of new radio sites**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2025 -** Installation of **two new mobile base station until 2025** that will support the demand for Nelson and Shoal Bay suburbs in case of a major event with 15,000 visitors.
- **2030 -** Installation of **three new mobile base station between 2025 and 2030**, resulting in a total of **12 radio mobile sites** in the Nelson and Shoal Bay suburbs.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	91.3%	89.3%	87.7%
2025	97.8%	95.7%	97.4%
2030	84.4%	83.8%	97.3%

<90%

90%-100%

>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Case Study 4: Nelson Bay/Shoal Bay - Other Technology Options

There are alternative technologies with the potential to accommodate the demand generated by events in defined regions. We have outlined potential technology options available for the Nelson and Shoal Bay region in the case of 15,000 visitors.

Other Technology Options

1 - Analysis (2030):

Low Scenario

- Total Devices **- 148,246**
- Visitor Devices - **43,500**
- As-Is %RAN Capacity - **109.0%**
- No. of Devices exceeding the network capacity - **12,240**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%)**:** **12,240 * 20% * 30% = 734**

Baseline Scenario

- Total Devices **- 212,251**
- Visitor Devices - **62,250**
- As-Is %RAN Capacity - **133.8%**
- No. of Devices exceeding the network capacity - **53,617**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%)**:** **53,617 * 20% * 30% = 3,217**

High Scenario

- Total Devices **- 303,459**
- Visitor Devices - **88,736**
- As-Is %RAN Capacity - **191.3%**
- No. of Devices exceeding the network capacity - **144,829**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%)**:** **144,829 * 20% * 30% = 8,689**

Technology	Description	Projected Cost	Effectiveness
Cell on Wheels	**Cell on Wheels (CoW) are temporary infrastructures** that provide mobile coverage and capacity, supporting an average of up to **350 devices simultaneously**. Therefore, in each of the following scenarios, and to accommodate exceeding network devices, the required number of CoWs (independent of the operator) are: • **Low Scenario**: 734 exceeding devices connected during the busy hour via mobile access. Since each CoW supports 350 devices, **2 CoWs are necessary**. • **Baseline Scenario**: 3,217 exceeding devices connected during the busy hour via mobile access. Since each CoW supports 350 devices, 10 **CoWs are necessary**. • **High Scenario**: 8,689 exceeding devices connected during the busy hour via mobile access. Since each CoW supports 350 devices, 2**5 CoWs are necessary**. Cell on Wheels can be installed during events, saving annual operational costs in terms of maintaining this infrastructure connected. The deployment of COWs by operators is specific to the respective operator (e.g., a COW implemented by Telstra is only accessible to Telstra mobile network users). The cost of this infrastructure is performed only one time, and the option of renting them is also available: • Acquisition Cost (per unit): **$500,000** • Rental Cost (per unit): **$30,000*** *Rental Costs provided by Telstra	**Low Scenario** Acquisition Cost: **$1,000,000** Rental Cost: **$60,000** **Baseline Scenario** Acquisition Cost: **$5,000,000** Rental Cost: **$300,000** **High Scenario** Acquisition Cost: **$12,500,000** Rental Cost: **$750,000**	**Low Scenario** ✔ **Baseline Scenario** ✖ **High Scenario** ✖

Case Study 4: Nelson Bay/Shoal Bay - Other Technology Options

There are alternative technologies with the potential to accommodate the demand generated by events in defined regions. We have outlined potential technology options available for the Nelson and Shoal Bay region in the case of 15,000 visitors.

Other Technology Options

1 - Analysis (2030):

Low Scenario

- Total Devices **- 148,246**
- Visitor Devices - **43,500**
- As-Is %RAN Capacity - **109.0%**
- No. of Devices exceeding the network capacity - **12,240**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%): **12,240 * 20% * 30% = 734**

Baseline Scenario

- Total Devices **- 212,251**
- Visitor Devices - **62,250**
- As-Is %RAN Capacity - **133.8%**
- No. of Devices exceeding the network capacity - **53,617**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%): **53,617 * 20% * 30% = 3,217**

High Scenario

- Total Devices **- 303,459**
- Visitor Devices - **88,736**
- As-Is %RAN Capacity - **191.3%**
- No. of Devices exceeding the network capacity - **144,829**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%): **144,829 * 20% * 30% = 8,689**

Technology	Description	Projected Cost	Effectiveness
Cold Mobile Site	The **Cold Mobile Site is a pre-located site** that contains all passive infrastructure components. It is only activated during major events, requiring the installation of antennas and connections to power and backhaul. Therefore, the implementation costs associated with this solution are included in the Wireless Costing, excluding the costs related to **associated infrastructure**. For this case study #4 (Nelson/Shoal Bay with a peak demand of 15,000 visitors), the projected need for 2030 is to implement: • **Low Scenario:** 1 new mobile site without active infrastructure • **Baseline Scenario:** 2 new mobile sites without active infrastructure • **High Scenario:** 5 new mobile sites without active infrastructure	**Low Scenario** Min: $560,856 Max: $721,351 **Baseline Scenario** Min: $747,808 Max: $961,801 **High Scenario** Min: $2,209,767 Max: $2.250,615	**Low Scenario** ✓ **Baseline Scenario** ✓ **High Scenario** ✓
Private 5G	The deployment of a **private wireless solution based on 5G** is a technology option to adopt in **events and specific zones** where a significant demand is expected. This solution, being **private, allows only selected devices in the region of Nelson/Shoal Bay to access the network**, with **capabilities designed according to the expected demand** The estimation of the number of access points depends on various factors. However, it is reasonable to assume that, given the forecast of the expected demand for the event/region and the dedicated spectrum, each access point (AP) can support an average of 100 devices. Therefore, the following number of access points would be necessary for the three scenarios • **Low Scenario:** 734 exceeding devices connected during the busy hour via mobile access. Since each AP supports 100 devices, **8 APs are necessary** (Small Site) • **Baseline Scenario:** 3,217 exceeding devices connected during the busy hour via mobile access. Since each AP supports 100 devices, **33 APs are necessary**. (Medium Site) • **High Scenario:** 8,689 exceeding devices connected during the busy hour via mobile access. Since each AP supports 100 devices, **87 APs are necessary**. (Medium Site)	**Low Scenario** Min: $978,000 Max: $989,000 **Baseline Scenario** Min: $1,494,000 Max: $1,538,000 **High Scenario** Min: $1,602,000 Max: $1,646,000	**Low Scenario** ✓ **Baseline Scenario** ✓ **High Scenario** ✓

Case Study 5: The Entrance, Central Coast - Technology Review

The detailed analysis of the number of sites, types of radio technology, and the evaluation of the NBN network offer insights into the current telecommunications maturity of a suburb, enabling the identification of potential gaps. This represents the current status for the suburb of The Entrance, located in the Central Coast region.

Existing Radio Mobile Sites

- The suburb of The Entrance currently has a total of 3 mobile radio sites (1 from Telstra, 1 from Optus, and 1 from TPG). Upon analyzing the coverage maps of the operators, there are no connectivity gaps for 3G and 4G technologies.
- Regarding the 5G, all of the mobile sites provide access to this technology.
- Despite there being only 3 sites located in The Entrance suburb, this area benefits from coverage and capacity of sites located in Blue Bay, approximately 1.5 km away."

Mobile Operator	# of Radio Mobile Sites	# of Sites with 3G Access	# of Sites with 4G Access	# of Sites with 5G Access
Telstra	1	1	1	1
Optus	1	1	1	1
TPG	1	1	1	1

Note: Some radio sites from different operators may be co-located on the same tower and may not be visible in the image above.

NBN Technology Types

- The suburb of The Entrance, due to being a highly populated area with no rural area, has a high number of dwellings and is located in a central area, mostly having access via Fibre to the Premises (FTTP), with some buildings covered by fibre to the building.

Case Study 5: The Entrance, Central Coast - Technology Review

The examination of coverage maps from the three major operators helps to understand the distribution of radio technologies across regions and identify potential connectivity challenges. In these maps, 3G is not separately detailed, as the radio sites are co-located with 4G, and considering that 3G is planned for discontinuation throughout 2024.

Current Mobile Coverage

Telstra Mobile Coverage

Optus Mobile Coverage

TPG Mobile Coverage

4G 5G

Sources: [ACCC Mobile Infrastructure Report - Coverage Maps 2023 (KML)]

Case Study 5: The Entrance, Central Coast - Region Characterisation

The below tables summarise all the data such as population, demographics, number of devices, visitor peak demand, and other aspects that characterise a specific region. The steps taken to determine these figures are presented in the Appendix of this report. This is the characterisation for The Entrance suburb.

Population and Demographic Aspects

Total Area
1.4 km^2

Urban vs Rural Split	
Urban	100%
Rural	0%

Total Population	
2023	4,326
2025	4,459
2030	4,753

Visitor Demand

Major Event	Estimated Number of Visitors
ChromeFest Event	20,000

Main Assumptions

- The peak number of visitors, 20,000, is derived from a previous 3-day event that drew over 50,000 people during the weekend. Saturday marked the highest day of attendance, with 20,000 individuals.
- To obtain the total number of devices for industrial sectors, the industry employment rate for the Central Coast region was used.

Number of Devices (Baseline Scenario)

Sectors	2023	2025	2030
Agriculture, Forestry, Fishing, Mining, Quarrying, Oil & Gas	290	390	819
Utilities	223	300	630
Construction	2,562	3,448	7,242
Manufacturing	1,315	1,769	3,715
Wholesale and Retail Trade	2,763	3,718	7,809
Transportation & Warehousing	824	1,109	2,330
Finance, Insurance, Real Estate, Rental & Leasing	1,092	1,469	3,086
Professional, Scientific & Technical Services	1,337	1,799	3,778
Business, Building & other support services	735	989	2,078
Educational services	1,827	2,459	5,164
Health care and social assistance	3,966	5,337	11,209
Arts, Information, Culture & Recreation	668	899	1,889
Accommodation and food services	1,560	2,099	4,408
Other services (excluding public administration)	847	1,139	2,393
Public administration	1,359	1,829	3,841
Households & Consumer Goods (Individual Devices)	17,612	18,166	19,630
Cedar Mill - Visitor Demand (Visitor Devices)	83,000	83,000	83,000

Case Study 5: The Entrance, Central Coast - Wireless Summarisation

Below, the As-Is and Future State in terms of RAN Capacity (Downlink, Uplink, Simultaneous Active Devices) for the different scenarios are represented in a peak demand case of 20,000 visitors event at The Entrance suburb.

Low Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 85,286
- **2025:** 90.806
- **2030:** 113,875

Current Number of Sites: **(3)**

- **4G co-located with 5G**: 3
- **Urban Sites:** 0
- **Rural Sites:** 0

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	63.8%	65.4%	92.7%
2025	67.9%	69.6%	98.7%
2030	81.5%	83.5%	123.8%

- Necessary increase of the network capacity in 2030.

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	63.8%	65.4%	92.7%
2025	67.9%	69.6%	98.7%
2030	61.1%	62.6%	92.8%

- **Until 2025**: No need of installation of new mobile sites
- **2025-2030**: Installation of one new mobile site
- **Total Radio Sites by 2030**: 4

Projected Costs: $552,441 - $840,269

Baseline Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 121,980
- **2025:** 129,919
- **2030:** 163,021

Current Number of Sites: **(3)**

- **4G co-located with 5G**: 3
- **Urban Sites:** 0
- **Rural Sites:** 0

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	91.2%	93.5%	132.6%
2025	97.2%	99.6%	141.2%
2030	116.6%	119.6%	177.2%

- Necessary increase of the network capacity at the moment.

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	54.7%	56.1%	79.6%
2025	58.3%	59.8%	84.7%
2030	58.3%	59.8%	88.6%

- **Until 2025**: Installation of two new mobile sites
- **2025-2030**: Installation of one new mobile site
- **Total Radio Sites by 2030**: 6

Projected Costs: $1,289,029 - $1,960,628

High Demand Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 173,967
- **2025:** 185,408
- **2030:** 232,941

Current Number of Sites: **(3)**

- **4G co-located with 5G**: 3
- **Urban Sites:** 0
- **Rural Sites:** 0

2 - As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	130.1%	133.4%	189.1%
2025	138.7%	142.1%	201.5%
2030	174.2%	178.6%	253.2%

- Necessary increase of the network capacity at the moment.

3 - Future State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	55.8%	57.2%	81.0%
2025	59.4%	60.9%	86.4%
2030	65.3%	67.0%	95.0%

- **Until 2025**: Installation of four new mobile sites
- **2025-2030**: Installation of one new mobile site
- **Total Radio Sites by 2030**: 8

Projected Costs: $1,657,323 - $3,080,986

Case Study 5: The Entrance, Central Coast - Wireless Simulated Capacity

In the table below, the capacity status for the Entrance suburb under a low demand scenario conditions and a peak demand of 20,000 visitors is presented.

Low Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 85,286
- **2025:** 90.806
- **2030:** 113,875

Visitor Peak Demand: **20,000 Visitors** (ChromeFest Event)

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(3)**

- **4G co-located with 5G:** 3
- **Urban Sites:** 0
- **Rural Sites:** 0

Urban vs Rural Split:

- **Urban** - 100%
- **Rural -** 0%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	63.8%	65.4%	92.7%
2025	67.9%	69.6%	98.7%
2030	81.5%	83.5%	123.8%

<90%
90%-100%
>100%

- After running the model for the The Entrance suburb in case of a major event with 20,000 visitors it can be observed that for the **year 2023 and 2025, the current scenario in terms of sites supports the necessary demand**. However, by the year **2030, there is already saturation in terms of network capacity**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2030 -** Installation of **one new mobile base station between 2025 and 2030**, resulting in a total of **4 radio mobile sites** in the The Entrance suburb.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	63.8%	65.4%	92.7%
2025	67.9%	69.6%	98.7%
2030	61.1%	62.6%	92.8%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Case Study 5: The Entrance, Central Coast - Wireless Simulated Capacity

In the table below, the capacity status for the Entrance suburb under a baseline demand scenario conditions and a peak demand of 20,000 visitors is presented.

Baseline Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 121,980
- **2025:** 129,919
- **2030:** 163,021

Visitor Peak Demand: **20,000 Visitors** (ChromeFest Event)

Current Number of Sites: **(3)**

- **4G co-located with 5G:** 3
- **Urban Sites:** 0
- **Rural Sites:** 0

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Urban vs Rural Split:

- **Urban** - 100%
- **Rural -** 0%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	91.2%	93.5%	132.6%
2025	97.2%	99.6%	141.2%
2030	116.6%	119.6%	177.2%

<90%
90%-100%
>100%

- After running the model for the Entrance suburb in case of a major event with 20,000 visitors, it can be observed that there is **currently saturation** in terms of **mobile network capacity**, requiring the **deployment of new radio sites**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2025 -** Installation of **two new mobile base station until 2025** that will support the demand for the Entrance suburb in case of a major event with 20,000 visitors.
- **2030 -** Installation of **one new mobile base station between 2025 and 2030**, resulting in a total of **6 radio mobile sites** in the Entrance suburb.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	54.7%	56.1%	79.6%
2025	58.3%	59.8%	84.7%
2030	58.3%	59.8%	88.6%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Case Study 5: The Entrance, Central Coast - Wireless Simulated Capacity

In the table below, the capacity status for the Entrance suburb under a high demand scenario conditions and a peak demand of 20,000 visitors is presented.

High Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 173,967
- **2025:** 185,408
- **2030:** 232,941

Visitor Peak Demand: **20,000 Visitors** (ChromeFest Event)

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(3)**

- **4G co-located with 5G:** 3
- **Urban Sites:** 0
- **Rural Sites:** 0

Urban vs Rural Split:

- **Urban** - 100%
- **Rural -** 0%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	130.1%	133.4%	189.1%
2025	138.7%	142.1%	201.5%
2030	174.2%	178.6%	253.2%

<90%
90%-100%
>100%

- After running the model for the Entrance suburb in case of a major event with 20,000 visitors, it can be observed that there is **currently saturation** in terms of **mobile network capacity**, requiring the **deployment of new radio sites**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2025 -** Installation of **four new mobile base station until 2025** that will support the demand for the Entrance suburb in case of a major event with 20,000 visitors.
- **2030 -** Installation of **one new mobile base station between 2025 and 2030**, resulting in a total of **8 radio mobile sites** in the Entrance suburb.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	55.8%	57.2%	81.0%
2025	59.4%	60.9%	86.4%
2030	65.3%	67.0%	95.0%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Case Study 5: The Entrance, Central Coast - Other Technology Options

There are alternative technologies with the potential to accommodate the demand generated by events in defined regions. We have outlined potential technology options available for The Entrance suburb in the case of 20,000 visitors.

Other Technology Options

1 - Analysis (2030):

Low Scenario

- Total Devices **- 113,875**
- Visitor Devices - **58,000**
- As-Is %RAN Capacity - **123.8%**
- No. of Devices exceeding the network capacity - **21,891**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%): **21,891 * 20% * 30% = 1,313**

Baseline Scenario

- Total Devices **- 163,021**
- Visitor Devices - **83,000**
- As-Is %RAN Capacity - **177,2%**
- No. of Devices exceeding the network capacity - **71,022**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%): **71,022 * 20% * 30% = 4,261**

High Scenario

- Total Devices **- 232,941**
- Visitor Devices - **118,400**
- As-Is %RAN Capacity - **253.2%**
- No. of Devices exceeding the network capacity - **140,942**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%): **140,942 * 20% * 30% = 8,456**

Technology	Description	Projected Cost	Effectiveness
Cell on Wheels	**Cell on Wheels (CoW) are temporary infrastructures** that provide mobile coverage and capacity, supporting an average of up to **350 devices simultaneously**. Therefore, in each of the following scenarios, and to accommodate exceeding network devices, the required number of CoWs (independent of the operator) are: • **Low Scenario**: 1,313 exceeding devices connected during the busy hour via mobile access. Since each CoW supports 350 devices, 4 **CoWs are necessary**. • **Baseline Scenario**: 4,261 exceeding devices connected during the busy hour via mobile access. Since each CoW supports 350 devices, **13 CoWs are necessary**. • **High Scenario**: 8,456 exceeding devices connected during the busy hour via mobile access. Since each CoW supports 350 devices, **25 CoWs are necessary**. Cell on Wheels can be installed during events, saving annual operational costs in terms of maintaining this infrastructure connected. The deployment of COWs by operators is specific to the respective operator (e.g., a COW implemented by Telstra is only accessible to Telstra mobile network users). The cost of this infrastructure is performed only one time, and the option of renting them is also available: • Acquisition Cost (per unit): **$500,000** • Rental Cost (per unit): **$30,000*** *Rental Costs provided by Telstra	**Low Scenario** Acquisition Cost: **$2,000,000** Rental Cost: **$120,000** **Baseline Scenario** Acquisition Cost: **$6,500,000** Rental Cost: **$390,000** **High Scenario** Acquisition Cost: **$12,500,000** Rental Cost: **$750,000**	**Low Scenario** (yellow minus icon) **Baseline Scenario** (red cross icon) **High Scenario** (red cross icon)

Case Study 5: The Entrance, Central Coast - Other Technology Options

There are alternative technologies with the potential to accommodate the demand generated by events in defined regions. We have outlined potential technology options available for The Entrance suburb in the case of 20,000 visitors.

Other Technology Options

1 - Analysis (2030):

Low Scenario

- Total Devices **- 113,875**
- Visitor Devices - **58,000**
- As-Is %RAN Capacity - **123.8%**
- No. of Devices exceeding the network capacity - **21,891**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%): **21,891 * 20% * 30% = 1,313**

Baseline Scenario

- Total Devices **- 163,021**
- Visitor Devices - **83,000**
- As-Is %RAN Capacity - **177,2%**
- No. of Devices exceeding the network capacity - **71,022**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%): **71,022 * 20% * 30% = 4,261**

High Scenario

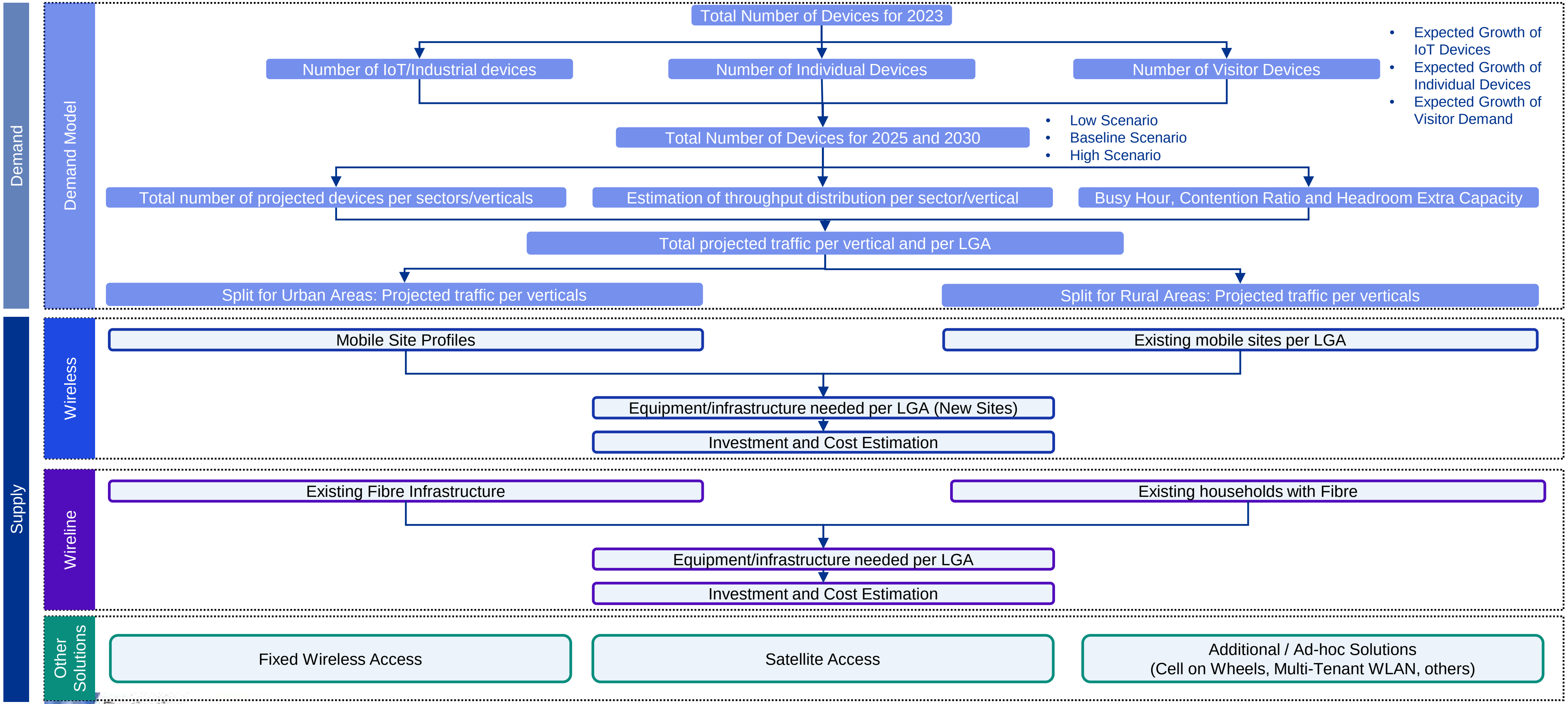
- Total Devices **- 232,941**
- Visitor Devices - **118,400**
- As-Is %RAN Capacity - **253.2%**
- No. of Devices exceeding the network capacity - **140,942**
- No. of exceeding devices in busy hour (20%) via mobile connection (30%): **140,942 * 20% * 30% = 8,456**

Technology	Description	Projected Cost	Effectiveness
Cold Mobile Site	The **Cold Mobile Site is a pre-located site** that contains all passive infrastructure components. It is only activated during major events, requiring the installation of antennas and connections to power and backhaul. Therefore, the implementation costs associated with this solution are included in the Wireless Costing, excluding the costs related to **associated infrastructure**. For this case study #5 (The Entrance with a peak demand of 20,000 visitors), the projected need for 2030 is to implement: • **Low Scenario:** 1 new mobile site without active infrastructure • **Baseline Scenario:** **3** new mobile sites without active infrastructure • **High Scenario:** **5** new mobile sites without active infrastructure	**Low Scenario** Min: $286,164 Max: $754,999 **Baseline Scenario** Min: $667,716 Max: $1,761,664 **High Scenario** Min: $858,492 Max: $2,768,330	**Low Scenario** ✓ **Baseline Scenario** ✓ **High Scenario** ✓
Private 5G	The deployment of a **private wireless solution based on 5G** is a technology option to adopt in **events and specific zones** where a significant demand is expected. This solution, being **private, allows only selected devices in the region of The Entrance to access the network**, with **capabilities designed according to the expected demand** The estimation of the number of access points depends on various factors. However, it is reasonable to assume that, given the forecast of the expected demand for the event/region and the dedicated spectrum, each access point (AP) can support an average of 100 devices. Therefore, the following number of access points would be necessary for the three scenarios • **Low Scenario:** 1,313 exceeding devices connected during the busy hour via mobile access. Since each AP supports 100 devices, **14 APs are necessary** (Small Site) • **Baseline Scenario:** 4,261 exceeding devices connected during the busy hour via mobile access. Since each AP supports 100 devices, **43 APs are necessary**. (Medium Site) • **High Scenario:** 8,456 exceeding devices connected during the busy hour via mobile access. Since each AP supports 100 devices, **85 APs are necessary**. (Medium Site)	**Low Scenario** Min: $990,000 Max: $1,001,000 **Baseline Scenario** Min: $1,514,000 Max: $1,558,000 **High Scenario** Min: $1,598,000 Max: $1,642,000	**Low Scenario** ✓ **Baseline Scenario** ✓ **High Scenario** ✓

Approach to conducting the Future State Characterisation

Overview of the Future Characterisation Key Steps

The below chart shows the key steps that our approach includes to model future connectivity demand and the network infrastructure investment needed to fulfil that demand.



Wireless Characterisation

Wireless - Existing Mobile Sites and Respective Profiles

Obtaining the count of existing sites for each region and defining their profiles is crucial for estimating the current capacity of the radio access network. These inputs determine whether the existing infrastructure can support both current and future demands.

Mobile Sites per LGA

To obtain the different existent sites according to their profiles and to perform the wireless capacity simulation for the different regions, the following types of radio sites were defined:

- **4G co-located with 5G Sites** - encompassing all existing sites with access to 5G. 5G sites enable high transmission capacity and can support a high number of devices simultaneously.
- **Urban Sites** - The number of urban sites was derived from the percentage ratio of urban population to the region's current number of 3G/4G sites in each region. These sites operate at higher frequencies to ensure greater transmission capacity.
- **Rural Sites** - In contrast to urban sites, rural sites were obtained through the percentage ratio of rural population to the region's current number of 3G/4G sites in each region. These sites operate at lower frequencies, reflecting lower capacity requirements and aiming to ensure greater coverage distance.

Region	Number of Sites	4G co-located with 5G	Urban Site	Rural Site
Central Coast	265	98	165	2
Cessnock City	59	17	0	42
Dungog Shire	13	0	0	13
Lake Macquarie	111	68	39	4
Maitland	50	20	19	11
Muswellbrook	28	2	0	26
Newcastle City	114	66	48	0
Port Stephens	79	27	9	43
Singleton	39	8	1	30
Upper Hunter	24	4	0	20

Mobile Sites Profiles

To estimate the current network capacity for different regions, three site profiles were considered:

1) **4G co-located sites with 5G** - sites incorporating all technologies, providing high capacity.
2) **Urban Sites** - 3G/4G standalone sites using high frequencies (e.g., LTE 1800, 2100, 2300, 2600).
3) **Rural Sites** - 3G/4G standalone sites using lower frequencies (e.g., LTE 700, 800, 900).

The definition of maximum transmission capabilities in terms of transmission, reception, and devices per mobile site depends on many technical telecommunications factors,. The values in the table below are average values, considering a starting point of a common topology 4G radio site user by mobile operators and according to the 3GPP standards.

Specifications	4G co-located with 5G	Urban Site	Rural Site
Maximum transmission link capacity per site (Mbps)	510	290	250
Maximum reception link capacity per site (Mbps)	105	60	55
Maximum Simultaneously Active Users per site	1,800	1,400	1,200

Wireless - Simulated Capacity Methodology

The below steps have been undertaken in the wireless modelling to identify areas where the existing network capacity does not support the estimated future demand.

Wireless Model Methodology

1 - Model Inputs

To estimate the current state capacity, previously estimated input assumptions feed into the wireless model. These inputs are:

- **1.1 - Total Number of Devices**: Estimated total number of devices for the years 2023, 2025, and 2030, for three scenarios.
- **1.2 - Total Number of Sites:** The existing number of mobile sites in the region categorised as 4G co-located with 5G, Urban Sites (4G with higher frequencies), and Rural Sites (4G with lower frequencies).
- **1.3 - Busy Hour Traffic associated with Mobile Access Technologies**: Traffic associated with the mobile network during the busy hour.
- **1.4 - Split Urban vs Rural:** The population ratio between urban and rural areas used to determine the type of traffic and the respective number of sites allocated to each region.

2 - Present State

After feeding the model with the inputs mentioned in step 1, it is possible to estimate the current state in terms of RAN (Radio Access Network) capacity across three different variables. In this analysis, it is assumed that the number of sites will remain the same until 2030.

- **Required Transmission Link Capacity as % of RAN Capacity:** This parameter aims to understand the network's capacity to handle data transmissions, information, and other network parameters between the radio site and user equipment.
- **Required Receive Link Capacity as % of RAN Capacity:** This parameter aims to understand the network's capacity to handle the reception of data, information, and other network parameters between user equipment and the base station.
- **Required Simultaneous Active Users/Devices (SAUs) as % of RAN Capacity:** This parameter allows the understanding of network's capacity to handle the number of simultaneous users/devices accessing during the busy hour.

For each of these parameters, the capacity based on the simulated demand is determined as a **percentage** and is represented as:

- <90% - The existing capacity is sufficient to **support the estimated future demand** and **no deployment** of new mobile sites is necessary.
- 90%-100% - The existing capacity is sufficient **to support the estimated future demand**, without the need to add new radio sites. However, despite already considering a 20% extra headroom, the network may experience saturation in the case of peak demand or unexpected network congestion
- >100% - The existing capacity **does not support the estimated future demand**, which may lead to **denial of mobile network** service. Installation of **new radio sites** is recommended.

3 - Future State

Through the analysis of the current state, the future state of the network is defined, providing the number of sites that need to be implemented \in 2025 and 2030 as necessary to address the simulated connectivity demand by increasing capacity.

Projected Years	Required Mbps - Downlink as % of RAN Capacity	Required Mbps - Uplink as % of RAN Capacity	Required SAUs as % of RAN Capacity
2023	97.6%	98.6%	69.6%
2025	108.2%	109.2%	95.9%
2030	141.6%	142.9%	162.7%

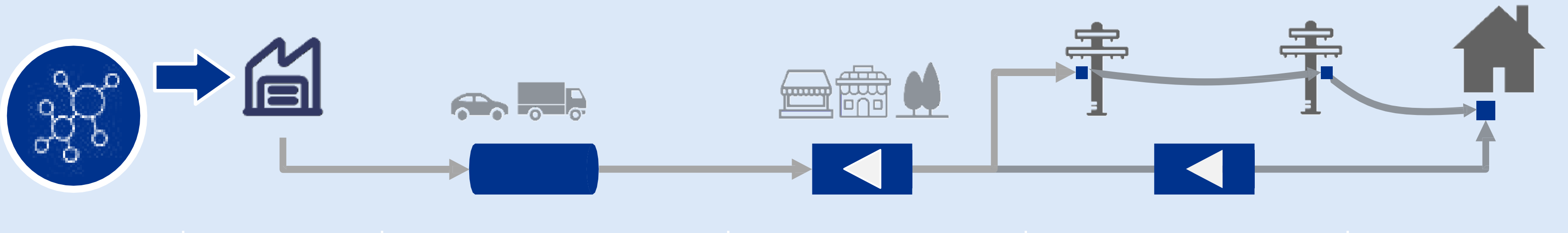
Illustrative Example

Wireline Characterisation

Wireline – Components of Existing Fibre Infrastructure

The diagram below illustrates the infrastructure of a fibre access technology that aligns with the architecture and access types provided by the NBN for accessing its services via fibre.

High-Level Diagram of Fibre Infrastructure

Program Designation	Fixed Core Network	Aggregation Network	Fibre to the Node (FTTN)	Fibre to the Curb (FTTC)	Fibre to the Premises (FTTP)
Graphical Representation of a Passive Optical Network (PON)					
Network Designation	Core Network / Local Exchange	Aggregation Network	Distribution Network	Premises Drop / Last Mile	Premises
Core Assets (Telecommunications)	Access to connectivity backbone	Optical Line Termination OLT	Multiple level of the application of Splitters		Optical Network Terminal ONT
Equipment	• Transport Network - Ducts • Transport Network - Fibre between Core PoPs (Point of Presence) • Transport Network - Fibre between Internet Exchange Points (IXP) connection • Transport Network - Connection to 3rd Parties	• Switches (MPLS and Ethernet) • Optical Line Terminator(OLT) • Power Systems • HVAC Systems • Optical Transmitters and Amplifiers • Shelter • Security and Monitoring System	• Optical Sub Splitter (OSS) • Optical Splitter (1:64) • Shelter • Joints • Manholes	• Optical Distribution Point (1:6) • Optical Splitter (1:16) • Distribution Point Unit (DPU) • Shelter	• Customer Box • Customer Router • Optical Distribution Box • Interior Wiring • Installation Materials

Wireline - Existing dwellings with Fibre

The analysis of the current number of dwellings with fibre access across different LGAs helps understand the current deployment status and estimate the infrastructure and associated costs in an attempt to provide FTTP (fibre to the Premises) to all dwellings by 2030.

Existing households with Fibre

To understand the maturity and installation status of fibre in different regions, the number of dwellings and their respective types of fixed access to NBN services were examined for each one of the suburbs.

According to the NBN's plan to fiberise **90% of homes and businesses with its fastest service** and with the investment from the Australian government for this transition, it is assumed that by 2030, the DSSN may aim to provide FTTP for all regions and their respective dwellings.

In summary, based on this assumption the following transition will be completed for the entire region by 2030:

- Transition of **13,836 private dwellings** from FTTC to FTTP
- Transition of **241,968 private dwellings** from FTTN to FTTP
- **Provision of FTTP to the 26,180 dwellings** currently without fibre.

This assumption does not include the transition from Fibre to the Building to Fibre to the Premises, as it has been observed that existing buildings with fibre are residual and belong to industrial sectors such as universities, hospitals, military areas, etc.

Current distribution of access types across dwellings for the different regions

Region	Total Private Dwellings	# of Dwellings with access to Fibre to the Premises (FTTP)	# of Dwellings with access to Fibre to the Curb (FTTC)	# of Dwellings with access to Fibre to the Node (FTTN)	# of Dwellings without access to Fibre
Central Coast	152,699	67,578	1,994	79,448	3,679
Cessnock City	26,304	2,441	4,286	15,693	3,884
Dungog Shire	3,905	0	0	1,863	2,042
Lake Macquarie	37,464	3,890	3,817	29,332	425
Maitland	35,343	23,345	0	10,546	1,452
Muswellbrook	8,193	948	50	6,335	860
Newcastle City	75,771	15,218	0	60,265	288
Port Stephens	37,730	3,421	3,716	27,088	3,505
Singleton	9,348	73	0	5,960	3,315
Upper Hunter	12,168	0	0	5,438	6,730
DSSN Region	398,925	116,914	13,863	241,968	26,180

Wireline – Cost Estimation of Wireline Expansion

The following table presents the costs associated with the wireline expansion for the different LGAs.

Cost Estimation of Wireline Upgrade to FTTP

According to statements provided by the CEO of NBN and following the expansion project currently underway to upgrade the various types of NBN access to FTTP, different costs associated with this expansion have been projected over the years:

- In **2020**, the government projected in their business case that fibre lead-in costs would be **$750 per connection**.
- In **2023**, NBN communicated a **$2,650 capital cost** per connection.
- In **2024**, NBN communicated the lead-in cost as **$1,400 per connection**.

Therefore, in order to calculate the costs associated with the expansion from **FTTN or FTTC to FTTP**, a cost of **$1,400 per dwelling** was used. The costs for each LGA associated with this expansion can be seen on the right side.

Regarding the **costs associated** with providing access **via fibre to dwellings** that currently do not **have access to this type of technology**, the cost of this expansion is inherent to **different factors** and the geographical location/distance of possible fibre cores. To estimate these costs, the following factors must be taken into consideration:

- **Presence of IXPs and POPs in the region -** The more distant these connection points are, the greater the amount of fiber required, consequently escalating costs..
- **Construction of Ducts** - In extremely rural regions with dispersed dwellings, the construction of ducts in various directions is required to provide FTTP.
- **Installation of OLTs** - In terms of fibre network aggregation, in remote areas, the number of necessary OLTs depends on the distance between dwellings and regions.

Regions	# of Dwellings with access to FTTC or FTTN	x$1,400	Cost of Expand to FTTP
Central Coast	81,442		$114,018,800
Cessnock	19,979		$27,970,600
Dungog	1,863		$2,608,200
Lake Macquarie	33,149		$46,408,600
Maitland	10,546		$14,764,400
Muswellbrook	6,385		$8,939,000
Newcastle	60,265		$84,371,000
Port Stephens	30,804		$43,125,600
Singleton	5,960		$8,344,000
Upper Hunter	5,438		$7,613,200
DSSN Region	255,831		$358,163,400

Future Characterisation Infrastructure & Costings: Wireless

Wireless – Components and Cost Estimation of new Mobile Sites

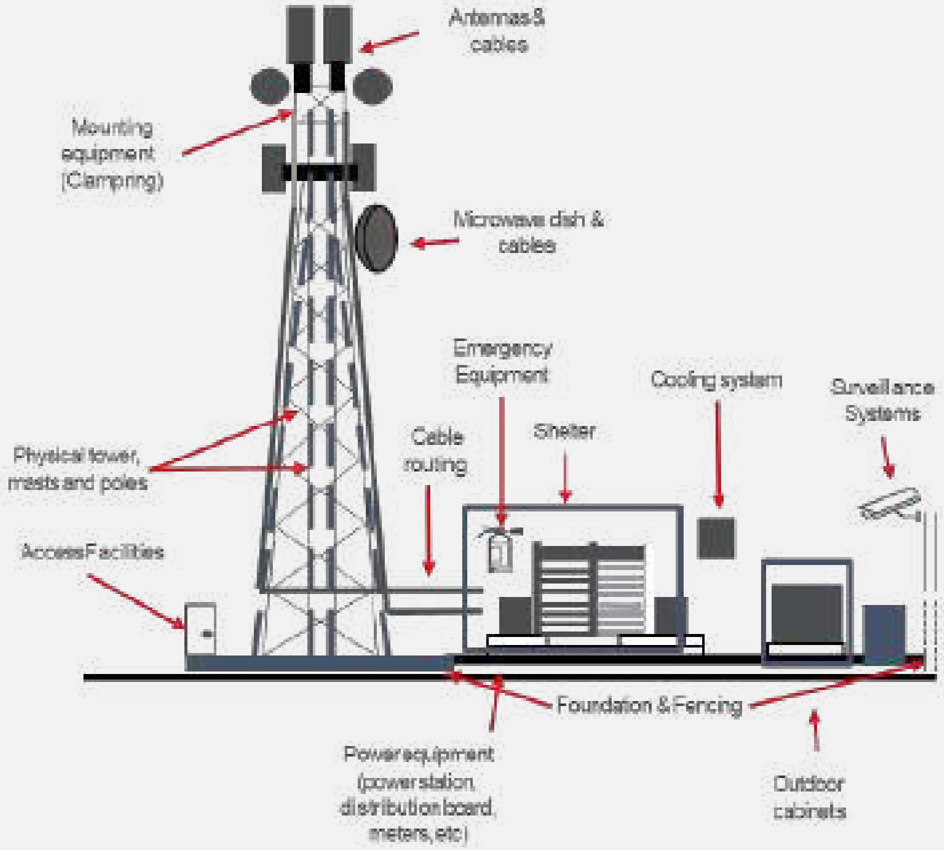
The diagram below illustrates the infrastructure for a radio mobile macro site.

Mobile Sites - Cost Estimation

- In order to project the costs associated with the necessary expansion to accommodate the future demand, it is necessary to understand the costs of each type of existing macro site. For this analysis, two types of macro sites were considered: Monopoles and Lattice Towers.
- These costs should not be regarded as precise figures, as they depend on site-specific features, such as height, structure type, distance from the power grid, access track, backhaul connection, and the fact that the site in question is co-located.
- For the cost estimation projection, the costs present in the ACCC report 'Regional Mobile Infrastructure Inquiry' were used as a reference.

Type of Infrastructure	Major Cities		Inner Regional Areas	
	Monopole Tower (25-50m)	Lattice Tower (30-60m)	Monopole Tower (25-50m)	Lattice Tower (30-60m)
Tower site selection and planning approvals	$69,885	$111,260	$369,563	$104,967
Tower site construction	$159,271	$287,866	$278,038	$318,456
Access to tower site (if an upgrade is required)	-	$120,387	-	$23,638
Connection to power	-	$235,486	$30,199	$113,795
Connection to backhaul	$57,008	-	$43,551	-
Associated infrastructure	$266,277	$85,270	$144,895	$65,113
Indicative total build cost	$552,441	$840,269	$866,246	$625,969

Cost of Radio Macro Sites | Source: ACCC Regional Mobile Infrastructure Inquiry - Sample of tower build costs



Composition of a Radio Mobile Macro Site

Wireless – Cost Estimation of new Mobile Sites

To conduct the study on the cost associated with mobile expansion, different assumptions have been defined and are explained below in terms of the type of mobile tower, location in urban or rural areas, and the existence of co-location among operators.

Cost Estimation of new Mobile Sites - Assumptions

Assumptions

To estimate the cost associated with each LGA, the following assumptions were made:

1. A radio site can be classified as either a monopole tower or lattice tower type. This decision depends on factors such as access type, area, space, aesthetic considerations, among others. Therefore, the following cost range was assumed for each radio site:
    - Cost range of a radio site in a Major City: $552,441 - $840,269
    - Cost range of a radio site in an Inner Regional Area: $625,969 - $866,246

2. To determine whether the cost of a site should be considered for a major city or inner regional areas, the urban vs rural split previously presented for each of the regions was taken into account.

3. Since the presence of currently co-located mobile radio sites, it is expected that new macro sites will also share infrastructure among the three operators. The table indicates a minimum co-location value of 44.5% for Telstra in 2023. Therefore, this projection assumes that 44.5% of additional sites will be co-located, requiring the construction of only one tower to accommodate the three different operator.

Operator	Co-located sites as percentage (%) of total sites
Telstra	44.5%
Optus	69.7%
TPG	88.7%

Source: ACCC Mobile Infrastructure Report 2023 - Co-Located Sites

Wireless – Cost Estimation of new Mobile Sites

Below, the additional number of mobile sites for each region is presented for the different scenarios.

Cost Estimation of new Mobile Sites - Number of Additional Mobile Sites

- The table below shows the estimated number of additional radio sites for each region, divided according to the previously explained rationale of Major City Site vs Inner Regional Area Site. In parentheses, the number of co-located radio sites is displayed, indicating radio sites from the three different operators that will share the same tower. Therefore, to calculate the cost of these co-located radio sites, the cost associated with the type of site (Major City vs Inner Regional) is divided by 3 (same tower, with radio sites from all 3 operators).

Region	Urban vs Rural Split		Low Scenario			Baseline Scenario			High Scenario		
	Urban	Rural	Additional Radio Sites	Major City Site (Co-Located)	Inner Regional Area Site (Co-Located)	Additional Radio Sites	Major City Site (Co-Located)	Inner Regional Area Site (Co-Located)	Additional Radio Sites	Major City Site (Co-Located)	Inner Regional Area Site (Co-Located)
Central Coast	98.8%	1.2%	+ 0	0 (0)	0 (0)	+ 11	11 (5)	0 (0)	+ 99	98 (43)	1 (1)
Cessnock City	0.0%	100.0%	+ 0	0 (0)	0 (0)	+ 8	0 (0)	8 (4)	+ 29	0 (0)	29 (13)
Dungog Shire	0.0%	100.0%	+ 0	0 (0)	0 (0)	+ 2	0 (0)	2 (1)	+ 5	0 (0)	5 (2)
Lake Macquarie	91.5%	8.5%	+ 0	0 (0)	0 (0)	+ 39	36 (16)	3 (1)	+ 99	91 (40)	8 (4)
Maitland	64.0%	36.0%	+ 2	1 (1)	1 (0)	+ 19	12 (5)	7 (3)	+ 45	29 (13)	16 (7)
Muswellbrook	0.0%	100.0%	+ 0	0 (0)	0 (0)	+ 0	0 (0)	0 (0)	+ 2	0 (0)	2 (1)
Newcastle City	100.0%	0.0%	+ 0	0 (0)	0 (0)	+ 27	27 (12)	0 (0)	+ 82	82 (36)	0 (0)
Port Stephens	17.4%	82.6%	+ 0	0 (0)	0 (0)	+ 2	0 (0)	2 (1)	+ 31	5 (2)	26 (11)
Singleton	1.7%	98.3%	+ 0	0 (0)	0 (0)	+ 0	0 (0)	0 (0)	+ 3	0 (0)	3 (1)
Upper Hunter	0.0%	100.0%	+ 0	0 (0)	0 (0)	+ 0	0 (0)	0 (0)	+ 1	0 (0)	1 (0)

Wireless – Cost Estimation of new Mobile Sites

The following table presents the costs associated with the installation of radio mobile sites for the different LGAs according to the defined scenarios.

Cost Estimation of new Mobile Sites - Comparison of Total Costs per Scenario

Regions	Low Scenario	Baseline Scenario	High Scenario
Central Coast	$0	$4,235,381 - $6,442,062	$38,591,325 - $58,467,640
Cessnock	$0	$3,343,835 - $4,619,979	$12,748,370 - $17,613,669
Dungog	$0	$835,959 - $1,154,995	$2,298,886 - $3,176,235
Lake Macquarie	$0	$16,016,413 - $22,749,742	$32,794,470 - $57,401,140
Maitland	$907,059 - $1,050,393	$9,119,052 - $10,417,176	$18,656,511 - $24,191,118
Muswellbrook	$0	$0	$835,959 - $1,154,995
Newcastle	$0	$10,496,379 - $15,965,111	$25,412,286 - $48,735,602
Port Stephens	$0	$835,959 - $1,154,995	$14,784,408 - $17,827,248
Singleton	$0	$0	$1,462,928 - $2,021,241
Upper Hunter	$0	$0	$626,969 - $866,246
DSSN Region	$907,059 - $1,050,393	$46,797,194 - $60,589,844	$158,114,226 - $221,553,020

5. Appendices

Appendix 5.1 Telecommunications Infrastructure Review

Methodology and findings of the technology review conducted for each LGA in the DSSN region.

Telecommunications Infrastructure Review

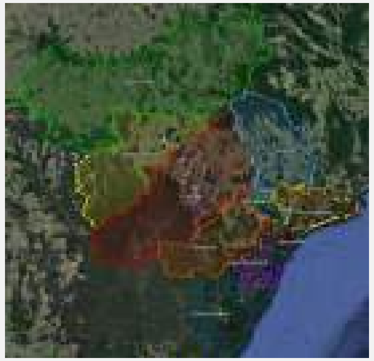
Methodology and findings of the technology review conducted for each LGA in the DSSN region.

Technology Review Approach

To comprehend the impact of demand growth on network infrastructure, it is important to assess the current status of the deployment of various network access types. Specifically, an evaluation was conducted on the deployment status of mobile access, fibre, fixed wireless, and satellite, focusing on the three major operators (Telstra, Optus, and TPG) and the National Broadband Network (nbn).

Analysis of Current Network Mobile State

- To analyse the **current radio infrastructure**, data concerning the **radio sites operated by Telstra, Optus, and TPG** in the different regions was collected.
- Mapping these sites based on their geographic coordinates, a comprehensive assessment of **coverage was conducted** using **maps provided by the operators**.
- This evaluation included an **examination of 3G, 4G, and 5G technologies**. It's crucial to highlight that the operators are planning to **discontinue 3G** technology in **2024.**



Existing Number of Mobile Sites for each DSSN Region:

Region	Telstra	Optus	TPG	Total
Central Coast	100	104	61	265
Newcastle	43	41	30	114
Lake Macquarie	40	39	32	111
Port Stephens	28	31	20	79
Cessnock	24	22	13	59
Maitland	22	18	10	50
Singleton	25	9	5	39
Muswellbrook	18	7	3	28
Upper Hunter	12	8	4	24
Dungog	10	3	0	13

Sources: ACCC Mobile Infrastructure Report | Telstra Coverage Maps | Optus Coverage Maps | TPG Coverage Maps

Analysis of nbn Types of Technology

In order to analyse the **current fixed/fibre network infrastructure** for each region, the deployment status of the **nbn network** was assessed.

The coverage maps for each region were examined in terms of **Fibre to the Premises** (FTTP**), Fibre to the Node** (FTTN), and **Fixed Wireless and Satellite**, as these are the most common types of access. The **types of connections** provided by the NBN are listed below:

Wired Connections

Fibre to the Premises (FTTP) - used in circumstances where a fibre optic line will be run from the nearest available fibre node, directly to population premises

Fibre to the Building (FTTB) - generally used when NBN connects an apartment block or similar types of buildings, running a fibre optic line to the fibre node in the building's communications room, and the using the exiting connection technology in the building.

Fibre to the Curb (FTTC) - used in circumstances where fibre is extended close to habitational premises, connecting to a small Distribution Point Unit (DPU), generally located inside a pit on the street**.**

Fibre to the Node (FTTN) - used where the existing copper phone and internet network from a nearby fibre node is used to make the final part of the connection to the NBN network

Wireless Connections

Fixed Wireless - typically used in circumstances where the distance between premises can be many kilometres.

Satellite - used in remote and residential areas that do not have access to the NBN network through wired/fibre connections or fixed wireless

Source: NBN National Map Datasets | NBN Australia

Technology Review - Central Coast

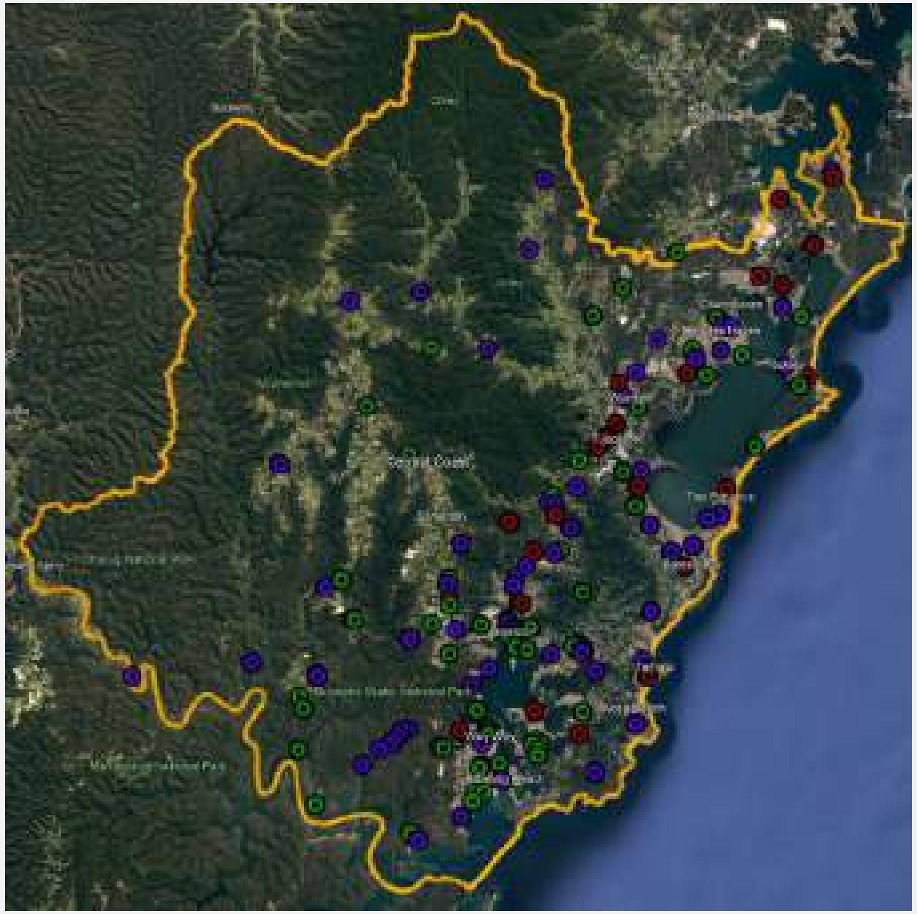
The determination of site numbers and subsequent analysis of coverage maps provides insight into the current state of coverage for various radio technologies (3G, 4G, and 5G), identifying potential connectivity gaps. The following analysis addresses the current mobile network in the region of Central Coast:

Existing Radio Mobile Sites

Mobile Operator	# of Radio Mobile Sites	# of Sites with 3G Access	# of Sites with 4G Access	# of Sites with 5G Access
Telstra	100	90	99	48
OPTUS	104	83	103	29
TPG	61	61	61	21

Analysis of Current State

- **Telstra**: Complete coverage for 3G and 4G technologies across the entire Central Coast region. Regarding 5G, the coverage is extensive, with only a few gaps in suburbs like Wamberal and Matcham. Terrigal is covered with 5G.
- **Optus**: Extensive network coverage for 3G and 4G technologies is available throughout the territory, with potential connectivity gaps in the Dharug National Park area. Concerning the implementation of 5G, it is deployed throughout the main suburbs. Terrigal is covered by 5G.
- **TPG**: Wide coverage for 3G and 4G technologies for the main suburbs. Regarding 5G technology, similar to Optus, it is implemented across the main suburbs, with 5G coverage also available in Terrigal.



Telstra Optus TPG

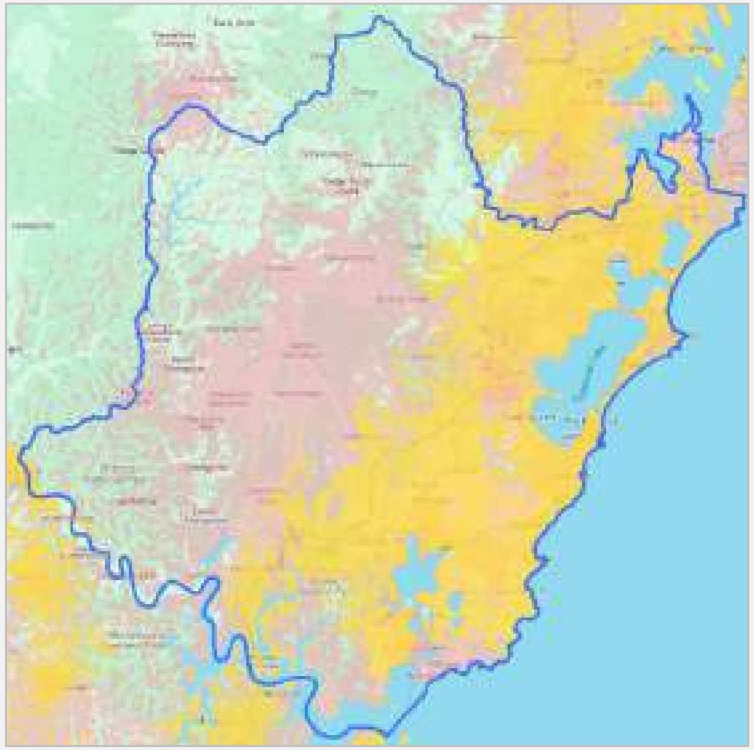
Technology Review - Central Coast

The examination of coverage maps from the three major operators helps to understand the distribution of radio technologies across regions and identify potential connectivity challenges. In these maps, 3G is not separately detailed, as the radio sites are co-located with 4G, and considering that 3G is planned for discontinuation throughout 2024.

Current Mobile Coverage

Telstra Mobile Coverage

Optus Mobile Coverage



TPG Mobile Coverage

4G 5G

Sources: [ACCC Mobile Infrastructure Report - Coverage Maps 2023 (KML)]

Technology Review - Central Coast

The analysis of coverage maps for the National Broadband Network (NBN) provides insight into the current deployment status, including fixed-line access (Fibre to the Premises and Fibre to the Node), as well as access to the network through fixed wireless and satellite. The following maps represent the current state of the Central Coast region.

NBN Technology Types

NBN - Fibre to the Premises

Fibre to the Premises

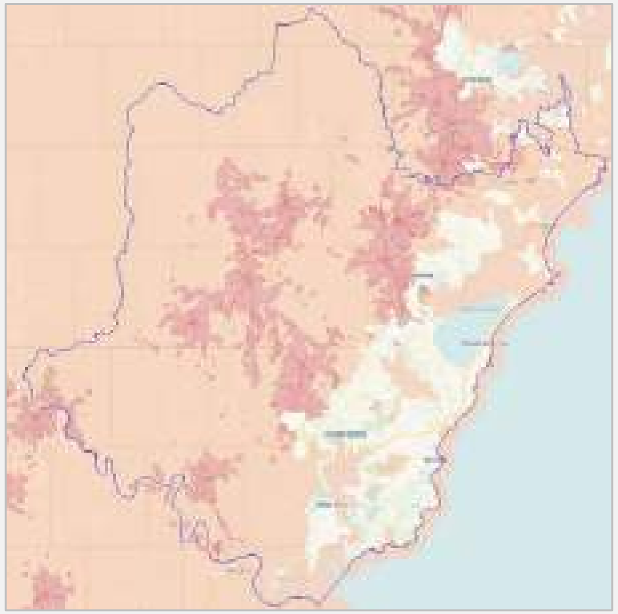
- The Central Coast region is densely urban in population (98.2 per cent) and, within the DSSN region group, it is one of the highest in terms of FTTP coverage. This access is ensured for the entire suburbs of Gosford and The Entrance.

NBN - Fibre to the Node

Fibre to the Node

- The remaining urban areas, and consequently densely populated areas, of the Central Coast region, such as Woy Woy, Terrigal, or Lisarow, where there is constant network access for various industrial sectors and individuals, have at least one Fibre to the Node connection.

NBN - Fixed Wireless and Satellite



Satellite Fixed Wireless

- The more rural areas of the Central Coast region, such as Mangrove and Somersby, where there are some residences, points of interest, or industrial zones, have access to fixed wireless, while the entire remaining mountainous area is connected via satellite.

Technology Review - Cessnock

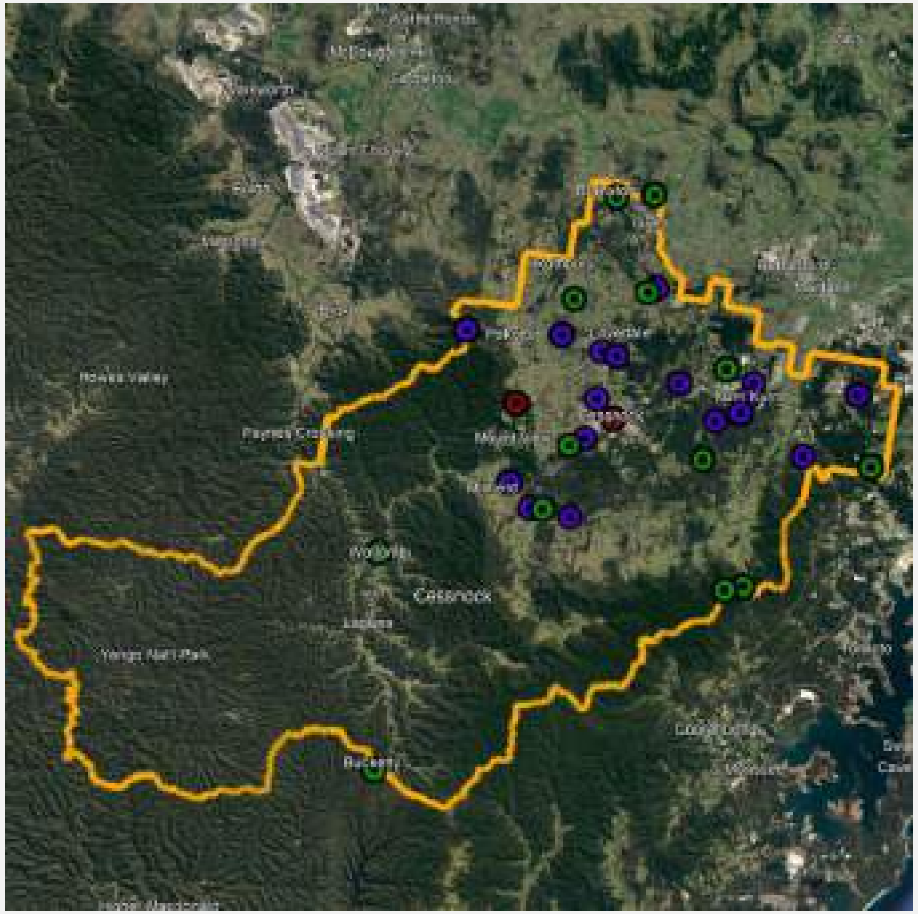
The determination of site numbers and subsequent analysis of coverage maps provides insight into the current state of coverage for various radio technologies (3G, 4G, and 5G), identifying potential connectivity gaps. The following analysis addresses the current mobile network in the region of Cessnock:

Existing Radio Mobile Sites

Mobile Operator	# of Radio Mobile Sites	# of Sites with 3G Access	# of Sites with 4G Access	# of Sites with 5G Access
Telstra	24	20	24	14
OPTUS	22	22	21	0
TPG	13	13	13	3

Analysis of Current State

- **Telstra**: Complete coverage of 3G and 4G in the inhabited and industrially active regions. Remote and forested areas like Pokolbin State Forest and Yengo National Park may have some coverage dead zones. 5G is available in all densely populated areas. The residential area of Pokolbin is covered via 5G by Telstra.
- **Optus**: 3G and 4G are available in central and residential areas of the Cessnock region. Similar to Telstra, there may be coverage dead zones in national parks and, in this case, in areas like Wollombi and Laguna. 5G coverage is not available from Optus in this region.
- **TPG**: Similar to Telstra and Optus, 3G and 4G are present in the more populated areas of the region. However, TPG may have coverage gaps in more peripheral areas of Pokolbin like Cedar Creek and Mount View. 5G coverage is limited east area of Cessnock regions, in suburbs such Kurri Kurri.



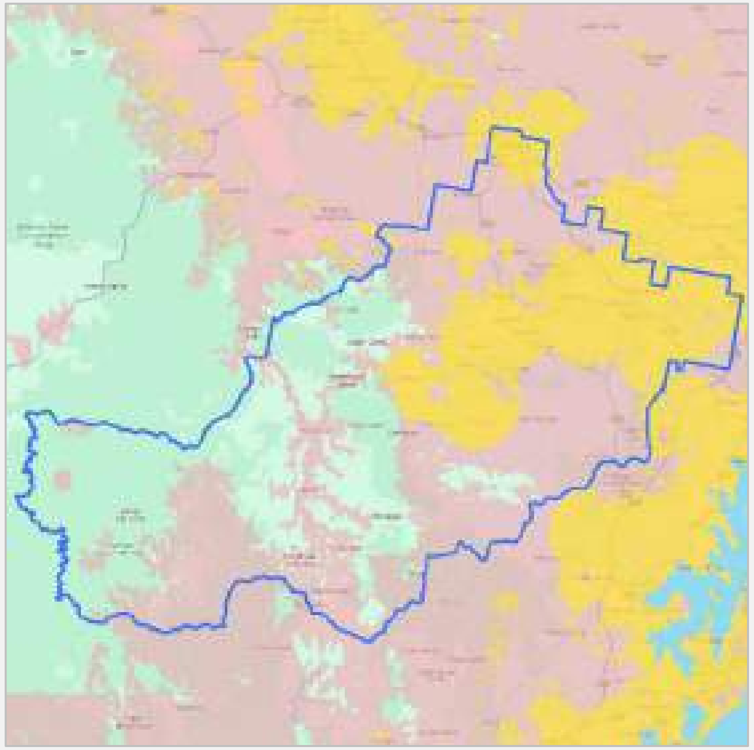
Telstra Optus TPG

Technology Review - Cessnock

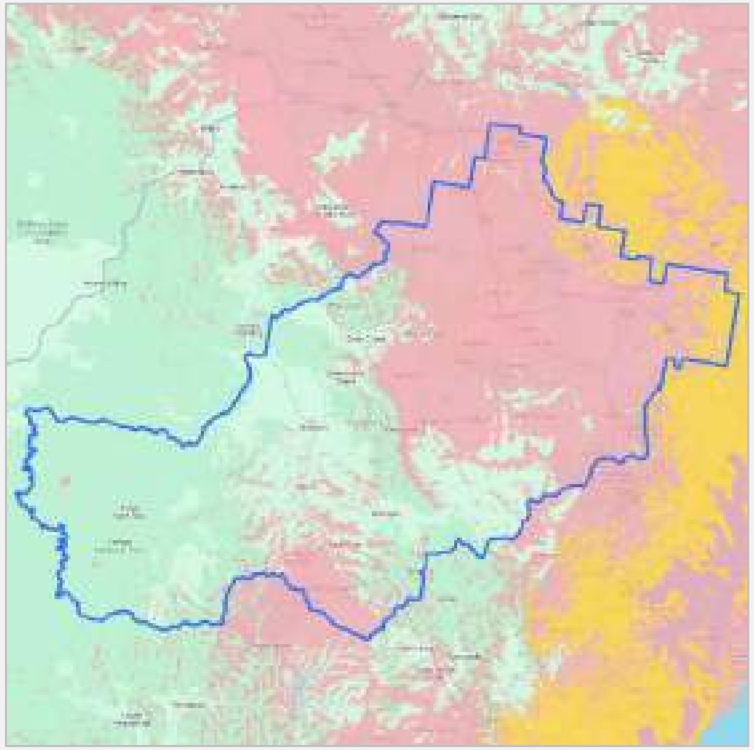
The examination of coverage maps from the three major operators helps to understand the distribution of radio technologies across regions and identify potential connectivity challenges. In these maps, 3G is not separately detailed, as the radio sites are co-located with 4G, and considering that 3G is planned for discontinuation throughout 2024.

Current Mobile Coverage

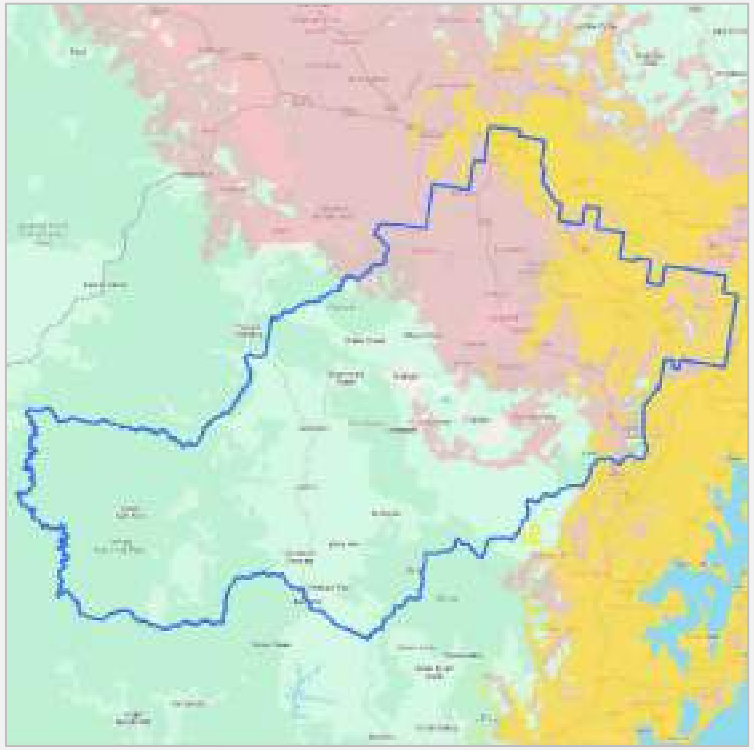
Telstra Mobile Coverage



Optus Mobile Coverage



TPG Mobile Coverage



4G 5G

Source: [ACCC Mobile Infrastructure Report - Coverage Maps 2023 (KML)]

Technology Review - Cessnock

The analysis of coverage maps for the National Broadband Network (NBN) provides insight into the current deployment status, including fixed-line access (Fibre to the Premises and Fibre to the Node), as well as access to the network through fixed wireless and satellite. The following maps represent the current state of the Cessnock region.

NBN Technology Types

NBN - Fibre to the Premises

Fibre to the Premises

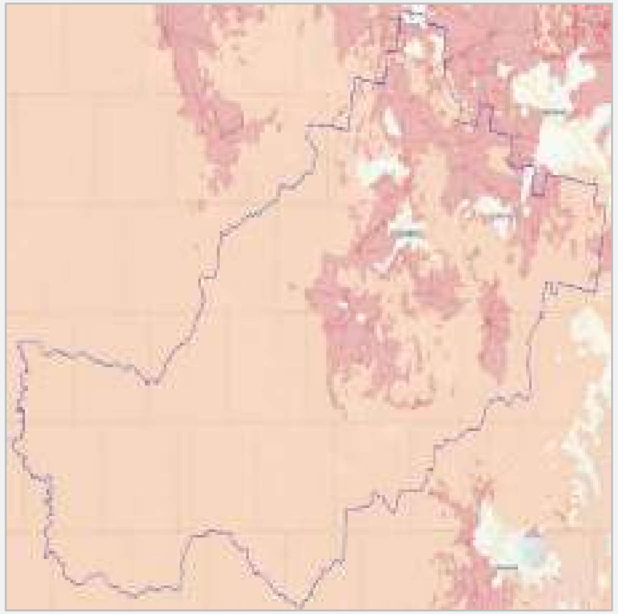
- The Cessnock region is considered a rural area, and as such, access to Fibre to the Premises is significantly limited throughout the entire region. Only a small central area of Cessnock and North Rothbury has access to this type of technology.

NBN - Fibre to the Node

Fibre to the Node

- For the remaining areas with some residences and consequently population, access to fibre is guaranteed at least up to a central node. This is the case for most of the suburbs of Cessnock, Kurri Kurri, Branxton, Greta and Pokolbin residential zone.

NBN - Fixed Wireless and Satellite



Satellite | Fixed Wireless

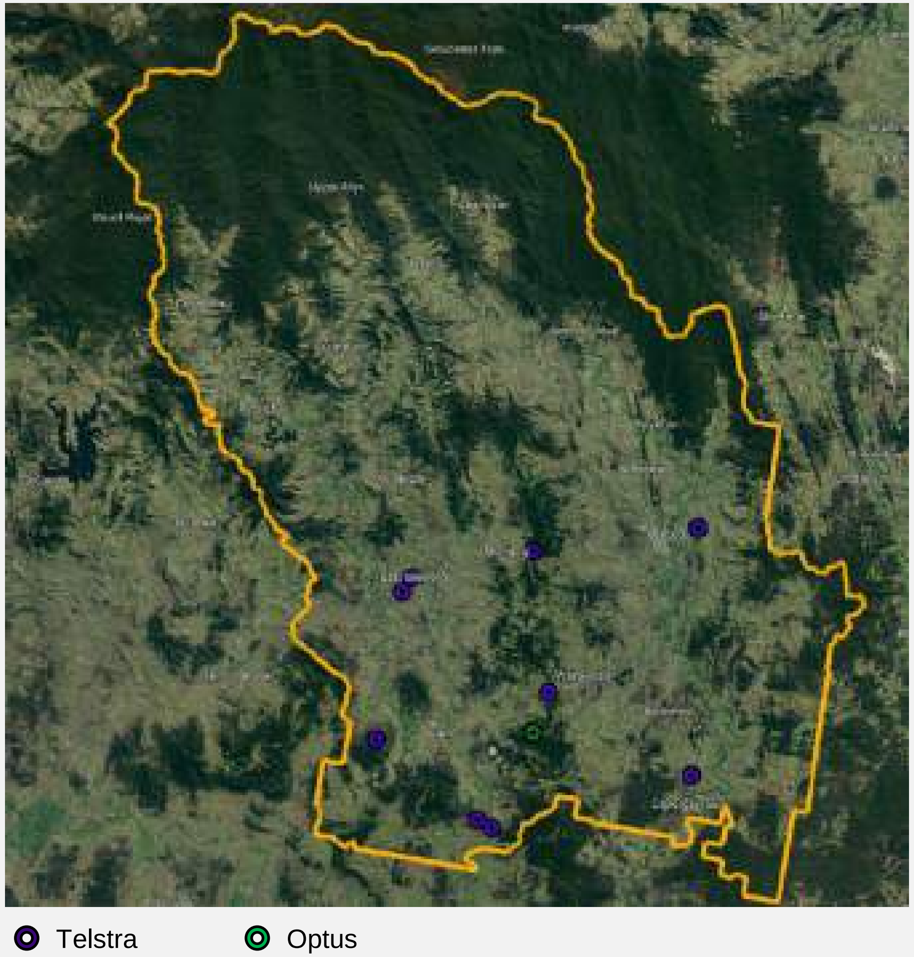
- The LGA of Cessnock is considered 100 per cent rural in terms of population. Consequently, it is natural that the NBN primarily offers network access through fixed wireless or satellite connections for the more remote areas with sparse resident population.

Technology Review - Dungog

The determination of site numbers and subsequent analysis of coverage maps provides insight into the current state of coverage for various radio technologies (3G, 4G, and 5G), identifying potential connectivity gaps. The following analysis addresses the current mobile network in the region of Dungog:

Existing Radio Mobile Sites

Mobile Operator	# of Radio Mobile Sites	# of Sites with 3G Access	# of Sites with 4G Access	# of Sites with 5G Access
Telstra	10	7	8	0
OPTUS	3	3	3	0
TPG	0	0	0	0



Analysis of Current State

- **Telstra**: 3G and 4G are available in the main residential areas of the Dungog region. There is no 5G coverage for this region.
- **Optus**: 3G and 4G are available in the residential areas of Dungog, Wallarobba, and Clarence Town. The northern area (area with lower population density) of the region has visible coverage gaps. There is no 5G coverage from Optus.
- **TPG**: There is no existence of any type of mobile base station in the Dungog region, and therefore, there is no coverage of 3G, 4G, and 5G from TPG.

Technology Review - Dungog

The examination of coverage maps from the three major operators helps to understand the distribution of radio technologies across regions and identify potential connectivity challenges. In these maps, 3G is not separately detailed, as the radio sites are co-located with 4G, and considering that 3G is planned for discontinuation throughout 2024.

Current Mobile Coverage

Telstra Mobile Coverage

Optus Mobile Coverage

TPG Mobile Coverage

4G 5G

Source: [ACCC Mobile Infrastructure Report - Coverage Maps 2023 (KML)]

Technology Review - Dungog

The analysis of coverage maps for the National Broadband Network (NBN) provides insight into the current deployment status, including fixed-line access (Fibre to the Premises and Fibre to the Node), as well as access to the network through fixed wireless and satellite. The following maps represent the current state of the Dungog region.

NBN Technology Types

NBN - Fibre to the Premises

Fibre to the Premises

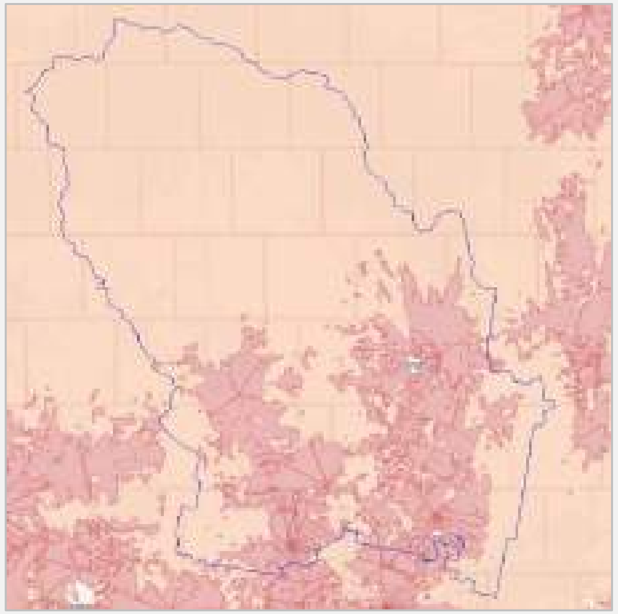
- The Dungog region is considered 100 per cent rural and has a total population of only 9,894 inhabitants. For this region, the NBN does not provide any type of access to its network through Fibre to the Premises.

NBN - Fibre to the Node

Fibre to the Node

- Fibre to the Node access is ensured in the residential zone of this Local Government Area (LGA), with the population of the suburbs of Dungog and Clarence Town having access to NBN services through this type of connection.

NBN - Fixed Wireless and Satellite



Satellite   Fixed Wireless

- Considering Dungog's status as an LGA with a vast and predominantly rural/remote area, the NBN primarily offers access to its services for Dungog through fixed wireless and satellite connections.

Technology Review - Lake Macquarie

The determination of site numbers and subsequent analysis of coverage maps provides insight into the current state of coverage for various radio technologies (3G, 4G, and 5G), identifying potential connectivity gaps. The following analysis addresses the current mobile network in the region of Lake Macquarie:

Existing Radio Mobile Sites

Mobile Operator	# of Radio Mobile Sites	# of Sites with 3G Access	# of Sites with 4G Access	# of Sites with 5G Access
Telstra	40	33	38	30
OPTUS	39	34	39	18
TPG	32	31	31	20

Analysis of Current State

- **Telstra:** 3G and 4G coverage available for the entire Lake Macquarie region. 5G coverage is well established in this region, including coverage for the Morisset area.
- **Optus:** 3G and 4G coverage available for all densely populated suburbs, including suburbs located in more outer areas like Martinsville. Regarding 5G, coverage is available for populated areas, including the suburbs of Charlestown, Belmont, Toronto, and Morisset.
- **TPG:** 3G and 4G coverage available throughout the Lake Macquarie region. 5G is also available for all suburbs with higher population density, presenting few coverage gaps.

Telstra Optus TPG

Technology Review - Lake Macquarie

The examination of coverage maps from the three major operators helps to understand the distribution of radio technologies across regions and identify potential connectivity challenges. In these maps, 3G is not separately detailed, as the radio sites are co-located with 4G, and considering that 3G is planned for discontinuation throughout 2024.

Current Mobile Coverage

Telstra Mobile Coverage

Optus Mobile Coverage

TPG Mobile Coverage

4G 5G

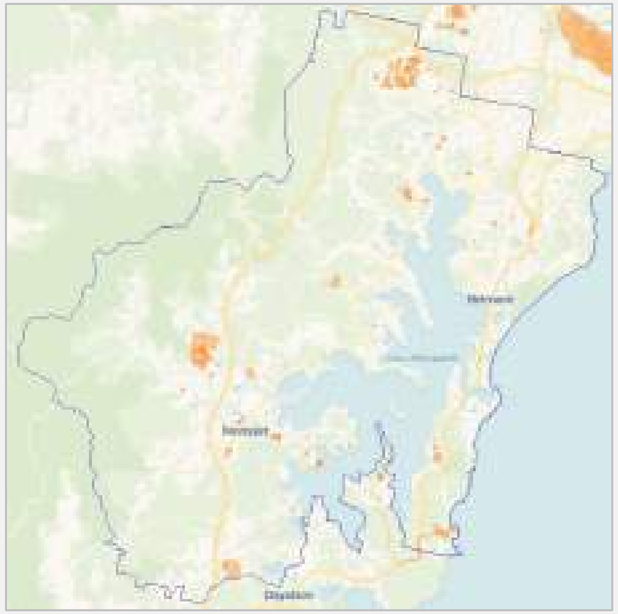
Source: ACCC Mobile Infrastructure Report - Coverage Maps 2023 (KML)

Technology Review - Lake Macquarie

The analysis of coverage maps for the National Broadband Network (NBN) provides insight into the current deployment status, including fixed-line access (Fibre to the Premises and Fibre to the Node), as well as access to the network through fixed wireless and satellite. The following maps represent the current state of the Lake Macquarie region.

NBN Technology Types

NBN - Fibre to the Premises



Fibre to the Premises

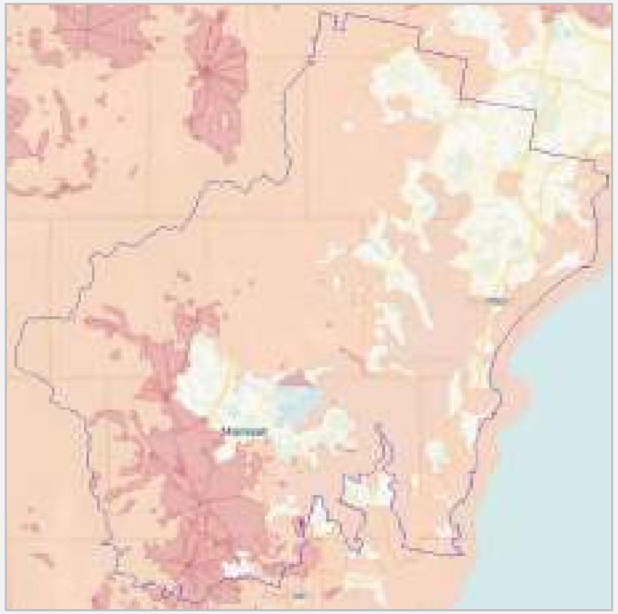
- Although the Lake Macquarie region has some population and is mostly urban, access to fibre to the premises is available only in certain residential areas of West Wall and North Cooranbong.

NBN - Fibre to the Node

Fibre to the Node

- Fibre to the Node access to the NBN network is predominantly available to all areas around the Lake, where the majority of residences and industrial sectors are located. The suburbs of Morisset, Toronto, and Charlestown have this type of access.

NBN - Fixed Wireless and Satellite



Satellite Fixed Wireless

- The areas farther away from the lake, consequently with lower population density, less tourist attraction, and fewer business opportunities, are more remote and rural. In these areas, access to the NBN network is provided through Fixed Wireless and Satellite connections.

Technology Review - Maitland

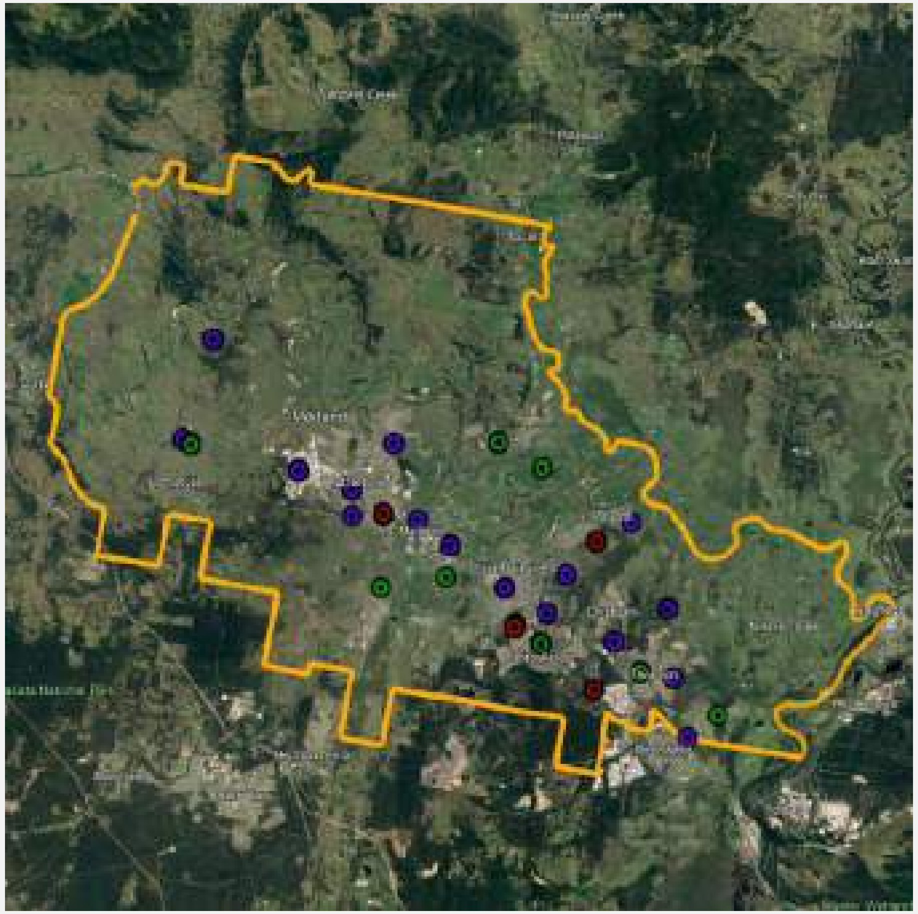
The determination of site numbers and subsequent analysis of coverage maps provides insight into the current state of coverage for various radio technologies (3G, 4G, and 5G), identifying potential connectivity gaps. The following analysis addresses the current mobile network in the region of Maitland:

Existing Radio Mobile Sites

Mobile Operator	# of Radio Mobile Sites	# of Sites with 3G Access	# of Sites with 4G Access	# of Sites with 5G Access
Telstra	22	16	21	16
OPTUS	18	15	18	3
TPG	10	10	10	1

Analysis of Current State

- **Telstra:** Complete coverage via 3G and 4G for the Maitland region. Regarding 5G, Telstra provides extensive coverage, including areas further from the centre such as Windella and the airport zone.
- **Optus:** 3G and 4G coverage available for the entire Maitland region with few gaps in the zone of Hillsborough. Concerning 5G, Optus has coverage southern zone of Maitland (Maitland Park) and East Maitland.
- **TPG:** 3G and 4G technology available for the entire Maitland region. With regard to 5G, despite TPG having only 1 5G radio site in the region (located between Maitland and Rutherford), there are other radio sites near the boundaries of the region (e.g., Greta) that provide 5G coverage, ensuring the existence of this technology throughout the Maitland, Rutherford, and East Maitland area.



Telstra Optus TPG

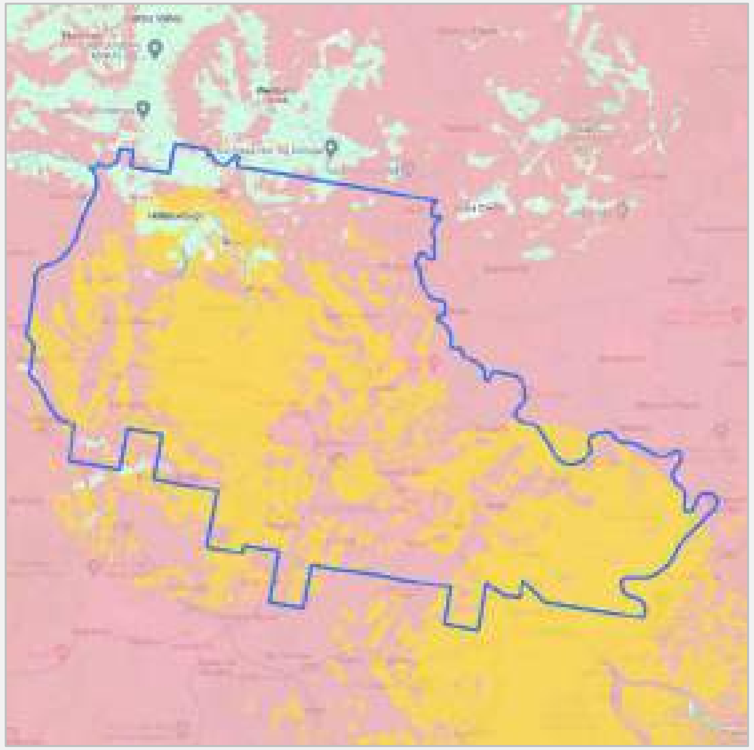
Technology Review - Maitland

The examination of coverage maps from the three major operators helps to understand the distribution of radio technologies across regions and identify potential connectivity challenges. In these maps, 3G is not separately detailed, as the radio sites are co-located with 4G, and considering that 3G is planned for discontinuation throughout 2024.

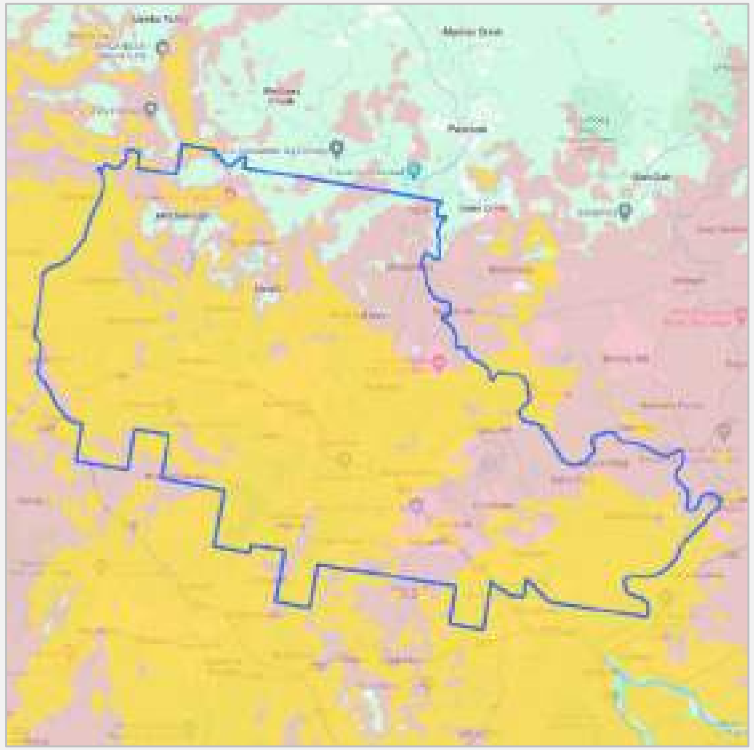
Current Mobile Coverage

Telstra Mobile Coverage

Optus Mobile Coverage



TPG Mobile Coverage



4G 5G

Source: ACCC Mobile Infrastructure Report - Coverage Maps 2023 (KML)

Technology Review - Maitland

The analysis of coverage maps for the National Broadband Network (NBN) provides insight into the current deployment status, including fixed-line access (Fibre to the Premises and Fibre to the Node), as well as access to the network through fixed wireless and satellite. The following maps represent the current state of the Maitland region.

NBN Technology Types

NBN - Fibre to the Premises

Fibre to the Premises

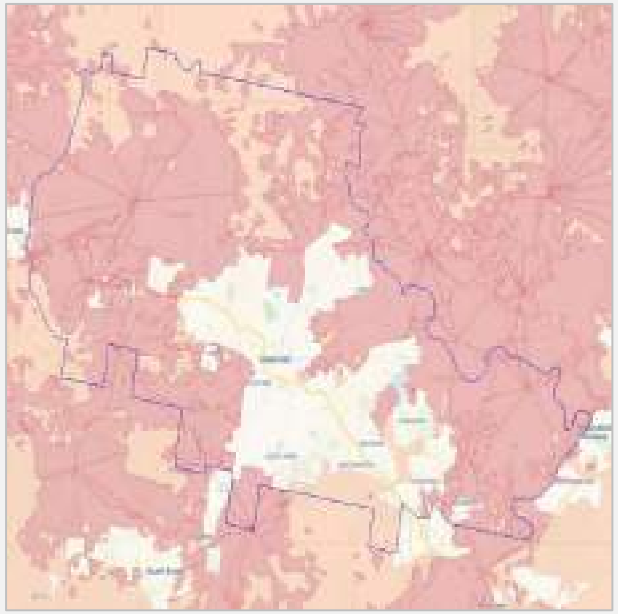
- In terms of absolute area, the Maitland region is the second smallest among the 10 regions of the DSSN. However, it is one of the largest in terms of population, and therefore, it features an extensive area with access to Fibre to the Premises, predominantly in the South and East Maitland areas.

NBN - Fibre to the Node

Fibre to the Node

- The remaining residential areas of Maitland, including less densely populated neighborhoods such as Rutherford, Thornton, and Woodberry, have access to the NBN network through Fibre to the Node.

NBN - Fixed Wireless and Satellite



Satellite Fixed Wireless

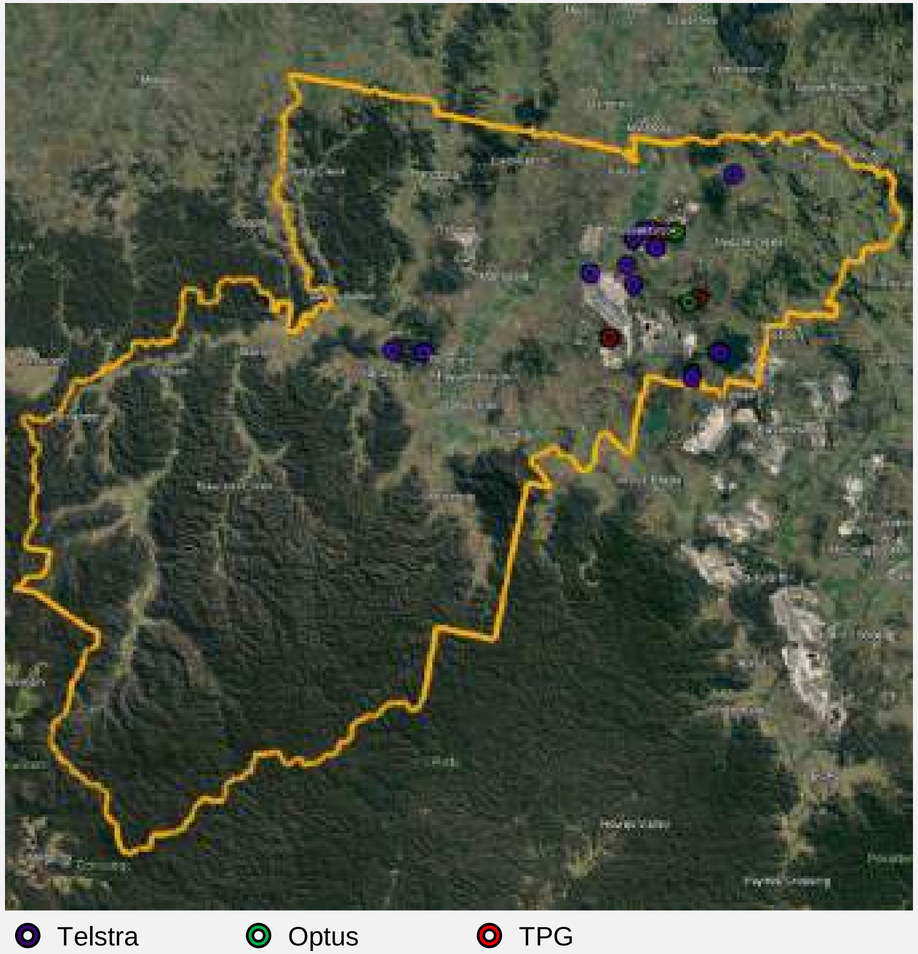
- The more remote areas of the Maitland region, consequently with less population and economic activity, have access to NBN network services through fixed wireless, and in extremely remote areas, through satellite connections.

Technology Review - Muswellbrook

The determination of site numbers and subsequent analysis of coverage maps provides insight into the current state of coverage for various radio technologies (3G, 4G, and 5G), identifying potential connectivity gaps. The following analysis addresses the current mobile network in the region of Muswellbrook:

Existing Radio Mobile Sites

Mobile Operator	# of Radio Mobile Sites	# of Sites with 3G Access	# of Sites with 4G Access	# of Sites with 5G Access
Telstra	18	10	16	2
OPTUS	7	7	7	0
TPG	3	3	2	0



Analysis of Current State

- **Telstra:** 3G and 4G coverage available for all residential and industrial areas. 5G coverage is only available in the central zone of Muswellbrook and Kayuga.
- **Optus**: 3G and 4G coverage available for densely populated areas. Areas further from the centre, such as the suburb of Martindale, may have some connectivity gaps in 3G and 4G. Optus does not have 5G radio sites within the Muswellbrook LGA. However, due to radio sites located in Aberdeen and Liddell, there may be coverage in and around these areas.
- **TPG**: 3G and 4G available for the central zone of Muswellbrook. The peripheral area, including suburbs like Denman and Wybong, may have only 3G connectivity. 5G is not available from TPG for the Muswellbrook region.

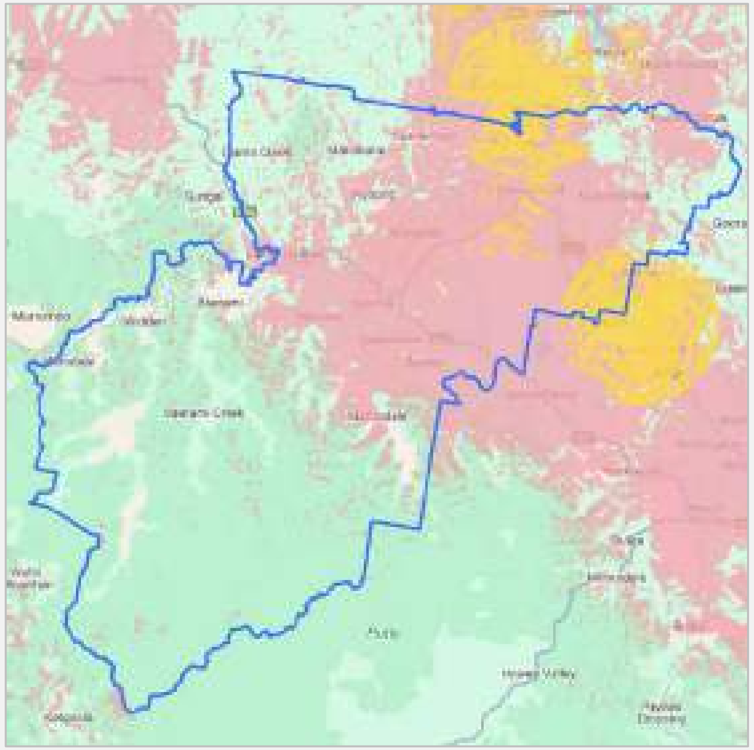
Technology Review - Muswellbrook

The examination of coverage maps from the three major operators helps to understand the distribution of radio technologies across regions and identify potential connectivity challenges. In these maps, 3G is not separately detailed, as the radio sites are co-located with 4G, and considering that 3G is planned for discontinuation throughout 2024.

Current Mobile Coverage

Telstra Mobile Coverage

Optus Mobile Coverage



TPG Mobile Coverage

4G 5G

Source: [ACCC Mobile Infrastructure Report - Coverage Maps 2023 (KML)]

Technology Review - Muswellbrook

The analysis of coverage maps for the National Broadband Network (NBN) provides insight into the current deployment status, including fixed-line access (Fibre to the Premises and Fibre to the Node), as well as access to the network through fixed wireless and satellite. The following maps represent the current state of the Muswellbrook region.

NBN Technology Types

NBN - Fibre to the Premises

Fibre to the Premises

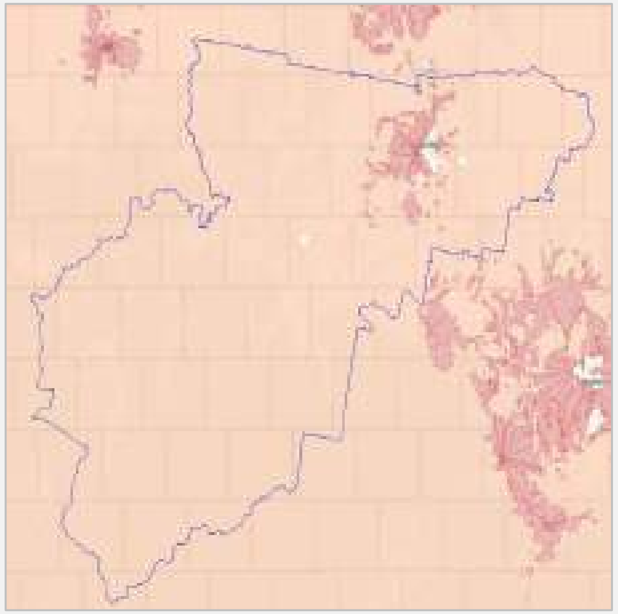
- The Muswellbrook region is considered 100 per cent rural in terms of population, and access to the NBN network through Fibre to the Premises is only available in a residential area of the city of Muswellbrook.

NBN - Fibre to the Node

Fibre to the Node

- The Muswellbrook region has a total population of only 18,154 inhabitants, all concentrated in the cities of Muswellbrook and Denman. These inhabitants have access to NBN services via Fibre to the Node.

NBN - Fixed Wireless and Satellite



Satellite | Fixed Wireless

- The Muswellbrook region is extremely rural, with a significant portion of its area covered by the Wollemi National Park. In this highly remote and mountainous region, access to the NBN network is only available via satellite.

Technology Review - Newcastle

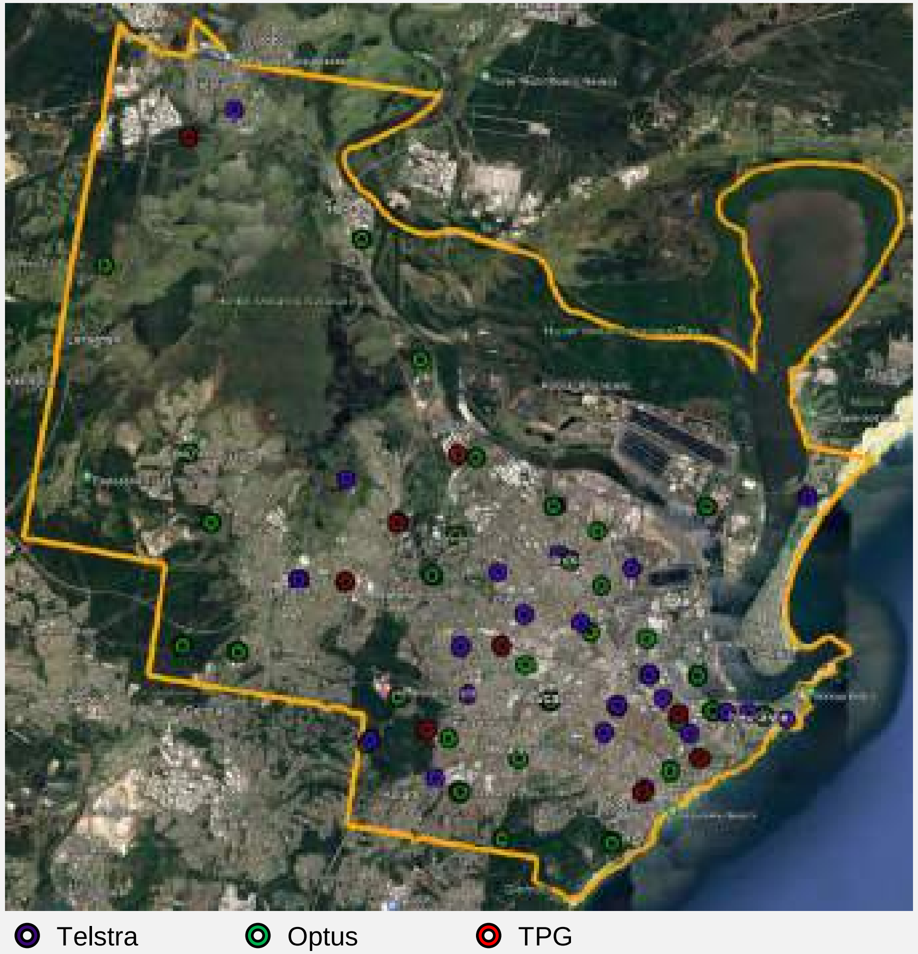
The determination of site numbers and subsequent analysis of coverage maps provides insight into the current state of coverage for various radio technologies (3G, 4G, and 5G), identifying potential connectivity gaps. The following analysis addresses the current mobile network in the region of Newcastle:

Existing Radio Mobile Sites

Mobile Operator	# of Radio Mobile Sites	# of Sites with 3G Access	# of Sites with 4G Access	# of Sites with 5G Access
Telstra	43	40	43	35
OPTUS	41	37	41	20
TPG	30	30	30	11

Analysis of Current State

- **Telstra**: 3G and 4G coverage available for the entire Newcastle region. Regarding 5G, Telstra provides coverage for densely populated areas such as the centre of Newcastle, Mayfield, Adamstown, Wallsend, and New Lambton.
- **Optus**: 3G and 4G coverage available for the entire Newcastle region. Extremely developed 5G coverage for the entire region, including the Hunter Wetland National Park, with few coverage gaps.
- **TPG**: 3G and 4G coverage available throughout the Newcastle region. Concerning 5G coverage, TPG provides coverage for populated areas, with few coverage gaps, only visible in the southern part of the suburb of Merewether.



Technology Review - Newcastle

The examination of coverage maps from the three major operators helps to understand the distribution of radio technologies across regions and identify potential connectivity challenges. In these maps, 3G is not separately detailed, as the radio sites are co-located with 4G, and considering that 3G is planned for discontinuation throughout 2024.

Current Mobile Coverage

Telstra Mobile Coverage

Optus Mobile Coverage

TPG Mobile Coverage

4G 5G

Source: ACCC Mobile Infrastructure Report - Coverage Maps 2023 (KML)

Technology Review - Newcastle

The analysis of coverage maps for the National Broadband Network (NBN) provides insight into the current deployment status, including fixed-line access (Fibre to the Premises and Fibre to the Node), as well as access to the network through fixed wireless and satellite. The following maps represent the current state of the Newcastle region.

NBN Technology Types

NBN - Fibre to the Premises

Fibre to the Premises

- The Newcastle region has the highest population density among all DSSN regions, making it expected that access to NBN network services for residents and industrial sectors is primarily through fibre. The suburbs of Mayfield and Waratah have access to Fibre to the Premises.

NBN - Fibre to the Node

Fibre to the Node

- The remaining residential and industrially active economic zones in Newcastle have access to Fibre to the Node for NBN services, ensuring a robust and high-speed network connection for both residential and business sectors in the densely populated Newcastle region.

NBN - Fixed Wireless and Satellite

Satellite   Fixed Wireless

- Due to its high population, the Newcastle region provides access through fibre to the majority of the area. Only the area around the Hunter Wetlands National Park needs to rely on fixed wireless access to the NBN network services.

Technology Review - Port Stephens

The determination of site numbers and subsequent analysis of coverage maps provides insight into the current state of coverage for various radio technologies (3G, 4G, and 5G), identifying potential connectivity gaps. The following analysis addresses the current mobile network in the region of Port Stephens:

Existing Radio Mobile Sites

Mobile Operator	# of Radio Mobile Sites	# of Sites with 3G Access	# of Sites with 4G Access	# of Sites with 5G Access
Telstra	28	23	27	13
OPTUS	31	26	31	10
TPG	20	20	20	4

Analysis of Current State

- **Telstra**: 3G and 4G coverage available for the entire Port Stephens region. Regarding 5G coverage, Telstra provides coverage for the Medowie and Raymond Terrace regions, Fingal Bay, and Nelson Bay. Shoal Bay currently does not have complete 5G coverage.
- **Optus**: 3G and 4G coverage is available for the entire Port Stephens region. 5G coverage is available for the suburb of Medowie, the bays of Salamander, Anna, Fingal, Nelson and Shoal.
- **TPG**: 3G and 4G coverage available in all residential areas of the Port Stephens region. Regarding 5G technology, TPG provides coverage in the Medowie area and areas of the bays of Salamander, Anna, and Nelson Bay. Shoal Bay and Fingal Bay may have some connectivity gaps in relation to 5G.

Telstra Optus TPG

Technology Review - Port Stephens

The examination of coverage maps from the three major operators helps to understand the distribution of radio technologies across regions and identify potential connectivity challenges. In these maps, 3G is not separately detailed, as the radio sites are co-located with 4G, and considering that 3G is planned for discontinuation throughout 2024.

Current Mobile Coverage

Telstra Mobile Coverage

Optus Mobile Coverage

TPG Mobile Coverage

4G 5G

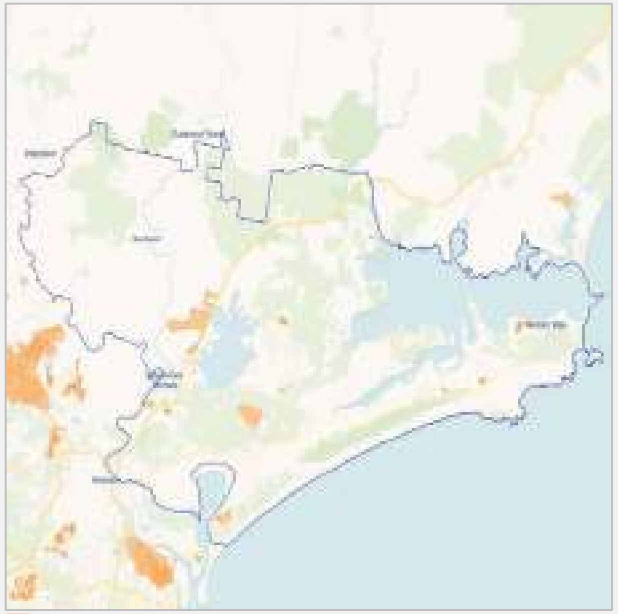
Source: ACCC Mobile Infrastructure Report - Coverage Maps 2023 (KML)

Technology Review - Port Stephens

The analysis of coverage maps for the National Broadband Network (NBN) provides insight into the current deployment status, including fixed-line access (Fibre to the Premises and Fibre to the Node), as well as access to the network through fixed wireless and satellite. The following maps represent the current state of the Port Stephens region.

NBN Technology Types

NBN - Fibre to the Premises



Fibre to the Premises

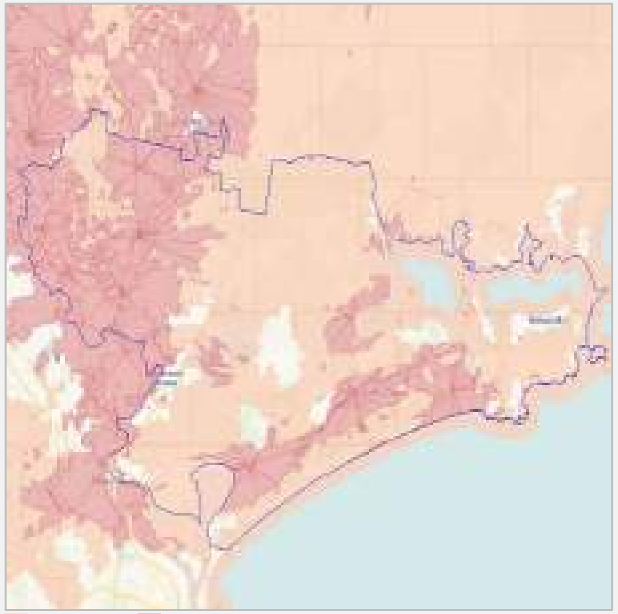
- The Port Stephens area is mostly rural, naturally lacking an extensive coverage in terms of access to NBN services through Fibre to the Premises. This type of access is available in the suburb of Corlette and on the outskirts of Eagleton.

NBN - Fibre to the Node

Fibre to the Node

- The residential areas of Port Stephens mostly have access to the NBN network through Fibre to the Node. This type of access is available in the more populated suburbs such as Medowie, Nelson Bay, and Shoal Bay.

NBN - Fixed Wireless and Satellite



Satellite Fixed Wireless

- Due to the Port Stephens region concentrating its population around the Karuah River and its bay, it is natural that the more remote areas are characterised as rural. In places like Wallaroo and Medowie Park, access to the NBN network is provided through fixed wireless or satellite connections.

Technology Review - Singleton

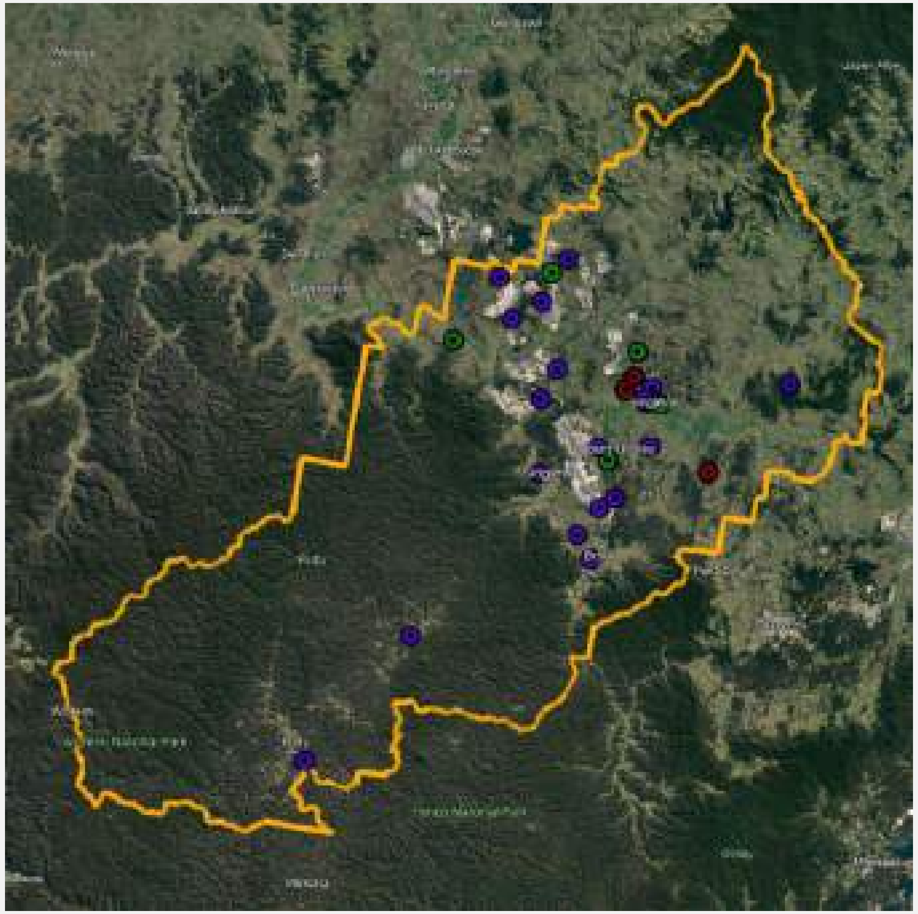
The determination of site numbers and subsequent analysis of coverage maps provides insight into the current state of coverage for various radio technologies (3G, 4G, and 5G), identifying potential connectivity gaps. The following analysis addresses the current mobile network in the region of Singleton:

Existing Radio Mobile Sites

Mobile Operator	# of Radio Mobile Sites	# of Sites with 3G Access	# of Sites with 4G Access	# of Sites with 5G Access
Telstra	25	19	21	7
OPTUS	9	9	9	1
TPG	5	5	5	0

Analysis of Current State

- **Telstra**: 4G coverage for the entire Singleton region. Remote suburbs like Putty and Garland Valley situated in the mountainous zone have access to 3G. Regarding 5G, Telstra provides coverage for the entire populated area of Singleton
- **Optus**: 3G and 4G coverage available for populated and industrial areas of Singleton. Concerning 5G, Optus only has one base station providing 5G coverage, located to the north, and does not guarantee coverage for the populated area of Singleton.
- **TPG**: 3G and 4G coverage available for the densely populated areas of the Singleton region. Regarding 5G technology, TPG does not have any base station in the Singleton region.



Telstra Optus TPG

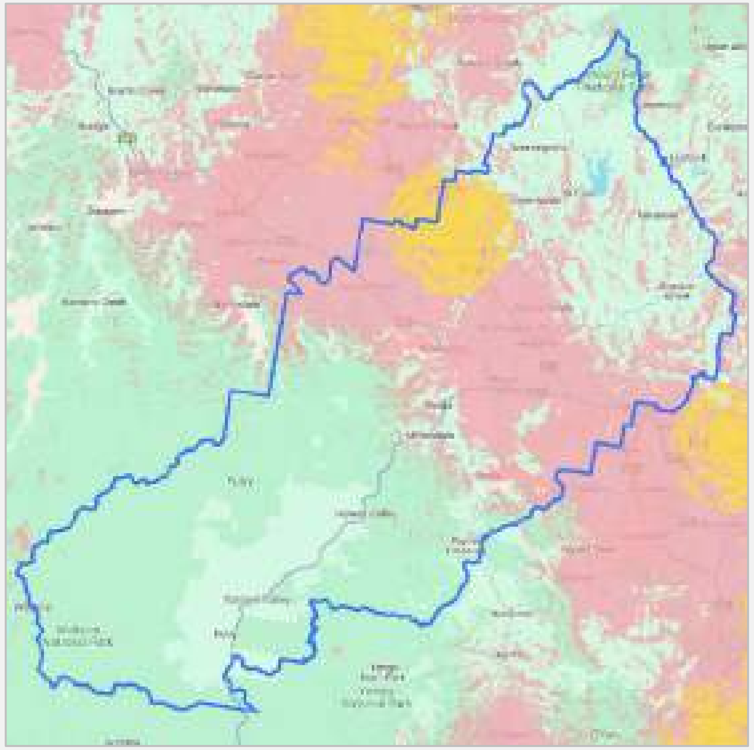
Technology Review - Singleton

The examination of coverage maps from the three major operators helps to understand the distribution of radio technologies across regions and identify potential connectivity challenges. In these maps, 3G is not separately detailed, as the radio sites are co-located with 4G, and considering that 3G is planned for discontinuation throughout 2024.

Current Mobile Coverage

Telstra Mobile Coverage

Optus Mobile Coverage



TPG Mobile Coverage

4G 5G

Source: [ACCC Mobile Infrastructure Report - Coverage Maps 2023 (KML)]

Technology Review - Singleton

The analysis of coverage maps for the National Broadband Network (NBN) provides insight into the current deployment status, including fixed-line access (Fibre to the Premises and Fibre to the Node), as well as access to the network through fixed wireless and satellite. The following maps represent the current state of the Singleton region.

NBN Technology Types

NBN - Fibre to the Premises

Fibre to the Premises

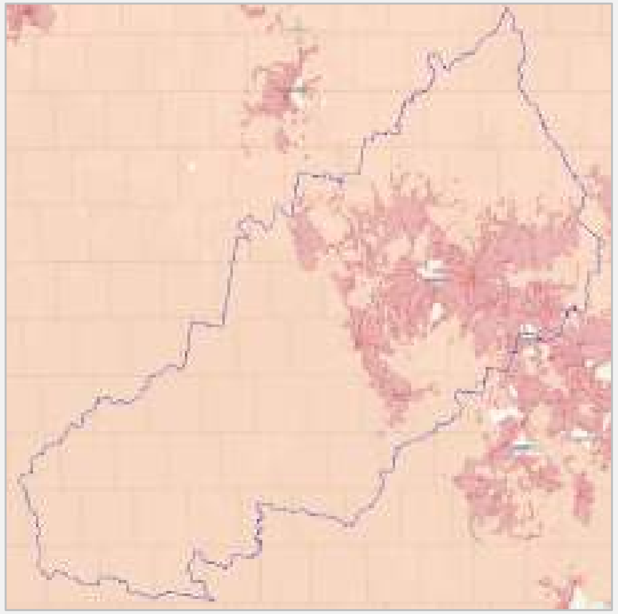
- The Singleton region is another area considered extremely rural, where access via Fibre to the Premises is only available in a limited part of the city of Singleton.

NBN - Fibre to the Node

Fibre to the Node

- Singleton is a region with a relatively low population of around 23 thousand inhabitants, most of whom reside in the centre of Singleton. For the majority of the populated areas, access to the NBN network is available through Fibre to the Node.

NBN - Fixed Wireless and Satellite



Satellite　Fixed Wireless

- The Singleton region is the second-largest with 4,893 km^2, however, a significant portion of this area is covered by the Wollemi National Park, where access to the NBN network is available via satellite. The more dispersed suburbs around Singleton with lower population have access through fixed wireless.

Technology Review - Upper Hunter

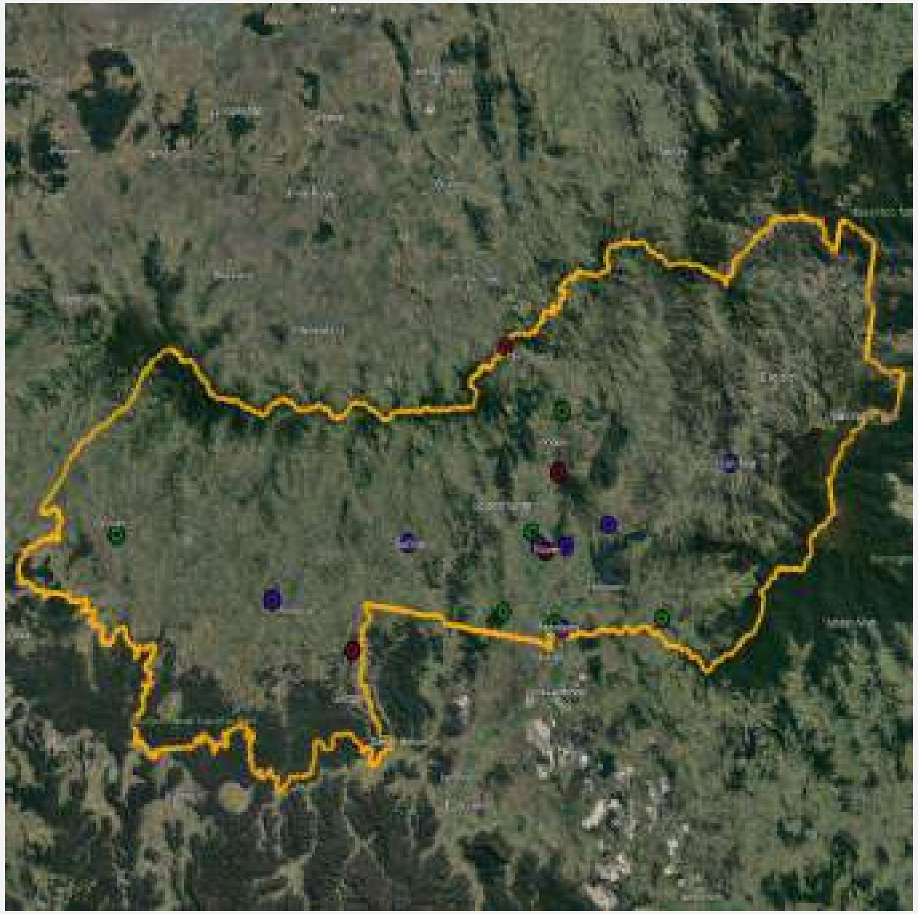
The determination of site numbers and subsequent analysis of coverage maps provides insight into the current state of coverage for various radio technologies (3G, 4G, and 5G), identifying potential connectivity gaps. The following analysis addresses the current mobile network in the region of Upper Hunter:

Existing Radio Mobile Sites

Mobile Operator	# of Radio Mobile Sites	# of Sites with 3G Access	# of Sites with 4G Access	# of Sites with 5G Access
Telstra	12	9	12	3
OPTUS	8	7	8	1
TPG	4	4	2	0

Analysis of Current State

- **Telstra**: 3G and 4G coverage available for the populated area. Telstra ensures 4G coverage for more remote areas like Cassilis, Merriwa, and Moonan Plat, where it has base stations. Regarding 5G coverage, it exists in the more populated suburbs (Scone and Aberdeen)
- **Optus**: 3G and 4G coverage available for the populated areas of Upper Hunter. Concerning 5G, Optus has installed a base station in Aberdeen, ensuring coverage of this technology in that suburb.
- **TPG**: 3G and 4G coverage for the main populated suburbs of Upper Hunter. In terms of 4G, there may be gaps in coverage in the Wingen and Gundy areas. TPG does not currently have 5G deployed in the Upper Hunter region.



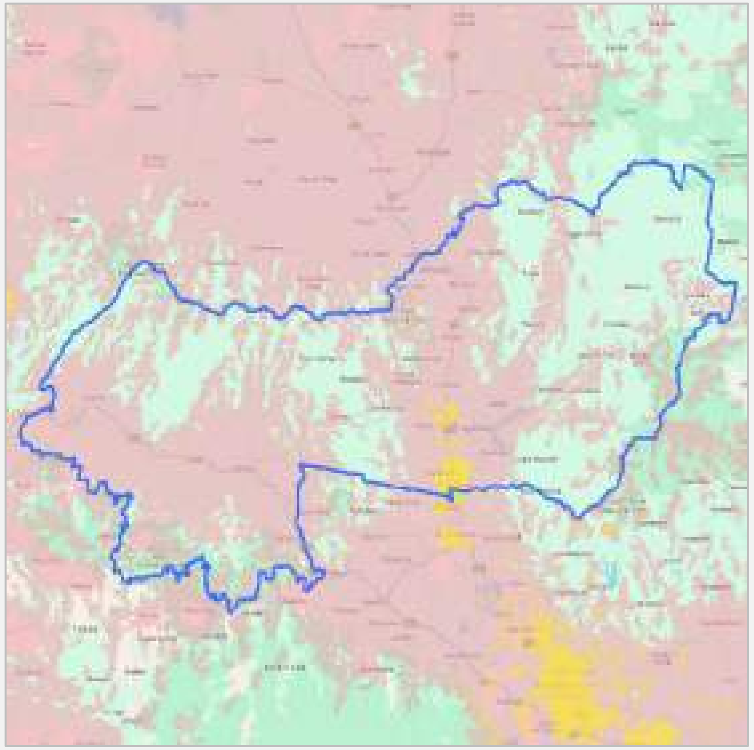
Telstra Optus TPG

Technology Review - Upper Hunter

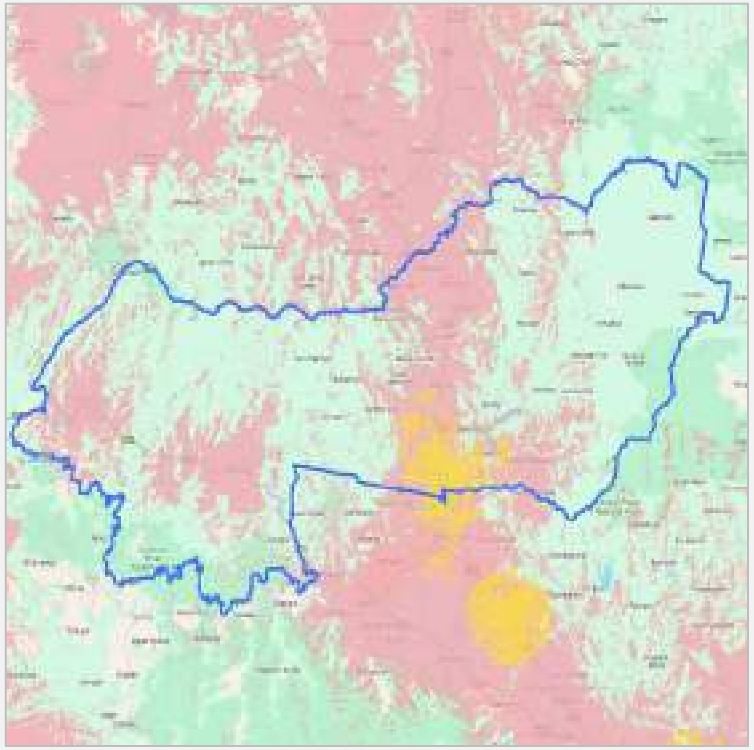
The examination of coverage maps from the three major operators helps to understand the distribution of radio technologies across regions and identify potential connectivity challenges. In these maps, 3G is not separately detailed, as the radio sites are co-located with 4G, and considering that 3G is planned for discontinuation throughout 2024.

Current Mobile Coverage

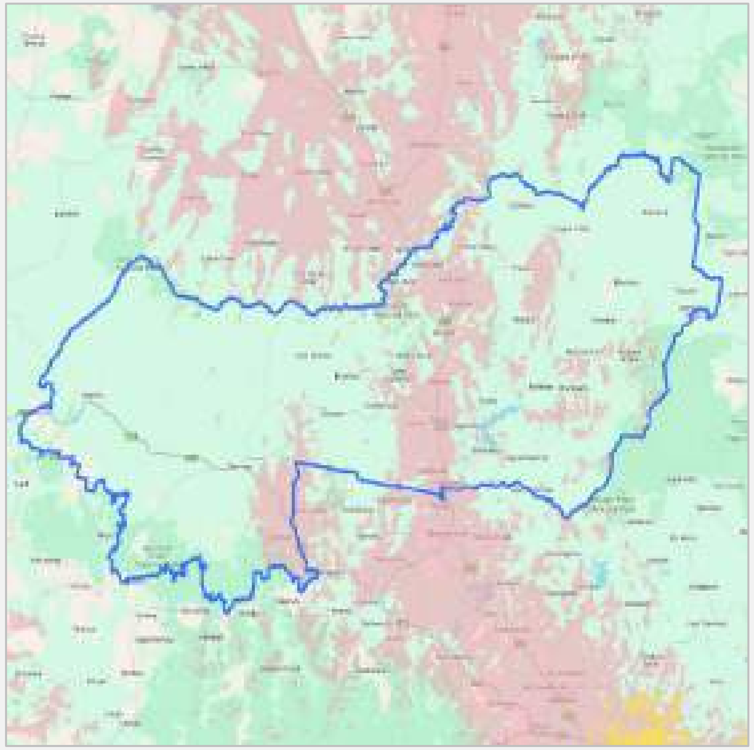
Telstra Mobile Coverage



Optus Mobile Coverage



TPG Mobile Coverage



4G 5G

Source: ACCC Mobile Infrastructure Report - Coverage Maps 2023 (KML)

Technology Review - Upper Hunter

The analysis of coverage maps for the National Broadband Network (NBN) provides insight into the current deployment status, including fixed-line access (Fibre to the Premises and Fibre to the Node), as well as access to the network through fixed wireless and satellite. The following maps represent the current state of the Upper Hunter region.

NBN Technology Types

NBN - Fibre to the Premises

Fibre to the Premises

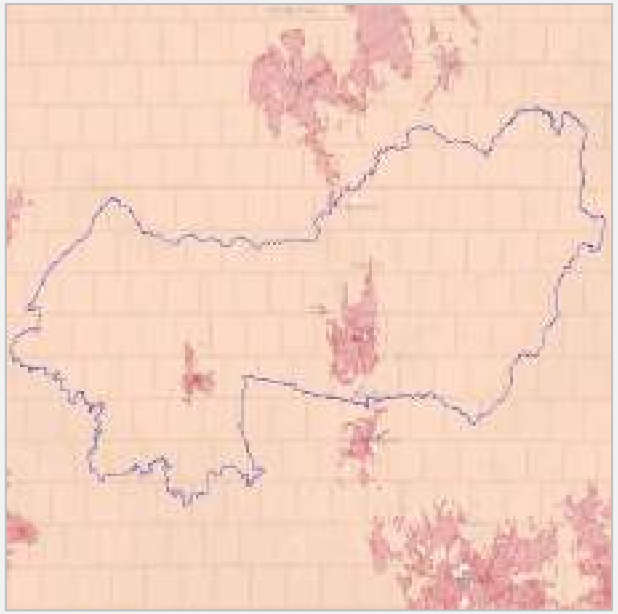
- The Upper Hunter region is considered 100 per cent rural, and due to its extensive area and low population concentration spread across different zones, it does not have access to the NBN network through Fibre to the Premises.

NBN - Fibre to the Node

Fibre to the Node

- The extensive area of Upper Hunter has its population primarily distributed across three main suburbs: Scone, Murrurundi, and Aberdeen. For these cities, access to the NBN network is ensured through Fibre to the Node.

NBN - Fixed Wireless and Satellite



Satellite Fixed Wireless

- The Upper Hunter is an area with extensive forested and remote areas where there is no presence of population and associated industrial activity. In these zones, access to the NBN network is exclusively through satellite connection.

Emerging technologies and trends in telecommunications infrastructure

Technology Review - Mobile Black Spot Program (MBSP)

The Mobile Black Spot Program, launched by the Australian Government, addresses the challenge of limited mobile coverage in rural and remote areas. The initiative focuses on creating and upgrading mobile infrastructure to improve communication and connectivity in underserved regions.

Mobile Black Spot Program

- The Mobile Black Spot Program, a government initiative, has significantly **improved mobile connectivity across the 10 DSSN regions.** Some of the regions faced **limited mobile coverage, hindering communication and access to essential services**, and the program was designed to overcome these challenges, ensuring residents and businesses have **access to reliable mobile networks**.
- The program was created with the following **objectives**:
    - **Improve Emergency Services**: Enhance emergency communication, providing critical support during disasters and ensuring a timely response from authorities.
    - **Boost Local Economies**: Stimulate economic growth by facilitating communication, online transactions, and business operations.
    - **Enhance Quality of Life**: Residents benefit from improved connectivity for daily activities, education, healthcare, and overall improved well-being.
- The program encompasses a total of **7 rounds of action** and has generated a total investment of more than $1 billion to deliver up to 1,400 new mobile base stations across Australia. **For the 10 DSSN regions, this is the current status of the mobile sites** included in this program:

Region	# of Mobile Sites (Completed)	# of Mobile Sites (In Progress)	Total
Central Coast	7	5	12
Dungog	3	0	3
Singleton	3	0	3
Lake Macquarie	0	2	2
Cessnock	0	1	1
Muswellbrook	1	0	1
Port Stephens	1	0	1
Upper Hunter	1	0	1
Maitland	0	0	0
Newcastle	0	0	0

Completed In Progress

Additional Technologies and Network Providers – Fixed Wireless Access

The absence of terrestrial connectivity, be it through fixed or mobile access, poses a significant hurdle in remote areas. This is where Fixed Wireless Access (FWA) technology comes into play—an evolving solution with the potential to offer internet access to any isolated zone, fostering communication and connectivity.

Fixed Wireless Access (FWA) - Definition

FWA technology employs ground-based wireless stations for internet connectivity in remote areas. These stations create a stable link to a nearby wireless base, delivering reliable, high-speed internet without the necessity of traditional wired infrastructure.

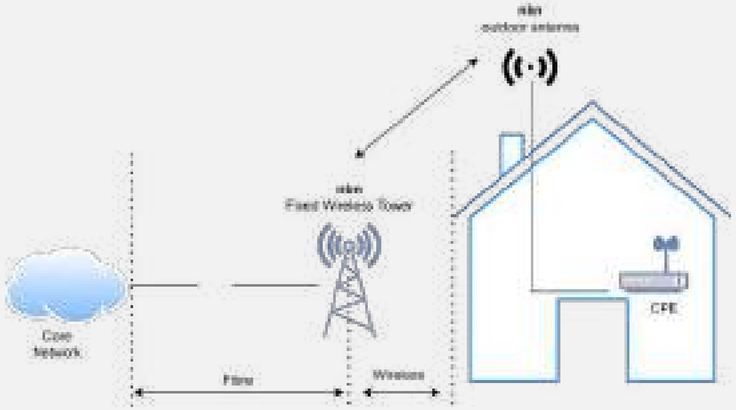
Main Advantages:

- **Remote Accessibility:** FWA extends internet access to remote areas where traditional infrastructure is challenging.
- **Quick Deployment:** FWA systems can be rapidly set up, making them efficient for major events, emergency situations or areas undergoing rapid development.
- **Scalability:** FWA networks can be easily scaled to accommodate growing demand by adding more base stations or upgrading existing infrastructure, providing flexibility to expand coverage areas as needed.

Current Initiatives and Deployment in Australia

- The Australian government has invested a total of $480 million in the NBN Fixed Wireless Network, with NBN contributing an additional $270 million to deliver faster wholesale speeds for regional Australia. NBN Co will use the funding to enable 5G on its network of more than 2,200 Fixed Wireless infrastructure sites and more than 22,000 cells in semi-rural areas and across regional and remote Australia.
- Ericsson and NBN Co have established a ten-year partnership aimed at providing fixed wireless access to 120,000 homes currently only served by satellite, joining over 650,000 premises with FWA currently across Australia.

Fixed Wireless Access (FWA) - Architecture



- **Customer Premises Equipment (CPE):** This is the equipment installed at the user's location, such as a home or business. It includes a wireless transceiver or modem that communicates with the base station.
- **FWA Outdoor Antenna:** The outdoor antenna is located on a fixed infrastructure point, often a tower or tall structure. It communicates with the CPE and serves as the central hub for wireless connectivity in a specific coverage area.
- **FWA Wireless Tower:** A FWA (Fixed Wireless Access) Wireless Tower is a tall structure or infrastructure point designed to transmitting signals to and receiving signals from FWA Outdoor Antennas. These towers are strategically placed to optimize coverage and connectivity within a specific geographic area, providing wireless internet access to users within its range.
- **Core Network:** The core network handles the overall management of the FWA system. It includes components like routers, switches, and servers that route data between the FWA network and the broader internet.

Additional Technologies and Network Providers - LEO Satellites

The lack of terrestrial connectivity, whether through fixed or mobile access, is often a challenge in remote areas. This is where Low-Earth Orbit Satellites (LEO) technology comes into play - an emerging solution capable of providing internet access to any remote zone and facilitating communication.

Low Earth Orbit Satellites (LEO) - Definition

LEO satellites function by orbiting the Earth at high velocities, enabling them to complete an orbit in a relatively brief timeframe, usually ranging from 90 to 120 minutes. Their proximity to Earth facilitates accelerated communication and minimised signal latency.

Main Advantages:

- **Low Latency:** LEO satellites offer low-latency communication due to their proximity to Earth, important for applications requiring real-time data transmission
- **High Data Throughput:** The relatively short distance between LEO satellites and user equipment allows for higher data transfer rates enabling faster download and upload speeds.
- **Global Coverage:** LEO satellites can provide global coverage, reaching remote and underserved areas where traditional communication infrastructure is challenging to deploy.

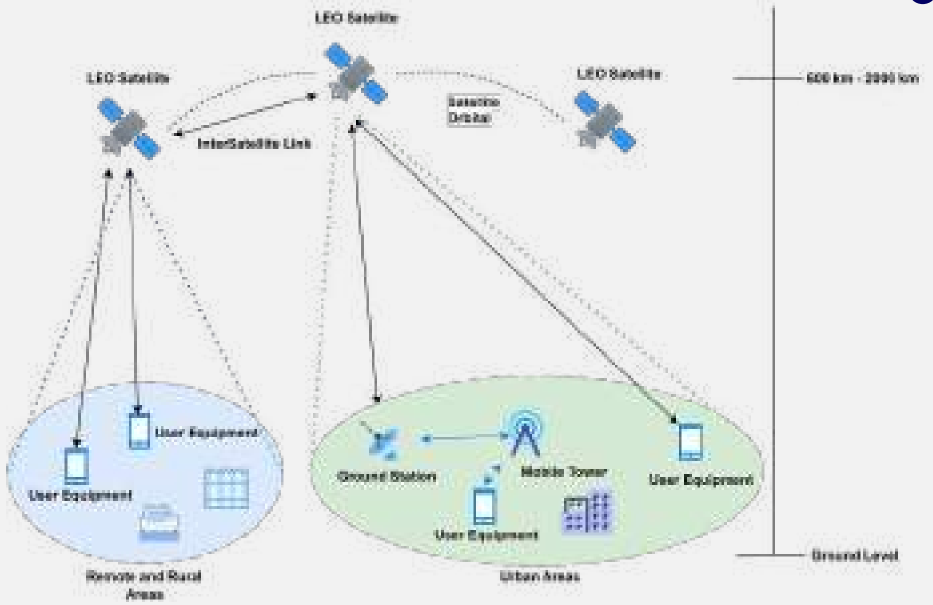
Current Initiatives and Deployment in Australia

Telstra and OneWeb have reached an agreement with the intention to transition hundreds of existing remote mobile base stations from satellite backhaul to OneWeb's LEO solution. The goal is to deliver up to 25 Gbit/s of LEO capacity, enhancing the mobile experience for Telstra's remote customers.

Optus, in collaboration with Lynk, conducted a live demonstration showcasing satellite direct-to-mobile technology. The demonstration involved connecting a standard mobile phone directly to Lynk's satellite mobile base station in orbit, enabling the sending and receiving of text messages via the Optus network

Starlink is currently available in Australia, providing connectivity in the most rural areas using this type of satellite technology. Future implementations are envisioned, such as the direct-to-cell technology, where a device communicates directly with the satellite.

Low Earth Orbit Satellites (LEO) - Architecture



- **User Equipment**: Industrial or individual devices or systems used by end-users to communicate with or access services provided by LEO satellites
- **Ground Station**: A terrestrial facility equipped with antennas and communication equipment that communicates with LEO satellites, serving as a point of contact between the satellites and the wider communication network.
- **LEO Satellite:** Satellites that orbit the Earth at altitudes typically ranging from around 600 to 2,000 kilometers, exhibiting short orbital periods and lower latency compared to satellites in higher orbits.

Additional Technologies and Network Providers - Starlink

Starlink is providing additional options for broadband connectivity at increasingly accessible rates, with new capabilities on the roadmap in 2024 (SMS) and 2025 (voice and data).

What is Starlink?

- Starlink is a private satellite internet service aimed at delivering high-speed broadband to customers globally who lack access to a reliable internet connection through existing technologies. In Australia, where NBN (National Broadband Network) services utilise fixed wireless and satellite technologies, Starlink is positioned to compete in the satellite access market.
- According to data provided by Optus, a partnering operator with Starlink, Optus asserts a 98.5 per cent mobile coverage guarantee for the Australian population. However, due to Australia's extensive scale and topography, mobile networks can only cover one-third of the country's landmass. In this scenario, Starlink, with its Direct to Cell technology, becomes essential, ensuring complete coverage across the entire Australian territory.

Technical Characteristics

Download Speed
20-100 Mbps

Latency
25-50 milliseconds

Availability

SMS
Late 2024

Voice and Data
Late 2025

Coverage

- According to the coverage map provided by Starlink, this technology/service is currently available throughout Australia, including the most remote areas, as it is a satellite-based service.

Source: Starlink Coverage Map

Additional Technologies and Network Providers - Cell on Wheels

The Cell on Wheels (CoW) is a mobile tower that can be deployed and installed in emergency situations or at large events, providing additional coverage and capacity to maintain communications and allow users access to the network.

Cell on Wheels Characterization

General Description

Cell on Wheels (COWs) are mobile telecommunications towers designed to provide temporary network coverage and capacity in various situations, including emergency response, special events, and remote locations. Major mobile network operators and NBN deploy COWs to address different communication needs.

While operators primarily use COWs to ensure capacity and coverage during events, NBN's COWs are mainly utilized in emergency situations. They are equipped with an NBN™ Sky Muster™ satellite dish, allowing them to provide emergency workers and evacuated residents with valuable Wi-Fi connections..

Main Advantages

Enhanced Capacity: COWs can help alleviate network congestion by providing additional capacity, ensuring that users have access to reliable and high-speed connectivity, even in densely populated areas or during peak usage periods.

Rapid Deployment: COWs can be quickly transported and set up, allowing for rapid deployment in emergency situations or at temporary events where immediate coverage is required.

Flexibility: COWs can support various wireless technologies and frequency bands, providing flexibility to adapt to different network requirements and standards.

Technical Specifications: Antenna Height, Coverage Radius, Capacity, Connectivity*

Antenna Height: 20 meters

Maximum height of 20 meters for each antenna, making this solution more adaptable for flat terrain

Coverage Radius: 5km

Depending on the terrain's topography, a CoW solution can cover up to 5 km

Capacity: ~350 simultaneous users

General capacity to support 350 active users (1750 people) considering a 20% of access in busy hour up to a maximum time of 72 hours

Connectivity: Access and Backhaul

Access: Mobile Access and Satellite (SatCOLT)
Backhaul: Satellite

Approx. Cost:**

Regular CoW: ~ $500,000

Satellite CoW (SatCOLT): ~ $750,000

*__Note 1__: The technical specifications of COWs may vary depending on the type of access technology and the specific type of COW used by the provider.
**__Note 2:__ The cost approximation is based on average prices from a North American emergency network provider.

Additional Technologies and Network Providers - Multi-Tenant WLAN

Implementing a multi-tenant WLAN (Wireless Local Area Network) consolidates multiple tenants or users onto a shared wireless infrastructure, enabling optimization and sharing of resources such as network bandwidth, hardware, and management overhead among multiple users or entities.

Multi-Tenant WLAN

General Description

- A multi-tenant WLAN (Wireless Local Area Network) is a wireless network infrastructure that serves multiple tenants or users within a certain area. In a multi-tenant WLAN setup, the WLAN infrastructure is designed to efficiently manage and segregate network traffic from different tenants or users to ensure security, performance, and quality of service.

Main Advantages

Network Allocation: **I**n high-demand scenarios, the WLAN infrastructure can dynamically allocate resources based on the needs of each tenant or user. This can involve prioritizing bandwidth for critical applications or users while ensuring fair access for all tenants.

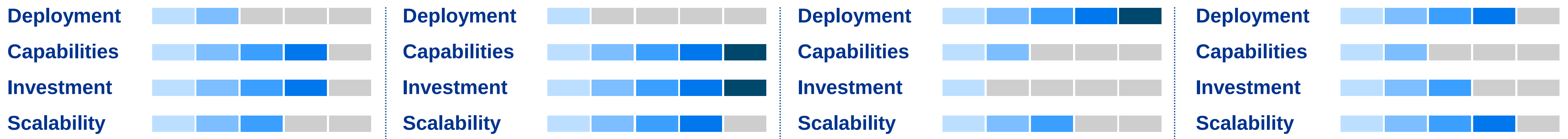
Scalability: Multi-tenant WLAN architectures are designed to scale easily to accommodate increasing numbers of users or devices. Additional access points can be deployed as needed to expand coverage and capacity without compromising performance.

Business Model Comparison

	Standalone	Partnership
Infrastructure	• In this option a single organisation will provide the all radio access system to support the multi tenant WLAN offer	• Partnership where broadband provider supply the upfront costs to cover regions and areas that still do not have fibre
Distribution Channels	• Broadband provider has control over distribution strategies and channels, allowing for targeted marketing and sales efforts.	• The Distribution channel is supported by the carriers/ MNO targeting business media
Support	• Broadband provider has full control over support policies, response times, and service quality. • Pre and post-sale costumer service support	• Client facing supported by partner • Network airtime SLA between parties (Broadband and partner)
Demand & Supply	• Demand and supply are primarily driven by the broadband provider’s own requirements and market dynamics.	• Demand and supply considerations involve coordination among partners to ensure adequate resources and support for shared infrastructure.

Additional Technologies and Network Providers - Summarisation

The following summarisation, encompassing various additional technologies, allows for the identification of common patterns, challenges, and opportunities across multiple technologies, leading to more informed strategic planning.



	Fixed Wireless Access (FWA)	Low-Earth-Orbit (LEO) Satellites	Cell on Wheels (CoW)	Multi-Tenant WLAN
Deployment	Solution already **widely existing in the region**, it can be an alternative with medium effort deployment (through outdoor antennas) in areas that are currently covered by this technology.	Solution **with a high complexity** in terms of deployment. To integrate a solution based on LEO satellites, it is necessary to consider the **coordination of multiple satellites** in low orbit and the respective configurations.	Solution that presents the **lowest complexity in terms of deploy**ment, due to the **simple and rapid installation**, and its ability to be easily adapted to different types of access technology.	Relative accelerated set-up considering the existence of **collocated infrastructure with carriers and by accessing to their competitive position** in the market (current portfolio, and overall brand awareness)
Capabilities	Offers moderate capabilities in terms of speed, reliability, and coverage. **The NBN is improving speeds up to 250 Mbps** and ensuring at least **50 Mbps** during **busy hours**.	**Provides high-speed internet** access with **low latency**, making it suitable for a wide range of applications and users, **available anywhere** due to its **extensive coverage**.	Assurance of capacity and coverage in pre-selected areas, it can establish **connections in emergency situations or sporadic events** that require a **high** network capacity.	Offers **robust capabilities** in providing wireless connectivity to **multiple tenants** within shared spaces, with features such as security, scalability, and quality of service.
Investment	**Considerable investment** is required to build and maintain fixed wireless infrastructure, including towers, antennas, and backhaul links, however Australian government and NBN are **investing in this technology ($750,000).**	**High investment** required, due to the complexity of the solution and its specific maintenance, requiring significant resources for both initial implementation and ongoing operation.	**Low investment**, as it is a relatively inexpensive solution compared to others, and does not **incur significant maintenance or partnership** costs.	Technical and **commercial investment quite balanced compared with other solutions**, though being necessary to guarantee the contracted SLAs with the partners
Scalability	**Medium scalability**, as the solution can be easily adopted, it consistently **depends on the existence of infrastructure** to ensure this access.	**High scalability** to serve a large number of users across vast geographical areas without significant infrastructure expansion.	**Medium scalability**, as despite being a highly mobile solution, it is **dependent on the existing infrastructure** for connection to the network core.	**High scalability**, since there is access to partner's existing customers seeking for **better capacity** and additionally the new businesses that a strong brand as the partner's may bring

Private Network Solutions - Private 5G Solution

Private 5G solutions redefine regional connectivity by offering dedicated, high-performance mobile networks tailored to accommodate peak demand scenarios.

Private 5G Solution

General Description

- A private 5G solution enhances the opportunity to deploy a dedicated, high-performance mobile network customized to meet specific requirements, empowering organizations to leverage the complete capabilities of 5G technology based on the network demands and expected usage across different regions or areas. This allows for precise adaptation of the network infrastructure to suit varied operational needs and optimize performance across diverse environments

Main Advantages

Performance: A 5G private network solution can efficiently manage network resources to accommodate varying levels of traffic and usage across different times and locations, ensuring optimal performance and user experience even during peak demand periods.

High-Development Plans: According to ACMA and the market study conducted in 2023, the market for solutions based on private wireless is growing by about 30% per year, and ACMA is aware of this trend to increase 5G connectivity. Currently, I have 5400 MHz of dedicated spectrum and a plan until 2027 to release additional spectrum to accommodate this solution

Technical Considerations

1. A subscription fee will be needed, increasing the overall cost of the service when compared to Wi-Fi, however, private networks are **less complex and do not require network cabling**

2. Cellular grade network security provides **increased privacy and data security when compared to Wi-Fi**

3. **Licensed Spectrum** leads to **greater reliability and better performance** in the world if IoT, as well as a dramatic increase in ability to connect to IoT enabled devices

4. **Private 5G networks** support seamless mobility and roaming, allowing **devices to move between cells or access points without losing connectivity**.

5. **Private Networks can be 'sliced' for multiple functions**
   - Creates separate networks or slides
   - Each slice can be configured separately
   - Cater to unique requirements and use cases

Private Network Solutions - Private 5G Solution

Private 5G solutions redefine regional connectivity by offering dedicated, high-performance mobile networks tailored to accommodate peak demand scenarios.

Private 5G Solution

Associated Costs

Small Site

Equipment	Baseline	Throughput	Unit Cost ($)
Access Points	5-25	12,5 ~ 25 Gbps	2,000 (per AP)
Access Switches	2-3	352 ~ 528 Gbps	11,000
Transport Switches	0	-	-
Core Switches	2	30 Tbps	70,000
Network Controllers	0	-	-
Firewalls	2	340 Gbps	400,000

Total Estimate Cost ($): 972,000 ~ 1,023,000

Location Types:
- Offices
- Hotels

Medium Site

Equipment	Baseline	Throughput	Unit Cost ($)
Access Points	25-100	25 – 75 Gbps	2,000 (per AP)
Access Switches	8-12	1,4 – 2,1 Tbps	11,000
Transport Switches	2	2,88 Tbps	200,000
Core Switches	2	30 Tbps	70,000
Network Controllers	0	-	-
Firewalls	2	340 Gbps	400,000

Total Estimate Cost ($): 1,478,000 ~ 1,672,000

Location Types:
- Supermarkets
- Warehouses
- Hospitals

Large Site

Equipment	Baseline	Throughput	Unit Cost ($)
Access Points	100+	75 – 125 + Gbps	2,000 (per AP)
Access Switches	20 +	3,5 + Tbps	11,000
Transport Switches	6 +	8,64 + Tbps	200,000
Core Switches	2	30 Tbps	70,000
Network Controllers	0 -2	0 - 80 Gbps	120,000
Firewalls	2	340 Gbps	400,000

Total Estimate Cost ($): 2,560,000 ~ 2,800,000

Location Types:
- Stadiums
- Shopping Malls

Private Network Solutions - Private Wi-Fi Solution

Private network solutions optimize network performance based on fluctuating demand patterns, guaranteeing uninterrupted service and enhanced user experiences.

Private Wi-Fi Solution

General Description

- A private Wi-Fi solution provides a dedicated wireless network infrastructure designed to meet the demands of high-traffic scenarios and peak usage periods. Tailored to specific locations, such as public venues, event spaces, or community centers, private Wi-Fi networks ensure reliable and seamless connectivity for users during busy times.

Main Advantages

Performance: Private Wi-Fi networks are designed to provide reliable and consistent wireless connectivity, even in high-density environments or areas with interference. Network performance can be enhanced through strategically deploying access points and optimizing channel utilization.

Capabilities and Access Control: A Private Wi-Fi solutions enable full management over the configuration and security of the network, allowing for the tailoring of network settings, allocation of bandwidth, and implementation of security protocols to align with specific requirements and usage policies.

Technical Considerations

1. Wi-Fi is **cheaper than 5G and LTE per square foot** and due to the fact there are no subscriptions involved in the service.
2. Compared to its Wi-Fi predecessor, **Wi-Fi 6 has implemented WPA3,** which generates a live password with every data transmission, resulting in more secure routers
3. Private Wi-Fi networks operate in **the unlicensed spectrum**, sharing the **frequency band** with other wireless technologies and devices.
4. Wi-Fi networks support QoS mechanisms to prioritize **traffic** and ensure the **timely delivery** of critical applications.
5. The deployment of multiple access points and **wireless mesh networks** extends **coverage** and improves **signal strength** in large or complex environments.

Private Network Solutions - Summarisation

The following comparison between private 4G/5G networks and private Wi-Fi solutions enables the understanding of different technical capabilities. This allows for the selection of the most suitable wireless technology based on specific use cases, requirements, and constraints.

Characteristic	Private 4G/5G Network	vs.	Private Wi-Fi
Common Use cases	Longer ranges – smart phones, personal mobile devices, connected cars, smart city deployments, large manufacturing operations, etc.		Shorter ranges – home and business environments
Security	Advanced security with commercial grade network; SIM based; Network slicing isolates different functions and users within separate network environments		New WPA3 secures routers more than previous Wi-Fi generations, however, still less secure than private networks
Latency	5G: 3 MS; 4G: 50 MS		20 MS
Speed	4G: 100 MBPS | 5G: 10 GBPS		9.6 GBPS
Session Management	Cellular Networks manage each session in terms of quality of service and built to service simultaneous connections without service degradation		Signal quality and reliability diminishes as more connections are on the network
Cost	Low CAPEX, OPEX compared to operator networks Higher cost relative to Wi-Fi due to infrastructure and licensing fees		Low CAPEX. however, still requires infrastructure upgrades, OPEX engrained in IT support model; Does not require license fee.
Spectrum	Both unlicensed CBRS spectrum and licensed Spectrum (bands can only be used by the company who licenses)		Unlicensed Spectrum (anyone has the ability to use)
Bands	MNO licensed 4G/5G: low, mid and mmWave		2.4GHz & 5GHz (mid-band)

Appendix 5.2 Estimation of Future Population and Visitor Demand

Methodology used to assess the current and project future population and visitor numbers across each LGA.

Approach to Estimate the Future Population and Visitor Demand

The following steps were undertaken to estimate the current and future population and visitor numbers in each DSSN region.

Population Demand

1 Assessment of Current Population for all DSSN Regions

2 Urban vs Rural Population Ratio

3 Projected Growth of Population

Visitor Demand

4 Assessment of Current Number of Visitors for all DSSN Regions

5 Future Visitor Demand Growth Until 2030

6 Obtain the Number of Visitors for the Main Events (ongoing)

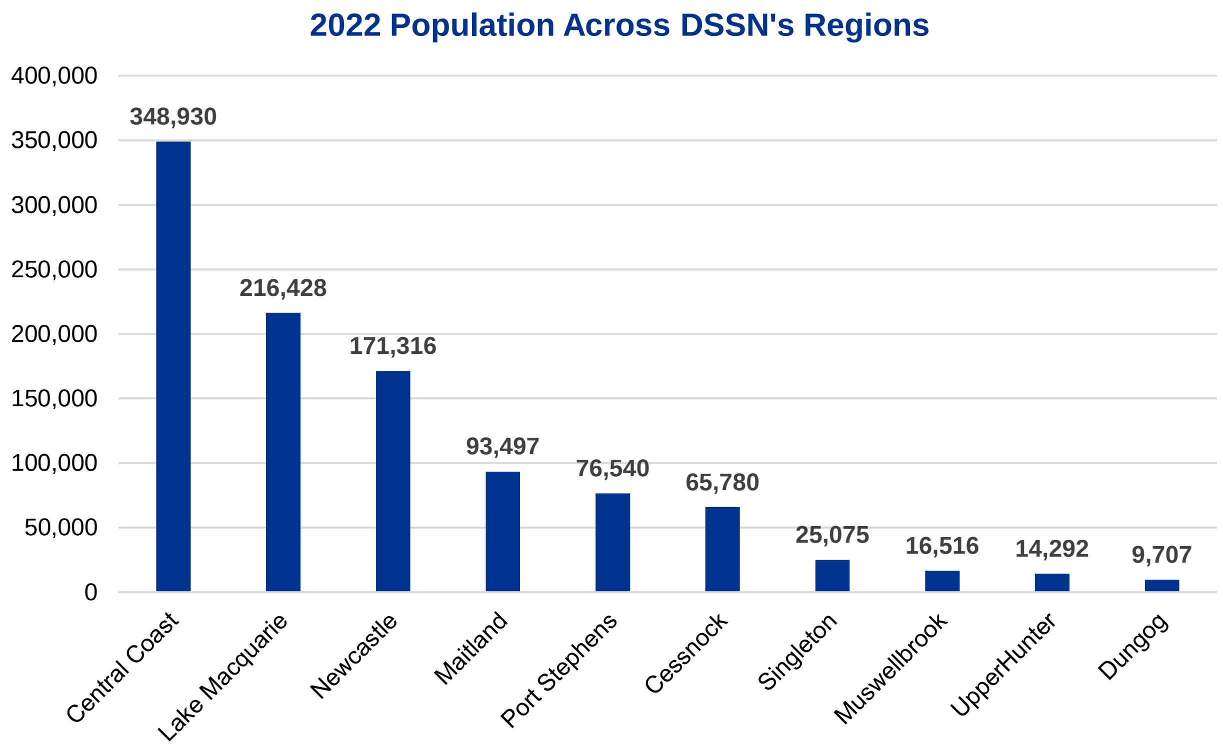
Population Demand - Assessment of Current Population

To understand current demand of network infrastructure, we need to understand the baseline demographic data across each of the DSSN regions.

Step 1: Obtain the population number for the different regions. This information was obtained through the ABS Data/Census and the most recent year provided is 2022.

Source: Australian Bureau of Statistics

Regions	Total Population (2022)	%
Central Coast	348,930	33.61%
Cessnock	65,780	6.34%
Dungog	9,707	0.94%
Lake Macquarie	216,428	20.85%
Maitland	93,497	9.01%
Muswellbrook	16,516	1.59%
Newcastle	171,316	16.50%
Port Stephens	76,540	7.37%
Singleton	25,075	2.42%
Upper Hunter	14,292	1.38%
DSSN Region	**1,038,081**	**100%**



Population Demand - Urban vs Rural Population Ratio

Urban and rural environments have distinct challenges, preferences, and demographics. Estimating the split between the urban vs rural population enables us to tailor policies and services to the specific network infrastructure needs.

Step 2: Obtain the population split between urban and rural to understand the distribution for one of the Local Government Areas.

Source: **Population (LGA and Suburb):** ABS 2021 Census

Suburbs by LGA: NSW Electorate

Urban/Rural Population by LGA: Federal Government - Department of Agriculture, Fisheries & Forestry

- In order to determine the Urban vs Rural split of the different DSSN regions, the population of each **suburb and their respective postcodes in different Local Government Areas (LGA)** were analysed. Subsequently, they were allocated to each type based **on the index (urban or rural)** defined by the Federal Government - Department of Agriculture, Fisheries & Forestry.
- Due to some **suburbs and postcodes being shared by different LGAs**, the following **assumptions** were made:
    a) A **suburb** has been **allocated** to a particular LGA based on **50% or more land area** or estimated **residential population**. For example, if land area mostly sits in LGA 1, but this is mostly State Forest and the residential population looks to be 50% or more located within LGA 2, then the suburb is allocated to LGA 2.

Region	Total Population	Total Area (km²)	Total Urban Population	% Urban Population	Total Rural Population	% Rural Population
Central Coast	348,930	33.61%	343,631	98.8%	4,236	1.2%
Cessnock	65,780	6.34%	0	0.0%	65,082	100.0%
Dungog	9,707	0.94%	0	0.0%	8,770	100.0%
Lake Macquarie	216,428	20.85%	80,750	91.5%	7,466	8.5%
Maitland	93,497	9.01%	57,646	64.0%	32,358	36.0%
Muswellbrook	16,516	1.59%	0	0.0%	18,154	100.0%
Newcastle	171,316	16.50%	172,820	100.0%	0	0.0%
Port Stephens	76,540	7.37%	14,376	17.4%	68,161	82.6%
Singleton	25,075	2.42%	378	1.7%	22,527	98.3%
Upper Hunter	14,292	1.38%	0	0.0%	24,463	100.0%
DSSN Region	**1,038,081**	**100%**	**669,601**	**72.7%**	**251,217**	**27.3%**

Population Demand - Projected Population Growth

The annual population growth projection in each DSSN region enables the calculation of the number of inhabitants for the upcoming years, providing a more accurate estimate of future network infrastructure demand.

Step 3: Project the anticipated population for each DSSN region within the defined scope until 2030, using annual growth rates.

Source: Population Projections - Australian Bureau of Statistics

- The annual population growth rate for the New South Wales region was determined. Subsequently, **this annual growth rate** was uniformly applied to **the various DSSN regions**.
- The dataset extracted from the ABS for this projection considers factors such as **life expectancy at birth, mortality, fertility, and migration**.

	Year	Population for New South Wales	Annual Growth
Population Projections for New South Wales (2022 - 2030)	2022	8,166,525	-
	2023	8,323,889	1.93%
	2024	8,453,902	1.56%
	2025	8,580,341	1.50%
	2026	8,702,446	1.42%
	2027	8,820,393	1.36%
	2028	8,933,348	1.28%
	2029	9,041,818	1.21%
	2030	9,145,140	1.14%

DSSN Population Estimation (2022 - 2030)

	Population	2022	2023	2024	2025	2026	2027	2028	2029	2030
DSSN Population (2022 - 2030)tion	Central Coast	348,930	355,654	361,209	366,611	371,828	376,868	381,694	386,329	390,743
	Cessnock	65,780	67,048	68,095	69,113	70,097	71,047	71,957	72,830	73,663
	Dungog	9,707	9,894	10,049	10,199	10,344	10,484	10,618	10,747	10,870
	Lake Macquarie	216,428	220,598	224,044	227,395	230,631	233,757	236,750	239,625	242,363
	Maitland	93,497	95,299	96,787	98,235	99,633	100,983	102,276	103,518	104,701
	Muswellbrook	16,516	16,834	17,097	17,353	17,600	17,838	18,067	18,286	18,495
	Newcastle	171,316	174,617	177,345	179,997	182,558	185,033	187,402	189,678	191,845
	Port Stephens	76,540	78,015	79,233	80,418	81,563	82,668	83,727	84,744	85,712
	Singleton	25,075	25,558	25,957	26,346	26,721	27,083	27,430	27,763	28,080
	Upper Hunter	14,292	14,567	14,795	15,016	15,230	15,436	15,634	15,824	16,005
	DSSN Region	1,038,081	1,058,084	1,074,611	1,090,683	1,106,204	1,121,197	1,135,555	1,149,343	1,162,477

+1.93% +1.56% +1.50% +1.42% +1.36% +1.28% +1.21% +1.14%

Destination Sydney Surrounds North

Visitor Demand - Total Visitors Across DSSN Regions

Understanding total visitor numbers across all DSSN regions provides valuable insights. This forms a foundational basis for estimating future visitor demand and determining the requisite or supplementary network infrastructure needed to support tourism in these regions.

Step 4: Obtain the available commercial and non-commercial accommodation to estimate the peak visitor numbers for the different LGAs.

Source: Visit NSW | Australian Tourism Data Warehouse (ATDW) | LGA/VIC Tourism websites

DSSN Peak Visitor Numbers according to the accommodation for the different LGAs

Region	Total Visitors (Low-50% of max. accommodation)	Total Visitors (Baseline-75% of max. accommodation)	Total Visitors (High-100% of max. accommodation)
Central Coast	6,631	9,947	13,263
Cessnock	6,216	9,324	12,432
Dungog	966	1,449	1,932
Lake Macquarie	3,041	4,562	6,082
Maitland	1,903	2,854	3,805
Muswellbrook	1,126	1,690	2,253
Newcastle	5,068	7,602	10,136
Port Stephens	7,097	10,645	14,194
Singleton	2,214	3,321	4,428
Upper Hunter	978	1,467	1,956
DSSN Region	**35,240**	**52,861**	**70,481**

- After conducting a comprehensive analysis of the available data, it becomes evident that **cities with larger populations**, such as Central Coast and Newcastle, **exhibit greater tourism demand, as do regions like Port Stephens and Cessnock.**
- The **total number of visitors**, calculated as a **peak number**, will play a pivotal role in **estimating** the **network demand** projection allocated to **visitor demand** and to calculate the **required network infrastructure.**

Visitor Demand - Projected Growth

Understanding the anticipated tourism growth across all DSSN regions will enable the estimation of the total approximate number of visitors by 2030. The corresponding demand estimate for network resources can be calculated to consequently estimate the infrastructure requirements to meet the connectivity needs of visitors.

Step 5: Estimate the annual growth in terms of the number of visitors for each of the regions.

Source: VES 2030 Regional NSW Forecast data

Annual Growth (%)	
From 2019	
To 2025	To 2030
4.5%	4.5%

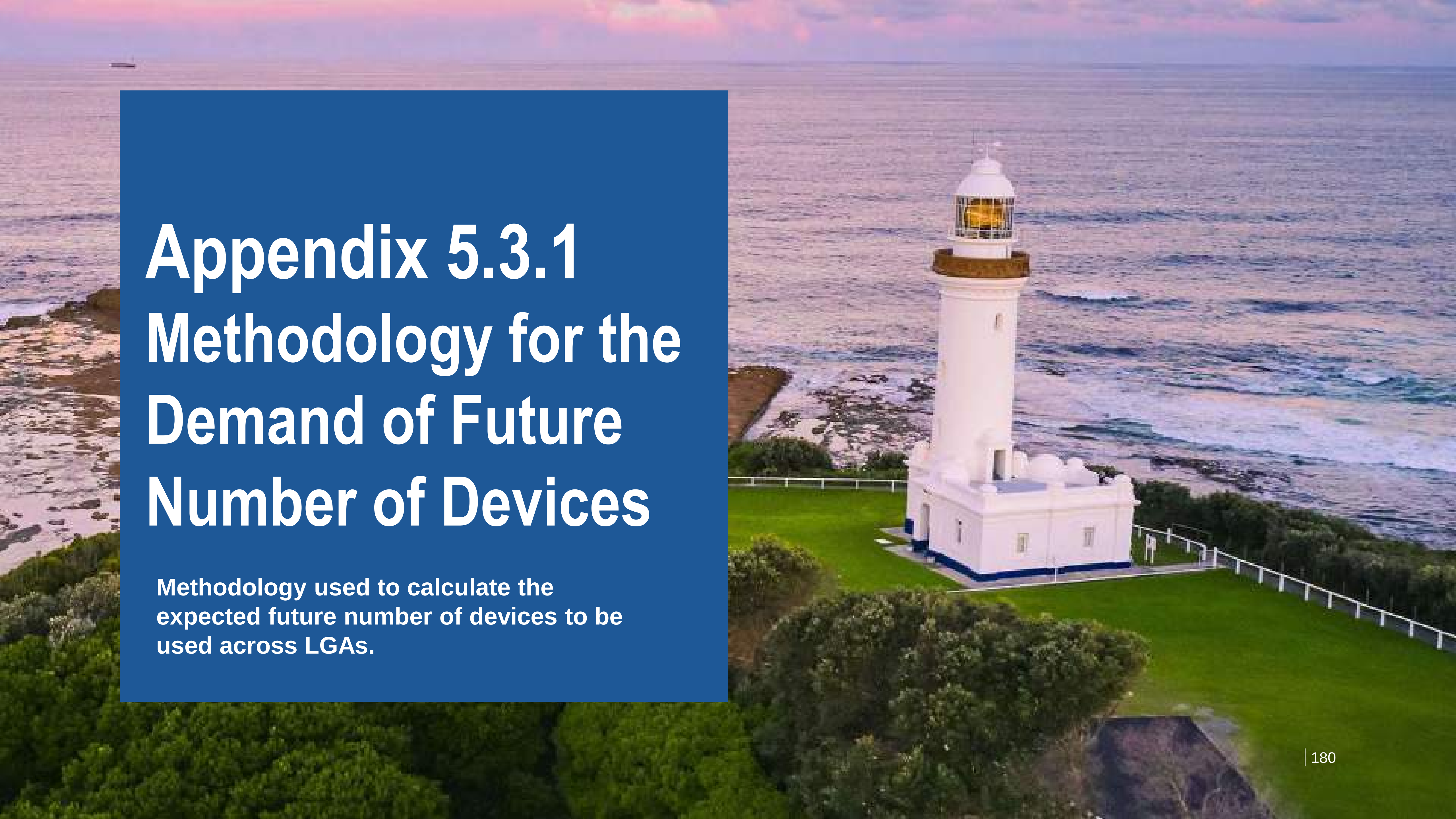
- To estimate the growth in the number of visitors for the different regions, a projected annual growth of 4.5% was used.
- These annual growth values were derived from a forecast provided by DSSN, which included both the total growth and annual growth for various Australian regions.

Total Number of Visitors (2023 - 2030)

	Region	2023	2024	2025	2026	2027	2028	2029	2030
Total Number of Visitors (2023-2030)	Central Coast	9,947	10,395	10,862	11,351	11,862	12,396	12,954	13,536
	Cessnock	9,234	9,650	10,084	10,538	11,012	11,507	12,025	12,566
	Dungog	1,449	1,514	1,582	1,654	1,728	1,806	1,887	1,972
	Lake Macquarie	4,562	4,767	4,982	5,206	5,440	5,685	5,941	6,208
	Maitland	2,854	2,982	3,117	3,257	3,403	3,557	3,717	3,884
	Muswellbrook	1,690	1,766	1,846	1,929	2,015	2,106	2,201	2,300
	Newcastle	7,602	7,944	8,302	8,675	9,066	9,473	9,900	10,345
	Port Stephens	10,645	11,124	11,625	12,148	12,694	13,266	13,863	14,486
	Singleton	3,321	3,470	3,627	3,790	3,960	4,139	4,325	4,519
	Upper Hunter	1,467	1,533	1,602	1,674	1,749	1,828	1,910	1,996
	DSSN Region	52,771	55,146	57,627	60,220	62,930	65,762	68,722	71,814

+4.5% +4.5% +4.5% +4.5% +4.5% +4.5% +4.5%

Destination Sydney Surrounds North



Appendix 5.3.1 Methodology for the Demand of Future Number of Devices

Methodology used to calculate the expected future number of devices to be used across LGAs.

Approach to Estimate the Number of Devices

The methodology employed comprises the following steps to assess the baseline quantity and distribution of devices in each DSSN region, encompassing various industry sectors and individual user devices.

1
Determination of Average Number of Devices Per Capita

2
Calculation of the Number of Devices Across DSSN Region

3
Estimation of the Total Number of Connections (IoT - Non-IoT)

4
Obtain the Employment Rate per Industry Sector

5
Estimation of Industrial Devices (IoT Devices) per Region and Sector

6
Estimation of Individual Devices (Non-IoT Devices) per Region

7
Total Number of Devices per Region (Industrial/IoT Devices + Individual/Non-IoT Devices)

Average Number of Devices per Capita

The primary objective is to calculate the average number of devices per capita and the corresponding population for all regions, in order to provide an estimate of the total number of devices that exist in the DSSN region.

Step 1: Obtain the average number of devices per capita. This value differs depending on the region of the world, and was projected by Cisco through the 2020 Cisco Annual Internet Report, with projections until 2023.

Source: Cisco Annual Internet Report

Note: In the baseline scenario, it was considered that Australia will be positioned according to Western Europe in terms of Average Devices per Capita (9.4 devices).

Worldwide Regions	2018	2023
Global	2.4	3.6
Asia Pacific	2.1	3.1
Central and Eastern Europe	2.5	4
Latin America	2.2	3.1
Middle East and Africa	1.1	1.5
North America	8.2	13.4
Western Europe	5.6	9.4

Table 1 - Average Number of Devices per Capita

Estimation of the Number of Devices for the DSSN Region

Estimating the total number of devices is a key input towards the telecommunications infrastructure requirements and planning within the DSSN Region.

Step 2: Calculate the total expected number of devices for the entire DSSN region.

Number of Devices per Capita (following Western Europe perspective)

9.4

x

Total Population DSSN Region (2022)

1,038,081

=

Expected Number of Devices

9,757,961

The calculation utilises the projection of **9.4** devices per capita, a figure aligned with Cisco's projection for **Western Europe**.

Multiplying the **average number of devices per capita** by the **total population** of the DSSN Region in 2022 (obtained in the previous chapter) gives the expected **total number of devices** for the DSSN Region.

Number of Devices per Capita * Total Population of DSSN Region = Total Number of Devices for DSSN Region

9.4 * 1,038,081 = 9,757,961 devices

Estimation of the Total Number of Connections

To estimate the existing traffic in the DSSN region, understanding the types of connections is crucial. This involves distinguishing between IoT connections, which are linked to industry devices and respective sectors, and non-IoT connections, which are more closely associated with private connections established by individual user devices.

Step 3: Obtain the division between the type of device connected to the network. For this projection, a distinction was made between an IoT connection and a non-IoT connection.

Total Number of Connections (billions)	=	IoT Connections - Industrial devices (billions)	+	Non-IoT Connections - Individual Devices (billions)
29.9		16.7		13.2

The IoT Analytics study projects that in 2023, there are a total number of 29.9 billion connections to the Internet performed by IoT (16.7 billions) and Non-IoT Connections (13.2 billions).

An IoT connection is generally associated with internet connections by sensors, access points, modems, and may be associated with a more industrial aspect.

A non-IoT connection is associated with a private connection of a user, such as a resident's mobile phone to an antenna or a personal computer at internet home.

Ratio IoT / Non-IoT	
IoT	56%
Non - IoT	44%

Number of Devices (Total: 9,757,961)	
Industrial Devices (56%)	5,450,099
Individual Devices (44%)	4,307,863

From the total number of IoT connections (29.9 billion by 2023) and based on the projections for IoT connections (16.7 billion) vs non-IoT connections (13.2 billion), it is possible to calculate the IoT/non-IoT ratio (56% vs 44%) and estimate the associated number of devices.

Individual Non-IoT Devices per Inhabitant		
	Individual Devices	4,307,863
	DSSN Total Population	1,038,081
	4.15 individual/non-IoT devices per inhabitant	

This value aligns with the projection in the Australian Competition & Consumer Commission (ACCC) in the Regional Mobile Infrastructure Inquiry of July 2023.

Sources: IoT Analytics - Total Number of Device Connections | IoT Analytics - Global IoT Market Forecast

DSSN'S Business Sectors to be Considered

In terms of connectivity requirements, the DSSN regions have specificities not only related to demography and tourism, but also related to the different industry sectors.

Step 4a: Understand the business/industrial sectors to project the distribution of IoT/industrial devices.

- 01 Agriculture, Forestry, Fishing, Mining, Quarrying, Oil & Gas
- 02 Utilities
- 03 Construction
- 04 Manufacturing
- 05 Wholesale and Retail Trade
- 06 Transportation & Warehousing
- 07 Finance, Insurance, Real Estate, Rental & Leasing
- 08 Professional, Scientific & Technical Services
- 09 Business, Building & other support services
- 10 Educational Services
- 11 Healthcare & Social Assistance
- 12 Arts, Information, Culture & Recreation
- 13 Accommodation & Food Services
- 14 Other Services (except Public Administration
- 15 Public Administration

Calculation of Employment Rate per Industry Sector

In this section, the goal is to obtain data on employment distribution across various industrial sectors in each region and understand which sectors have greater influence on connectivity demand in each respective DSSN region.

Step 4b: Obtain data on the employment distribution across various industrial sectors in each region to understand which sectors have greater influence in each respective area.

Sectors/Verticals	DSSN Region	Central Coast	Cessnock	Dungog	Lake Macquarie	Maitland	Muswellbrook	Newcastle	Port Stephens	Singleton	Upper Hunter
Agriculture, Forestry, Fishing, Mining, Quarrying, Oil & Gas	12.4%	1.3%	10.0%	13.7%	3.0%	7.3%	28.6%	2.3%	3.2%	25.4%	28.9%
Utilities	1.7%	1.0%	1.3%	1.5%	1.4%	1.4%	3.8%	1.2%	1.0%	2.4%	1.5%
Construction	9.2%	11.5%	9.2%	12.3%	11.2%	9.0%	5.7%	7.8%	10.8%	7.2%	7.0%
Manufacturing	5.7%	5.9%	7.5%	5.9%	5.8%	6.7%	3.8%	4.8%	6.2%	4.2%	6.3%
Wholesale and Retail Trade	11.2%	12.4%	12.1%	10.6%	11.6%	12.7%	10.5%	10.4%	12.0%	10.7%	8.5%
Transportation and Warehousing	3.8%	3.7%	4.1%	4.7%	3.8%	4.3%	2.9%	3.5%	4.9%	2.9%	2.8%
Finance, Insurance, Real Estate, Rental & Leasing	3.3%	4.9%	3.0%	3.1%	4.5%	3.5%	2.0%	4.6%	3.4%	2.0%	1.7%
Professional, Scientific, and Technical services	4.8%	6.0%	3.6%	5.2%	5.7%	4.7%	2.5%	7.7%	5.2%	3.0%	4.0%
Management of Business, Building & other support services	3.7%	3.3%	4.7%	3.2%	3.1%	3.7%	5.0%	2.9%	3.8%	4.5%	3.1%
Educational Services	7.7%	8.2%	6.0%	8.3%	9.2%	7.8%	6.3%	10.2%	7.4%	5.8%	7.4%
Healthcare and Social Assistance	14.2%	17.8%	14.3%	12.2%	19.1%	16.2%	9.0%	20.6%	14.5%	8.8%	9.1%
Arts, Information, Culture & Recreation	1.8%	3.0%	1.5%	1.3%	1.8%	1.4%	1.4%	2.4%	1.7%	1.1%	2.7%
Accommodation and Food Services	7.0%	7.0%	8.8%	4.4%	6.3%	6.8%	6.8%	8.3%	9.1%	6.8%	5.6%
Other Services (excluding Public Administration)	4.1%	3.8%	4.6%	4.6%	4.1%	4.3%	4.1%	3.3%	4.3%	4.4%	3.5%
Public Administration	5.8%	6.1%	5.0%	4.8%	5.6%	6.5%	3.9%	6.4%	8.4%	7.0%	4.4%
Industry of Employment Not Stated	3.9%	4.1%	4.3%	4.2%	3.8%	3.7%	3.7%	3.6%	4.1%	3.8%	3.5%

Note: Some of the sectors/verticals were combined due to their identical network demand in terms of throughputs and traffic patterns.

Source: Australian Bureau of Statistics

Estimation of the Total Number of Connections (IoT)

In this section, the goal is to estimate the number of industrial devices by analysing the distribution of the employed population in each industry sector.

Step 5: From the distribution of the employed population in each sector, the estimation of the number of industrial devices is carried out through the following calculation:

Number of Industrial Devices per Sector/Region = Total Number of Industrial Devices for DSSN * Percentage of Population for the Region * Industry Employment Distribution for the Region

Sectors/Verticals	DSSN Region	Central Coast	Cessnock	Dungog	Lake Macquarie	Maitland	Muswellbrook	Newcastle	Port Stephens	Singleton	Upper Hunter
Agriculture, Forestry, Fishing, Mining, Quarrying, Oil & Gas	248,725	23,815	34,536	6,982	34,088	35,834	24,800	20,687	12,859	33,439	21,685
Utilities	68,746	18,319	4,490	764	15,908	6,872	3,295	10,793	4,018	3,160	1,126
Construction	553,386	210,673	31,773	6,268	127,264	44,179	4,943	70,156	43,400	9,479	5,252
Manufacturing	317,425	108,085	25,902	3,007	65,904	32,889	3,295	43,173	24,915	5,529	4,727
Wholesale and Retail Trade	639,833	227,161	41,788	5,402	131,809	62,341	9,105	93,542	48,222	14,086	6,378
Transportation and Warehousing	208,227	67,782	14,160	2,395	43,179	21,108	2,515	31,480	19,691	3,818	2,101
Finance, Insurance, Real Estate, Rental & Leasing	230,699	89,765	10,361	1,580	51,133	17,181	1,734	41,374	13,663	2,633	1,276
Professional, Scientific, and Technical Services	312,110	109,916	12,433	2,650	64,768	23,071	2,168	69,257	20,896	3,949	3,001
Management of Business, Building & other support services	185,644	60,454	16,232	1,631	35,225	18,162	4,336	26,084	15,270	5,924	2,326
Educational Services	458,127	150,219	20,721	4,230	104,538	38,288	5,463	91,743	29,737	7,636	5,553
Healthcare and Social Assistance	948,010	326,085	49,386	6,218	217,030	79,522	7,804	185,284	58,268	11,585	6,828
Arts, Information, Culture & Recreation	121,232	54,958	5,180	663	20,453	6,872	1,214	21,587	6,831	1,448	2,026
Accommodation and Food Services	396,107	128,236	30,391	2,242	71,586	33,379	5,896	74,653	36,568	8,952	4,202
Other Services (excluding Public Administration)	214,475	69,614	15,886	2,344	46,588	21,108	3,555	29,681	17,279	5,793	2,626
Public Administration	334,219	111,748	17,268	2,446	63,632	31,907	3,382	57,564	33,755	9,215	3,302
Industry of Employment Not Stated	213,134	75,110	14,850	2,140	43,179	18,162	3,208	32,380	16,476	5,003	2,626
Total	5,450,099	1,831,941	345,356	50,963	1,136,283	490,875	86,712	899,438	401,848	131,648	75,035

Estimation of the Total Number of Connections (Non-IoT)

In this section, the goal is to obtain the number of individual devices (e.g. computers, mobile phones, smartwatches) and the number of visitor devices for each DSSN region.

Step 6a: Obtain the number of **individual devices** (computers, mobile phones, smartwatches) for each region. This estimation is obtained through the following calculation:

Number of Individual Devices per Region = Total Number of Individual Devices for DSSN * Percentage of Population for the Region

Regions	Number of Individual Devices
Central Coast	1,448,001
Cessnock	272,976
Dungog	40,282
Lake Macquarie	898,140
Maitland	387,997
Muswellbrook	68,539
Newcastle	710,993
Port Stephens	317,628
Singleton	104,057
Upper Hunter	59,309
DSSN Region	4,307,863

Step 6b: Obtain the expected **number of devices allocated for visitors**. For the calculation of this projection, it is assumed that each visitor, on average, will have **4.15 connected devices** to the network, similar to inhabitants.

Number of Total Devices per Region Used by Visitors = Total Number of Individual Devices per Visitor * Average Visitors per Day

Regions	Number of Visitor Devices
Central Coast	41,278
Cessnock	38,320
Dungog	6,013
Lake Macquarie	18,932
Maitland	11,844
Muswellbrook	7,013
Newcastle	31,547
Port Stephens	44,175
Singleton	13,782
Upper Hunter	6,088
DSSN Region	218,991

Total Number of Connections per Region (Non-IoT & IoT)

In this section, the goal is to obtain the total number of devices for each region for Industrial/IoT devices & Individual/Non-IoT devices.

Step 7: Obtain the total number of devices for each region.

Regions	Number of IoT Devices	Number of Non-IoT Individual Devices	Number of Non-IoT Visitor Devices	Total
Central Coast	1,831,941	1,448,001	41,278	3,321,220
Cessnock	345,356	272,976	38,320	656,652
Dungog	50,963	40,282	6,013	97,259
Lake Macquarie	1,136,283	898,140	18,932	2,053,355
Maitland	490,875	387,997	11,844	890,715
Muswellbrook	86,712	68,539	7,013	162,264
Newcastle	899,438	710,993	31,547	1,641,917
Port Stephens	401,848	317,628	44,175	763,651
Singleton	131,648	104,057	13,782	249,487
Upper Hunter	75,035	59,309	6,088	140,433
DSSN Region	5,450,099	4,307,863	218,991	9,976,952

Appendix 5.3.2 Methodology and Analysis of Demand

Methodology and Analysis of Future Demand based on Sector Characteristics and Future Traffic

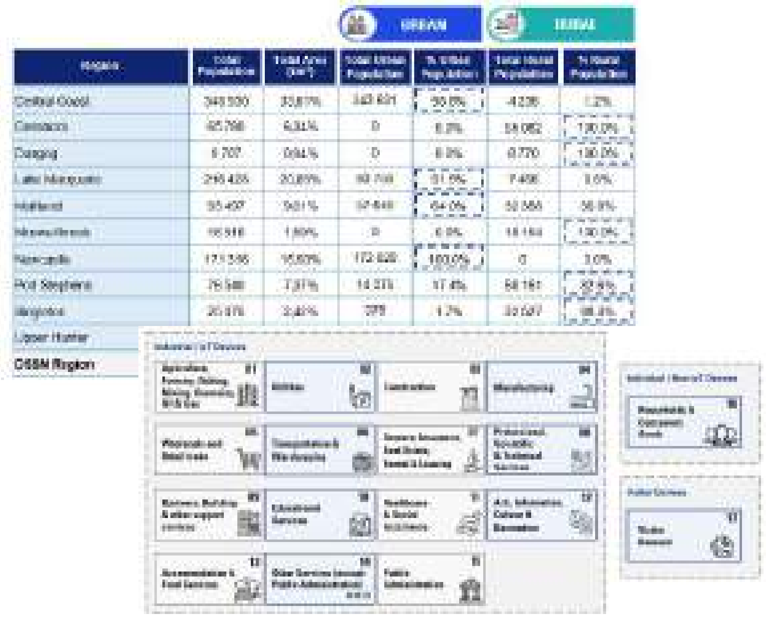
Methodology: Connectivity Demand Model

Connectivity Demand Model Approach

To understand DSSN's future needs, the steps below identify the demand that requires the network investment:

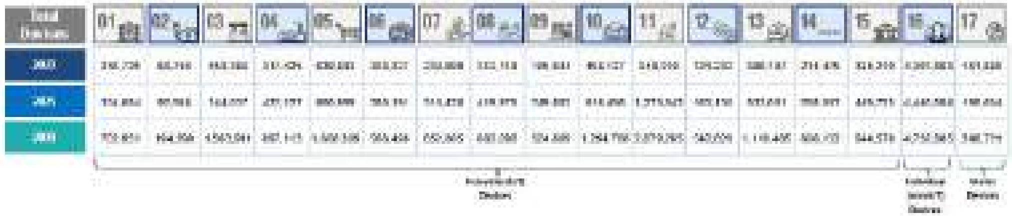
Universal Definition

- DSSN data analysis and information research

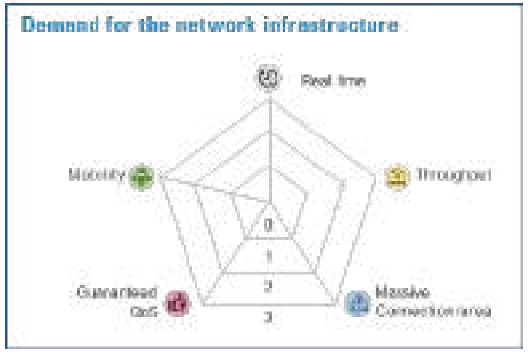


Demand Model

- Definition of number of devices to be connected per sector and area



- Definition of technical requirements to serve the volume of devices



[1]period during which occurs the maximum total traffic load in a given 24−hour period, [2]ratio of the potential maximum demand to the actual bandwidth, [3],extra capacity to assure consistency of network modelling

Demand Model: DSSN's Population To Be Served

Analysing DSSN's demographics enables a targeted approach to connectivity planning, acknowledging the variation in demand across regions. By considering Urban and Rural personas, infrastructure investments can be tailored to meet the specific needs of each area.

- The first variable to consider is the DSSN's demographics, as demand for connectivity will not be equal across DSSN's regions.

- In the Telco industry, traditionally two types of personas are considered, **Urban** and **Rural**, especially because for carriers, infrastructure investment relies on the potential revenue generated. Therefore, Rural areas, with higher area to be covered and significantly lower population density, are not as attractive as Urban areas. This also means that the starting point in terms of already deployed technology will differ significantly.

			URBAN		RURAL	
Region	**Total Population**	**Total Area (km^2)**	**Total Urban Population**	**% Urban Population**	**Total Rural Population**	**% Rural Population**
Central Coast	348,930	33.61%	343,631	98.8%	4,236	1.2%
Cessnock	65,780	6.34%	0	0.0%	65,082	100.0%
Dungog	9,707	0.94%	0	0.0%	8,770	100.0%
Lake Macquarie	216,428	20.85%	80,750	91.5%	7,466	8.5%
Maitland	93,497	9.01%	57,646	64.0%	32,358	36.0%
Muswellbrook	16,516	1.59%	0	0.0%	18,154	100.0%
Newcastle	171,316	16.50%	172,820	100.0%	0	0.0%
Port Stephens	76,540	7.37%	14,376	17.4%	68,161	82.6%
Singleton	25,075	2.42%	378	1.7%	22,527	98.3%
Upper Hunter	14,292	1.38%	0	0.0%	24,463	100.0%
DSSN Region	**1,038,081**	**100%**	**669,601**	**72.7%**	**251,217**	**27.3%**

These personas will also serve as blueprints for the needs estimation in the following years.

Demand Model: DSSN Sector Segmentation

In terms of business requirements, the 10 DSSN regions under analysis have specificities not only related to population demography in each region, but also related to the different business sector needs. Therefore, regardless of the deployment mode retained, the model will consider 17 vectors of modeling and perform sensitivity analyses and develop the demand growth scenarios.

Industrial / IoT Devices

- 01 Agriculture, Forestry, Fishing, Mining, Quarrying, Oil & Gas
- 02 Utilities
- 03 Construction
- 04 Manufacturing
- 05 Wholesale and Retail Trade
- 06 Transportation & Warehousing
- 07 Finance, Insurance, Real Estate, Rental & Leasing
- 08 Professional, Scientific & Technical Services
- 09 Business, Building & other support services
- 10 Educational Services
- 11 Healthcare & Social Assistance
- 12 Arts, Information, Culture & Recreation
- 13 Accommodation & Food Services
- 14 Other Services (except Public Administration)
- 15 Public Administration

Individual / Non-IoT Devices

- 16 Households & Consumers Goods

Visitor Devices

- 17 Visitor Demand

Demand Model: Number of Connected Devices per Sector

Each vector will have specific connectivity needs for their users/devices independently if connected through mobile or fixed technology, which will be stressing the network differently. Therefore, it is necessary to understand the expected demand required by each vector. The table below shows the number of devices for all regions per business sector in 2023.

Number of Connected Devices per Sector and Region

	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17
Central Coast	23,815	18,319	210,673	108,085	227,161	67,782	89,765	109,916	60,454	150,219	326,085	54,958	128,236	69,614	111,748	1,448,001	41,278
Cessnock	34,536	4,490	31,773	25,902	41,788	14,160	10,361	12,433	16,232	20,721	49,386	5,180	30,391	15,886	17,268	272,976	38,320
Dungog	6,982	764	6,268	3,007	5,402	2,395	1,580	2,650	1,631	4,230	6,218	663	2,242	2,344	2,446	40,282	6,013
Lake Macquarie	34,088	15,908	127,264	65,904	131,809	43,179	51,133	64,768	35,225	104,538	217,030	20,453	71,586	46,588	63,632	898,140	18,932
Maitland	35,834	6,872	44,179	32,889	62,341	21,108	17,181	23,071	18,162	38,288	79,522	6,872	33,379	21,108	31,907	387,997	11,844
Muswellbrook	24,800	3,295	4,943	3,295	9,105	2,515	1,734	2,168	4,336	5,463	7,804	1,214	5,896	3,555	3,382	68,539	7,013
Newcastle	20,687	10,793	70,156	43,173	93,542	31,480	41,374	69,257	26,084	91,743	185,284	21,587	74,653	29,681	57,564	710,933	31,547
Port Stephen	12,859	4,018	43,400	24,915	48,222	19,691	13,633	20,896	15,270	29,737	58,268	6,831	36568	17,279	33,755	317,628	44,175
Singleton	33,439	3,160	9,479	5,529	14,086	3,818	2,633	3,949	5,924	7,636	11,585	1,448	8,952	5,793	9,215	104,057	13,782
Upper Hunter	21,685	1,126	5,252	4,727	6,378	2,101	1,276	3,001	2,326	5,553	6,828	2,026	4,202	2,626	3,302	59,309	6,088
Total Devices (2023)	248,725	68,746	553,386	317,425	639,833	208,227	230,699	312,110	185,644	458,127	948,010	121,232	396,107	214,475	334,219	4,307,863	218,991

Demand Model: Number of Connected Devices per Sector

In order to anticipate future demand across various sectors, it is crucial to estimate the growth in the number of devices. Below, the estimation and the underlying assumptions used to derive the final device count are outlined.

Total Devices	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17
2023	248,725	68,746	553,386	317,425	639,833	208,227	230,699	312,110	185,644	458,127	948,010	121,232	396,107	214,475	334,219	4,307,863	218,991
2025	334,684	92,504	744,637	427,127	860,959	280,191	310,428	419,975	249,802	616,456	1,275,642	163,130	533,001	288,597	449,725	4,440,584	239,143
2030	702,951	194,290	1,563,991	897,113	1,808,309	588,496	652,005	882,092	524,669	1,294,768	2,679,285	342,629	1,119,485	606,152	944,576	4,732,885	299,445

$\underbrace{01 \ldots 15}_{\text{Industrial (IoT) Devices}}$ $\underbrace{16}_{\text{Individual (non-IoT) Devices}}$ $\underbrace{17}_{\text{Visitor Devices}}$

ASSUMPTIONS

- To estimate the growth in **the number of IoT/Industrial** devices between 2023 and 2030 for different regions, the projection by IoT Analytics and Ericsson was considered, indicating **an annual growth of 16%**.
- For non-IoT/individual devices, an **annual growth rate** aligned with the **population growth** in the respective regions was assumed .

Expected Annual Growth of IoT Devices	**16%**
Expected Annual Growth of Non-IoT Devices	**Follows the Population Growth**
Expected Annual Growth of Visitor Devices	**Follows the Visitor Demand Growth**

Sources: IoT Analytics | Ericsson

Demand Model: Technical Requirements

The data collection and information research facilitated the acquisition and analysis of network parameters (e.g., number of sites, location, technologies). Subsequently, the initial phase of the demand model generated an estimate of the number of devices and their growth for the target years, accounting for various geographic factors (e.g., current and future number of devices, projected required throughput). In order to establish the technical requirements derived from the demand model and facilitate the definition of current and future capacity, certain assumptions were considered:

Assumptions

Use Cases Definition

For each vertical (sector), several use cases were selected to best represent the future and current implementations in each sector.

Throughput Estimations

Three throughput scales were defined, based on the use case studies from GSMA, Kearney Article and Wireless Labs Study.

1. Lowest interval [0,5;1;2] Mbps < 20 Mbps
2. Medium interval [2;5;10] Mbps < 50 Mbps
3. Highest interval [10;50;100] Mbps >50 Mbps

Throughput Calculation

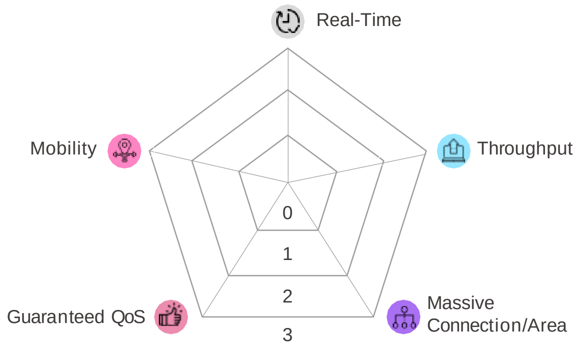
Throughput distribution per vertical and calculation of average throughput per sector.

Cross Network Factors Consideration (e.g., Busy Hour, Extra Capacity, others)

After estimating the average throughput per sector, a **Busy Hour**[1] factor of 20% and a **Contention Ratio**[2] of 1/50 were considered. A **Headroom extra capacity**[3] of 20% was also included for consistency of the network modeling.

[1] period during which occurs the maximum total traffic load in a given 24−hour period, [2] ratio of the potential maximum demand to the actual bandwidth, [3] extra capacity to assure consistency of network modelling

Demand for the network infrastructure



For the evaluation of network requirements per type of device used in each sector, a radar chart was used, divided into **four** levels: Level 0, 1, 2 and 3, where level 0 represents the lowest level and level 3 the highest.

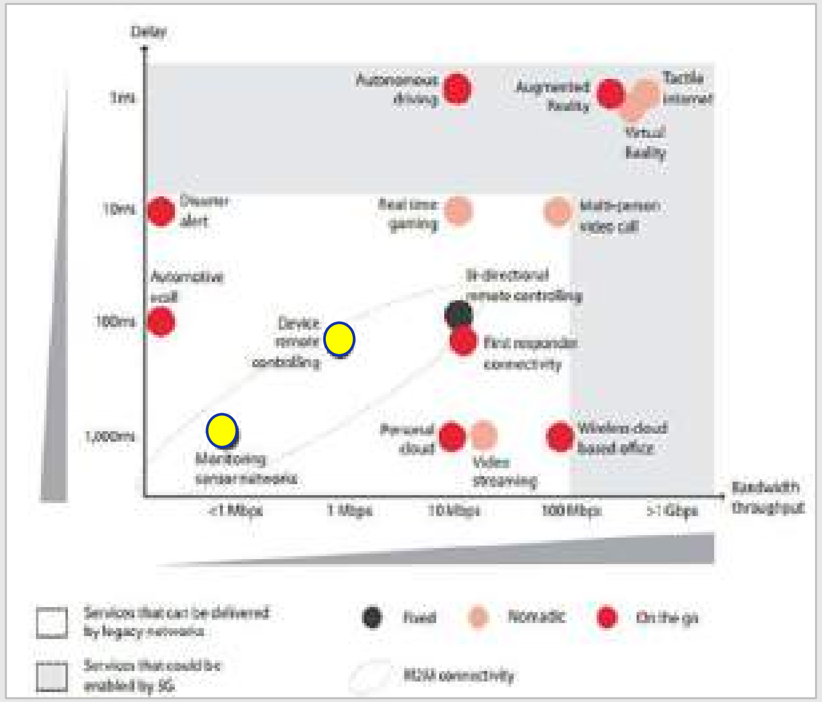
Each vertex of the radar chart has the following requirement meaning:

- **Mobility**: relates to the ability of a device to be mobile, meaning a connection starts in one access point (AP), and device can switch between APs without losing connection (e.g., drones).
- **Real Time**: relates to the ability of exchanging data instantly or with negligible latency of transmission (e.g., live video streaming).
- **Throughput**: relates to the volume of data that can be processed each instant (e.g., sensors; AR/VR).
- **Massive Connection/Area**: relates to number of devices connected to the network at the same time (e.g., Wireless Robot Control).
- **Guaranteed Quality of Service (QoS)**: relates to the quality of data exchanged (e.g., VR/AR).

Demand Model : Example of Use Case Used

These use cases already implemented and future test-proved use case studies help identify the throughput requirements for a standard device for each of the use cases, based on the specific region and vertical/sector characteristics to determine the number of devices and their contribution to the sector. The objective was to obtain the final average traffic per device.

For example, in Sector 1 - **Agriculture + Forestry, Fishing, Mining, Quarrying, Oil and Gas**, which is one of the sectors that will have a greater impact in rural areas, most 5G use cases are sensor-based to control and improve efficiency in production. Some of the applications are monitoring sensor networks and device remote controlling. According to Wireless Labs and GSMA studies, the picture below, in yellow, represents use case applications that will require an average throughput per device between 0.5 and 1 Mbps.



The presented use cases require real-time data, which will ultimately increase production efficiency. The ability to monitor, track and automate systems will allow producers to measure things on a day-to-day basis.

In Aggrotech, devices will allow farmers to control production by using sensors to communicate moisture, fertilisation and nutrition levels, etc., and to report on current and predicted weather patterns to allow improved management and analysis.

	Throughput calculation [Mbps]							
Mbps	0.5	1	2	5	10	50	100	1000
% of devices that use the specific throughput in this sector	30%	30%	25%	5%	5%	2%	2%	1%

The average traffic per device determined for this sector is 14.7 Mbps. In Singleton, as an example, considering its population as 100 per cent rural, there is an estimated 33,439 devices in 2023 in this sector. After taking into consideration a busy hour factor of 20 per cent, a concentration ratio of 1:50, as well as a headroom extra capacity of 20 per cent, the estimated required throughput for all devices would be 3,237 Mbps.

Connectivity Demand Model – Overview of Sector Demand Characteristics

Demand for Agric., Forestry, Fishing, Mining, Quarrying, Oil & Gas

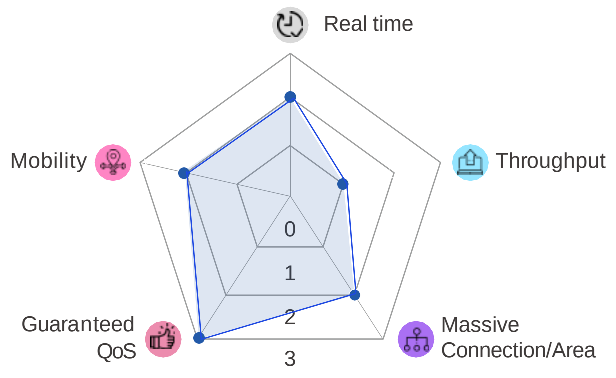
The use cases per sector help to understand the expected requirements for the network, considering type and number of devices required for the applications identified and the throughput necessary.

Agriculture, Forestry, Fishing, Mining, Quarrying, Oil & Gas 01

APPLICATIONS

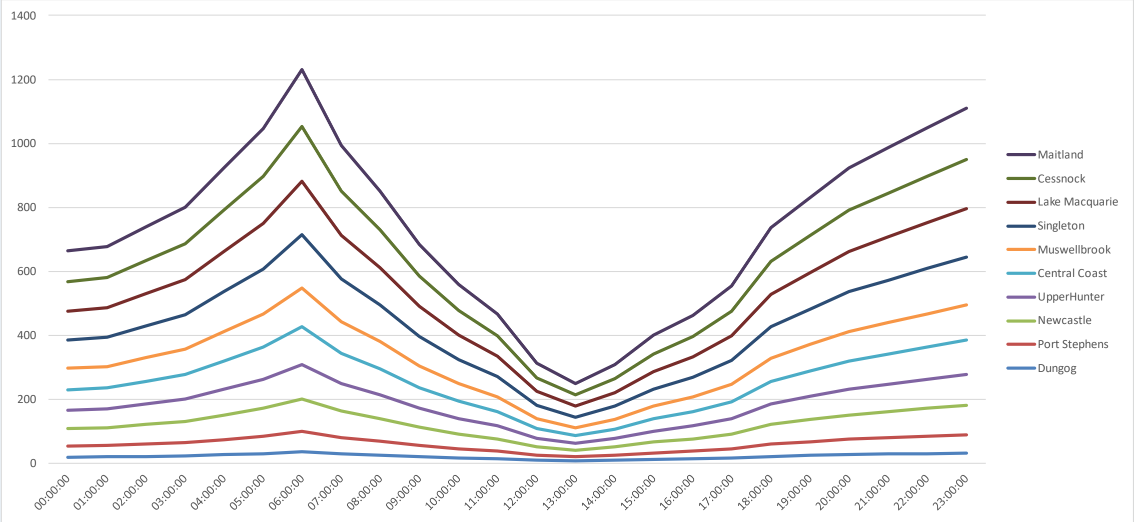
- Remote monitoring of farm conditions and infrastructure, saving time and labour on routine farm checks
- Faster insights from real-time data across the value-chain and higher data analytics capacity, which will improve producers' decision-making and time to market
- High-definition cameras transmit real-time video and robot/drone inspection
- AR/VR applications

Demand for the network infrastructure



Demand will differ by region depending on the impact that the sector has on each region

Evaluation of usage throughout the day



ASSUMPTIONS

- Demand during early morning (12-6am) and late afternoon (6-11pm), e.g., irrigation system
- Less demand during warm hours (11am-6pm)
- Medium demand in the morning (8-11am)
- Most prevalent in rural regions

Demand for Utilities

The same approach was followed for the following vectors. The expected demand for each sector considers the type and number of devices required for the applications identified and the throughput necessary.

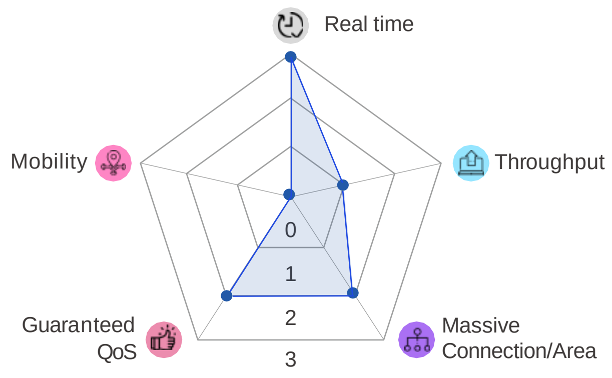
02

Utilities

APPLICATIONS

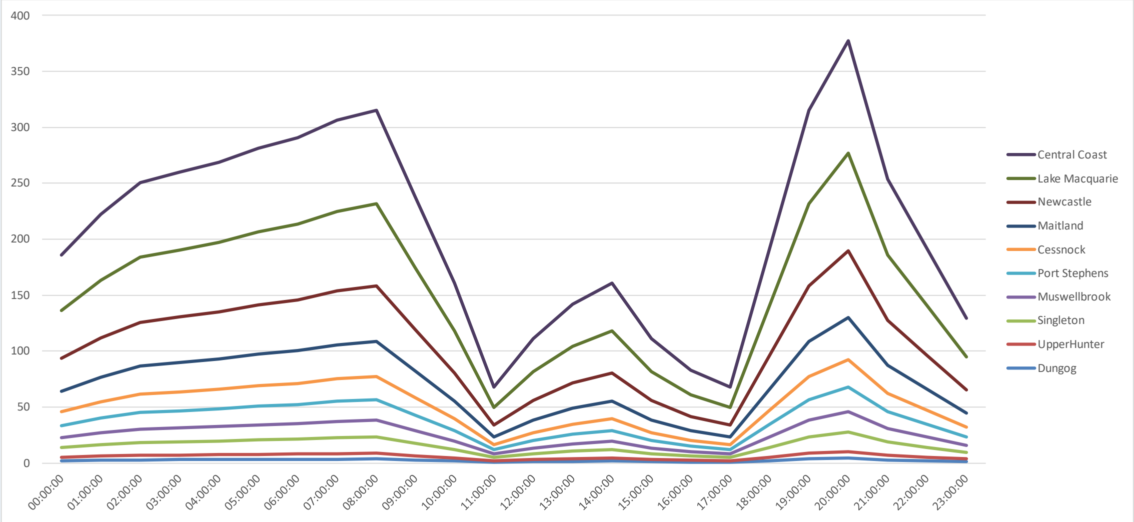
- Smart meters not only for consumers with higher levels of detail
- Remote monitoring of electrical grids
- Smart street lighting (through integrated sensors) to enable efficiency in public areas and provide lighting accordingly

Demand for the network infrastructure



Demand will differ by region depending on the impact that the sector has on each region

Evaluation of usage throughout the day



ASSUMPTIONS

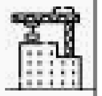
- Highest demand between 6-10pm, e.g., when people return home
- Between 12-8am is off-peak time with less demand
- Between 12-2pm is average demand, e.g., people go home for lunch, machines, household appliances
- Lower demand between 9-11am, 3-6pm and 10-12pm
- If we consider teleworking, there is a peak between 9-12am and 2-6pm, with the demand becoming more constant throughout the day and higher in absolute terms
- More prevalent in urban regions

Demand for Construction

The expected demand for each sector considers the type and number of devices required for the applications identified and the throughput necessary.

03

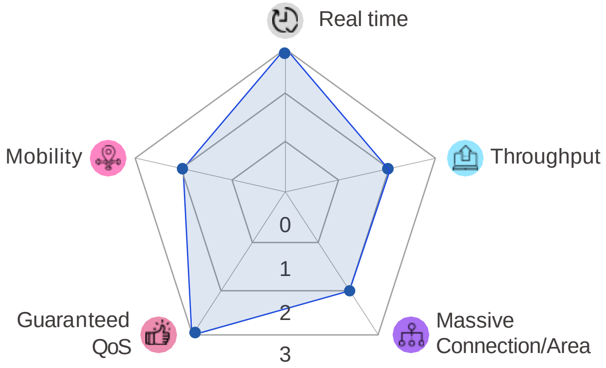
Construction



APPLICATIONS

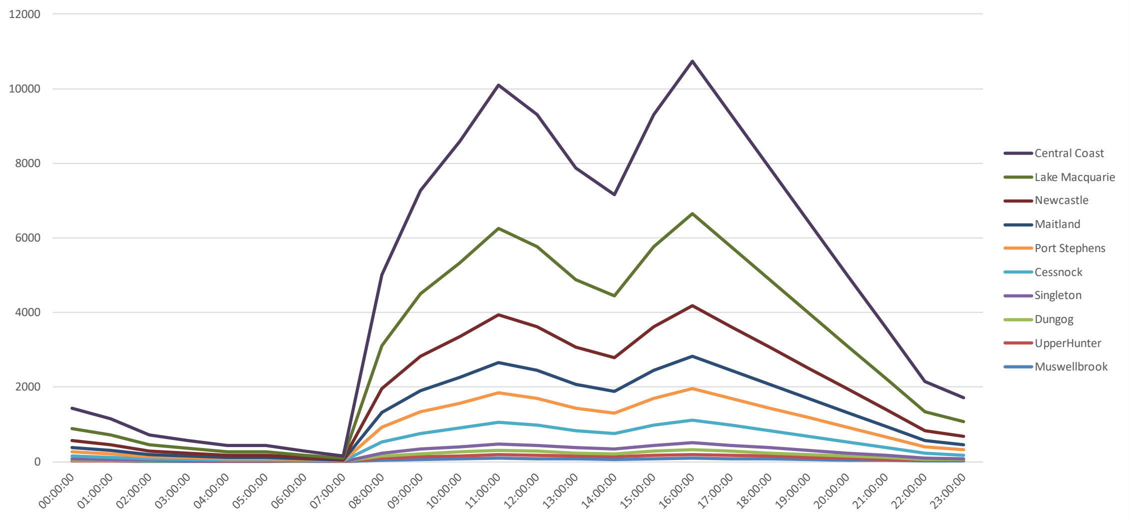
- Holographic Building Visualisation
- 360-degree 8K streaming and QR code scanning from wireless video cameras
- Internet of Things (IoT) structural sensing
- Real-time design displays

Demand for the network infrastructure



Demand will differ by region depending on the impact that the sector has on each region

Evaluation of usage throughout the day



ASSUMPTIONS

- Highest demand between 8am-12pm and 2-6pm
- Lower demand between 12-2pm and 6pm-8am
- Most prevalent in urban areas

Demand for Manufacturing

The expected demand for each sector considers the type and number of devices required for the applications identified and the throughput necessary.

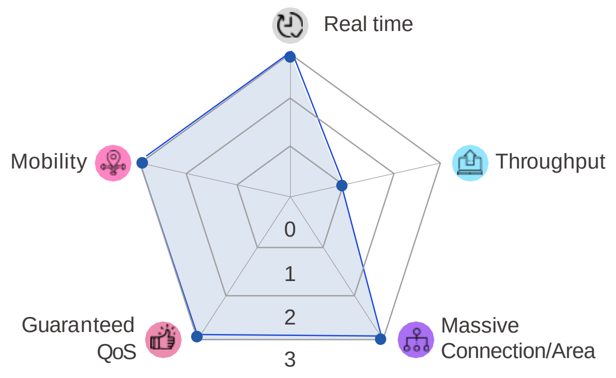
04

Manufacturing

APPLICATIONS

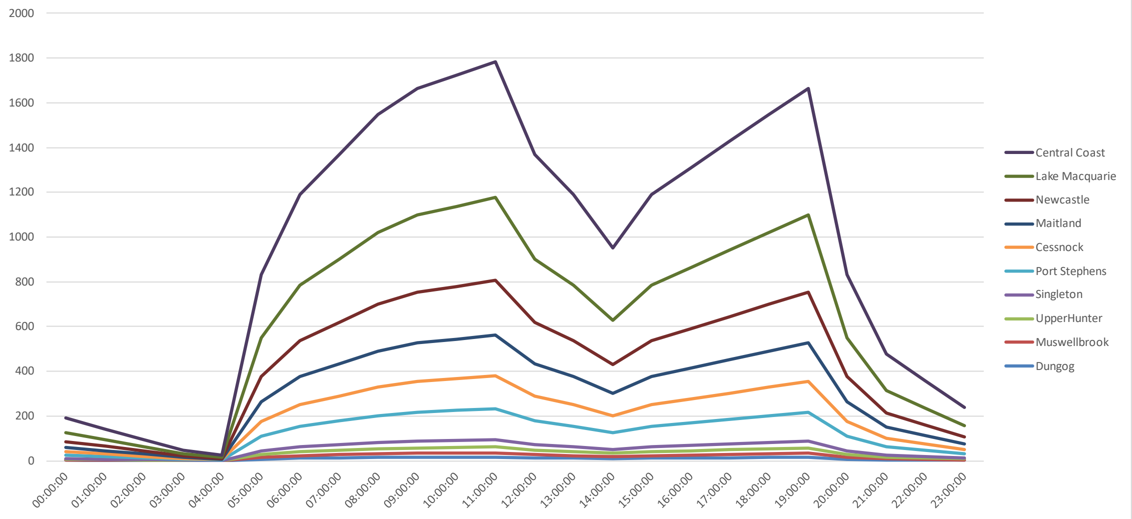
- VR/AR equipment to assist in assembling lines
- Real-time control
- Connecting equipment (sensors, etc.)
- Synchronised robots, control by AI-based detection

Demand for the network infrastructure



Demand will differ by region depending on the impact that the sector has on each region

Evaluation of usage throughout the day



ASSUMPTIONS

- Relatively constant demand
- Peak starting earlier (5am-12pm)
- Decrease in demand between 12-2pm
- Peak between 2-7pm
- Demand almost constant but never zero between 8pm-5am,
- Most prevalent in urban regions

Demand Wholesale and Retail Trade

The expected demand for each sector considers the type and number of devices required for the applications identified and the throughput necessary.

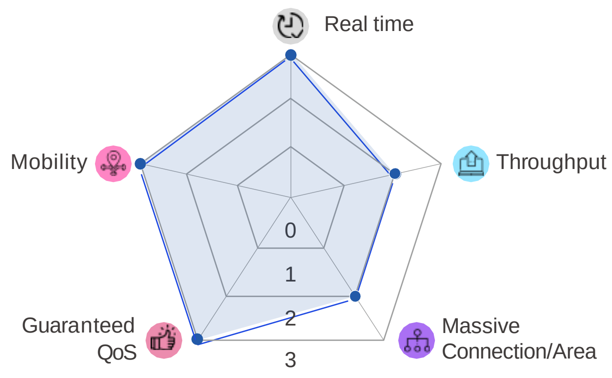
05

Wholesale and Retail Trade

APPLICATIONS

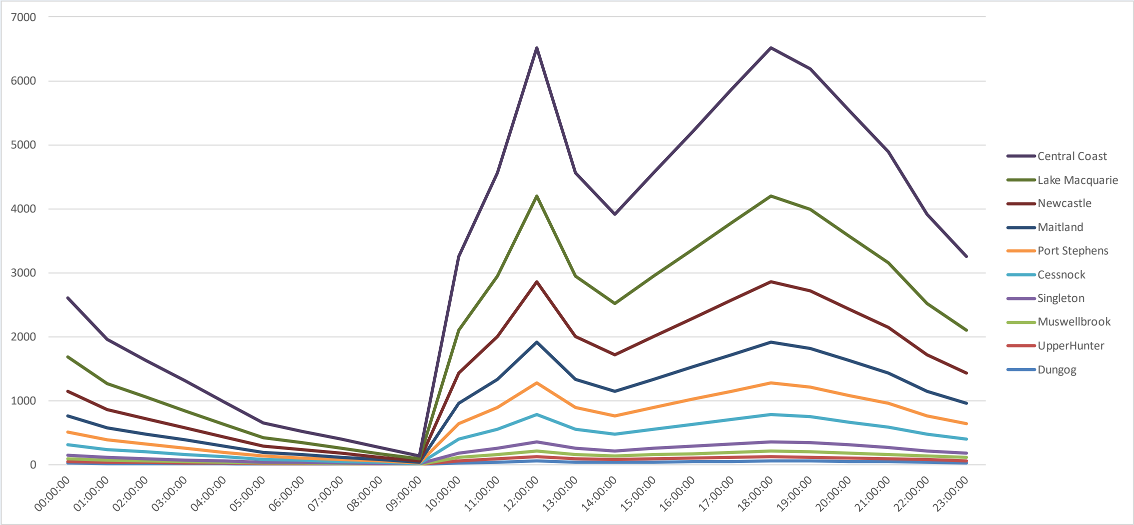
- Sensors to provide real-time inventory visibility
- Immersive experiences (e.g. shoppers are able to immediately check product materials or ingredients through the use of smart glasses or smartphones)
- Personalisation (with lower latency, retailers will also be able to respond to purchasing patterns and behaviours with immersive, tailored content in real time)

Demand for the network infrastructure



Demand will differ by region depending on the impact that the sector has on each region

Evaluation of usage throughout the day



ASSUMPTIONS

- Highest demand between 12-2pm and 6-10pm
- Low demand between 10-12am and 2-4pm
- Average demand 4-6pm
- Demand near zero between 10pm-10am
- Most prevalent in urban regions

Demand for Transportation and Warehousing

The expected demand for each sector considers the type and number of devices required for the applications identified and the throughput necessary.

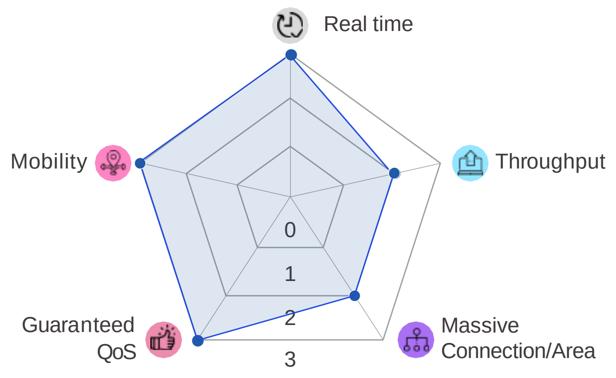
06

Transportation & Warehousing

APPLICATIONS

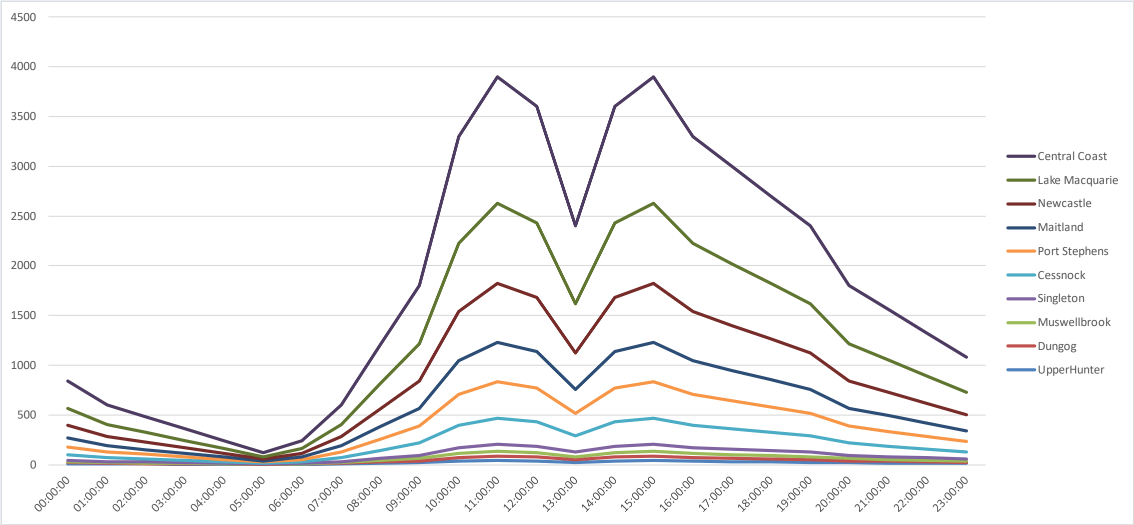
- End-to-end connectivity
- Vehicle-to-vehicle (V2V): Vehicles relay signals directly to each other
- Vehicle-to-infrastructure (V2I): Vehicles communicate with sensors on bridges, roads and traffic lights

Demand for the network infrastructure



Demand will differ by region depending on the impact that the sector has on each region

Evaluation of usage throughout the day



ASSUMPTIONS

- Highest demand between 10am-12pm and 2-4pm
- Demand close to zero between 7pm-7am
- Low demand between 8-9am and 4-7pm
- Most prevalent in urban regions

Demand for Finance, Insurance, Real Estate and Leasing

The expected demand for each sector considers the type and number of devices required for the applications identified and the throughput necessary.

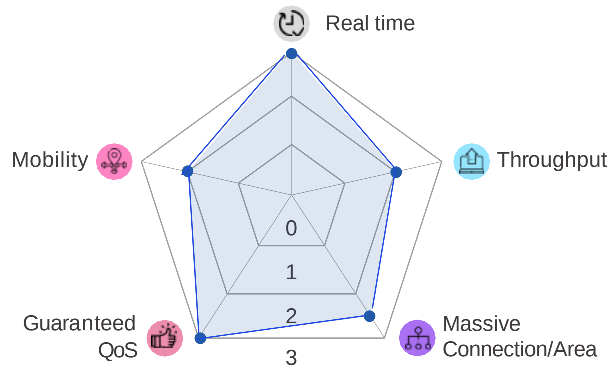
07

Finance, Insurance, Real Estate, Rental Leasing

APPLICATIONS

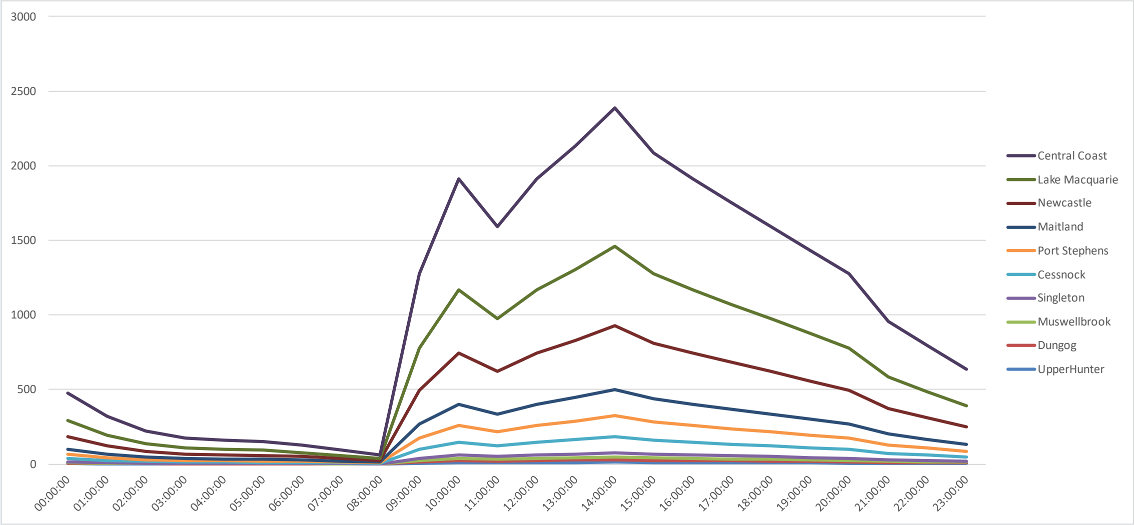
- Financial advice from AI robots
- Increased security and personalised banking
- Blockchain and trade finance
- Faster insurance analysis
- Wearable technology and banking
- Pop-up branches and ATMs
- Finance apps will move to the cloud

Demand for the network infrastructure



Demand will differ by region depending on the impact that the sector has on each region

Evaluation of usage throughout the day



ASSUMPTIONS

- Highest demand between 9am-3pm
- Low demand between 3-9pm
- Peak demand 12-3pm
- Most prevalent in urban regions

Demand for Professional Scientific and Technical Services

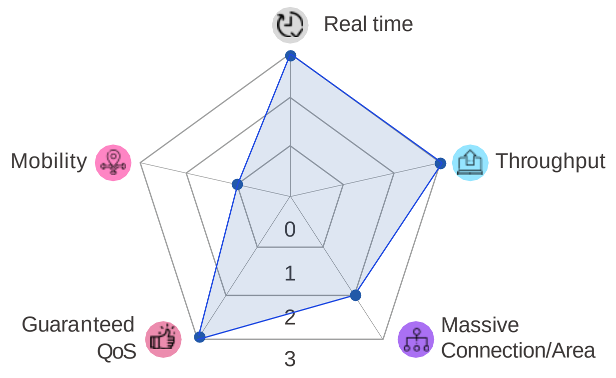
The expected demand for each sector considers the type and number of devices required for the applications identified and the throughput necessary.

08
Professional, Scientific & Technical Services

APPLICATIONS

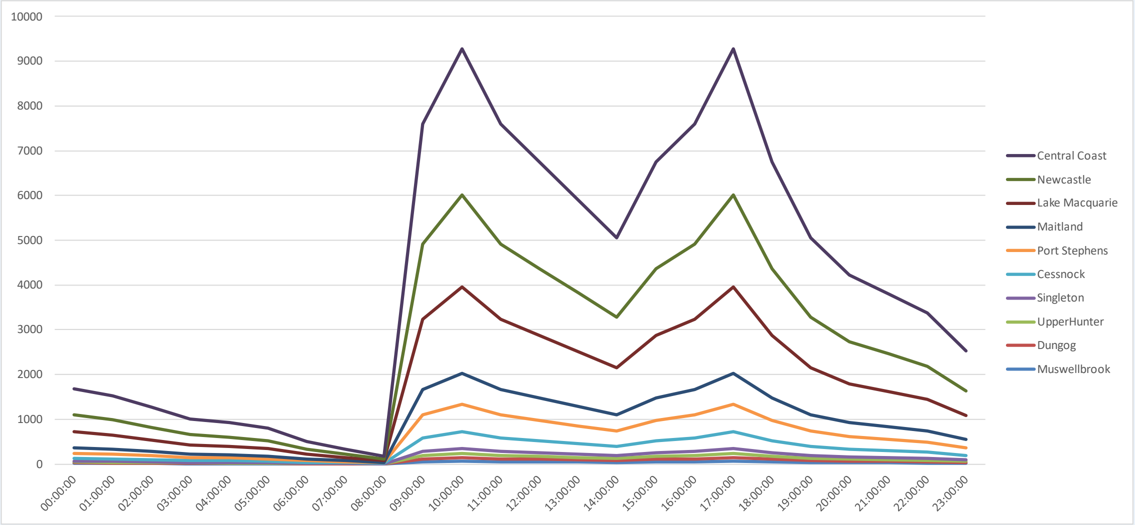
- 5G IoT via nanosatellite
- Real-time and predictive analytics trough sensors
- Robotisation and Science Experimental Automation

Demand for the network infrastructure



Demand will differ by region depending on the impact that the sector has on each region

Evaluation of usage throughout the day



ASSUMPTIONS

- Highest demand between 9am-6pm
- Peak between 9am-12pm and 3-6pm
- Low demand between 6-11pm
- Close to zero between 11pm-9am
- Most prevalent in urban regions

Demand Business, Building, and other support services

The expected demand for each sector considers the type and number of devices required for the applications identified and the throughput necessary.

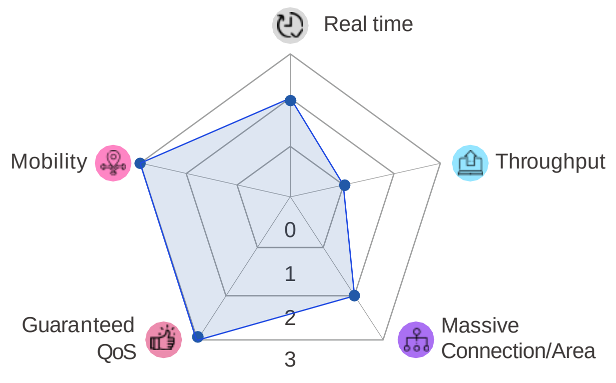
09

Business, Building and other support services

APPLICATIONS

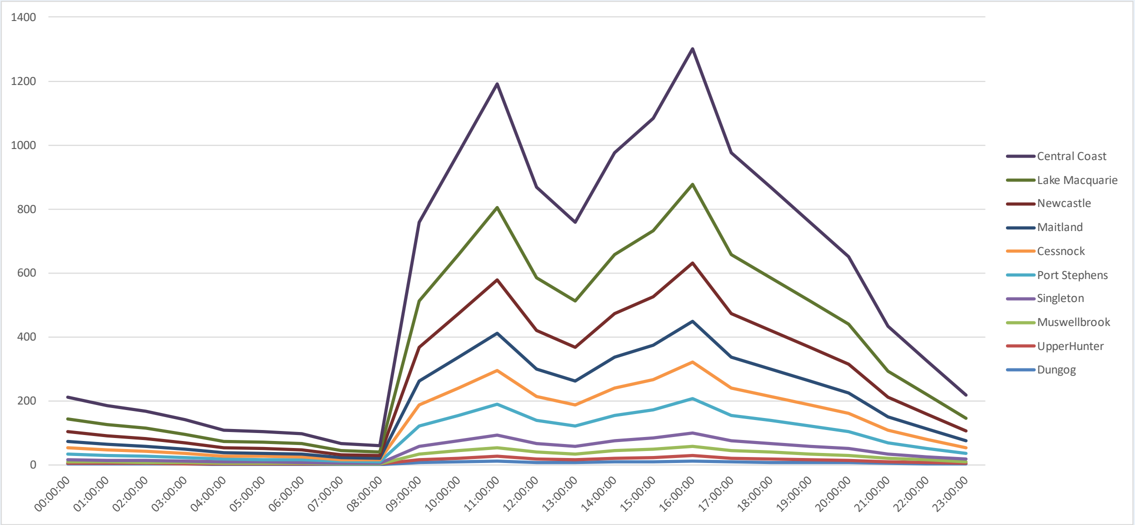
- Harmonise building use and equipment utilisation (orchestrating heating, air conditioning, and ventilation systems)
- Better utilisation of space
- Automated systems to monitor and regulate air quality and IT-assisted booking options for parking spaces or desks

Demand for the network infrastructure



Demand will differ by region depending on the impact that the sector has on each region

Evaluation of usage throughout the day



ASSUMPTIONS

- Peak between 10am-12pm and 2-6pm
- Demand never zero
- Average demand between 8-10am, 12-2pm and 6-10pm
- Demand close to zero between 10pm-8am
- Most prevalent in urban regions

Demand for Educational Services

The expected demand for each sector considers the type and number of devices required for the applications identified and the throughput necessary.

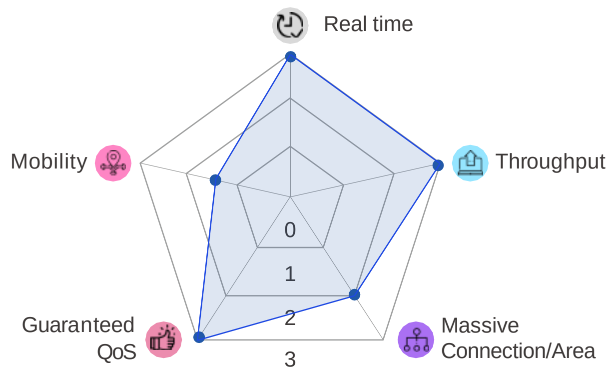
10

Educational Services

APPLICATIONS

- VR/AR-enhanced education
- IoT offerings
- Remote learning

Demand for the network infrastructure

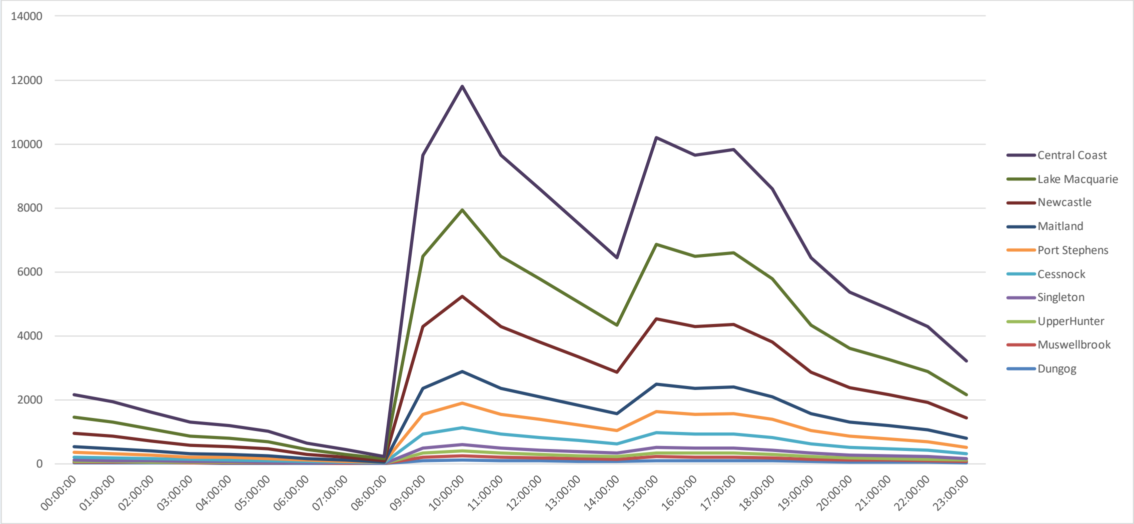


ASSUMPTIONS

- Highest demand between 8am-1pm and 2-5/6pm
- Average demand between 12-2pm
- Low demand between 6pm-8am
- Predominant in urban and rural but more in urban regions

Demand will differ by region depending on the impact that the sector has on each region

Evaluation of usage throughout the day



Demand for Healthcare and Social Assistance

The expected demand for each sector considers the type and number of devices required for the applications identified and the throughput necessary.

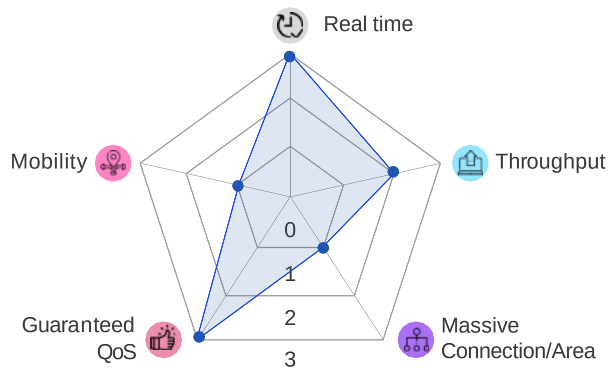
11

Healthcare & Social Assistance

APPLICATIONS

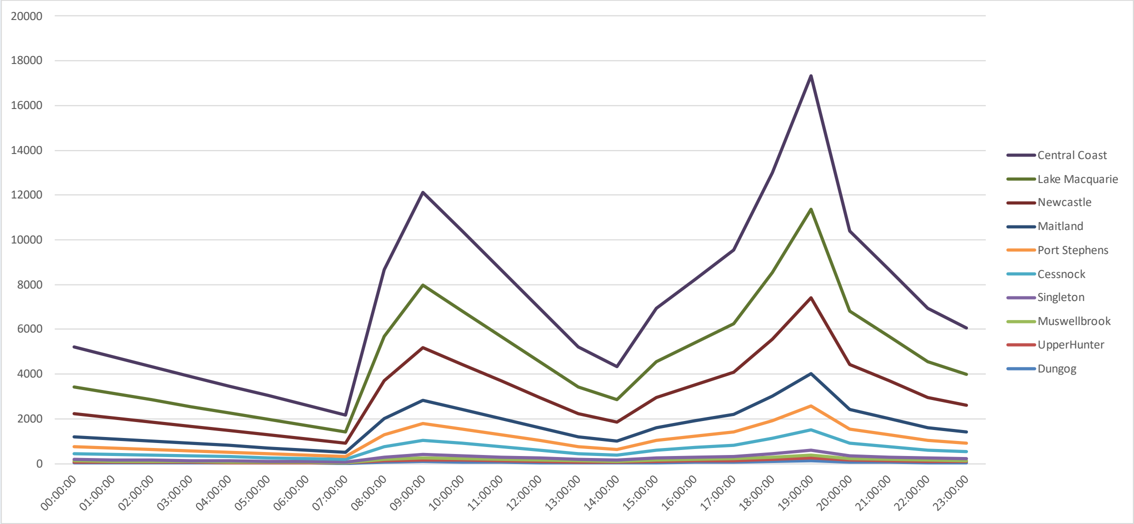
- Remote patient monitoring
- Connected ambulance
- HD virtual consultations
- Video-enabled prescription management
- AR/VR assistance for the blind
- Distraction and rehabilitation therapy
- Remote expert for collaboration in surgery
- AR/VR training and education
- Real-time, high-throughput computational processing
- Video analytics for behavioural recognition

Demand for the network infrastructure



Demand will differ by region depending on the impact that the sector has on each region

Evaluation of usage throughout the day



ASSUMPTIONS

- Vertical with higher values because it has more devices
- Lowest demand between 12-7am
- High demand between 9am-12pm and 4-8pm
- Average demand between 7-9am, 8pm-12am
- Never zero
- More prevalent in urban regions

Demand for Arts, Information, Culture and Recreation

The expected demand for each sector considers the type and number of devices required for the applications identified and the throughput necessary.

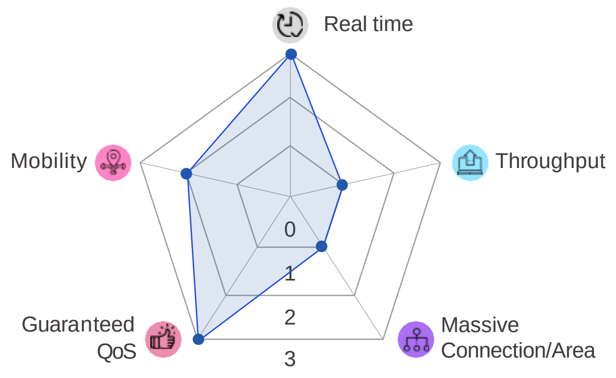
12

Arts, Information, Culture and Recreation

APPLICATIONS

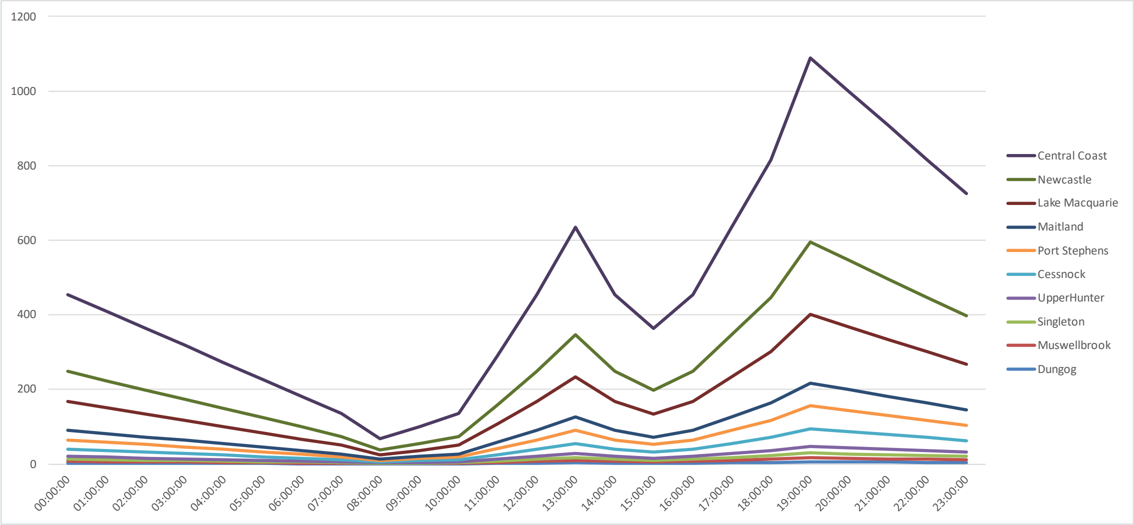
- Ultra-high-resolution scan capture technology
- Immersive experiences
- Real-time rendering and interactive AI

Demand for the network infrastructure



Demand will differ by region depending on the impact that the sector has on each region

Evaluation of usage throughout the day



ASSUMPTIONS

- Highest demand between 6pm-12am
- Average demand between 12-2pm
- Almost zero demand between 12-9am
- Low demand between 9am-12pm and 2-6pm

Demand for Accommodation & Food Services

The expected demand for each sector considers the type and number of devices required for the applications identified and the throughput necessary.

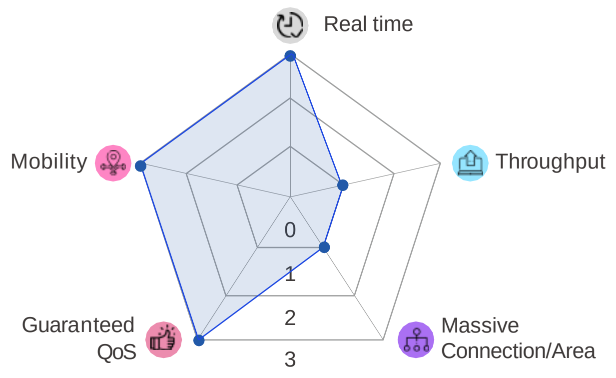
13

Accommodation & Food Services

APPLICATIONS

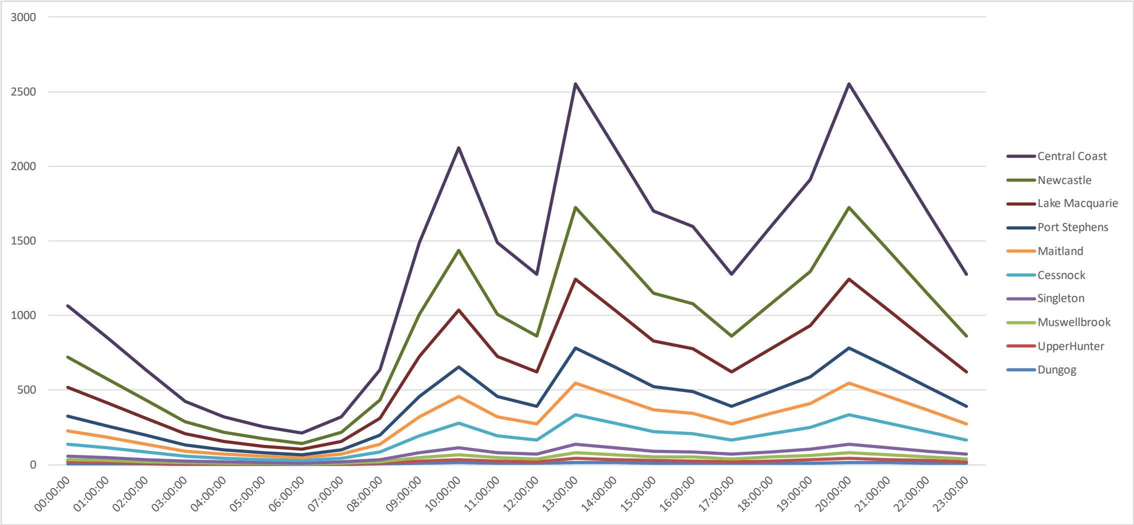
- Enhanced guest experiences with VR
- Drones
- Blockchain, IoT and AI for food end-to-end traceability

Demand for the network infrastructure



Demand will differ by region depending on the impact that the sector has on each region

Evaluation of usage throughout the day



ASSUMPTIONS

- Highest demand between 9-11am, 12-2pm, 7-9pm
- Average demand between 11am-12pm, 5-7pm, 9-11pm
- Low demand between 2-5pm and 11pm-9am

Demand for Other Services (Non-Public Administration)

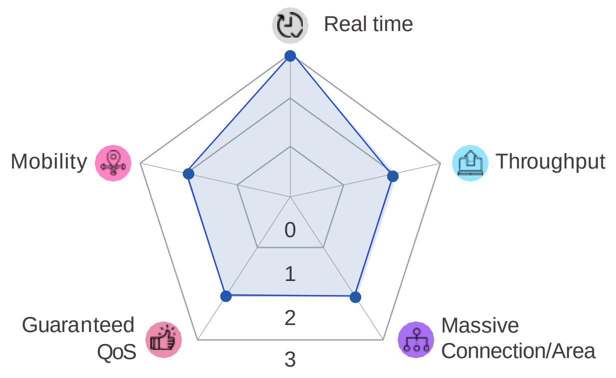
The expected demand for each sector considers the type and number of devices required for the applications identified and the throughput necessary.

14
Other Services (Non-Public Administration)

APPLICATIONS

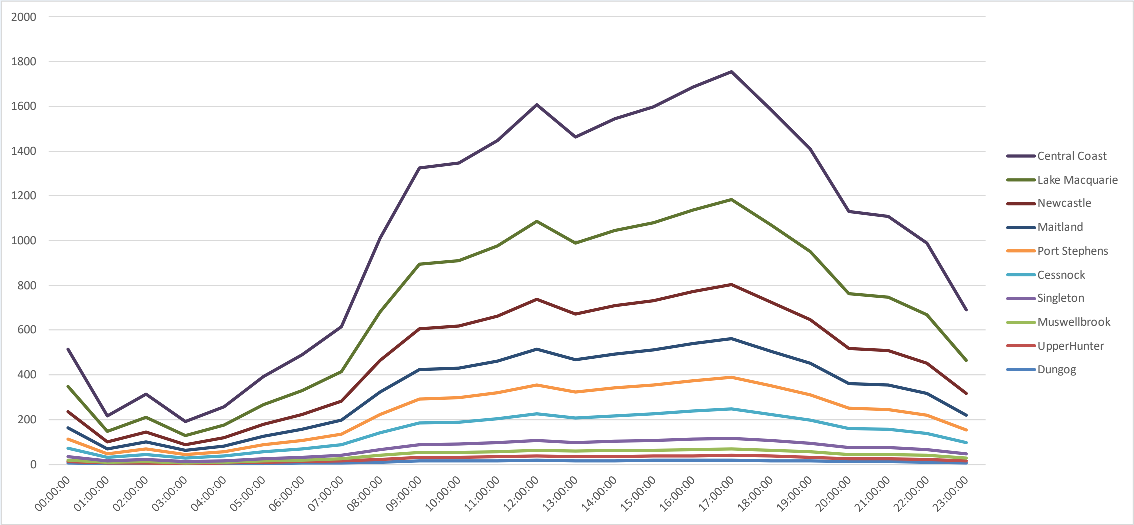
- Connected Field Services
- Immersive Customer Experiences
- Advanced Fleet Management

Demand for the network infrastructure



Demand will differ by region depending on the impact that the sector has on each region

Evaluation of usage throughout the day



ASSUMPTIONS

- Highest demand between 10am-12pm, 2-4pm, 7-9pm
- Average demand between 12-2pm and 4-7pm
- Low demand between 9pm-10am

Demand for Public Administration

The expected demand for each sector considers the type and number of devices required for the applications identified and the throughput necessary.

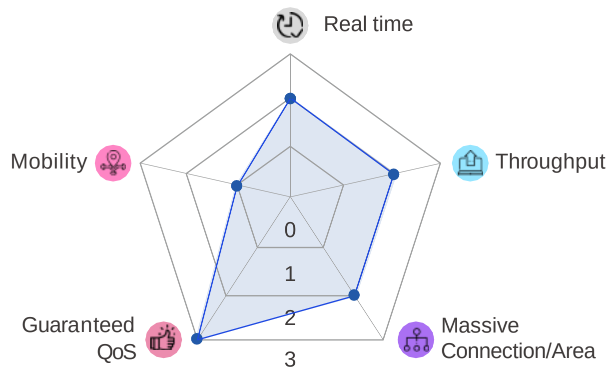
15

Public Administration

APPLICATIONS

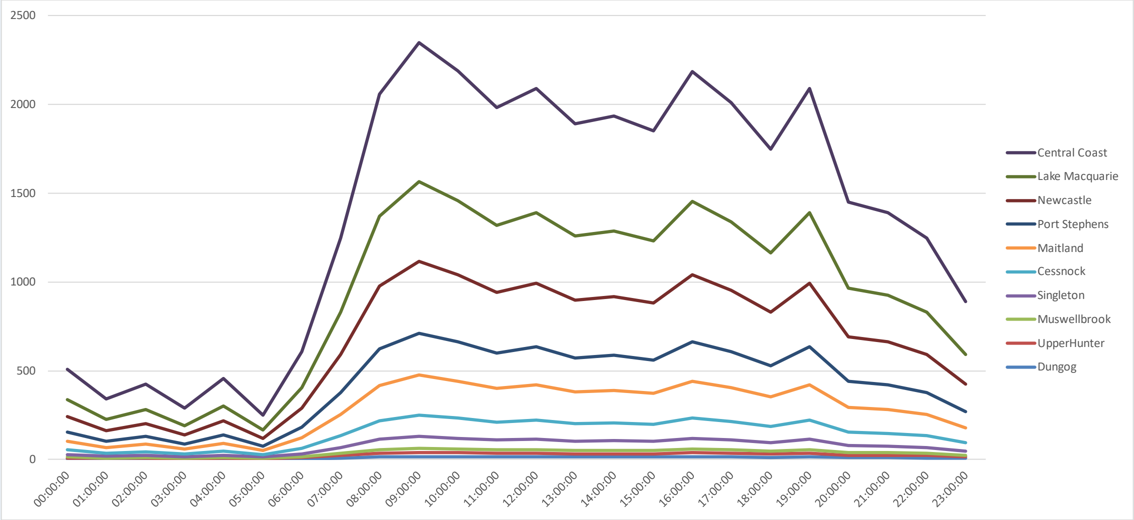
- Smart city management
- Augmented Reality (AR) for public services
- Secure telecommuting

Demand for the network infrastructure



Demand will differ by region depending on the impact that the sector has on each region

Evaluation of usage throughout the day



ASSUMPTIONS

- Highest demand between 9-11am, 3-4pm, 6-7pm
- Average demand between 11am-2pm and 5-6pm
- Low demand between 8pm-9am

Demand for Households and Consumer Goods

The expected demand for each sector considers the type and number of devices required for the applications identified and the throughput necessary.

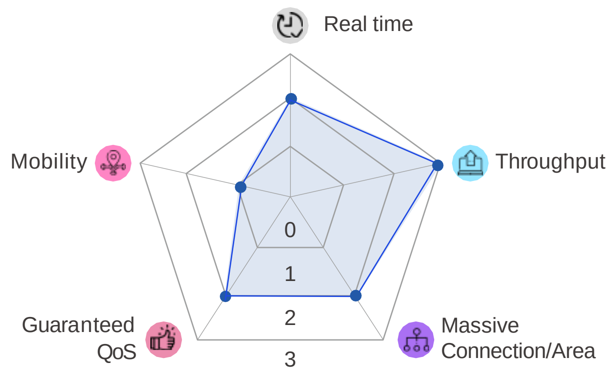
16

Households and Consumer Goods

APPLICATIONS

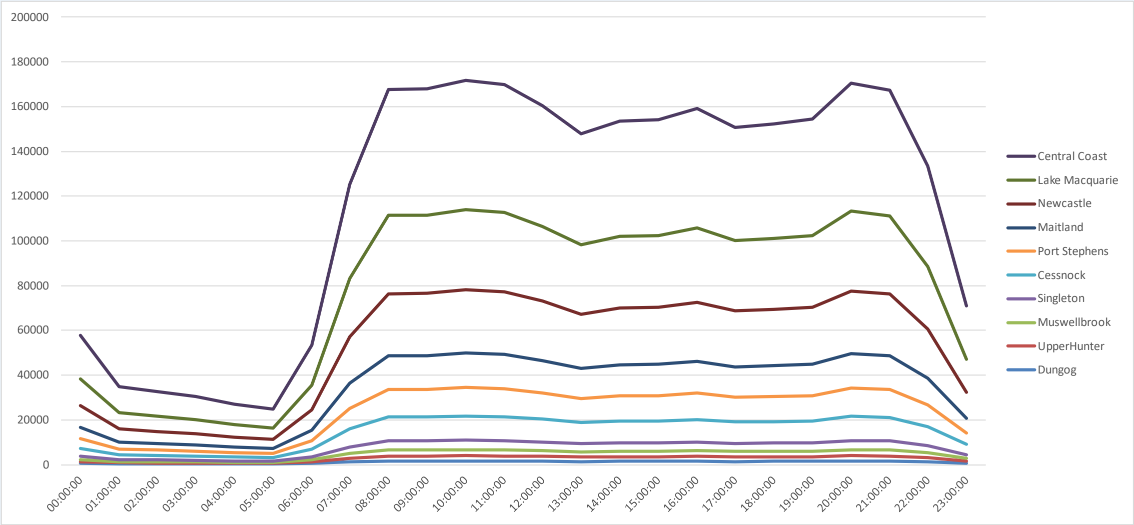
- Smart home automation
- Connected appliances
- Teleworking

Demand for the network infrastructure



Demand will differ by region depending on the impact that the sector has on each region

Evaluation of usage throughout the day



ASSUMPTIONS

- Highest demand between 8-10am, 4-5pm, 8-9pm
- Average demand between 11am-3pm, 6-7pm
- Low demand between 10pm-6am

Demand for Visitors/Tourism

The expected demand for each sector considers the type and number of devices required for the applications identified and the throughput necessary.

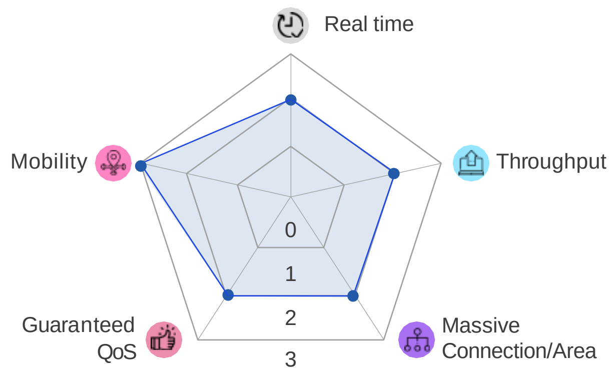
17

Visitors/ Tourism

APPLICATIONS

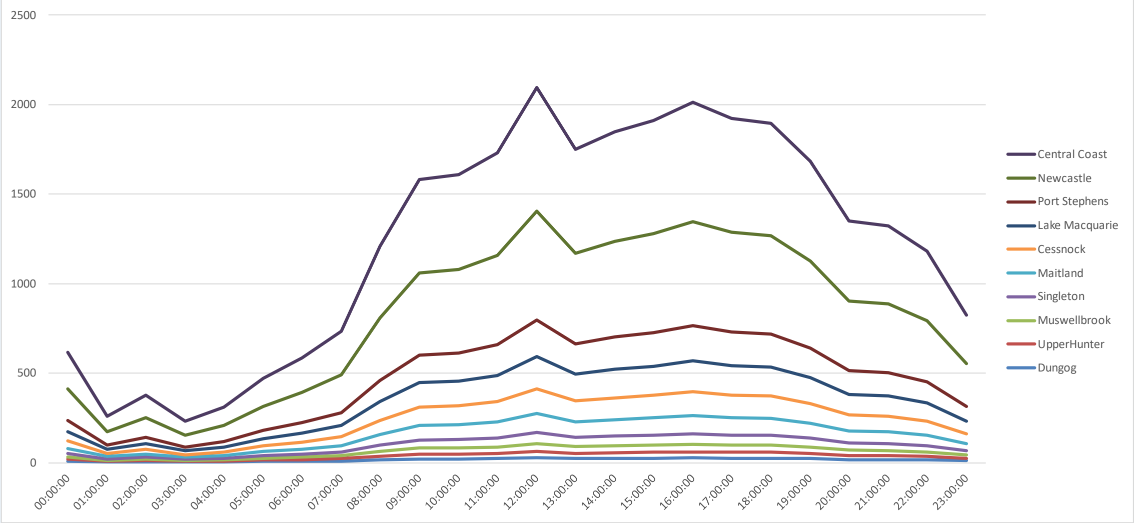
- Augmented Reality (AR) tourism guides
- Virtual Reality travel experiences
- Real-time language translation

Demand for the network infrastructure



Demand will differ by region depending on the impact that the sector has on each region

Evaluation of usage throughout the day



ASSUMPTIONS

- Highest demand between 10am-12pm and 3-7pm
- Average demand between 1-3pm and 7-9pm
- Low demand between 9pm-10am

Connectivity Demand Model – Estimating network traffic

Demand Model - Approach to Estimate the Traffic for Each Region

There are six steps in our approach to develop the future connectivity and capacity model in the DSSN region, across the 17 sectors and 10 LGAs.

1 Throughput distribution estimation per industry sector / vertical

2 Estimation of average traffic per device, per vertical

3 Calculate busy hour peak traffic / network usage

4 Calculate the busy hour contention ratio

5 Calculate the headroom extra capacity

Demand Model - Throughput Distribution

Tailoring throughput estimates to specific industry sectors ensures a more accurate representation of their unique demands, allowing for targeted infrastructure planning and network resources allocation.

Step 1: Estimation of the throughput distribution per industry sector.

Throughput Definition: Speed at which data is successfully transmitted or processed through a system or network.

1a

Verticals / Indsutry Sectors	Throughput [Mbps]							
	0.5	1	2	5	10	50	100	1000
Agriculture, Forestry, Fishing, and Hunting + Mining, Quarrying, and Oil and Gas Extraction	30%	30%	25%	5%	5%	2%	2%	1.0%
Utilities	30%	30%	20%	5%	10%	2%	2%	1.0%
Construction	5%	15%	15%	25%	22%	10%	5%	3.0%
Manufacturing	20%	25%	30%	15%	5%	2%	2%	1.0%
Wholesale Trade + Retail Trade	5%	15%	20%	24%	15%	15%	5%	1.0%
Transportation and Warehousing	12%	10%	10%	20%	30%	10%	5%	3.0%
Finance and Insurance + Real Estate and Rental and Leasing Services	5%	20%	30%	15%	14%	10%	5%	1.0%

2

1a

To define throughput, a range spanning from **0.5 Mbps** to **1000 Mbps** (1 Gbps) has been established.

2

For each industry sector, a percentage distribution is allocated to each throughput value, taking into account the aforementioned scale.

For example, the manufacturing sector falls within the **'lowest**' scale, indicating that the maximum throughput percentages will be up to **20 Mbps**.

Demand Model - Average Traffic per Device

Understanding the average traffic per device and vertical enables precise capacity planning, ensuring that the network is equipped to handle the typical usage patterns of different sectors.

Step 2: Estimation of average traffic per device and vertical.

Average Traffic per Device Definition: Estimated traffic that each device in the respective sector consumes on the network per second.

Verticals / Industry Sectors	Throughput [Mbps]								1 Average Throughput per Device [Mbps]
	0.5	1	2	5	10	50	100	1000	
Agriculture, Forestry, Fishing, and Hunting + Mining, Quarrying, and Oil and Gas Extraction	30%	30%	25%	5%	5%	2%	2%	1.0%	14.7
Utilities	30%	30%	20%	5%	10%	2%	2%	1.0%	15.1
Construction	5%	15%	15%	25%	22%	10%	5%	3.0%	43.9
Manufacturing	20%	25%	30%	15%	5%	2%	2%	1.0%	15.2
Wholesale Trade + Retail Trade	5%	15%	20%	24%	15%	15%	5%	1.0%	25.8
Transportation and Warehousing	12%	10%	10%	20%	30%	10%	5%	3.0%	44.4
Finance and Insurance + Real Estate and Rental and Leasing Services	5%	20%	30%	15%	14%	10%	5%	1.0%	22.9

1

The estimation of average traffic per device for each industry sector is determined by **multiplying the allocated percentages by their respective throughput values.**

Example of calculation:

Average Traffic per Device for the Manufacturing Sector = (20% x 0.5Mbps) + (25% x 1Mbps) + (30% x 2Mbps) + (15% x 5Mbps) + (5% x 10Mbps) + (2% x 50Mbps) + (2% x 100Mbps) + (1% x 1000Mbps) = **15.2 Mbps**

Demand Model - Busy Hour

Determining peak traffic during busy hours provides insights into the maximum load that the network might experience. This information aids in dimensioning the network infrastructure to accommodate peak demand without performance degradation.

Step 3: Calculate Busy Hour peak traffic / network usage

Busy Hour Definition: Period during the day when **network usage or traffic is at its highest level**. It is a specific one-hour time frame within a 24-hour day when the demand for network resources, such as bandwidth and connectivity, is most intensive.

1

Busy Hour
20%*

2

Verticals/ Sectors	Devices in 2023	Traffic (Mbps)	Busy Hour 20%
Agriculture, forestry, fishing, and hunting + Mining, quarrying, and oil and gas extraction	45277	14,7	133114,4829

1

The busy hour value is set at 20% based on industry standards, meaning that during the peak demand hour, it is expected that **20% of the devices** allocated to the region will be **connected to the network**.

2

For each of the verticals, as indicated in the preceding slide 'Traffic Estimation per Vertical,' the average throughput consumed by each device is estimated. In the specific case of **Cessnock**, **45,277 devices** are connected to the **agriculture, fishing, and mining sector**. Multiplying this by the average throughput per device (**14.7 Mbps**) provides the total throughput value. However, given the assumption that **the maximum number of devices connected to the network** during the **peak demand hour** is **20%**, the result is **133,144 Mbps**.

Traffic in busy hour = **Average Traffic for the sector** x **Total Number of Devices** x **Percentage of Devices in the Busy Hour**

133,114 = 14.7 x 45,277 x 20%

***Source:** Traffic Analysis - Cisco - "In the standard business environment, the busy hour of any given day accounts for approximately 15 to 20 percent of the traffic for that day"

Demand Model - Contention Ratio

The busy hour contention ratio helps evaluate the network's ability to handle concurrent demands. By calculating this ratio, it is possible to identify potential bottlenecks and optimise the network for improved performance during peak periods.

Step 4: Calculate the busy hour contention ratio

Contention Ratio Definition: Insight into the relationship between the resources available in the network and the level of demand placed on it. In this case, if the contention ratio is 1/50, it means that the available network capacity is 1 unit for every 50 units of demand or usage.

1

Contention Ratio
1/50*

2

Verticals/ Sectors	Devices in 2023	Traffic [Mbps]	Busy Hour 20%	Busy Hour/Contention Ratio [Mbps] 50
Agriculture, forestry, fishing, and hunting + Mining, quarrying, and oil and gas extraction	45277	14,7	133114,4829	2662,289657

1

The contention ratio value is set at 1/50 based on industry standards. It is used in situations of **peak demand** to **enable service providers to manage bandwidth for different devices**. For example, an access point with **1 Gbps of access speed during peak demand** may see its traffic **contained to up to 50 times** (20 Mbps) **to prevent network saturation** and consequently availability of the service.

2

After calculating the busy hour throughput in the previous slide, with a value of **133,114 Mbps**, a contention ratio of 1/50 is then applied, resulting in a value of **2,662 Mbps.**

This value (2,662 Mbps) represents the **portion of the total available bandwidth that is allocated to users during the busy hour**.

Traffic in busy hour with contention ratio applied = **Traffic in busy hour** / **50**

2,662 = 133,114 / 50

***Source:** Truespeed - Contention Ratio - “Most residential broadband customers would normally be hovering at around a 1:50 contention ratio.”

Demand Model - Headroom Extra Capacity

Computing headroom extra capacity ensures that the network has a buffer to handle unexpected surges in demand or future growth. This proactive approach minimises the risk of congestion and service degradation, providing a more robust and resilient network infrastructure.

Step 5: Calculate the headroom extra capacity

Headroom Extra Capacity Definition: The additional capacity intentionally built into a network infrastructure beyond the expected peak demand during the busy hour. This extra capacity serves as a buffer or safety margin to accommodate unforeseen increases in network traffic or unexpected spikes in demand.

1

Headroom Extra Capacity

20%

2

Verticals/ Sectors	Devices in 2023	Traffic [Mbps]	Busy Hour 20%	Busy Hour/Contention Ratio [Mbps] 50	+ Headroom Extra Capacity 20%
Agriculture, forestry, fishing, and hunting + Mining, quarrying, and oil and gas extraction	45277	14.7	133134.4820	2662.289657	3194.747589

1

The headroom extra capacity value is set at 20% based on industry standards, meaning that during the **peak demand hour**, the service provider has allocated an **additional 20% buffer of network capacity**.

Why is it important to define extra capacity?
1 - **Buffer for specific peaks**, such as special events.
2 - **Optimising user experience,** ensuring that during peak demand situations, users do not experience constraints in accessing the network.
3 - **Future growth,** considering future capacity planning reducing the need for frequent updates.
4 - **Redundancy,** ensuring that backup resources are available in case of a failure.

2

After calculating the estimated traffic during the busy hour and accounting for the contention factor, it is necessary to **allocate an additional portion of network capacity** for situations where there is a **peak demand higher than estimated**, such as during **special events.** This ensures **the best quality of service to users** in **case of possible network failures and issues**.

To calculate the estimated traffic with the headroom extra capacity (**3,194 Mbps**), a **20% increase** was added to the estimated traffic during the busy hour with the contention factor applied (**2,662 Mbps**).

Traffic considering headroom extra capacity = **Traffic in the busy hour with contention ratio applied** + **Additional headroom capacity**

$$3{,}194 = 2{,}662 + (2{,}662 \times 20\%)$$

Demand Model Output Example (Central Coast Region, 2023)

Following the execution of the connectivity demand model with the inputs provided, a comprehensive overview of network traffic, encompassing factors such as contention ratio and headroom. This data feeds into models for projecting and estimating the current and future network requirements.

2023	Central Coast													
Verticals/ Sectors	Devices in 2023	Throughput [Mbps]								Use Cases	Average Throughput per Device [Mbps]	Busy Hour	Busy Hour/Contention Ratio [Mbps]	+ Headroom Extra Capacity [Mbps]
		0,5	1	2	5	10	50	100	1000			20%	50	20%
Agriculture, Forestry, Fishing, Mining, Quarrying, Oil & Gas	23,815	30%	30%	25%	5%	5%	2%	2%	1%	Monitoring Sensor Networks / Device Remote Controlling	14.7	70,017	1,400	1,680
Utilities	18,319	30%	30%	20%	5%	10%	2%	2%	1%	Monitoring Sensor Networks / Device Remote Controlling / Wireless Cloud-based office	15.1	55,325	1,106	1,328
Construction	210,673	5%	15%	15%	25%	22%	10%	5%	3%	Monitoring Sensor Networks / Device Remote Controlling / Bi-directional remote controlling / Virtual Reality / Real time 3D modelling / GPS tracking and tools / IoT sensor structuring	43.9	1,850,764	37,015	44,418
Manufacturing	108,085	20%	25%	30%	15%	5%	2%	2%	1%	Device Remote Controlling / Bi-directional remote controlling	15.2	328,577	6,572	7,886
Wholesale and Retail Trade	227,161	5%	15%	20%	24%	15%	15%	5%	1%	Monitoring Sensor Networks / Device Remote Controlling / Wireless Cloud-based office	25.8	1,171,013	23,420	28,104
Transportation and Warehousing	67,782	12%	10%	10%	20%	30%	10%	5%	3%	Autonomous Driving, Automotive ecall, Monitoring Sensor Networks/Device Remote Controlling, First responder connectivity	44.4	601,360	12,027	14,433
Finance, Insurance, Real Estate, Rental & Leasing	89,765	5%	20%	30%	15%	14%	10%	5%	1%	Wireless Cloud-based office, Online Banking, Mobile Banking, Blockchain, Trade Finance, Wearable devices (Digital Payment)	23.0	412,471	8,249	9,899
Professional, Scientific, and Technical Services	109,916	5%	10%	10%	15%	25%	16%	15%	4%	Virtual Reality / Tactile Internet / AR/VR, Nanosatellites	66.6	1,463,538	29,271	35,125
Management of Business, Building & Other Support Services	60,454	30%	25%	25%	10%	5%	2%	2%	1%	Monitoring Sensor Networks/Device Remote Controlling / Disaster alert	14.9	180,153	3,603	4,324
Educational Services	150,219	10%	12%	12%	10%	18%	20%	15%	3%	Multi-Person Video Call / Video Streaming/ AR/VR / Remote Learning	57.7	1,733,829	34,677	41,612
Healthcare and Social Assistance	326,085	10%	15%	20%	18%	15%	10%	10%	2%	Monitoring Sensor Networks / Device Remote Controlling / Connected Ambulances / Augmented Reality / Virtual Reality / Multi-person video call	38.0	2,478,250	49,565	59,478
Arts, Information, Culture & Recreation	54,958	25%	20%	17%	15%	10%	10%	2%	1%	Video streaming / Personal cloud / Real time gaming / Device Remote Controlling / VR	19.4	213,403	4,268	5,122
Accommodation and Food Services	128,236	30%	27%	20%	5%	10%	5%	2%	1%	Monitoring Sensor Networks / Device Remote Controlling / Disaster alert / First responder connectivity	16.6	424,974	8,499	10,199
Other Services (Excluding Public Administration)	69,614	10%	14%	15%	20%	25%	10%	5%	1%	Monitoring Sensor Networks / Device Remote Controlling / Bi-directional remote controlling/ Wireless cloud-based office	24.0	334,007	6,680	8,016
Public Administration	111,748	10%	15%	20%	22%	20%	10%	2%	1%	Multi-Person Video Call / Video Streaming / Monitoring Sensor Networks / Bi-directional remote controlling	20.7	462,638	9,253	11,103
Households & Consumer Goods	1,448,001	5%	5%	10%	10%	15%	20%	25%	10%	Videostreaming / Real time gaming / First responder connectivity / VR / Multi-person video call / Personal Cloud / Device remote controlling / Monitoring sensor networks	137.3	39,754,872	795,097	954,117
Visitor Demand	41,278	5%	13%	20%	25%	20%	10%	5%	2%	Video Streaming / Multi-Person Video Call / Personal Cloud	33.8	279,083	5,582	6,698

Appendix 5.4 Telecommunications Infrastructure Options

Analysis of the simulated capacity demand for each LGA based on the three scenarios, and infrastructure needed to meet the simulated demand.

Wireless Simulated Capacity for each LGA

Wireless - Simulated Capacity: Central Coast

Below, the capacity status for the Central Coast region under low demand scenario conditions is presented.

Low Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023**: 2,315,222
- **2025**: 2,788,162
- **2030**: 4,750,299

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(265)**

- **4G co-located with 5G**: 98
- **Urban Sites:** 165
- **Rural Sites:** 2

Urban vs Rural Split:

- **Urban** – 98.8%
- **Rural –** 1.2%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	61.6%	57.2%	43.2%
2025	68.3%	63.4%	52.1%
2030	93.2%	86.4%	88.7%

<90%
90%-100%
>100%

- After running the model for the Central Coast region, it can be observed that for the **year 2023, 2025, and 2030, the current scenario in terms of sites supports the necessary demand**.

3 - Future State

Conducting traffic projections associated with devices for **the Central Coast** region in the Wireless component, it is possible to conclude that in a **Low Scenario** regarding the number of devices, **the current network infrastructure** will **sustain the projected demand** until the year **2030**, with the highest value being **93.2% capacity** in terms of utilization for downlink/transmission communication from the base station to the respective devices.

The installation/deployment of new radio mobile sites is not necessarily required.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	61.6%	57.2%	43.2%
2025	68.3%	63.4%	52.1%
2030	93.2%	86.4%	88.7%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Central Coast

Below, the capacity status for the Central Coast region under baseline demand scenario conditions is presented.

Baseline Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023**: 3,321,220
- **2025**: 4,002,749
- **2030**: 6,824,775

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(265)**

- **4G co-located with 5G**: 98
- **Urban Sites:** 165
- **Rural Sites:** 2

Urban vs Rural Split:

- **Urban** – 98.8%
- **Rural –** 1.2%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	69.8%	64.7%	49.0%
2025	77.5%	71.9%	59.0%
2030	105.7%	98.0%	100.6%

<90%
90%-100%
>100%

- After running the model for the Central Coast region, it can be observed that for the **year 2023 and 2025, the current scenario in terms of sites supports the necessary demand**. However, by the year **2030, there is already saturation in terms of network capacity**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2030** - Installation of **11 new base stations between 2025 and 2030**, resulting in a total of **276 sites** in the Central Coast region.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	69.8%	64.7%	49.0%
2025	77.5%	71.9%	59.0%
2030	99.5%	92.8%	95.9%

<90%
90%-100%
>100%

*__Important Note:__ While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Central Coast

Below, the capacity status for the Central Coast region under high demand scenario conditions is presented.

High Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023**: 4,754,122
- **2025**: 5,737,456
- **2030**: 9,792,225

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(265)**

- **4G co-located with 5G**: 98
- **Urban Sites:** 165
- **Rural Sites:** 2

Urban vs Rural Split:

- **Urban** – 98.8%
- **Rural –** 1.2%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	99.9%	92.7%	70.1%
2025	111.0%	103.0%	84.6%
2030	151.6%	140.6%	144.4%

<90%
90%-100%
>100%

- After running the model for the Central Coast region, it can be observed that for the **year 2023 the current scenario in terms of sites supports the necessary demand**. However, by the year **2025, there is already saturation in terms of network capacity**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2025 -** Installation of **20 new mobile base stations until 2025.**
- **2030 -** Installation of **79 new mobile base stations between 2025 and 2030**, resulting in a total of **364 radio mobile sites** in the Central Coast region.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	99.9%	92.7%	70.1%
2025	99.7%	93.4%	77.6%
2030	97.1%	93.3%	99.7%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Cessnock

Below, the capacity status for the Cessnock region under low demand scenario conditions is presented.

Low Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 450,889
- **2025:** 541,375
- **2030:** 915,154

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(59)**

- **4G co-located with 5G**: 17
- **Urban Sites:** 0
- **Rural Sites:** 42

Urban vs Rural Split:

- **Urban -** 0%
- **Rural -** 100%

2 - Present State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	58.6%	55.1%	37.1%
2025	64.7%	60.8%	44.6%
2030	83.6%	78.6%	75.4%

<90%
90%-100%
>100%

- After running the model for the Cessnock region, it can be observed that for the **year 2023 2025 and 2030, the current scenario in terms of sites supports the necessary demand**.

3 - Future State

Conducting traffic projections associated with devices for **the Cessnock** region in the Wireless component, it is possible to conclude that in a **Low Scenario** regarding the number of devices, **the current network infrastructure** will **sustain the projected demand** until the year **2030**, with the highest value being **83.6% capacity** in terms of utilization for downlink/transmission communication from the base station to the respective devices.

The installation/deployment of new radio mobile sites is not necessarily required.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	58.6%	55.1%	37.1%
2025	64.7%	60.8%	44.6%
2030	83.6%	78.6%	75.4%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Cessnock

Below, the capacity status for the Cessnock region under baseline demand scenario conditions is presented.

Baseline Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 656,652
- **2025:** 787,943
- **2030:** 1,328,358

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(59)**

- **4G co-located with 5G**: 17
- **Urban Sites:** 0
- **Rural Sites:** 42

Urban vs Rural Split:

- **Urban -** 0%
- **Rural -** 100%

2 - Present State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	83.1%	78.1%	54.1%
2025	91.4%	85.9%	64.9%
2030	121.4%	114.1%	109.4%

- <90%
- 90%-100%
- >100%

- After running the model for the Cessnock region, it can be observed that for the **year 2023 and 2025, the current scenario in terms of sites supports the necessary demand**. However, by the year **2030, there is already saturation in terms of network capacity**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2030** - Installation of **8 new base stations between 2025 and 2030**, resulting in a total of **67 radio mobile sites** in the Cessnock region.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	83.1%	78.1%	54.1%
2025	91.4%	85.9%	64.9%
2030	98.0%	92.7%	93.7%

- <90%
- 90%-100%
- >100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Cessnock

Below, the capacity status for the Cessnock region under high demand scenario conditions is presented.

High Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 954,996
- **2025:** 1,145,780
- **2030:** 1,925,977

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(59)**

- **4G co-located with 5G**: 17
- **Urban Sites:** 0
- **Rural Sites:** 42

Urban vs Rural Split:

- **Urban -** 0%
- **Rural -** 100%

2 - Present State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	120.8%	113.6%	78.6%
2025	132.9%	124.9%	94.3%
2030	176.1%	165.4%	158.6%

<90%
90%-100%
>100%

- After running the model for the Cessnock region, it can be observed that there is **currently saturation** in terms of **mobile network capacity**, requiring the **deployment of new radio sites**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2025 -** Installation of **12 new mobile base stations until 2025.**
- **2030 -** Installation of **17 new mobile base stations between 2025 and 2030**, resulting in a total of **88 radio mobile sites** in the Cessnock region.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	89.0%	84.3%	62.9%
2025	97.8%	92.7%	75.4%
2030	94.3%	90.0%	98.8%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Dungog

Below, the capacity status for the Dungog region under low demand scenario conditions is presented.

Low Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 66,678
- **2025:** 80,044
- **2030:** 135,240

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(13)**

- **4G co-located with 5G:** 0
- **Urban Sites:** 0
- **Rural Sites:** 13

Urban vs Rural Split:

- **Urban -** 0%
- **Rural -** 100%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	58.5%	53.2%	32.1%
2025	62.8%	57.1%	38.5%
2030	84.3%	76.6%	65.0%

<90%
90%-100%
>100%

- After running the model for the Dungog region, it can be observed that for the **year 2023, 2025, and 2030, the current scenario in terms of sites supports the necessary demand**.

3 - Future State

Conducting traffic projections associated with devices for **the Dungog** region in the Wireless component, it is possible to conclude that in a **Low Scenario** regarding the number of devices, **the current network infrastructure** will **sustain the projected demand** until the year **2030**, with the highest value being **84.3% capacity** in terms of utilization for downlink/transmission communication from the base station to the respective devices.

The installation/deployment of new radio mobile sites is not necessarily required.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	58.5%	53.2%	32.1%
2025	62.8%	57.1%	38.5%
2030	84.3%	76.6%	65.0%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Dungog

Below, the capacity status for the Dungog region under baseline demand scenario conditions is presented.

Baseline Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 97,259
- **2025:** 116,666
- **2030:** 196,513

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(13)**

- **4G co-located with 5G:** 0
- **Urban Sites:** 0
- **Rural Sites:** 13

Urban vs Rural Split:

- **Urban -** 0%
- **Rural -** 100%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	85.3%	77.5%	46.8%
2025	91.5%	83.2%	56.1%
2030	122.4%	111.3%	94.5%

<90%
90%-100%
>100%

- After running the model for the Dungog region, it can be observed that for the **year 2023 and 2025, the current scenario in terms of sites supports the necessary demand**. However, by the year **2030, there is already saturation in terms of network capacity**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2030** - Installation of **2 new base station between 2025 and 2030**, resulting in a total of **15 radio mobile sites** in the Dungog region.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	85.3%	77.5%	46.8%
2025	91.5%	83.2%	56.1%
2030	87.9%	81.4%	76.8%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Dungog

Below, the capacity status for the Dungog region under baseline demand scenario conditions is presented.

High Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 141,503
- **2025:** 169,710
- **2030:** 284,996

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(13)**

- **4G co-located with 5G:** 0
- **Urban Sites:** 0
- **Rural Sites:** 13

Urban vs Rural Split:

- **Urban -** 0%
- **Rural -** 100%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	124.1%	112.8%	68.0%
2025	137.1%	124.6%	81.6%
2030	184.2%	167.4%	137.0%

<90%
90%-100%
>100%

- After running the model for the Dungog region, it can be observed that there is **currently saturation** in terms of **mobile network capacity**, requiring the **deployment of new radio sites**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2025 -** Installation of **2 new mobile base stations until 2025.**
- **2030 -** Installation of **3 new mobile base stations between 2025 and 2030**, resulting in a total of **18 radio mobile sites** in the Dungog region.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	89.1%	82.5%	55.3%
2025	98.5%	91.1%	66.3%
2030	93.0%	87.3%	86.9%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Lake Macquarie

Below, the capacity status for the Lake Macquarie region under low demand scenario conditions is presented.

Low Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 1,432,930
- **2025:** 1,725,990
- **2030:** 2,942,192

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(111)**

- **4G co-located with 5G:** 68
- **Urban Sites:** 39
- **Rural Sites:** 4

Urban vs Rural Split:

- **Urban** – 91.5%
- **Rural –** 8.5%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	60.6%	59.0%	47.1%
2025	67.2%	65.5%	56.7%
2030	91.7%	89.3%	96.7%

<90%
90%-100%
>100%

- After running the model for the Lake Macquarie region, it can be observed that for the **year 2023, 2025, and 2030, the current scenario in terms of sites supports the necessary demand**.

3 - Future State

Conducting traffic projections associated with devices for **the Lake Macquarie** region in the Wireless component, it is possible to conclude that in a **Low Scenario** regarding the number of devices, **the current network infrastructure** will **sustain the projected demand** until the year **2030**, with the highest value being **96.7% capacity** in terms of simultaneous number of devices accessing the network via mobile access

The installation/deployment of new radio mobile sites is not necessarily required.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	60.6%	59.0%	47.1%
2025	67.2%	65.5%	56.7%
2030	91.7%	89.3%	96.7%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Lake Macquarie

Below, the capacity status for the Lake Macquarie region under baseline demand scenario conditions is presented.

Baseline Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 2,053,355
- **2025:** 2,475,467
- **2030:** 4,224,025

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(111)**

- **4G co-located with 5G:** 68
- **Urban Sites:** 39
- **Rural Sites:** 4

Urban vs Rural Split:

- **Urban** – 91.5%
- **Rural –** 8.5%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	86.8%	84.6%	67.5%
2025	96.4%	94.0%	81.3%
2030	131.6%	128.3%	138.8%

<90%

90%-100%

>100%

- After running the model for the Lake Macquarie region, it can be observed that for the **year 2023 and 2025, the current scenario in terms of sites supports the necessary demand**. However, by the year **2030, there is already saturation in terms of network capacity**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2030** - Installation of **39 new base station between 2025 and 2030**, resulting in a total of **150 radio mobile sites** in the Lake Macquarie region.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	86.8%	84.6%	67.5%
2025	96.4%	94.0%	81.3%
2030	91.1%	90.1%	99.6%

<90%

90%-100%

>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Lake Macquarie

Below, the capacity status for the Lake Macquarie region under high demand scenario conditions is presented.

High Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 2,936,115
- **2025:** 3,544,872
- **2030:** 6,056,480

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(111)**

- **4G co-located with 5G:** 68
- **Urban Sites:** 39
- **Rural Sites:** 4

Urban vs Rural Split:

- **Urban** – 91.5%
- **Rural** – 8.5%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	124.1%	121.0%	96.5%
2025	138.0%	134.5%	116.5%
2030	188.7%	183.9%	199.0%

- <90%
- 90%-100%
- >100%

- After running the model for the Lake Macquarie region, it can be observed that there is **currently saturation** in terms of **mobile network capacity**, requiring the **deployment of new radio sites**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2025 -** Installation of **34 new mobile base stations until 2025.**
- **2030 -** Installation of **65 new mobile base stations between 2025 and 2030**, resulting in a total of **210 radio mobile sites** in the Lake Macquarie region.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	99.2%	97.7%	79.0%
2025	99.5%	98.3%	86.7%
2030	88.6%	88.7%	99.6%

- <90%
- 90%-100%
- >100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Maitland

Below, the capacity status for the Maitland region under low demand scenario conditions is presented.

Low Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 620,738
- **2025:** 747,498
- **2030:** 1,273,358

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(50)**

- **4G co-located with 5G:** 20
- **Urban Sites:** 19
- **Rural Sites:** 11

Urban vs Rural Split:

- **Urban** - 64%
- **Rural** - 36%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	70.7%	67.2%	49.7%
2025	78.4%	74.5%	59.8%
2030	103.1%	97.9%	101.9%

<90%
90%-100%
>100%

- After running the model for the Maitland region, it can be observed that for the **year 2023 and 2025, the current scenario in terms of sites supports the necessary demand**. However, by the year **2030, there is already saturation in terms of network capacity**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2030** - Installation of **2 new base station between 2025 and 2030**, resulting in a total of **52 radio mobile sites** in the Maitland region.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	70.7%	67.2%	49.7%
2025	78.4%	74.5%	59.8%
2030	97.1%	92.6%	97.2%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Maitland

Below, the capacity status for the Maitland region under baseline demand scenario conditions is presented.

Baseline Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 890,715
- **2025:** 1,073,406
- **2030:** 1,829,793

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(50)**

- **4G co-located with 5G:** 20
- **Urban Sites:** 19
- **Rural Sites:** 11

Urban vs Rural Split:

- **Urban** - 64%
- **Rural** - 36%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	101.5%	96.4%	71.3%
2025	112.7%	107.0%	85.9%
2030	148.1%	140.7%	146.5%

<90%
90%-100%
>100%

- After running the model for the Maitland region, it can be observed that there is **currently saturation** in terms of **mobile network capacity**, requiring the **deployment of new radio sites**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2025 -** Installation of **5 new mobile base stations until 2025.**
- **2030 -** Installation of **14 new mobile base stations between 2025 and 2030**, resulting in a total of **69 radio mobile sites** in the Maitland region.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	98.5%	93.7%	69.6%
2025	97.6%	93.6%	76.5%
2030	93.5%	91.3%	99.9%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Maitland

Below, the capacity status for the Maitland region under high demand scenario conditions is presented.

High Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 1,275,369
- **2025:** 1,538,994
- **2030:** 2,625,882

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(50)**

- **4G co-located with 5G:** 20
- **Urban Sites:** 19
- **Rural Sites:** 11

Urban vs Rural Split:

- **Urban** - 64%
- **Rural -** 36%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	145.3%	138.0%	102.1%
2025	161.5%	153.4%	123.2%
2030	212.6%	201.9%	210.2%

<90%
90%-100%
>100%

- After running the model for the Maitland region, it can be observed that there is **currently saturation** in terms of **mobile network capacity**, requiring the **deployment of new radio sites**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2025 -** Installation of **21 new mobile base stations until 2025.**
- **2030 -** Installation of **24 new mobile base stations between 2025 and 2030**, resulting in a total of **95 radio mobile sites** in the Maitland region.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	99.5%	96.7%	74.6%
2025	98.2%	96.0%	81.3%
2030	89.2%	88.5%	99.9%

<90%
90%-100%
>100%

*__Important Note:__ While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Muswellbrook

Below, the capacity status for the Muswellbrook region under low demand scenario conditions is presented.

Low Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 111,946
- **2025:** 134,549
- **2030:** 228,058

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(28)**

- **4G co-located with 5G:** 2
- **Urban Sites:** 0
- **Rural Sites:** 26

Urban vs Rural Split:

- **Urban** - 0%
- **Rural -** 100%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	38.9%	35.7%	24.1%
2025	42.8%	39.4%	29.0%
2030	55.0%	50.5%	49.2%

<90%
90%-100%
>100%

- After running the model for the Muswellbrook region, it can be observed that for the **year 2023, 2025, and 2030, the current scenario in terms of sites supports the necessary demand**.

3 - Future State

Conducting traffic projections associated with devices for the **Muswellbrook** region in the Wireless component, it is possible to conclude that in a **Low Scenario** regarding the number of devices, **the current network infrastructure** will **sustain the projected demand** until the year **2030**, with the highest value being **55% capacity** in terms of utilization for downlink/transmission communication from the base station to the respective devices.

The installation/deployment of new radio mobile sites is not necessarily required.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	38.9%	35.7%	24.1%
2025	42.8%	39.4%	29.0%
2030	55.0%	50.5%	49.2%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Muswellbrook

Below, the capacity status for the Muswellbrook region under baseline demand scenario conditions is presented.

Baseline Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 162,264
- **2025:** 194,988
- **2030:** 329,957

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(28)**

- **4G co-located with 5G:** 2
- **Urban Sites:** 0
- **Rural Sites:** 26

Urban vs Rural Split:

- **Urban** - 0%
- **Rural -** 100%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	56.3%	51.8%	35.0%
2025	60.2%	55.3%	42.0%
2030	79.6%	73.1%	71.1%

<90%
90%-100%
>100%

- After running the model for the Muswellbrook region, it can be observed that for the **year 2023, 2025, and 2030, the current scenario in terms of sites supports the necessary demand**.

3 - Future State

Conducting traffic projections associated with devices for the **Muswellbrook** region in the Wireless component, it is possible to conclude that in a **Baseline Scenario** regarding the number of devices, **the current network infrastructure** will **sustain the projected demand** until the year **2030**, with the highest value being **79.6% capacity** in terms of utilization for downlink/transmission communication from the base station to the respective devices.

The installation/deployment of new radio mobile sites is not necessarily required.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	56.3%	51.8%	35.0%
2025	60.2%	55.3%	42.0%
2030	79.6%	73.1%	71.1%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Muswellbrook

Below, the capacity status for the Muswellbrook region under high demand scenario conditions is presented.

High Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 234,643
- **2025:** 282,072
- **2030:** 476,582

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(28)**

- **4G co-located with 5G:** 2
- **Urban Sites:** 0
- **Rural Sites:** 26

Urban vs Rural Split:

- **Urban** - 0%
- **Rural** - 100%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	81.5%	74.9%	50.6%
2025	89.8%	82.5%	60.8%
2030	114.9%	105.6%	102.7%

<90%
90%-100%
>100%

- After running the model for the Muswellbrook region, it can be observed that for the **year 2023 and 2025, the current scenario in terms of sites supports the necessary demand**. However, by the year **2030, there is already saturation in terms of network capacity**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2030** - Installation of **2 new base station between 2025 and 2030**, resulting in a total of **30 radio mobile sites** in the Muswellbrook region.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	81.5%	74.9%	50.6%
2025	89.8%	82.5%	60.8%
2030	98.7%	91.4%	93.1%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Newcastle

Below, the capacity status for the Newcastle region under low demand scenario conditions is presented.

Low Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 1,141,981
- **2025:** 1,374,668
- **2030:** 2,339,444

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(114)**

- **4G co-located with 5G:** 66
- **Urban Sites:** 48
- **Rural Sites:** 0

Urban vs Rural Split:

- **Urban** - 100%
- **Rural** - 0%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	54.7%	53.1%	43.0%
2025	60.7%	58.9%	51.8%
2030	82.6%	80.1%	88.1%

<90%
90%-100%
>100%

- After running the model for the Newcastle region, it can be observed that for the **year 2023, 2025, and 2030, the current scenario in terms of sites supports the necessary demand**.

3 - Future State

Conducting traffic projections associated with devices for **the Newcastle** region in the Wireless component, it is possible to conclude that in a **Low Scenario** regarding the number of devices, **the current network infrastructure** will **sustain the projected demand** until the year **2030**, with the highest value being **88.1% capacity** in terms of simultaneous number of devices accessing the network via mobile access

The installation/deployment of new radio mobile sites is not necessarily required.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	54.7%	53.1%	43.0%
2025	60.7%	58.9%	51.8%
2030	82.6%	80.1%	88.1%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Newcastle

Below, the capacity status for the Newcastle region under baseline demand scenario conditions is presented.

Baseline Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 1,641,917
- **2025:** 1,977,569
- **2030:** 3,366,220

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(114)**

- **4G co-located with 5G:** 66
- **Urban Sites:** 48
- **Rural Sites:** 0

Urban vs Rural Split:

- **Urban** - 100%
- **Rural** - 0%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	78.7%	76.3%	61.8%
2025	87.3%	84.7%	74.5%
2030	118.9%	115.3%	126.7%

<90%

90%-100%

>100%

- After running the model for the Newcastle region, it can be observed that for the **year 2023 and 2025, the current scenario in terms of sites supports the necessary demand**. However, by the year **2030, there is already saturation in terms of network capacity**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2030** - Installation of **27 new base station between 2025 and 2030**, resulting in a total of **141 radio mobile sites** in the Newcastle region.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	78.7%	76.3%	61.8%
2025	87.3%	84.7%	74.5%
2030	92.2%	89.4%	99.7%

<90%

90%-100%

>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Newcastle

Below, the capacity status for the Newcastle region under high demand scenario conditions is presented.

High Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 2,355,596
- **2025:** 2,840,362
- **2030:** 4,836,917

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(114)**

- **4G co-located with 5G:** 66
- **Urban Sites:** 48
- **Rural Sites:** 0

Urban vs Rural Split:

- **Urban** - 100%
- **Rural** - 0%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	112.9%	109.5%	88.7%
2025	125.4%	121.6%	106.9%
2030	170.8%	165.7%	182.1%

<90% | 90%-100% | >100%

- After running the model for the Newcastle region, it can be observed that there is **currently saturation** in terms of **mobile network capacity**, requiring the **deployment of new radio sites**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2025 -** Installation of **24 new mobile base stations until 2025.**
- **2030 -** Installation of **58 new mobile base stations between 2025 and 2030**, resulting in a total of **196 radio mobile sites** in the Newcastle region.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	99.1%	96.1%	78.5%
2025	99.7%	96.8%	86.2%
2030	90.9%	88.2%	99.9%

<90% | 90%-100% | >100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Port Stephens

Below, the capacity status for the Port Stephens region under low demand scenario conditions is presented.

Low Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 524,249
- **2025:** 629,500
- **2030:** 1,064,314

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(79)**

- **4G co-located with 5G:** 27
- **Urban Sites:** 9
- **Rural Sites:** 43

Urban vs Rural Split:

- **Urban** – 17.4%
- **Rural –** 82.6%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	47.8%	45.4%	34.9%
2025	52.9%	50.2%	41.9%
2030	69.0%	65.5%	70.8%

<90%
90%-100%
>100%

- After running the model for the Port Stephens region, it can be observed that for the **year 2023, 2025, and 2030, the current scenario in terms of sites supports the necessary demand**.

3 - Future State

Conducting traffic projections associated with devices for the **Port Stephens** region in the Wireless component, it is possible to conclude that in a **Low Scenario** regarding the number of devices, **the current network infrastructure** will **sustain the projected demand** until the year **2030**, with the highest value being **70.8% capacity** in terms of simultaneous number of devices accessing the network via mobile access

The installation/deployment of new radio mobile sites is not necessarily required.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	47.8%	45.4%	34.9%
2025	52.9%	50.2%	41.9%
2030	69.0%	65.5%	70.8%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Port Stephens

Below, the capacity status for the Port Stephens region under baseline demand scenario conditions is presented.

Baseline Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 763,651
- **2025:** 916,381
- **2030:** 1,545,080

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(79)**

- **4G co-located with 5G:** 27
- **Urban Sites:** 9
- **Rural Sites:** 43

Urban vs Rural Split:

- **Urban** – 17.4%
- **Rural –** 82.6%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	69.7%	66.1%	50.8%
2025	77.0%	73.1%	60.9%
2030	100.2%	95.0%	102.7%

<90%
90%-100%
>100%

- After running the model for the Port Stephens region, it can be observed that for the **year 2023 and 2025, the current scenario in terms of sites supports the necessary demand**. However, by the year **2030, there is already saturation in terms of network capacity**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2030 -** Installation of **2 new mobile base stations between 2025 and 2030**, resulting in a total of **81 radio mobile sites** in the Port Stephens region.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	69.7%	66.1%	50.8%
2025	77.0%	73.1%	60.9%
2030	96.3%	91.4%	99.6%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Port Stephens

Below, the capacity status for the Port Stephens region under high demand scenario conditions is presented.

High Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 1,109,604
- **2025:** 1,331,448
- **2030:** 2,238,833

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(79)**

- **4G co-located with 5G:** 27
- **Urban Sites:** 9
- **Rural Sites:** 43

Urban vs Rural Split:

- **Urban** – 17.4%
- **Rural –** 82.6%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	101.3%	96.1%	73.8%
2025	111.9%	106.2%	88.5%
2030	150.6%	142.8%	148.9%

- <90%
- 90%-100%
- >100%

- After running the model for the Port Stephens region, it can be observed that there is **currently saturation** in terms of **mobile network capacity**, requiring the **deployment of new radio sites**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2025 -** Installation of **6 new mobile base stations until 2025.**
- **2030 -** Installation of **25 new mobile base stations between 2025 and 2030**, resulting in a total of **110 radio mobile sites** in the Port Stephens region.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	99.3%	94.2%	72.6%
2025	99.7%	94.8%	80.8%
2030	92.2%	88.3%	99.6%

- <90%
- 90%-100%
- >100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Singleton

Below, the capacity status for the Singleton region under low demand scenario conditions is presented.

Low Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 171,425
- **2025:** 205,876
- **2030:** 348,237

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(39)**

- **4G co-located with 5G:** 8
- **Urban Sites:** 1
- **Rural Sites:** 30

Urban vs Rural Split:

- **Urban** – 1.7%
- **Rural –** 98.3%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	35.7%	33.4%	24.8%
2025	39.3%	36.7%	29.8%
2030	50.4%	47.1%	50.5%

<90%
90%-100%
>100%

- After running the model for the Singleton region, it can be observed that for the **year 2023, 2025, and 2030, the current scenario in terms of sites supports the necessary demand**.

3 - Future State

Conducting traffic projections associated with devices for the **Singleton** region in the Wireless component, it is possible to conclude that in a **Low Scenario** regarding the number of devices, **the current network infrastructure** will **sustain the projected demand** until the year **2030**, with the highest value being **50.5% capacity** in terms of simultaneous number of devices accessing the network via mobile access

The installation/deployment of new radio mobile sites is not necessarily required.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	35.7%	33.4%	24.8%
2025	39.3%	36.7%	29.8%
2030	50.4%	47.1%	50.5%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Singleton

Below, the capacity status for the Singleton region under baseline demand scenario conditions is presented.

Baseline Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 249,487
- **2025:** 299,458
- **2030:** 505,234

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(39)**

- **4G co-located with 5G:** 8
- **Urban Sites:** 1
- **Rural Sites:** 30

Urban vs Rural Split:

- **Urban** – 1.7%
- **Rural –** 98.3%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	52.0%	48.5%	36.1%
2025	57.2%	53.4%	43.4%
2030	73.2%	68.3%	73.2%

<90%
90%-100%
>100%

- After running the model for the Singleton region, it can be observed that for the **year 2023, 2025, and 2030, the current scenario in terms of sites supports the necessary demand**.

3 - Future State

Conducting traffic projections associated with devices for the **Singleton** region in the Wireless component, it is possible to conclude that in a **Baseline Scenario** regarding the number of devices, **the current network infrastructure** will **sustain the projected demand** until the year **2030**, with the highest value being **73.2% capacity** in terms of utilization for downlink/transmission communication from the base station to the respective devices, and in the simultaneous number of devices accessing the network via mobile access

The installation/deployment of new radio mobile sites is not necessarily required.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	52.0%	48.5%	36.1%
2025	57.2%	53.4%	43.4%
2030	73.2%	68.3%	73.2%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Singleton

Below, the capacity status for the Singleton region under high demand scenario conditions is presented.

High Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 362,200
- **2025:** 434,756
- **2030:** 731,669

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(39)**

- **4G co-located with 5G:** 8
- **Urban Sites:** 1
- **Rural Sites:** 30

Urban vs Rural Split:

- **Urban** – 1.7%
- **Rural –** 98.3%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	75.4%	70.5%	52.4%
2025	83.0%	77.6%	62.9%
2030	110.1%	102.8%	105.9%

<90%
90%-100%
>100%

- After running the model for the Singleton region, it can be observed that for the **year 2023 and 2025, the current scenario in terms of sites supports the necessary demand**. However, by the year **2030, there is already saturation in terms of network capacity**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2030** - Installation of **3 new base station between 2025 and 2030**, resulting in a total of **42 radio mobile sites** in the Singleton region.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	75.4%	70.5%	52.4%
2025	83.0%	77.6%	62.9%
2030	95.9%	90.1%	95.9%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Upper Hunter

Below, the capacity status for the Upper Hunter region under low demand scenario conditions is presented.

Low Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 96,882
- **2025:** 116,443
- **2030:** 197,362

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(24)**

- **4G co-located with 5G:** 4
- **Urban Sites:** 0
- **Rural Sites:** 20

Urban vs Rural Split:

- **Urban** - 0%
- **Rural -** 100%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	34.6%	32.2%	23.3%
2025	38.2%	35.5%	28.0%
2030	51.0%	47.4%	47.4%

<90%
90%-100%
>100%

- After running the model for the Upper Hunter region, it can be observed that for the **year 2023, 2025, and 2030, the current scenario in terms of sites supports the necessary demand**.

3 - Future State

Conducting traffic projections associated with devices for the **Upper Hunter** region in the Wireless component, it is possible to conclude that in a **Low Scenario** regarding the number of devices, **the current network infrastructure** will **sustain the projected demand** until the year **2030**, with the highest value being **51% capacity** in terms of utilization for downlink/transmission communication from the base station to the respective devices.

The installation/deployment of new radio mobile sites is not necessarily required.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	34.6%	32.2%	23.3%
2025	38.2%	35.5%	28.0%
2030	51.0%	47.4%	47.4%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Upper Hunter

Below, the capacity status for the Upper Hunter region under baseline demand scenario conditions is presented.

Baseline Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 140,433
- **2025:** 168,752
- **2030:** 285,552

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(24)**

- **4G co-located with 5G:** 4
- **Urban Sites:** 0
- **Rural Sites:** 20

Urban vs Rural Split:

- **Urban** - 0%
- **Rural -** 100%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	50.2%	46.7%	33.8%
2025	55.3%	51.4%	40.6%
2030	73.8%	68.5%	68.6%

<90%
90%-100%
>100%

- After running the model for the Upper Hunter region, it can be observed that for the **year 2023, 2025, and 2030, the current scenario in terms of sites supports the necessary demand**.

3 - Future State

Conducting traffic projections associated with devices for the **Upper Hunter** region in the Wireless component, it is possible to conclude that in a **Baseline Scenario** regarding the number of devices, **the current network infrastructure** will **sustain the projected demand** until the year **2030**, with the highest value being **73.8% capacity** in terms of utilization for downlink/transmission communication from the base station to the respective devices.

The installation/deployment of new radio mobile sites is not necessarily required.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	50.2%	46.7%	33.8%
2025	55.3%	51.4%	40.6%
2030	73.8%	68.5%	68.6%

<90%
90%-100%
>100%

***Important Note:** While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireless - Simulated Capacity: Upper Hunter

Below, the capacity status for the Upper Hunter region under high demand scenario conditions is presented.

High Scenario

1 - Model Inputs:

Total Number of Devices:

- **2023:** 203,084
- **2025:** 244,130
- **2030:** 412,458

Busy(h) Traffic associated to Mobile Access Technologies:

- **30%***

Current Number of Sites: **(24)**

- **4G co-located with 5G:** 4
- **Urban Sites:** 0
- **Rural Sites:** 20

Urban vs Rural Split:

- **Urban** - 0%
- **Rural** - 100%

2- As-Is State

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	72.6%	67.5%	48.8%
2025	80.0%	74.4%	58.7%
2030	106.5%	99.0%	99.2%

<90%
90%-100%
>100%

- After running the model for the Upper Hunter region, it can be observed that for the **year 2023 and 2025, the current scenario in terms of sites supports the necessary demand**. However, by the year **2030, there is already saturation in terms of network capacity**.

3 - Future State

To address the As-Is saturation, and considering only mobile infrastructure, the following number of base stations needs to be installed:

- **2030** - Installation of **1 new base station between 2025 and 2030**, resulting in a total of **25 radio mobile sites** in the Upper Hunter region.

It was assumed that all sites deployed will include 5G technology.

Projected Years	% RAN Capacity (Downlink)	% RAN Capacity (Uplink)	% RAN Capacity (Active Devices)
2023	72.6%	67.5%	48.8%
2025	80.0%	74.4%	58.7%
2030	98.2%	91.6%	93.7%

<90%
90%-100%
>100%

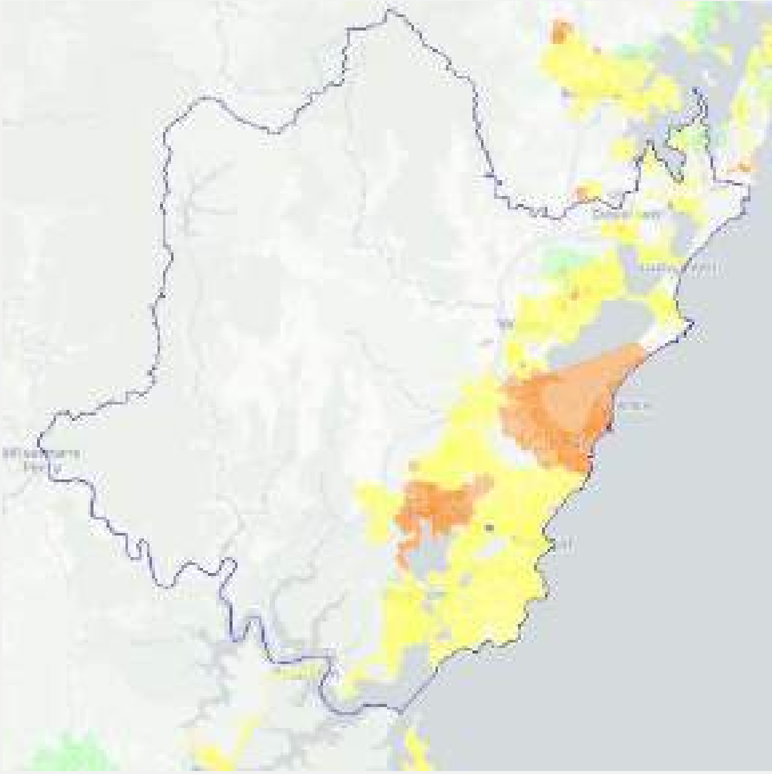
*__Important Note:__ While performing the forward looking scenario simulation, the model adds +20% of headroom traffic capacity on top of this value.

Wireline Capacity for each LGA: Existing Households with Fibre

Wireline - Existing households with Fibre: Central Coast

The analysis below enables the understanding of the current state in terms of development of the different types of fibre access provided by the NBN and comprehending the number of existing homes covered by each of these technologies. The analysis below relates to the Central Coast region.

Existing households with Fibre



Fibre to the Premises
Fibre to the Curb
Fibre to the Building
Fibre to the Node

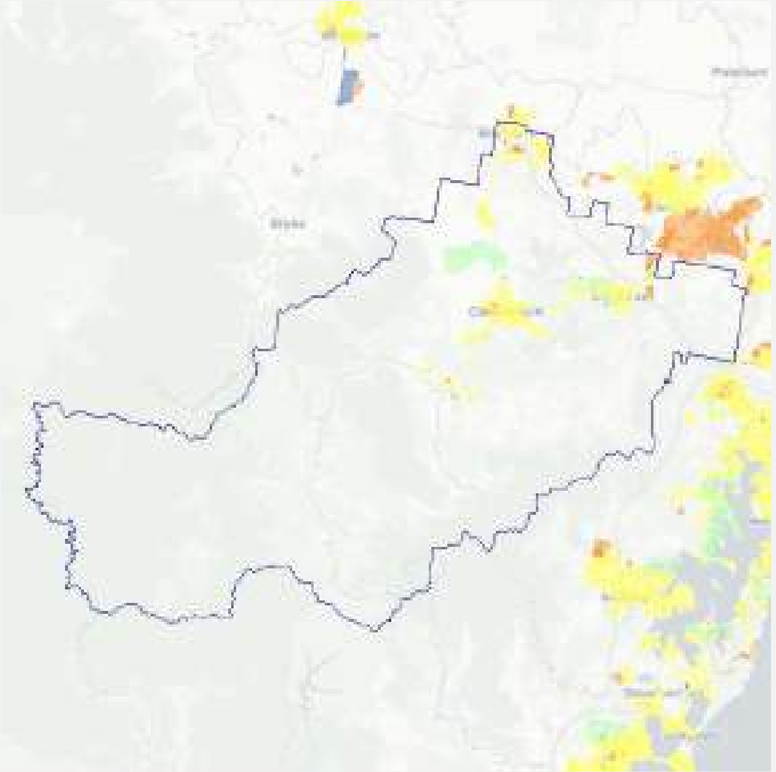
To understand the infrastructure required to fibre a certain region, it is necessary to obtain and comprehend the current deployed infrastructure and the existing number of houses with fibre access at the moment. In this case, for the Central Coast region, it is possible to draw the following conclusions

- Total Number of private Dwellings for Central Coast Region: **152,699**
- Current Percentage of private dwellings with fibre access: **97.59%**
- Existing Types of Fibre Access:
  - **Fibre to the Premises:** Present in around **44%** of the dwellings
  - **Fibre to the Building:** Deployed in private buildings such Bateau Bay Square and Erina Fair Shopping Centre
  - **Fibre to the Curb:** Present in around **1%** of the dwellings
  - **Fibre to the Node:** Present in around **52%** of total dwellings
- Current suburbs without any type of fibre access (top 3):
  - Jilliby **531 dwellings**
  - Somersby **387 dwellings**
  - Mangrove Mountain **280 dwellings**

Wireline - Existing households with Fibre: Cessnock

The analysis below enables the understanding of the current state in terms of development of the different types of fibre access provided by the NBN and comprehending the number of existing homes covered by each of these technologies. The analysis below relates to the Cessnock region.

Existing households with Fibre



Fibre to the Premises

Fibre to the Curb

Fibre to the Node

To understand the infrastructure required to fibre a certain region, it is necessary to obtain and comprehend the current deployed infrastructure and the existing number of houses with fibre access at the moment. In this case, for the Cessnock region, it is possible to draw the following conclusions

- Total Number of private Dwellings for Cessnock Region: **26,304**
- Current Percentage of private dwellings with fibre access: **85.23%**
- Existing Types of Fibre Access:
  - **Fibre to the Premises:** Present in around **9%** of the dwellings
  - **Fibre to the Curb:** Present in around **16%** of total dwellings
  - **Fibre to the Node:** Present in around **60%** of total dwellings
- Current suburbs without any type of fibre access (top 3):
  - Ellalong **492 dwellings**
  - Millfield **492 dwellings**
  - Mulbring **255 dwellings**

Wireline - Existing households with Fibre: Dungog

The analysis below enables the understanding of the current state in terms of development of the different types of fibre access provided by the NBN and comprehending the number of existing homes covered by each of these technologies. The analysis below relates to the Dungog region

Existing households with Fibre

Fibre to the Node

To understand the infrastructure required to fibre a certain region, it is necessary to obtain and comprehend the current deployed infrastructure and the existing number of houses with fibre access at the moment. In this case, for the Dungog region, it is possible to draw the following conclusions

- Total Number of private Dwellings for Dungog Region: **3,905**
- Current Percentage of private dwellings with fibre access: **47.71%**
- Existing Types of Fibre Access:

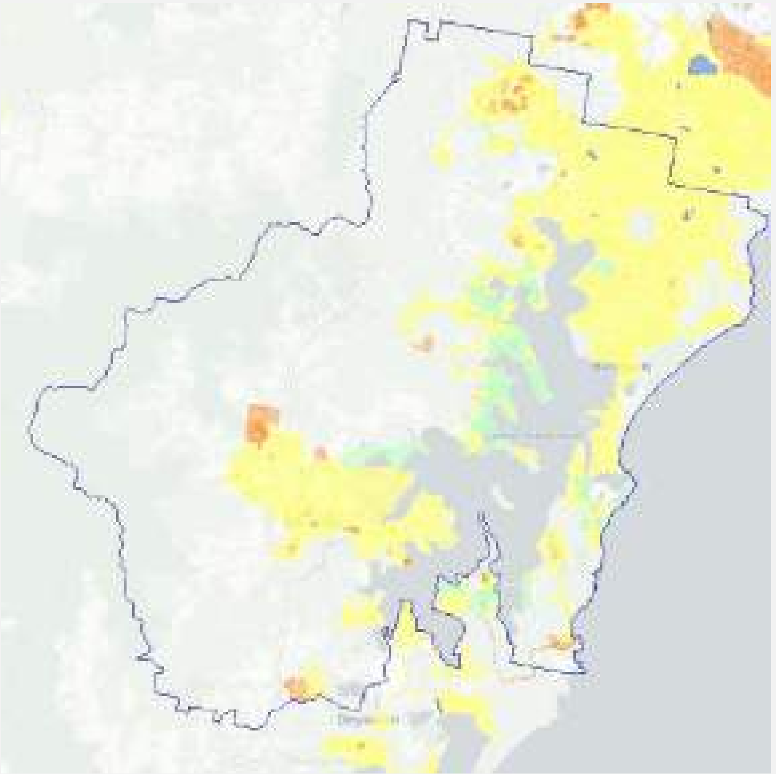
  Fibre to the Node: Present in around 47% of total dwellings

- Current suburbs without any type of fibre access (top 3):
  - Paterson **374 dwellings**
  - East Gresford **159 dwellings**
  - Martins Creek **149 dwellings**

Wireline - Existing households with Fibre: Lake Macquarie

The analysis below enables the understanding of the current state in terms of development of the different types of fibre access provided by the NBN and comprehending the number of existing homes covered by each of these technologies. The analysis below relates to the Lake Macquarie region

Existing households with Fibre



Fibre to the Premises
Fibre to the Curb
Fibre to the Building
Fibre to the Node

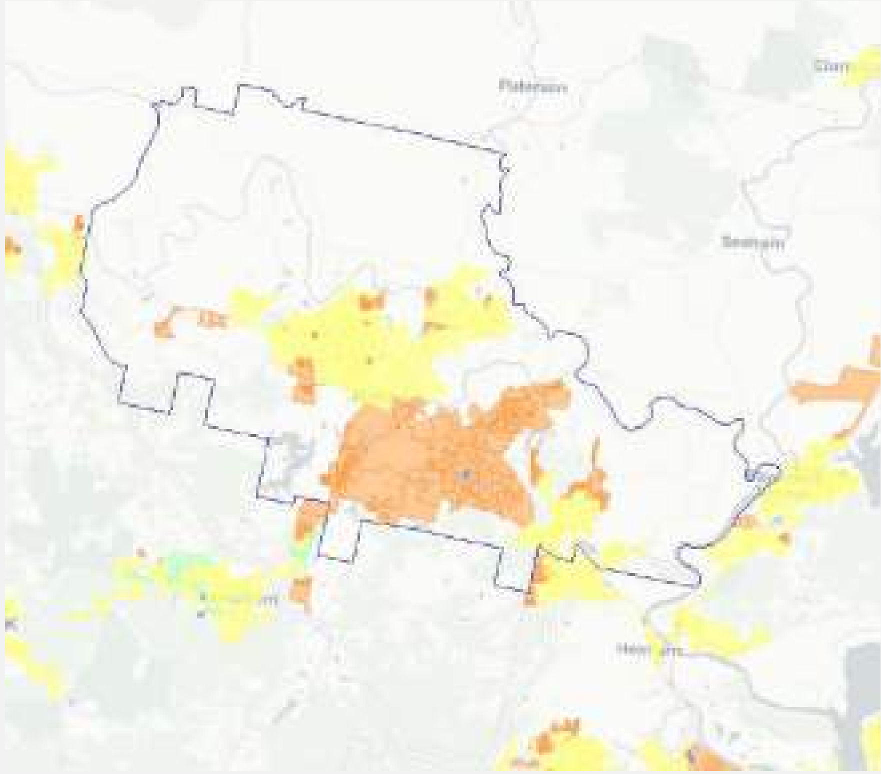
To understand the infrastructure required to fibre a certain region, it is necessary to obtain and comprehend the current deployed infrastructure and the existing number of houses with fibre access at the moment. In this case, for the Lake Macquarie region, it is possible to draw the following conclusions

- Total Number of private Dwellings for Lake Macquarie region: **37,464**
- Current Percentage of private dwellings with fibre access: **98.87%**
- Existing Types of Fibre Access:
  - **Fibre to the Premises:** Present in around **10%** of the dwellings
  - **Fibre to the Building:** Deployed in private buildings such Stockland Glendale and Charlestown Square
  - **Fibre to the Curb:** Present in around **10%** of the dwellings
  - **Fibre to the Node:** Present in around **78%** of total dwellings
- Current suburbs without any type of fibre access (top 3):
  - Mandalong **169 dwellings**
  - Martinsville **150 dwellings**
  - Freemans Waterhole **49 dwellings**

Wireline - Existing households with Fibre: Maitland

The analysis below enables the understanding of the current state in terms of development of the different types of fibre access provided by the NBN and comprehending the number of existing homes covered by each of these technologies. The analysis below relates to the Maitland region.

Existing households with Fibre



Fibre to the Premises
Fibre to the Building
Fibre to the Node

To understand the infrastructure required to fibre a certain region, it is necessary to obtain and comprehend the current deployed infrastructure and the existing number of houses with fibre access at the moment. In this case, for the Maitland region, it is possible to draw the following conclusions

- Total Number of private Dwellings for Maitland Region: **35,343**
- Current Percentage of private dwellings with fibre access: **95.89%**
- Existing Types of Fibre Access:

Fibre to the Premises: Present in around 66% of the dwellings

Fibre to the Building: Deployed in private buildings such Maitland Private Hospital and Stockland Green Hills.

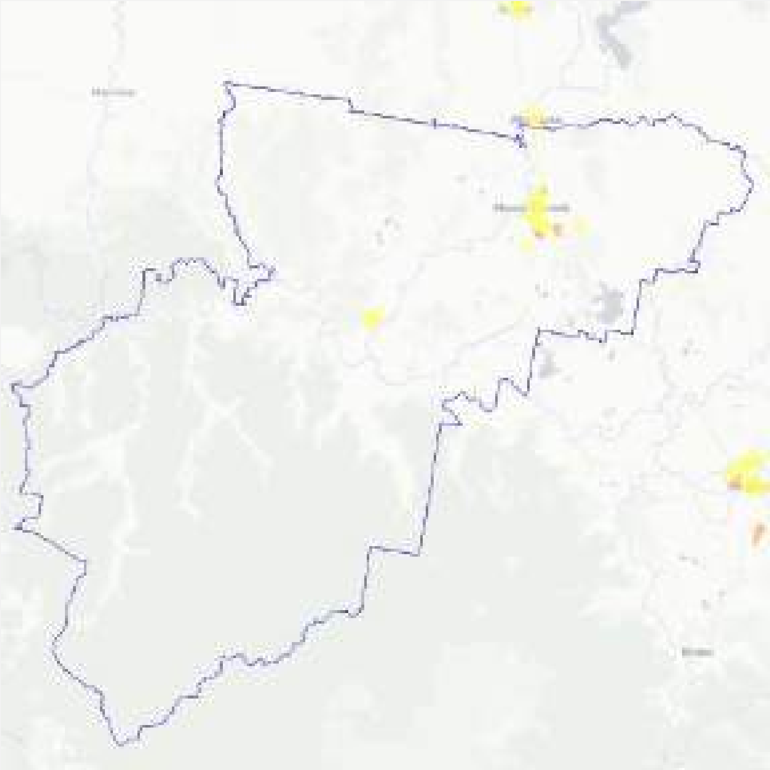
Fibre to the Node: Present in around 30% of total dwellings

- Current suburbs without any type of fibre access (top 3):
  - Lochinvar **439 dwellings**
  - Millers Forest **128 dwellings**
  - Maitland Vale **90 dwellings**

Wireline - Existing households with Fibre: Muswellbrook

The analysis below enables the understanding of the current state in terms of development of the different types of fibre access provided by the NBN and comprehending the number of existing homes covered by each of these technologies. The analysis below relates to the Muswellbrook region.

Existing households with Fibre



Fibre to the Premises
Fibre to the Curb
Fibre to the Node

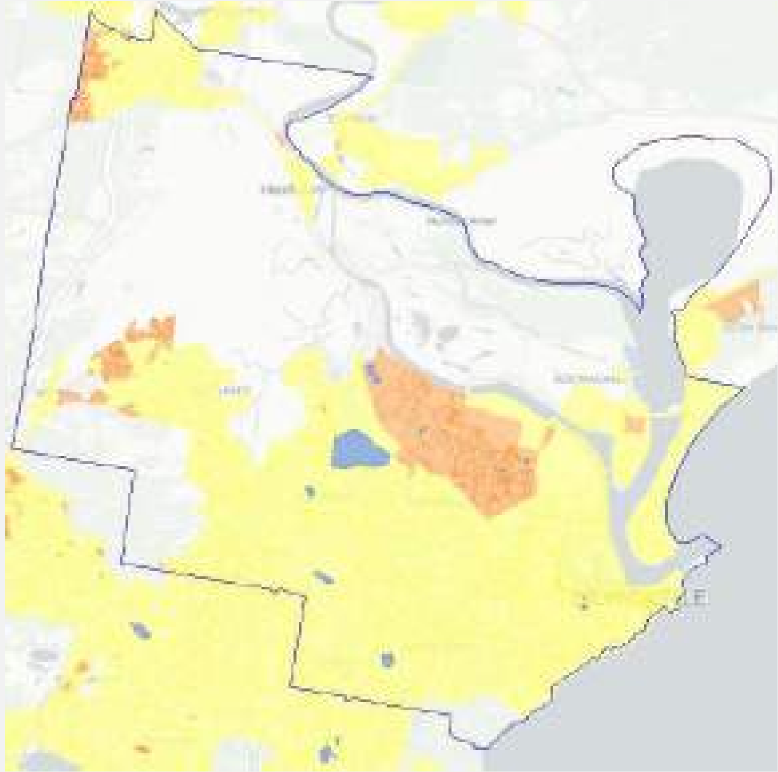
To understand the infrastructure required to fibre a certain region, it is necessary to obtain and comprehend the current deployed infrastructure and the existing number of houses with fibre access at the moment. In this case, for the Muswellbrook region, it is possible to draw the following conclusions

- Total Number of private Dwellings for Muswellbrook Region: **8,193**
- Current Percentage of private dwellings with fibre access: **89.57%**
- Existing Types of Fibre Access:
  - **Fibre to the Premises:** Present in around **11%** of the dwellings
  - **Fibre to the Curb:** Present in around **1%** of total dwellings
  - **Fibre to the Node:** Present in around **77%** of total dwellings
- Current suburbs without any type of fibre access (top 3):
  - Muscle Creek **871 dwellings**
  - McCullys Gap **101 dwellings**
  - Sandy Hollow **92 dwellings**

Wireline - Existing households with Fibre: Newcastle

The analysis below enables the understanding of the current state in terms of development of the different types of fibre access provided by the NBN and comprehending the number of existing homes covered by each of these technologies. The analysis below relates to the Newcastle region.

Existing households with Fibre



Fibre to the Premises

Fibre to the Building

Fibre to the Node

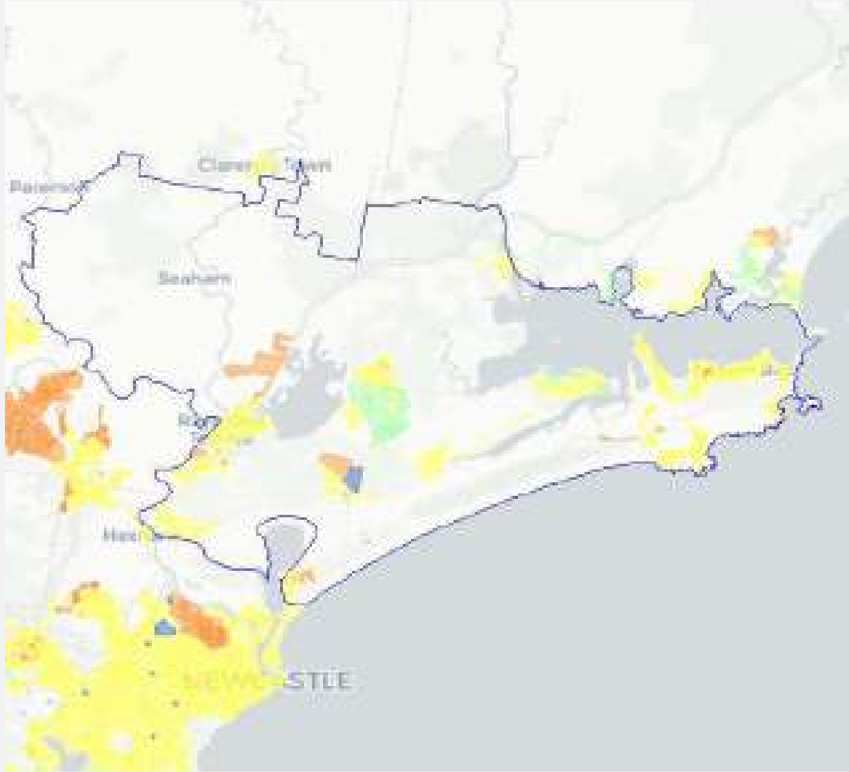
To understand the infrastructure required to fibre a certain region, it is necessary to obtain and comprehend the current deployed infrastructure and the existing number of houses with fibre access at the moment. In this case, for the Newcastle region, it is possible to draw the following conclusions

- Total Number of private Dwellings for Newcastle Region: **75,771**
- Current Percentage of private dwellings with fibre access: **99.62%**
- Existing Types of Fibre Access:
  - **Fibre to the Premises:** Present in around 20% of the dwellings
  - **Fibre to the Building:** Deployed in buildings such Callaghan - University of Newcastle and John Hunter Hospital
  - **Fibre to the Node:** Present in around 89% of total dwellings
- Current suburbs without any type of fibre access (top 3):
  - Black Hill **181 dwellings**
  - Sandgate **276 dwellings**
  - Lenaghan **22 dwellings**

Wireline - Existing households with Fibre: Port Stephens

The analysis below enables the understanding of the current state in terms of development of the different types of fibre access provided by the NBN and comprehending the number of existing homes covered by each of these technologies. The analysis below relates to the Port Stephens region.

Existing households with Fibre



- Fibre to the Premises
- Fibre to the Curb
- Fibre to the Building
- Fibre to the Node

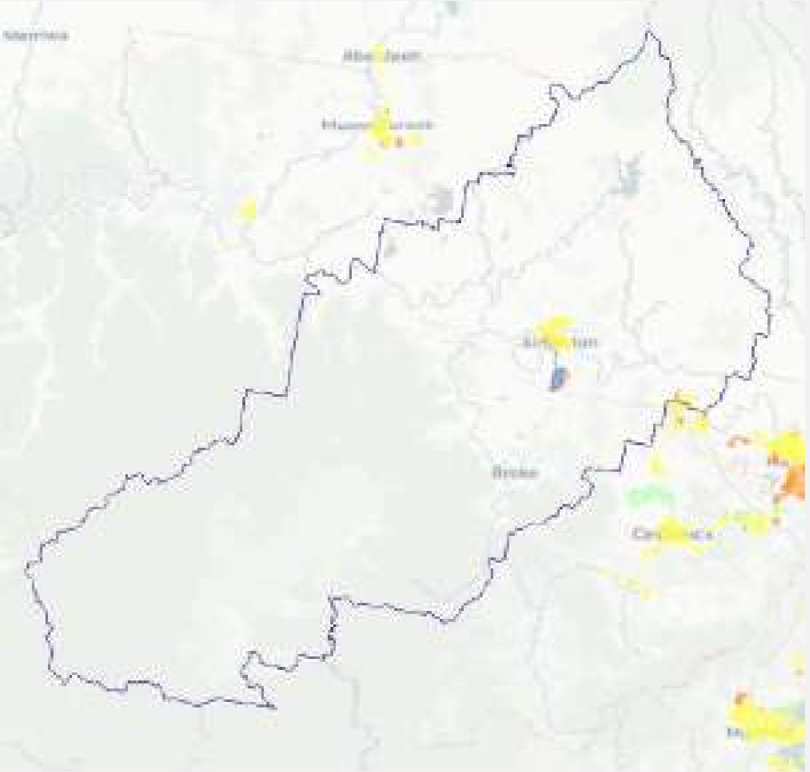
To understand the infrastructure required to fibre a certain region, it is necessary to obtain and comprehend the current deployed infrastructure and the existing number of houses with fibre access at the moment. In this case, for the Port Stephens region, it is possible to draw the following conclusions

- Total Number of private Dwellings for Port Stephens Region: **37,730**
- Current Percentage of private dwellings with fibre access: **90.71%**
- Existing Types of Fibre Access:
  - **Fibre to the Premises:** Present in around **9%** of the dwellings
  - **Fibre to the Building:** Deployed in part of the RAAF Base Williamtown
  - **Fibre to the Curb:** Present in around **10%** of the dwellings
  - **Fibre to the Node:** Present in around **71%** of total dwellings
- Current suburbs without any type of fibre access (top 3):
  - North Arm Cove **340 dwellings**
  - Seaham **339 dwellings**
  - Wallalong **339 dwellings**

Wireline - Existing households with Fibre: Singleton

The analysis below enables the understanding of the current state in terms of development of the different types of fibre access provided by the NBN and comprehending the number of existing homes covered by each of these technologies. The analysis below relates to the Singleton region.

Existing households with Fibre



Fibre to the Premises
Fibre to the Building
Fibre to the Node

To understand the infrastructure required to fibre a certain region, it is necessary to obtain and comprehend the current deployed infrastructure and the existing number of houses with fibre access at the moment. In this case, for the Singleton region, it is possible to draw the following conclusions

- Total Number of private Dwellings for Singleton Region: **9,348**
- Current Percentage of private dwellings with fibre access: **64.54%**
- Existing Types of Fibre Access:

  Fibre to the Premises: Present in around **1%** of the dwellings

  Fibre to the Building: Deployed in the Singleton Military Area

  Fibre to the Node: Present in around 63% of total dwellings

- Current suburbs without any type of fibre access (top 3):
  - Wattle Ponds **382 dwellings**
  - Broke **280 dwellings**
  - Whittingham **172 dwellings**

Wireline - Existing households with Fibre: Upper Hunter

The analysis below enables the understanding of the current state in terms of development of the different types of fibre access provided by the NBN and comprehending the number of existing homes covered by each of these technologies. The analysis below relates to the Upper Hunter region.

Existing households with Fibre

Fibre to the Node

To understand the infrastructure required to fibre a certain region, it is necessary to obtain and comprehend the current deployed infrastructure and the existing number of houses with fibre access at the moment. In this case, for the Upper Hunter region, it is possible to draw the following conclusions

- Total Number of private Dwellings for Upper Hunter Region: **12,168**
- Current Percentage of private dwellings with fibre access: **44.69%**
- Existing Types of Fibre Access:

  Fibre to the Node: Present in around **44%** of total dwellings

- Current suburbs without any type of fibre access (top 3):
  - Merriwa **871 dwellings**
  - Gunning **357 dwellings**
  - Taralga **243 dwellings**

The Case for Improved Digital Connectivity in the Hunter and Central Coast Regions

Destination Sydney Surrounds North

February 2024

Acknowledgement of funding

This project was funded by the NSW Government Regional NSW Business Case and Strategy Development Fund that supports councils, not-for-profit, industry and Aboriginal community groups develop business cases or strategies for projects delivering significant economic or social benefits to regional communities, with a focus on infrastructure.

Proudly funded by

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Disclaimer and limitations

KPMG has been engaged by Destination Sydney Surrounds North as its professional adviser.

The *Case for Improved Digital Connectivity in the Hunter and Central Coast Regions* (the Business Case) has been prepared on the basis of a literature review and modelling of publicly available data, including the following key steps:

1. Telecommunications infrastructure review of existing wireless and wireline infrastructure.
2. Forecast of the future population and visitor numbers to the region to determine the expected number of devices to be in use and subsequent future connectivity demand.
3. Modelling of future connectivity demand scenarios and the wireless and wireline infrastructure required to meet the demand scenarios.

The results presented in this document are modelled estimates using calculations and assumptions as noted throughout the Business Case. The data, information and scenarios presented in this report have not been separately confirmed or verified. Population and visitation growth, and growth in the number of devices in use across the region, are estimates and are based on data from publicly available sources that was available. Generic cost estimates provided in this report are indicative only and based on available data from the ACCC, published economic assessments or media releases. These cost estimates have not been informed by specific quotations or construction plans and should be used as indicative costs.

All images used in the Business Case are for illustrative purposes and provided by Destination Sydney Surrounds North as approved images.

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01 | Executive Summary

Executive Summary

Digital connectivity is a critical enabler to the citizen and visitor experience.

Digital connectivity is a challenge for most of the DSSN region, and demand on telecommunications infrastructure will only increase.

- The NSW Digital Connectivity Index currently measures seven out of ten LGAs across the DSSN region as having 'Average' or 'Below Average' connectivity.
- Digital connectivity challenges will continue to worsen as the population, the number of annual visitors to the region, and the subsequent number of devices per capita collectively contribute to increased demand on telco infrastructure.

This study models wireless digital connectivity demand out to 2030 across three demand scenarios: Low, Baseline and High.

- The wireless connectivity demand model inputs used for this study include LGA residential populations, industry employment and visitor numbers to determine the projected peak wireless connectivity demand across three demand scenarios ('Low', 'Baseline' and 'High') in 2023, 2025 and 2030.
- As of 2023, only 29 per cent of dwellings had access to FTTP and 71 per cent of dwellings require a wireline infrastructure upgrade to transition to FTTP.

The Baseline demand scenario projection indicates that existing wireless network capacity will not meet future demand in seven out of ten LGAs in the region.

- Anecdotally, the digital connectivity issue is often occurring when there are large visitor numbers and events, with the Baseline and High demand scenarios showing that existing network capacity is insufficient to meet peak demand.
- In the Low demand scenario, the modelling indicates that nine LGAs should have sufficient network capacity to meet future demand, driven by lower visitor numbers and lower devices per capita assumptions.

108 new radio sites are required by 2030 across the region to meet the wireless connectivity future demand in the Baseline scenario, at a cost of $46.8M to $60.6M.

- Seven of ten LGAs in the DSSN region will require an investment into additional wireless infrastructure in order to meet the future demand from a growing population and higher visitor numbers in the Baseline demand scenario.
- To address current connectivity gaps and future demand in the Baseline demand scenario by 2030, an estimated capital expenditure of $46.8M to $60.6M in wireless infrastructure will be required and $357.4M to upgrade all dwellings to FTTP.

There will be an economic and social cost to the region if no action is taken to address digital connectivity gaps.

- GDP growth may be hindered if the region's connectivity does not keep up with demand. Business productivity and innovation are limited when connectivity is poor, and employment opportunities are not as competitive for hybrid and remote workers.
- Reliable connectivity is crucial for communities to access basic services including telehealth and emergency services. Digital inclusion is particularly important for regional and rural communities, especially for First Nations communities.
- nbn's recent report (January 2024) provided insights as to the tangible social and economic benefits that are realised when communities have access to reliable fibre (wireline) connectivity.

Summary of key recommendations and considerations to address connectivity gaps

To uplift digital connectivity outcomes in the DSSN region, there are multiple avenues to be pursued which address root cause issues through education, deployment of best fit technology and pursuing various co-investment approaches.

Education and awareness of the existing solutions available to residents and businesses.

Many businesses are not aware of the connectivity options that are available in market or which service plans are best suited to their needs.

Many households and businesses are likely on sub-optimal service plans or are not aware they are eligible to be upgraded to higher speeds.

To increase awareness and uptake of the services currently available in the market, particularly for those in regional areas, further education and awareness campaigns directed at industry is required, including those within tourist hot spots who experience challenges during periods of peak demand.

Public-private partnerships for investment into a mix of technology solutions.

Public-private shared investment into telecommunications infrastructure such as the installation of new towers or upgrades to existing infrastructure is already being rolled out through Federal Government initiatives, nbn and the private sector to a large degree.

Existing large infrastructure and long-term project sites such as stadiums, concert venues and mines can consider Private 5G enabled networks to address peak demand.

This solution is particularly effective for large venues and an opportunity for public and private sectors to co-invest for improved community and visitor experiences during large events such a stadium concerts. This solution is suitable for a wide range of venues and projects, and can be utilised to develop 'smart' cities and sites.

Shared infrastructure in adjacent industries such as energy and transport.

Integrating telecommunications infrastructure with energy and transport projects is a strategic and efficient way to expand digital connectivity, especially in underserved and rural areas.

The Hunter-Central Coast region is undergoing a significant energy transition towards renewables, presenting an opportunity to simultaneously lay telecommunications infrastructure, such as fibre option cables, to enhance digital connectivity in the area.

Energy and transport projects such as power stations, transmission lines, railways and roads are ideal for shared telecommunications infrastructure, and network providers are encouraged to take advantage of the major investments committed into connecting the region over the coming decade to achieve shared objectives with adjacent industries.

Additional technologies can be deployed for permanent and temporary solutions to meet peak connectivity demand.

There are a range of technology solutions and providers that can be deployed to meet connectivity demand.

To meet peak demand from surges in visitor numbers during tourist seasons and major events, public and private entities are encouraged to consider a mix of permanent and temporary infrastructure as cost-effective solutions, tailored to different areas and requirements.

Technologies such as Cell on Wheels (CoWs) and Cold Mobile Sites can be utilised as needed, and are a suitable option to manage surges in connectivity demand. Other technologies for consideration include Fixed Wireless Access (FWA), Low-Earth Orbit (LEO) Satellites, Multi-Tenant WLAN, Private 5G and Private WiFi Networks.

02 | Digital Connectivity in the DSSN Region

Background and Introduction to the Business Case

The need for digital connectivity in regional NSW

Digital connectivity is a key factor in the roadmap towards growth of the region's $4.1B visitor economy.

Regional populations and tourism numbers are growing and subsequently demand for digital connectivity is increasing.

The Hunter and Central Coast include the largest populations and economies in NSW outside of Sydney, including the state's fastest growing region, Maitland. The natural coastal and inland environments combined with events, wineries and other attractions, mean that digital connectivity infrastructure is crucial for a thriving tourism sector, as well as the residents and businesses who call the region home.

Destination Sydney Surrounds North (DSSN) is one of seven Destination Networks in regional NSW, with the network's combined ambition to reach the goal of $25B in visitor expenditure by 2030. DSSN captures ten Local Government Areas (LGAs) within the Hunter and Central Coast of NSW and contributes a significant percentage towards economic activity in NSW.

DSSN's Destination Management Plan identifies digital connectivity as a thread that runs through many of the actions required to facilitate regional economic growth and is closely linked to the NSW State Government's strategy to upgrade digital infrastructure.

Digitally connecting our regions has been identified as a key need and priority for Government.

The Australian Digital Inclusion Index (2023) found digital exclusion is more pronounced in regional areas.

The 2024 Regional Telecommunications Review has been announced by the Albanese Government to commence public consultation in April, with the final report to be submitted by December 2024.

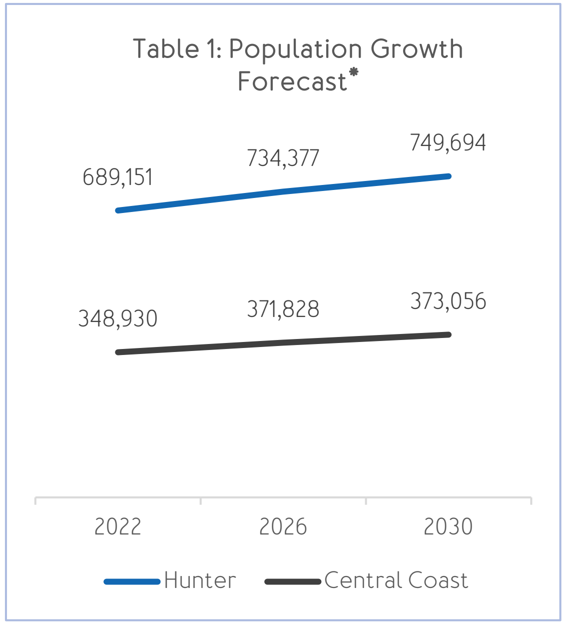
The review will examine inequities in access to telecommunications services faced by communities outside of urban parts of Australia. It will also review the needs of key stakeholders including First Nations' communities, the current state of connectivity barriers and the potential of Government investment schemes and emerging technologies.

> *"All Australians deserve access to quality communications service – no matter where they live or work."*
>
> Minister for Communications, the Hon Michelle Rowland MP

The Hunter and Central Coast Regions

The population, economic activity and tourism are expected to increase significantly across the region over the next five years.

The Hunter and Central Coast Regions are located north of Sydney, most well-known for its history as a coal mining region, as well as being a major tourist destination. The Central Coast and Greater Newcastle (within the Hunter) LGAs are located along the New South Wales East Coast, with Newcastle being the second-largest city in NSW after Sydney. The Hunter and Central Coast regions combined attract over 15M visitors annually.



Resident Demographics

There are an estimated 689,151 residents living within the Hunter region, and 348,930 within the Central Coast LGA (South of the Hunter). These populations are expected to increase by over 120,000 by 2030.

Business and Industry

The Hunter and Central Coast regions boast a dynamic employment landscape. In the Hunter region, excluding Newcastle, coal mining emerges as the leading sector, driving 7.1 per cent of the area's employment. Healthcare and Social Assistance stands out as a primary employment industry in Newcastle and the Central Coast accounting for 14.2 per cent of the region's workforce.

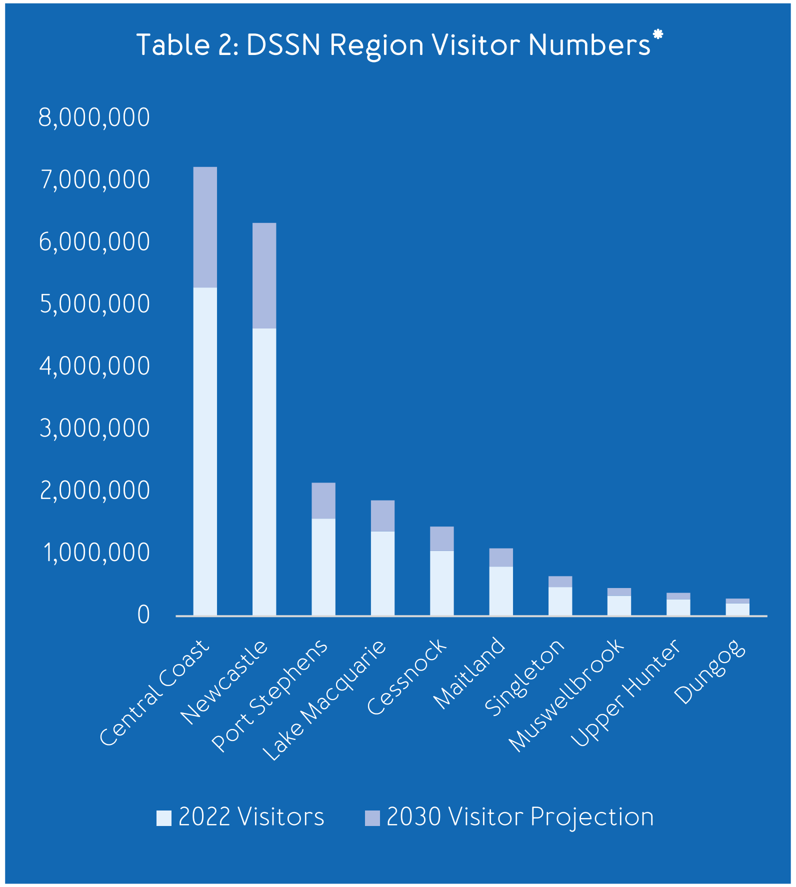
Economic Overview

The Hunter and Central Coast has an older population with a unique economic landscape. In the Hunter, 19.5 per cent hold a Certificate Level III as their highest qualification. The Central Coast and Newcastle have 17.9 per cent and 23 per cent with a Bachelor's or higher, respectively. Income levels are usually below the national median of $805, except for Newcastle at $852. Employment in Agriculture, Forestry, Fishing, Mining is at 12.4 per cent, while the Professional, Scientific, and Technical sector is concentrated in Newcastle, employing 7.7 per cent.

** Population is sourced from the ABS, Forecast Percentage Growth (2022): [Population Projections - Australian Bureau of Statistics]*
The DSSN Region includes all LGAs within the Hunter and Central goes region, excluding Mid-Coast LGA

The Visitor Economy

The Hunter and Central Coast regions are experiencing a significant inflow of visitors, with $5.3B in annual visitor expenditure. Between 2022 and 2030, visitor numbers are expected to increase from 16M to 21.8M people annually.



* *DSSN Region Visitor Numbers are sourced from* [VES 2030 Regional NSW Forecast data]

Visitor numbers are expected to increase by 37 per cent by 2030

- Between 2022 and 2030, the number of total visitors to the DSSN region is expected to increase by 36.7 per cent, from 16 million to 21.8 million people annually.
- The highest visited LGA is Central Coast with over 7.2M annual visitors expected by 2030, followed by Newcastle with over 6.3M annual visitors expected by 2030.
- Port Stephens expects the third highest number of annual visitors at 2.1M by 2030.

Internal visitor movement within the DSSN Region

- The Hunter and Central Coast regions welcome a significant number of national and international visitors each year, with an estimated 42.6 per cent reporting they travel to the region for holidays.
- There is also substantial movement within the region, with residents visiting neighbouring LGAs. Large events such as concerts, music festivals, hot spots such as Hunter Valley Wineries and natural scenic activities such as hiking, whale watching, and beach hopping attracting both local and external tourists.

The DSSN Region's current digital connectivity snapshot

Key
- Below average connectivity
- Average connectivity
- Above average connectivity

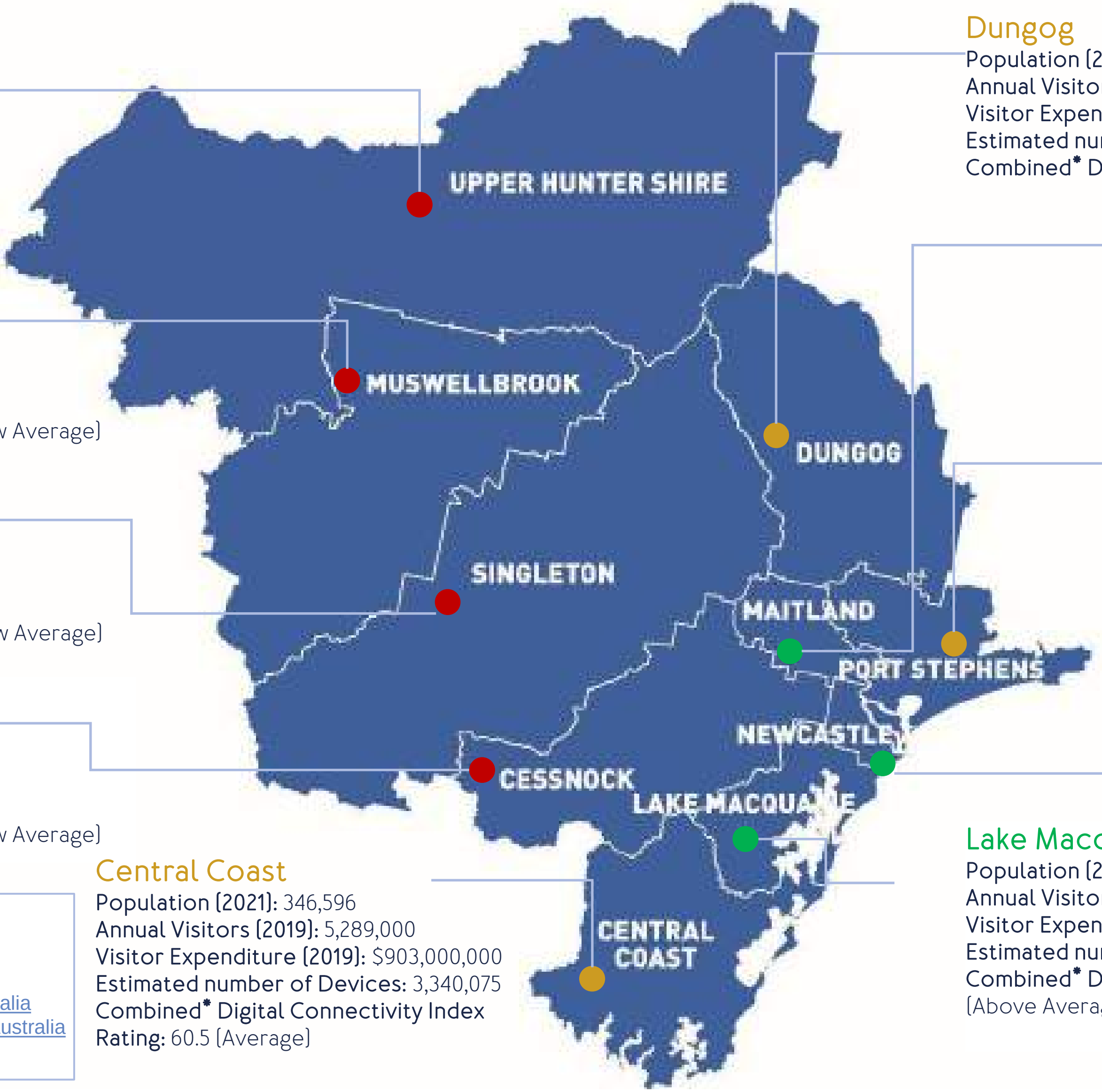
Based on the NSW Digital Connectivity Index, 70 per cent of the region is experiencing average or below average digital connectivity.

Upper Hunter Region Shire
Population (2021): 14,229
Annual Visitors (2019): 279,000
Visitor Expenditure (2019): $52,000,000
Estimated number of Devices: 137,471
Combined* Digital Connectivity Index Rating: 27 (Below Average)

Muswellbrook
Population (2021): 16,357
Annual Visitors (2019): 335,000
Visitor Expenditure (2019): $59,000,000
Estimated number of Devices: 159,036
Combined* Digital Connectivity Index Rating: 37.5 (Below Average)

Singleton
Population (2021): 24,577
Annual Visitors (2019): 473,000
Visitor Expenditure (2019): $123,000,000
Estimated number of Devices: 241,071
Combined* Digital Connectivity Index Rating: 40.5 (Below Average)

Cessnock
Population (2021): 63,632
Annual Visitors (2019): 1,053,000
Visitor Expenditure (2019): $328,000,000
Estimated number of Devices: 630,315
Combined* Digital Connectivity Index Rating: 38.5 (Below Average)



Dungog
Population (2021): 9,541
Annual Visitors (2019): 211,000
Visitor Expenditure (2019): $28,000,000
Estimated number of Devices: 93,662
Combined* Digital Connectivity Index Rating: 42 (Average)

Maitland
Population (2021): 90,226
Annual Visitors (2019): 801,000
Visitor Expenditure (2019): 1,610,370
Estimated number of Devices: 887,979
Combined* Digital Connectivity Index Rating: 62 (Above Average)

Port Stephens
Population (2021): 75,276
Annual Visitors (2019): 1,573,000
Visitor Expenditure (2019): $563,000,000
Estimated number of Devices: 737,349
Combined* Digital Connectivity Index Rating: 46 (Average)

Newcastle
Population (2021): 168,873
Annual Visitors (2019): 4,627,000
Visitor Expenditure (2019): $1,056,000,000
Estimated number of Devices: 1,662,988
Combined* Digital Connectivity Index Rating: 75 (Above Average)

Lake Macquarie
Population (2021): 213,845
Annual Visitors (2019): 1,365,000
Visitor Expenditure (2019): $210,000,000
Estimated number of Devices: 2,049,942
Combined* Digital Connectivity Index Rating: 64.5 (Above Average)

Central Coast
Population (2021): 346,596
Annual Visitors (2019): 5,289,000
Visitor Expenditure (2019): $903,000,000
Estimated number of Devices: 3,340,075
Combined* Digital Connectivity Index Rating: 60.5 (Average)

** Combined Digital Connectivity Index Rating is the average of: 'On the Move' and 'Stationary' index*
- *Population (2021) is sourced from* ABS
- *Annual Visitors (2019) is sourced from* Tourism Research Australia
- *Visitor Expenditure (2019) is sourced from* Tourism Research Australia
- Digital Connectivity Index is sourced from NSW Government

The purpose of this business case

Taking a proactive approach to planning for future demand will minimise challenges associated with inadequate infrastructure and enhance the attractiveness of the Hunter and Central Coast as great places to visit.

The purpose of this business case

This report has been developed to aid in planning for the necessary infrastructure to accommodate the expected increase in population and visitors to the DSSN region.

This report outlines the opportunities to implement measures that accommodate immediate demands, and also contribute to the region's longer-term resilience and sustainability to fulfil digital connectivity demand from future growth.

The following activities were undertaken

To understand the current and forecasted challenges, opportunities and case for investment into improved digital infrastructure for the DSSN region, the following key steps were taken:

- Current Demand - Telecommunications infrastructure review: an analysis of the current digital connectivity and the existing infrastructure that is available in each of the ten LGAs. This includes 3G, 4G and 5G mobile coverage by Australia's top three telecommunications retail service providers and the services as provided by nbn. This was conducted with further connectivity analysis of the population of each LGA, urban or rural location, and the region's connectivity needs based on the needs of the different industry sectors.
- Future Demand – Forecast of the future population and visitation: research on the current and projected future residential populations and visitor numbers for each LGA, and the subsequent expected demand on telecommunications infrastructure based on the number of people and the average number of devices they use at home, work and whilst travelling.
- Modelling of scenarios and options for investment: analysis of priority areas for immediate, medium and long-term investment into improved digital infrastructure. Different approaches are recommended for consideration based on prioritisation, major developments planned for the region, and an analysis of the expected costs and benefits of each scenario.

Key Drivers of Digital Connectivity Demand

- The impact of digital connectivity challenges
- Key connectivity trends influencing the sector
- The benefits of improved digital connectivity
- The risk of doing nothing

The impact of digital connectivity challenges

Digital connectivity challenges have the potential to significantly impact economic growth and community outcomes by affecting the experience of those who live, work and travel in the region.

Impact to households

Households are reliant on digital connectivity for their employment, education, entertainment and access to government services.

- Employment opportunities: As of 2021, up to 30 per cent of all the work done in NSW was performed remotely. Lack of reliable connectivity impacts people's ability to engage in remote work opportunities.
- Access to services: With 27.3 per cent of rural areas lacking adequate digital connectivity, accessing essential services digitally such as healthcare and government assistance can be a challenge.
- Emergencies: Some rural and remote dwellings with poor connectivity may also face safety concerns in emergency situations.
- Cost of living: Limited coverage in some areas results in households spending more to obtain reliable connectivity. It has been reported that some consumers devise work-arounds by using multiple providers to maximise service coverage.

Impact to businesses

For businesses to be efficient, competitive and support economic growth, they require reliable digital connectivity services.

- Productivity: The digital divide can impact businesses in rural areas struggling to access a digitally skilled workforce. Some businesses also report that the slow speeds "distract significantly from having a productive workforce", with EFTPOS transactions timing out due to congestion in some cases.
- Innovation: Businesses can be limited with the adoption of emerging technologies with inadequate digital connectivity, limiting innovation and growth prospects as well as cyber security measures.
- Industry growth: As Internet of Things (IoT) devices continue to proliferate and new technologies are adopted by industry that need high quality 5G connectivity, there is an expectation that digital connectivity services will be available especially in sectors such as mining, construction and agriculture.

Impact to visitors

Visitors have an expectation of being connected without disruption while travelling, so good digital connectivity is fundamental to their experience while visiting the DSSN region.

- Major events: Major events in the region attract thousands of attendees. Recent events include the Elton John concert in Newcastle (50,000 attendees), the Fast and Loud festival in Lake Macquarie (40,000 attendees), and ChromeFest on the Central Coast (50,000 attendees). With surges of visitors and their digital devices, the existing telecommunications infrastructure in some areas has been insufficient to meet the surge in peak demand.
- International gateway: The Newcastle Airport is undergoing upgrades to become an international airport, with airlines increasingly introducing new routes. In 2023 the Port of Newcastle has secured a 10-year license agreement to accept cruise liners, which will also further increase visitors to the Hunter region.
- Travel challenges: Incomplete mobile coverage and blackspots can hinder visitors' ability to stay connected, impacting their experience and navigation during their stay in the region.
- Visitor expectations: Tourism businesses in the region have reported that it is becoming "impossible to meet guest expectations" with visitors often disappointed by the speed and availability of mobile and internet services.

Key connectivity trends influencing the sector

Emerging technologies and government initiatives are improving digital inclusion especially for very remote and rural areas, and with a growing remote workforce there is an increased need for reliable digital connectivity.

Government initiatives

Key initiatives by the Federal Government are expected to drive digital connectivity improvements in regional and rural areas.

- **Mobile Blackspot Program:** The Federal Government continues to drive mobile coverage improvement through the Mobile Blackspot program. 66 sites are addressed in the new funding round across NSW and includes projects in Lake Macquarie, Port Stephens and Cessnock.
- **National Mobile Coverage Audit:** This program will better identify blackspots for future investment, under the Better Connectivity Plan for Regional and Rural Australia.
- **National Broadband investment:** $2.4B has been committed to nbn with the goal of connecting 1.5 million homes and businesses with Fibre to the Premises (FTTP).
- **Digital inclusivity:** To deliver modern and fit for purpose connectivity under the Universal Service Obligation, the Government is exploring options to deliver better communications outcomes - particularly for rural and regional, and First Nations communities.

Emerging technologies

Technology advancements are driving industry and major telecommunications providers to introduce new solutions and connectivity services.

- **Low-Earth Orbit Satellites (LeoSat) for consumer connectivity:** Advancements in LeoSat technologies are being rolled out at pace and there are several LeoSat providers who are in market or trialling new services. New services currently available in market are for internet services with Starlink and there are plans to introduce voice calls, SMS and data for mobile services via LeoSat, which will benefit very remote and rural areas.
- **Low-Earth Orbit Satellites (LeoSat) for backhaul:** Advancements in LeoSat technologies such as laser based communications can enable the rollout of new sites / exchanges in remote and very remote areas at a lower cost compared to current technology options.
- **Rollout of 5G:** 3G and 4G sites continue to be upgraded to 5G and low-band spectrum (<1Ghz) is being re-purposed for 5G to improve coverage, offering faster and more reliable connectivity. In addition, mobile network operators are increasingly co-locating mobile sites to reduce roll out costs, adding their own antennas to lower deployment costs in regional areas.

Digitally enabled

Enhanced digital connectivity promotes economic growth by boosting productivity, fostering innovation, and enabling remote work.

- **A growing remote workforce:** Sydney is only a drive or train ride away from much of the DSSN Region, and the feasibility of a fast train from Sydney to Newcastle is currently being investigated. With 43 per cent of employers indicating that remote working improves productivity, and employees are increasingly working in remote and hybrid working environments.
- **Smart Cities:** Digital connectivity supports the development of smart cities, improving resource management, enhancing public services, and driving economic growth through intelligent urban infrastructure. For example, City of Newcastle's Smart City Strategy outlines strategies to enhance connectivity including the installation of 'Smart' poles throughout the CBD to provide free WiFi and enable other digital services if needed.

The benefits of improved digital connectivity

A more connected region brings many economic and social benefits, especially to communities living in regional, rural and remote areas.

Economic benefits

The Hunter is the leading regional economy in Australia and is home to the highest producing manufacturing precincts for products such as coal and steel, as well as being one of the country's most productive wine regions.

- **GDP uplift:** Improved digital connectivity can uplift GDP in the region by building an improved working and visitor experience, driving industry and tourism growth. nbn reports that between 2023 – 2030, national GDP is expected to be uplifted by $399 billion due to improved digital connectivity*.
- **Employment benefits:** Tourism is the second largest source of employment across the Hunter Valley, and is expected to continue to grow. Projections indicate strong visitor growth to the region and are expected to drive the visitor economy and businesses operating in popular 'wine country' areas. nbn has estimated an additional 113,000 additional jobs will be created by nbn upgrades and improved connectivity between 2023 and 2030.
- **Attracting new business:** Improving digital infrastructure across the region can attract new businesses such as e-commerce, cloud service providers, co-working spaces, professional services and any business that aims to provide remote working opportunities for employees living in the DSSN region. nbn estimated that an additional 55,000 businesses are expected to be enabled by the nbn network nationally between 2023 – 2030.

Social benefits

With the population across the DSSN region projected to increase to over 1M people by 2030, pressures on the education, health and community services sectors will also increase. Reliable digital connectivity will be important for local communities and visitors.

- **Improved quality of education:** Educational institutions, including primary, secondary, vocational and tertiary institutions, are increasingly offering online learning content and programs. 82 per cent of nbn users have reported a positive impact on education outcomes as a result of nbn connectivity. The Hunter region is home to the University of Newcastle and the University of New England, two major tertiary institutions, as well as schools and TAFE. University of Newcastle is planning to expand to Gosford on the Central Coast, where they will open a new campus that begins welcoming students from 2025.
- **Improved access to health services:** The Healthcare and Social Assistance sector has the highest estimated number of industrial devices in the DSSN region, highlighting the importance of digital connectivity for the sector. Enhanced connectivity improves access to healthcare specialists via telehealth, enables faster access for care, alleviates pressure on emergency departments, and may reduce clinician travel time. The Primary Health Network for the Hunter New England and Central Coast region reported in the last financial year that over 95% of eligible general practices in the region are currently accessing the SeNT eReferral system, and the use of digital health in primary care for communities remains a high priority.
- **Community wellbeing:** With 57 per cent of the Hunter region's population experiencing socioeconomic disadvantage, digital infrastructure enables community and social services to reach rural and remote areas that are outside of urban centres such as the Greater Newcastle region. The ongoing trend towards remote work, coupled with advancements in digital connectivity, is also anticipated to significantly enhance social wellbeing.

* Source: The economic and social impact of investment in the nbn network (2024)

The risk of doing nothing

Without continued investment in telecommunications infrastructure upgrades, the DSSN region is exposed to economic, social, environment and other risks which also impact tourism and the visitor economy.

Economic risks

Without addressing digital connectivity challenges, the regions may experience economic stagnation as businesses struggle to compete in a digital-centric environment.

- Inadequate internet has been identified as a significant barrier to technology adoption by businesses, particularly in the agriculture, forestry and fishing industry. The lack of robust digital infrastructure could limit the growth of industries that heavily depend on digital technologies, leading to fewer job opportunities for residents and less competitive businesses.
- Insufficient digital connectivity may deter potential investors looking for regions with advanced technological infrastructure, hindering economic growth. For example, poor mobile phone coverage in Lachlan Shire, NSW is limiting businesses in adopting technological developments that are occurring in urban areas, which is deterring investment in the area.[2]

Infrastructure risks

This can include challenges related to the development, maintenance, and adaptability of physical and digital infrastructure in the context of connectivity initiatives.

- It is estimated that accelerating adoption of 5G in Australia can result in $27.2B value over 9 years.[4] Failure to address digital connectivity challenges may lead to a technological backlog, making it difficult to catch up with rapidly advancing technologies.
- The regions may miss out on opportunities to develop smart city initiatives that enhance efficiency, sustainability, and quality of life.

Social and environmental risks

Inadequate digital connectivity can widen socio-economic gaps even further, as well as impacting industry's ability to remain up to date with environmental sustainability measures.

- Inadequate connectivity may contribute to social isolation, particularly among communities that rely on digital communication for social interactions. It hinders residents' access to essential services (e.g., healthcare, Centrelink, MyGov, NDIS), especially given the increasing digitisation of government services.
- Poor connectivity may also widen the educational gap, limiting access to online learning resources and opportunities for skill development. 85 per cent of educational organisations believe that poor connectivity is limiting students in developing essential skills.[1] In Wilcannia, NSW, residents have reported difficulty accessing home schooling and video calls due to a lack of reliable and affordable coverage[3].
- Without advanced digital infrastructure, the regions may struggle to implement and monitor sustainability initiatives that rely on connected technologies. 68 per cent of business leaders agree that poor connectivity impeded their sustainability projects in 2023. Digital connectivity will also be important to enable the transition towards renewables and introduces new technology and projects.[1]

Innovation risks

Risks associated with the development and adoption of new technologies and practices within a digital connectivity framework.

- Inadequate digital connectivity may impede innovation and research initiatives, hindering the regions' ability to stay competitive in knowledge-based industries. Over 83 per cent of organisations agree that poor connectivity is causing rural regions to fall behind in medical innovation.[1]

*Source: [1]Regional Development Australia Central West, [2]The State of Connectivity in Australia 2023, [3]Mapping the Digital Gap, [4]5G Unleashed: Australian Mobile Telecommunications Association

03 | Digital Connectivity Gaps for the DSSN Region

Methodology and Summary of Key Modelling Findings

- Methodology to determine current and future connectivity demand
- Methodology to determine future infrastructure investment
- Summary of key findings for future digital connectivity demand and new infrastructure requirements

Methodology: Determining current and future connectivity demand

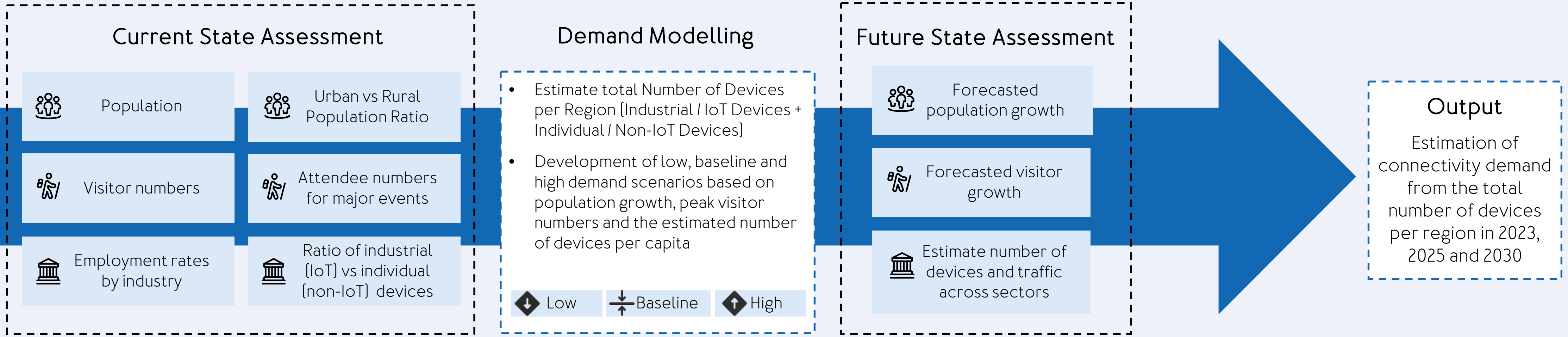
The assessment of digital connectivity demand across regions considers demographic factors to derive the number of devices connected by citizens, visitors, and businesses in 2023, and projections for 2025 and 2030.

Overview of the steps taken as part of this assessment:

1. To evaluate the present and future digital connectivity demand across all regions, usage patterns among citizens, visitors, and businesses were analysed. Data on current population, anticipated growth, and distribution across rural and urban areas were sourced from ABS, NSW Electorate and Department of Agriculture, Fisheries and Forestry.
2. Visitor data and peak demand during selected events were gathered from Visit NSW and the Australian Tourism Data Warehouse. Information on employment across key sectors and industrial device usage was obtained from ABS and IoT Analytics.
3. The total number of devices per region and total connections were simulated, considering the demand from residents, visitors, and businesses. Three scenarios were developed based on the average devices per capita: Low (6.58), Baseline (9.4), and High (13.4), as per Cisco IBSG Group and Cisco Annual Internet Report.
4. Using these scenarios and growth estimates for population, visitors, and sectors (data from ABS, VES 2030 regional NSW forecast and IoT analytics forecast], the baseline, low, and high scenarios for the total number of connected devices for 2025 and 2030 were developed. This was then used to develop the network capacity requirements across each LGA.

Limitations:

- The analysis is based on publicly available data and standard industry parameters.
- The simulated calculation assumes a certain number of devices per user, regardless of urban or rural areas.



A detailed overview of the methodology, inputs and data sources is included in Appendix 2: Inputs for Demand Modelling (page 130)

Methodology: Assessing digital connectivity supply gap and future state

The supply capacity as provided by existing infrastructure is evaluated against future demand scenarios and gaps are identified. Subsequently, additional infrastructure required to close the supply gap and the associated cost estimates are determined.

Overview of the steps taken as part of this assessment:

- A technology review was conducted to analyse the range of technologies utilised and the extent of coverage provided by wireless and wireline infrastructure. This encompassed a) evaluation of current mobile technologies such as 3G, 4G, 5G, and fibre connections, including assessments of dwellings equipped with FTTP, FTTC, and FTTN access, b) examination of coverage maps to identify existing gaps, sourced from ACCC Mobile Infrastructure report, network operator coverage maps and nbn service availability maps, and c) analysis of the Digital Connectivity Index from the NSW Telco Authority, which assesses the quality of digital connectivity across LGAs.
- Radio network capacity based on simulated demand is determined to demand on average and busy hour demand. This was determined using a) network's capacity to handle data transmissions between the radio access site and user devices, and b) network's capacity to handle the number of simultaneous devices / active users.
- The projected costs for wireless and wireline infrastructure incorporate capital expenditures for establishing new mobile radio access sites (e.g. monopoles and lattice towers) and standard wireline infrastructure to upgrade dwellings to FTTP.

Limitations:

- Only fibre is included in this assessment; nbn Fixed Wireless and LeoSat upgrades are not included in the modelling.
- The CapEx estimate includes infrastructure costs and excludes construction, labour and other costs.

Current State Assessment

- Analysis of existing Mobile Technologies (3G, 4G, 5G) and the locations of radio access sites
- Analysis of wireless coverage maps and identification of coverage gaps for the three major network operators
- 'On-the-move' Digital Connectivity Index

- Analysis of different types of nbn technologies
- Analysis of nbn coverage maps and identification of wireline connectivity gaps
- 'Stationery' Digital Connectivity Index

Network Capacity Modelling

Simulate capacity demand based on:

- Total number of connected devices for three scenarios
- Account for existing mobile sites
- Simulate network traffic requirements for IoT and Non-IoT devices
- Estimate the radio access network capacity gap across the future demand scenarios

Assess the existing infrastructure and number of dwellings with fibre access (FTTP, FTTC, FTTN) or with no fibre

Future State Assessment

Determine the number of new mobile / radio access sites needed to fulfil the simulated future connectivity demand

Assess the new infrastructure required to upgrade all dwellings to FTTP

Outputs:

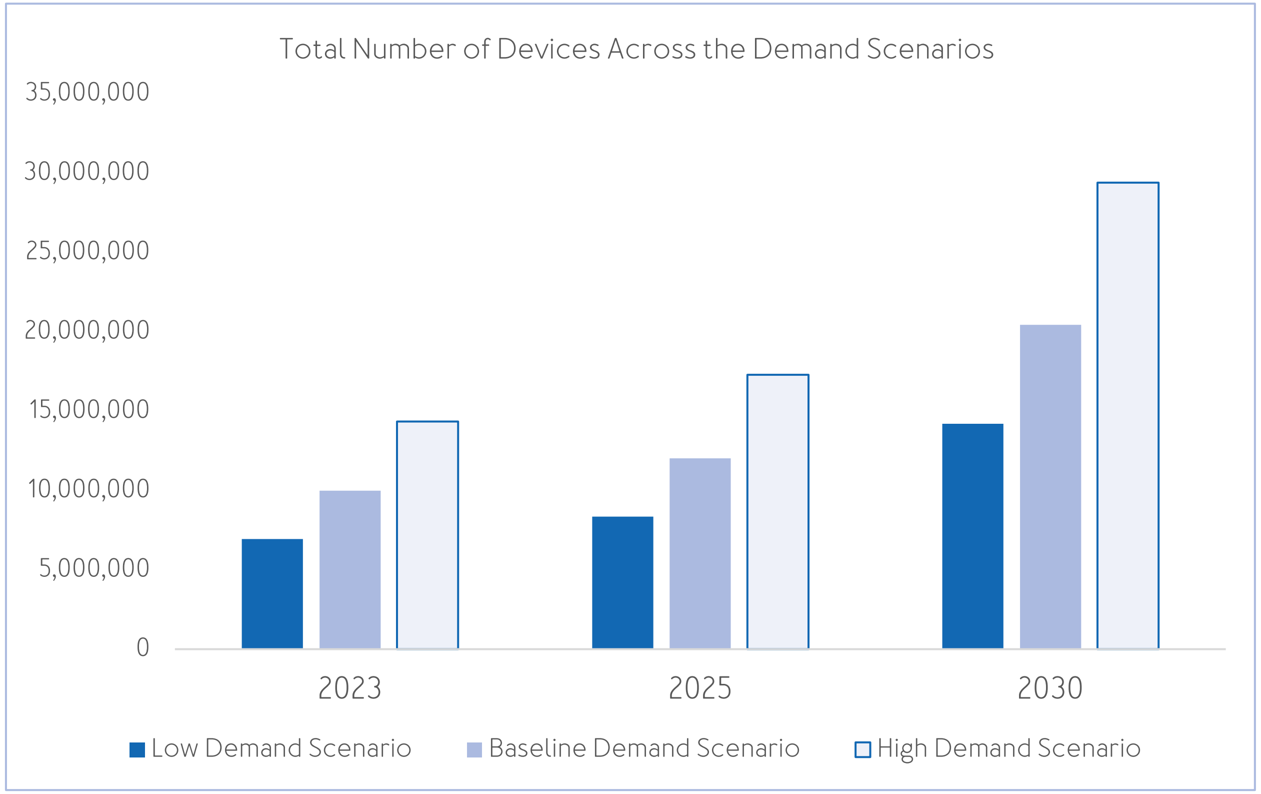
Projected costs for new wireless infrastructure necessary to meet future demand

Projected costs to transition all dwellings to FTTP

A detailed overview of the methodology, inputs and data sources is included in Appendix 2: Inputs for Demand Modelling (page 130)

Key Findings: Growth in devices and future digital connectivity demand

The total number of connected devices is expected to grow by 106 per cent from 2023 to 2030, increasing from 9.9M to 20.4M devices in the Baseline Demand Scenario. This is driven by growth in population, visitors and the average number of devices per capita.



Key insights:

- The three demand scenarios have been developed by considering the number of devices per capita, population growth, visitor growth, industrial (IoT) devices, individual (Non-IoT) devices and visitor devices.
- For the Baseline Demand Scenario, by 2030 the total population of the DSSN region is projected to increase to **1.16M**, visitor numbers to **52,861**, and the total number of devices in use by the local population and visitors to the region to **20.4M**.
- In the Baseline Demand Scenario, the total number of devices is expected to rise from 9.9 million in 2023 to 20.4 million by 2030, indicating a growth of approximately **106 per cent**.
- The number of projected devices to be in use by 2030 aligns with the projected growth in population for each LGA.
- The LGAs driving the highest connectivity demand across the DSSN region are Central Coast (34 per cent), followed by Lake Macquarie (21 per cent) and Newcastle (17 per cent).

A detailed overview of the methodology, inputs and data sources is included in Appendix 2: Inputs for Demand Modelling (page 130), and Appendix 4: Calculations for Connectivity Demand Scenarios (page 135)

Key Findings: Digital connectivity gaps

The modelling indicates that seven LGAs will have insufficient wireless network capacity in 2030 for the Baseline Demand Scenario. For wirelines connectivity, the majority of dwellings currently only have access to legacy FTTC/FTTN nbn services.

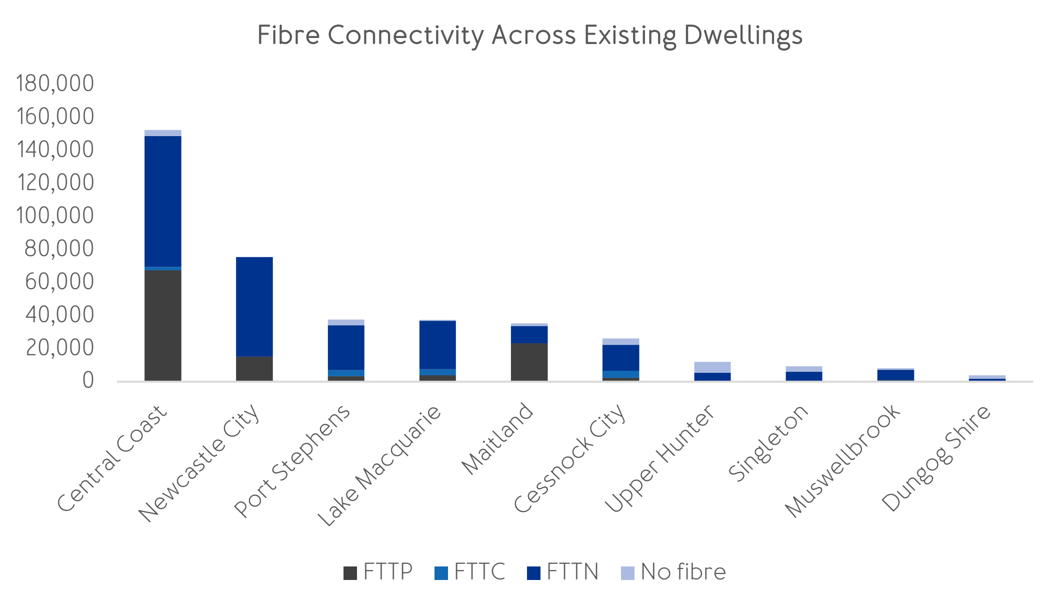
Wireless network capacity projection on existing the infrastructure based on 2030 demand scenarios

	Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
Central Coast	Yellow	Red	Red
Cessnock City	Green	Red	Red
Dungog Shire	Green	Red	Red
Lake Macquarie	Yellow	Red	Red
Maitland	Red	Red	Red
Muswellbrook	Green	Green	Red
Newcastle City	Green	Red	Red
Port Stephens	Green	Red	Red
Singleton	Green	Green	Red
Upper Hunter	Green	Green	Red

Existing network capacity:
- Green: Meets the estimated demand
- Yellow: May experience congestion during peak demand
- Red: Does not support estimated demand

- None of the LGAs in the DSSN region can meet the High Demand Scenario connectivity needs in 2030 based on the existing infrastructure.
- Only Muswellbrook, Singleton and Upper Hunter have adequate infrastructure in place to meet the projected Baseline Demand Scenario wireless connectivity needs in 2030.

Wireline connectivity technologies in 2023



- Maitland and Central Coast LGAs have the highest proportion of households with FTTP access, with 66 per cent and 44 per cent respectively.
- Singleton and Dungog Shire regions have limited FTTP connectivity (<1 per cent of dwellings).
- Upper Hunter and Dungog Shire regions have the highest proportion of households with no fibre access, at 55 per cent and 52 per cent respectively.
- Dwellings with no fibre have access to fixed wireless and LeoSat nbn services.

Key Findings: Future infrastructure requirements to meet digital connectivity demand

108 new radio sites are projected to be required across the DSSN region by 2030 to meet future wireless demand in the Baseline Demand Scenario, and almost 71% of existing dwellings are candidates for wireline infrastructure upgrades to FTTP.

Additional Radio Sites / Mobile Base Stations that are required by 2030 for each LGA to fulfil future demand scenarios

Local Government Area	Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
Central Coast	0	11	99
Cessnock City	0	8	29
Dungog Shire	0	2	5
Lake Macquarie	0	39	99
Maitland	2	19	45
Muswellbrook	0	0	2
Newcastle City	0	27	82
Port Stephens	0	2	31
Singleton	0	0	3
Upper Hunter	0	0	1
DSSN Region	2	108	396

- In the high-growth scenario, the regions of Lake Macquarie, Central Coast, and Newcastle demonstrate the highest need for additional radio access sites, driven by escalating demand within the area.
- Conversely, the Upper Hunter, Muswellbrook, and Singleton regions exhibit a comparatively lower demand, necessitating fewer additional sites by the year 2030.

Total number of dwellings across the DSSN region that require upgrades to achieve 100% FTTP connectivity

Local Government Area	Total Private Dwellings	FTTC to FTTP transition	FTTN to FTTP transition	No fibre to FTTN
Central Coast	152,699	1.3%	52.0%	2.4%
Cessnock City	26,304	16.3%	59.7%	14.8%
Dungog Shire	3,905	0.0%	47.7%	52.3%
Lake Macquarie	37,464	10.2%	78.3%	1.1%
Maitland	35,343	0.0%	29.8%	4.1%
Muswellbrook	8,193	0.6%	77.3%	10.5%
Newcastle City	75,771	0.0%	79.5%	0.4%
Port Stephens	37,730	9.8%	71.8%	9.3%
Singleton	9,348	0.0%	63.8%	35.5%
Upper Hunter	12,168	0.0%	40.3%	55.3%
DSSN Region	398,925	3.5%	60.5%	6.6%

- Up to 60% of all dwellings require a transition from FTTN to FTTP in the region.
- Singleton, Muswellbrook, Dungog Shire and Upper Hunter regions has a substantial number of dwellings which require transition to FTTP.

Key Findings: Future telecommunications infrastructure investment

To address current connectivity gaps and future demand in the Baseline Demand Scenario by 2030, an estimated capital expenditure of $46.8M to $60.6M in wireless infrastructure will be required and $358.1M to upgrade all dwellings to FTTP.

Local Government Area	Wireless investment for new radio access towers / sites by 2030: Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario	Wireline investment: Upgrade existing dwellings to FTTP
Central Coast	$0	$4.2M -$6.4M	$38.6M -$58.5M	$114.0M
Cessnock	$0	$3,3M -$4.6M	$12.8M -$17.6	$28.0M
Dungog	$0	$0.8M -$1.1M	$2.3M -$3.2M	$2.6M
Lake Macquarie	$0	$16.0M-$22.7M	$32.8M -$57.4M	$46.4M
Maitland	$0.9M -$1.0M	$9.1M -$10.4M	$18.7M -$24.2M	$14.8M
Muswellbrook	$0	$0	$0.8M-$1.2M	$8.9M
Newcastle	$0	$10.5M -$16M	$25.4M -$48.7M	$84.4M
Port Stephens	$0	$0.8M -$1.1M	$14.8M -$17.8M	$43.1M
Singleton	$0	$0	$1.5M -$2.0M	$8.3M
Upper Hunter	$0	$0	$0.6M-$0.8M	$7.6M
DSSN Region	$0.9M -$1.0M	$46.8M -$60.6M	$158.1M -$221.6M	$358.1M

- Capital Expenditure (CapEx) is the estimated cost of infrastructure (direct material costs). The CapEx estimate excludes costs such as construction, labour or other costs.
- A detailed overview of the approach and assumptions used for infrastructure investment estimates is included in Appendix 5 (page 139) and Appendix 6 (page 144). For fibre upgrades from FTTC and FTTN to FTTP, an average lead-in cost of $1,400 per connection is assumed in the modelling, as indicated by Mr Stephen Rue, nbn CEO, at the Senate Estimates held on 13 February 2024.

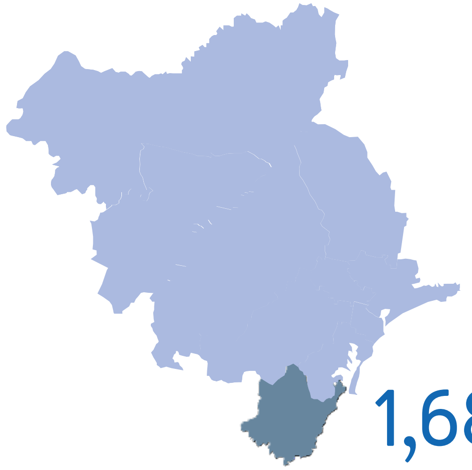
Local Government Areas Current Infrastructure, Gaps and Options for Investment

Central Coast

- LGA overview
- Telecommunications infrastructure review
- Wireless connectivity gaps
- Wireline connectivity gaps
- Infrastructure requirements to meet future demand

LGA Overview: Central Coast

With the anticipated growth in population, visitation and economic activity in Central Coast, the total number of projected connections is expected to double to over 6.6M from 2023 to 2030 in the Baseline Demand Scenario, driving up demand.



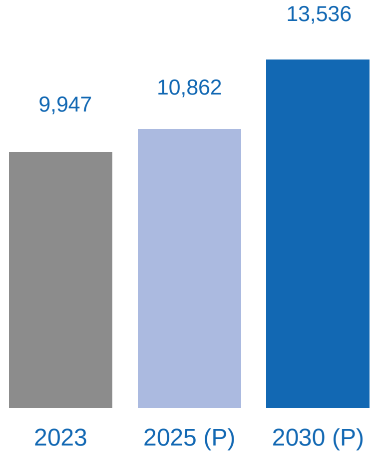
1,682km²

Total land area

Daily Visitors to the Area
(Baseline Demand Scenario)

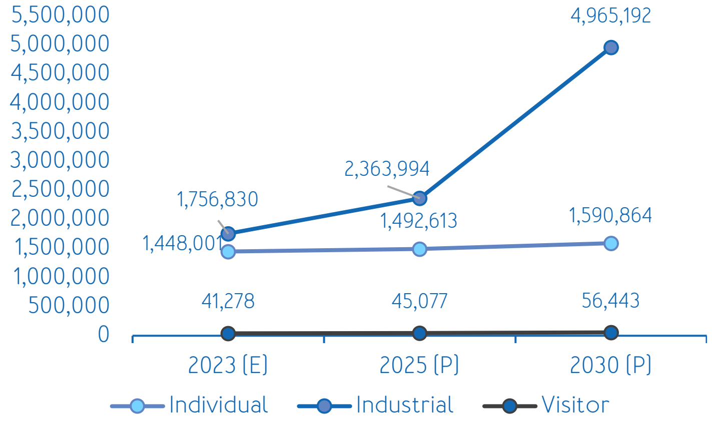
Annual Central Coast highlights include Flavours by the Sea in Terrigal held in March, ChromeFest in The Entrance held in October with over 50,000 visitors, and New Year's Eve fireworks.

The region has 41 beaches along its 80km coastline, great walks in Bouddi National Park, and popular coastal towns such as Terrigal and The Entrance.

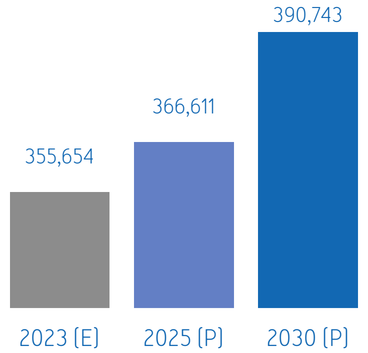


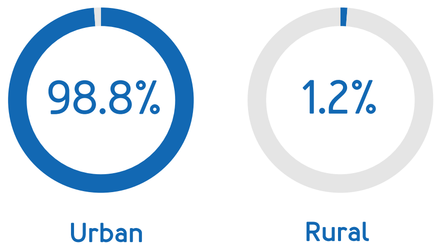
*The simulated number of visitors to the LGA per day in the Baseline Demand Scenario **

Total Number of Connected Devices
(Baseline Demand Scenario)



Population





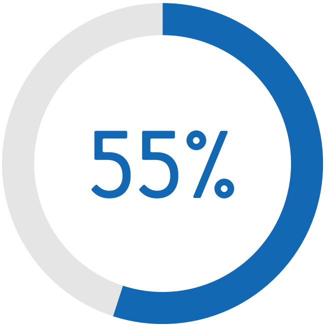
Key Insights:

- Central Coast is the most populated and most visited LGA in the DSSN region. As a popular tourist area during the Summer holiday season, some towns may need additional resources to deal with peak connectivity demands.
- A Strategy for Economic Growth has been developed by the Greater Cities Commission in partnership with Central Coast Council, defining the regions priorities which include innovation and delivering a high-speed internet network. Enhancing local infrastructure will increase efficiency, connectivity, and capacity, allowing further innovation and developments.
- Anticipated growth in population, increased visitation, and the expansion of various industries are expected to augment the overall number of device connections in the region to over 6.M by 2030. The University of Newcastle has plans to build a new campus in Gosford, which will also increase the student population and digital connectivity demand.

** Visitor numbers have been calculated using the total number of commercial accommodation rooms available in the LGA, and a final maximum number of visitors assumed to visit each day based on the number of day trippers, overnight visitors and additional visitors who stay with friends or family. A 'Low' scenario was calculated at 50% of this maximum figure ('High' demand scenario), and a 'Baseline' scenario was calculated at 75% of the maximum.*

Telecommunications Infrastructure Review: Central Coast

Central Coast has an average 'on the move' digital connectivity index with widespread 3G/4G coverage and 5G services in densely populated areas. The 'stationary' digital connectivity index is above average with fibre available in most urban areas.



Digital Connectivity Index (On the Move)

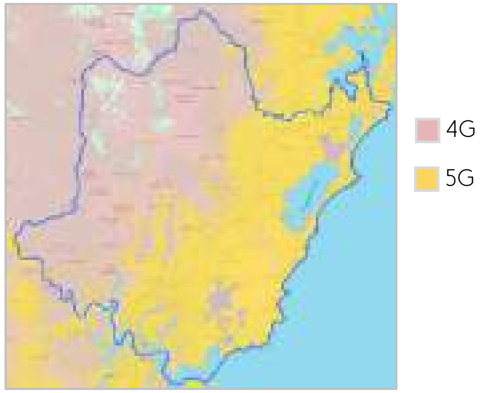
Access	83	●●●●●
Affordability	86	●●●●●
Demographics	59	●●●○○

Telstra		Optus		TPG	
3G	✓	3G	✓	3G	✓
4G	✓	4G	✓	4G	✓
5G	✓	5G	✓	5G	✓

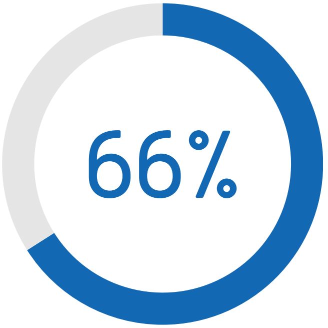
Key Insights:

- High Digital Connectivity Index, reflected by complete 3G and 4G coverage in residential areas.
- Average Download Speed of 76.06 Mbps and Upload Speed of 7.35 Mbps.
- Presence of 5G in major suburbs. Connectivity gaps in 5G observed in suburbs such as Wamberal and Matcham.
- Remote area of Dharug National Park lacks any site infrastructure, resulting in no coverage.

Current Mobile Coverage



The map above shows the current 4G and 5G coverage by the main network providers (Telstra, Optus, and TPG)



Digital Connectivity Index (Stationary)

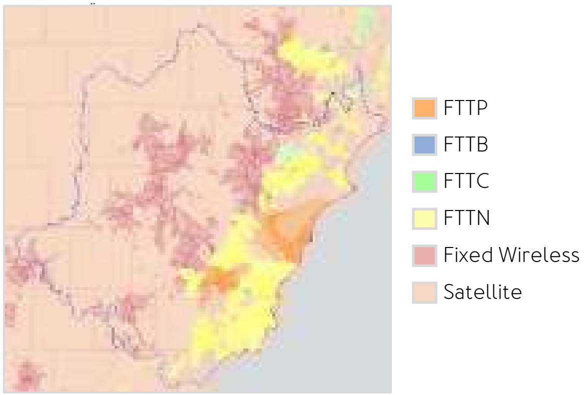
Access	96	●●●●●
Affordability	90	●●●●●
Demographics	59	●●●○○

Fibre to the Premises	✓
Fibre to the Building	✓
Fibre to the Curb	✓
Fibre to the Node	✓
Fixed Wireless	✓
Satellite	✓

Key Insights:

- Access via Fibre to the Premises (FTTP) is available for the Gosford and The Entrance regions.
- Fibre to the Node (FTTN) is provided for the remaining densely populated areas.
- Rural areas with some population density, such as Mangrove or Somersby, have access via fixed wireless.
- The remaining very remote areas have access via satellite.

nbn Current nbn Services



Wireless Connectivity Gaps: Central Coast

To provide insight into the range of demand conditions and how they may impact demand for network capacity, three demand scenarios have been developed. Based on the Central Coast demand scenarios, the existing radio access infrastructure will not be able to meet future wireless connectivity needs in the Baseline Demand Scenario in 2030 and the High Demand Scenario in 2025.

Current Number of Radio Access Sites: 265

4G co-located with 5G: 98 | **Urban Sites:** 165 | **Rural Sites:** 2

The three scenarios developed to understand the potential demand for digital connectivity are based on population and visitor growth, and the subsequent increase in the expected number of devices that will be in use based on 'Low', 'Baseline' or 'High' demand scenarios.

		Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
2023 (E)	**Connected devices**	2,315,222	3,321,220	4,754,122
	Network capacity	⚪⚪🟢	⚪⚪🟢	⚪🟡⚪
2025 (P)	**Connected devices**	2,788,162	4,002,749	5,737,456
	Network capacity	⚪⚪🟢	⚪⚪🟢	🔴⚪⚪
2030 (P)	**Connected devices**	4,750,299	6,824,775	9,792,225
	Network capacity	⚪🟡⚪	🔴⚪⚪	🔴⚪⚪

(P) is for Projected Growth
(E) is for Estimated

Key insights:

- The existing infrastructure will cater for mobile connectivity demand in the Low demand scenario. No additional mobile towers are required.
- In the Baseline demand scenario, the existing infrastructure is projected to be sufficient through to 2025, however, by 2030 it is projected that it will not be able to meet future demand for number of connections. Therefore, additional mobile sites will need to be installed by 2030 to cater for future demand.
- In the High demand scenario, network capacity is challenged from 2023 and insufficient from 2025. Therefore, new mobile sites will need to be installed starting from 2025 onwards to meet future demand.

Key for network capacity:

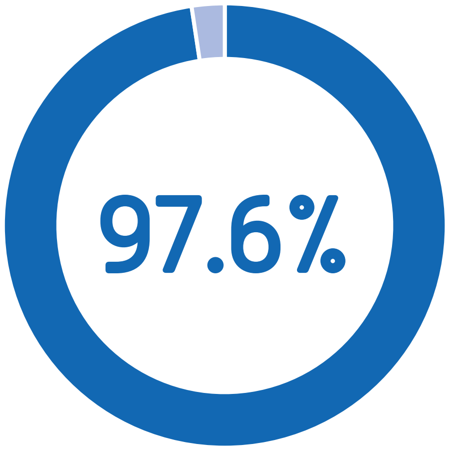
- ⚪⚪🟢 Existing network capacity meets the estimated demand
- ⚪🟡⚪ Existing network capacity may experience congestion during peak demand
- 🔴⚪⚪ Existing network capacity does not support estimated demand

Wireline Connectivity Gaps: Central Coast

In 2023, 97.6 per cent of dwellings in Central Coast had fibre access, however, only 44.3 per cent had access to FTTP which represents the ideal fibre connection to fulfil future demand. Therefore, the other 55.7 per cent of dwellings may experience connectivity challenges with access limited to FTTC or FTTN in urban areas and fixed wireless or satellite in remote areas.

Total private dwellings*: 152,699

There were 152,699 private dwellings in the Central Coast LGA, 97.6% of which are estimated to have had fibre access. This access consisted of 44.3% FTTP, the ideal fibre connection for digital connectivity. The breakdown of types of access are as follows:



Dwellings with no fibre access

Dwellings with fibre access

Fibre to the Premises (FTTP):
44.3% (67,578 Dwellings)

Fibre to the Curb (FTTC):
1.3% (1,994 Dwellings)

Fibre to the Node (FTTN):
52% (79,448 Dwellings)

Fixed Wireless or Satellite:
2.4% (3,679 Dwellings)

* 'Private Dwellings' are typically a house, flat or apartment for residential use; it can also refer to a caravan, houseboat, or other form of residential living space. The figures included in this assessment are from the ABS 2021 Census.

Key insights:

- 55.7% of households in Central Coast do not have access to FTTP services and therefore may experience digital connectivity challenges such as limited download speeds or high latency.
- 53.3% of dwellings have access to FTTC or FTTN services, for which the last mile fibre roll out is feasible to the dwelling from the curb or the node.
- 2.4% of households on the Central Coast had no fibre access in 2023 (1,944 dwellings in total), so they are currently reliant on nbn fixed wireless or satellite services.
- In order to provide FTTP to all dwellings in the Central Coast, additional wireline infrastructure is required.

Top three suburbs with no fibre access:

- **Jilliby:** 531 dwellings
- **Somersby:** 387 dwellings
- **Mangrove Mountain:** 280 dwellings

Infrastructure Requirements to meet Future Demand: Central Coast

In the baseline demand scenario, an estimated CapEx* investment of $4.2M - $6.4M is required to build 11 new radio access sites to fulfil future wireless connectivity demand and $114M to upgrade existing dwellings on FTTC and FTTN to FTTP.

Wireless infrastructure requirements & investment

The table below outlines the estimated investment in new radio access sites / mobile base stations that need to be deployed between 2025 and 2030 to increase network capacity and fulfil projected connectivity demand across the three scenarios.

	Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
Additional Radio Sites / Mobile Base Stations Required	0	11	99
Major City Sites (co-located)	0	11 (5)	98 (43)
Inner Regional Area Sites (co-located)	0	0	1
CapEx Investment Estimate*	$0	$4.2M - $6.4M	$38.6M - $58.5M

Wireline infrastructure requirements & investment

The table below outlines the estimated investment to upgrade wireline infrastructure and transition dwellings in the LGA with FTTC and FTTN to FTTP.

Costs associated with providing access via fibre to dwellings that currently do not have access to this type of technology, have not been included below. The cost of this expansion is inherent to different factors and the geographical location / distance of possible fibre cores.

Fibre Upgrade Type	Number of Dwellings	Estimated Investment
FTTC to FTTP	1,994	$2.8M
FTTN to FTTP	79,448	$111.2M
CapEx Investment Estimate*		$114M

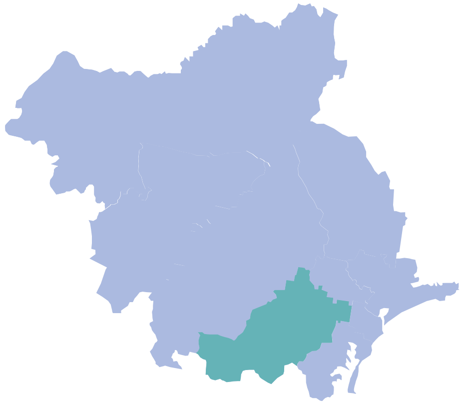
- Capital Expenditure (CapEx) is the estimated cost of infrastructure (direct material costs). The CapEx estimate excludes other costs such as construction, labour or other costs. The estimated CapEx investment is indicative to fulfil projected future demand for wireless services and upgrading dwellings with FTTC and FTTN to FTTP. For fibre upgrades from FTTC and FTTN to FTTP, an average lead-in cost of $1,400 per connection is assumed in the modelling, as indicated by Mr Stephen Rue, nbn CEO, at the Senate Estimates held on 13 February 2024. It should be noted that nbn is currently rolling out a fibre upgrade program with the ambition to provide FTTP services to over 90% of residences and businesses nationally by the end of 2025. Therefore, it is expected that a large portion of the projected fibre upgrade CapEx investment is already in plan for roll out by nbn to residential and business customers who are eligible and request an upgrade to a high speed service plan through their Retail Service Provider (RSP). A breakdown of wireless infrastructure cost assumptions can be found in Appendix 6 (page 144). In addition, this analysis excludes nbn fixed wireless and satellite upgrades, noting that nbn is currently rolling out upgrades to these technologies to improve coverage and capacity.

Cessnock

- LGA overview
- Telecommunications infrastructure review
- Wireless connectivity gaps
- Wireline connectivity gaps
- Infrastructure requirements to meet future demand

LGA Overview: Cessnock

Over 1.3M connected devices are projected in Cessnock by 2030 in the Baseline Demand Scenario and with 1M visitors drawn to the region annually, demand for connectivity will continue to increase.



1,966km^2

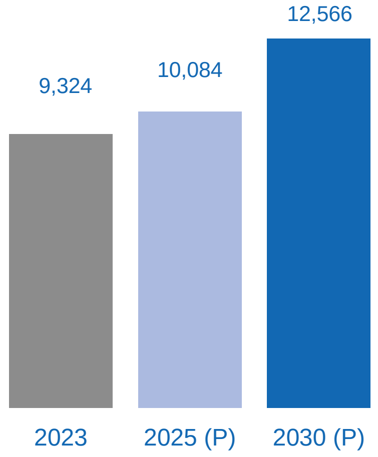
Total land area

Daily Visitors to the Area

(Baseline Demand Scenario)

The vineyards in Pokolbin and Lovedale are at the heart of Australia's oldest wine region.

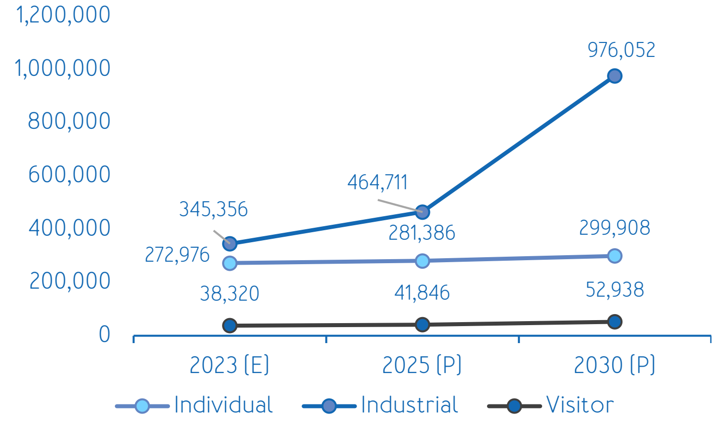
Major draws for tourists include music events at Bimbadgen and Hope Estate, and the Lovedale Long Lunch, a food and wine highlight every May. The Kurri Kurri Nostalgia Fest brings over 30,000 visitors for three days of vintage charm every March.



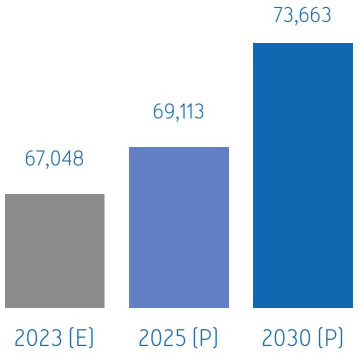
*The simulated number of visitors to the LGA per day in the baseline scenario used for this assessment**

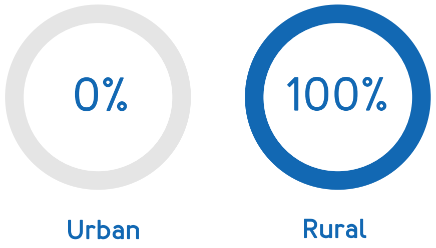
Total Number of Connected Devices

(Baseline Demand Scenario)



Population





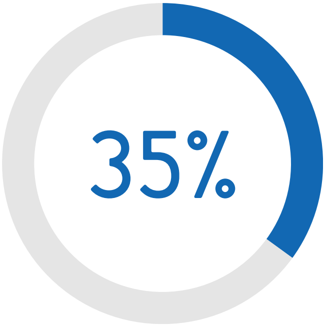
Key Insights:

- Cessnock is considered completely rural. Over 1M visitors are drawn to the region annually, mostly by events held in the wine region.
- The highest employment sector in the region is Healthcare and Social Assistance. Increasing trends of telehealth, sensors, and IoT devices will continue to increase the device demand and the required level of digital connectivity in the region.
- Cessnock City Council has identified 54 black spots across the LGA, with constraints in mobile phone coverage and capacity restricting the growth of the visitor economy. During peak visitation periods in Wine Country, EFTPOS transactions can be affected by the current limited capacity.
- Anticipated growth in population, increased visitation, and the expansion of various industries is expected to augment the overall number of connections in the region to over 1.2M by the year 2030.

** Visitor numbers have been calculated using the total number of commercial accommodation rooms available in the LGA, and a final maximum number of visitors assumed to visit each day based on the number of day trippers, overnight visitors and additional visitors who stay with friends or family. A 'Low' scenario was calculated at 50% of this maximum figure ('High' demand scenario), and a 'Baseline' scenario was calculated at 75% of the maximum.*

Telecommunications Infrastructure Review: Cessnock

Cessnock has below average 'on the move' and 'stationary' digital connectivity, with limited 5G coverage and FTTP accessibility limited to a small part of Cessnock City.



Digital Connectivity Index (On the Move)

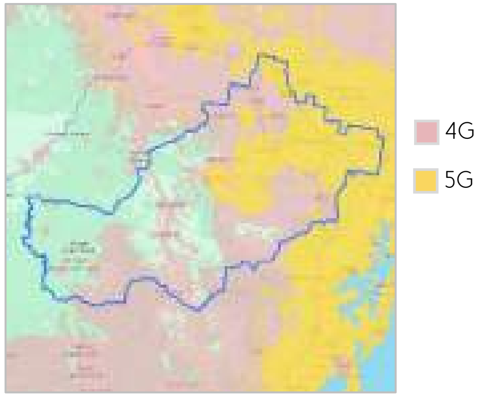
Access	77	●●●●○
Affordability	85	●●●●●
Demographics	36	●●○○○

Telstra		Optus		TPG	
3G	✓	3G	✓	3G	✓
4G	✓	4G	✓	4G	✓
5G	✓	5G	✗	5G	✓

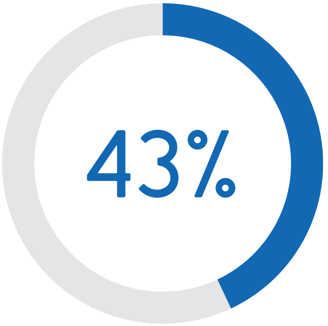
Key Insights:

- Complete 3G and 4G coverage in inhabited and industrial zones of the region.
- Coverage gaps identified Pokolbin State Forest and Yengo National Park.
- Digital Connectivity Index is below average. This is attributed not to access issues but to the demographic characteristics of the region.
- Presence of 5G coverage in the central part of Cessnock.

Current Mobile Coverage



Map showing current mobile coverage in terms of 4G and 5G (Telstra, Optus, and TPG combined)



Digital Connectivity Index (Stationary)

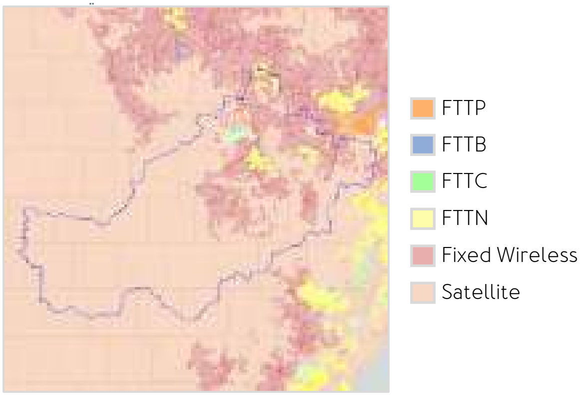
Access	96	●●●●●
Affordability	90	●●●●●
Demographics	59	●●●○○

Fibre to the Premises	✓
Fibre to the Building	✗
Fibre to the Curb	✓
Fibre to the Node	✓
Fixed Wireless	✓
Satellite	✓

Key Insights:

- Fibre to the Premises is significantly limited throughout the entire region, available only for a small part of Cessnock City.
- Access via Fibre to the Node is available for the remaining residential areas.
- Due to the rural nature of the Cessnock region, remote areas with occasional housing have access via Fixed Wireless.

nbn Current nbn Services



Wireless Connectivity Gaps: Cessnock

To provide insight into the range of demand conditions and how they may impact demand for network capacity, three demand scenarios have been developed. Based on the Cessnock demand scenarios, the existing radio access infrastructure will not be able to meet future wireless connectivity needs in the baseline scenario in 2030 and the high scenario from 2023.

Current Number of Radio Access Sites: 59

4G co-located with 5G: 17 | Urban Sites: 0 | Rural Sites: 42

The three scenarios developed to understand the potential demand for digital connectivity are based on population and visitor growth, and the subsequent increase in the expected number of devices that will be in use based on ‘Low’, ‘Baseline’ or ‘High’ demand scenarios.

		Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
2023 (E)	**Connected devices**	450,889	656,652	954,996
	Network capacity	⚪ ⚪ 🟢	⚪ ⚪ 🟢	🔴 ⚪ ⚪
2025 (P)	**Connected devices**	541,375	787,943	1,145,780
	Network capacity	⚪ ⚪ 🟢	⚪ 🟡 ⚪	🔴 ⚪ ⚪
2030 (P)	**Connected devices**	915,154	1,328,358	1,925,977
	Network capacity	⚪ ⚪ 🟢	🔴 ⚪ ⚪	🔴 ⚪ ⚪

(P) is for Projected Growth
(E) is for Estimated

Key insights:

- The existing infrastructure will cater for mobile connectivity demand in the low demand scenario. No additional mobile towers are required.
- In the Baseline demand scenario, the existing infrastructure is projected to be challenged in 2025 and by 2030 it will not be able to meet future demand for connectivity. Therefore, additional mobile sites are required from 2025 onwards to cater for this future demand.
- In the high demand scenario, network capacity does not support estimated demand from 2023 and beyond. Therefore, new mobile sites will need to be installed immediately to meet both current and future demand.

Key for network capacity:

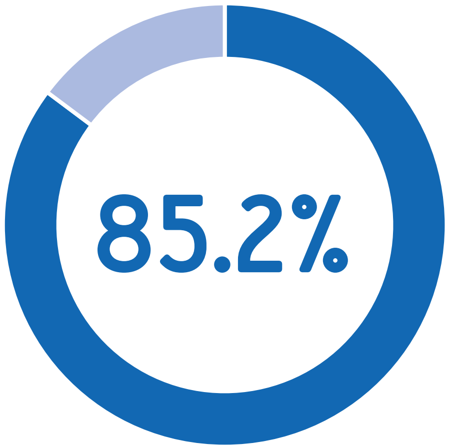
- ⚪ ⚪ 🟢 Existing network capacity meets the estimated demand
- ⚪ 🟡 ⚪ Existing network capacity may experience congestion during peak demand
- 🔴 ⚪ ⚪ Existing network capacity does not support estimated demand

Wireline Connectivity Gaps: Cessnock

In 2023, 85.2 per cent of dwellings in Cessnock had fibre access, with 76 per cent having access to FTTC/FTTN, representing the least ideal fibre connection for future demand. Only 9 per cent of dwellings had access to FTTP, the fastest and most reliable connection available.

Total private dwellings*: 26,304

There were 26,304 private dwellings in the Cessnock LGA, 85.23 per cent of which are estimated to have had fibre access. This access consisted of 60% FTTN, the least ideal fibre connection for digital connectivity. The breakdown of types of access are as follows:



Fibre to the Premises (FTTP):
9% (2,411 Dwellings)

Fibre to the Curb (FTTC):
16% (4,286 Dwellings)

Fibre to the Node (FTTN):
60% (15,693 Dwellings)

Fixed Wireless or Satellite:
15% (3,884 Dwellings)

* 'Private Dwellings' are typically a house, flat or apartment for residential use; it can also refer to a caravan, houseboat, or other form of residential living space. The figures included in this assessment are from the ABS 2021 Census.

Key insights:

- 91 per cent of households in Cessnock do not have access to FTTP services and therefore may experience digital connectivity challenges such as limited download speeds or high latency.
- 76 per cent of dwellings have access to FTTC or FTTN services, for which the "last mile" fibre roll out is feasible to the dwelling from the curb or the node.
- 15 per cent of households in Cessnock had no fibre access in 2023 (3,884 dwellings in total), so they are currently reliant on nbn fixed wireless or satellite services.
- Only 9 per cent of dwellings in Cessnock have access to FTTP, indicating major fibre rollout or fixed wireless upgrades would be required.

Top three suburbs with no fibre access:

- Ellalong: 492 dwellings
- Millfield: 492 dwellings
- Mulbring: 255 dwellings

Infrastructure Requirements to meet Future Demand: Cessnock

In the baseline demand scenario, an estimated CapEx* investment of $3.3M - $4.6M is required to build 8 new radio access sites to fulfil future wireless connectivity demand and $28M to upgrade existing dwellings to FTTP from FTTC and FTTN.

Wireless infrastructure requirements & investment

The table below outlines the estimated investment in new radio access sites / mobile base stations that need to be deployed between 2025 and 2030 to increase network capacity and fulfil projected connectivity demand across the three scenarios.

	Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
Additional Radio Sites / Mobile Base Stations Required	0	8	29
Major City Sites (co-located)	0	0 (0)	0 (0)
Inner Regional Area Sites (co-located)	0	8 (4)	29 (13)
CapEx Investment Estimate*	$0	$3.3M - $4.6M	$12.7 - $17.6M

Wireline infrastructure requirements & investment

The table below outlines the estimated investment to upgrade wireline infrastructure and transition dwellings in the LGA with FTTC and FTTN to FTTP.

Costs associated with providing access via fibre to dwellings that currently do not have access to this type of technology, have not been included below. The cost of this expansion is inherent to different factors and the geographical location/distance of possible fibre cores.

Fibre Upgrade Type	Number of Dwellings	Estimated Investment
FTTC to FTTP	4,286	$6.0M
FTTN to FTTP	15,693	$22.0M
CapEx Investment Estimate*		$28.0M

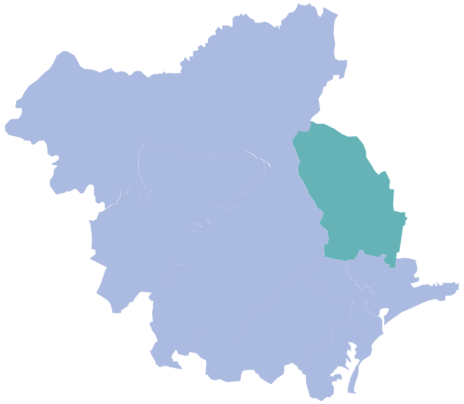
- Capital Expenditure (CapEx) is the estimated cost of infrastructure (direct material costs). The CapEx estimate excludes other costs such as construction, labour or other costs. The estimated CapEx investment is indicative to fulfil projected future demand for wireless services and upgrading dwellings with FTTC and FTTN to FTTP. For fibre upgrades from FTTC and FTTN to FTTP, an average lead-in cost of $1,400 per connection is assumed in the modelling, as indicated by Mr Stephen Rue, nbn CEO, at the Senate Estimates held on 13 February 2024. It should be noted that nbn is currently rolling out a fibre upgrade program with the ambition to provide FTTP services to over 90% of residences and businesses nationally by the end of 2025. Therefore, it is expected that a large portion of the projected fibre upgrade CapEx investment is already in plan for roll out by nbn to residential and business customers who are eligible and request an upgrade to a high speed service plan through their Retail Service Provider (RSP). A breakdown of wireless infrastructure cost assumptions can be found in Appendix 6 (page 144). In addition, this analysis excludes nbn fixed wireless and satellite upgrades, noting that nbn is currently rolling out upgrades to these technologies to improve coverage and capacity.

Dungog

- LGA overview
- Telecommunications infrastructure review
- Wireless connectivity gaps
- Wireline connectivity gaps
- Infrastructure requirements to meet future demand

LGA Overview: Dungog

Despite holding the smallest population in the DSSN region, Dungog is projected to have almost 200K connections in 2030, with growing demand for IoT in industries like Agriculture and mining driving increased connectivity requirements.



2,250km^2

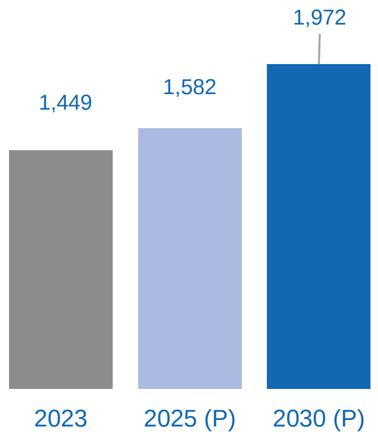
Total land area

Daily Visitors to the Area

(Baseline Demand Scenario)

Dungog is known for its country charm and nature, featuring the Barrington Tops National Park and the Williams River.

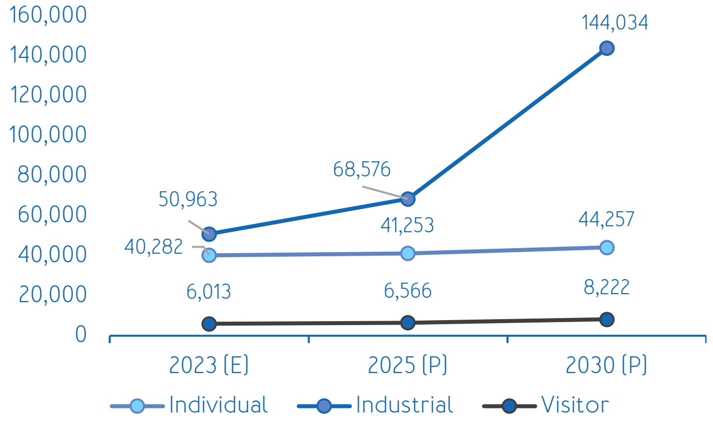
Visitors frequent the region for extensive bike trails, camping adventures, the annual Dungog Show, and the popular Dungog Rodeo held in April with over 6,000 attendees in 2023.



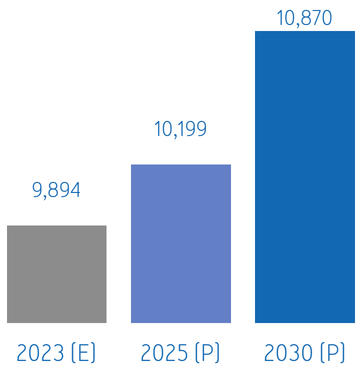
*The simulated number of visitors to the LGA per day in the baseline scenario used for this assessment**

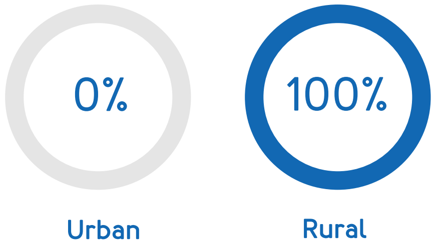
Total Number of Connected Devices

(Baseline Demand Scenario)



Population





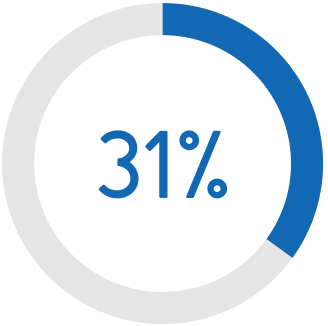
Key Insights:

- Dungog has the smallest population of all LGAs in the DSSN region and is completely rural. The main draw for the region is outdoor activities including camping, with events held occasionally, drawing many visitors to the region annually.
- The highest employment sector for the region is Agriculture, Forestry, Fishing, Mining, Quarrying, Oil & Gas. Increasing usage of sensors, remote monitoring devices, and other IoT devices will continue to drive demand for digital connectivity in the region.
- Improving infrastructure in the Dungog LGA will provide new opportunities and enable growth for businesses in the area. Opportunities include improving information delivery, marketing, and promotion. Improved digital connectivity will enable digital technologies to be used to showcase the Shire's history.
- Anticipated growth in population, increased visitation, and the expansion of various industries are expected to drive the number of connections in the region to almost 200K by the year 2030.

** Visitor numbers have been calculated using the total number of commercial accommodation rooms available in the LGA, and a final maximum number of visitors assumed to visit each day based on the number of day trippers, overnight visitors and additional visitors who stay with friends or family. A 'Low' scenario was calculated at 50% of this maximum figure ('High' demand scenario), and a 'Baseline' scenario was calculated at 75% of the maximum.*

Telecommunications Infrastructure Review: Dungog

The Dungog region has no access to 5G coverage and experiences connectivity gaps amongst its highly rural areas. Fibre connection is restricted to FTTN in the central area and Clarence Town, with remaining areas accessing fixed wireless.



Digital Connectivity Index (On the Move)

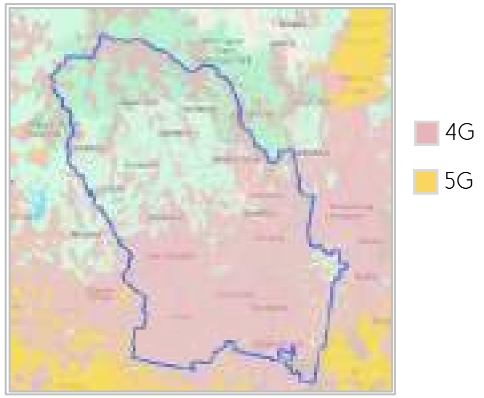
Access	49
Affordability	81
Demographics	59

Telstra		Optus		TPG	
3G	✓	3G	✓	3G	✗
4G	✓	4G	✓	4G	✗
5G	✗	5G	✗	5G	✗

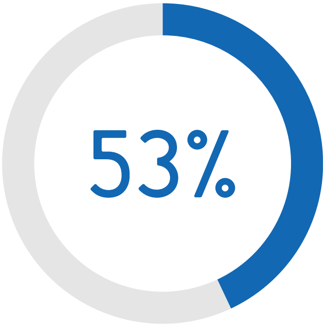
Key Insights:

- TPG has not deployed any radio sites in the region.
- No 5G coverage is available.
- Majority of residential areas are covered, although there may be some connectivity gaps in the northern part of the region, which is highly rural.

Current Mobile Coverage



Map showing current mobile coverage in terms of 4G and 5G (Telstra, Optus, and TPG combined)



Digital Connectivity Index (Stationary)

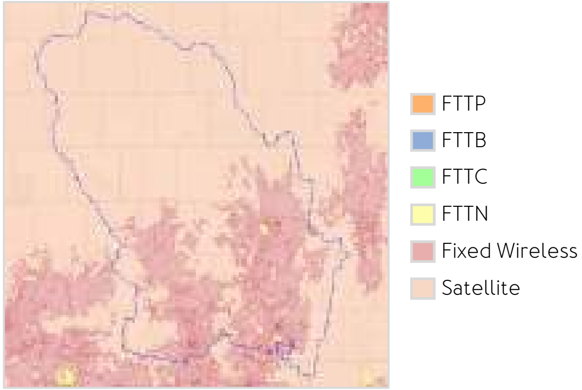
Access	76
Affordability	88
Demographics	59

Fibre to the Premises	✗
Fibre to the Building	✗
Fibre to the Curb	✗
Fibre to the Node	✓
Fixed Wireless	✓
Satellite	✓

Key Insights:

- In terms of fibre, only Fibre to the Node is available for the central area of Dungog and the residential area of Clarence Town.
- The remaining areas with housing have access via Fixed Wireless.
- Satellite access is provided for remote areas.

nbn Current nbn Services



Wireless Connectivity Gaps: Dungog

To provide insight into the range of demand conditions and how they may impact demand for network capacity, three demand scenarios have been developed. Based on the Dungog demand scenarios, the existing radio access infrastructure will not be able to meet connectivity needs in the baseline demand scenario in 2030 and the high demand scenario from 2023.

Current Number of Radio Access Sites: 13

4G co-located with 5G: 0 | **Urban Sites: 0** | **Rural Sites: 13**

The three scenarios developed to understand the potential demand for digital connectivity are based on population and visitor growth, and the subsequent increase in the expected number of devices that will be in use based on 'Low', 'Baseline' or 'High' demand scenarios.

		Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
2023 (E)	**Connected devices**	66,678	97,259	141,503
	Network capacity	⚪⚪🟢	⚪⚪🟢	🔴⚪⚪
2025 (P)	**Connected devices**	80,044	116,666	169,710
	Network capacity	⚪⚪🟢	⚪🟡⚪	🔴⚪⚪
2030 (P)	**Connected devices**	135,240	196,513	284,996
	Network capacity	⚪⚪🟢	🔴⚪⚪	🔴⚪⚪

(P) is for Projected Growth
(E) is for Estimated

Key insights:

- The existing infrastructure will cater for mobile connectivity demand in the low demand scenario. No additional mobile towers are required.
- In the baseline demand scenario, the existing infrastructure is projected to be sufficient for 2023. However, by 2025 network capacity will be challenged and by 2030 will be inadequate for estimated demand. Therefore, additional mobile sites will need to be installed by 2025 to cater for future demand.
- In the high demand scenario, network capacity is insufficient from 2023 onwards. Therefore, new mobile sites will need to be installed in 2023 onwards to meet future demand.

Key for network capacity:

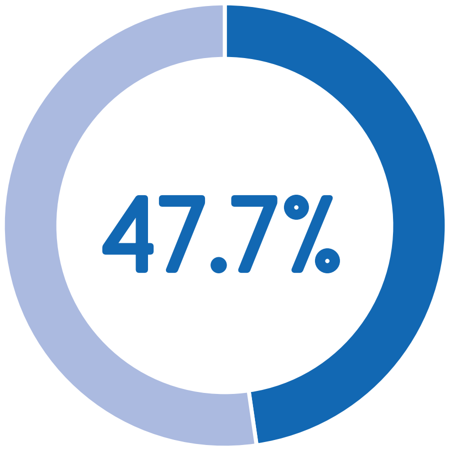
- ⚪⚪🟢 Existing network capacity meets the estimated demand
- ⚪🟡⚪ Existing network capacity may experience congestion during peak demand
- 🔴⚪⚪ Existing network capacity does not support estimated demand

Wireline Connectivity Gaps: Dungog

In 2023, only 47.7 per cent of dwellings in Dungog had access to a fibre connection and with only FTTN provided to these dwellings. The remaining 52.3 per cent or 2,042 dwellings are serviced by a fixed wireless or a satellite connection.

Total private dwellings*: 3,905

There were 3,905 private dwellings in the Dungog LGA, 47.71 per cent of which are estimated to have had fibre access. This access consisted of 47.71 per cent FTTN, the least ideal fibre connection for digital connectivity. The breakdown of types of access are as follows:



Dwellings with no fibre access
Dwellings with fibre access

Fibre to the Premises (FTTP):
0% (0 Dwellings)

Fibre to the Curb (FTTC):
0% (0 Dwellings)

Fibre to the Node (FTTN):
47.71% (1,863 Dwellings)

Fixed Wireless or Satellite:
52.29% (2,042 Dwellings)

* 'Private Dwellings' are typically a house, flat or apartment for residential use; it can also refer to a caravan, houseboat, or other form of residential living space. The figures included in this assessment are from the ABS 2021 Census.

Key insights:

- The only fibre connection available in the Dungog region is FTTN, the least ideal fibre connection for connectivity available to users.
- Due to the rural nature of the Dungog region the majority of dwellings are serviced by fixed wireless or satellite, which may result in reduced connectivity in comparison to fibre alternatives.
- FTTN is only available in the centre of Dungog and Clarence Town.
- In order to provide FTTP to all dwellings in the Dungog, additional wireline infrastructure is required across the whole region, with a large proportion of dwellings currently serviced by fixed wireless or satellite connections.

Top three suburbs with no fibre access:

- **Paterson:** 374 dwellings
- **East Gresford: 159** dwellings
- **Martins Creek:** 149 dwellings

Infrastructure Requirements to meet Future Demand: Dungog

In the baseline demand scenario, an estimated CapEx* investment of $836K - $1.1M is required to build 2 new radio access sites to fulfil future wireless connectivity demand and $2.6M to upgrade existing dwellings from FTTN to FTTP.

Wireless infrastructure requirements & investment

The table below outlines the estimated investment in new radio access sites / mobile base stations that need to be deployed between 2025 and 2030 to increase network capacity and fulfil projected connectivity demand across the three scenarios.

	Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
Additional Radio Sites / Mobile Base Stations Required	0	2	5
Major City Sites (co-located)	0	0 (0)	0 (0)
Inner Regional Area Sites (co-located)	0	2 (1)	5 (2)
CapEx Investment Estimate*	$0	$836K - $1.1M	$2.3 - $3.1M

Wireline infrastructure requirements & investment

The table below outlines the estimated investment to upgrade wireline infrastructure and transition dwellings in the LGA with FTTC and FTTN to FTTP.

Costs associated with providing access via fibre to dwellings that currently do not have access to this type of technology, have not been included below. The cost of this expansion is inherent to different factors and the geographical location/distance of possible fibre cores.

Fibre Upgrade Type	Number of Dwellings	Estimated Investment
FTTC to FTTP	0	$0K
FTTN to FTTP	1,863	$2.6M
CapEx Investment Estimate*		$2.6M

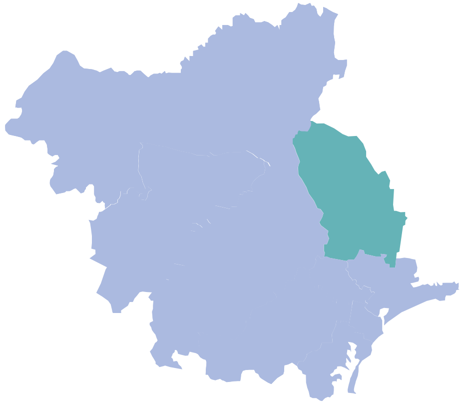
- Capital Expenditure (CapEx) is the estimated cost of infrastructure (direct material costs). The CapEx estimate excludes other costs such as construction, labour or other costs. The estimated CapEx investment is indicative to fulfil projected future demand for wireless services and upgrading dwellings with FTTC and FTTN to FTTP. For fibre upgrades from FTTC and FTTN to FTTP, an average lead-in cost of $1,400 per connection is assumed in the modelling, as indicated by Mr Stephen Rue, nbn CEO, at the Senate Estimates held on 13 February 2024. It should be noted that nbn is currently rolling out a fibre upgrade program with the ambition to provide FTTP services to over 90% of residences and businesses nationally by the end of 2025. Therefore, it is expected that a large portion of the projected fibre upgrade CapEx investment is already in plan for roll out by nbn to residential and business customers who are eligible and request an upgrade to a high speed service plan through their Retail Service Provider (RSP). A breakdown of wireless infrastructure cost assumptions can be found in Appendix 6 (page 144). In addition, this analysis excludes nbn fixed wireless and satellite upgrades, noting that nbn is currently rolling out upgrades to these technologies to improve coverage and capacity.

Lake Macquarie

- LGA overview
- Telecommunications infrastructure review
- Wireless connectivity gaps
- Wireline connectivity gaps
- Infrastructure requirements to meet future demand

LGA Overview: Lake Macquarie

Anticipated growth in population and increased demand for IoT devices across the Lake Macquarie, is projected to drive over 4M connected devices by 2030 driving the need for greater digital connectivity for the region.



649km²

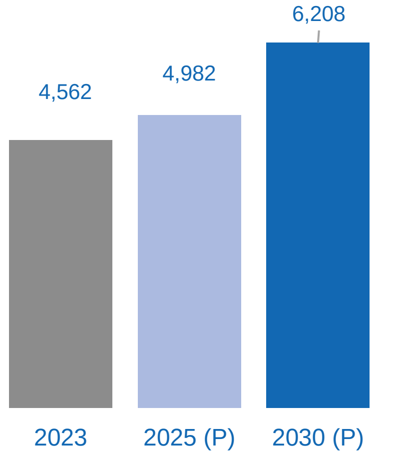
Total land area

Daily Visitors to the Area

(Baseline Demand Scenario)

Lake Macquarie is centred around the vast lake, with scenic walking trails and a selection of beaches, including the popular Naru Beach.

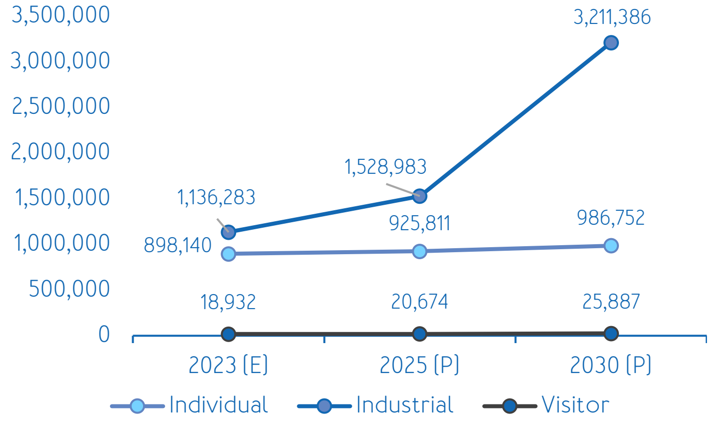
The annual Fast and Loud Festival attracts over 40,000 visitors, while the Lake Macquarie Food & Wine Festival provides a gourmet experience with local produce.



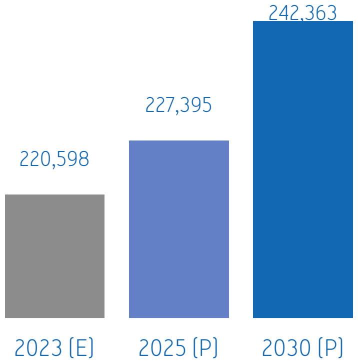
*The simulated number of visitors to the LGA per day in the baseline scenario used for this assessment**

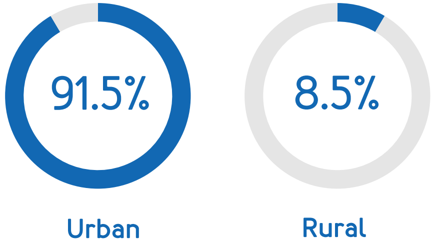
Total Number of Connected Devices

(Baseline Demand Scenario)



Population





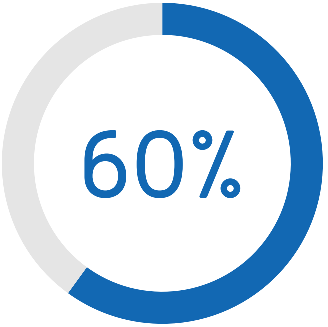
Key Insights:

- Lake Macquarie is the second most populated and fourth most visited LGA in the DSSN region. The region is mostly urban. Events and nature in the region draw over 1.3M visitors annually.
- The highest employment sector in the region is Healthcare and Social Assistance. Increasing trends of telehealth, sensors, and IoT devices will continue to increase the device demand and the required level of digital connectivity in the region.
- Lake Macquarie City Council is continuing to invest in smart cities initiatives such as the community IoT network, and city insights sensor program. The council is continuing to run programs and promote opportunities to educate residents about digital technologies, which will increase the demographic factor for the Digital Connectivity Index.
- Anticipated growth in population, increased visitation, and the expansion of various industries are expected to augment the overall number of connections in the region to over 4M by the year 2030.

** Visitor numbers have been calculated using the total number of commercial accommodation rooms available in the LGA, and a final maximum number of visitors assumed to visit each day based on the number of day trippers, overnight visitors and additional visitors who stay with friends or family. A 'Low' scenario was calculated at 50% of this maximum figure ('High' demand scenario), and a 'Baseline' scenario was calculated at 75% of the maximum.*

Telecommunications Infrastructure Review: Lake Macquarie

Lake Macquarie has above average digital connectivity for both 'On the Move' and 'Stationary'. Extensive 5G coverage is provided in population and industry dense areas, with a mix of FTTP, FTTN and fixed wireless/satellite services the region.



Digital Connectivity Index (On the Move)

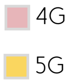
Access	86
Affordability	87
Demographics	60

Telstra	Optus	TPG
3G ✓	3G ✓	3G ✓
4G ✓	4G ✓	4G ✓
5G ✓	5G ✓	5G ✓

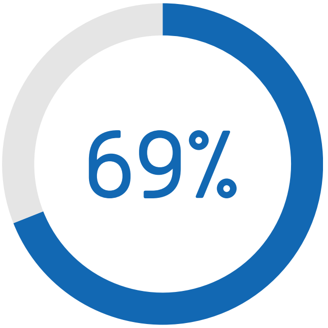
Key Insights:

- 3G and 4G connectivity available throughout the entire region.
- A high Digital Connectivity Index, ensuring robust access.
- Well-developed 5G infrastructure in areas with high population density and associated industry.

Current Mobile Coverage

Map showing current mobile coverage in terms of 4G and 5G (Telstra, Optus, and TPG combined)



Digital Connectivity Index (Stationary)

Access	97
Affordability	91
Demographics	60

Fibre to the Premises	✓
Fibre to the Building	✓
Fibre to the Curb	✓
Fibre to the Node	✓
Fixed Wireless	✓
Satellite	✓

Key Insights:

- Access via Fibre to the Premises is available only in certain residential areas of West Wall and North Cooranbong.
- Access via Fibre to the Node is provided for the area around the lake, where the most densely populated part of the region is located.
- Remote areas of the region have access via Fixed Wireless and satellite.

nbn Current nbn Services


Wireless Connectivity Gaps: Lake Macquarie

To provide insight into the range of demand conditions and how they may impact demand for network capacity, three demand scenarios have been developed. Based on the Lake Macquarie demand scenarios, the existing radio access infrastructure does not meet wireless connectivity needs in the baseline demand scenario in 2030 or the high demand scenario from 2023 onwards.

Current Number of Radio Access Sites: 111

4G co-located with 5G: 68 | Urban Sites: 39 | Rural Sites: 4

The three scenarios developed to understand the potential demand for digital connectivity are based on population and visitor growth, and the subsequent increase in the expected number of devices that will be in use based on 'Low', 'Baseline' or 'High' demand scenarios.

		Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
2023 (E)	Connected devices	1,432,930	2,053,355	2,936,115
	Network capacity	⚪ ⚪ 🟢	⚪ ⚪ 🟢	🔴 ⚪ ⚪
2025 (P)	Connected devices	1,725,990	2,475,467	3,544,872
	Network capacity	⚪ ⚪ 🟢	⚪ 🟡 ⚪	🔴 ⚪ ⚪
2030 (P)	Connected devices	2,942,192	4,224,025	6,056,480
	Network capacity	⚪ 🟡 ⚪	🔴 ⚪ ⚪	🔴 ⚪ ⚪

(P) is for Projected Growth
(E) is for Estimated

Key insights:

- The existing infrastructure caters for mobile connectivity demand in the low demand scenario until 2030, where it may experience potential congestion.
- In the baseline demand scenario, the existing infrastructure will begin to be challenged and by 2030 it is projected that it will not be able to meet future demand for number of connections. Therefore, additional mobile sites will need to be installed by potentiallyy 2025 to cater for future demand.
- In the high demand scenario, network capacity does not support demand currently . Therefore, new mobile sites will need to be installed immediately to meet current and future demand.

Key for network capacity:

- ⚪ ⚪ 🟢 Existing network capacity meets the estimated demand
- ⚪ 🟡 ⚪ Existing network capacity may experience congestion during peak demand
- 🔴 ⚪ ⚪ Existing network capacity does not support estimated demand

Wireline Connectivity Gaps: Lake Macquarie

In 2023, 98.8 per cent of dwellings in Lake Macquarie had fibre access, however, only 10.4 per cent had access to FTTP which represents the ideal fibre connection to fulfil future demand. 88.5 per cent of dwellings may experience digital connectivity challenges with their access limited to FTTC or FTTN services.

Total private dwellings*: 37,464

There were 37,464 private dwellings in the Lake Macquarie LGA, 98.87 per cent of which are estimated to have had fibre access. The majority of connections are provided by FTTN, the least ideal fibre connection for digital connectivity. The remainder of dwellings are serviced by a mixture of FTTP and FTTC The breakdown of types of access are as follows:

Fibre to the Premises (FTTP):
10.4% (3,890 Dwellings)

Fibre to the Curb (FTTC):
10.2% (3,817 Dwellings)

Fibre to the Node (FTTN):
78.3% (29,332 Dwellings)

Fixed Wireless or Satellite:
1.1% (425 Dwellings)

* 'Private Dwellings' are typically a house, flat or apartment for residential use; it can also refer to a caravan, houseboat, or other form of residential living space. The figures included in this assessment are from the ABS 2021 Census.

Key insights:

- 89.6 per cent of households in Lake Macquarie do not have access to FTTP services and therefore may experience digital connectivity challenges such as limited download speeds or high latency.
- 88.5 per cent of dwellings have access to FTTC or FTTN services, for which the "last mile" fibre roll out is feasible to the dwelling from the curb or the node.
- 1.1 per cent of households on the Central Coast had no fibre access in 2023 (425 dwellings in total), so they are currently reliant on nbn fixed wireless or satellite services.
- In order to provide FTTP to all dwellings in the Lake Macquarie, additional wireline infrastructure is required.

Top three suburbs with no fibre access:

- **Mandalong:** 169 dwellings
- **Martinsville: 150** dwellings
- **Freemans Waterholes:** 49 dwellings

Infrastructure Requirements to meet Future Demand: Lake Macquarie

In the baseline demand scenario, an estimated CapEx* investment of $16M - $22.7M is required to build 39 new radio access sites to fulfil future wireless connectivity demand and $46.4M to upgrade existing dwellings on FTTC and FTTN to FTTP.

Wireless infrastructure requirements & investment

The table below outlines the estimated investment in new radio access sites / mobile base stations that need to be deployed between 2025 and 2030 to increase network capacity and fulfil projected connectivity demand across the three scenarios.

	Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
Additional Radio Sites / Mobile Base Stations Required	0	39	99
Major City Sites (co-located)	0	36 (16)	91 (40)
Inner Regional Area Sites (co-located)	0	3 (1)	8 (4)
CapEx Investment Estimate*	$0	$16.0M– $22.7M	$32.8M - $57.4M

Wireline infrastructure requirements & investment

The table below outlines the estimated investment to upgrade wireline infrastructure and transition dwellings in the LGA with FTTC and FTTN to FTTP.

Costs associated with providing access via fibre to dwellings that currently do not have access to this type of technology, have not been included below. The cost of this expansion is inherent to different factors and the geographical location/distance of possible fibre cores.

Fibre Upgrade Type	Number of Dwellings	Estimated Investment
FTTC to FTTP	3,817	$5.3M
FTTN to FTTP	29,332	$41.1M
CapEx Investment Estimate*		$46.4M

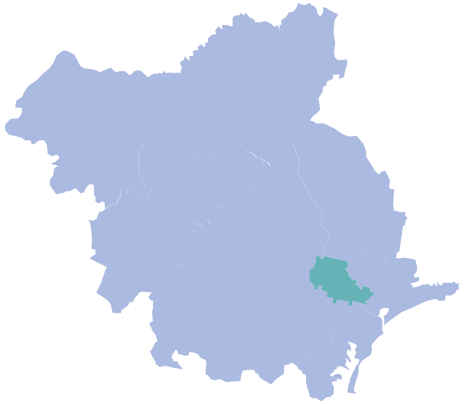
- Capital Expenditure (CapEx) is the estimated cost of infrastructure (direct material costs). The CapEx estimate excludes other costs such as construction, labour or other costs. The estimated CapEx investment is indicative to fulfil projected future demand for wireless services and upgrading dwellings with FTTC and FTTN to FTTP. For fibre upgrades from FTTC and FTTN to FTTP, an average lead-in cost of $1,400 per connection is assumed in the modelling, as indicated by Mr Stephen Rue, nbn CEO, at the Senate Estimates held on 13 February 2024. It should be noted that nbn is currently rolling out a fibre upgrade program with the ambition to provide FTTP services to over 90% of residences and businesses nationally by the end of 2025. Therefore, it is expected that a large portion of the projected fibre upgrade CapEx investment is already in plan for roll out by nbn to residential and business customers who are eligible and request an upgrade to a high speed service plan through their Retail Service Provider (RSP). A breakdown of wireless infrastructure cost assumptions can be found in Appendix 6 (page 144). In addition, this analysis excludes nbn fixed wireless and satellite upgrades, noting that nbn is currently rolling out upgrades to these technologies to improve coverage and capacity.

Maitland

- LGA overview
- Telecommunications infrastructure review
- Wireless connectivity gaps
- Wireline connectivity gaps
- Infrastructure requirements to meet future demand

LGA Overview: Maitland

With Maitland's growing population and a council focus on smart city initiatives, demand for digital connectivity is expected to increase to over 1.8M connected devices by the year 2030.



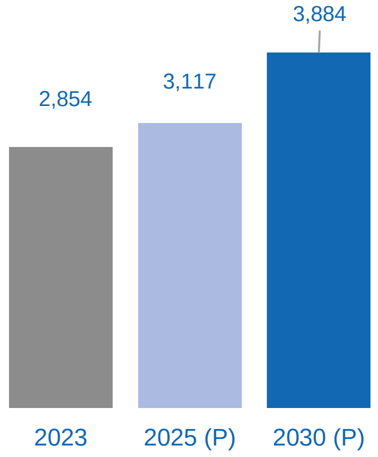
392km²

Total land area

Daily Visitors to the Area
(Baseline Demand Scenario)

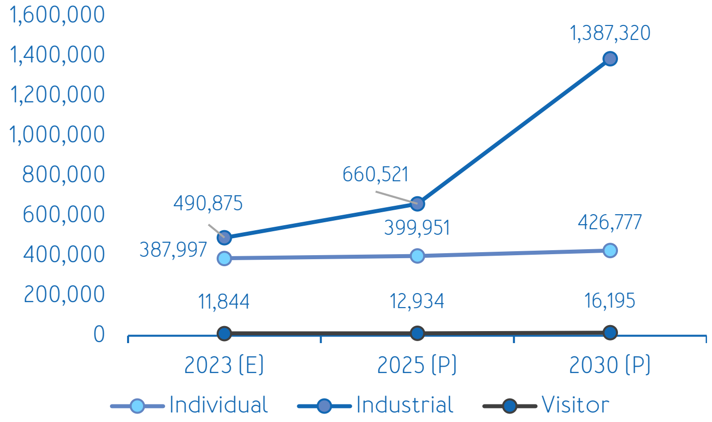
Maitland is a vibrant region rich in heritage and cultural events, drawing thousands to its annual festivals.

Some popular events in the region are the annual Steamfest, Aroma festival highlighting coffee and chocolate in August with 15,000 attendees, the culturally diverse Riverlights, and the three-day Taste festival for local flavours with 15,000 attendees.

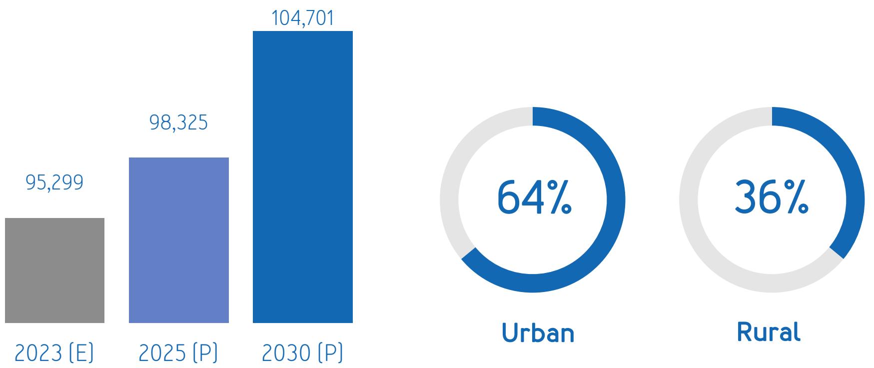


*The simulated number of visitors to the LGA per day in the baseline scenario used for this assessment**

Total Number of Connected Devices
(Baseline Demand Scenario)



Population



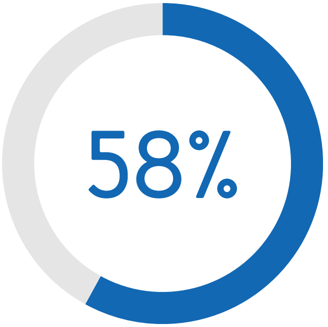
Key Insights:

- Maitland is the fourth most populated LGA in the DSSN region and attracts over 800,000 visitors each year. The region is mostly urban with a considerable rural area.
- The highest employment sector in the region is Healthcare and Social Assistance. Increasing trends of telehealth, sensors, and IoT devices will continue to increase the device demand and the required level of digital connectivity in the region.
- As Maitland City Council continues to implement smart city initiatives and opportunities for tourism experience such as smart parking and self-guided walking apps, the demand for digital connectivity will increase.
- Anticipated growth in population, increased visitation, and the expansion of various industries are expected to augment the overall number of connections in the region to over 1.8M by the year 2030.

** Visitor numbers have been calculated using the total number of commercial accommodation rooms available in the LGA, and a final maximum number of visitors assumed to visit each day based on the number of day trippers, overnight visitors and additional visitors who stay with friends or family. A 'Low' scenario was calculated at 50% of this maximum figure ('High' demand scenario), and a 'Baseline' scenario was calculated at 75% of the maximum.*

Telecommunications Infrastructure Review: Maitland

Maitland has widespread 5G coverage across the LGA from all three major telecommunications service providers. FTTP is the prominent wireline connection with FTTN servicing the remaining fibre connections in the area.



Digital Connectivity Index (On the Move)

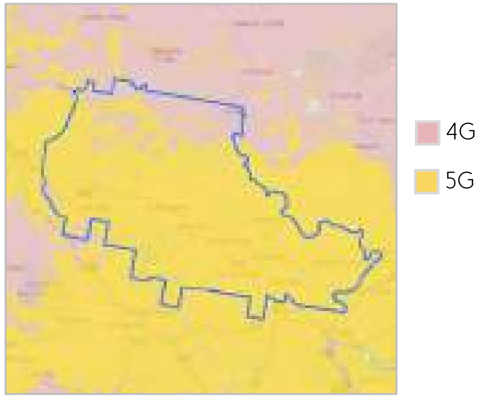
Access	90	●●●●●
Affordability	91	●●●●●
Demographics	56	●●●○○

Telstra		Optus		TPG	
3G	✓	3G	✓	3G	✓
4G	✓	4G	✓	4G	✓
5G	✓	5G	✓	5G	✓

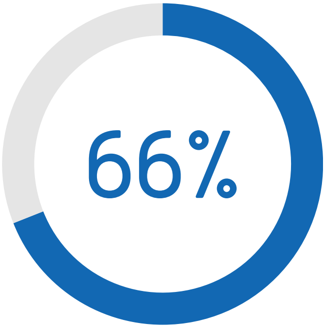
Key Insights:

- Download speed of 86.40 Mbps and upload speed of 8.55 Mbps.*
- Region with the highest index in terms of access.
- Complete 3G and 4G coverage for the Maitland region. The absence of extensive forested and remote areas allows for coverage throughout the region.
- A strong presence of 5G in the residential areas of the region.

Current Mobile Coverage



Map showing current mobile coverage in terms of 4G and 5G (Telstra, Optus, and TPG combined)



Digital Connectivity Index (Stationary)

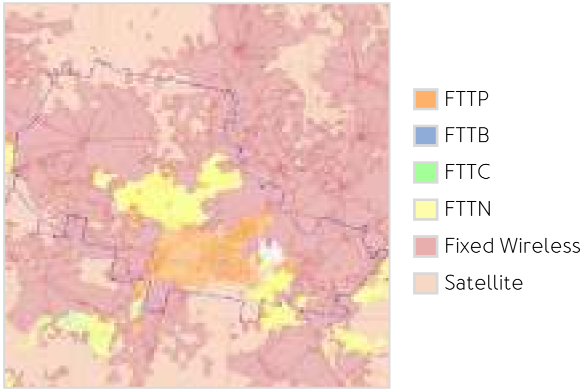
Access	99	●●●●●
Affordability	94	●●●●●
Demographics	56	●●●○○

Fibre to the Premises	✓
Fibre to the Building	✓
Fibre to the Curb	✗
Fibre to the Node	✓
Fixed Wireless	✓
Satellite	✓

Key Insights:

- Average download speeds of 54.18 Mbps and upload speeds of 18 Mbps for fixed access.
- A considerably extensive area has access via Fibre to the Premises, with the majority of the southern region using this type of access. The remaining residential areas have access via Fibre to the Node.
- Fixed Wireless and Satellite options are available for more remote areas.

nbn Current nbn Services



Wireless Connectivity Gaps: Maitland

To provide insight into the range of demand conditions and how they may impact demand for network capacity, three demand scenarios have been developed. Based on the Maitland demand scenarios, the existing radio access infrastructure will not be able to meet future wireless connectivity needs in the low demand scenario in 2030 and the baseline and high demand scenarios from 2023.

Current Number of Radio Access Sites: 50

4G co-located with 5G: 20 | **Urban Sites: 19** | **Rural Sites: 11**

The three scenarios developed to understand the potential demand for digital connectivity are based on population and visitor growth, and the subsequent increase in the expected number of devices that will be in use based on 'Low', 'Baseline' or 'High' demand scenarios.

		Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
2023 (E)	**Connected devices**	620,738	890,715	1,275,369
	Network capacity	⚪⚪🟢	🔴⚪⚪	🔴⚪⚪
2025 (P)	**Connected devices**	747,498	1,073,406	1,538,994
	Network capacity	⚪⚪🟢	🔴⚪⚪	🔴⚪⚪
2030 (P)	**Connected devices**	1,273,358	1,829,793	2,625,882
	Network capacity	🔴⚪⚪	🔴⚪⚪	🔴⚪⚪

(P) is for Projected Growth
(E) is for Estimated

Key insights:

- The existing infrastructure does not support the expected baseline demand for 2023 and beyond, requiring immediate investment in network capacity.
- In the low demand scenario network capacity will not be able to adequately meet demand from 2030, where it is projected existing infrastructure will be unable to support the estimated demand.
- In line with the baseline demand scenario, existing infrastructure is currently unable to meet the expected demand for 2023 in the high demand scenario.

Key for network capacity:

⚪⚪🟢 Existing network capacity meets the estimated demand

⚪🟡⚪ Existing network capacity may experience congestion during peak demand

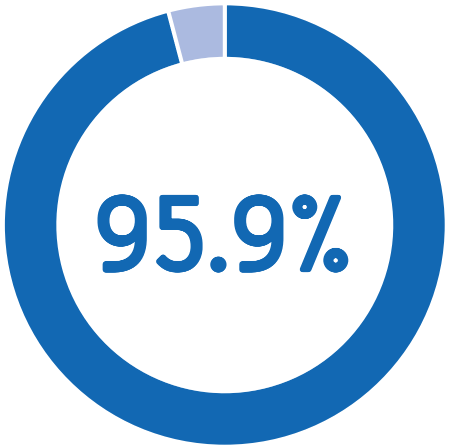
🔴⚪⚪ Existing network capacity does not support estimated demand

Wireline Connectivity Gaps: Maitland

In 2023, 95.9 per cent of dwellings in Maitland had fibre access, with 66.1 per cent provided with access to FTTP, the ideal connectivity to meet their demand. 29.8 per cent of dwellings have access to FTTN and may experience digital connectivity challenges with connections. Fixed wireless or satellite connection are provided to the remaining 4.1 per cent of dwellings.

Total private dwellings*: 35,343

There were 35,343 private dwellings in the Maitland LGA, 95.89 per cent of which are estimated to have had fibre access. This access consisted of a mix of FTTP and FTTN, with a small portion of the region access Fixed Wireless or Satellite connections. The breakdown of types of access are as follows:



Dwellings with no fibre access

Dwellings with fibre access

Fibre to the Premises (FTTP):
66.1% (23,345 Dwellings)

Fibre to the Curb (FTTC):
0% (0 Dwellings)

Fibre to the Node (FTTN):
29.8% (10,546 Dwellings)

Fixed Wireless or Satellite:
4.1% (1,452 Dwellings)

* 'Private Dwellings' are typically a house, flat or apartment for residential use; it can also refer to a caravan, houseboat, or other form of residential living space. The figures included in this assessment are from the ABS 2021 Census.

Key insights:

- 33.9 per cent of households in Maitland do not have access to FTTP services and therefore may experience digital connectivity challenges such as limited download speeds or high latency.
- 29.8 per cent of dwellings have access to FTTN services, for which the "last mile" fibre roll out is feasible to the dwelling from the curb or the node.
- 4.1 per cent of households on the Central Coast had no fibre access in 2023 (1,542 dwellings in total), so they are currently reliant on nbn fixed wireless or satellite services.

Top three suburbs with no fibre access:

- Lochinvar 439 dwellings
- Millers Forest 128 dwellings
- Maitland Vale 90 dwellings

Infrastructure Requirements to meet Future Demand: Maitland

In the baseline demand scenario, an estimated CapEx* investment of $9.1M - $10.4M is required to build 19 new radio access sites to fulfil future wireless connectivity demand and $14.7M to upgrade existing dwellings from FTTN to FTTP.

Wireless infrastructure requirements & investment

The table below outlines the estimated investment in new radio access sites / mobile base stations that need to be deployed between 2025 and 2030 to increase network capacity and fulfil projected connectivity demand across the three scenarios.

	Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
Additional Radio Sites / Mobile Base Stations Required	2	19	45
Major City Sites (co-located)	1 (1)	12 (5)	29 (13)
Inner Regional Area Sites (co-located)	1 (0)	7 (3)	16 (7
CapEx Investment Estimate*	$907K - $1M	$9.1M - $10.4M	$18.6M - $24.2M

Wireline infrastructure requirements & investment

The table below outlines the estimated investment to upgrade wireline infrastructure and transition dwellings in the LGA with FTTC and FTTN to FTTP.

Costs associated with providing access via fibre to dwellings that currently do not have access to this type of technology, have not been included below. The cost of this expansion is inherent to different factors and the geographical location/distance of possible fibre cores.

Fibre Upgrade Type	Number of Dwellings	Estimated Investment
FTTC to FTTP	0	$0
FTTN to FTTP	10,546	$14.7M
CapEx Investment Estimate*		$14.7M

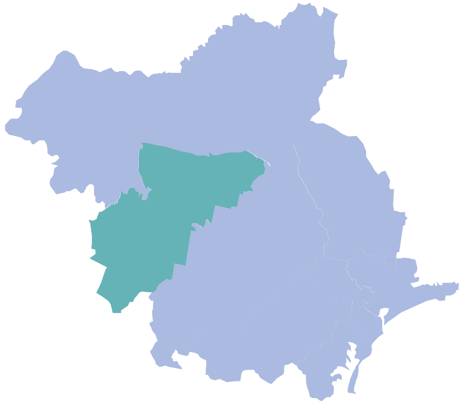
- Capital Expenditure (CapEx) is the estimated cost of infrastructure (direct material costs). The CapEx estimate excludes other costs such as construction, labour or other costs. The estimated CapEx investment is indicative to fulfil projected future demand for wireless services and upgrading dwellings with FTTC and FTTN to FTTP. For fibre upgrades from FTTC and FTTN to FTTP, an average lead-in cost of $1,400 per connection is assumed in the modelling, as indicated by Mr Stephen Rue, nbn CEO, at the Senate Estimates held on 13 February 2024. It should be noted that nbn is currently rolling out a fibre upgrade program with the ambition to provide FTTP services to over 90% of residences and businesses nationally by the end of 2025. Therefore, it is expected that a large portion of the projected fibre upgrade CapEx investment is already in plan for roll out by nbn to residential and business customers who are eligible and request an upgrade to a high speed service plan through their Retail Service Provider (RSP). A breakdown of wireless infrastructure cost assumptions can be found in Appendix 6 (page 144). In addition, this analysis excludes nbn fixed wireless and satellite upgrades, noting that nbn is currently rolling out upgrades to these technologies to improve coverage and capacity.

Muswellbrook

- LGA overview
- Telecommunications infrastructure review
- Wireless connectivity gaps
- Wireline connectivity gaps
- Infrastructure requirements to meet future demand

LGA Overview: Muswellbrook

A completely rural region, Muswellbrook's agriculture and mining industries are key drivers for increased 5G coverage and the anticipated increase to over 300K device connections by 2030.

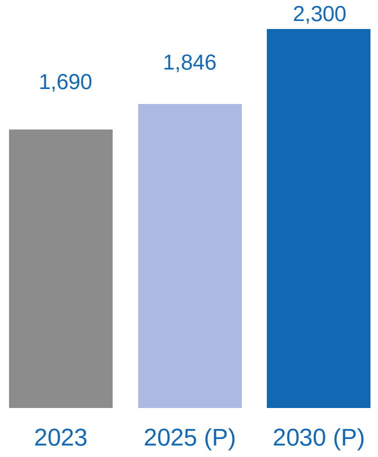


3,405km²
Total land area

Daily Visitors to the Area
(Baseline Demand Scenario)

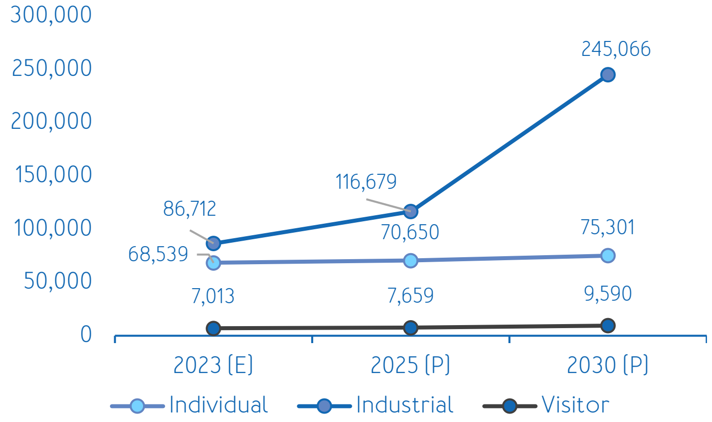
Muswellbrook LGA, at the heart of the Hunter Valley's mining region, boasts a rich blend of industry and culture.

Key events include the Upper Hunter Show and the Muswellbrook Gold Cup in March, the Great Cattle Dog Muster in September, and the Upper Hunter Wine and Food Affair, highlighting the food and wine of the region including Pukara Estate.

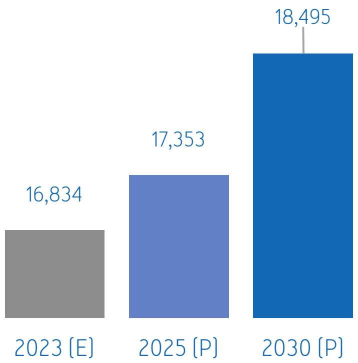


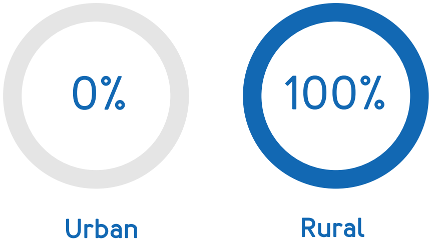
*The simulated number of visitors to the LGA per day in the baseline scenario used for this assessment**

Total Number of Connected Devices
(Baseline Demand Scenario)



Population





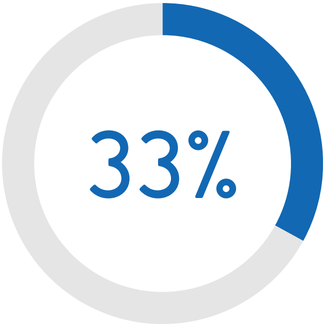
Key Insights:

- Muswellbrook is the third least populated LGA and is extremely rural, with national park covering almost half of the region.
- Agriculture, Forestry, Fishing, Mining, Quarrying, Oil & Gas are the dominant industries. Improved digital connectivity, such as improving 5G coverage, will assist Muswellbrook's planned move towards renewable energy, bioresources and intensive agriculture.
- The region holds several events each year and is known for food and wine, in addition to coal mining and horse breeding.
- Anticipated growth in population, increased visitation, and the expansion of various industries are expected to augment the overall number of connections in the region to an estimated 316,479 by the year 2030.

** Visitor numbers have been calculated using the total number of commercial accommodation rooms available in the LGA, and a final maximum number of visitors assumed to visit each day based on the number of day trippers, overnight visitors and additional visitors who stay with friends or family. A 'Low' scenario was calculated at 50% of this maximum figure ('High' demand scenario), and a 'Baseline' scenario was calculated at 75% of the maximum.*

Telecommunications Infrastructure Review: Muswellbrook

Muswellbrook has a below average Digital Connectivity Index in both 'On the Move' and 'Stationary' categories. This is driven by the rural demographic with limited 5G coverage and fixed wireless and satellite servicing the region.



Digital Connectivity Index (On the Move)

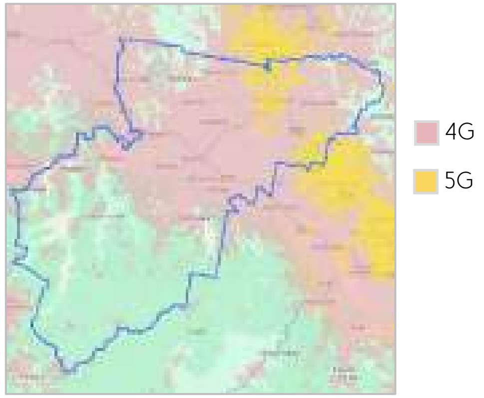
Access	68
Affordability	79
Demographics	34

Telstra		Optus		TPG	
3G	✓	3G	✓	3G	✓
4G	✓	4G	✓	4G	✓
5G	✓	5G	✗	5G	✗

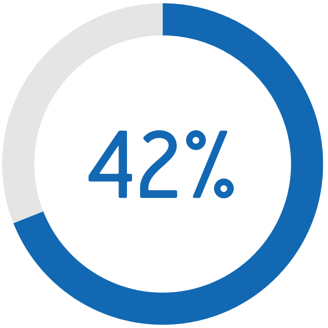
Key Insights:

- 3G and 4G coverage available in residential and industrial zones.
- 5G coverage is limited to the central area of Muswellbrook.
- No 5G coverage provided by Optus and TPG for the Muswellbrook region.

Current Mobile Coverage



Map showing current mobile coverage in terms of 4G and 5G (Telstra, Optus, and TPG combined)



Digital Connectivity Index (Stationary)

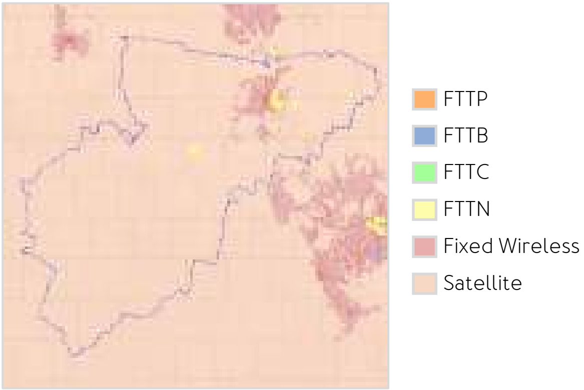
Access	86
Affordability	83
Demographics	34

Fibre to the Premises	✓
Fibre to the Building	✗
Fibre to the Curb	✓
Fibre to the Node	✓
Fixed Wireless	✓
Satellite	✓

Key Insights:

- Access via Fibre to the Premises is available only for part of the residential area in the region. The remaining residential zone is served by Fibre to the Node and Fixed Wireless.
- Given the extremely rural nature of the region, the non-residential areas have access via satellite.

nbn Current nbn Services



Wireless Connectivity Gaps: Muswellbrook

To provide insight into the range of demand conditions and how they may impact demand for network capacity, three demand scenarios have been developed. Based on the Muswellbrook demand scenarios, the existing radio access infrastructure will be able to meet all demand scenarios until a high demand scenario in 2030, where network capacity will no longer be able to support estimated demand.

Current Number of Radio Access Sites: 28

4G co-located with 5G: 2 | Urban Sites: 0 | Rural Sites: 26

The three scenarios developed to understand the potential demand for digital connectivity are based on population and visitor growth, and the subsequent increase in the expected number of devices that will be in use based on 'Low', 'Baseline' or 'High' demand scenarios.

		Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
2023 (E)	Connected devices	111,946	162,264	234,643
	Network capacity	🔵🔵🟢	🔵🔵🟢	🔵🔵🟢
2025 (P)	Connected devices	134,549	194,988	282,072
	Network capacity	🔵🔵🟢	🔵🔵🟢	🔵🔵🟢
2030 (P)	Connected devices	288,058	329,957	476,852
	Network capacity	🔵🔵🟢	🔵🔵🟢	🔴🔵🔵

(P) is for Projected Growth
(E) is for Estimated

Key insights:

- The existing infrastructure will cater for mobile connectivity demand in the both low and baseline demand scenarios until 2030.
- In the High demand scenario, network capacity is sufficient to meet anticipated demand until 2030, where existing infrastructure will no longer support estimated demand.
- No immediate mobile sites are required, until potentially 2030 under a high demand scenario.

Key for network capacity:

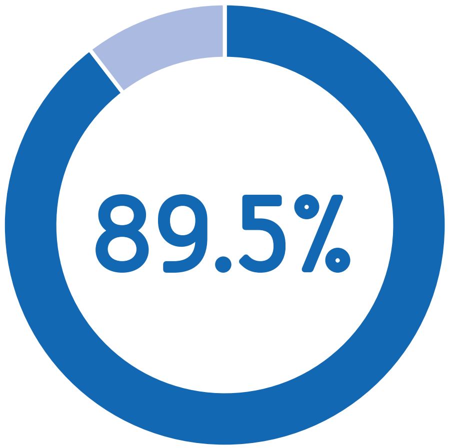
- 🔵🔵🟢 Existing network capacity meets the estimated demand
- 🔵🟡🔵 Existing network capacity may experience congestion during peak demand
- 🔴🔵🔵 Existing network capacity does not support estimated demand

Wireline Connectivity Gaps: Muswellbrook

In 2023, 89.5 per cent of dwellings in Muswellbrook had fibre access, however, 77.3 per cent only had access to FTTN and may experience connectivity challenges. 11.5 per cent of the region has FTTP access, the most ideal connection, while 10.5 per cent of dwellings are serviced by Fixed Wireless or Satellite connections.

Total private dwellings*: 8,193

There were 8,193 private dwellings in the Muswellbrook LGA, 89.57 per cent of which are estimated to have had fibre access. This access consisted of FTTP, FTTC and FTTN. The breakdown of types of access are as follows:



Fibre to the Premises (FTTP):
11.6% (948 Dwellings)

Fibre to the Curb (FTTC):
0.6% (50 Dwellings)

Fibre to the Node (FTTN):
77.3% (6,335 Dwellings)

Fixed Wireless or Satellite:
10.5% (860 Dwellings)

* 'Private Dwellings' are typically a house, flat or apartment for residential use; it can also refer to a caravan, houseboat, or other form of residential living space. The figures included in this assessment are from the ABS 2021 Census.

Key insights:

- 88.9 per cent of households in Muswellbrook do not have access to FTTP services and therefore may experience digital connectivity challenges such as limited download speeds or high latency.
- 77.3 per cent of dwellings have access to FTTC or FTTN services, for which the "last mile" fibre roll out is feasible to the dwelling from the curb or the node.
- 10.5 per cent of households had no fibre access in 2023 (860 dwellings in total), so they are currently reliant on nbn fixed wireless or satellite services.
- Additional wireline infrastructure will be required in order to upgrade the majority of dwellings in the region from FTTN.

Top three suburbs with no fibre access:

- Muscle Creek 871 dwellings
- McCullys Gap 101 dwellings
- Sandy Hollow 92 dwellings

Infrastructure Requirements to meet Future Demand: Maitland

In the baseline demand scenario, no new radio access sites are required to fulfil future wireless connectivity demand. To upgrade existing dwellings to FTTP from FTTC and FTTN, an estimated CapEx* investment of $8.8M is required.

Wireless infrastructure requirements & investment

The table below outlines the estimated investment in new radio access sites / mobile base stations that need to be deployed between 2025 and 2030 to increase network capacity and fulfil projected connectivity demand across the three scenarios.

	Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
Additional Radio Sites / Mobile Base Stations Required	0	0	2
Major City Sites (co-located)	0 (0)	0 (0)	0 (0)
Inner Regional Area Sites (co-located)	0 (0)	0 (0)	2 (1)
CapEx Investment Estimate*	$0	$0	$836K - $1.2M

Wireline infrastructure requirements & investment

The table below outlines the estimated investment to upgrade wireline infrastructure and transition dwellings in the LGA with FTTC and FTTN to FTTP.

Costs associated with providing access via fibre to dwellings that currently do not have access to this type of technology, have not been included below. The cost of this expansion is inherent to different factors and the geographical location/distance of possible fibre cores.

Fibre Upgrade Type	Number of Dwellings	Estimated Investment
FTTC to FTTP	50	$70K
FTTN to FTTP	6,335	$8.8M
CapEx Investment Estimate*		$8.9M

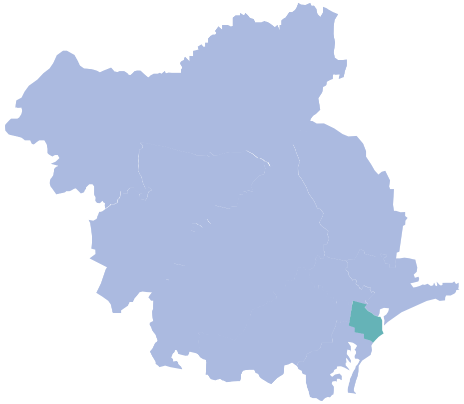
- Capital Expenditure (CapEx) is the estimated cost of infrastructure (direct material costs). The CapEx estimate excludes other costs such as construction, labour or other costs. The estimated CapEx investment is indicative to fulfil projected future demand for wireless services and upgrading dwellings with FTTC and FTTN to FTTP. For fibre upgrades from FTTC and FTTN to FTTP, an average lead-in cost of $1,400 per connection is assumed in the modelling, as indicated by Mr Stephen Rue, nbn CEO, at the Senate Estimates held on 13 February 2024. It should be noted that nbn is currently rolling out a fibre upgrade program with the ambition to provide FTTP services to over 90% of residences and businesses nationally by the end of 2025. Therefore, it is expected that a large portion of the projected fibre upgrade CapEx investment is already in plan for roll out by nbn to residential and business customers who are eligible and request an upgrade to a high speed service plan through their Retail Service Provider (RSP). A breakdown of wireless infrastructure cost assumptions can be found in Appendix 6 (page 144). In addition, this analysis excludes nbn fixed wireless and satellite upgrades, noting that nbn is currently rolling out upgrades to these technologies to improve coverage and capacity.

Newcastle

- LGA overview
- Telecommunications infrastructure review
- Wireless connectivity gaps
- Wireline connectivity gaps
- Infrastructure requirements to meet future demand

LGA Overview: Newcastle

A densely populated urban area, Newcastle's high concentration of businesses and homes are driving demand for increased connectivity into 2030, where a projected 1.7M additional digital devices will be connected across the LGA.



187km²

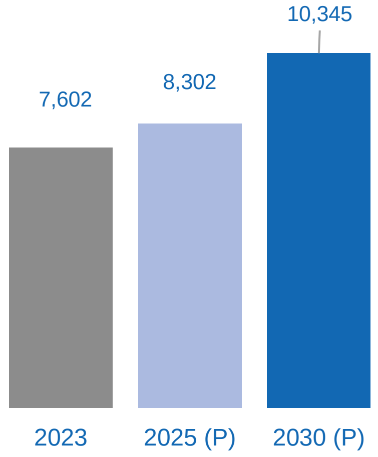
Total land area

Daily Visitors to the Area

(Baseline Demand Scenario)

Newcastle is a coastal hub with rich culture and a vibrant events calendar. New Annual arts festival is held over 10 days, beginning in September, with over 40,000 attendees in 2022.

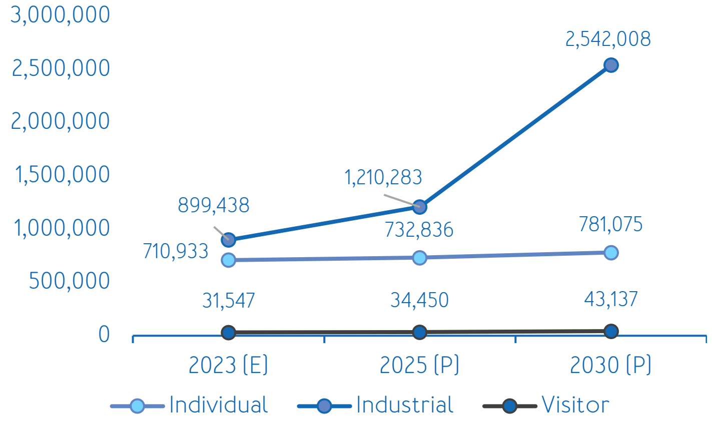
Major concerts are being held at the McDonald Jones Stadium, including Elton John with over 50,000 tickets sold for two performances that injected over $12M into the visitor economy.



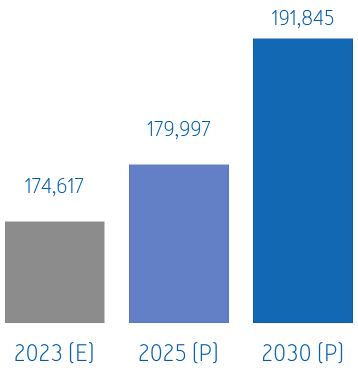
*The simulated number of visitors to the LGA per day in the baseline scenario used for this assessment**

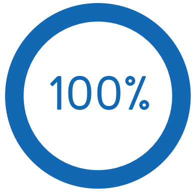
Total Number of Connected Devices

(Baseline Demand Scenario)

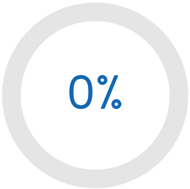


Population





Urban



Rural

Key Insights:

- Newcastle, the 3rd most populated LGA in the DSSN region, is characterised by its high urban density. Densely populated urban area typically has a higher concentration of businesses, homes, and individuals requiring reliable and high-speed digital connectivity. This demand could include robust broadband internet, efficient mobile networks, and other digital services.
- The City of Newcastle has embraced a smart city strategy designed to establish a thriving ecosystem that stimulates innovation and creativity. Central to the success of this initiative is the imperative for robust digital connectivity, forming the backbone that supports and facilitates innovative endeavours.
- Anticipated growth in population, increased visitation, and the expansion of various industries are expected to augment the overall number of connections in the region to an estimated 3.3M by the year 2030.

** Visitor numbers have been calculated using the total number of commercial accommodation rooms available in the LGA, and a final maximum number of visitors assumed to visit each day based on the number of day trippers, overnight visitors and additional visitors who stay with friends or family. A 'Low' scenario was calculated at 50% of this maximum figure ('High' demand scenario), and a 'Baseline' scenario was calculated at 75% of the maximum.*

Telecommunications Infrastructure Review: Newcastle

Newcastle has the highest Digital Connectivity Index both 'On the Move' and 'Stationary' of all the DSSN LGAs. These high scores are driven by widespread 5G coverage by all major providers and extensive fibre accessibility throughout the region.

70%

Digital Connectivity Index (On the Move)

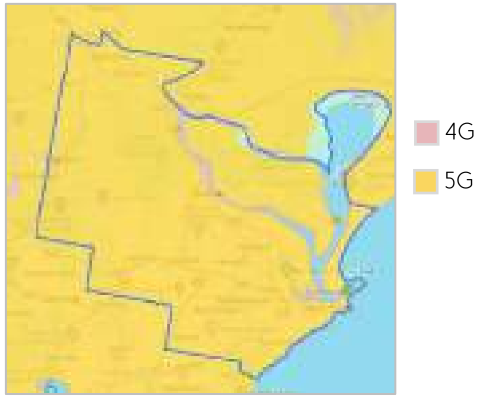
Access	89	●●●●●
Affordability	90	●●●●●
Demographics	76	●●●●○

Telstra		Optus		TPG	
3G	✓	3G	✓	3G	✓
4G	✓	4G	✓	4G	✓
5G	✓	5G	✓	5G	✓

Key Insights:

- 3G and 4G available throughout the region.
- Average download speed of 110.39 Mbps and upload speed of 8.55 Mbps.*
- The area has the highest digital connectivity index.
- Widespread implementation of 5G in the area by all three operators, with few coverage gaps.

Current Mobile Coverage



Map showing current mobile coverage in terms of 4G and 5G (Telstra, Optus, and TPG combined)

80%

Digital Connectivity Index (Stationary)

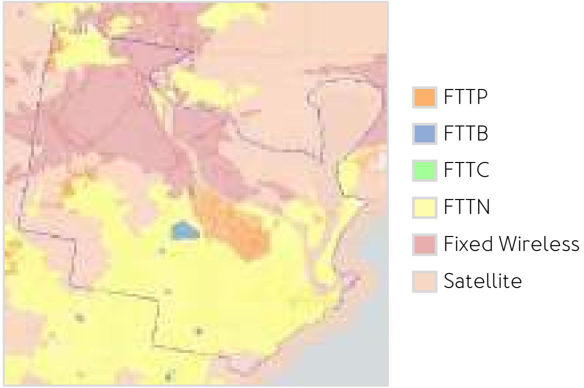
Access	99	●●●●●
Affordability	92	●●●●●
Demographics	76	●●●●○

Fibre to the Premises	✓
Fibre to the Building	✓
Fibre to the Curb	✗
Fibre to the Node	✓
Fixed Wireless	✓
Satellite	✓

Key Insights:

- Average download speeds of 51.45 Mbps and upload speeds of 18.09 Mbps for fixed access.
- The Newcastle area is highly urbanised, with the entire residential zone having access via fibre.
- Only the area around the Hunter Wetlands National Park relies on fixed wireless.
- The region has the highest digital connectivity index

nbn™ Current nbn Services



Wireless Connectivity Gaps: Newcastle

To provide insight into the range of demand conditions and how they may impact demand for network capacity, three demand scenarios have been developed. Based on the Newcastle demand scenarios, the existing radio access infrastructure will not be able to meet future wireless connectivity needs in the baseline demand scenario in 2030 and the high demand scenario from 2023.

Current Number of Radio Access Sites: 114

4G co-located with 5G: 66 | Urban Sites: 48 | Rural Sites: 0

The three scenarios developed to understand the potential demand for digital connectivity are based on population and visitor growth, and the subsequent increase in the expected number of devices that will be in use based on 'Low', 'Baseline' or 'High' demand scenarios.

		Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
2023 (E)	Connected devices	1,141,981	1,641,917	2,234,484
	Network capacity	⚪⚪🟢	⚪⚪🟢	🔴⚪⚪
2025 (P)	Connected devices	1,374,668	1,977,569	2,794,682
	Network capacity	⚪⚪🟢	⚪⚪🟢	🔴⚪⚪
2030 (P)	Connected devices	3,366,220	3,366,220	4,727,428
	Network capacity	⚪⚪🟢	🔴⚪⚪	🔴⚪⚪

(P) is for Projected Growth
(E) is for Estimated

Key insights:

- The existing infrastructure will cater for mobile connectivity demand in the low demand scenario. No additional mobile towers are required.
- In the baseline demand scenario, the existing infrastructure is projected to be sufficient through to 2025, however, by 2030 it is projected that it will not be able to meet future connectivity demand. Therefore, additional mobile sites will need to be installed by 2030 to cater for future demand.
- In the high demand scenario, network capacity is insufficient from 2023 onwards. Therefore, new mobile sites will need to be installed starting immediately to meet current and future demand.

Key for network capacity:

- ⚪⚪🟢 Existing network capacity meets the estimated demand
- ⚪🟡⚪ Existing network capacity may experience congestion during peak demand
- 🔴⚪⚪ Existing network capacity does not support estimated demand

Wireline Connectivity Gaps: Newcastle

In 2023, 99.6 per cent of dwellings in Newcastle had fibre access, however, only 20.1 per cent had access to FTTP which represents the ideal fibre connection to fulfil future demand. 79.5 per cent of dwellings may experience digital connectivity challenges with their access limited to FTTN.

Total private dwellings*: 75,771

There were 75,771 private dwellings in the Newcastle LGA, 99.62 per cent of which are estimated to have had fibre access. This access consisted of FTTP and FTTN, the least ideal fibre connection for digital connectivity. The breakdown of types of access are as follows:

Fibre to the Premises (FTTP):
20.1% (15,218 Dwellings)

Fibre to the Curb (FTTC):
0% (0 Dwellings)

Fibre to the Node (FTTN):
79.5% (60,265 Dwellings)

Fixed Wireless or Satellite:
0.04% (288 Dwellings)

* 'Private Dwellings' are typically a house, flat or apartment for residential use; it can also refer to a caravan, houseboat, or other form of residential living space. The figures included in this assessment are from the ABS 2021 Census.

Key insights:

- Approximately 79.9 per cent of dwellings in Newcastle do not have access FTTP services and therefore may experience digital connectivity challenges such as limited download speeds or high latency.
- 79.5 per cent of dwellings have access to FTTN services, for which the "last mile" fibre roll out is feasible to the dwelling from the node.
- Only 288 dwellings are serviced by Fixed Wireless or Satellite due to the urban demographics of the region.
- Additional wireline infrastructure will be required to upgrade 60,265 dwellings from FTTN to FTTP services.

Top three suburbs with no fibre access:

- Black Hill 181 dwellings
- Sandgate 276 dwellings
- Lenaghan 22 dwellings

Infrastructure Requirements to meet Future Demand: Newcastle

In the baseline demand scenario, an estimated CapEx* investment of $10.5M - $16.0M is required to build 27 new radio access sites to fulfil future wireless connectivity demand and $84.3M to upgrade existing dwellings from FTTN to FTTP.

Wireless infrastructure requirements & investment

The table below outlines the estimated investment in new radio access sites / mobile base stations that need to be deployed between 2025 and 2030 to increase network capacity and fulfil projected connectivity demand across the three scenarios.

	Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
Additional Radio Sites / Mobile Base Stations Required	0	27	82
Major City Sites (co-located)	0 (0)	27 (12)	82 (36)
Inner Regional Area Sites (co-located)	0 (0)	0 (0)	0 (0)
CapEx Investment Estimate*	$0	$10.5M – 16.0M	$25.4M - $48.7M

Wireline infrastructure requirements & investment

The table below outlines the estimated investment to upgrade wireline infrastructure and transition dwellings in the LGA with FTTC and FTTN to FTTP.

Costs associated with providing access via fibre to dwellings that currently do not have access to this type of technology, have not been included below. The cost of this expansion is inherent to different factors and the geographical location/distance of possible fibre cores.

Fibre Upgrade Type	Number of Dwellings	Estimated Investment
FTTC to FTTP	0	$0
FTTN to FTTP	60,265	$84.3M
CapEx Investment Estimate*		$84.3M

- Capital Expenditure (CapEx) is the estimated cost of infrastructure (direct material costs). The CapEx estimate excludes other costs such as construction, labour or other costs. The estimated CapEx investment is indicative to fulfil projected future demand for wireless services and upgrading dwellings with FTTC and FTTN to FTTP. For fibre upgrades from FTTC and FTTN to FTTP, an average lead-in cost of $1,400 per connection is assumed in the modelling, as indicated by Mr Stephen Rue, nbn CEO, at the Senate Estimates held on 13 February 2024. It should be noted that nbn is currently rolling out a fibre upgrade program with the ambition to provide FTTP services to over 90% of residences and businesses nationally by the end of 2025. Therefore, it is expected that a large portion of the projected fibre upgrade CapEx investment is already in plan for roll out by nbn to residential and business customers who are eligible and request an upgrade to a high speed service plan through their Retail Service Provider (RSP). A breakdown of wireless infrastructure cost assumptions can be found in Appendix 6 (page 144). In addition, this analysis excludes nbn fixed wireless and satellite upgrades, noting that nbn is currently rolling out upgrades to these technologies to improve coverage and capacity.

Port Stephens

LGA overview

Telecommunications infrastructure review

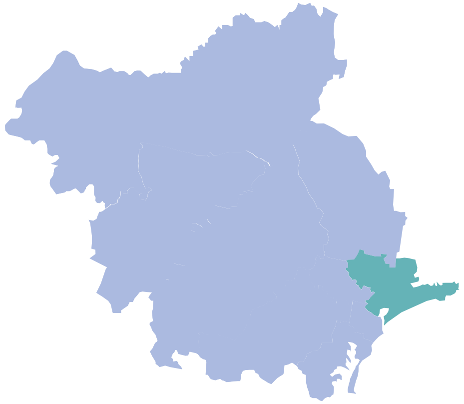
Wireless connectivity gaps

Wireline connectivity gaps

Infrastructure requirements to meet future demand

LGA Overview: Port Stephens

Visitors are drawn to Port Stephens' diverse nature experiences which help boost tourism throughout the region. As these numbers increase, businesses and visitors alike willl require and demand more reliable and faster digital connectivity



858km²

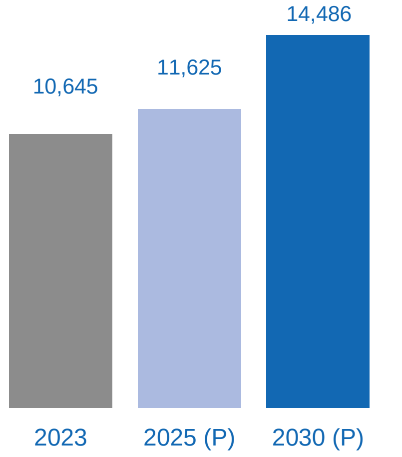
Total land area

Daily Visitors to the Area

(Baseline Demand Scenario)

Port Stephens is well-known for its stunning beaches, wildlife experiences, and nature, with Shoal Bay being a popular holiday destination. Diverse nature experiences include the Stockton Sand Dunes, Tomaree Head Summit with 250,000 visitors per annum, and the 27km Tomaree Coastal Walk.

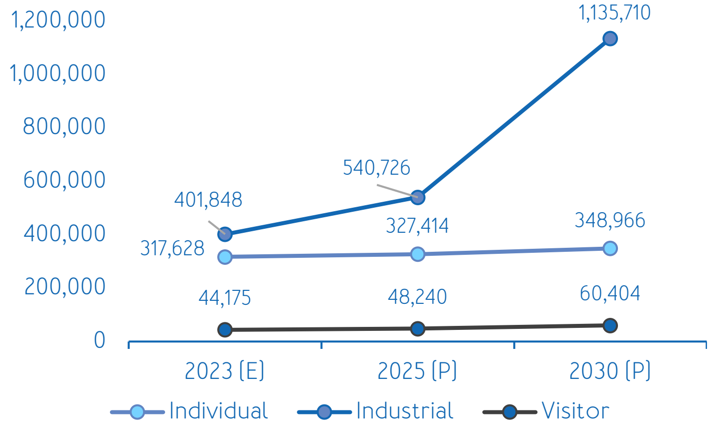
Sail Port Stephens is an annual event, that injected over $2M into the visitor economy in 2022.



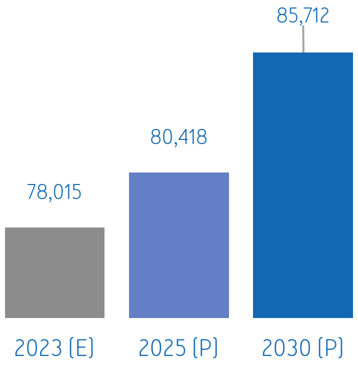
*The simulated number of visitors to the LGA per day in the baseline scenario used for this assessment**

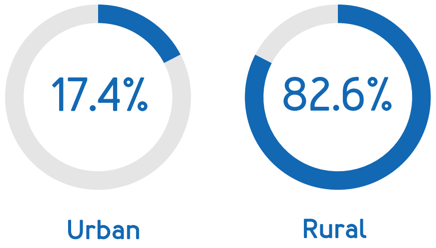
Total Number of Connected Devices

(Baseline Demand Scenario)



Population





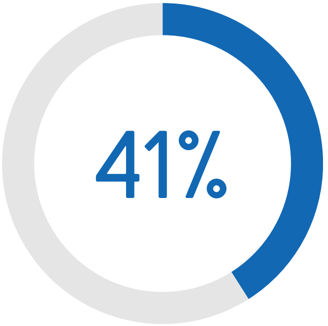
Key Insights:

- Port Stephens is the most visited LGA, with nature experiences helping boost daily visitor numbers. Tourism businesses and visitors require reliable and fast digital connectivity, further attracting more visitors to the region and supporting the local economy.
- Port Stephens is continuing to work with Telstra and NBN to address blackspots and advocate for service improvement. Improved digital connectivity will enable the Port Stephens Council to continue to implement smart city initiatives, improving the local economy and liveability of town centres.
- Anticipated growth in population, increased visitation, and the expansion of various industries are expected to increase the overall number of connections in the region to over an estimated 1.4M device connections by the year 2030.

** Visitor numbers have been calculated using the total number of commercial accommodation rooms available in the LGA, and a final maximum number of visitors assumed to visit each day based on the number of day trippers, overnight visitors and additional visitors who stay with friends or family. A 'Low' scenario was calculated at 50% of this maximum figure ('High' demand scenario), and a 'Baseline' scenario was calculated at 75% of the maximum.*

Telecommunications Infrastructure Review: Port Stephens

Port Stephens has a below average ‘On the Move’ Digital Connectivity Index, despite having widespread 4G and 5G coverage. The ‘Stationary’ Digital Connectivity Index is rated as average with strong accessibility throughout.



Digital Connectivity Index (On the Move)

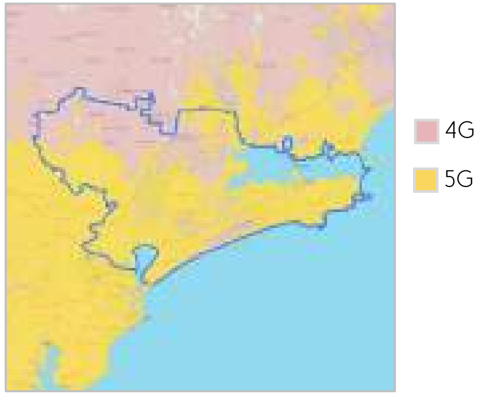
Access	77	●●●●○
Affordability	79	●●●●○
Demographics	46	●●●○○

Telstra		Optus		TPG	
3G	✓	3G	✓	3G	✓
4G	✓	4G	✓	4G	✓
5G	✓	5G	✓	5G	✓

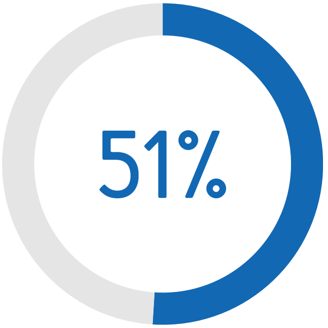
Key Insights:

- 3G and 4G connectivity available throughout the Port Stephens region with no notable coverage issues.
- 5G is accessible in the main residential and tourist-interest areas of the region, provided by Telstra and Optus.

Current Mobile Coverage



Map showing current mobile coverage in terms of 4G and 5G (Telstra, Optus, and TPG combined)



Digital Connectivity Index (Stationary)

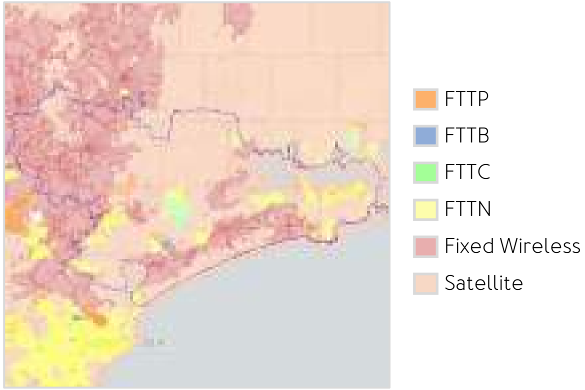
Access	91	●●●●●
Affordability	85	●●●●●
Demographics	46	●●●○○

Fibre to the Premises	✓
Fibre to the Building	✓
Fibre to the Curb	✓
Fibre to the Node	✓
Fixed Wireless	✓
Satellite	✓

Key Insights:

- The residential area of Port Stephens primarily has access via fibre, with Corlette and Eagleton enjoying the best access through Fibre to the Premises.
- More remote areas of the region, such as Wallaroo and Medowie Park, have access via fixed wireless and satellite.

nbn™ Current nbn Services



Wireless Connectivity Gaps: Port Stephens

To provide insight into the range of demand conditions and how they may impact demand for network capacity, three demand scenarios have been developed. Based on the Port Stephens demand scenarios, the existing radio access infrastructure will not be able to meet future wireless connectivity needs in the baseline demand scenario in 2030 and the high demand scenario from 2023.

Current Number of Radio Access Sites: 79

4G co-located with 5G: 27 | Urban Sites: 9 | Rural Sites: 43

The three scenarios developed to understand the potential demand for digital connectivity are based on population and visitor growth, and the subsequent increase in the expected number of devices that will be in use based on 'Low', 'Baseline' or 'High' demand scenarios.

		Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
2023 (E)	**Connected devices**	524,249	763,651	1,109,604
	Network capacity	⚪⚪🟢	⚪⚪🟢	🔴⚪⚪
2025 (P)	**Connected devices**	629,500	916,381	1,331,448
	Network capacity	⚪⚪🟢	⚪⚪🟢	🔴⚪⚪
2030 (P)	**Connected devices**	1,064,314	1,545,080	2,238,833
	Network capacity	⚪⚪🟢	🔴⚪⚪	🔴⚪⚪

(P) is for Projected Growth
(E) is for Estimated

Key insights:

- The existing infrastructure will cater for mobile connectivity demand in the low demand scenario up to 2030. No additional mobile towers are required.
- In the baseline demand scenario, the existing infrastructure is projected to be sufficient through to 2025, however, by 2030 it is projected that it will not be able to meet future demand for digital connectivity. Therefore, additional mobile sites will need to be installed by 2030 to cater for future demand.
- In the high demand scenario, network capacity is insufficient from 2023. Therefore, new mobile sites will need to be installed immediately to meet expected demand for 2023.

Key for network capacity:

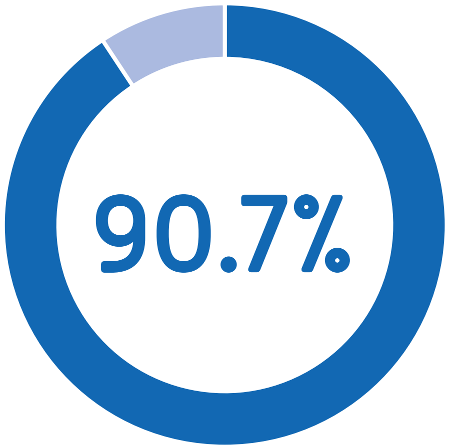
- ⚪⚪🟢 Existing network capacity meets the estimated demand
- ⚪🟡⚪ Existing network capacity may experience congestion during peak demand
- 🔴⚪⚪ Existing network capacity does not support estimated demand

Wireline Connectivity Gaps: Port Stephens

In 2023, 90.7 per cent of dwellings in Port Stephens had fibre access, however, only 9 per cent had access to FTTP which represents the ideal fibre connection to fulfil future demand. 90.7 per cent of dwellings may experience digital connectivity challenges with their access limited to FTTC or FTTN in urban areas and fixed wireless or satellite in rural areas.

Total private dwellings*: 37,730

There were 37,730 private dwellings in the Port Stephens LGA, 90.71 per cent of which are estimated to have had fibre access. This access consisted of a mix of FTTP. FTTC and FTTN, however the majority of dwellings are serviced by FTTN. The breakdown of types of access are as follows:



Dwellings with no fibre access

Dwellings with fibre access

Fibre to the Premises (FTTP):
9% (3,421 Dwellings)

Fibre to the Curb (FTTC):
9.8% (3,716 Dwellings)

Fibre to the Node (FTTN):
71.9% (27,088 Dwellings)

Fixed Wireless or Satellite:
9.3% (3,505 Dwellings)

* 'Private Dwellings' are typically a house, flat or apartment for residential use; it can also refer to a caravan, houseboat, or other form of residential living space. The figures included in this assessment are from the ABS 2021 Census.

Key insights:

- 91 per cent of households in Port Stephens do not have access to FTTP services and therefor may experience digital connectivity challenges such as limited download speeds or high latency.
- 81.7 per cent of dwellings have access to FTTC or FTTN services, for which the "last mile" fibre roll out is feasible to the dwelling from the curb or the node.
- 9.3 per cent of households in Port Stephens had no fibre access in 2023 (3,505 dwellings in total), meaning they are currently reliant on nbn fixed wireless or satellite services.
- Widescale wireline infrastructure will be required across the region to upgrade all dwellings to FTTP.

Top three suburbs with no fibre access:

- North Arm Cove 340 dwellings
- Seaham 339 dwellings
- Wallalong 339 dwellings

Infrastructure Requirements to meet Future Demand: Port Stephens

In the baseline demand scenario, an estimated CapEx* investment of $836K - $1.2M is required to build 2 new radio access sites to fulfil future wireless connectivity demand and $43.1M to upgrade existing dwellings from FTTC and FTTN to FTTP.

Wireless infrastructure requirements & investment

The table below outlines the estimated investment in new radio access sites / mobile base stations that need to be deployed between 2025 and 2030 to increase network capacity and fulfil projected connectivity demand across the three scenarios.

	Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
Additional Radio Sites / Mobile Base Stations Required	0	2	31
Major City Sites (co-located)	0 (0)	0 (0)	5 (2)
Inner Regional Area Sites (co-located)	0 (0)	2 (1)	26 (11)
CapEx Investment Estimate*	$0	$836K – $1.2M	$14.7M - $17.8M

Wireline infrastructure requirements & investment

The table below outlines the estimated investment to upgrade wireline infrastructure and transition dwellings in the LGA with FTTC and FTTN to FTTP.

Costs associated with providing access via fibre to dwellings that currently do not have access to this type of technology, have not been included below. The cost of this expansion is inherent to different factors and the geographical location/distance of possible fibre cores.

Fibre Upgrade Type	Number of Dwellings	Estimated Investment
FTTC to FTTP	3,716	$5.2M
FTTN to FTTP	27,088	$37.9M
CapEx Investment Estimate*		$43.1M

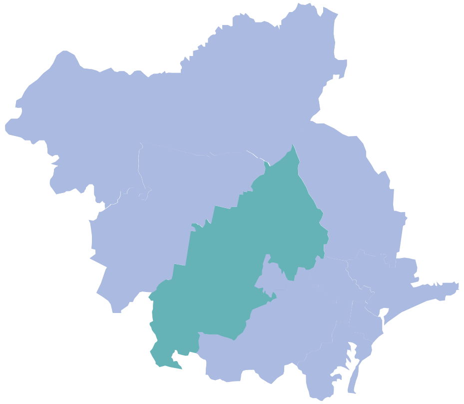
- Capital Expenditure (CapEx) is the estimated cost of infrastructure (direct material costs). The CapEx estimate excludes other costs such as construction, labour or other costs. The estimated CapEx investment is indicative to fulfil projected future demand for wireless services and upgrading dwellings with FTTC and FTTN to FTTP. For fibre upgrades from FTTC and FTTN to FTTP, an average lead-in cost of $1,400 per connection is assumed in the modelling, as indicated by Mr Stephen Rue, nbn CEO, at the Senate Estimates held on 13 February 2024. It should be noted that nbn is currently rolling out a fibre upgrade program with the ambition to provide FTTP services to over 90% of residences and businesses nationally by the end of 2025. Therefore, it is expected that a large portion of the projected fibre upgrade CapEx investment is already in plan for roll out by nbn to residential and business customers who are eligible and request an upgrade to a high speed service plan through their Retail Service Provider (RSP). A breakdown of wireless infrastructure cost assumptions can be found in Appendix 6 (page 144). In addition, this analysis excludes nbn fixed wireless and satellite upgrades, noting that nbn is currently rolling out upgrades to these technologies to improve coverage and capacity.

Singleton

- LGA overview
- Telecommunications infrastructure review
- Wireless connectivity gaps
- Wireline connectivity gaps
- Infrastructure requirements to meet future demand

LGA Overview: Singleton

A predominantly rural area, Singleton is projected to have over 450K connected devices by 2030, with demand driven by the desire to appeal to the 'digital nomad' segment who are currently limited by the region's network infrastructure.



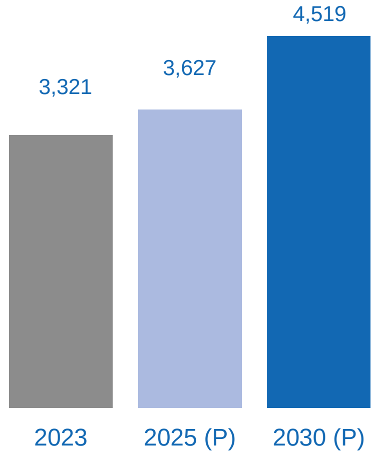
4,893km²

Total land area

Daily Visitors to the Area
(Baseline Demand Scenario)

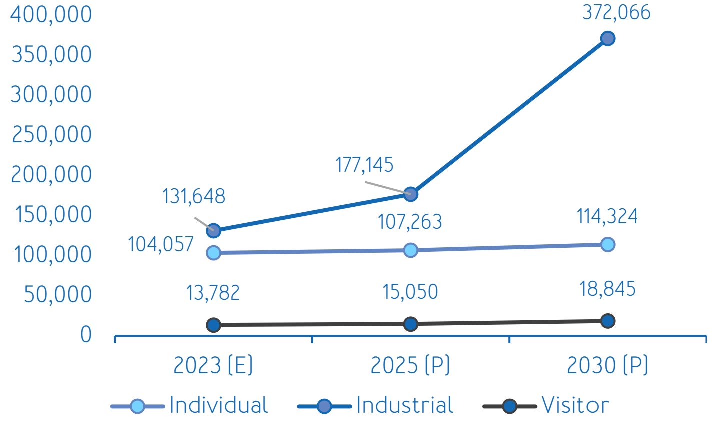
The Singleton LGA is a prominent mining hub in the heart of Hunter Valley's wine region. The annual Singleton Firelight Festival held each May showcases the area's community spirit and distinct identity.

As part of the community strategic plan, Singleton LGA commits to initiatives aimed at reinforcing Singleton's brand.

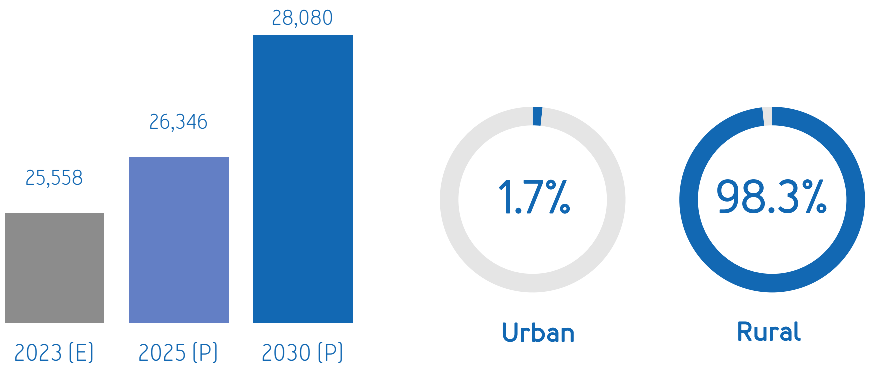


*The simulated number of visitors to the LGA per day in the baseline scenario used for this assessment**

Total Number of Connected Devices
(Baseline Demand Scenario)



Population



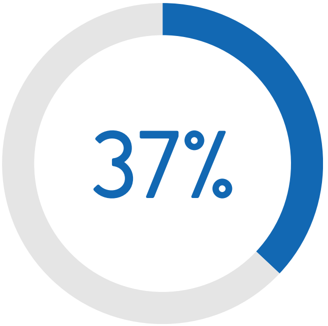
Key Insights:

- Singleton is a predominantly rural region with wineries and historical attractions propelling tourism.
- Agriculture, Forestry, Fishing, Mining, Quarrying, Oil & Gas are the main industries in Singleton. Reliable and digital connectivity is necessary to drive the adoption of digital technologies that boost growth across these industries.
- The LGA aims to improve digital connectivity in the region to increase the region's appeal for the 'digital nomad' consumer segment. The current limited connectivity restricts visitors from staying connected, as well as the digital delivery of information while in the region.
- Anticipated growth in population, increased visitation, and the expansion of various industries are expected to augment the overall number of connections in the region to over 450,000 by the year 2030.

** Visitor numbers have been calculated using the total number of commercial accommodation rooms available in the LGA, and a final maximum number of visitors assumed to visit each day based on the number of day trippers, overnight visitors and additional visitors who stay with friends or family. A 'Low' scenario was calculated at 50% of this maximum figure ('High' demand scenario), and a 'Baseline' scenario was calculated at 75% of the maximum.*

Telecommunications Infrastructure Review: Singleton

Due to the regional demographic of Singleton, the region has a below average Digital Connectivity Index for both 'On the Move' and 'Stationary' categories. The region is mainly serviced by 3G, 4G and fixed wireless and satellite services.



Digital Connectivity Index (On the Move)

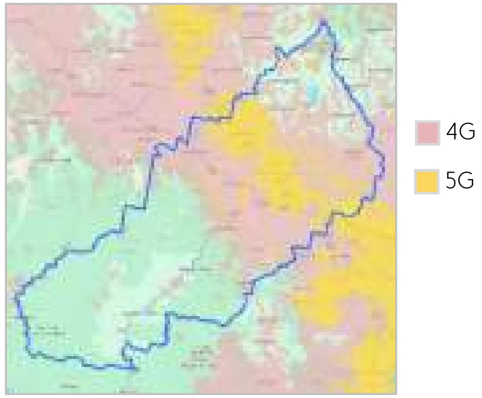
Access	59	●●●○○
Affordability	87	●●●●●
Demographics	54	●●●○○

	Telstra	Optus	TPG
3G	✓	✓	✓
4G	✓	✓	✓
5G	✓	✓	✗

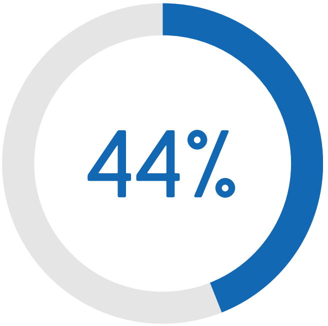
Key Insights:

- The region has a below-average digital connectivity index.
- 3G and 4G connectivity available throughout the inhabited region.
- Outlying areas such as Putty and Garland Valley, away from the central region, have 3G and 4G coverage provided by Telstra.
- Limited 5G access is available only in the populated area of Singleton.

Current Mobile Coverage



Map showing current mobile coverage in terms of 4G and 5G (Telstra, Optus, and TPG combined)



Digital Connectivity Index (Stationary)

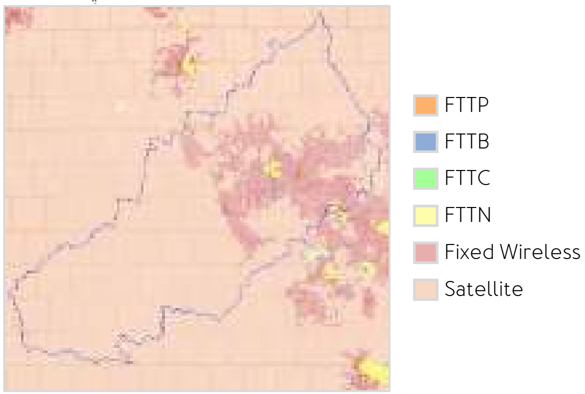
Access	72	●●●●○
Affordability	90	●●●●●
Demographics	54	●●●○○

Fibre to the Premises	✓
Fibre to the Building	✓
Fibre to the Curb	✗
Fibre to the Node	✓
Fixed Wireless	✓
Satellite	✓

Key Insights:

- Due to Singleton being an extremely rural area, including the Wollemi National Park, the region is predominantly covered via fixed wireless and satellite.
- Access via fibre is only available in the central part of Singleton city.

nbn Current nbn Services



Wireless Connectivity Gaps: Singleton

To provide insight into the range of demand conditions and how they may impact demand for network capacity, three demand scenarios have been developed. Based on the Singleton demand scenarios, the existing radio access infrastructure will be able to meet all low and baseline demand scenarios, however under the high demand scenario in 2030 existing infrastructure will not be able to meet projected demand.

Current Number of Radio Access Sites: 39

4G co-located with 5G: 8 | Urban Sites: 1 | Rural Sites: 30

The three scenarios developed to understand the potential demand for digital connectivity are based on population and visitor growth, and the subsequent increase in the expected number of devices that will be in use based on 'Low', 'Baseline' or 'High' demand scenarios.

		Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
2023 (E)	**Connected devices**	171,425	249,487	362,200
	Network capacity	● ● ●	● ● ●	● ● ●
2025 (P)	**Connected devices**	205,876	299,458	434,756
	Network capacity	● ● ●	● ● ●	● ● ●
2030 (P)	**Connected devices**	348,237	505,234	731,669
	Network capacity	● ● ●	● ● ●	● ● ●

(P) is for Projected Growth
(E) is for Estimated

Key insights:

- The existing infrastructure will cater for mobile connectivity demand in both the low and baseline demand scenarios. No additional mobile towers are required.
- In the high demand scenario, existing infrastructure will be able to adequately cater for projected demand up to 2030, where it will then be insufficient to support demand. At this point additional mobile sites will need to be installed to support the network.

Key for network capacity:

● ● ● Existing network capacity meets the estimated demand

● ● ● Existing network capacity may experience congestion during peak demand

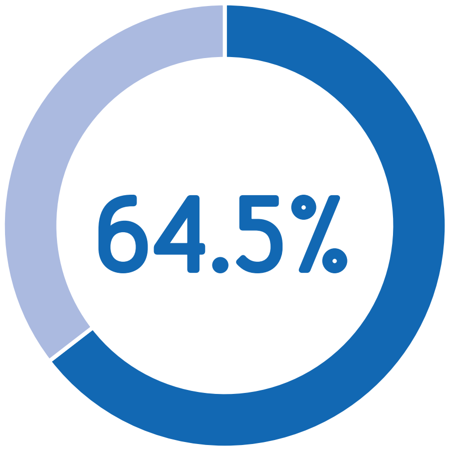
● ● ● Existing network capacity does not support estimated demand

Wireline Connectivity Gaps: Singleton

In 2023, 64.5 per cent of dwellings in Singleton had fibre access, however, only 0.7 per cent had access to FTTP the ideal fibre connection. 99.3 per cent of dwellings may experience digital connectivity challenges with their access limited to FTTN in urban areas and fixed wireless or satellite in rural areas.

Total private dwellings*: 9,348

There were 9,348 private dwellings in the Singleton LGA, 64.54 per cent of which are estimated to have had fibre access. This access consisted of mainly of FTTN, the least ideal fibre connection for digital connectivity. The breakdown of types of access are as follows:



Dwellings with no fibre access
Dwellings with fibre access

Fibre to the Premises (FTTP):
0.7% (73 Dwellings)

Fibre to the Curb (FTTC):
0% (0 Dwellings)

Fibre to the Node (FTTN):
63.8% (5,960 Dwellings)

Fixed Wireless or Satellite:
35.5% (3,315 Dwellings)

* 'Private Dwellings' are typically a house, flat or apartment for residential use; it can also refer to a caravan, houseboat, or other form of residential living space. The figures included in this assessment are from the ABS 2021 Census.

Key insights:

- 35.5 per cent of dwellings in Singleton have no access to fibre connections, due to the large proportion of dwellings found within rural areas.
- Only 0.7 per cent or 73 dwellings have access to a FTTP connection, providing them ideal connectivity.
- FTTC is not provided within Singleton, instead 63.8 per cent of dwellings are serviced by FTTN connections.
- Additional wireline connections will be required within the urban areas of Singleton, to upgrade dwellings from an FTTN connection to FTTP services.

Top three suburbs with no fibre access:

- Wattle Ponds 382 dwellings
- Broke 280 dwellings
- Whittingham 172 dwellings

Infrastructure Requirements to meet Future Demand: Singleton

In the baseline demand scenario, no new radio access sites are required to fulfil future wireless connectivity demand. To upgrade existing dwellings serviced from FTTN to FTTP would require an estimated CapEx* investment of $8.3M.

Wireless infrastructure requirements & investment

The table below outlines the estimated investment in new radio access sites / mobile base stations that need to be deployed between 2025 and 2030 to increase network capacity and fulfil projected connectivity demand across the three scenarios.

	Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
Additional Radio Sites / Mobile Base Stations Required	0	0	3
Major City Sites (co-located)	0 (0)	0 (0)	0 (0)
Inner Regional Area Sites (co-located)	0 (0)	0 (0)	3 (1)
CapEx Investment Estimate*	$0	$0	$1.4M - $2.0M

Wireline infrastructure requirements & investment

The table below outlines the estimated investment to upgrade wireline infrastructure and transition dwellings in the LGA with FTTC and FTTN to FTTP.

Costs associated with providing access via fibre to dwellings that currently do not have access to this type of technology, have not been included below. The cost of this expansion is inherent to different factors and the geographical location/distance of possible fibre cores.

Fibre Upgrade Type	Number of Dwellings	Estimated Investment
FTTC to FTTP	0	$0
FTTN to FTTP	27,088	$8.3M
CapEx Investment Estimate*		$8.3M

- Capital Expenditure (CapEx) is the estimated cost of infrastructure (direct material costs). The CapEx estimate excludes other costs such as construction, labour or other costs. The estimated CapEx investment is indicative to fulfil projected future demand for wireless services and upgrading dwellings with FTTC and FTTN to FTTP. For fibre upgrades from FTTC and FTTN to FTTP, an average lead-in cost of $1,400 per connection is assumed in the modelling, as indicated by Mr Stephen Rue, nbn CEO, at the Senate Estimates held on 13 February 2024. It should be noted that nbn is currently rolling out a fibre upgrade program with the ambition to provide FTTP services to over 90% of residences and businesses nationally by the end of 2025. Therefore, it is expected that a large portion of the projected fibre upgrade CapEx investment is already in plan for roll out by nbn to residential and business customers who are eligible and request an upgrade to a high speed service plan through their Retail Service Provider (RSP). A breakdown of wireless infrastructure cost assumptions can be found in Appendix 6 (page 144). In addition, this analysis excludes nbn fixed wireless and satellite upgrades, noting that nbn is currently rolling out upgrades to these technologies to improve coverage and capacity.

Upper Hunter

LGA overview

Telecommunications infrastructure review

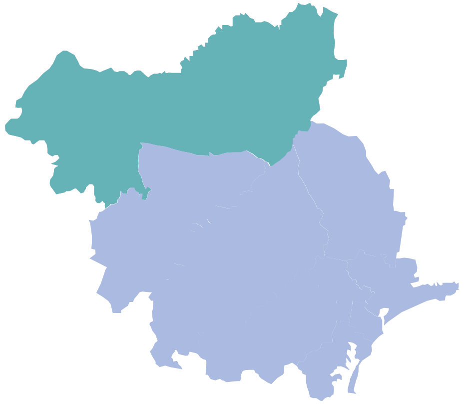
Wireless connectivity gaps

Wireline connectivity gaps

Infrastructure requirements to meet future demand

LGA Overview: Upper Hunter

The Upper Hunter is the largest LGA in terms of land area within the DSSN region, which when combined with the rural nature of the area drives low digital connectivity for the small living and visiting population.



8,096km²

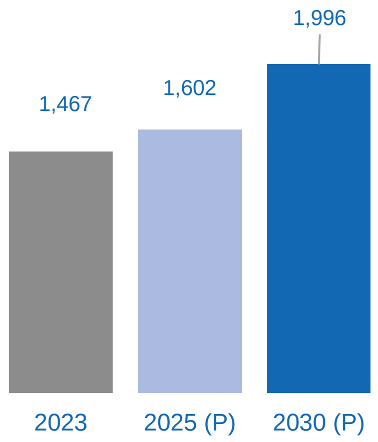
Total land area

Daily Visitors to the Area

(Baseline Demand Scenario)

Upper Hunter hosts the Scone Horse Festival in May, celebrating its equine heritage with 10,000 visitors over 10 days.

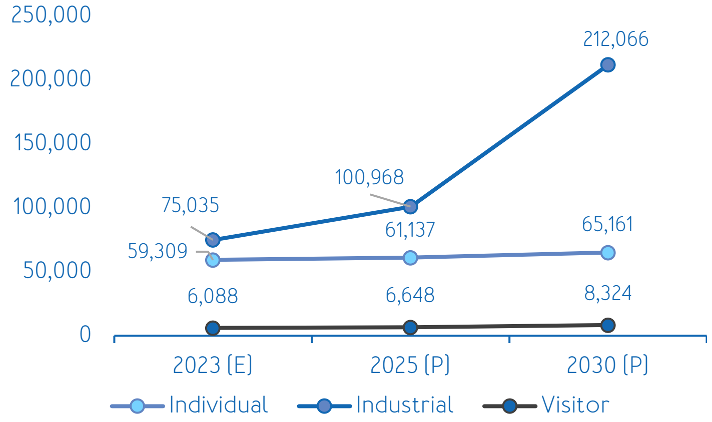
The Aberdeen Highland Games are held annually in July, with the Rosto Festival of the Fleeces held in Merriwa every June with over 6,000 visitors. Warbirds over Scone attracts a loyal crowd with 8,000 attendees, injecting an estimated $2.4 million into the local economy.



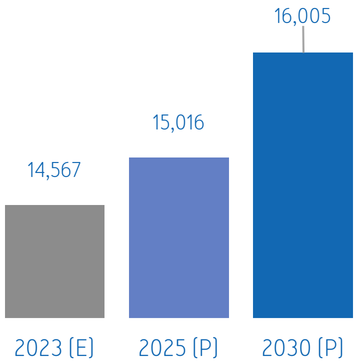
*The simulated number of visitors to the LGA per day in the baseline scenario used for this assessment**

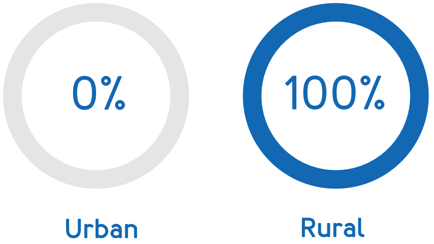
Total Number of Connected Devices

(Baseline Demand Scenario)



Population





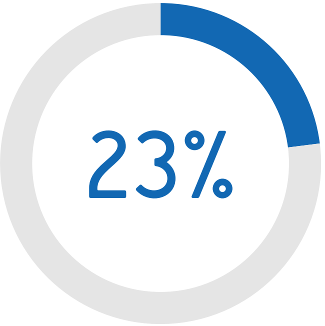
Key Insights:

- Upper Hunter is the largest LGA in terms of land area and is 100% rural. While the LGA's population density is low, it hosts several festivals throughout the year that attracts visitors. Coal mining is also a key activity in the region, with major mines owned by companies such as Glencore attracting FiFo workers.
- Key industrial sectors are agriculture, forestry, mining, quarrying, oil & gas, where poor Internet is a significant barrier to technology and data adoption that could boost productivity.
- Upper Hunter Shire Council is investing in projects that help stimulate the local economy, such as revitalising Scone CBD. Robust digital connectivity is vital in supporting these initiatives.
- Upper Hunter has the lowest digital connectivity index (on the move and stationary) out of all LGAs. Anticipated growth in population, increased visitation, and the expansion of various industries are expected to more than double the overall number of connections to 274,081 by 2030.

** Visitor numbers have been calculated using the total number of commercial accommodation rooms available in the LGA, and a final maximum number of visitors assumed to visit each day based on the number of day trippers, overnight visitors and additional visitors who stay with friends or family. A 'Low' scenario was calculated at 50% of this maximum figure ('High' demand scenario), and a 'Baseline' scenario was calculated at 75% of the maximum.*

Telecommunications Infrastructure Review: Upper Hunter

The Upper Hunter has the lowest Digital Connectivity Index for both 'On the Move' and 'Stationary' in the DSSN area. The rural demographic means 3G and 4G are only available in populated areas, while FTTN is the only fibre connection available.



Digital Connectivity Index (On the Move)

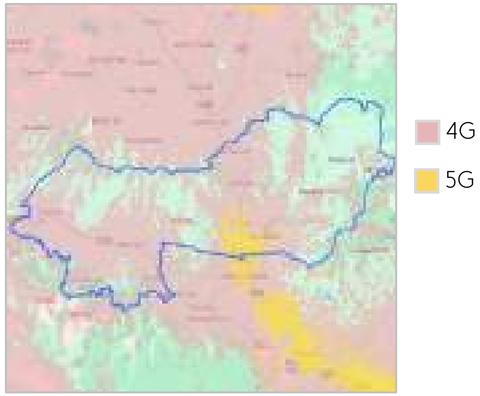
Access	51	●●●○○
Affordability	74	●●●●○
Demographics	40	●●○○○

	Telstra	Optus	TPG
3G	✓	✓	✓
4G	✓	✓	✓
5G	✓	✓	✗

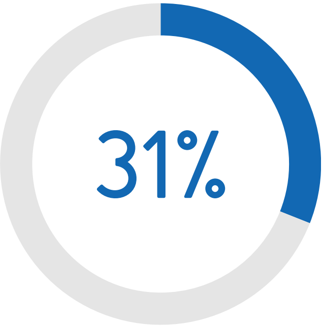
Key Insights:

- The region has the lowest digital connectivity index among the top DSSN regions.
- It is an extremely rural area where 3G and 4G coverage is limited to populated areas, including residences and industry.
- 5G is only available in the more populated areas such as Scone and Aberdeen.
- TPG lacks 5G coverage in the region.

Current Mobile Coverage



Map showing current mobile coverage in terms of 4G and 5G (Telstra, Optus, and TPG combined)



Digital Connectivity Index (Stationary)

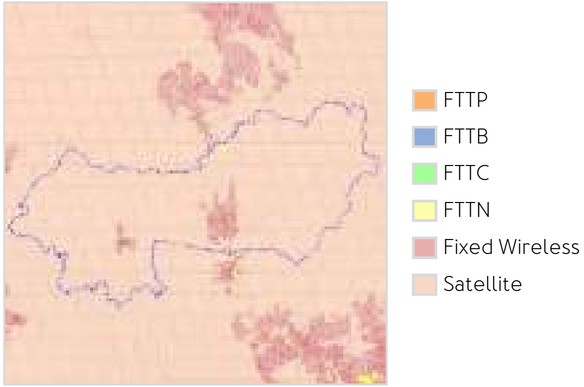
Access	61	●●●●○
Affordability	83	●●●●●
Demographics	40	●●○○○

Fibre to the Premises	✗
Fibre to the Building	✗
Fibre to the Curb	✗
Fibre to the Node	✓
Fixed Wireless	✓
Satellite	✓

Key Insights:

- The area has the lowest stationary digital connectivity index.
- Access via fibre is only available in the form of Fibre to the Node for the cities of Scone, Murrurundi, and Aberdeen.

nbn Current nbn Services



Wireless Connectivity Gaps: Upper Hunter

To provide insight into the range of demand conditions and how they may impact demand for network capacity, three demand scenarios have been developed. Based on the Upper Hunter demand scenarios, the existing radio access infrastructure will be able to meet both low and baseline demand scenarios, as well as the high demand scenario until 2030.

Current Number of Radio Access Sites: 24

4G co-located with 5G: 4 | Urban Sites: 0 | Rural Sites: 20

The three scenarios developed to understand the potential demand for digital connectivity are based on population and visitor growth, and the subsequent increase in the expected number of devices that will be in use based on 'Low', 'Baseline' or 'High' demand scenarios.

		Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
2023 (E)	Connected devices	96,882	140,433	203,084
	Network capacity	⚪ ⚪ 🟢	⚪ ⚪ 🟢	⚪ ⚪ 🟢
2025 (P)	Connected devices	116,443	168,752	244,130
	Network capacity	⚪ ⚪ 🟢	⚪ ⚪ 🟢	⚪ ⚪ 🟢
2030 (P)	Connected devices	197,362	285,552	412,458
	Network capacity	⚪ ⚪ 🟢	⚪ ⚪ 🟢	🔴 ⚪ ⚪

(P) is for Projected Growth
(E) is for Estimated

Key insights:

- The existing infrastructure will cater for mobile connectivity demand in both the low and baseline demand scenarios. No additional mobile towers are required.
- In the high demand scenario, existing infrastructure will be able to adequately cater for projected demand up to 2030, where it will then be insufficient to support demand. At this point additional mobile sites will need to be installed to support the network.

Key for network capacity:

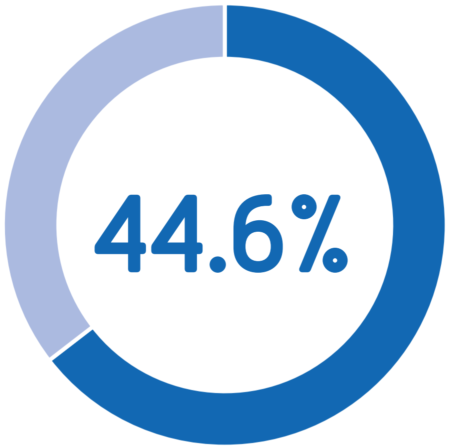
- ⚪ ⚪ 🟢 Existing network capacity meets the estimated demand
- ⚪ 🟡 ⚪ Existing network capacity may experience congestion during peak demand
- 🔴 ⚪ ⚪ Existing network capacity does not support estimated demand

Wireline Connectivity Gaps: Upper Hunter

In 2023, access to a fibre connection was available to only 44.6% of dwellings in Upper Hunter and only FTTN provided to these dwellings. The remaining 55.4 per cent or 6,730 dwellings are serviced by a fixed wireless or satellite connection.

Total private dwellings*: 12,168

There were 12,168 private dwellings in the Upper Hunter LGA, 64.54 per cent of which are estimated to have had fibre access. This access consisted of FTTN, the least ideal fibre connection for digital connectivity. The breakdown of types of access are as follows:



Fibre to the Premises (FTTP):
0% (0 Dwellings)

Fibre to the Curb (FTTC):
0% (0 Dwellings)

Fibre to the Node (FTTN):
44.6% (5,438 Dwellings)

Fixed Wireless or Satellite:
55.4% (6,730 Dwellings)

* 'Private Dwellings' are typically a house, flat or apartment for residential use; it can also refer to a caravan, houseboat, or other form of residential living space. The figures included in this assessment are from the ABS 2021 Census.

Key insights:

- Due to the rural nature of the Upper Hunter region, 55.4%of dwellings are serviced by fixed wireless or satellite, which may result in reduced connectivity in comparison to fibre alternatives.
- No dwellings have access to a FTTP connection, so the ideal connectivity is absent.
- 44.6% of dwellings have access to FTTN services, for which the "last mile" fibre roll out is feasible to the dwelling from the curb or the node.
- In order to provide FTTP to existing dwellings in the Upper Hunter with FTTN services, additional wireline infrastructure is required.

Top three suburbs with no fibre access:

- Merriwa 871 dwellings
- Gunning 357 dwellings
- Taralga 243 dwellings

Infrastructure Requirements to meet Future Demand: Upper Hunter

In the baseline demand scenario, no new radio access sites are required to fulfil future wireless connectivity demand. To upgrade existing dwellings from FTTN to FTTP would require an estimated CapEx* investment of $7.6M.

Wireless infrastructure requirements & investment

The table below outlines the estimated investment in new radio access sites / mobile base stations that need to be deployed between 2025 and 2030 to increase network capacity and fulfil projected connectivity demand across the three scenarios.

	Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
Additional Radio Sites / Mobile Base Stations Required	0	0	1
Major City Sites (co-located)	0 (0)	0 (0)	0 (0)
Inner Regional Area Sites (co-located)	0 (0)	0 (0)	1 (0)
CapEx Investment Estimate*	$0	$0	$626K – $866K

Wireline infrastructure requirements & investment

The table below outlines the estimated investment to upgrade wireline infrastructure and transition dwellings in the LGA with FTTC and FTTN to FTTP.

Costs associated with providing access via fibre to dwellings that currently do not have access to this type of technology, have not been included below. The cost of this expansion is inherent to different factors and the geographical location/distance of possible fibre cores.

Fibre Upgrade Type	Number of Dwellings	Estimated Investment
FTTC to FTTP	0	$0
FTTN to FTTP	5,438	$7.6M
CapEx Investment Estimate*		$7.6M

- Capital Expenditure (CapEx) is the estimated cost of infrastructure (direct material costs). The CapEx estimate excludes other costs such as construction, labour or other costs. The estimated CapEx investment is indicative to fulfil projected future demand for wireless services and upgrading dwellings with FTTC and FTTN to FTTP. For fibre upgrades from FTTC and FTTN to FTTP, an average lead-in cost of $1,400 per connection is assumed in the modelling, as indicated by Mr Stephen Rue, nbn CEO, at the Senate Estimates held on 13 February 2024. It should be noted that nbn is currently rolling out a fibre upgrade program with the ambition to provide FTTP services to over 90% of residences and businesses nationally by the end of 2025. Therefore, it is expected that a large portion of the projected fibre upgrade CapEx investment is already in plan for roll out by nbn to residential and business customers who are eligible and request an upgrade to a high speed service plan through their Retail Service Provider (RSP). A breakdown of wireless infrastructure cost assumptions can be found in Appendix 6 (page 144). In addition, this analysis excludes nbn fixed wireless and satellite upgrades, noting that nbn is currently rolling out upgrades to these technologies to improve coverage and capacity.

Case Studies: peak future demand in the tourism sector

1. Pokolbin, Hunter Valley: Supercars Race
2. Pokolbin, Hunter Valley: Concert Venue
3. Nelson Bay, Port Stephens: Summer Period
4. Morisset, Lake Macquarie: Concert Venue
5. The Entrance, Central Coast: ChromeFest

Pokolbin Hunter Valley

- Area demographics and peak visitor demand
- Telecommunications infrastructure review
- Future connectivity gap
- Telecommunications infrastructure scenarios

Area demographics and peak visitor demand: Pokolbin

Pokolbin, located in Cessnock within the Hunter Valley (wine country) region, currently has adequate 3G and 4G coverage, with a gap in 5G connectivity. To accommodate a large event, additional stationary and mobile connectivity options would be required to meet the surge in demand.

Case Study 1) Supercars Race

62,000

The highest number of event attendees on a single day for a Supercars race.

The *Newcastle 500,* previously hosted by Newcastle under an agreement between the City of Newcastle, Destination NSW and Supercars, came to the end of its five-year agreement after the final 2023 event.

Held over three days (Friday to Sunday), the annual event (which was not held in 2021 and 2022 due to the COVID-19 pandemic) brought 160,000 visitors to Newcastle. The Saturday (11 March, 2023) saw the peak number of attendees on one day, hitting just under 62,000.

Case Study 2) Concert Venue

20,000

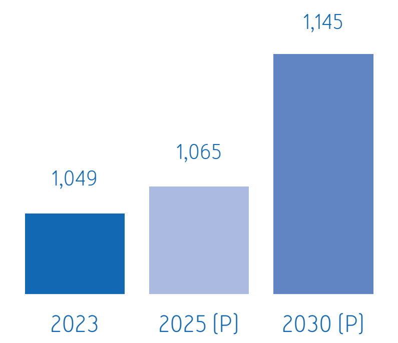
The maximum venue capacity for Hope Estate to hold a live music event.

Pokolbin has an existing healthy events calendar, with two main venues where most music concerts are held: Hope Estate and Bimbadgen.

Hope Estate is a winery, brewery and cellar door, with Australia's largest purpose-built outdoor winery concert amphitheatre that hosts a variety of live music events throughout the year.

The concert venue has a maximum capacity for 20,000 attendees at a single event.

Pokolbin's population



Rural

(P) is for Projected Growth

Telecommunications Infrastructure Review: Pokolbin

Pokolbin does have 3G and 4G coverage, however there is limited 5G connectivity and the 'on the move' connectivity index is poor at 31 per cent. Fibre services are limited, while nbn fixed wireless and satellite are widely available.

31%

Digital Connectivity Index (On the Move)

Access	38	●●○○○
Affordability	74	●●●●○
Demographics	100	●●●●●

	Telstra	Optus	TPG
3G	✔	✔	✔
4G	✔	✔	✔
5G	✔	✘	✘

Key Insights:

- The area has a total of 10 base stations distributed among the three operators.
- The region does not have connectivity gaps in terms of 3G and 4G in the populated zone. However, given the extent of the suburb, there may be a need to install base stations to ensure continuous coverage throughout.
- There is a co-located site (with antennas from all three operators) in the mountainous area, ensuring good coverage to the west.
- There is only one radio site with 5G technology, in the residential area.

Current Mobile Coverage

4G
5G

Map showing current mobile coverage in terms of 4G and 5G (Telstra, Optus, and TPG combined)

69%

Digital Connectivity Index (Stationary)

Access	69	●●●●○
Affordability	89	●●●●●
Demographics	100	●●●●●

Fibre to the Premises	✔
Fibre to the Building	✘
Fibre to the Curb	✔
Fibre to the Node	✔
Fixed Wireless	✔
Satellite	✔

Key Insights:

- As Pokolbin is a rural region characterised by extensive vineyards and a distributed population across various areas without a distinct population centre, the existing fibre access is mainly provided via FTTC.
- There is a small area with access via FTTP and FTTN.

nbn Current nbn Services

FTTP
FTTB
FTTC
FTTN
Fixed Wireless
Satellite

Wireless Connectivity Gaps: Pokolbin (Hope Estate - 20,000 visitors)

To provide insight into the range of demand conditions and how they may impact demand for network capacity, three scenarios have been developed. The existing infrastructure will not be able to meet wireless connectivity needs in any of the demand scenarios for Pokolbin during a peak demand event of 20,000 visitors.

Current Number of Radio Access Sites: 3

4G co-located with 5G: 1 | **Urban Sites:** 0 | **Rural Sites:** 2

The three scenarios developed to understand the potential demand for digital connectivity are based on population and visitor growth, and the subsequent increase in the expected number of devices that will be in use based on 'Low', 'Baseline' or 'High' demand scenarios.

		Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
2023 (E)	**Connected devices**	64,737	92,624	132,119
	Network capacity	🔴 ⚪ ⚪	🔴 ⚪ ⚪	🔴 ⚪ ⚪
2025 (P)	**Connected devices**	66,096	94,582	134,941
	Network capacity	🔴 ⚪ ⚪	🔴 ⚪ ⚪	🔴 ⚪ ⚪
2030 (P)	**Connected devices**	71,734	102,748	146,667
	Network capacity	🔴 ⚪ ⚪	🔴 ⚪ ⚪	🔴 ⚪ ⚪

(P) is for Projected Growth
(E) is for Estimated

Key insights:

- The current wireless infrastructure in Pokolbin (three radio access sites) is insufficient to meet the connectivity demand driven by a surge of up to 20,000 visitors for an event.
- If no additional infrastructure is provided to Pokolbin to adequately meet visitor demand, both visitor and local population experience is expected to worsen during peak demand periods.
- This is expected to create tensions for the local population and business owners who will experience connectivity challenges when large events are held.

Key for network capacity:

- ⚪ ⚪ 🟢 Existing network capacity meets the estimated demand
- ⚪ 🟡 ⚪ Network may experience congestion during peak demand
- 🔴 ⚪ ⚪ Existing network capacity does not support estimated demand

Infrastructure Requirements to meet Future Demand in Pokolbin: 20,000 visitors

The table below outlines five different infrastructure options to meet wireless connectivity demand to support an event with up to 20,000 visitors, including both permanent and temporary solutions with different cost profiles.

Technology Options	Description	Low Demand Scenario		Baseline Demand Scenario		High Demand Scenario	
		Qty	Indicative Cost*	Qty	Indicative Cost*	Qty	Indicative Cost*
Additional Radio Sites / Mobile Base Stations	Permanent stations (towers) installed by telecommunications providers to provide wireless coverage to the surrounding area.	1	$626,969 - $866,246	2	$835,958 - $1,154,994	4	$1,671,917 – $2,309,989
Cell on Whells (CoW)	Temporary infrastructures that provides mobile coverage and capacity, supporting an average of up to 350 devices simultaneously.	2	Acquisition: $1,000,000 Rental: $60,000	7	Acquisition: $3,500,000 Rental: $210,000	15	Acquisition: $7,500,000 Rental: $450,000
Cold Mobile Sites	Pre-located sites that contain all passive infrastructure components, and only activated during major events.	1	$560,856 - $721,351	2	$747,808 - $961,801	4	**$1,495,616 - $1,923,603**
Private 5G	A private wireless solution based on 5G, which allows only selected devices in a designated area to access the network. 'Qty' is based on the number of access points estimated to be required.	7	$976,000 - $987,000	25	$1,478,000 - $1,522,000	51	$1,530,000 - $1,574,000
Private Wi-Fi	This solution is ideal for closed/concentrated areas, and allows for greater control of usage and network capabilities. 'Qty' is based on the number of access points estimated to be required.	7	$36,000 - $47,000	25	$72,000 - $83,000	51	$190,000 - $234,000

* Capital Expenditure (CapEx) is the estimated cost of infrastructure (direct material costs). The CapEx estimate excludes costs such as construction, labour or other costs.
More details on the types of technology options for consideration are provided in Chapter 4: Recommendations and Considerations (page 113), and in Appendix 7 (page 149).

Wireless Connectivity Gaps: Pokolbin (Supercars – 62,000 visitors)

To provide insight into the range of demand conditions and how they may impact demand for network capacity, three scenarios have been developed. The existing infrastructure will not be able to meet wireless connectivity needs in any of the demand scenarios for Pokolbin during a peak demand event of 62,000 visitors.

Current Number of Radio Access Sites: 3

4G co-located with 5G: 1 | **Urban Sites:** 0 | **Rural Sites:** 2

The three scenarios developed to understand the potential demand for digital connectivity are based on population and visitor growth, and the subsequent increase in the expected number of devices that will be in use based on 'Low', 'Baseline' or 'High' demand scenarios.

		Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
2023 (E)	Connected devices	186,537	266,914	380,759
	Network capacity	🔴⚪⚪	🔴⚪⚪	🔴⚪⚪
2025 (P)	Connected devices	187,896	288,872	383,581
	Network capacity	🔴⚪⚪	🔴⚪⚪	🔴⚪⚪
2030 (P)	Connected devices	193,534	277,038	395,307
	Network capacity	🔴⚪⚪	🔴⚪⚪	🔴⚪⚪

(P) is for Projected Growth
(E) is for Estimated

Key insights:

- The current wireless infrastructure in Pokolbin (three radio access sites) is insufficient to meet the connectivity demand driven by a surge of up to 62,000 visitors for an event.
- If no additional infrastructure is provided to Pokolbin to adequately meet visitor demand, both visitor and local population experience is expected to worsen during peak demand periods.
- This is expected to create tensions for the local population and business owners who will experience connectivity challenges when large events are held.

Key for network capacity:

- ⚪⚪🟢 Existing network capacity meets the estimated demand
- ⚪🟡⚪ Network may experience congestion during peak demand
- 🔴⚪⚪ Existing network capacity does not support estimated demand

Infrastructure Requirements to meet Future Demand in Pokolbin: 62,000 visitors

The table below outlines four different infrastructure options to meet wireless connectivity demand to support an event with up to 62,000 visitors, including both permanent and temporary solutions with different cost profiles.

Technology Options	Description	Low Demand Scenario		Baseline Demand Scenario		High Demand Scenario	
		Qty	Indicative Cost*	Qty	Indicative Cost*	Qty	Indicative Cost*
Additional Radio Sites / Mobile Base Stations	Permanent stations (towers) installed by telecommunications providers to provide wireless coverage to the surrounding area.	1	$626,969 - $866,246	4	$1,671,917 – 2,309,989	8	$3,343,835 – 4,619,979
Cell on Whells (CoW)	Temporary infrastructures that provides mobile coverage and capacity, supporting an average of up to 350 devices simultaneously.	1	**Acquisition:** $500,000 **Rental:** $30,000	15	**Acquisition:** $7,500,000 **Rental:** $450,000	35	**Acquisition:** $17,500,000 **Rental:** $1,050,000
Cold Mobile Sites	Pre-located sites that contain all passive infrastructure components, and only activated during major events.	1	$560,856 - $721,351	4	$1,495,616 - $1,923,603	8	$2,991,232 - $3,847,205
Private 5G	A private wireless solution based on 5G, which allows only selected devices in a designated area to access the network. 'Qty' is based on the number of access points estimated to be required.	2	$966,000 - $977,000	51	$1,530,000 - $1,574,000	122	$2,604,000 - $2,844,000

* Capital Expenditure (CapEx) is the estimated cost of infrastructure (direct material costs). The CapEx estimate excludes costs such as construction, labour or other costs.
More details on the types of technology options for consideration are provided in Chapter 4: Recommendations and Considerations (page 113), and in Appendix 7 (page 149).

Nelson Bay
Port Stephens

- Area demographics and peak visitor demand
- Telecommunications infrastructure review
- Future connectivity gap
- Telecommunications infrastructure scenarios

Area demographics and peak visitor demand: Nelson Bay

Nelson Bay, situated along the Port Stephens coastline, draws significant tourism during peak seasons such as summer and holidays. Meeting the wireless connectivity demand to support events like Tastes at the Bay necessitates the implementation of both temporary and permanent infrastructure solutions.

Nelson Bay has a population of 8,109 with an aging demographic. The area is located within Port Stephens and is two hours north of Sydney and one hour north of Newcastle. The area is known for its family friendly entertainment options with beaches, hiking trails and whale-watching.

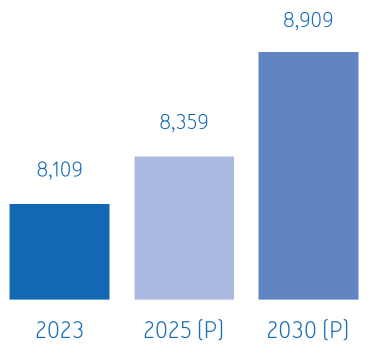
As a holiday destination with a broad range of activities on offer, visitor numbers peak during the Christmas, Easter and the October long weekend periods. During holiday periods additional events are on offer, including Christmas carols, markets, and fireworks for New Years Eve that attract high numbers. The region is appealing for remote workers looking for a coastal break due to the proximity to Newcastle and Sydney.

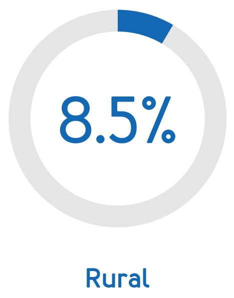
15,000

The estimated peak number of visitors in Nelson Bay during a Summer event.

Tastes at the Bay is Port Stephen's largest annual event, a food festival held at Nelson Bay. In previous years the number of attendees have been estimated to be around 15,000, which is estimated to be the peak number of visitors to the area during Summer months and holidays.

Nelson Bay's population



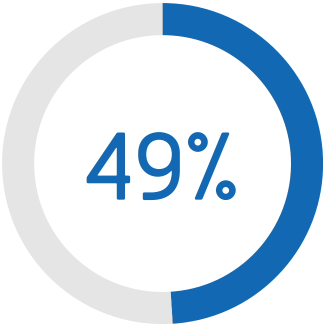


(P) is for Projected Growth

Destination Sydney Surrounds North

Telecommunications Infrastructure Review: Nelson Bay

While Nelson Bay has adequate 4G and 5G coverage, Shoal Bay lacks essential base stations for reliable mobile connectivity, highlighting the need for infrastructure development to address connectivity gaps in the region.



Digital Connectivity Index (On the Move)

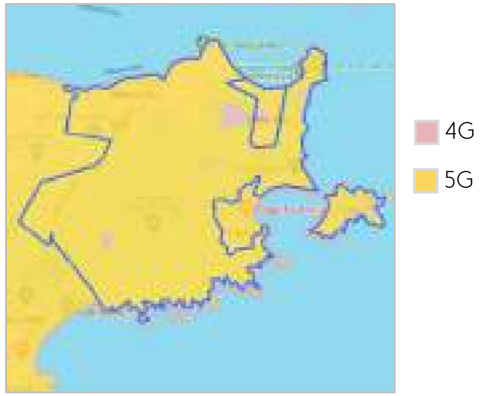
Access	86	●●●●●
Affordability	70	●●●●●
Demographics	53	●●●●●

Telstra		Optus		TPG	
3G	✔	3G	✔	3G	✔
4G	✔	4G	✔	4G	✔
5G	✔	5G	✔	5G	✔

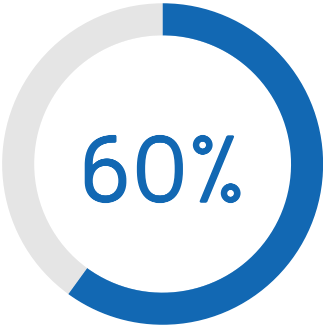
Key Insights:

- A total of seven base stations in Nelson Bay, with no apparent coverage issues in terms of 3G and 4G connectivity.
- No base stations in the Shoal Bay area. The installation of a base station in this zone may be necessary to ensure 3G and 4G mobile connectivity.
- 5G coverage is ensured in the majority of the Nelson Bay area.

Current Mobile Coverage



Map showing current mobile coverage in terms of 4G and 5G (Telstra, Optus, and TPG combined)



Digital Connectivity Index (Stationary)

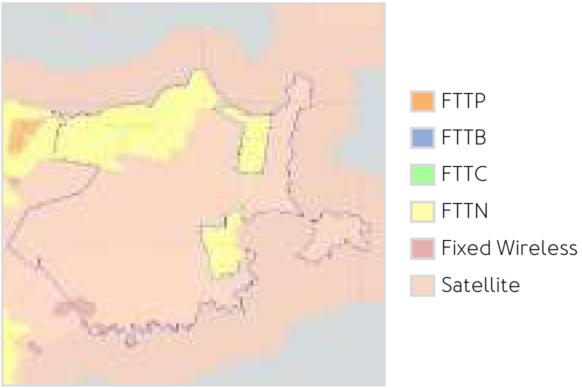
Access	99	●●●●●
Affordability	78	●●●●●
Demographics	53	●●●●●

Fibre to the Premises	✔
Fibre to the Building	✘
Fibre to the Curb	✘
Fibre to the Node	✔
Fixed Wireless	✔
Satellite	✔

Key Insights:

- The Nelson Bay/Shoal Bay area provides fibre access for the entire residential zone of the region, with this access primarily through Fibre to the Node.
- The more remote areas, without permanent housing or any type of industry, have access via satellite.

nbn Current nbn Services



Wireless Connectivity Gaps: Nelson Bay

To provide insight into the range of demand conditions and how they may impact demand for network capacity, three scenarios have been developed. The existing infrastructure will not be able to meet wireless connectivity needs for Nelson Bay during a peak demand of 15,000 visitors for an event in the baseline and high demand scenarios.

Current Number of Radio Access Sites: 7

4G co-located with 5G: 2 | Urban Sites: 1 | Rural Sites: 4

The three scenarios developed to understand the potential demand for digital connectivity are based on population and visitor growth, and the subsequent increase in the expected number of devices that will be in use based on 'Low', 'Baseline' or 'High' demand scenarios.

		Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
2023 (E)	Connected devices	94,652	135,324	192,905
	Network capacity	⚪⚪🟢	⚪🟡⚪	🔴⚪⚪
2025 (P)	Connected devices	105,000	150,207	214,352
	Network capacity	⚪⚪🟢	🔴⚪⚪	🔴⚪⚪
2030 (P)	Connected devices	148,246	212,251	303,459
	Network capacity	🔴⚪⚪	🔴⚪⚪	🔴⚪⚪

(P) is for Projected Growth
(E) is for Estimated

Key insights:

- The current wireless infrastructure in Nelson Bay is able to meet the demand levels for Low demand scenario for 2023 and 2025.
- The wireless infrastructure is insufficient to meet the connectivity demand for Baseline and High demand scenarios.
- If no additional infrastructure is provided to Pokolbin to adequately meet visitor demand, both visitor and local population experience is expected to worsen during peak demand periods.

Key for network capacity:

- ⚪⚪🟢 Existing network capacity meets the estimated demand
- ⚪🟡⚪ Network may experience congestion during peak demand
- 🔴⚪⚪ Existing network capacity does not support estimated demand

Infrastructure Requirements to meet Future Demand in Nelson Bay

The table below outlines four different infrastructure options to meet wireless connectivity demand to support an event with up to 15,000 visitors, including both permanent and temporary solutions with different cost profiles.

Technology Options	Description	Low Demand Scenario		Baseline Demand Scenario		High Demand Scenario	
		Qty	Indicative Cost*	Qty	Indicative Cost*	Qty	Indicative Cost*
Additional Radio Sites / Mobile Base Stations	Permanent stations (towers) installed by telecommunications providers to provide wireless coverage to the surrounding area.	1	$626,969 - $866,246	2	$835,958 - $1,154,994	5	$2,512,186 - $2,862,430
Cell on Whells (CoW)	Temporary infrastructures that provides mobile coverage and capacity, supporting an average of up to 350 devices simultaneously.	2	**Acquisition:** $1,000,000 **Rental:** $60,000	10	**Acquisition:** $5,000,000 **Rental:** $300,000	25	**Acquisition:** $12,500,000 **Rental:** $750,000
Cold Mobile Sites	Pre-located sites that contain all passive infrastructure components, and only activated during major events.	1	$560,856 - $721,351	2	$747,808 - $961,801	5	$2,209,767 - $2,250,615
Private 5G	A private wireless solution based on 5G, which allows only selected devices in a designated area to access the network. 'Qty' is based on the number of access points estimated to be required.	8	$978,000 - $989,000	33	$1,494,000 - $1,538,000	87	$1,602,000 - $1,646,000

* Capital Expenditure (CapEx) is the estimated cost of infrastructure (direct material costs). The CapEx estimate excludes costs such as construction, labour or other costs.
More details on the types of technology options for consideration are provided in Chapter 4: Recommendations and Considerations (page 113), and in Appendix 7 (page 149).

Morisset
Lake Macquarie

- Area demographics and peak visitor demand
- Telecommunications infrastructure review
- Future connectivity gap
- Telecommunications infrastructure scenarios

Area demographics and peak visitor demand: Morisset

The development of the Cedar Mill Lake Macquarie tourism, cultural and event space may necessitate additional base stations to close connectivity gaps from increased visitation during peak demand.

The Cedar Mill development in Morisset is a transformative project for the Lake Macquarie region, introducing a multifaceted entertainment hub through the $235M redevelopment of the Morisset Golf Course. The redevelopment is expected to be completed by late 2025, positioning Cedar Mill as a premier destination for live entertainment and events.

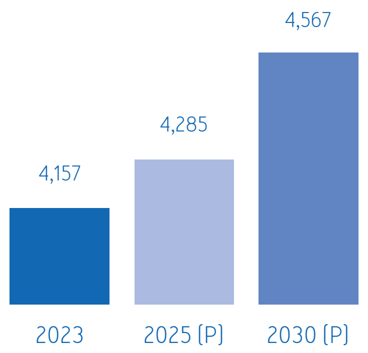
Cedar Mill's location is conveniently located roughly halfway between Newcastle and Sydney. Proximity to public transport options and the freeway provides easy access for patrons. The project is anticipated to generate a surge in economic activity, bringing $450M to the local economy every year, and local employment opportunities while also increasing tourism and community engagement.

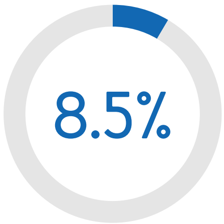
30,000

Cedar Mill concert venue peak attendee capacity for an event.

With plans for a 30,000-capacity concert venue, Cedar Mill is expected to draw significant crowds, satisfying future demands for large-scale, open-air live performances. An aquatic play park that is set to be the largest in Australia will also be included in the precinct, providing a family-friendly recreation area. The precinct will also feature cafes and restaurants, and is expected to draw more live acts and visitors to the area.

Nelson Bay's population





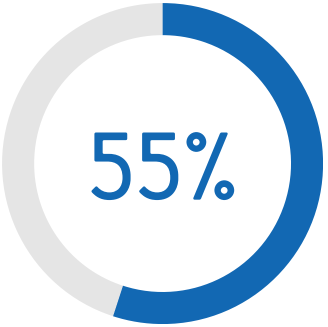
Rural

(P) is for Projected Growth

Destination Sydney Surrounds North

Telecommunications Infrastructure Review: Cedar Mill (Morisset)

Cedar Mill (Morisset) has well-developed 4G and 5G coverage, however the 'on the move' connectivity index is average at 55 per cent. Fibre access is mainly provided via FTTN and the remainder by fixed wireless and satellite.



Digital Connectivity Index (On the Move)

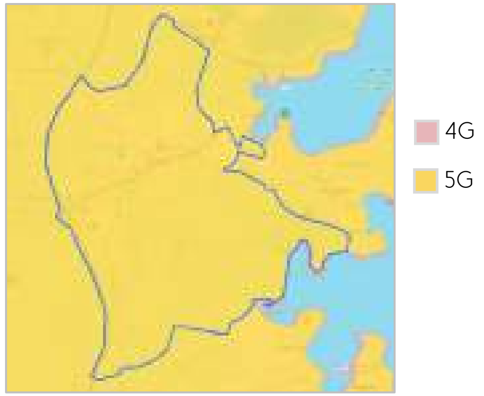
Access	84	●●●●●
Affordability	78	●●●●○
Demographics	32	●●○○○

	Telstra	Optus	TPG
3G	✔	✔	✔
4G	✔	✔	✔
5G	✔	✔	✔

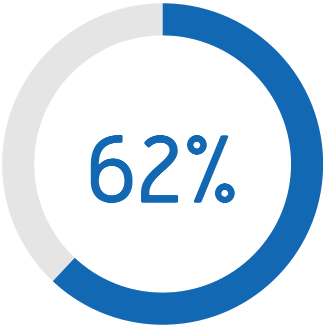
Key Insights:

- A total of five base stations distributed among the three operators.
- 3G and 4G connectivity ensured for the entire region without apparent gaps in the residential zone.
- 5G is well-developed in the Morisset region with the presence of five base stations offering this technology.
- The Cedar Mill project's expansion may necessitate the deployment of new base stations to ensure continuous capacity in terms of network demand.

Current Mobile Coverage



Map showing current mobile coverage in terms of 4G and 5G (Telstra, Optus, and TPG combined)



Digital Connectivity Index (Stationary)

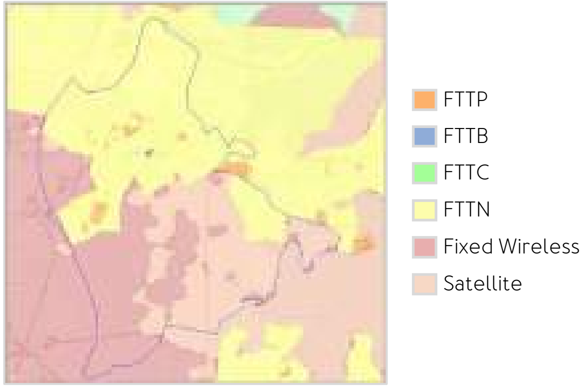
Access	95	●●●●●
Affordability	86	●●●●●
Demographics	32	●●○○○

Fibre to the Premises	✔
Fibre to the Building	✔
Fibre to the Curb	✘
Fibre to the Node	✔
Fixed Wireless	✔
Satellite	✔

Key Insights:

- The Morisset area provides complete fibre access to the residential zone, with the majority of the population having access via Fibre to the Node.
- Some residential clusters have access via Fibre to the Premises and Fibre to the Building.

nbn Current nbn Services



Wireless Connectivity Gaps: Cedar Mill (Morisset)

To provide insight into the range of demand conditions and how they may impact demand for network capacity, three scenarios have been developed. The existing infrastructure will not be able to meet wireless connectivity needs for Cedar Mill (Morisset) during a peak demand of 30,000 visitors for an event in baseline and high demand scenarios 2023 onwards.

Current Number of Radio Access Sites: 5

4G co-located with 5G: 4 | Urban Sites: 1 | Rural Sites: 0

The three scenarios developed to understand the potential demand for digital connectivity are based on population and visitor growth, and the subsequent increase in the expected number of devices that will be in use based on 'Low', 'Baseline' or 'High' demand scenarios.

		Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
2023 (E)	**Connected devices**	113,265	162,020	231,085
	Network capacity	⚪⚪🟢	🔴⚪⚪	🔴⚪⚪
2025 (P)	**Connected devices**	118,584	169,671	242,110
	Network capacity	⚪🟡⚪	🔴⚪⚪	🔴⚪⚪
2030 (P)	**Connected devices**	140,816	201,573	287,919
	Network capacity	🔴⚪⚪	🔴⚪⚪	🔴⚪⚪

(P) is for Projected Growth
(E) is for Estimated

Key insights:

- The current wireless infrastructure (five radio access sites) in Cedar Mill (Morisset) is insufficient to meet the connectivity demand driven by a surge of up to 30,000 visitors for an event.
- The wireless infrastructure is insufficient to meet the connectivity demand for baseline and high demand scenarios from the year 2023 onwards.
- If no additional infrastructure is deployed to Morisset to adequately meet visitor demand, both the visitor and local population experience is expected to worsen during peak demand periods.

Key for network capacity:

- ⚪⚪🟢 Existing network capacity meets the estimated demand
- ⚪🟡⚪ Network may experience congestion during peak demand
- 🔴⚪⚪ Existing network capacity does not support estimated demand

Infrastructure Requirements to meet Future Demand in Morisset: 30,000 visitors

The table below outlines five different infrastructure options to meet wireless connectivity demand to support an event with up to 30,000 visitors, including both permanent and temporary solutions with different cost profiles.

Technology Options	Description	Low Demand Scenario		Baseline Demand Scenario		High Demand Scenario	
		Qty	Indicative Cost*	Qty	Indicative Cost*	Qty	Indicative Cost*
Additional Radio Sites / Mobile Base Stations	Permanent stations (towers) installed by telecommunications providers to provide wireless coverage to the surrounding area.	1	$552,441 - $840,269	2	$736,588 - $1,120,359	5	$1,657,323 - $3,080,986
Cell on Whells (CoW)	Temporary infrastructures that provides mobile coverage and capacity, supporting an average of up to 350 devices simultaneously.	2	Acquisition: $1,000,000 Rental: $60,000	10	Acquisition: $5,000,000 Rental: $300,000	25	Acquisition: $12,500,000 Rental: $750,000
Cold Mobile Sites	Pre-located sites that contain all passive infrastructure components, and only activated during major events.	1	$286,164 - $754,999	2	$381,552 - $1,006,665	5	**$858,492 - $2,768,330**
Private 5G	A private wireless solution based on 5G, which allows only selected devices in a designated area to access the network. 'Qty' is based on the number of access points estimated to be required.	6	$974,000 - $985,000	34	$1,496,000 - $1,540,000	86	$1,600,000 – $1,644,000
Private Wi-Fi	This solution is ideal for closed/concentrated areas, and allows for greater control of usage and network capabilities. 'Qty' is based on the number of access points estimated to be required.	6	$34,000 - $45,000	34	$156,000 - $200,000	86	$260,000 - $304,000

* Capital Expenditure (CapEx) is the estimated cost of infrastructure (direct material costs). The CapEx estimate excludes costs such as construction, labour or other costs.
More details on the types of technology options for consideration are provided in Chapter 4: Recommendations and Considerations (page 113), and in Appendix 7 (page 149).

The Entrance
Central Coast

- Area demographics and peak visitor demand
- Telecommunications infrastructure review
- Future connectivity gap
- Telecommunications infrastructure scenarios

Area demographics and peak visitor demand: The Entrance

The Entrance currently offers adequate 4G and 5G coverage. Meeting the wireless connectivity demand to support events such as ChromeFest necessitates the implementation of temporary and/or permanent infrastructure solutions.

The Entrance is a coastal town located on the Central Coast region. It is renowned for its picturesque beaches, recreational activities, and vibrant local community. With its scenic waterfront, bustling esplanade, and array of dining and entertainment options, The Entrance attracts visitors year-round, making it a popular tourist destination.

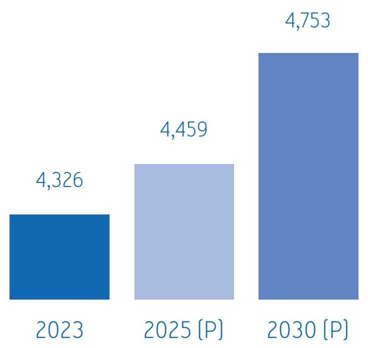
20,000

Peak attendees on the Saturday of the three-day event, ChromeFest.

ChromeFest is a large annual three-day car show held at The Entrance in October. The event showcases over 450 cars and includes live entertainment, market stalls, and multiple day and night concerts.

An estimated 50,000 people have attended ChromeFest in recent years, with the highest attendee day being the Saturday. Using the assumption that approximately 39 per cent of total attendees were present on the Saturday, the same percentage as *Newcastle 500* attendees on the Saturday of the event, the peak number of visitors has been estimated at 20,000.

The Entrance's population



0%

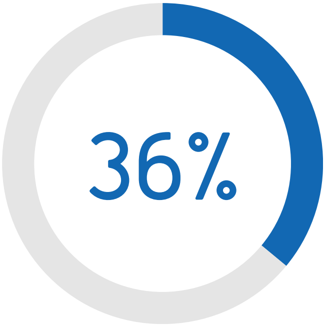
Rural

(P) is for Projected Growth

Destination Sydney Surrounds North

Telecommunications Infrastructure Review: The Entrance

The Entrance does not have any connectivity gaps for 3G and 4G, and full coverage in terms of 5G. Fibre access is provided via Fibre to the Premises and Fibre to the Building.



Digital Connectivity Index (On the Move)

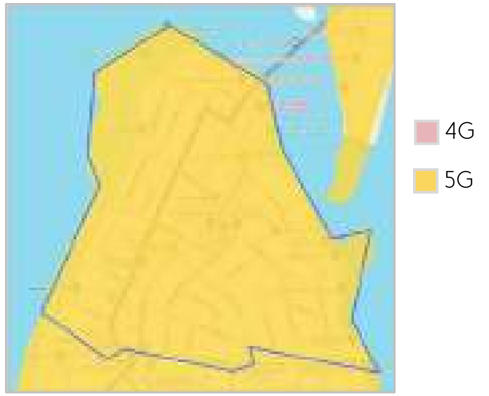
Access	80
Affordability	76
Demographics	26

Telstra		Optus		TPG	
3G	✓	3G	✓	3G	✓
4G	✓	4G	✓	4G	✓
5G	✓	5G	✓	5G	✓

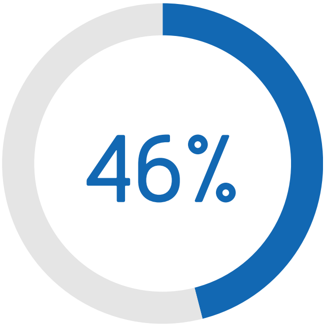
Key Insights:

- The suburb has a total of three mobile sites co-located, one for each operator.
- The Entrance is a densely populated suburb where 3G and 4G connectivity are available throughout the region,
- 5G coverage is available throughout the entire suburb without any coverage gaps.

Current Mobile Coverage



Map showing current mobile coverage in terms of 4G and 5G (Telstra, Optus, and TPG combined)



Digital Connectivity Index (Stationary)

Access	98
Affordability	77
Demographics	26

Fibre to the Premises	✓
Fibre to the Building	✓
Fibre to the Curb	✗
Fibre to the Node	✗
Fixed Wireless	✗
Satellite	✗

Key Insights:

- Access to NBN services is exclusively provided through fibre.
- The Entrance is a highly densely populated area, with the majority of dwellings having access to Fibre to the Premises.
- Commercial spaces and buildings with a higher number of floors have access via Fibre to the Building.

nbn™ Current nbn Services

Wireless Connectivity Gaps: The Entrance

To provide insight into the range of demand conditions and how they may impact demand for network capacity, three scenarios have been developed. The existing infrastructure will not be able to meet wireless connectivity needs for The Entrance during a peak demand of 20,000 visitors for the Chromefest event in any of the demand scenarios.

Current Number of Radio Access Sites: 3

4G co-located with 5G: 3 | **Urban Sites:** 0 | **Rural Sites:** 0

The three scenarios developed to understand the potential demand for digital connectivity are based on population and visitor growth, and the subsequent increase in the expected number of devices that will be in use based on ‘Low’, ‘Baseline’ or ‘High’ demand scenarios.

		Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario
2023 (E)	**Connected devices**	85,286	121,980	173,967
	Network capacity	⚪🟡⚪	🔴⚪⚪	🔴⚪⚪
2025 (P)	**Connected devices**	90,806	129,919	185,408
	Network capacity	⚪🟡⚪	🔴⚪⚪	🔴⚪⚪
2030 (P)	**Connected devices**	113,875	163,021	232,941
	Network capacity	🔴⚪⚪	🔴⚪⚪	🔴⚪⚪

(P) is for Projected Growth
(E) is for Estimated

Key insights:

- The current wireless infrastructure in The Entrance (three radio access sites) is insufficient to meet the connectivity demand driven by a surge of up to 20,000 visitors for an event.
- The current infrastructure will not be able to meet the demand in the low, baseline or high scenarios.
- If no additional infrastructure is provided to The Entrance to adequately meet visitor demand, both visitor and local population experience is expected to worsen during peak demand periods.

Key for network capacity:

- ⚪⚪🟢 Existing network capacity meets the estimated demand
- ⚪🟡⚪ Network may experience congestion during peak demand
- 🔴⚪⚪ Existing network capacity does not support estimated demand

Infrastructure Requirements to meet Future Demand in The Entrance

The table below outlines four different infrastructure options to meet wireless connectivity demand to support an event with up to 20,000 visitors, including both permanent and temporary solutions with different cost profiles.

Technology Options	Description	Low Demand Scenario		Baseline Demand Scenario		High Demand Scenario	
		Qty	Indicative Cost*	Qty	Indicative Cost*	Qty	Indicative Cost*
Additional Radio Sites / Mobile Base Stations	Permanent stations (towers) installed by telecommunications providers to provide wireless coverage to the surrounding area.	1	$552,441 - $840,269	3	$1,289,029 - $1,960,628	5	$1,657,323 - $3,080,986
Cell on Whells (CoW)	Temporary infrastructures that provides mobile coverage and capacity, supporting an average of up to 350 devices simultaneously.	4	**Acquisition:** $2,000,000 **Rental:** $120,000	13	**Acquisition:** $6,500,000 **Rental:** $390,000	25	**Acquisition:** $12,500,000 **Rental:** $750,000
Cold Mobile Sites	Pre-located sites that contain all passive infrastructure components, and only activated during major events.	1	$286,164 - $754,999	3	$667,716 – $1,761,664	5	$858,492 - $2,768,330
Private 5G	A private wireless solution based on 5G, which allows only selected devices in a designated area to access the network. 'Qty' is based on the number of access points estimated to be required.	14	$990,000 - $1,001,000	43	$1,514,000 - $1,558,000	85	$1,598,000 - $1,642,000

* Capital Expenditure (CapEx) is the estimated cost of infrastructure (direct material costs). The CapEx estimate excludes costs such as construction, labour or other costs.
More details on the types of technology options for consideration are provided in Chapter 4: Recommendations and Considerations (page 113), and in Appendix 7 (page 149).

04 | Recommendations and Delivery Considerations

Recommendations and Delivery Considerations

- Education and awareness
- Public-Private partnerships for investment into a mix of technology solutions
- Shared infrastructure in adjacent industries, including energy and transport
- Additional technologies for consideration

Education and Awareness

There is a need to improve the awareness of the DSSN region population on their connectivity options that are currently available, particularly for businesses. For example, based on nbn estimates, the vast majority of businesses nationally are connected to a residential service plan instead of a business plan which may better suit their internet connectivity needs.

Many businesses are not aware of the connectivity options that are available in market or which service plans are best suited to their needs.

- According to nbn, many businesses connected to the national broadband network are on a slower service than residents, and are more often than not using a residential service rather than a business one.
- The vast majority of businesses connected to nbn are on a residential service plan, and approximately half of connected businesses only have a 50Mbps connection, which is probably insufficient for many businesses.
- nbn's Fibre Upgrade Program aims to enable up to 10 million premises, or up to 90 per cent of homes and businesses across the country, to FTTP connections by the end of 2025. Homes and businesses identified across Australia, with many suburbs in NSW being located in the DSSN region, are currently serviced by nbn on FTTN and FTTC connections, and are eligible to upgrade to FTTP with 'near-gigabit speeds' and more reliable connections.
- Many households and businesses are likely on sub-optimal service plans or are not aware they are eligible to be upgraded to higher speeds. To increase awareness and uptake of the services currently available in the market, particularly for those in regional areas, further education and awareness campaigns directed at industry is required, including those within tourist hot spots who experience challenges during periods of peak demand.

Businesses and residents can enquire directly about upgrading to a high-speed service plan.

- Businesses can request an assessment to identify the right plan for their needs and eligibility, and to recommend the right plan and schedule an installation for a business-grade connectivity service. Fibre upgrades are provided at an on-request basis. It is available only within the nbn Fixed Line network footprint and at limited premises served by the nbn Fixed Wireless and Satellite networks. Residents and businesses can take action themselves to determine their current connectivity status and eligibility for a fibre upgrade by searching their address and available options on the nbn website.
- nbn's Enterprise Ethernet fibre access product is designed to provide high bandwidth as required by industry. The product is also available via data centres, which enables businesses to utilise 'hybrid' IT infrastructure models for their internal IT operations, including data storage and other cloud applications.
- It is important to note that not all premises will be eligible for upgrades at no or low cost by nbn. There is healthy competition within the telco market to provide alternative coverage options by major providers as well as smaller retail service providers.

Public-Private partnerships for investment into a mix of technology solutions

Co-investment into permanent and temporary solutions to address peak connectivity challenges will enable the region to meet the growing demand from population growth and tourist attractions.

Public-Private partnerships to improve permanent digital infrastructure.

- **Public-private shared investment into telecommunications infrastructure** such as the installation of new towers or upgrades to existing infrastructure is already being rolled out through Federal Government initiatives, nbn and the private sector to a large degree. Further investment of public funds to improve connectivity could also help to improve the attractiveness of the region to major and minor telecommunications service providers. Increased coverage by telecommunications providers means both the public and private sector benefit.
- **Private 5G enabled networks for major precincts:** Existing large infrastructure and long-term project sites such as stadiums, concert venues and mines can consider Private 5G enabled networks to address peak demand. This solution is particularly effective for large venues and an opportunity for public and private sectors to co-invest for improved community and visitor experiences during large events such a stadium concerts. This solution is suitable for a wide range of venues and projects, and can be utilised to develop 'smart' cities and sites.

Government and industry can utilise cost-effective solutions to meet temporary peaks in demand.

- To meet peak demand from surges in visitor numbers during events, public and private entities can invest in solutions such as Cell on Wheels (CoWs) and Cold Mobile Sites. Both of these solutions can be utilised as needed, and are a suitable option to manage surges in connectivity demand.
- **Cold Mobile Sites** require an initial capital investment for the infrastructure installation but requires minimal operational costs incurred at the time of use. These sites are dormant (or 'cold') unless needed to meet demand in the case of large events or other incidents such as emergency situations.
- **CoWs** can be transported between sites and utilised to provide coverage for major events and emergency services alike. CoWs can be purchased or rented from major telecommunications providers, and utilised by a single owner or shared for coverage of a wider area and events.
- Fixed Wireless as provided by nbn is another option to fulfil connectivity demand where fibre is not available, such as in regional areas. nbn has deployed Fixed Wireless throughout Australia and is currently rolling out upgrades that will double the range coverage of each tower and greatly increase capacity during peaks.

Smart cities integrate technology and 5G enabled networks to create a more efficient and connected city. Connected solutions can include smart parking and payment processing, early warning systems, intelligent and autonomous transportation systems, smart infrastructure (lighting, CTV, public WiFi, communication), smart public facilities for healthcare, and more.

Detailed information on Private 5G enabled networks and other technology options can be found in Appendix 7 (page 149).

Shared infrastructure in adjacent industries

Integrating telecommunications infrastructure with energy and transport projects is a strategic and efficient way to expand digital connectivity, especially in underserved and rural areas.

Building energy and transport projects such as power stations and transmission lines presents an opportunity to simultaneously lay telecommunications infrastructure, such as fibre optic cables, to enhance digital connectivity in the area. Benefits of this shared infrastructure include:

Shared infrastructure and trenching costs

When constructing power lines or power stations, trenches or conduits are often required. Sharing these with telecommunications infrastructure reduces the overall cost of laying fibre optic cables, and is particularly cost-effective in rural areas where the cost of trenching can be higher due to remote or difficult terrain. This also enables a more efficient use of resources for construction and labour, and enables delivery of major adjacent sector projects in parallel.

Reduced environmental impact

By consolidating construction efforts, the cumulative environmental footprint can be reduced. This is particularly relevant for areas in the DSSN region which are currently in the midst of stakeholder engagement with local communities and Indigenous landowners, regarding major energy infrastructure and transmission lines planned for construction, such as the Hunter Transmission Project and Renewable Energy Zones.

Strategic placement of infrastructure

Power lines, roads and railways often follow strategic routes that connect key urban and rural areas. By laying fibre optic cables along these routes, telecommunications providers can expand network coverage and improve connectivity in underserved locations. Blackspots can also be addressed by utilising energy and transport infrastructure, directly addressing low or no connectivity zones located along railway lines (such as the Central Coast railway line) for example.

Opportunity to meet broader policy goals

The inclusion of telecommunications infrastructure in utility and transport projects to meet broader policy goals related to digital inclusion strengthens the business case for investment and enables key connectivity milestones to become more feasible to meet.

Infrastructure sharing is encouraged for major network providers to consider when applying for Commonwealth funding to deliver new or upgraded telecommunications infrastructure.

In December 2023 the Federal Government announced Round 2 of the Peri-Urban Mobile Program (PUMP) to be open for applications, closing in March 2024. Round 2 will provide network providers grant funding to upgrade existing or deliver new wireless coverage for communities on the fringes of major urban centres in bushfire prone areas.

This is particularly targeted to areas that have longstanding coverage issues and are at risk of natural disasters, requiring improved connectivity and particularly in the case of emergency situations. Areas in the Hunter and Central Coast are eligible, such as those surrounding Newcastle.

The Minister for Communications, the Hon Michelle Rowland MP, is encouraging collaboration and partnership to take advantage of shared infrastructure opportunities to benefit regional communities:

"I encourage telcos, communities and other interested parties to work together to submit applications that will deliver new or improved mobile coverage in these areas".

The energy transition in the DSSN region

The region is undergoing a major transition towards clean energy, creating additional opportunity to simultaneously improve telecommunications infrastructure.

The transition away from coal-fired power stations towards a renewables powered state.

- The Hunter and Central Coast region has a long history of coal mining and heavy industry such as manufacturing, transport and power generation. As power stations reaching the end of their technical lives plan for closure, the region's power industry is now moving towards a significant transition, with the NSW Government's target of supplying 82 per cent renewables to the National Electricity Market (NEM) by 2030.
- The NSW Electricity Strategy outlines how current challenges with ageing infrastructure and congestion will be addressed to deliver a new, affordable and reliable energy system. Specifically, the NSW Electricity Infrastructure Roadmap which will support the private sector to deliver at least 12 gigawatts of new renewable electricity generation and 2 gigawatts of long-duration storage.
- This has led to the development of the Hunter Region Central Coast Renewable Energy Zone (HCC REZ) and the planned upgrade of transmission lines. Initial scoping through EOI, identified over 2 gigawatts of generation from onshore wind and solar generation projects located in the Upper Hunter Region near Muswellbrook.

Emerging technologies and new industry such as hydrogen and offshore wind.

- The Port of Newcastle is planning a Clean Energy Precinct to begin construction in 2025, which will provide common user, open access, shared infrastructure across clean energy storage, transport and export facilities.
- There has been significant federal investment in the development of the Hunter Region's hydrogen economy, with $82M already allocated across the Port of Newcastle and Origin Energy hydrogen hubs, and an announcement in 2023 of a further $70M for the Origin & Orica project. Large-scale hydrogen production facilities expect to produce between 150MW to 2GW of power and would require access to significant renewable energy.
- With the recent declaration that the Hunter Region has a suitable location for offshore wind development, the planning for offshore wind is now progressing and it will play an important role in diversifying the renewable energy portfolio in the Hunter Region and the broader National Electricity Market (NEM).

Plans to upgrade existing and building new energy infrastructure to power the region.

- There is significant work ongoing to transform the grid to overcome congestion. By 2030, major initiatives such as the Hunter Region Transmission Project and Clean Energy Precinct will be operating.
- Through the federal Rewiring the Nation program, 8 critical transmission and Renewable Energy Zones (REZ) projects will be delivered in NSW. The Hunter Region-Central Coast (HCC) REZ is in the planning stage, scheduled for completed by 2030, and will likely comprise of solar, wind (on and off-shore), pumped hydro and large-scale batteries.
- The Hunter Region Transmission Project aims to deliver up to 8 GW of additional transfer capacity from other inland REZs to the HCC REZ. This may include the Waratah Super Battery, which is planned to secure a reliable energy supply following the closure of the Eraring power station in 2025.
- The NSW government has set a target of 50 per cent renewable energy by 2030. The REZs are expected to provide about 20 per cent of this target. The remaining 30 per cent will come from other renewable energy projects, such as solar farms, wind farms, and pumped hydro.

Transport infrastructure to connect the region

The DSSN region has an established transport network, with plans to further improve the road and rail transport infrastructure. This presents an opportunity for telecommunications infrastructure deployments that can leverage transport infrastructure works, to add new digital connectivity capacity along road and railway lines.

State and Federal Government investment into connecting our regions.

- Established transport network: The region's transportation network, including road, rail and maritime systems, are well equipped as supporting infrastructure for the local supply chain. The NSW Government has also included plans for significant investment into road and rail upgrades as part of the Future Transport Strategy to connect the 'Six Cities Region' of NSW, which includes Newcastle.
- NSW State Infrastructure Strategy 2022-2042: The strategy includes the following recommendations related to improved transport infrastructure to better connect the region:
    - Recommendation 4: Progressively fund and deliver the Fast Rail Strategy based on a prioritised and staged program of network enhancements.
    - Recommendation 6: Plan and deliver projects to increase the efficiency and reliability of freight networks in regional NSW.

Major planned transport infrastructure projects present an opportunity for digital connectivity.

- Newcastle Airport Upgrade: $250M has been committed to upgrading the regional airport into an international gateway, introducing new airlines and routes with the aim of significantly increasing visitor numbers. Located in Williamtown, Port Stephens, the Newcastle Airport is also nearby to the Williamtown RAF base. The airport has a private enabled 5G network already in place.
- Singleton Bypass – New England Highway: The Australian Government and New South Wales Government are investing a total of $700M into building the Singleton Bypass, as part of the New England Highway, which links the Upper Hunter to Maitland and Newcastle. The project is expected to improve traffic flow by removing 15,000 vehicles from the town centre each day. Early work began in 2022 and the bypass is expected to open to traffic in late 2026.
- M1 Pacific Motorway extension to Raymond Terrace: $2.1B has been dedicated to extending the M1 Pacific Motorway by 15km to the Pacific Highway at Raymond Terrace. This extension is expected to reduce travel times during peak periods by nine minutes and will open to traffic in 2028.
- Lower Hunter Freight Corridor: The freight rail line will span from Fassifern on the Main North Railway line to Hexham on the Hunter Valley Rail Line. It will bypass the Newcastle urban area, alleviating congestion on the rail network. The project has the potential to generate $440M in economic benefits and may be completed within 10-20 years.

Planned energy and transport projects and potential shared sites for telecommunications deployments

Renewable energy projects
Transport projects

Hunter Region Coast Transmission Project

Transmission lines between Bayswater and Eraring power stations to add capacity for electricity transmission across the Hunter Region. The project is approved, with stakeholder consultation beginning in 2023 and scheduled for operation by 2027.

Bayswater & Liddell Power Stations

AGL is closing the Bayswater and Liddell Power Stations in Muswellbrook, with plans to replace these with a Clean Energy Precinct.

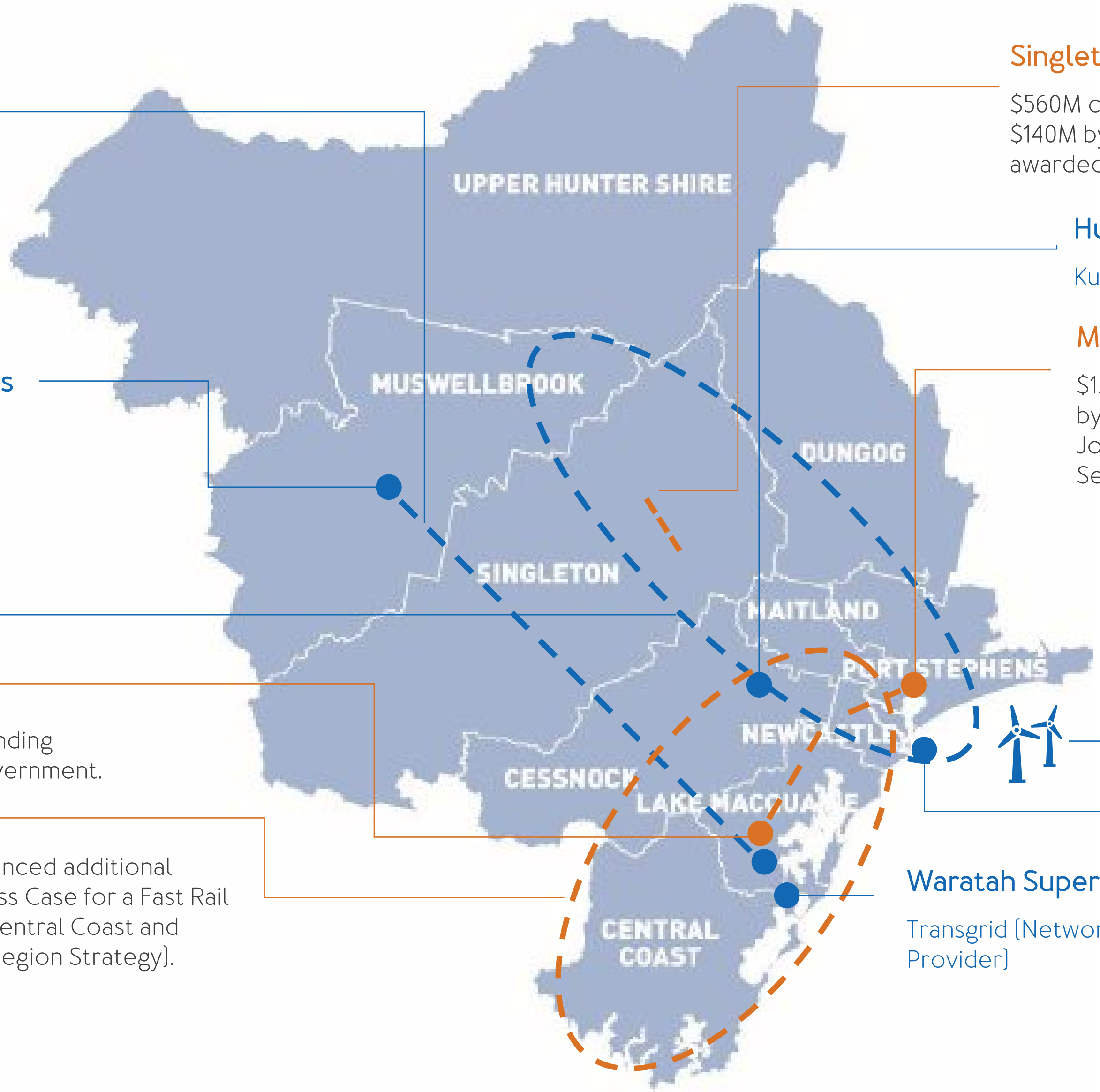
Hunter Region-Central Coast Renewable Energy Zone (REZ)

Lower Hunter Freight Corridor

In the feasibility stage, with no further funding commitments from State or Federal Government.

Fast Rail

Federal Government has recently announced additional funding for the development of a Business Case for a Fast Rail line connecting Greater Sydney to the Central Coast and Hunter regions (as part of the Six Cities Region Strategy).



Singleton Bypass

$560M committed by Federal Government and $140M by State Government. Major contract awarded to Acciona Construction Australia Pty Ltd.

Hunter Region Power Project

Kurri Kurri Snowy Hydro Hub

M1 Pacific Motorway extension

$1.68B committed by the Federal Government and $420M by the State Government. Major contracts awarded to John Holland Gamuda Australia Joint Venture and Seymour Whyte Constructions.

Offshore Wind Farm

Zone declared in 2023, applications for feasibility studies are currently underway. Floating wind turbines will generate 1.725 GW of energy that will be transmitted to onshore substations and transmission lines in Newcastle and Port Stephens.

Clean Energy Precinct

Port of Newcastle

Waratah Super Battery

Transgrid (Network Operator), Akaysha Energy (SIPS Service Provider)

Timeline for planned energy and transport development across the DSSN region

The next six years will see a high number of infrastructure projects rolled out across the region, many of which will also increase the region's workforce and grow visitor numbers, driving an uptake in devices and digital connectivity demand.

- Renewable energy projects
- Transport projects

2023

Lower Hunter Freight Corridor is confirmed and is currently in the feasibility stage

Energy Co began community engagement on the **Hunter Region Transmission Project** in late 2023

Energy Co's **Waratah Super Battery** at Lake Macquarie began construction in 2023

2024

Major work for the **Singleton Bypass** starts in 2024

Hunter Region Hydrogen Hub (Orica & Origin Energy) is currently in the feasibility stage, with final investment decision to be made in 2024

The **Hunter Region Power Project** (Kurri Kurri) is approved and scheduled to be operational in 2024

2025

Bowman's Creek Windfarm (east of Muswellbrook) is approved and due to be completed in 2025

Waratah Super Battery project is approved and due to be completed in 2025

Construction on the **Clean Energy Precinct** is scheduled to begin. This project is currently in the feasibility stage.

2026

Singleton Bypass will be operational in late 2026

2027

Central-West Orana REZ completed by 2027

The **Hunter Region Transmission Project** must be operating by 2027

2028

The **Clean Energy Precinct** is fully operational

M1 Pacific Motorway extension to Raymond Terrace will be operational in 2028

2029

New England REZ completed by 2029

2030

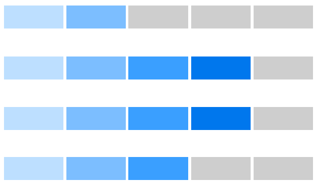
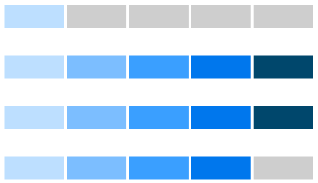
Offshore Windfarm

Construction underway

Hunter Region-Central Coast REZ and **Illawara REZ** completed by 2030

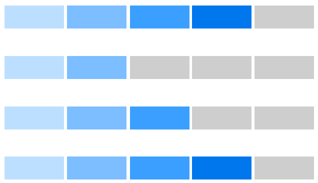
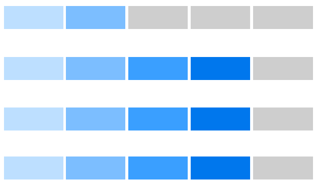
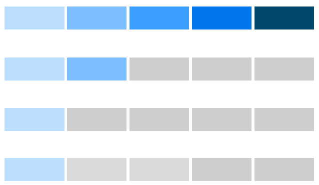
Additional technologies for consideration

There are a range of technology solutions that can be deployed to meet connectivity demand. A mix of permanent and temporary infrastructure can provide cost-effective solutions, tailored to different areas and requirements.

	Fixed Wireless Access (FWA)	Low-Earth-Orbit (LEO) Satellites	Cell on Wheels (CoW)
Effectiveness and suitability of the solution	Deployment Capabilities Investment Scalability 	Deployment Capabilities Investment Scalability 	Deployment Capabilities Investment Scalability 
Deployment	Relative accelerated set-up considering the existence of collocated infrastructure with carriers and by accessing to their competitive position in the market (current portfolio, and overall brand awareness)	Solution with a high complexity in terms of deployment. To integrate a solution based on LEO satellites, it is necessary to consider the coordination of multiple satellites in low orbit and the respective configurations.	Solution that presents the lowest complexity in terms of deployment, due to the simple and rapid installation, and its ability to be easily adapted to different types of access technology.
Capabilities	Offers moderate capabilities in terms of speed, reliability, and coverage. The nbn is improving speeds up to 250 Mbps and ensuring at least 50 Mbps during busy hours.	Provides high-speed internet access with low latency, making it suitable for a wide range of applications and users, available anywhere due to its extensive coverage.	Assurance of capacity and coverage in pre-selected areas, it can establish connections in emergency situations or sporadic events that require a high network capacity.
Investment	Considerable investment is required to build and maintain fixed wireless infrastructure, including towers, antennas, and backhaul links, however Australian government and nbn are investing in this technology ($750,000).	High investment required, due to the complexity of the solution and its specific maintenance, requiring significant resources for both initial implementation and ongoing operation.	Low investment, as it is a relatively inexpensive solution compared to others, and does not incur significant maintenance or partnership costs.
Scalability	Medium scalability, as the solution can be easily adopted, it consistently depends on the existence of infrastructure to ensure this access.	High scalability to serve a large number of users across vast geographical areas without significant infrastructure expansion.	Medium scalability, as despite being a highly mobile solution, it is dependent on the existing infrastructure for connection to the network core.

Additional technologies for consideration

There are a range of technology solutions that can be deployed to meet connectivity demand. A mix of permanent and temporary infrastructure can provide cost-effective solutions, tailored to different areas and requirements.

	Multi-Tenant WLAN	Private 5G Network	Private WiFi
Effectiveness and suitability of the solution	Deployment Capabilities Investment Scalability 	Deployment Capabilities Investment Scalability 	Deployment Capabilities Investment Scalability 
Deployment	Solution already widely existing in the region, it can be an alternative with medium effort deployment (through outdoor antennas) in areas that are currently covered by this technology.	A subscription fee will be needed, increasing the overall cost of the service when compared to Wi-Fi, however, private networks are less complex and do not require network cabling.	The deployment of multiple access points and wireless mesh networks extends coverage and improves signal strength in large or complex environments.
Capabilities	Offers robust capabilities in providing wireless connectivity to multiple tenants within shared spaces, with features such as security, scalability, and quality of service.	For longer ranges, providing coverage for a range of devices. Licensed spectrum leads to greater reliability and better performance, and a dramatic increase in ability to connect to IoT enabled devices. Cellular grade network security provides increased privacy and data security when compared to Wi-Fi.	For shorter ranges, such as home and business environments. Signal quality and reliability diminishes as more connections are on the network.
Investment	Technical and commercial investment quite balanced compared with other solutions, though being necessary to guarantee the contracted SLAs with the partners.	Low CAPEX, OPEX compared to operator networks. Higher cost relative to Wi-Fi due to infrastructure and licensing fees.	Low CAPEX., however, still requires infrastructure upgrades, OPEX engrained in IT support model. Wi-Fi is cheaper than 5G and LTE per square foot as there are no subscriptions involved in the service.
Scalability	High scalability, since there is access to partner's existing customers seeking for better capacity and additionally the new businesses that a strong brand as the partner's may bring.	High scalability, within a limited network area. Private 5G networks can be 'sliced' for multiple functions and catering to unique requirements.	Medium scalability, as despite being a highly mobile solution, it is dependent on the existing infrastructure for connection to the network core.

05 | Appendices

Appendix 1

Glossary of Terms

Referenced Sources

Glossary

TERM	DEFINITION
3G	The third generation in mobile technology standards prepared by the 3GPP global partnership.
3GPP	The 3rd Generation Partnership Project is an umbrella term for a consortium of mobile operators, vendors and international standards organisations that develop protocols and interfaces for mobile telecommunications, including 3G, 4G, and 5G standards.
4G	The fourth generation in mobile technology standards prepared by the 3GPP global partnership.
5G	The fifth generation in mobile technology standards prepared by the 3GPP global partnership.
Busy hour	Period of time during a day when network usage or traffic is at its highest level. It is a specific one-hour timeframe within a 24-hour day when the demand for network resources, such as bandwidth and connectivity, is most intensive.
Contention Ratio	Represents the relationship between the total available bandwidth and the bandwidth allocated to a specific group of users.
Co-location	A form of passive infrastructure sharing where a mobile network operator deploys its active equipment on the same passive infrastructure as another mobile network operator.
Digital Connectivity Index	A measure of the quality and effectiveness of digital connectivity in a selected area that indicates the capability of a location to support various digital activities such as remote work, online learning, or mobile internet usage.
Gbps	"Gigabits per second". Represents the number of gigabits (one billion bits) that can be transmitted or processed in one second.
Headroom Extra Capacity	Additional capacity deliberately built into a system or network beyond the anticipated peak demand or regular usage.
IoT	The Internet of Things (IoT) describes physical objects (or groups of such objects) with sensors, processing ability, software and other technologies that connect and exchange data with other devices and systems over the Internet or other communications networks.
Mbps	"Megabits per second". Represents the number of megabits (one million bits) that can be transmitted or processed in one second.

Glossary (cont.)

TERM	DEFINITION
Mobile network operator	A mobile network operator supplies mobile services to customers at the retail level. Examples include Telstra, Optus and TPG Telecom.
Non-IoT	Connections that are not associated with IoT. These connections are associated with a private connection of a user, such as a resident's mobile phone to an antenna or a personal computer at internet home.
Passive infrastructure	Assets and equipment which are not part of the active layer of a telecommunications network (the signal path), including but not limited to sites, buildings, shelters, towers, masts, poles, ducts, trenches, electric power supply/generators and air conditioning.
Passive sharing	Passive infrastructure sharing is where mobile network operators share non-electronic infrastructure, such as tower, land, power and other physical elements.
Spectrum	The radio spectrum is part of the electromagnetic spectrum with frequencies from 3 Hz to 3,000 GHz (3 THz). Active equipment uses radiofrequency spectrum to provide connectivity to mobile devices.
Throughput	Speed at which data is successfully transmitted or processed through a system or network.
Tower	A structure on which a radio base station equipment can be installed. It includes telecommunications towers that are part of the National Broadband Network, radio and television broadcasting towers and other suitable towers or similar structures that could be used to improve mobile telecommunications coverage or can be used in the supply of mobile telecommunications and other radiocommunications services, including rooftops or utility masts.

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Appendix 2: Inputs for demand modelling

Methodology and assumptions for calculating visitor numbers

Calculation of total number of devices in use

Methodology and assumptions for calculating visitor numbers

To obtain the peak number of visitors across the different LGAs and thereby estimate the number of devices associated with visitor demand, it was necessary to formulate a methodology, which is presented below.

Step-by-Step Methodology

1. Obtain the number of commercial rooms for overnight visitors. This number includes rooms in hotels, motels, apartments, villas, houses, and caravan parks.
   Source: DSSN Accommodation Audit

2. Calculation of the number of overnight visitors staying in commercial accommodation. It was considered 1.5 people per room.
   Source: DSSN Assumption

3. Calculation of the additional number of overnight visitors who visit the regions to be with friends and family. To obtain this value, it was assumed a percentage of 33% of these visitors compared to overnight visitors. In the case of Central Coast, the value was 66%.
   Source: NSW Regional Data

4. Obtain the number of day trip visitors. To obtain this number, a ratio of 59% for day trip visitors and 41% for overnight visitors was considered, in accordance with the Hunter Valley Destination Management Plan.
   Source: Hunter Valley Destination Management Plan

5. Definition of the number of visitors for the different scenarios:
   - **High Scenario:** 100% of max. accommodation (day visitors + overnight visitors)
   - **Baseline Scenario:** 75% of max. accommodation (day visitors + overnight visitors)
   - **Low Scenario:** 50% of max. accommodation (day visitors + overnight visitors)

DSSN Daily Peak Visitor Assumptions for the three Demand Scenarios

Region	Total Visitors (Low-50% of max. accommodation)	Total Visitors (Baseline-75% of max. accommodation)	Total Visitors (High-100% of max. accommodation)
Central Coast	6,631	9,947	13,263
Cessnock	6,216	9,324	12,432
Dungog	966	1,449	1,932
Lake Macquarie	3,041	4,562	6,082
Maitland	1,903	2,854	3,805
Muswellbrook	1,126	1,690	2,253
Newcastle	5,068	7,602	10,136
Port Stephens	7,097	10,645	14,194
Singleton	2,214	3,321	4,428
Upper Hunter	978	1,467	1,956
DSSN Region	**35,240**	**52,861**	**70,481**

Calculation for total number of devices in use in 2023 (IoT & Non-IoT)

The total number of devices for each region for Industrial/IoT devices & Individual/Non-IoT devices is 9.9 million (in 2023). This has been calculated using the assumption that 9.4 devices per capita will be in use, a figure aligned with Cisco's projection for Western Europe, in lieu of an existing per capita prediction for the Australian market.

Regions	Number of IoT Devices	Number of Non-IoT Individual Devices	Number of Non-IoT Visitor Devices	Total
Central Coast	1,831,941	1,448,001	41,278	3,321,220
Cessnock	345,356	272,976	38,320	656,652
Dungog	50,963	40,282	6,013	97,259
Lake Macquarie	1,136,283	898,140	18,932	2,053,355
Maitland	490,875	387,997	11,844	890,715
Muswellbrook	86,712	68,539	7,013	162,264
Newcastle	899,438	710,993	31,547	1,641,917
Port Stephens	401,848	317,628	44,175	763,651
Singleton	131,648	104,057	13,782	249,487
Upper Hunter	75,035	59,309	13,782	140,433
DSSN Region	5,450,099	4,307,863	218,991	9,976,952

Appendix 3: Approach to reviewing current telecommunications infrastructure

Technology Review Approach

To comprehend the impact of demand growth on network infrastructure, it is important to assess the current status of the deployment of various network access types. Specifically, an evaluation was conducted on the deployment status of mobile access, fibre, fixed wireless, and satellite, focusing on the three major telecommunications operators (Telstra, Optus, and TPG) and nbn.

Analysis of Current Network Mobile State

- To analyse the **current radio infrastructure**, data concerning the **radio sites operated by Telstra, Optus, and TPG** in the different regions was collected.
- Mapping these sites based on their geographic coordinates, a comprehensive assessment of **coverage was conducted** using **maps provided by the operators**.
- This evaluation included an **examination of 3G, 4G, and 5G technologies**. It's crucial to highlight that the operators are planning to **discontinue 3G** technology in 2024.

Existing Number of Mobile Sites for each DSSN Region:

Region	Telstra	Optus	TPG	Total
Central Coast	100	104	61	265
Newcastle	43	41	30	114
Lake Macquarie	40	39	32	111
Port Stephens	28	31	20	79
Cessnock	24	22	13	59
Maitland	22	18	10	50
Singleton	25	9	5	39
Muswellbrook	18	7	3	28
Upper Hunter	12	8	4	24
Dungog	10	3	0	13

Sources: ACCC Mobile Infrastructure Report | Telstra Coverage Maps | Optus Coverage Maps | TPG Coverage Maps

Analysis of nbn Types of Technology

In order to analyse the **current fixed/fibre network infrastructure** for each region, the deployment status of the **nbn network** was assessed.

The coverage maps for each region were examined in terms of **Fibre to the Premises** (FTTP), **Fibre to the Node** (FTTN), and **Fixed Wireless and Satellite**, as these are the most common types of access. The **types of connections** provided by the NBN are listed below:

Wired Connections

Fibre to the Premises (FTTP) - used in circumstances where a fibre optic line will be run from the nearest available fibre node, directly to population premises

Fibre to the Building (FTTB) - generally used when NBN connects an apartment block or similar types of buildings, running a fibre optic line to the fibre node in the building's communications room, and the using the exiting connection technology in the building.

Fibre to the Curb (FTTC) - used in circumstances where fibre is extended close to habitational premises, connecting to a small Distribution Point Unit (DPU), generally located inside a pit on the street.

Fibre to the Node (FTTN) - used where the existing copper phone and internet network from a nearby fibre node is used to make the final part of the connection to the NBN network

Wireless Connections

Fixed Wireless - typically used in circumstances where the distance between premises can be many kilometres.

Satellite - used in remote and residential areas that do not have access to the NBN network through wired/fibre connections or fixed wireless

Source: NBN National Map Datasets | NBN Australia

Appendix 4: Calculations for Connectivity Demand Scenarios

- Low Demand Scenario
- Baseline Demand Scenario
- High Demand Scenario

Low Demand Scenario

Low Demand Scenario

Assumptions

1 - Average Number of Devices per Capita:
- 6.58

Source: Cisco IBSG Group

2 - IoT vs Non-IoT Connections Ratio
- 56% vs 44%

Source: IoT Analytics

3 - Industrial Devices vs Individual Devices per inhabitant
- Industrial Devices: 3.68
- Individual/Visitor Devices: 2.90

4 - Total Population (2023)
- 1,038,081

5 - Total Industrial Devices (2023)
- 3,815,069 (1,038,081 * 3.68)

6 - Total Individual Devices (2023)
- 3,015,504 (1,038,081 * 2.90)

7 - Annual Growth of Industrial Devices
- 16% (Source: Ericsson)

8 - Annual Growth of Individual Devices
- Follow the annual growth of population (table on the right)

9 - Annual Growth of Visitor Demand
- 4.5% per year

10 - Total Visitor Devices
- Visitor Numbers (50% of max. accommodation) * 2.90

11 - Population Growth Rate:
- Population growth for the DSSN Regions based on the lower projection from the ABS for New South Wales.

Year	Population for New South Wales	Annual Growth
2022	8,166,525	-
2023	8,308,795	1.74%
2024	8,426,235	1.41%
2025	8,538,190	1.33%
2026	8,644,507	1.25%
2027	8,746,490	1.18%
2028	8,841,657	1.09%
2029	8,931,668	1.02%
2030	9,015,876	0.94%

Source: Population Projections - ABS

Regions	2023				2025				2030			
	Industrial Devices	Individual Devices	Visitor Devices	Total	Industrial Devices	Individual Devices	Visitor Devices	Total	Industrial Devices	Individual Devices	Visitor Devices	Total
Central Coast	1,282,359	1,013,601	19,262	2,315,222	1,725,542	1,041,585	21,035	2,788,162	3,624,227	1,099,859	26,213	4,750,299
Cessnock City	241,749	191,083	18,057	450,889	325,298	196,359	19,718	541,375	683,236	207,344	24,573	915,154
Dungog Shire	35,674	28,198	2,806	66,678	48,003	28,976	3,064	80,044	100,824	30,597	3,819	135,240
Lake Macquarie	795,398	628,698	8,834	1,432,930	1,070,288	646,056	9,647	1,725,990	2,247,970	682,200	12,022	2,942,192
Maitland	343,612	271,598	5,528	620,738	462,365	279,096	6,037	747,498	971,124	294,711	7,523	1,273,358
Muswellbrook	60,698	47,977	3,271	111,946	81,676	49,302	3,572	134,549	171,547	52,060	4,451	228,058
Newcastle City	629,606	497,653	14,722	1,141,981	847,198	511,392	16,077	1,374,668	1,779,406	540,003	20,035	2,339,444
Port Stephens	281,293	222,340	20,616	524,249	378,508	228,478	22,513	629,500	794,997	241,261	28,055	1,064,314
Singleton	92,154	72,840	6,431	171,425	124,002	74,851	7,023	205,876	260,446	79,039	8,752	348,237
Upper Hunter	52,525	41,517	2,841	96,882	70,677	42,663	3,102	116,443	148,447	45,050	3,866	197,362
DSSN Region	**3,815,069**	**3,015,504**	**102,368**	**6,932,941**	**5,133,557**	**3,098,758**	**111,788**	**8,344,104**	**10,782,224**	**3,272,124**	**139,309**	**14,193,657**

Baseline Demand Scenario

Baseline Demand Scenario

Assumptions

1 - Average Number of Devices per Capita:

- 9.4

Source: Cisco Annual Internet Report

2 - IoT vs Non-IoT Connections Ratio

- 56% vs 44%

Source: IoT Analytics

3 - Industrial Devices vs Individual Devices per inhabitant

- Industrial Devices: 5.25
- Individual/Visitor Devices: 4.15

4 - Total Population (2023)

- 1,038,081

5 - Total Industrial Devices (2023)

- 5,450.099 (1,038,081 * 5.25)

6 - Total Individual Devices (2023)

- 4,307,863 (1,038,081 * 4.15)

7 - Annual Growth of Industrial Devices

- 16% (Source: Ericsson)

8 - Annual Growth of Individual Devices

- Follow the annual growth of population (table on the right)

9 - Annual Growth of Visitor Demand

- 4.5% per year

10 - Total Visitor Devices

- Visitor Numbers (75% of max. accommodation) *

4.15

11 - Population Growth Rate:

- Population growth for the DSSN Regions based on the lower projection from the ABS for New South Wales.

Year	Population for New South Wales	Annual Growth
2022	8,166,525	-
2023	8,323,889	1.93%
2024	8,453,902	1.56%
2025	8,580,341	1.50%
2026	8,702,446	1.42%
2027	8,820,393	1.36%
2028	8,933,348	1.28%
2029	9,041,818	1.21%
2030	9,145,140	1.14%

Source: Population Projections - ABS

Regions	2023				2025				2030			
	Industrial Devices	Individual Devices	Visitor Devices	Total	Industrial Devices	Individual Devices	Visitor Devices	Total	Industrial Devices	Individual Devices	Visitor Devices	Total
Central Coast	1,831,941	1,448,001	41,278	3,321,220	2,465,060	1,492,613	45,077	4,002,749	5,177,467	1,590,864	56,443	6,824,775
Cessnock City	345,356	272,976	38,320	656,652	464,711	281,386	41,846	787,943	976,052	299,908	52,398	1,328,358
Dungog Shire	50,963	40,282	6,013	97,259	68,576	41,523	6,566	116,666	144,034	44,257	8,222	196,513
Lake Macquarie	1,136,283	898,140	18,932	2,053,355	1,528,983	925,811	20,674	2,475,467	3,211,386	986,752	25,887	4,224,025
Maitland	490,875	387,997	11,844	890,715	660,521	399,951	12,934	1,073,406	1,387,320	426,277	16,195	1,829,793
Muswellbrook	86,712	68,539	7,013	162,264	116,679	70,650	7,659	194,988	245,066	75,301	9,590	329,957
Newcastle City	899,438	710,933	31,547	1,641,917	1,210,283	732,836	34,450	1,977,569	2,542,008	781,075	43,137	3,366,220
Port Stephens	401,848	317,628	44,175	763,651	540,726	327,414	48,240	916,381	1,135,710	348,966	60,404	1,545,080
Singleton	131,648	104,057	13,782	249,487	177,145	107,263	15,050	299,458	372,066	114,324	18,845	505,234
Upper Hunter	75,035	59,309	6,088	140,433	100,968	61,137	6,648	168,752	212,066	65,161	8,324	285,552
DSSN Region	**5,450,099**	**4,307,863**	**218,991**	**9,976,952**	**7,333,653**	**4,440,584**	**239,143**	**12,013,381**	**15,403,177**	**4,732,885**	**299,445**	**20,435,506**

High Demand Scenario

High Demand Scenario

Assumptions

1 - Average Number of Devices per Capita:

- 13.4

Source: Cisco Annual Internet Report

2 - IoT vs Non-IoT Connections Ratio

- 56% vs 44%

Source: IoT Analytics

3 - Industrial Devices vs Individual Devices per inhabitant

- Industrial Devices: 7.48
- Individual/Visitor Devices: 5.92

4 - Total Population (2023)

- 1,038,081

5 - Total Industrial Devices (2023)

- 7,769,290 (1,038,081 * 7.48)

6 - Total Individual Devices (2023)

- 6,140,996 (1,038,081 * 5.92)

7 - Annual Growth of Industrial Devices

- 16% (Source: Ericsson)

8 - Annual Growth of Individual Devices

- Follow the annual growth of population (table on the right)

9 - Annual Growth of Visitor Demand

- 4.5% per year

10 - Total Visitor Devices

- Visitor Numbers (100% of max. accommodation) * 5.92

11 - Population Growth Rate:

- Population growth for the DSSN Regions based on the lower projection from the ABS for New South Wales.

Year	Population for New South Wales	Annual Growth
2022	8,166,525	-
2023	8,341,073	2.14%
2024	8,491,447	1.80%
2025	8,638,413	1.73%
2026	8,781,199	1.65%
2027	8,920,424	1.59%
2028	9,055,666	1.52%
2029	9,186,911	1.45%
2030	9,313,449	1.38%

Source: Population Projections - ABS

Regions	2023				2025				2030			
	Industrial Devices	Individual Devices	Visitor Devices	Total	Industrial Devices	Individual Devices	Visitor Devices	Total	Industrial Devices	Individual Devices	Visitor Devices	Total
Central Coast	2,611,490	2,064,172	78,460	4,754,122	3,514,021	2,137,755	85,680	5,737,456	7,380,645	2,304,807	106,773	9,792,225
Cessnock City	492,316	389,136	73,544	954,996	662,460	403,008	80,312	1,145,780	1,391,393	434,500	100,084	1,925,977
Dungog Shire	72,650	57,424	11,429	141,503	97,758	59,471	12,481	169,710	205,325	64,118	15,554	284,996
Lake Macquarie	1,619,808	1,280,327	35,979	2,936,115	2,179,614	1,325,968	39,290	3,544,872	4,577,933	1,429,584	48,963	6,056,480
Maitland	699,758	553,102	22,509	1,275,369	941,594	572,819	24,581	1,538,994	1,977,669	617,581	30,632	2,625,882
Muswellbrook	123,610	97,704	13,328	234,643	166,330	101,187	14,555	282,072	349,350	109,094	18,138	476,582
Newcastle City	1,282,177	1,013,457	59,962	2,355,596	1,725,297	1,049,585	65,480	2,840,362	3,623,714	1,131,603	81,600	4,836,917
Port Stephens	572,847	452,789	83,968	1,109,604	770,823	468,930	91,695	1,331,448	1,618,991	505,574	114,268	2,238,833
Singleton	187,668	148,337	26,195	362,200	252,527	153,625	28,605	434,756	530,392	165,629	35,648	731,669
Upper Hunter	106,965	84,547	11,571	203,084	143,933	87,561	12,636	244,130	302,308	94,404	15,747	412,458
DSSN Region	**7,769,290**	**6,140,996**	**416,946**	**14,327,231**	**10,454,356**	**6,359,908**	**455,315**	**17,269,580**	**21,957,720**	**6,856,893**	**567,406**	**29,382,019**

Appendix 5: Wireless infrastructure capacity modelling approach and assumptions

Modelling Approach Overview

The below steps have been undertaken in the wireless modelling to determine new telecommunications infrastructure requirements and the associated cost estimates.

1

Assess existing radio mobile site profiles

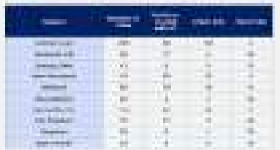
- Analysis of emission frequencies for the various radio technologies used by the three major Australian mobile operators.
- Define radio mobile site profiles and their technical characteristics.

Specifications	3G/4G co-located with 5G	Urban Site	Rural Site
Maximum throughput downlink per site (Mbps)	630	290	250
Maximum throughput uplink per site (Mbps)	120	60	55
Maximum Simultaneously Active Users per site	2300	1700	1400

2

Model the topology / profile of mobile sites per LGA

- Analysis of the current number of radio sites for the DSSN regions.
- Distribution of the number of sites across the different topologies/profiles defined according to the urban vs rural split by LGA.



3

Determine new equipment / infrastructure needed per LGA

- Execute the wireless model to understand the current state in terms of capacity requirements and new infrastructure that's needed to accommodate the new demand.
- Analysis of capacity in terms of transmission, reception, and simultaneous number of active devices across the different LGAs according to their existing mobile sites and the distribution of the number of devices across the three defined scenarios (Low, Medium, and High).

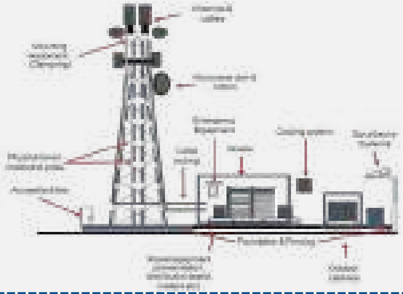
Projected Years	Required Mbps - Downlink as % of RAN Capacity	Required Mbps - Uplink as % of RAN Capacity	Required SAUs as % of RAN Capacity
2023	97.6%	98.6%	69.6%
2025	108.2%	109.2%	95.9%
2030	141.6%	142.9%	162.7%

Projected Years	Required Mbps - Downlink as % of RAN Capacity	Required Mbps - Uplink as % of RAN Capacity	Required SAUs as % of RAN Capacity
2023	97.6%	98.6%	79.8%
2025	96.2%	97.5%	76.2%
2030	90.8%	93.0%	98.5%

4

Cost estimation for the new equipment / infrastructure

- Obtain average costs related to the installation of new macro sites based on tower types and areas. Note that the average cost assumptions in Australia are based on the ACCC regional mobile enquiry report from July 2023.
- Define assumptions to estimate a cost range, area where the macro site will be built, and current mobile site co-location arrangement for the different radio sites.
- Calculate the wireless network costs for each of the three demand scenarios, in line with the number of new macro sites that will need to be added for each region.



Wireless - Mobile Site Profiles

Understanding the mobile site technologies, frequencies and characteristics across co-located, urban and rural sites is important to establish mobile site throughput assumptions.

Existing technologies & frequencies in use for radio access

- According to ACCC data for mobile sites for the three main operators, the existing 3G, 4G and 5G technologies and radio frequencies are currently in use.

Technology	Frequency [Mhz]	Operator		
		Telstra	OPTUS	TPG
3G	850	X		
	900		X	X
	2100	X	X	X
4G	700	X	X	X
	800			X
	900	X	X	
	1800	X	X	X
	2100	X	X	X
	2300		X	
	2600	X	X	
5G	700	X		X
	900		X	
	2100	X	X	X
	2300		X	
	2600	X		
	3500		X	
	3600	X		X
	26000	X	X	X

Lower frequencies ensure lower capacity but greater coverage.

Higher frequencies ensure greater capacity but lower coverage.

Sources: ACCC Mobile Infrastructure Report - Datasets of Mobile Sites for the three operators (2023)

Mobile sites profiles

- To estimate the current network capacity for different regions, three site profiles were considered:

  1) **4G co-located sites with 5G** - sites incorporating all technologies, providing high capacity.
  2) **Urban Sites** - 3G/4G standalone sites using high frequencies (e.g., LTE 1800, 2100, 2300, 2600).
  3) **Rural Sites** - 3G/4G standalone sites using lower frequencies (e.g., LTE 700, 800, 900).

- The definition of maximum transmission capabilities in terms of transmission, reception, and devices per mobile site depends on many factors, including channel bandwidth, modulation and coding scheme, number of MIMO streams, among others. The values in the table below are average values, considering a starting point of a 4G radio site with a 20MHz bandwidth, modulation at 64-QAM, and the use of multiple 2x2 antennas (MIMO). This type of calculation is theoretical and based on the 3GPP communication standards.

Specifications	4G co-located with 5G	Urban Site	Rural Site
Maximum transmission link capacity per site (Mbps)	510	290	250
Maximum reception link capacity per site (Mbps)	105	60	55
Maximum Simultaneously Active Users per site	1,800	1,400	1,200

Existing Mobile Sites per LGA

Understanding the existing mobile sites and technologies currently deployed in each LGA, across urban vs rural areas, is an important input assumption for the capacity modelling.

Existing mobile sites per LGA

Region	Number of Sites	3G Radio Access	4G Radio Access	5G Radio Access
Central Coast	265	234	263	98
Cessnock City	59	55	58	17
Dungog Shire	13	10	11	0
Lake Macquarie	111	98	108	68
Maitland	50	41	49	20
Muswellbrook	28	20	25	2
Newcastle City	114	107	114	66
Port Stephens	79	69	78	27
Singleton	39	33	35	8
Upper Hunter	24	20	22	4

Urban vs rural population split by LGA

Region	Urban Population	% Urban Population	Rural Population	% Rural Population
Central Coast	343,631	98.8%	4,236	1.2%
Cessnock City	0	0.0%	65,082	100.0%
Dungog Shire	0	0.0%	8,770	100.0%
Lake Macquarie	80,750	91.5%	7,466	8.5%
Maitland	57,646	64.0%	32,358	36.0%
Muswellbrook	0	0.0%	18,154	100.0%
Newcastle City	172,820	100.0%	0	0.0%
Port Stephens	14,376	17.4%	68,161	82.6%
Singleton	378	1.7%	22,527	98.3%
Upper Hunter	0	0.0%	24,463	100.0%

Mobile sites per LGA - topology

<u>Assumptions</u>

- Given that there are currently no standalone 5G sites at any of the LGAs, it is assumed that any site with 5G access is co-located with an existing 4G site.
- To determine the split of the remaining mobile sites between urban and rural, the ratio between the percentage of urban vs rural population was used as a proxy.

Region	Number of Sites	4G co-located with 5G	Urban Site	Rural Site
Central Coast	265	98	165	2
Cessnock City	59	17	0	42
Dungog Shire	13	0	0	13
Lake Macquarie	111	68	39	4
Maitland	50	20	19	11
Muswellbrook	28	2	0	26
Newcastle City	114	66	48	0
Port Stephens	79	27	9	43
Singleton	39	8	1	30
Upper Hunter	24	4	0	20

Wireless - Simulated Capacity Methodology

The below steps have been undertaken in the wireless modelling to identify areas where the existing network capacity does not support the estimated future demand.

Wireless Model Methodology

1 - Model Inputs

To estimate the current state capacity, previously estimated input assumptions feed into the wireless model. These inputs are:

- 1.1 - Total Number of Devices: Estimated total number of devices for the years 2023, 2025, and 2030, for three scenarios.
- 1.2 - Total Number of Sites: The existing number of mobile sites in the region categorised as 4G co-located with 5G, Urban Sites (4G with higher frequencies), and Rural Sites (4G with lower frequencies).
- 1.3 - Busy Hour Traffic associated with Mobile Access Technologies: Traffic associated with the mobile network during the busy hour.
- 1.4 - Split Urban vs Rural: The population ratio between urban and rural areas used to determine the type of traffic and the respective number of sites allocated to each region.

2 - As-Is State

After feeding the model with the inputs mentioned in step 1, it is possible to estimate the current state in terms of RAN (Radio Access Network) capacity across three different variables. In this analysis, it is assumed that the number of sites will remain the same until 2030.

- **Required Transmission Link Capacity as % of RAN Capacity:** This parameter aims to understand the network's capacity to handle data transmissions, information, and other network parameters between the radio site and user equipment.
- **Required Receive Link Capacity as % of RAN Capacity:** This parameter aims to understand the network's capacity to handle the reception of data, information, and other network parameters between user equipment and the base station.
- **Required Simultaneous Active Users/Devices (SAUs) as % of RAN Capacity:** This parameter allows the understanding of network's capacity to handle the number of simultaneous devices/users accessing during the busy hour.

For each of these parameters, the capacity based on the simulated demand is determined as a **percentage** and is represented as:

<90% - The existing capacity is sufficient to **support the estimated future demand** and **no deployment** of new mobile sites is necessary.

90%-100% - The existing capacity is sufficient **to support the estimated future demand, without the need to add new radio sites.** However, despite already considering a 20% extra headroom, the network may experience saturation in the case of peak demand or unexpected network congestion

>100% - The existing capacity **does not support the estimated future demand**, which may lead to **denial of mobile network** service. Installation of **new radio sites** is recommended.

3 - Future State

Through the analysis of the current state, the future state of the network is defined, providing the number of sites that need to be implemented \in 2025 and 2030 as necessary to address the simulated connectivity demand by increasing capacity.

Projected Years	Required Mbps - Downlink as % of RAN Capacity	Required Mbps - Uplink as % of RAN Capacity	Required SAUs as % of RAN Capacity
2023	97.6%	98.6%	69.6%
2025	108.2%	109.2%	95.9%
2030	141.6%	142.9%	162.7%

Illustrative Example

Appendix 6: Wireless Infrastructure costing approach

Components and cost estimation of new mobile sites
Cost estimation assumptions for new mobile sites
Estimated number of new mobile sites per LGA
Cost estimation of new mobile sites per LGA

Components and cost estimation of new mobile sites

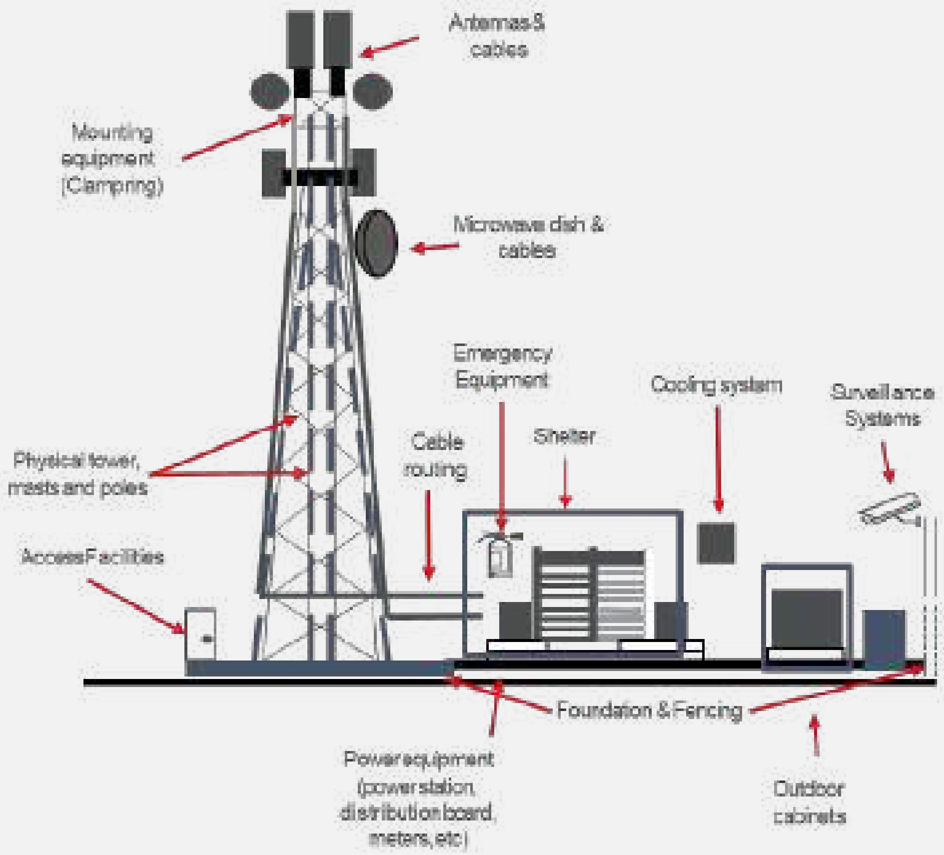
The diagram below illustrates the infrastructure for a radio mobile macro site.

Mobile Sites - Cost Estimation

- In order to project the costs associated with the necessary expansion to accommodate the future demand, it is necessary to understand the costs of each type of existing macro site. For this analysis, two types of macro sites were considered: Monopoles and Lattice Towers.
- These costs should not be regarded as precise figures, as they depend on site-specific features, such as height, structure type, distance from the power grid, access track, backhaul connection, and the fact that the site in question is co-located.
- For the cost estimation projection, the costs provided in the ACCC report 'Regional Mobile Infrastructure Inquiry' were used as input assupmtions.

Type of Infrastructure	Major Cities		Inner Regional Areas	
	Monopole Tower (25-50m)	Lattice Tower (30-60m)	Monopole Tower (25-50m)	Lattice Tower (30-60m)
Tower site selection and planning approvals	$69,885	$111,260	$369,563	$104,967
Tower site construction	$159,271	$287,866	$278,038	$318,456
Access to tower site (if an upgrade is required)	-	$120,387	-	$23,638
Connection to power	-	$235,486	$30,199	$113,795
Connection to backhaul	$57,008	-	$43,551	-
Associated infrastructure	$266,277	$85,270	$144,895	$65,113
Indicative total build cost	$552,441	$840,269	$866,246	$625,969

Cost of Radio Macro Sites | Source: ACCC Regional Mobile Infrastructure Inquiry - Sample of tower build costs



Composition of a Radio Mobile Macro Site

Cost estimation assumptions for new mobile sites

To conduct the study on the cost associated with mobile expansion, different assumptions have been defined and are explained below in terms of the type of mobile tower, location in urban or rural areas, and the existence of co-location among operators.

Cost Estimation of new Mobile Sites - Assumptions

Assumptions

To estimate the cost associated with each LGA, the following assumptions were made:

1. A radio site can be classified as either a monopole tower or lattice tower type. This decision depends on factors such as access type, area, space, aesthetic considerations, among others. Therefore, the following cost range was assumed for each radio site:
    - Cost range of a radio site in a Major City: $552,441 - $840,269
    - Cost range of a radio site in an Inner Regional Area: $625,969 - $866,246

2. To determine whether the cost of a site should be considered for a major city or inner regional areas, the urban vs rural split previously presented for each of the regions was taken into account.

3. Since the presence of currently co-located mobile radio sites, it is expected that new macro sites will also share infrastructure among the three operators. The table indicates a minimum co-location value of 44.5% for Telstra in 2023. Therefore, this projection assumes that 44.5% of additional sites will be co-located, requiring the construction of only one tower to accommodate the three different operator.

Operator	Co-located sites as percentage (%) of total sites
Telstra	44.5%
Optus	69.7%
TPG	88.7%

Source: ACCC Mobile Infrastructure Report 2023 - Co-Located Sites

Estimated number of new mobile sites per LGA

Below, the additional number of mobile sites for each region is presented for the different scenarios.

Cost Estimation of new Mobile Sites - Number of Additional Mobile Sites

- The table below shows the estimated number of additional radio sites for each region, divided according to the previously explained rationale of Major City Site vs Inner Regional Area Site. In parentheses, the number of co-located radio sites is displayed, indicating radio sites from the three different operators that will share the same tower. Therefore, to calculate the cost of these co-located radio sites, the cost associated with the type of site (Major City vs Inner Regional) is divided by 3 (same tower, with radio sites from all 3 operators).

Region	Urban vs Rural Split		Low Scenario			Baseline Scenario			High Scenario		
	Urban	Rural	Additional Radio Sites	Major City Site (Co-Located)	Inner Regional Area Site (Co-Located)	Additional Radio Sites	Major City Site (Co-Located)	Inner Regional Area Site (Co-Located)	Additional Radio Sites	Major City Site (Co-Located)	Inner Regional Area Site (Co-Located)
Central Coast	98.8%	1.2%	+ 0	0 (0)	0 (0)	+ 11	11 (5)	0 (0)	+ 99	98 (43)	1 (1)
Cessnock City	0.0%	100.0%	+ 0	0 (0)	0 (0)	+ 8	0 (0)	8 (4)	+ 29	0 (0)	29 (13)
Dungog Shire	0.0%	100.0%	+ 0	0 (0)	0 (0)	+ 2	0 (0)	2 (1)	+ 5	0 (0)	5 (2)
Lake Macquarie	91.5%	8.5%	+ 0	0 (0)	0 (0)	+ 39	36 (16)	3 (1)	+ 99	91 (40)	8 (4)
Maitland	64.0%	36.0%	+ 2	1 (1)	1 (0)	+ 19	12 (5)	7 (3)	+ 45	29 (13)	16 (7)
Muswellbrook	0.0%	100.0%	+ 0	0 (0)	0 (0)	+ 0	0 (0)	0 (0)	+ 2	0 (0)	2 (1)
Newcastle City	100.0%	0.0%	+ 0	0 (0)	0 (0)	+ 27	27 (12)	0 (0)	+ 82	82 (36)	0 (0)
Port Stephens	17.4%	82.6%	+ 0	0 (0)	0 (0)	+ 2	0 (0)	2 (1)	+ 31	5 (2)	26 (11)
Singleton	1.7%	98.3%	+ 0	0 (0)	0 (0)	+ 0	0 (0)	0 (0)	+ 3	0 (0)	3 (1)
Upper Hunter	0.0%	100.0%	+ 0	0 (0)	0 (0)	+ 0	0 (0)	0 (0)	+ 1	0 (0)	1 (0)

Cost estimation for new mobile sites per LGA

The following table presents the costs associated with the installation of radio mobile sites for the different LGAs according to the defined scenarios.

Cost Estimation of new Mobile Sites - Comparison of Total Costs per Scenario

Regions	Low Scenario	Baseline Scenario	High Scenario
Central Coast	$0	$4,235,381 - $6,442,062	$38,591,325 - $58,467,640
Cessnock	$0	$3,343,835 - $4,619,979	$12,748,370 - $17,613,669
Dungog	$0	$835,959 - $1,154,995	$2,298,886 - $3,176,235
Lake Macquarie	$0	$16,016,413 - $22,749,742	$32,794,470 - $57,401,140
Maitland	$907,059 - $1,050,393	$9,119,052 - $10,417,176	$18,656,511 - $24,191,118
Muswellbrook	$0	$0	$835,959 - $1,154,995
Newcastle	$0	$10,496,379 - $15,965,111	$25,412,286 - $48,735,602
Port Stephens	$0	$835,959 - $1,154,995	$14,784,408 - $17,827,248
Singleton	$0	$0	$1,462,928 - $2,021,241
Upper Hunter	$0	$0	$626,969 - $866,246
DSSN Region	$907,059 - $1,050,393	$46,797,194 - $60,589,844	$158,114,226 - $221,553,020

Appendix 7: Additional technologies and network providers

- Fixed Wireless Access
- Low Earth Orbit Satellites (LEO)
- Cell on Wheels (CoW)
- Multi-Tenant Wireless Local Area Network (WLAN)
- Private 5G
- Private Wi-Fi

Fixed Wireless Access

The absence of terrestrial connectivity, be it through fixed or mobile access, poses a significant hurdle in remote areas. This is where Fixed Wireless Access (FWA) technology comes into play—an evolving solution with the potential to offer internet access to any isolated zone, fostering communication and connectivity.

Fixed Wireless Access (FWA) - Definition

FWA technology employs ground-based wireless stations for internet connectivity in remote areas. These stations create a stable link to a nearby wireless base, delivering reliable, high-speed internet without the necessity of traditional wired infrastructure.

Main Advantages:

Remote Accessibility: FWA extends internet access to remote areas where traditional infrastructure is challenging.

Quick Deployment: FWA systems can be rapidly set up, making them efficient for major events, emergency situations or areas undergoing rapid development.

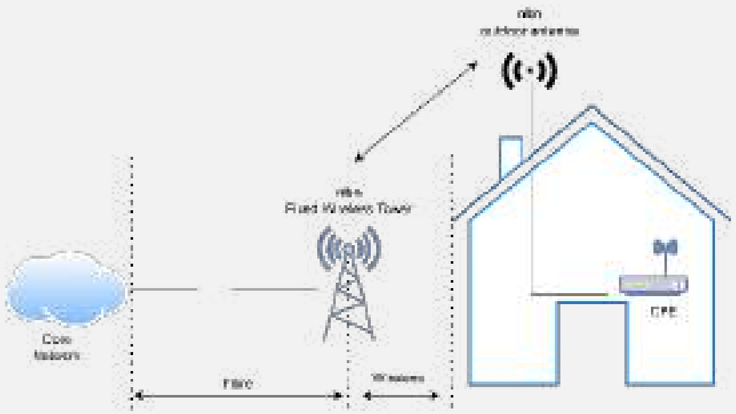
Scalability: FWA networks can be easily scaled to accommodate growing demand by adding more base stations or upgrading existing infrastructure, providing flexibility to expand coverage areas as needed.

Current Initiatives and Deployment in Australia

- The Australian government has invested a total of $480 million in the nbn Fixed Wireless Network, with nbn contributing an additional $270 million to deliver faster wholesale speeds for regional Australia. nbn Co will use the funding to enable 5G on its network of more than 2,200 Fixed Wireless infrastructure sites and more than 22,000 cells in semi-rural areas and across regional and remote Australia.

- Ericsson and nbn Co have established a ten-year partnership aimed at providing fixed wireless access to 120,000 homes currently only served by satellite, joining over 650,000 premises with FWA currently across Australia.

Fixed Wireless Access (FWA) - Architecture



- **Customer Premises Equipment (CPE):** This is the equipment installed at the user's location, such as a home or business. It includes a wireless transceiver or modem that communicates with the base station.
- **FWA Outdoor Antenna:** The outdoor antenna is located on a fixed infrastructure point, often a tower or tall structure. It communicates with the CPE and serves as the central hub for wireless connectivity in a specific coverage area.
- **FWA Wireless Tower:** A FWA (Fixed Wireless Access) Wireless Tower is a tall structure or infrastructure point designed to transmitting signals to and receiving signals from FWA Outdoor Antennas. These towers are strategically placed to optimise coverage and connectivity within a specific geographic area, providing wireless internet access to users within its range.
- **Core Network:** The core network handles the overall management of the FWA system. It includes components like routers, switches, and servers that route data between the FWA network and the broader internet.

LEO Satellites

The lack of terrestrial connectivity, whether through fixed or mobile access, is often a challenge in remote areas. This is where Low-Earth Orbit Satellites (LEO) technology comes into play - an emerging solution capable of providing internet access to any remote zone and facilitating communication.

Low Earth Orbit Satellites (LEO) - Definition

LEO satellites function by orbiting the Earth at high velocities, enabling them to complete an orbit in a relatively brief timeframe, usually ranging from 90 to 120 minutes. Their proximity to Earth facilitates accelerated communication and minimised signal latency.

Main Advantages:

- **Low Latency:** LEO satellites offer low-latency communication due to their proximity to Earth, important for applications requiring real-time data transmission
- **High Data Throughput:** The relatively short distance between LEO satellites and user equipment allows for higher data transfer rates enabling faster download and upload speeds.
- **Global Coverage:** LEO satellites can provide global coverage, reaching remote and underserved areas where traditional communication infrastructure is challenging to deploy.

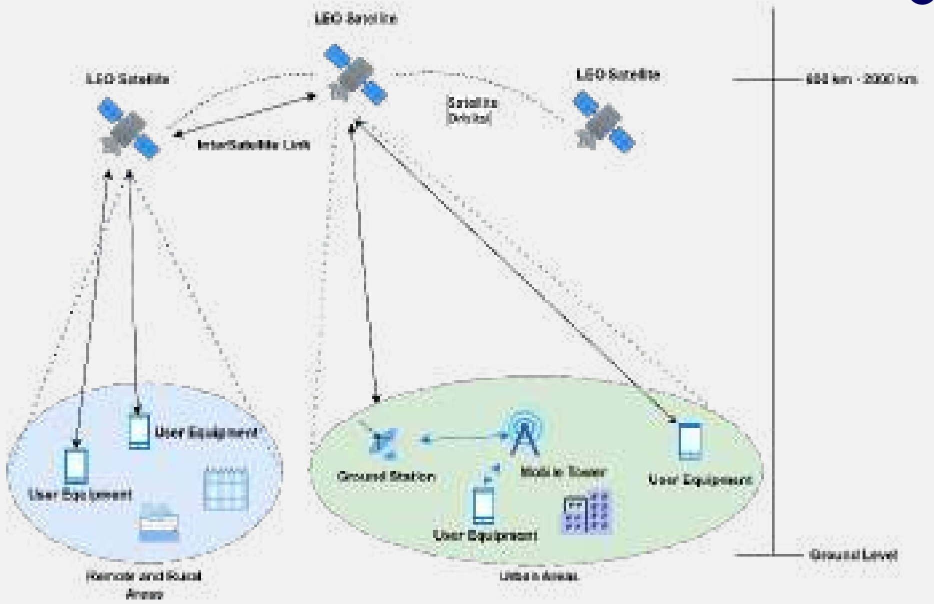
Current Initiatives and Deployment in Australia

Telstra and OneWeb have reached an agreement with the intention to transition hundreds of existing remote mobile base stations from satellite backhaul to OneWeb's LEO solution. The goal is to deliver up to 25 Gbit/s of LEO capacity, enhancing the mobile experience for Telstra's remote customers.

Optus, in collaboration with Lynk, conducted a live demonstration showcasing satellite direct-to-mobile technology. The demonstration involved connecting a standard mobile phone directly to Lynk's satellite mobile base station in orbit, enabling the sending and receiving of text messages via the Optus network

Starlink is currently available in Australia, providing connectivity in the most rural areas using this type of satellite technology. Future implementations are envisioned, such as the direct-to-cell technology, where a device communicates directly with the satellite.

Low Earth Orbit Satellites (LEO) - Architecture



- **User Equipment:** Industrial or individual devices or systems used by end-users to communicate with or access services provided by LEO satellites
- **Ground Station:** A terrestrial facility equipped with antennas and communication equipment that communicates with LEO satellites, serving as a point of contact between the satellites and the wider communication network.
- **LEO Satellite:** Satellites that orbit the Earth at altitudes typically ranging from around 600 to 2,000 kilometers, exhibiting short orbital periods and lower latency compared to satellites in higher orbits.

LEO Satellites example: Starlink

Starlink is providing additional options for broadband connectivity at increasingly accessible rates, with new capabilities on the roadmap in 2024 (SMS) and 2025 (voice and data).

What is Starlink?

- Starlink is a private satellite internet service aimed at delivering high-speed broadband to customers globally who lack access to a reliable internet connection through existing technologies. In Australia, where nbn (National Broadband Network) services utilise fixed wireless and satellite technologies, Starlink is positioned to compete in the satellite access market.
- According to data provided by Optus, a partnering operator with Starlink, Optus asserts a 98.5 per cent mobile coverage guarantee for the Australian population. However, due to Australia's extensive scale and topography, mobile networks can only cover one-third of the country's landmass. In this scenario, Starlink, with its Direct to Cell technology, becomes essential, ensuring complete coverage across the entire Australian territory.

Technical Characteristics

Download Speed
20-100 Mbps

Latency
25-50 milliseconds

Availability

SMS
Late 2024

Voice and Data
Late 2025

Coverage

- According to the coverage map provided by Starlink, this technology/service is currently available throughout Australia, including the most remote areas, as it is a satellite-based service.

Source: Starlink Coverage Map

Cell on Wheels

The Cell on Wheels (CoW) is a mobile tower that can be deployed and installed in emergency situations or at large events, providing additional coverage and capacity to maintain communications and allow users access to the network.

Cell on Wheels Characterization

General Description

Cell on Wheels (COWs) are mobile telecommunications towers designed to provide temporary network coverage and capacity in various situations, including emergency response, special events, and remote locations. Major mobile network operators and nbn deploy COWs to address different communication needs.

While operators primarily use COWs to ensure capacity and coverage during events, nbn's COWs are mainly utilized in emergency situations. They are equipped with an nbn™ Sky Muster™ satellite dish, allowing them to provide emergency workers and evacuated residents with valuable Wi-Fi connections..

Main Advantages

Enhanced Capacity: COWs can help alleviate network congestion by providing additional capacity, ensuring that users have access to reliable and high-speed connectivity, even in densely populated areas or during peak usage periods.

Rapid Deployment: COWs can be quickly transported and set up, allowing for rapid deployment in emergency situations or at temporary events where immediate coverage is required.

Flexibility: COWs can support various wireless technologies and frequency bands, providing flexibility to adapt to different network requirements and standards.

Technical Specifications: Antenna Height, Coverage Radius, Capacity, Connectivity*

Antenna Height: 20 meters

Maximum height of 20 meters for each antenna, making this solution more adaptable for flat terrain

Coverage Radius: 5km

Depending on the terrain's topography, a CoW solution can cover up to 5 km

Capacity: ~350 simultaneous users

General capacity to support 350 active users (1750 people) considering a 20% of access in busy hour up to a maximum time of 72 hours

Connectivity: Access and Backhaul

Access: Mobile Access and Satellite (SatCOLT)

Backhaul: Satellite

Approx. Cost:**

Regular CoW: ~ $500,000

Satellite CoW (SatCOLT): ~ $750,000

*Note 1: The technical specifications of COWs may vary depending on the type of access technology and the specific type of COW used by the provider.

**Note 2: The cost approximation is based on average prices from a North American emergency network provider.

Multi-Tenant WLAN

Implementing a multi-tenant WLAN (Wireless Local Area Network) consolidates multiple tenants or users onto a shared wireless infrastructure, enabling optimization and sharing of resources such as network bandwidth, hardware, and management overhead among multiple users or entities.

Multi-Tenant WLAN

General Description

- A multi-tenant WLAN (Wireless Local Area Network) is a wireless network infrastructure that serves multiple tenants or users within a certain area. In a multi-tenant WLAN setup, the WLAN infrastructure is designed to efficiently manage and segregate network traffic from different tenants or users to ensure security, performance, and quality of service.

Main Advantages

Network Allocation: In high-demand scenarios, the WLAN infrastructure can dynamically allocate resources based on the needs of each tenant or user. This can involve prioritizing bandwidth for critical applications or users while ensuring fair access for all tenants.

Scalability: Multi-tenant WLAN architectures are designed to scale easily to accommodate increasing numbers of users or devices. Additional access points can be deployed as needed to expand coverage and capacity without compromising performance.

Business Model Comparison

	Standalone	Partnership
Infrastructure	• In this option a single organisation will provide the all radio access system to support the multi tenant WLAN offer	• Partnership where broadband provider supply the upfront costs to cover regions and areas that still do not have fibre
Distribution Channels	• Broadband provider has control over distribution strategies and channels, allowing for targeted marketing and sales efforts.	• The Distribution channel is supported by the carriers/ MNO targeting business media
Support	• Broadband provider has full control over support policies, response times, and service quality. • Pre and post-sale costumer service support	• Client facing supported by partner • Network airtime SLA between parties (Broadband and partner)
Demand & Supply	• Demand and supply are primarily driven by the broadband provider's own requirements and market dynamics.	• Demand and supply considerations involve coordination among partners to ensure adequate resources and support for shared infrastructure.

Private 5G

Private 5G solutions redefine regional connectivity by offering dedicated, high-performance mobile networks tailored to accommodate peak demand scenarios.

Private 5G Solution

General Description

- A private 5G solution enhances the opportunity to deploy a dedicated, high-performance mobile network customized to meet specific requirements, empowering organizations to leverage the complete capabilities of 5G technology based on the network demands and expected usage across different regions or areas. This allows for precise adaptation of the network infrastructure to suit varied operational needs and optimise performance across diverse environments

Main Advantages

Performance: A 5G private network solution can efficiently manage network resources to accommodate varying levels of traffic and usage across different times and locations, ensuring optimal performance and user experience even during peak demand periods.

High-Development Plans: According to ACMA and the market study conducted in 2023, the market for solutions based on private wireless is growing by about 30% per year, and ACMA is aware of this trend to increase 5G connectivity. Currently, I have 5400 MHz of dedicated spectrum and a plan until 2027 to release additional spectrum to accommodate this solution

Technical Considerations

1. A subscription fee will be needed, increasing the overall cost of the service when compared to Wi-Fi, however, private networks are **less complex and do not require network cabling**
2. Cellular grade network security provides **increased privacy and data security when compared to Wi-Fi**
3. **Licensed Spectrum** leads to **greater reliability and better performance** in the world if IoT, as well as a dramatic increase in ability to connect to IoT enabled devices
4. **Private 5G networks** support seamless mobility and roaming, allowing **devices to move between cells or access points without losing connectivity**.
5. **Private Networks can be 'sliced' for multiple functions**
   - Creates separate networks or slides
   - Each slice can be configured separately
   - Cater to unique requirements and use cases

Private Wi-Fi

Private network solutions optimise network performance based on fluctuating demand patterns, guaranteeing uninterrupted service and enhanced user experiences.

Private Wi-Fi Solution

General Description

- A private Wi-Fi solution provides a dedicated wireless network infrastructure designed to meet the demands of high-traffic scenarios and peak usage periods. Tailored to specific locations, such as public venues, event spaces, or community centers, private Wi-Fi networks ensure reliable and seamless connectivity for users during busy times.

Main Advantages

Performance: Private Wi-Fi networks are designed to provide reliable and consistent wireless connectivity, even in high-density environments or areas with interference. Network performance can be enhanced through strategically deploying access points and optimizing channel utilization.

Capabilities and Access Control: A Private Wi-Fi solutions enable full management over the configuration and security of the network, allowing for the tailoring of network settings, allocation of bandwidth, and implementation of security protocols to align with specific requirements and usage policies.

Technical Considerations

1. Wi-Fi is **cheaper than 5G and LTE per square foot** and due to the fact there are no subscriptions involved in the service.
2. Compared to its Wi-Fi predecessor, **Wi-Fi 6 has implemented WPA3,** which generates a live password with every data transmission, resulting in more secure routers
3. Private Wi-Fi networks operate in **the unlicensed spectrum**, sharing the **frequency band** with other wireless technologies and devices.
4. Wi-Fi networks support QoS mechanisms to prioritize **traffic** and ensure the **timely delivery** of critical applications.
5. The deployment of multiple access points and **wireless mesh networks** extends **coverage** and improves **signal strength** in large or complex environments.