The Case for Improved Digital Connectivity in the Hunter and Central Coast Regions

Destination Sydney Surrounds North

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Acknowledgement of funding

![NSW Government logo]

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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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

The Hunter and Central Coast Regions

The visitor economy

The DSSN Region's digital connectivity snapshot

The purpose of this 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.
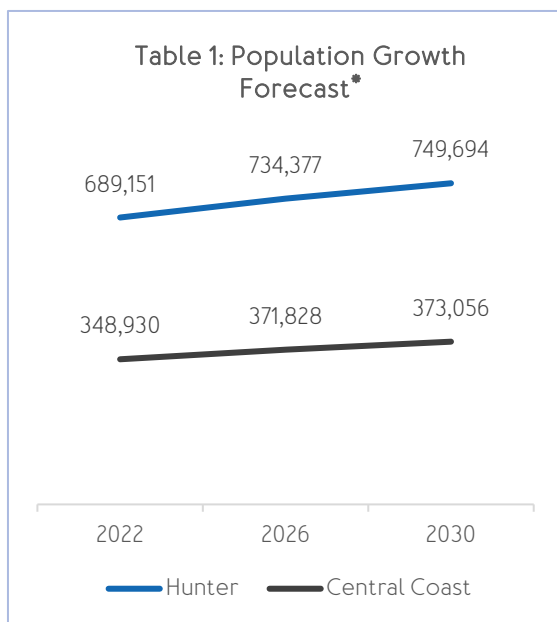
"All Australians deserve access to quality communications service – no matter where they live or work."

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.

Table 1: Population Growth Forecast*

689,151   734,377   749,694

348,930   371,828   373,056

2022   2026   2030

—— Hunter   —— Central Coast

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.
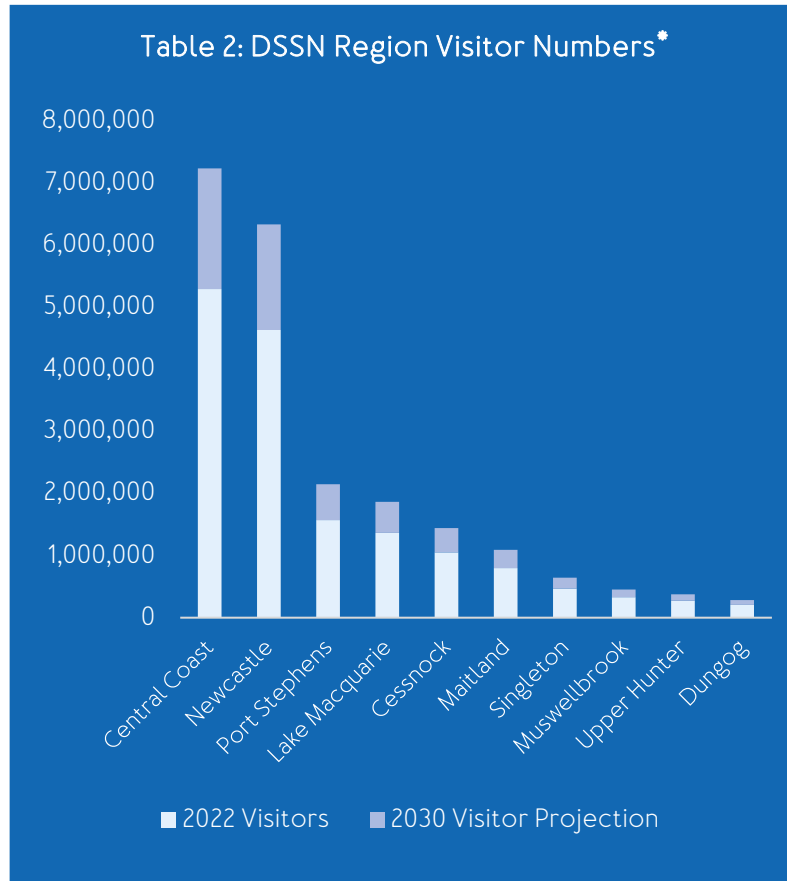
Economic Overview

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.

Table 2: DSSN Region Visitor Numbers*

Legend: ■ 2022 Visitors ■ 2030 Visitor Projection

(Bar chart categories, left to right: Central Coast, Newcastle, Port Stephens, Lake Macquarie, Cessnock, Maitland, Singleton, Muswellbrook, Upper Hunter, Dungog. Y-axis: 0 to 8,000,000)

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.

* DSSN Region Visitor Numbers are sourced from VES 2030 Regional NSW Forecast data

The DSSN Region's current digital connectivity snapshot

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)

Map labels: UPPER HUNTER SHIRE, MUSWELLBROOK, SINGLETON, DUNGOG, MAITLAND, PORT STEPHENS, NEWCASTLE, LAKE MACQUARIE, CESSNOCK, CENTRAL COAST

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.

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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]

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

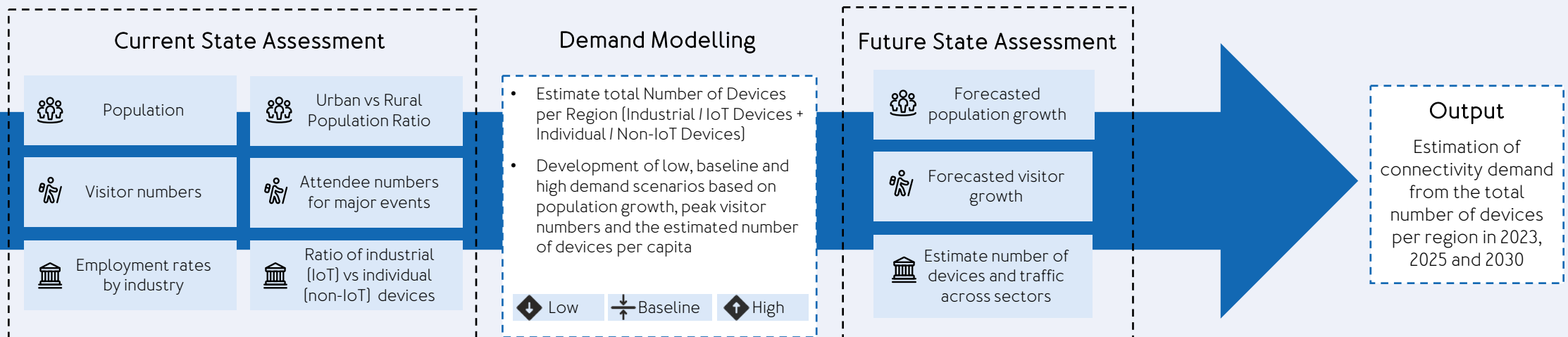# Methodology: Determining current and future connectivity demand

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.

Current State Assessment
- Population
- Urban vs Rural Population Ratio
- Visitor numbers
- Attendee numbers for major events
- Employment rates by industry
- Ratio of industrial (IoT) vs individual (non-IoT) devices

Demand Modelling
- Estimate total Number of Devices per Region (Industrial / IoT Devices + Individual / Non-IoT Devices)
- Development of low, baseline and high demand scenarios based on population growth, peak visitor numbers and the estimated number of devices per capita

Low | Baseline | High

Future State Assessment
- Forecasted population growth
- Forecasted visitor growth
- Estimate number of devices and traffic across sectors

Output
Estimation of connectivity demand from the total number of devices per region in 2023, 2025 and 2030

A detailed overview of the methodology, inputs and data sources is included in Appendix 2: Inputs for Demand Modelling (page 130)

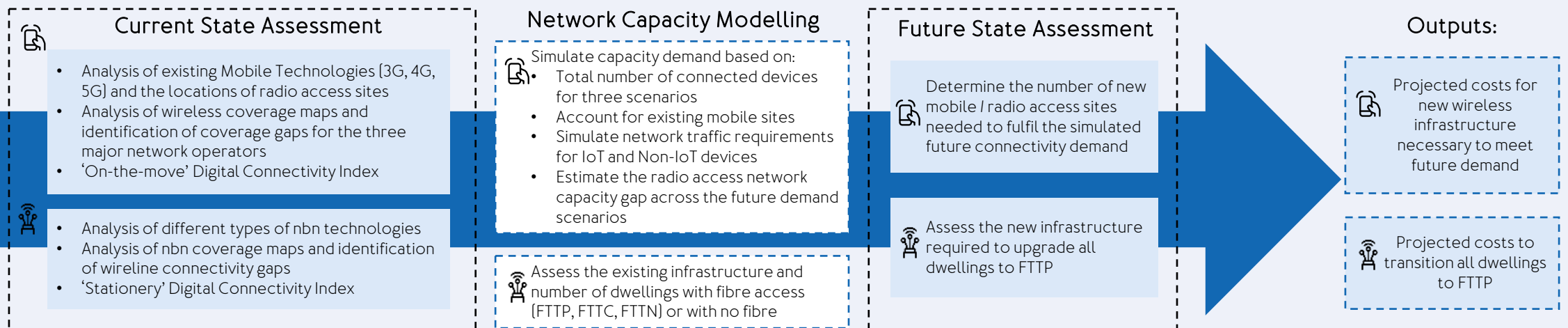# Methodology: Assessing digital connectivity supply gap and future state

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.

Total Number of Devices Across the Demand Scenarios

Legend: ■ Low Demand Scenario   ■ Baseline Demand Scenario   □ High Demand Scenario
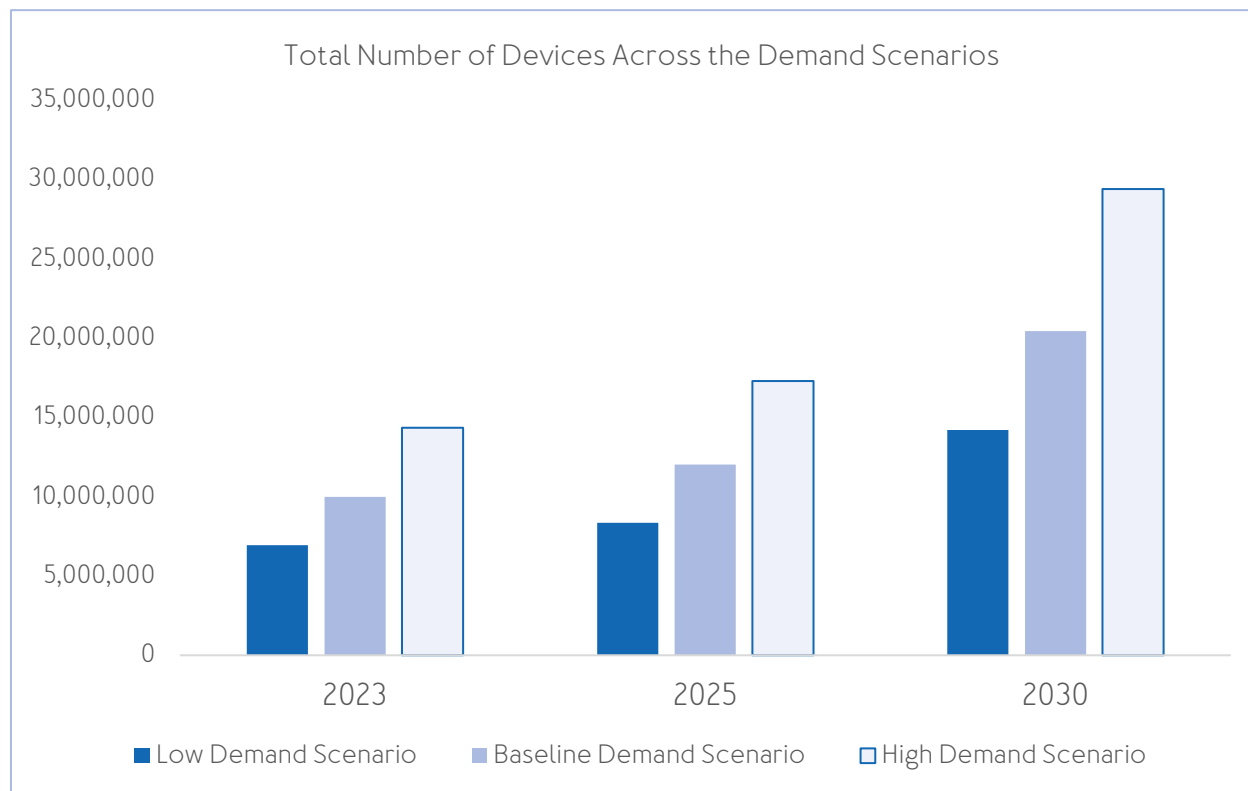
Key insights:

- 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	🟡	🔴	🔴
Cessnock City	🟢	🔴	🔴
Dungog Shire	🟢	🔴	🔴
Lake Macquarie	🟡	🔴	🔴
Maitland	🔴	🔴	🔴
Muswellbrook	🟢	🟢	🔴
Newcastle City	🟢	🔴	🔴
Port Stephens	🟢	🔴	🔴
Singleton	🟢	🟢	🔴
Upper Hunter	🟢	🟢	🔴

Existing network capacity:
- 🟢 Meets the estimated demand
- 🟡 May experience congestion during peak demand
- 🔴 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

Fibre Connectivity Across Existing Dwellings

Legend: FTTP, FTTC, FTTN, No fibre
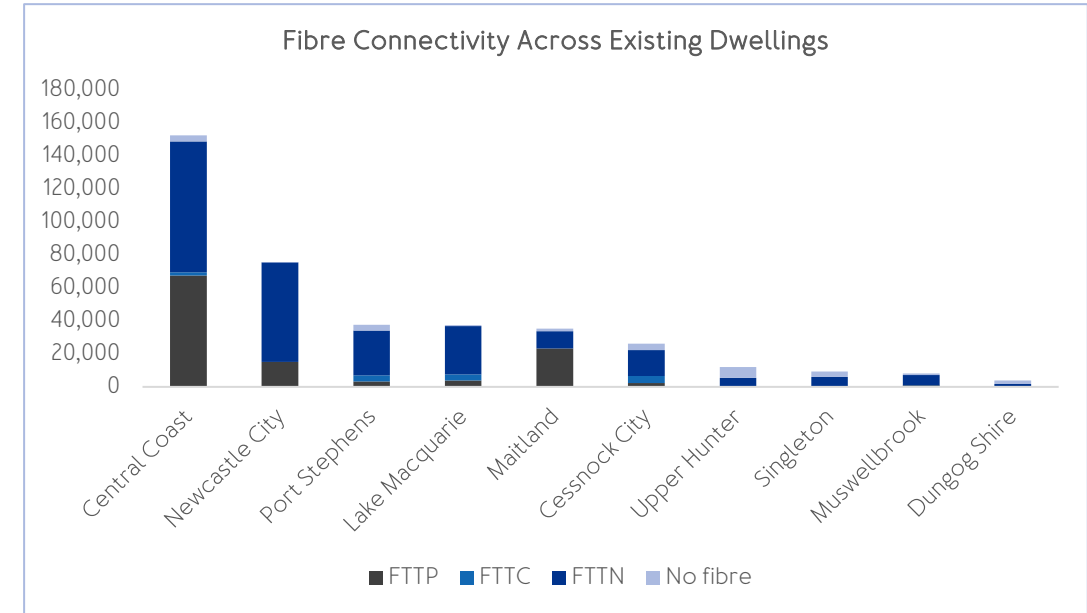
- Maitland and Central Coast LGAs have the highest proportion of households with FTTP access, with 66 per cent and 44 per cent respectively.
- Singleton and Dungog Shire regions have limited FTTP connectivity (<1 per cent of dwellings).
- Upper Hunter and Dungog Shire regions have the highest proportion 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.

Wireless investment for new radio access towers / sites by 2030   Wireline investment

Local Government Area	Low Demand Scenario	Baseline Demand Scenario	High Demand Scenario	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	29
Cessnock	35
Dungog	41
Lake Macquarie	47
Maitland	54
Muswellbrook	59
Newcastle	65
Port Stephens	71
Singleton	77
Upper Hunter	83

Central Coast

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
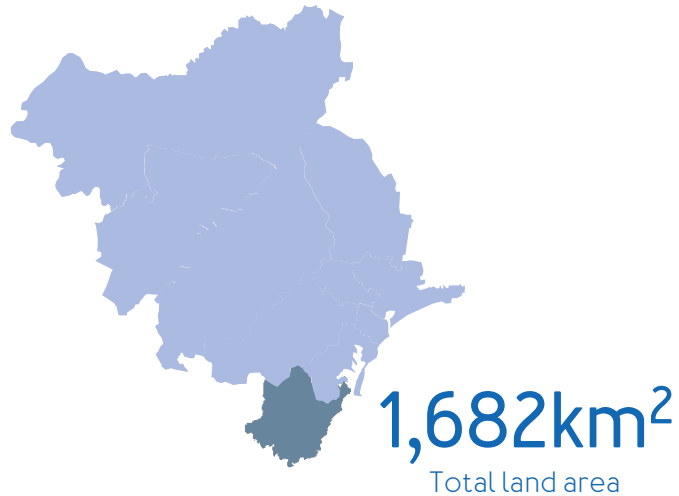
Daily Visitors to the Area
(Baseline Demand Scenario)

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.
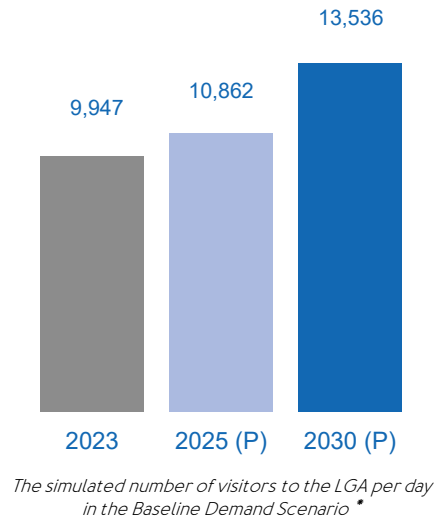
2023	2025 (P)	2030 (P)
9,947	10,862	13,536

*The simulated number of visitors to the LGA per day in the Baseline Demand Scenario **

Total Number of Connected Devices
(Baseline Demand Scenario)

Individual: 1,448,001 (2023 [E]), 1,492,613 (2025 [P]), 1,590,864 (2030 [P])
Industrial: 1,756,830 (2023 [E]), 2,363,994 (2025 [P]), 4,965,192 (2030 [P])
Visitor: 41,278 (2023 [E]), 45,077 (2025 [P]), 56,443 (2030 [P])

Legend: Individual — Industrial — Visitor

Population

2023 [E]	2025 (P)	2030 (P)
355,654	366,611	390,743

- Urban: 98.8%
- Rural: 1.2%
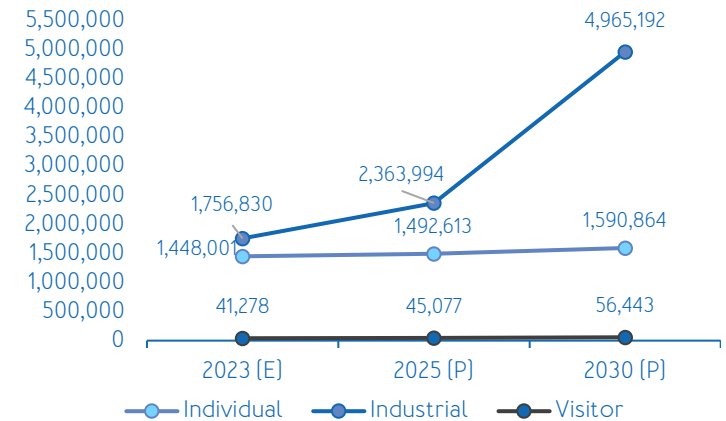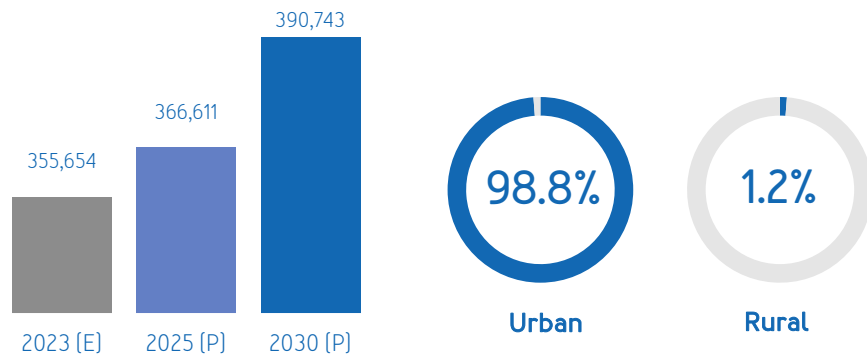
Key Insights:

- 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.

55%
Digital Connectivity Index (On the Move)
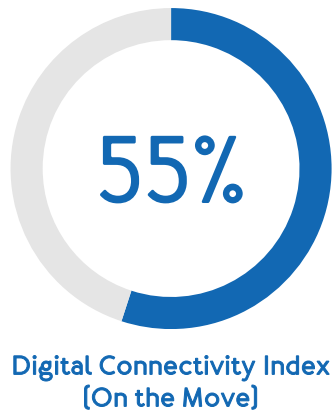
Access	83	●●●●●
Affordability	86	●●●●●
Demographics	59	●●●○○

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

- 4G
- 5G
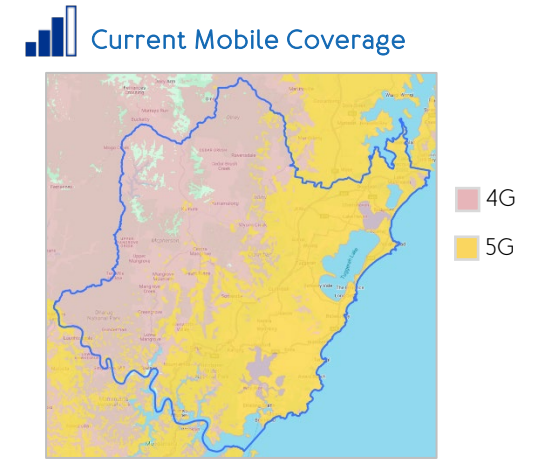
The map above shows the current 4G and 5G coverage by the main network providers (Telstra, Optus, and TPG)
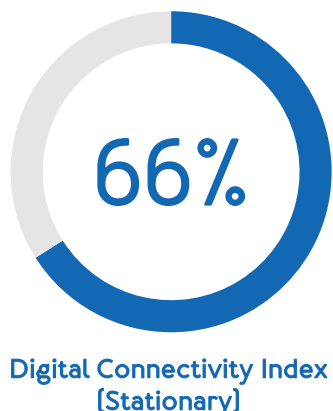
66%
Digital Connectivity Index (Stationary)

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

- FTTP
- FTTB
- FTTC
- FTTN
- Fixed Wireless
- Satellite
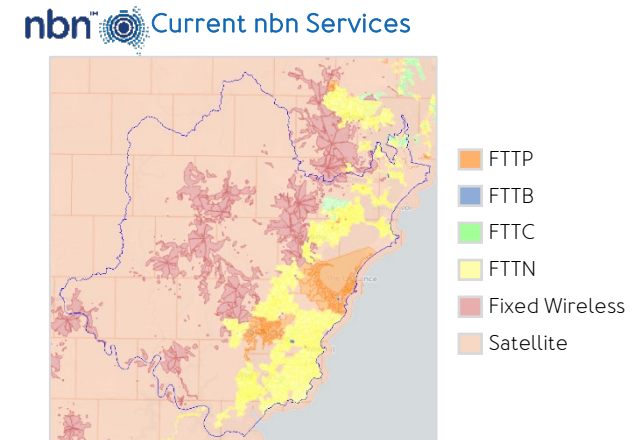
Wireless Connectivity Gaps: Central Coast

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:

97.6%

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.
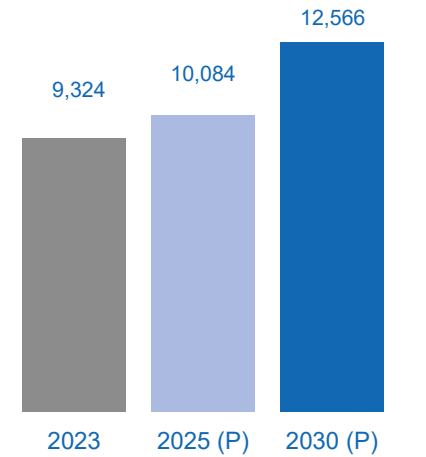
Cessnock

LGA Overview: 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.

1,966km²
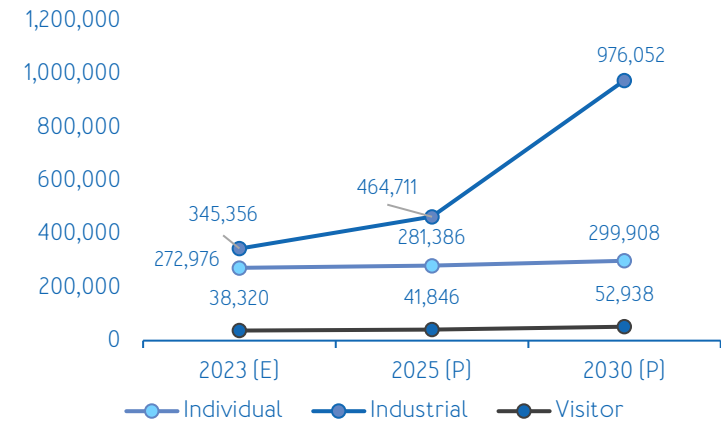Total land area

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.

2023	2025 (P)	2030 (P)
9,324	10,084	12,566

*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)

Individual: 272,976 (2023 E), 281,386 (2025 P), 299,908 (2030 P)
Industrial: 345,356 (2023 E), 464,711 (2025 P), 976,052 (2030 P)
Visitor: 38,320 (2023 E), 41,846 (2025 P), 52,938 (2030 P)

— Individual — Industrial — Visitor

Population

2023 (E)	2025 (P)	2030 (P)
67,048	69,113	73,663

0% Urban   100% Rural
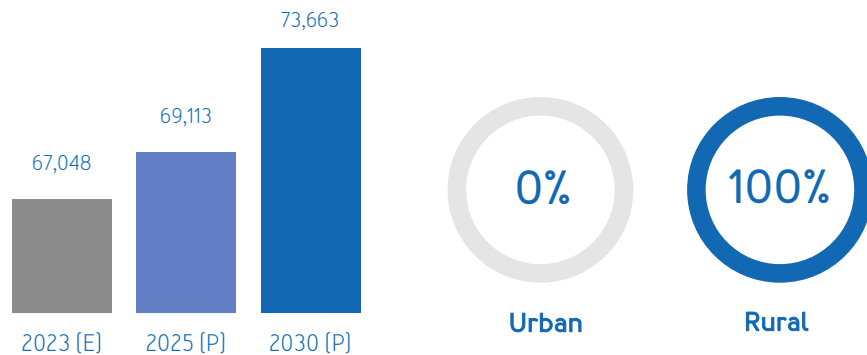
Key Insights:

- 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.

Destination Sydney Surrounds North

*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.

35%
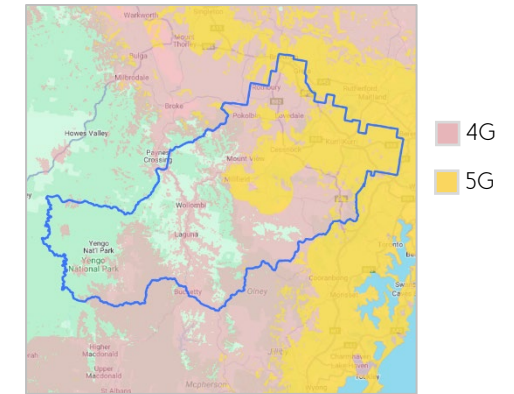**Digital Connectivity Index (On the Move)**
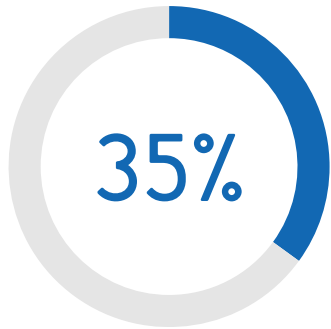
Access	77	●●●●○
Affordability	85	●●●●●
Demographics	36	●●○○○

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

4G
5G

Map showing current mobile coverage in terms of 4G and 5G (Telstra, Optus, and TPG combined)

43%
Digital Connectivity Index (Stationary)
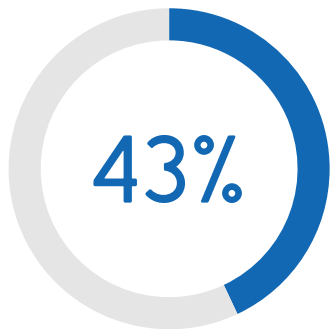
Access	96	●●●●●
Affordability	90	●●●●●
Demographics	59	●●●○○

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

FTTP
FTTB
FTTC
FTTN
Fixed Wireless
Satellite
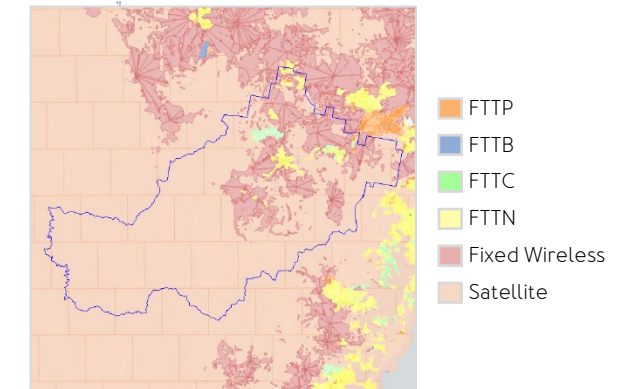
Wireless Connectivity Gaps: Cessnock

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:

85.2%
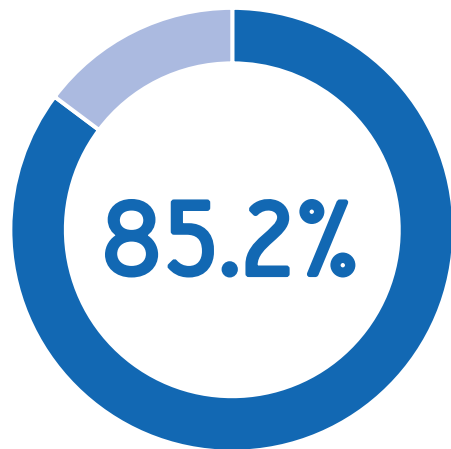
Dwellings with no fibre access
Dwellings with fibre access

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.
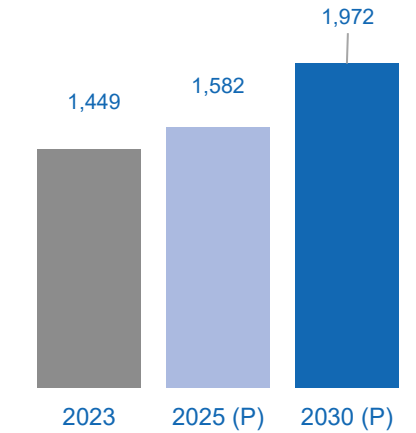
Dungog

LGA Overview: 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.

2,250km²
Total land area
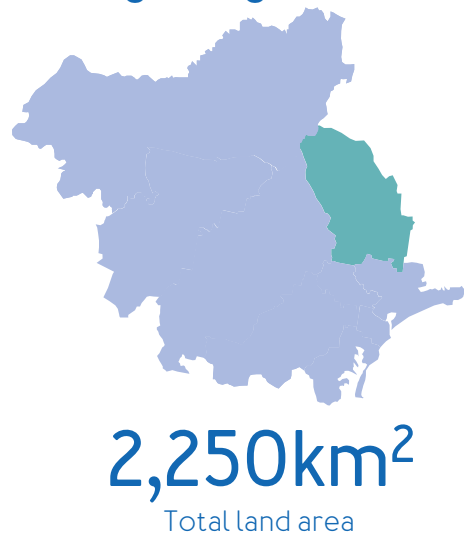
Daily Visitors to the Area
(Baseline Demand Scenario)

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.

2023	2025 (P)	2030 (P)
1,449	1,582	1,972

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)

	2023 (E)	2025 (P)	2030 (P)
Individual	40,282	41,253	44,257
Industrial	50,963	68,576	144,034
Visitor	6,013	6,566	8,222

Legend: Individual — Industrial — Visitor

Population

2023 [E]	2025 (P)	2030 (P)
9,894	10,199	10,870

0% Urban   100% Rural
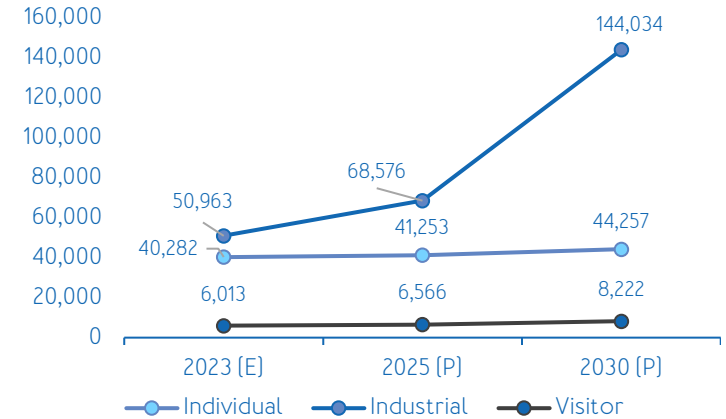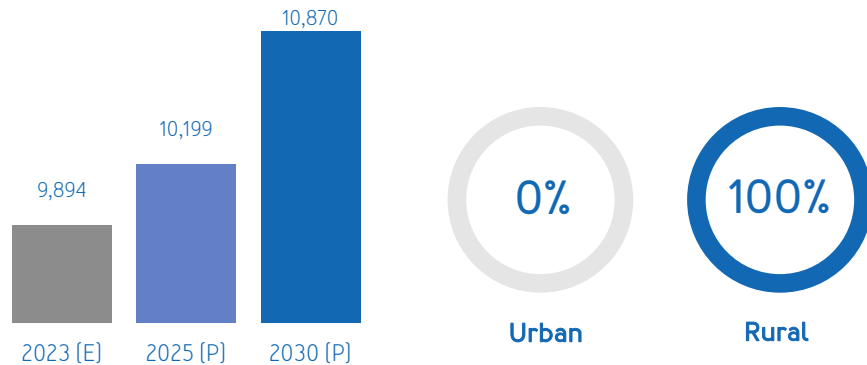
Key Insights:

- 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.

Destination Sydney Surrounds North

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.
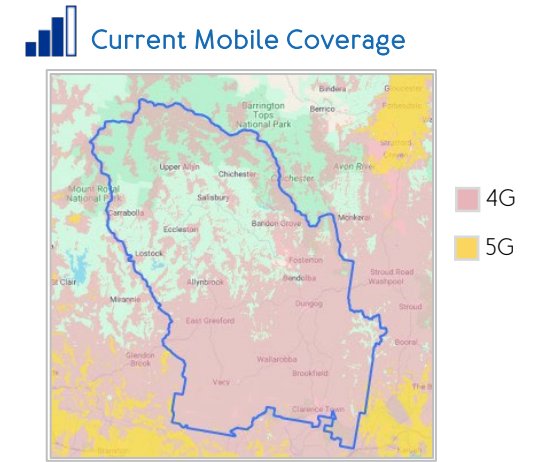
31%
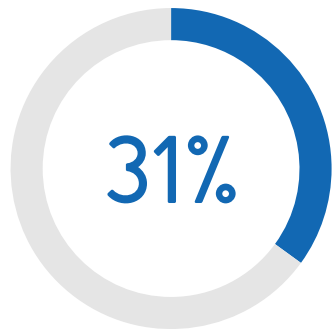
Digital Connectivity Index (On the Move)

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

- 4G
- 5G

Map showing current mobile coverage in terms of 4G and 5G (Telstra, Optus, and TPG combined)

53%
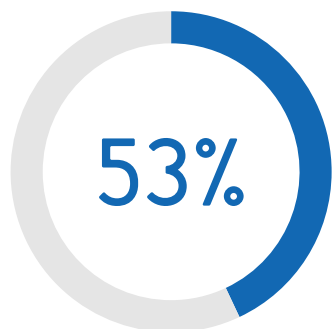
Digital Connectivity Index (Stationary)

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

- FTTP
- FTTB
- FTTC
- FTTN
- Fixed Wireless
- Satellite
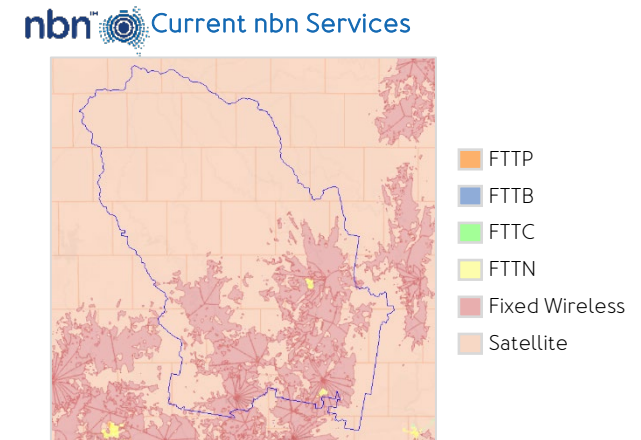
Wireless Connectivity Gaps: Dungog

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	●●● (green)	●●● (green)	●●● (red)
2025 [P]	Connected devices	80,044	116,666	169,710
	Network capacity	●●● (green)	●●● (yellow)	●●● (red)
2030 [P]	Connected devices	135,240	196,513	284,996
	Network capacity	●●● (green)	●●● (red)	●●● (red)

[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:

- ●●● (green) Existing network capacity meets the estimated demand

- ●●● (yellow) Existing network capacity may experience congestion during peak demand

- ●●● (red) 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:

47.7%
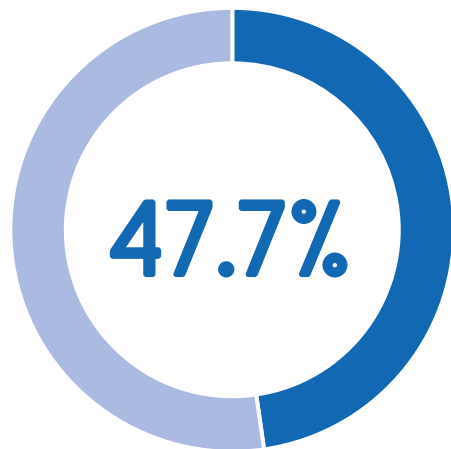
Dwellings with no fibre access

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
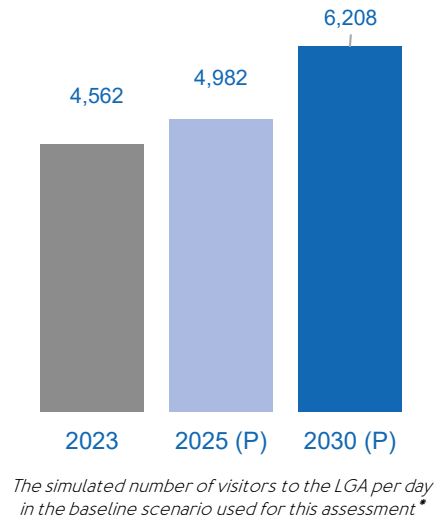
LGA Overview: Lake Macquarie

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.
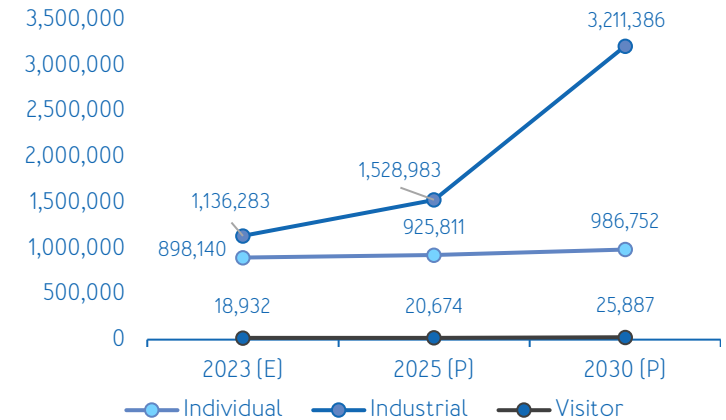
649km²
Total land area

Daily Visitors to the Area
(Baseline Demand Scenario)

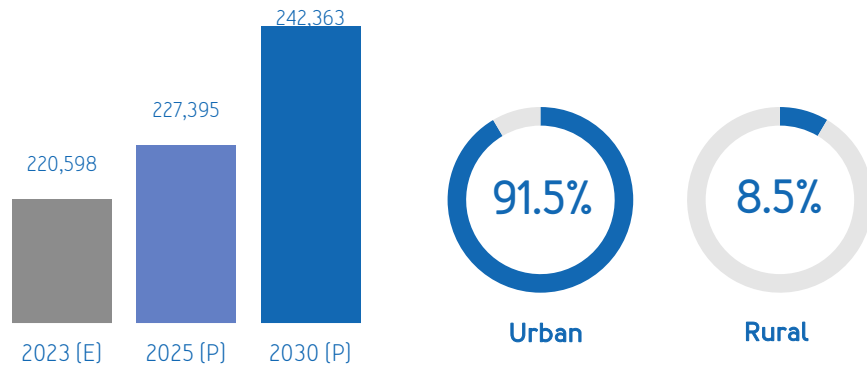Lake Macquarie is centred around the vast lake, with scenic walking trails and a selection of beaches, including the popular Naru Beach.

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.

2023	2025 (P)	2030 (P)
4,562	4,982	6,208

*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)

	2023 [E]	2025 [P]	2030 [P]
Individual	898,140	925,811	986,752
Industrial	1,136,283	1,528,983	3,211,386
Visitor	18,932	20,674	25,887

—○— Individual —●— Industrial —●— Visitor

Population

2023 [E]	2025 (P)	2030 (P)
220,598	227,395	242,363

91.5% Urban   **8.5%** Rural

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.

Destination Sydney Surrounds North

*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.

60%
Digital Connectivity Index (On the Move)
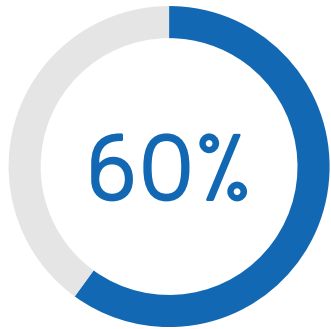
Access	86
Affordability	87
Demographics	60

	Telstra	Optus	TPG
3G	✓	✓	✓
4G	✓	✓	✓
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
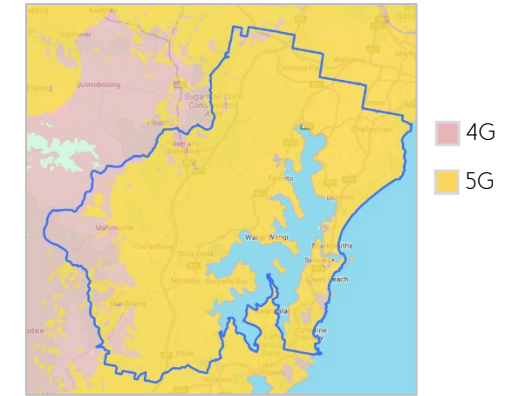
- 4G
- 5G

Map showing current mobile coverage in terms of 4G and 5G (Telstra, Optus, and TPG combined)
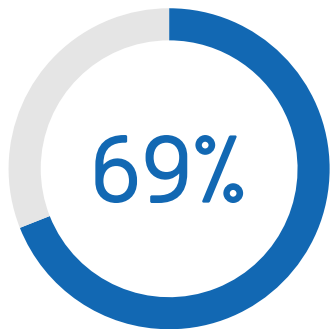
69%
Digital Connectivity Index (Stationary)

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

- FTTP
- FTTB
- FTTC
- FTTN
- Fixed Wireless
- Satellite
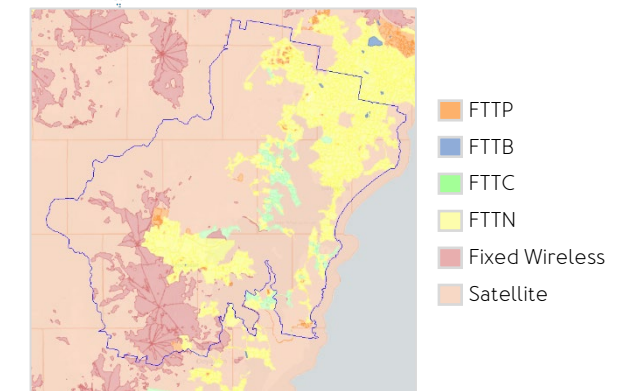
Wireless Connectivity Gaps: Lake Macquarie

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	●●● (green)	●●● (green)	●●● (red)
2025 [P]	Connected devices	1,725,990	2,475,467	3,544,872
	Network capacity	●●● (green)	●●● (yellow)	●●● (red)
2030 [P]	Connected devices	2,942,192	4,224,025	6,056,480
	Network capacity	●●● (yellow)	●●● (red)	●●● (red)

[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:

- ●●● (green) Existing network capacity meets the estimated demand

- ●●● (yellow) Existing network capacity may experience congestion during peak demand

- ●●● (red) 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:

98.8%

Dwellings with no fibre access
Dwellings with fibre access

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: 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.

$392km^2$

Total land area

Daily Visitors to the Area
(Baseline Demand Scenario)

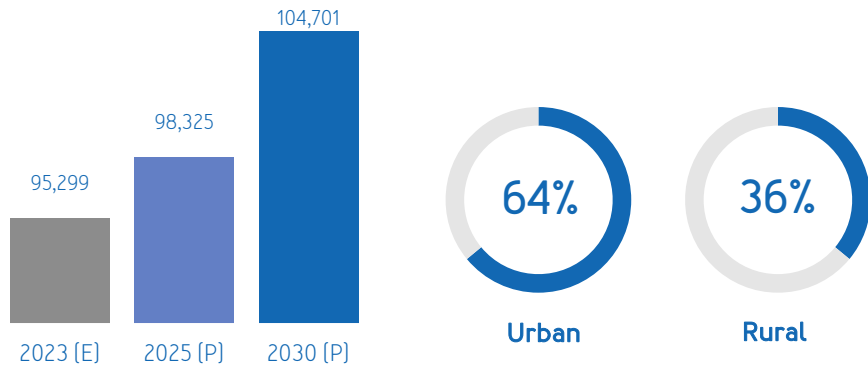Maitland is a vibrant region rich in heritage and cultural events, drawing thousands to its annual festivals.

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.
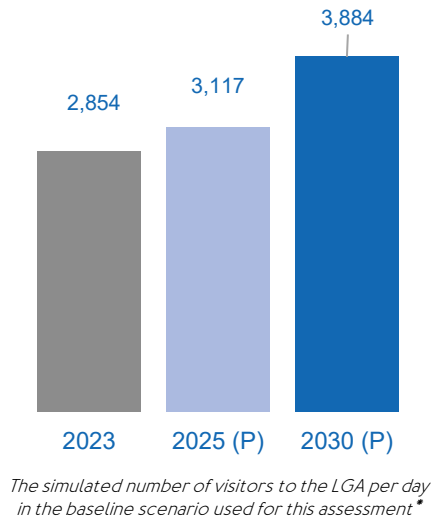
2023	2025 (P)	2030 (P)
2,854	3,117	3,884

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)

Individual: 387,997 (2023 [E]) → 399,951 (2025 [P]) → 426,777 (2030 [P])
Industrial: 490,875 (2023 [E]) → 660,521 (2025 [P]) → 1,387,320 (2030 [P])
Visitor: 11,844 (2023 [E]) → 12,934 (2025 [P]) → 16,195 (2030 [P])

Legend: —○— Individual —●— Industrial —●— Visitor

Population

2023 [E]	2025 (P)	2030 (P)
95,299	98,325	104,701

64% Urban
36% Rural
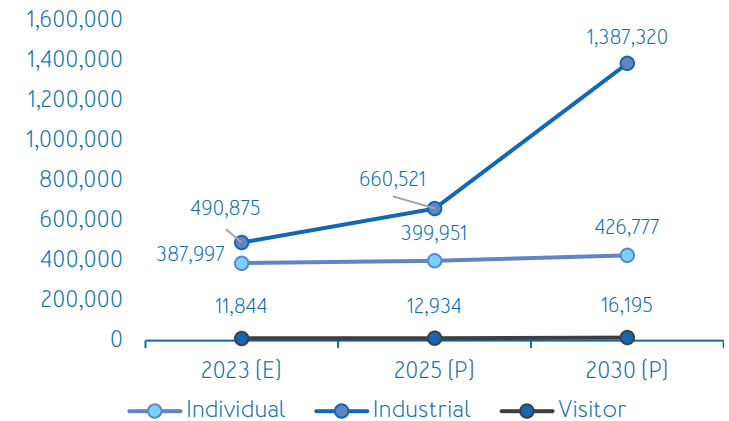
Key Insights:

- 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.
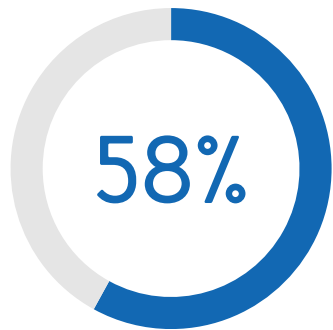
58%
**Digital Connectivity Index
(On the Move)**

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.
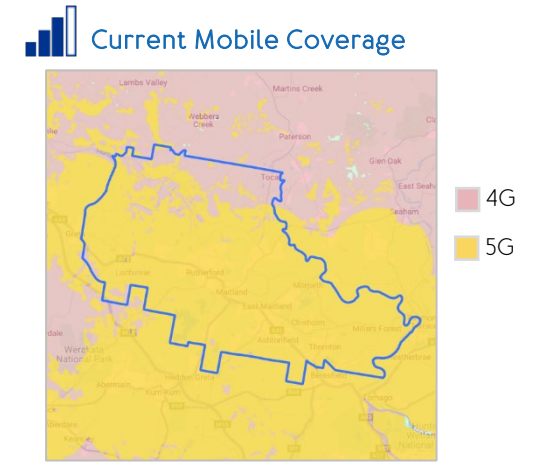
📶 Current Mobile Coverage

4G
5G

Map showing current mobile coverage in terms of 4G and 5G (Telstra, Optus, and TPG combined)

66%
**Digital Connectivity Index
(Stationary)**
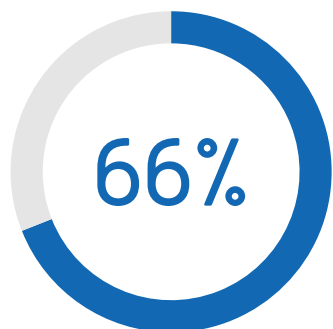
Access	99
Affordability	94
Demographics	56

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

FTTP
FTTB
FTTC
FTTN
Fixed Wireless
Satellite
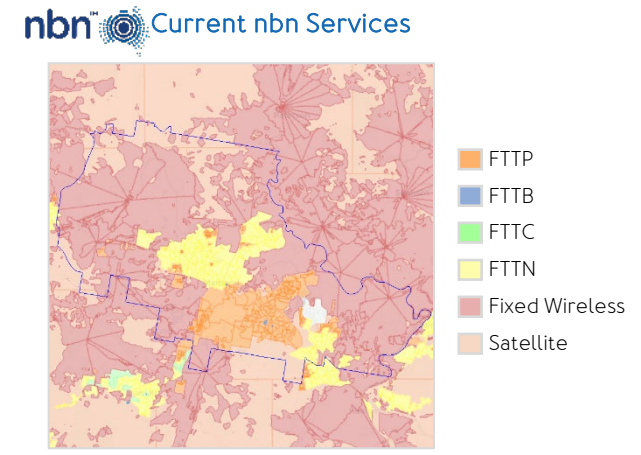
Wireless Connectivity Gaps: Maitland

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:

95.9%
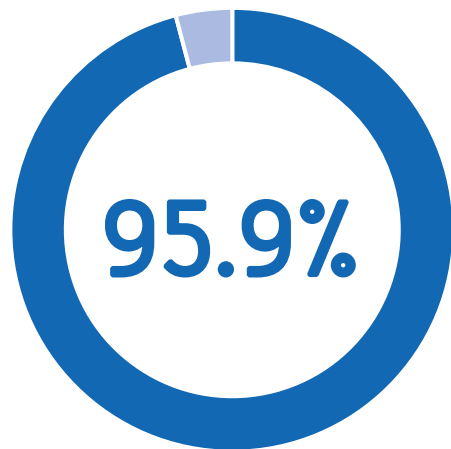
Dwellings with no fibre access
Dwellings with fibre access

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: 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.
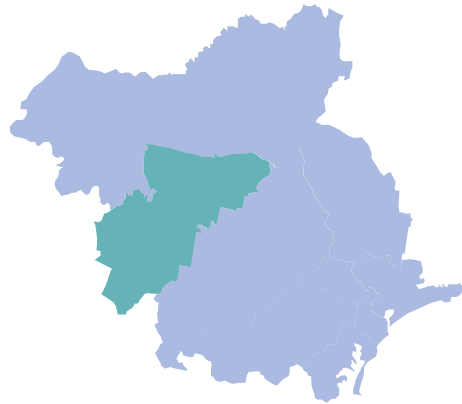
$3,405km^2$

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.
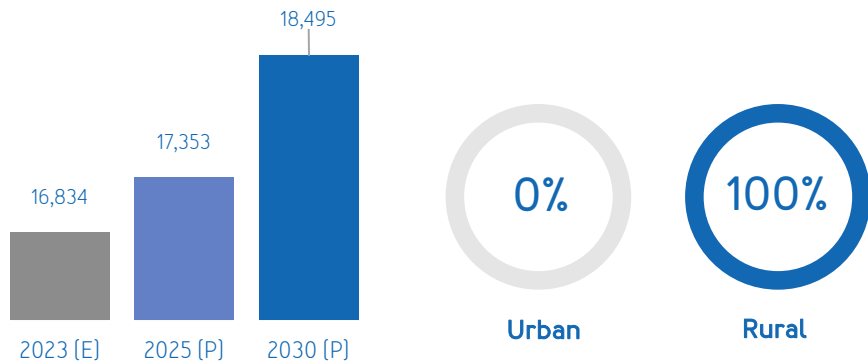
Key events include the Upper Hunter Show and the Muswellbrook Gold Cup in March, the Great Cattle Dog Muster in September, and the Upper Hunter Wine and Food Affair, highlighting the food and wine of the region including Pukara Estate.
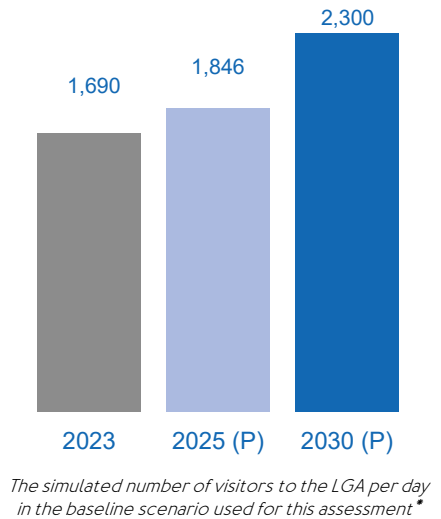
1,690	1,846	2,300
2023	2025 (P)	2030 (P)

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)

	2023 (E)	2025 (P)	2030 (P)
Individual	68,539	70,650	75,301
Industrial	86,712	116,679	245,066
Visitor	7,013	7,659	9,590

Individual   Industrial   Visitor

Population

16,834	17,353	18,495
2023 [E]	2025 (P)	2030 (P)

0% Urban

100% Rural
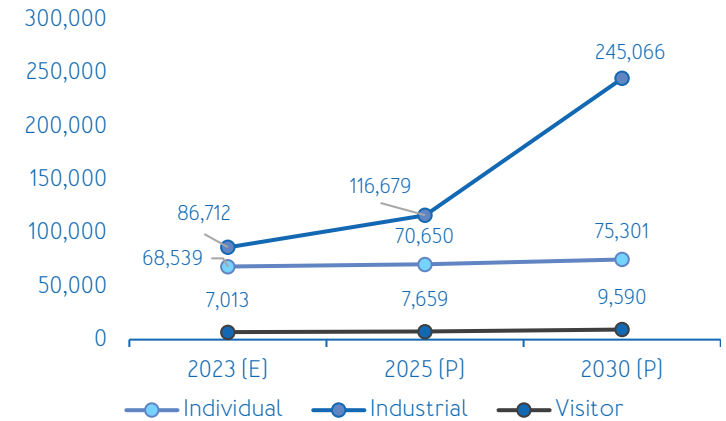
Key Insights:

- 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.
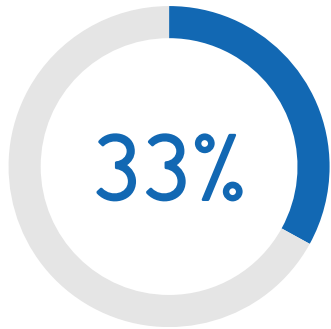
33%
Digital Connectivity Index (On the Move)

Access	68
Affordability	79
Demographics	34

	Telstra	Optus	TPG
3G	✓	✓	✓
4G	✓	✓	✓
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
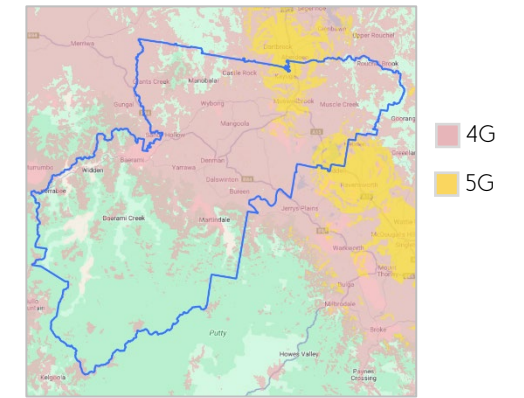
4G
5G

Map showing current mobile coverage in terms of 4G and 5G (Telstra, Optus, and TPG combined)
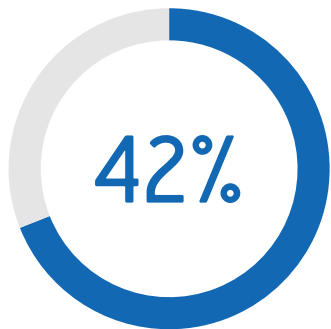
42%
Digital Connectivity Index (Stationary)

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

FTTP
FTTB
FTTC
FTTN
Fixed Wireless
Satellite

Destination Sydney Surrounds North
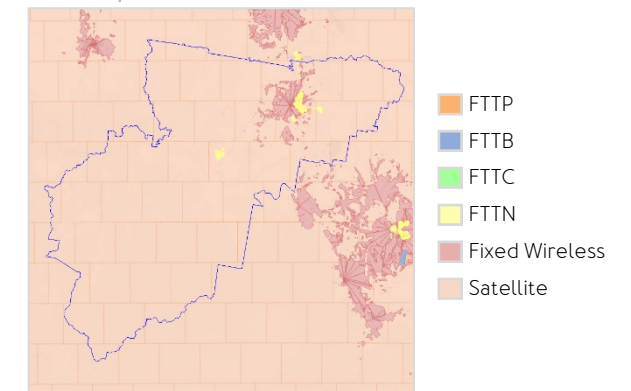
Wireless Connectivity Gaps: Muswellbrook

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:

89.5%
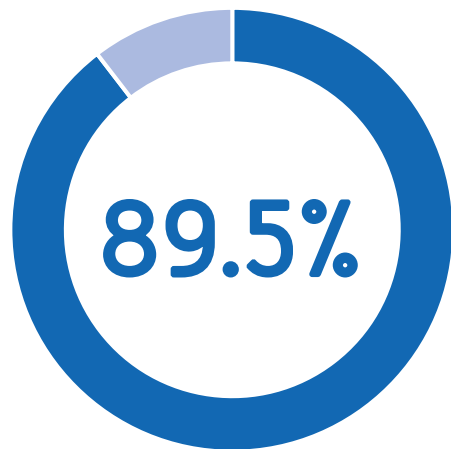
Dwellings with no fibre access
Dwellings with fibre access

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: 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.
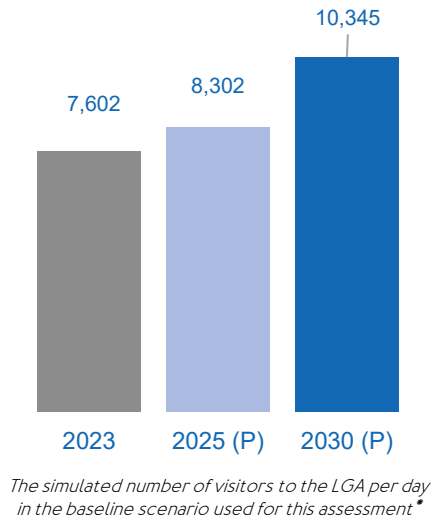
Daily Visitors (Baseline Demand Scenario):
- 2023: 7,602
- 2025 (P): 8,302
- 2030 (P): 10,345

*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)

Individual:
- 2023 (E): 710,933
- 2025 (P): 732,836
- 2030 (P): 781,075

Industrial:
- 2023 (E): 899,438
- 2025 (P): 1,210,283
- 2030 (P): 2,542,008

Visitor:
- 2023 (E): 31,547
- 2025 (P): 34,450
- 2030 (P): 43,137

Legend: Individual | Industrial | Visitor

Population

- 2023 (E): 174,617
- 2025 (P): 179,997
- 2030 (P): 191,845

Urban: 100%
Rural: 0%
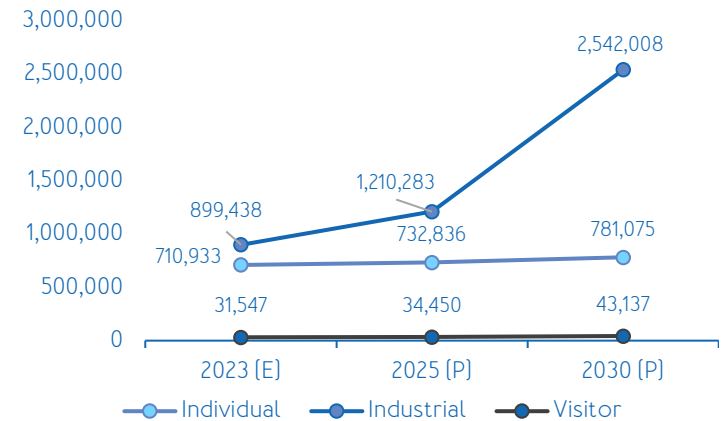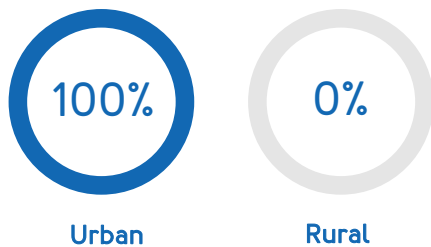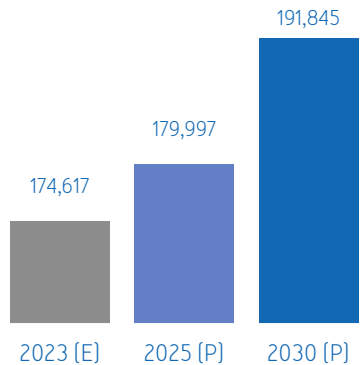
Key Insights:

- 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%
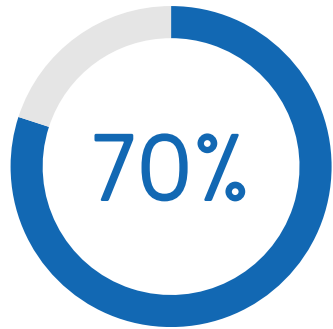
Digital Connectivity Index (On the Move)

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
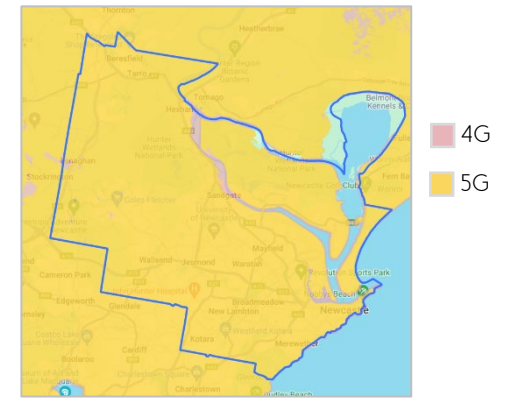
4G
5G

Map showing current mobile coverage in terms of 4G and 5G (Telstra, Optus, and TPG combined)

80%
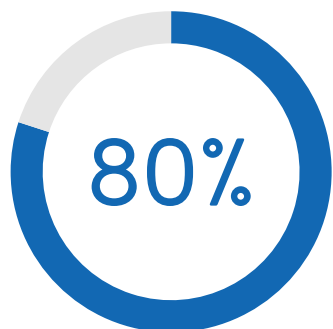
Digital Connectivity Index (Stationary)

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

FTTP
FTTB
FTTC
FTTN
Fixed Wireless
Satellite

Destination Sydney Surrounds North
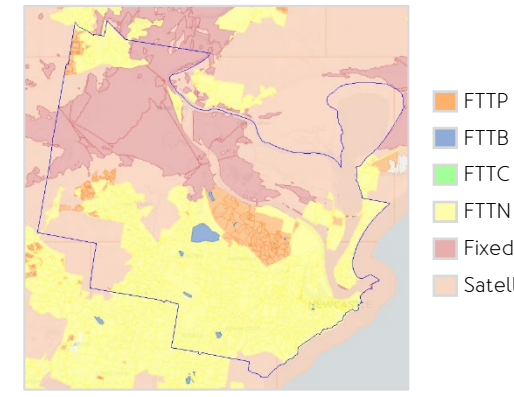
Wireless Connectivity Gaps: Newcastle

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:

99.6%

Dwellings with no fibre access

Dwellings with fibre access

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: 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.
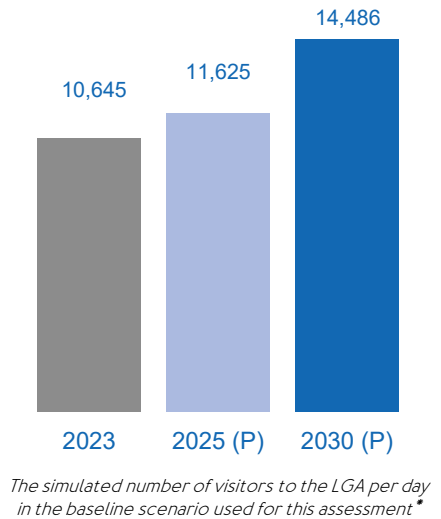
2023	2025 (P)	2030 (P)
10,645	11,625	14,486

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)

Individual: 317,628 (2023 E), 327,414 (2025 P), 348,966 (2030 P)
Industrial: 401,848 (2023 E), 540,726 (2025 P), 1,135,710 (2030 P)
Visitor: 44,175 (2023 E), 48,240 (2025 P), 60,404 (2030 P)

— Individual — Industrial — Visitor

Population

2023 (E)	2025 (P)	2030 (P)
78,015	80,418	85,712

17.4% Urban   **82.6%** Rural
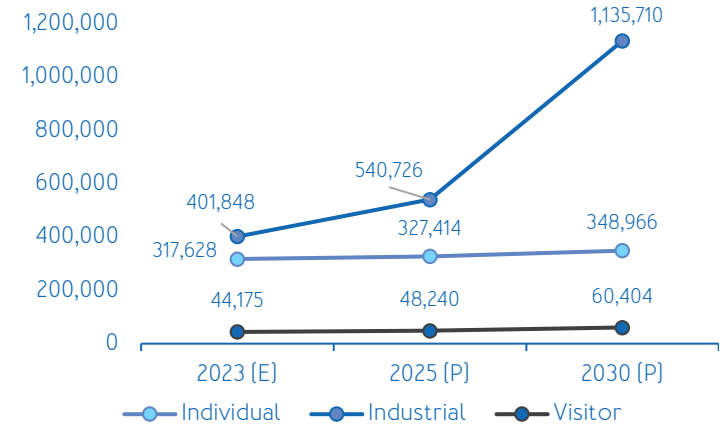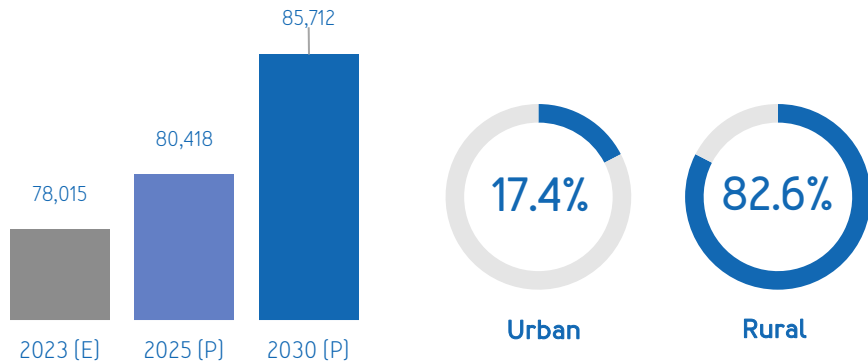
Key Insights:

- 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.

Destination Sydney Surrounds North

*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.

41%
Digital Connectivity Index (On the Move)
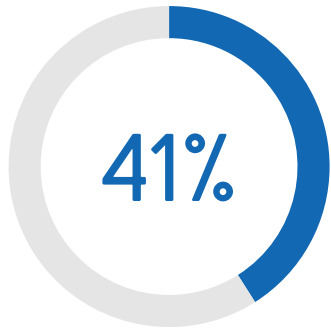
Access	77
Affordability	79
Demographics	46

	Telstra	Optus	TPG
3G	✓	✓	✓
4G	✓	✓	✓
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
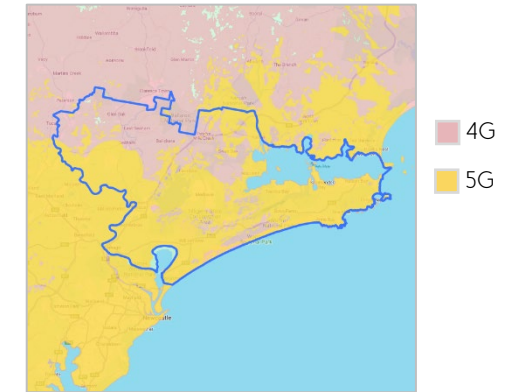
4G
5G

Map showing current mobile coverage in terms of 4G and 5G (Telstra, Optus, and TPG combined)
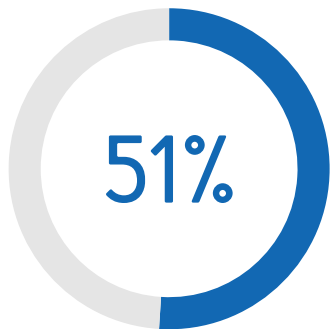
51%
Digital Connectivity Index (Stationary)

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

FTTP
FTTB
FTTC
FTTN
Fixed Wireless
Satellite
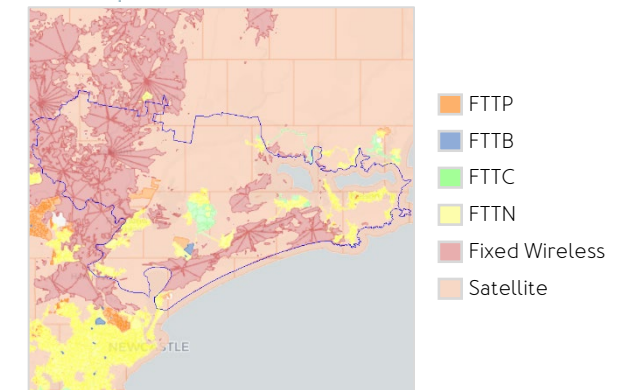
Wireless Connectivity Gaps: Port Stephens

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	● ● ● (green)	● ● ● (green)	● ● ● (red)
2025 (P)	Connected devices	629,500	916,381	1,331,448
	Network capacity	● ● ● (green)	● ● ● (green)	● ● ● (red)
2030 (P)	Connected devices	1,064,314	1,545,080	2,238,833
	Network capacity	● ● ● (green)	● ● ● (red)	● ● ● (red)

(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:

90.7%
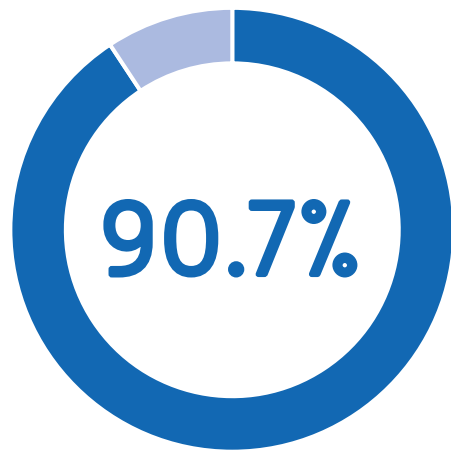
Dwellings with no fibre access
Dwellings with fibre access

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: 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.
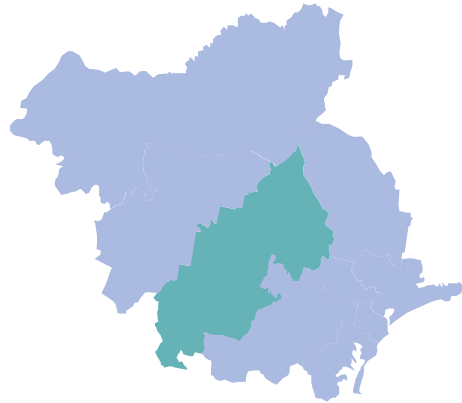
4,893km²
Total land area

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.
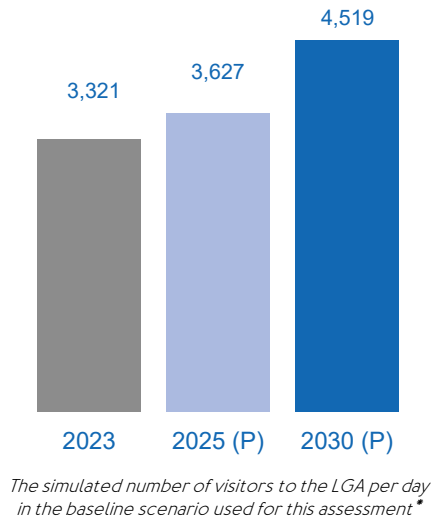
2023	2025 (P)	2030 (P)
3,321	3,627	4,519

*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)

Industrial: 131,648 (2023 E), 177,145 (2025 P), 372,066 (2030 P)
Individual: 104,057 (2023 E), 107,263 (2025 P), 114,324 (2030 P)
Visitor: 13,782 (2023 E), 15,050 (2025 P), 18,845 (2030 P)

Legend: Individual — Industrial — Visitor

Population

2023 [E]	2025 (P)	2030 (P)
25,558	26,346	28,080

1.7% Urban

98.3% Rural
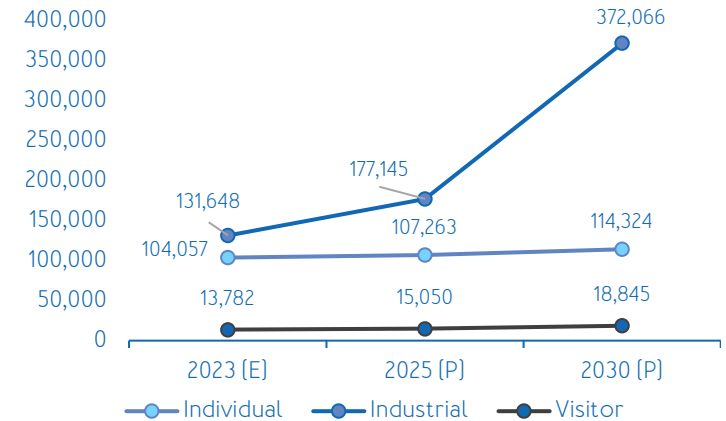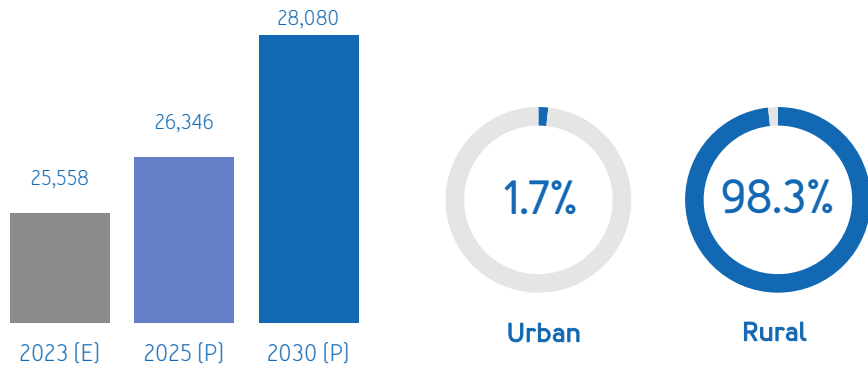
Key Insights:

- 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.
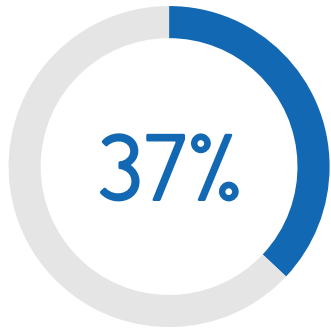
37%
Digital Connectivity Index (On the Move)

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
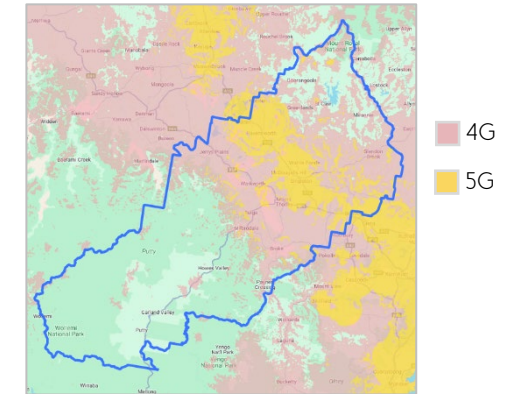
4G
5G

Map showing current mobile coverage in terms of 4G and 5G (Telstra, Optus, and TPG combined)
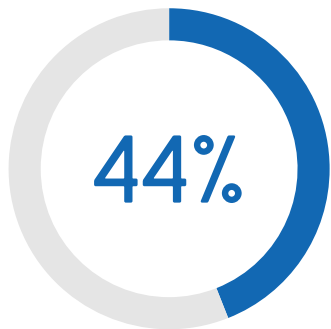
44%
Digital Connectivity Index (Stationary)

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

FTTP
FTTB
FTTC
FTTN
Fixed Wireless
Satellite

Destination Sydney Surrounds North
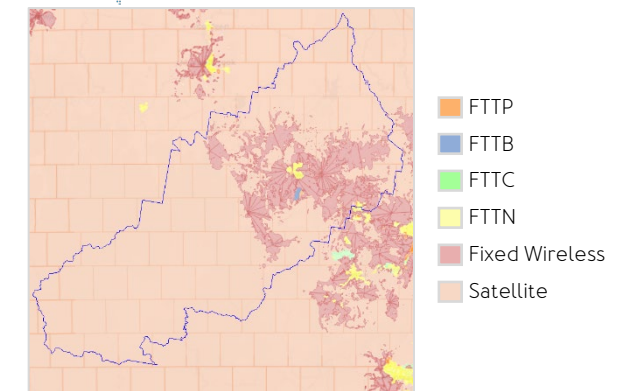
Wireless Connectivity Gaps: Singleton

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:

64.5%
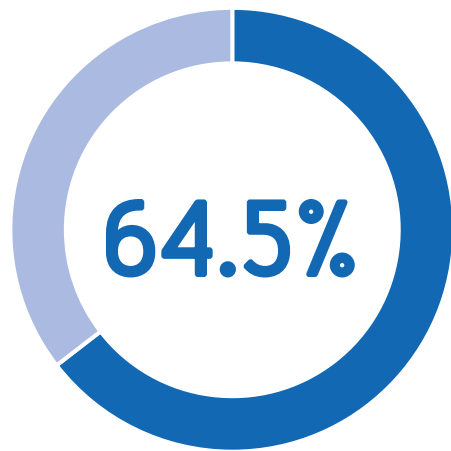
Dwellings with no fibre access

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: 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.
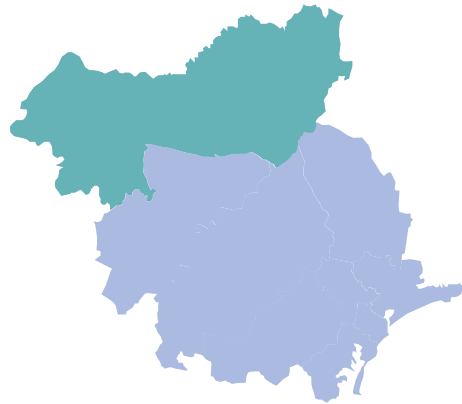
8,096km²
Total land area

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.
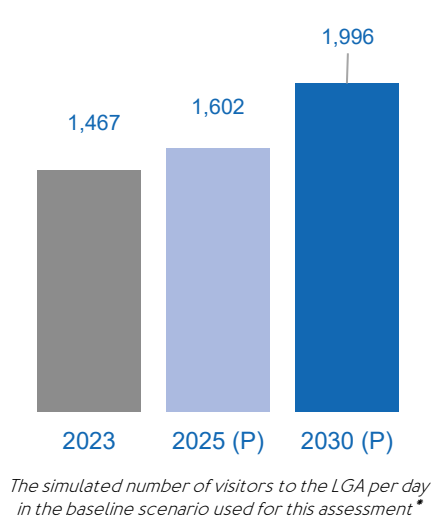
	2023	2025 (P)	2030 (P)
	1,467	1,602	1,996

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)

	2023 (E)	2025 (P)	2030 (P)
Individual	59,309	61,137	65,161
Industrial	75,035	100,968	212,066
Visitor	6,088	6,648	8,324

Population

2023 (E)	2025 (P)	2030 (P)
14,567	15,016	16,005

0% Urban
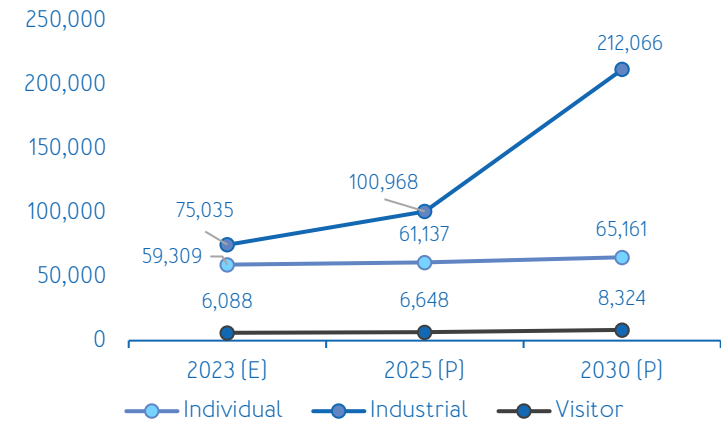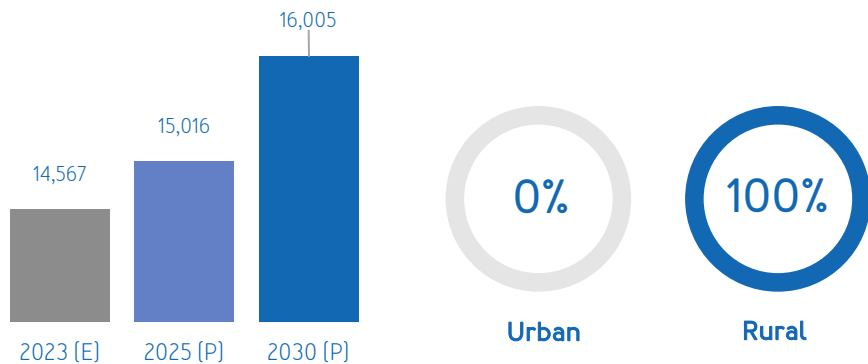
100% Rural

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.
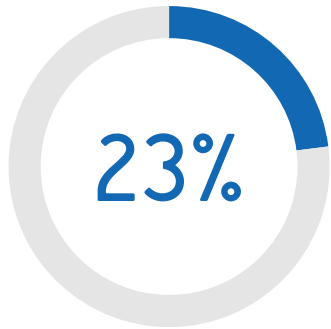
23%
Digital Connectivity Index (On the Move)

Access	51
Affordability	74
Demographics	40

Telstra	Optus	TPG
3G ✅	3G ✅	3G ✅
4G ✅	4G ✅	4G ✅
5G ✅	5G ✅	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
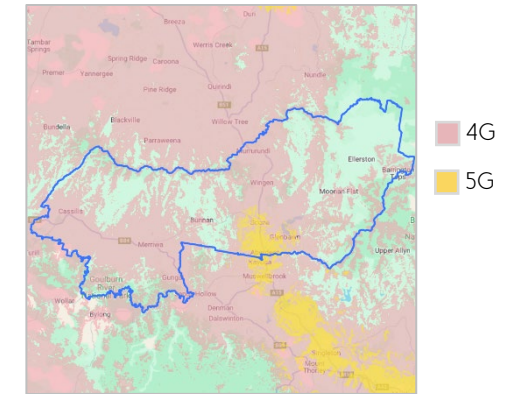
4G
5G

Map showing current mobile coverage in terms of 4G and 5G (Telstra, Optus, and TPG combined)
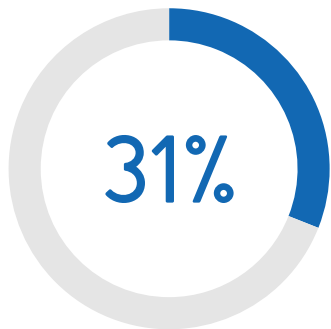
31%
Digital Connectivity Index (Stationary)

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

FTTP
FTTB
FTTC
FTTN
Fixed Wireless
Satellite
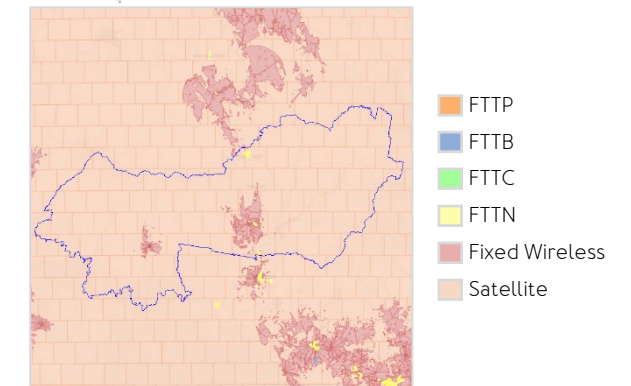
Wireless Connectivity Gaps: Upper Hunter

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:

44.6%
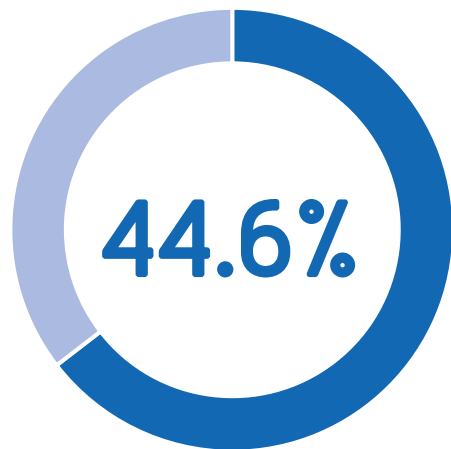
Dwellings with no fibre access
Dwellings with fibre access

Fibre to the Premises (FTTP):
0% (0 Dwellings)

Fibre to the Curb (FTTC):
0% (0 Dwellings)

Fibre to the Node (FTTN):
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: 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

Year	Population
2023	1,049
2025 (P)	1,065
2030 (P)	1,145

100%

Rural

(P) is for Projected Growth

Destination Sydney Surrounds North
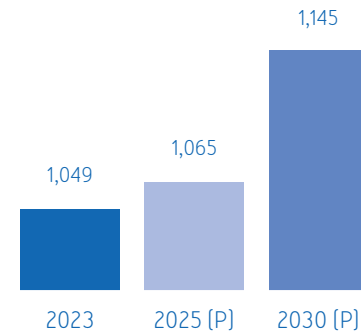
Telecommunications Infrastructure Review: Pokolbin

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.
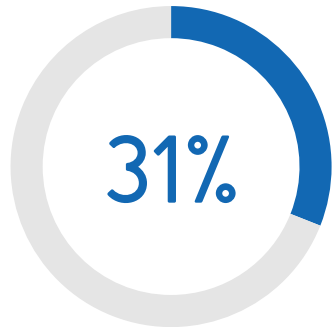
31%
**Digital Connectivity Index
(On the Move)**

Access	38	●●○○○
Affordability	74	●●●●○
Demographics	100	●●●●●

Telstra	Optus	TPG
3G ✅	3G ✅	3G ✅
4G ✅	4G ✅	4G ✅
5G ✅	5G ❌	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
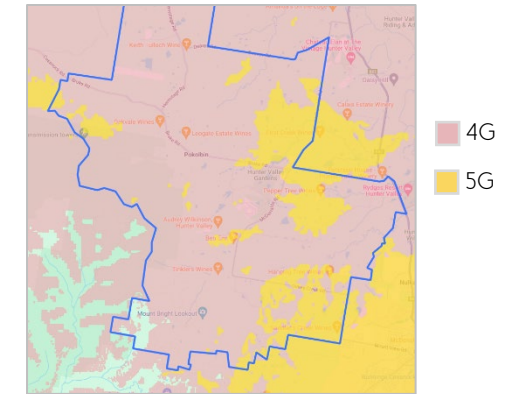
▨	4G
▨	5G

Map showing current mobile coverage in terms of 4G and 5G (Telstra, Optus, and TPG combined)
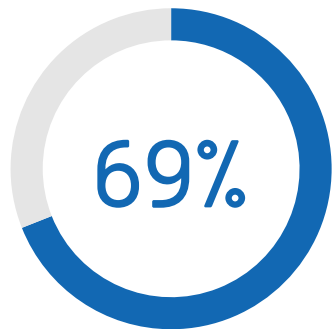
69%
**Digital Connectivity Index
(Stationary)**

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
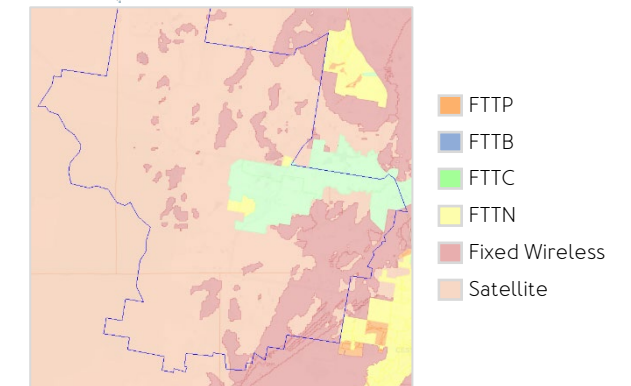
Wireless Connectivity Gaps: Pokolbin (Hope Estate - 20,000 visitors)

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: 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

8,109	8,359	8,909
2023	2025 (P)	2030 (P)

8.5%

Rural

*(P) is for Projected Growth*

Destination Sydney Surrounds North
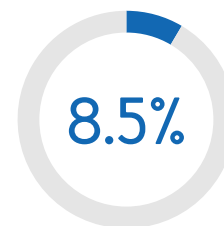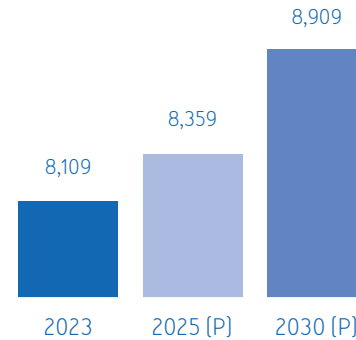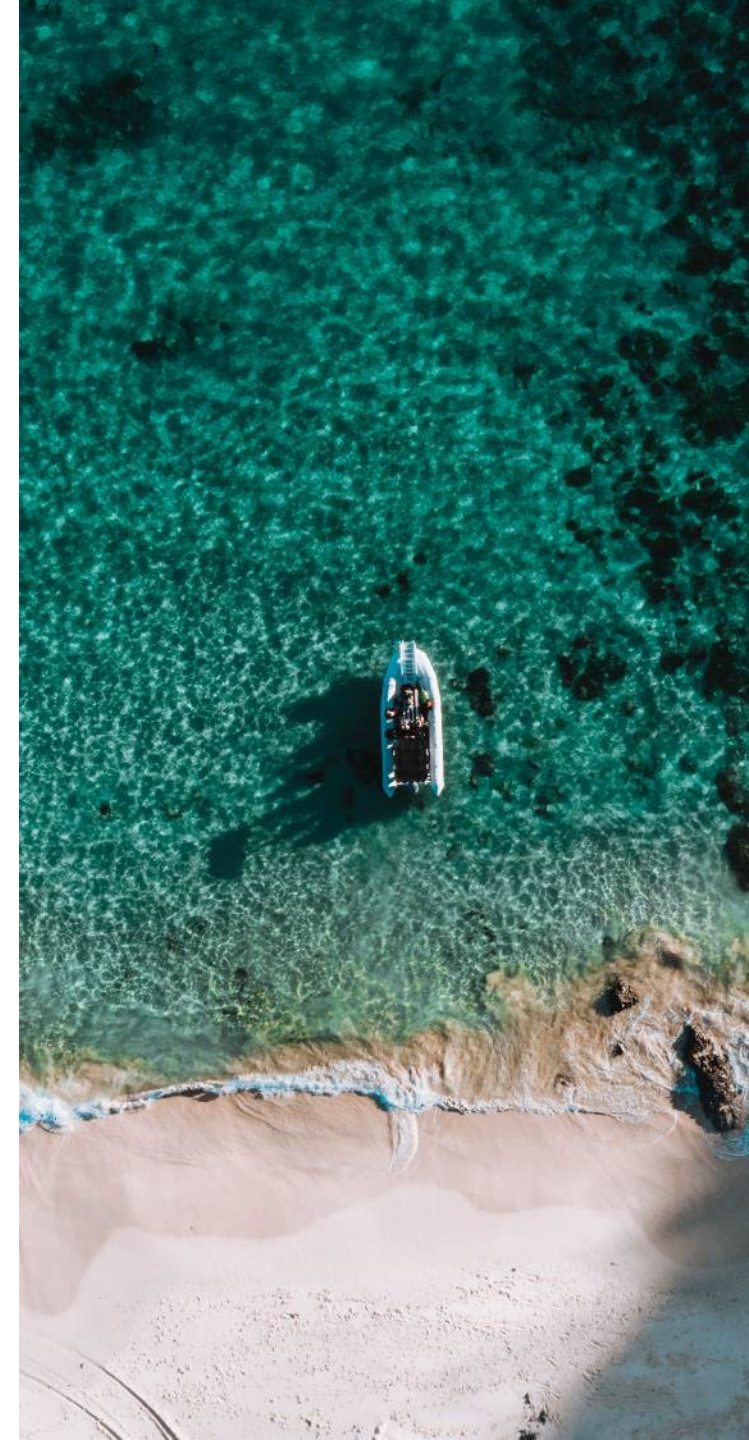
Telecommunications Infrastructure Review: Nelson Bay

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.

## 49%
Digital Connectivity Index (On the Move)
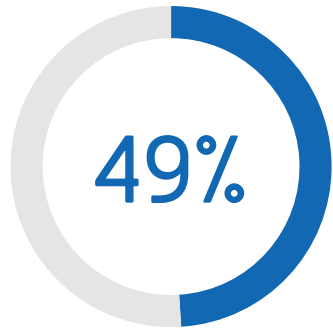
Access	86
Affordability	70
Demographics	53

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
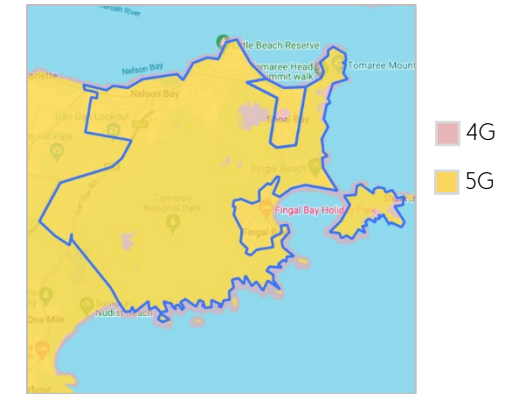
4G
5G

Map showing current mobile coverage in terms of 4G and 5G (Telstra, Optus, and TPG combined)

60%
Digital Connectivity Index (Stationary)
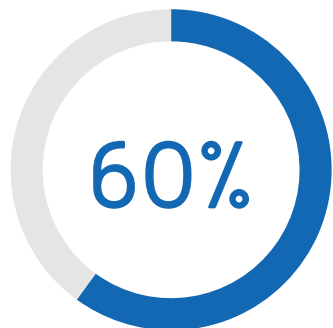
Access	99
Affordability	78
Demographics	53

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.

Current nbn Services

FTTP
FTTB
FTTC
FTTN
Fixed Wireless
Satellite
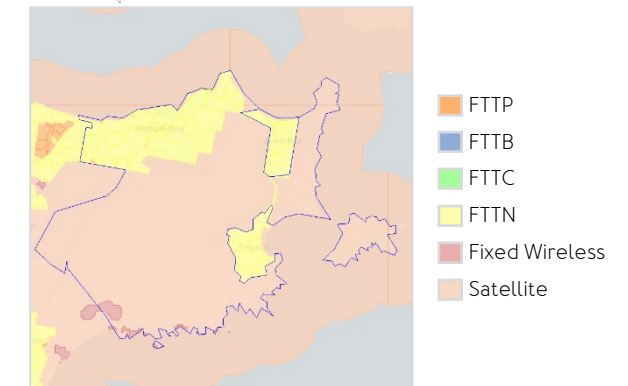
Wireless Connectivity Gaps: Nelson Bay

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.

(P) is for Projected Growth

Destination Sydney Surrounds North

Nelson Bay's population

| 2023	2025 (P)	2030 (P)
4,157	4,285	4,567

8.5%
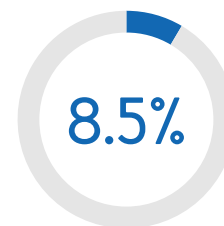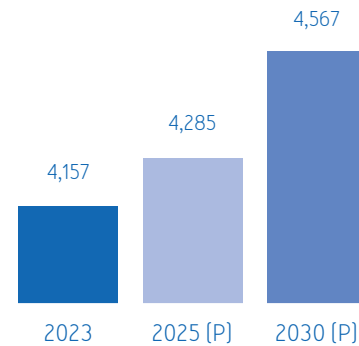
Rural

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.

55%

Digital Connectivity Index (On the Move)
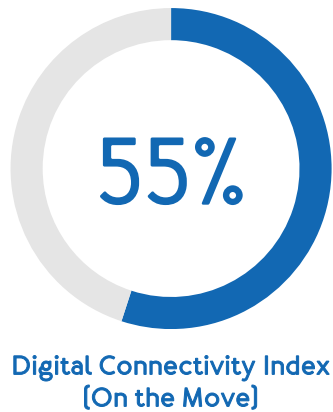
Access	**84**
Affordability	**78**
Demographics	**32**

|	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.
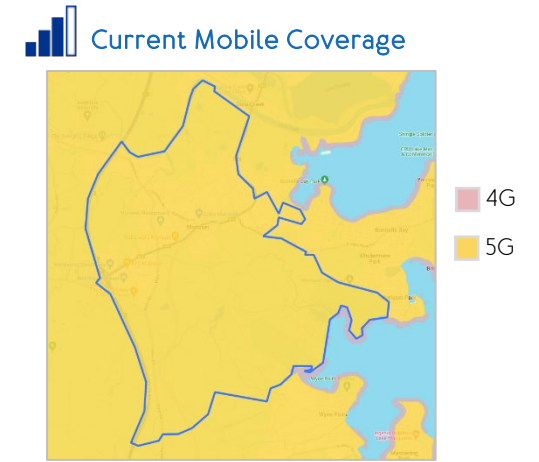
Current Mobile Coverage

- 4G
- 5G

Map showing current mobile coverage in terms of 4G and 5G (Telstra, Optus, and TPG combined)

62%

Digital Connectivity Index (Stationary)
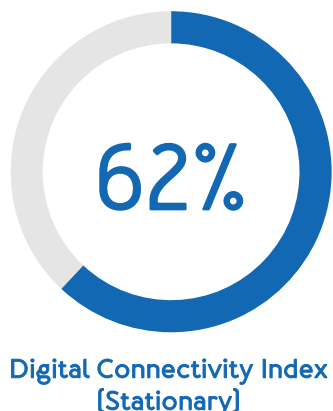
Access	**95**
Affordability	**86**
Demographics	**32**

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

- FTTP
- FTTB
- FTTC
- FTTN
- Fixed Wireless
- Satellite

Destination Sydney Surrounds North
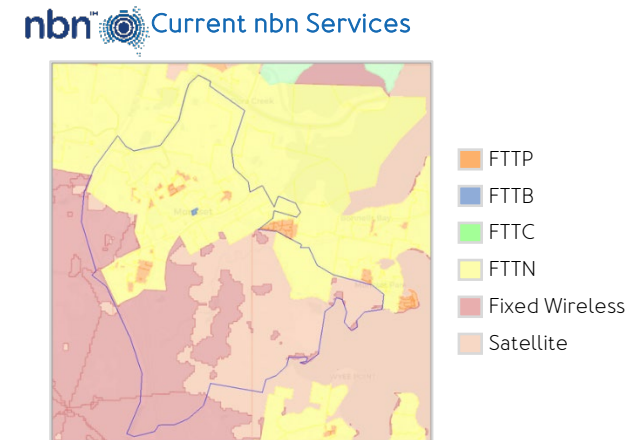
Wireless Connectivity Gaps: Cedar Mill (Morisset)

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	●●● (green)	●●● (red)	●●● (red)
2025 (P)	Connected devices	118,584	169,671	242,110
	Network capacity	●●● (yellow)	●●● (red)	●●● (red)
2030 (P)	Connected devices	140,816	201,573	287,919
	Network capacity	●●● (red)	●●● (red)	●●● (red)

(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:

- ●●● (green) Existing network capacity meets the estimated demand

- ●●● (yellow) Network may experience congestion during peak demand

- ●●● (red) 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.

(P) is for Projected Growth

Destination Sydney Surrounds North

The Entrance's population

2023	2025 (P)	2030 (P)
4,326	4,459	4,753

0%
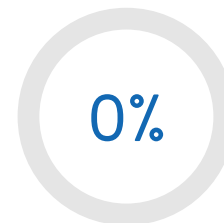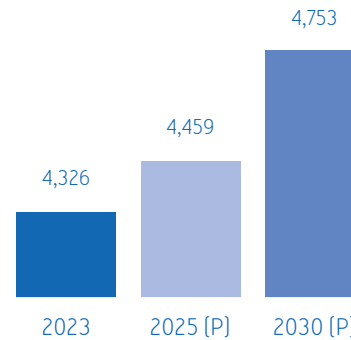
Rural

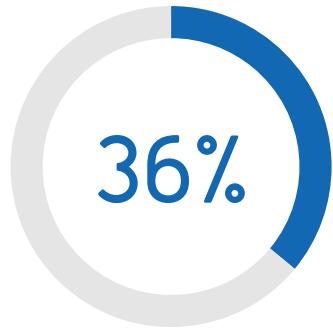# Telecommunications Infrastructure Review: The Entrance

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.

36%

Digital Connectivity Index
(On the Move)

Access	80
Affordability	76
Demographics	26

|	Telstra	Optus	TPG
3G	✓	✓	✓
4G	✓	✓	✓
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
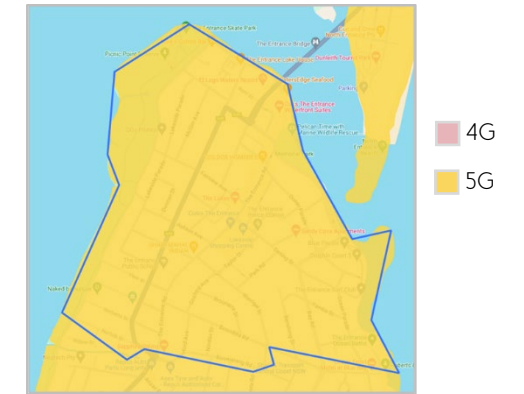
■ 4G
■ 5G

Map showing current mobile coverage in terms of 4G and 5G (Telstra, Optus, and TPG combined)

46%
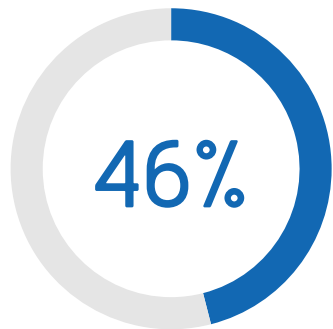
Digital Connectivity Index
(Stationary)

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

■ FTTP
■ FTTB
■ FTTC
■ FTTN
■ Fixed Wireless
■ Satellite

Destination Sydney Surrounds North
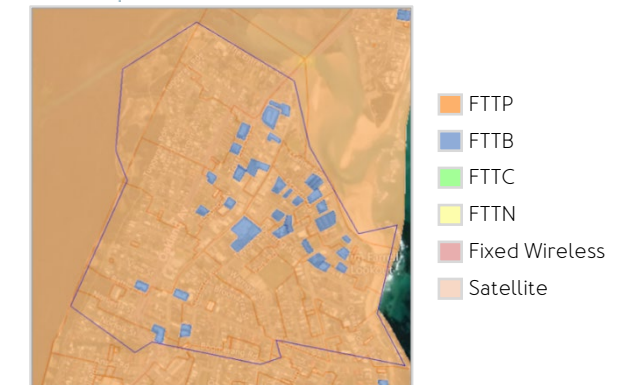
Wireless Connectivity Gaps: The Entrance

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).

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

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).
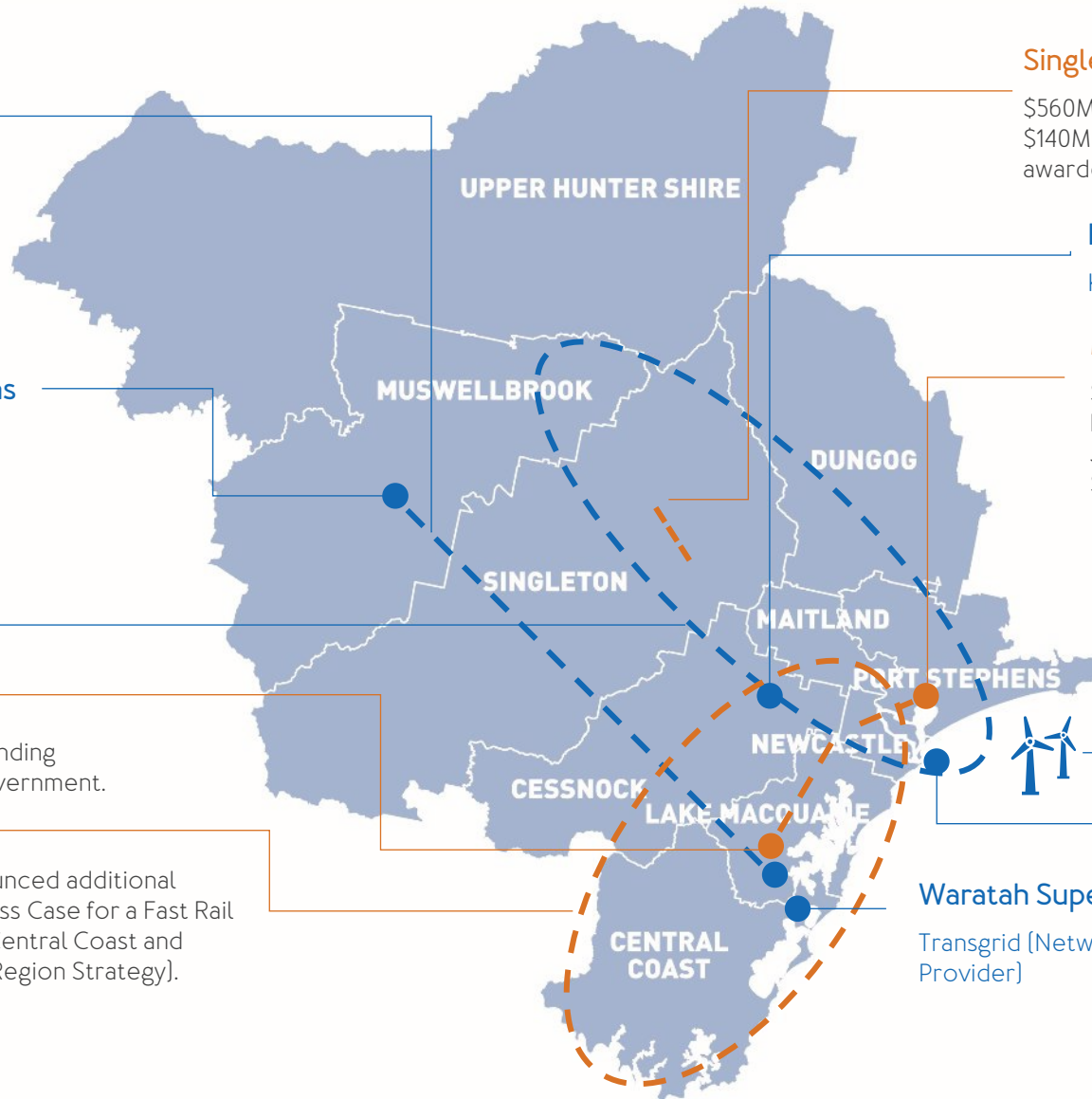
Singleton Bypass

$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
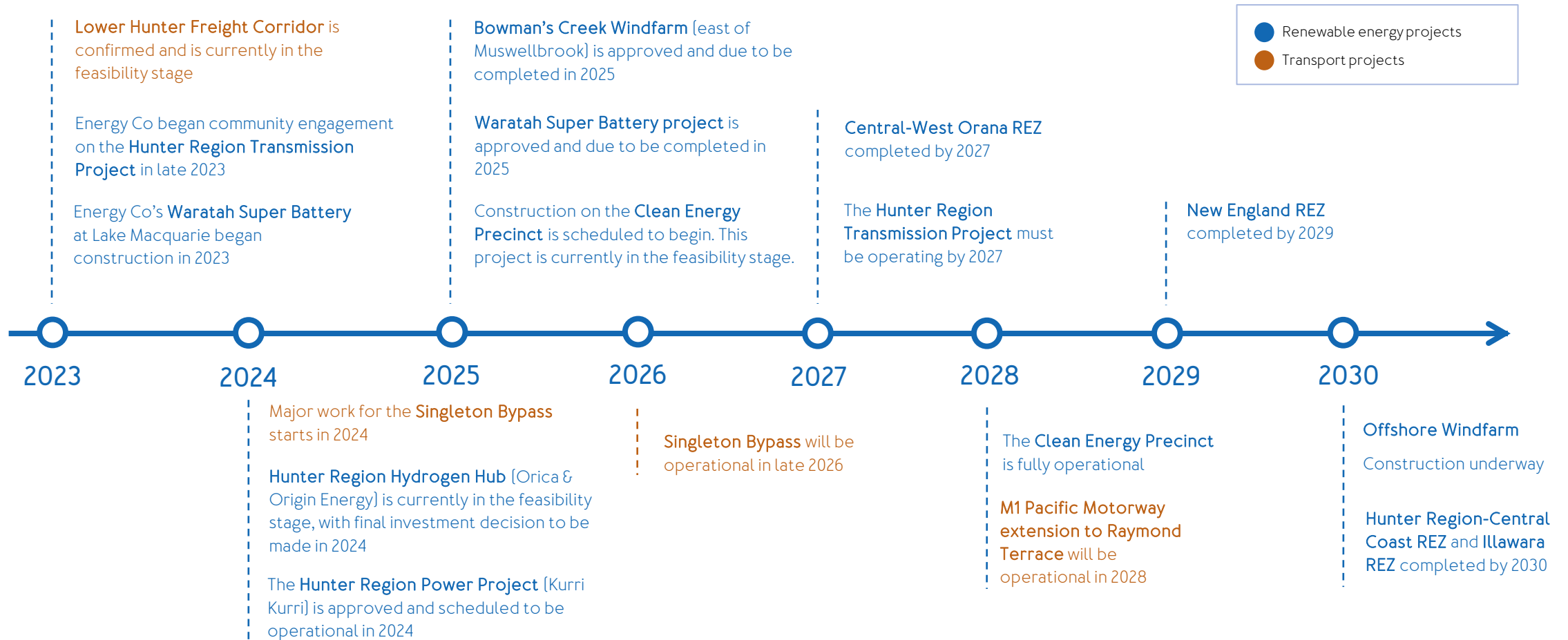
Port of Newcastle

Waratah Super Battery

Transgrid (Network Operator), Akaysha Energy (SIPS Service Provider)

UPPER HUNTER SHIRE
MUSWELLBROOK
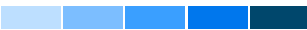DUNGOG
SINGLETON
MAITLAND
PORT STEPHENS
NEWCASTLE
CESSNOCK
LAKE MACQUARIE
CENTRAL COAST

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.

Legend:
- ● Renewable energy projects
- ● Transport projects

Above the timeline:

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

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.

2027
- **Central-West Orana REZ** completed by 2027
- The **Hunter Region Transmission Project** must be operating by 2027

2029
- **New England REZ** completed by 2029

Timeline years: 2023 — 2024 — 2025 — 2026 — 2027 — 2028 — 2029 — 2030

Below the timeline:

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

2026
- **Singleton Bypass** will be operational in late 2026

2028
- The **Clean Energy Precinct** is fully operational
- **M1 Pacific Motorway** extension to Raymond Terrace will be operational in 2028

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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Urban/Rural Population by LGA	Postcode delivery classifications - DAFF (agriculture.gov.au)
LGA Tourism Profiles	Local Government Area profiles	Tourism Research Australia
NSW Visitor Economy Strategy – projected visitor growth	NSW Visitor Economy Strategy 2030 (destinationnsw.com.au)
Average Number of Devices Per Capita	Cisco Annual Internet Report - Cisco Annual Internet Report (2018–2023) White Paper - Cisco
IoT Analytics – Total Number of Device Connections	IoT Analytics - Total Number of Device Connections
IoT Analytics – Global IoT Market Forecast	IoT Analytics - Global IoT Market Forecast
IoT Connections Forecast	IoT connections forecast – Mobility Report - Ericsson
Busy Hour calculations	Traffic Analysis - Cisco
Contention Ratio	Everything You Need To Know About Contention Ratio	Truespeed
Coverage Maps	ACCC Mobile Infrastructure Report	Telstra Coverage Maps	Optus Coverage Maps	TPG Coverage Maps	nbn National Map Datasets
nbn Technology Definitions	nbn Australia

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The Six Cities Region	The Six Cities Region: Discussion Paper, September 2022 (nsw.gov.au)
Singleton Bypass	Singleton Bypass - New England Highway	Transport for NSW
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Media article – Universal Service Obligation Update	Albanese Govt Seeks Input on Universal Service Obligation Update	Mirage News
Media article – FTTN upgrades	nbn Co to receive $2.4 billion to extend FTTN overbuild - Telco/ISP – iTnews
NSW Remote Working Insights 2 Report	https://www.investment.nsw.gov.au/assets/Uploads/publications/NSW-Remote-Working-Insights-November-2021-report.pdf

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**.
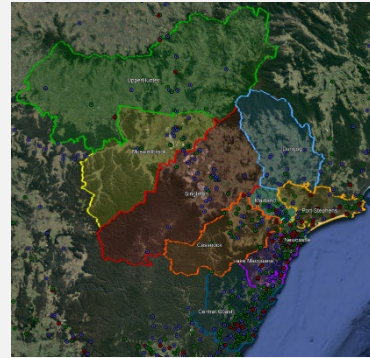
Existing Number of Mobile Sites for each DSSN Region:

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

nbn™ 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

Mobile site profiles

Existing mobile sites per LGA

Simulated capacity methodology

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.

Region	Number of Sites	3G/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	40	0
Port Stephens	79	27	9	43
Singleton	39	8	1	30
Upper Hunter	24	4	0	20

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.
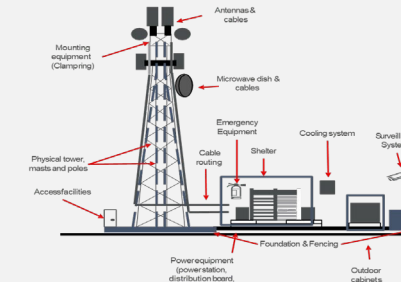
Wireless - Mobile Site Profiles

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.

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

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

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
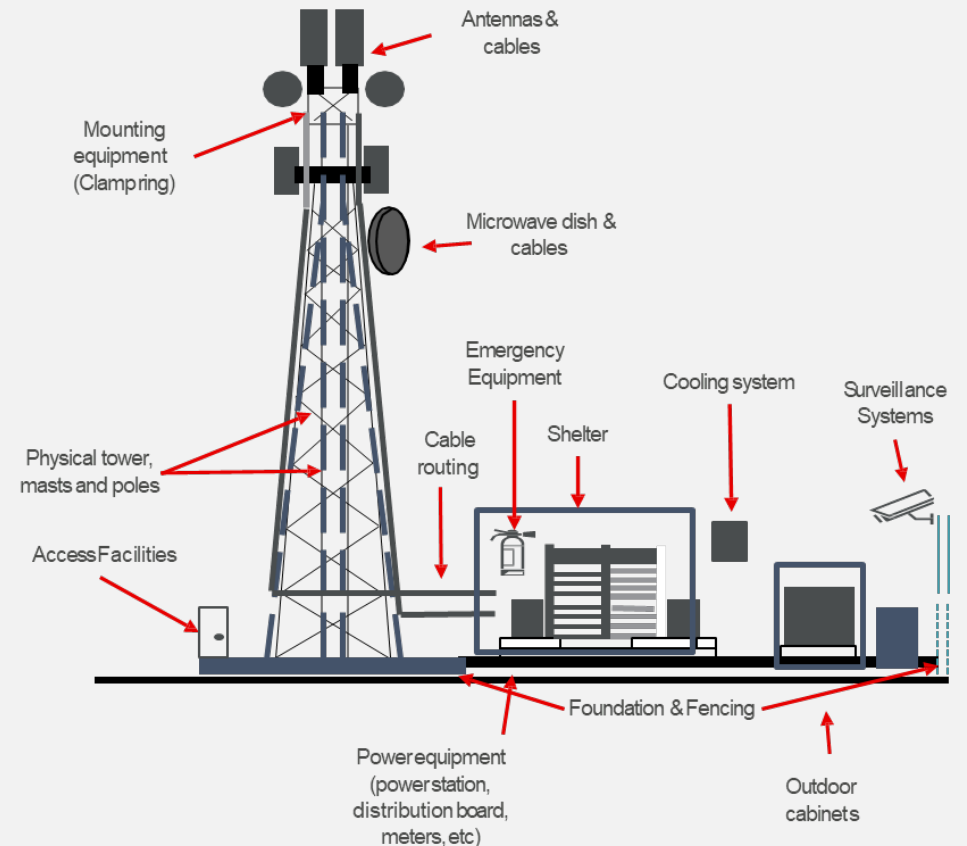
Components and cost estimation of new mobile sites

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
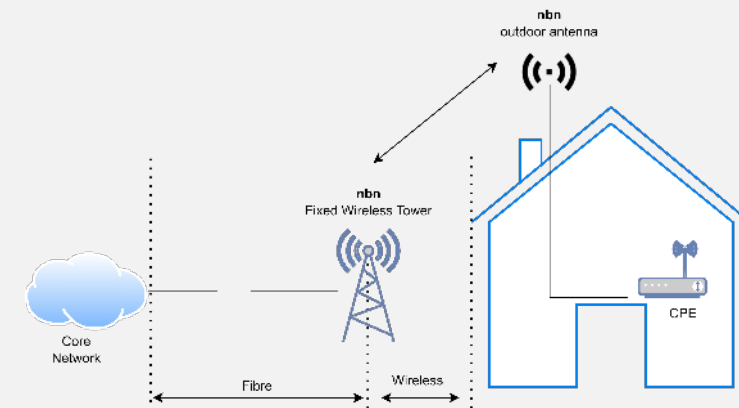
- **Customer Premises Equipment (CPE):** This is the equipment installed at the user's location, such as a home or business. It includes a wireless transceiver or modem that communicates with the base station.

- **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 / OneWeb — 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 / Lynk — 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 — 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
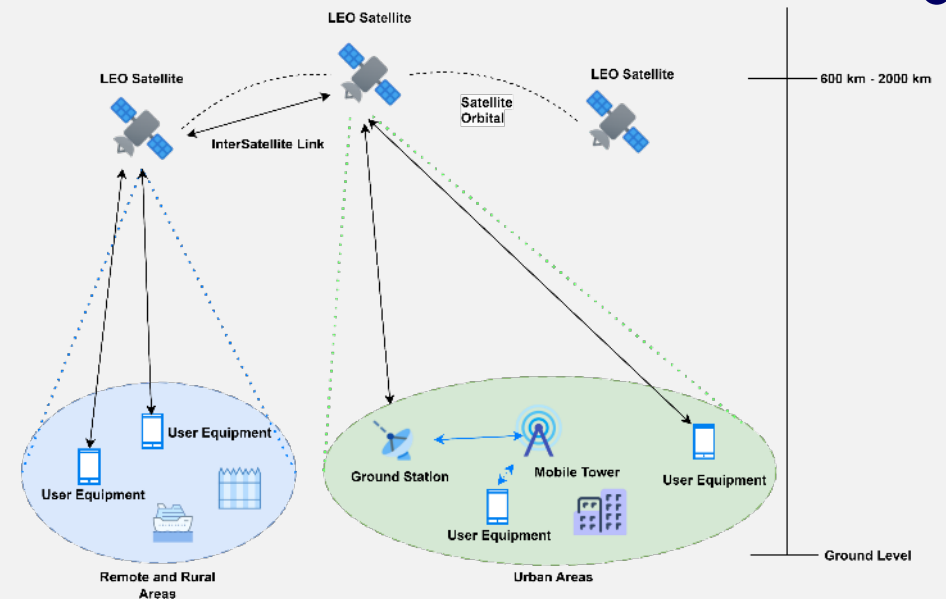
- **User Equipment**: Industrial or individual devices or systems used by end-users to communicate with or access services provided by LEO satellites

- **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	Coverage Radius: 5km	Capacity: ~350 simultaneous users	Connectivity: Access and Backhaul	Approx. Cost:**
Maximum height of 20 meters for each antenna, making this solution more adaptable for flat terrain	Depending on the terrain's topography, a CoW solution can cover up to 5 km	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	**Access:** Mobile Access and Satellite (SatCOLT) **Backhaul:** Satellite	**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.