

Infrastructure Western Australia

State Infrastructure Strategy
Digital and Telecommunications



Assessment Report



Author	Version	Date	Description	Reviewed By
GreX	V3.0	23/07/2021	Revision for Publication	GreX Consulting

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1. Executive Summary

Findings and Recommendations

Digital Connectivity is a key enabler than underpins all of the priority sectors considered under the State Infrastructure Strategy, in addition to being a sector in its own right.

The single most pressing issue identified from the findings is that there are many areas of regional and remote WA which are currently either underserved or unserved entirely, and this situation will continue unless there is a coordinated program of action to address the gap. This is the summary based on the desktop assessment conducted on the input data provided by IWA, the Australian Digital Inclusion Index, analysis of the current state digital connectivity across WA and the anticipated increased demand for digital connectivity.

The challenge for Government is to determine its role, along with that of Commonwealth Government, Local Government, Industry Business, and the Community, in improving digital connectivity within the current telecommunications market and regulatory structure in WA to maximise the economic, social and productivity benefits that connectivity can bring.

The recommendations proposed detail the Government's opportunities to act from four perspectives:

- **Partner and Collaborate** – creating an engagement and relationship environment with the Commonwealth Government and Industry bodies to leverage capabilities, co-investment, and program opportunities to proactively develop and implement sustainable digital connectivity solutions that address the digital divide, in alignment to a statewide integrated plan for digital connectivity.
- **Governance and Oversight** – establishing the Whole of Government state-wide integrated plan that provides focus, co-ordination, and accountability to address the digital divide as a Government priority, supported by a governance framework that enables data-driven, benefits-oriented decision making and direction.
- **Policy and Supporting Capabilities** – leveraging State Government's policy powers and assets to support the development of digital connectivity, increasing Government's participation in creating the digital divide solution and reducing the entry-cost barriers for industry.
- **Transformation Enablement** – supporting the development of digital ability and increasing affordability for community and businesses to enable increased adoption of digital connectivity and creating an environment by which to share digital connectivity knowledge to encourage innovation and commitment.

The benefits of improving digital connectivity include:

- **Increased business activity and economic growth**, enabling access to global markets, that flows-on to new employment opportunities and increased regional and economic activity.
- **Price decreases for businesses and households**, resulting from the evolution and improvement in broadband services to consumers on standardised plans (rather than bespoke)
- **Increased social inclusion**, through:
 - Increased opportunity to work remotely,
 - Improved access to on-line services,
 - Enhanced ability to connect with family and friends.

- **Environmental improvements**, from reduced carbon emissions due to reduced travel and improved transport management
- **Health impacts**, with increased access to health care services and the psychological benefits from inclusion.

Report Development Process

A structured approach was taken by Grex in assessing digital connectivity within Western Australia, as shown in Figure 1.

Based on the SIS Consultation Outcomes Report, SIS Scenario Planning report, a number of other inputs received from Infrastructure Western Australia and the stakeholder engagement interviews conducted with selected WA State Government departments, government owned enterprises and industry players, a state-wide target state for digital connectivity was defined and characterised in a set of outcomes statements.

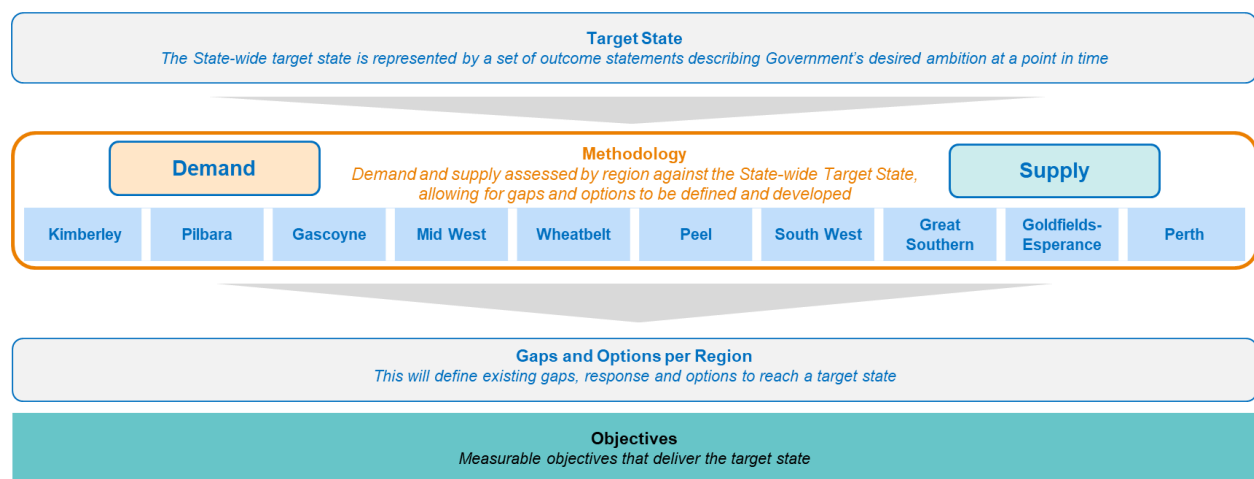


Figure 1 Grex Report Development Approach (Source: Grex)

Based on the target state, an analysis of the demand and supply of digital connectivity for Perth and each of 9 regional development commission areas was conducted. A subsequent gap analysis between the demand and supply states for each of the regions was identified along with a set of options to achieve the target state. From the gap analysis, the objectives, and opportunities for Government to act, across the four areas previously discussed, were developed.

The stakeholder interviews were conducted with industry players and:

Government Departments:

- Office of Digital Government, Department of the Premier and Cabinet
- Department of Primary Industries and Regional Development
- Department of Jobs, Tourism, Science, and Innovation
- Department of Fire and Emergency Services

Government Trading Enterprises:

- Horizon Power
- Water Corporation
- Western Power

Current State Summary

Digital Connectivity Market in WA

The Australian digital connectivity market comprises:

1. telecommunications network owners/operators, dominated by a small number of tier 1 organisations operating national fixed and/or mobile networks and services, and tier 2 service providers operating limited national or regionally focused networks and services.
2. An increasing number of global, national, and local data centre owners and operators and content providers.

In regional WA, access is provided using Fixed Wireless and Satellite technology, which has the largest coverage footprint with Fibre to the Node/Premises/Curb serving higher density population areas.

From a mobile coverage perspective whilst there is good coverage in metro areas and regional population centres, there are 1750¹ registered mobile blackspots across the State. Of these registered blackspots, approximately 1350 are located in outer regional, remote, and very remote locations.

There are large areas of regional and rural WA where fixed service, (including Fibre to the Premises/Building/Node/Curb, Hybrid Fibre Coax, Fixed Wireless² and Satellite technologies) is the only broadband connectivity option for residential and small to medium sized businesses, as the mobile coverage either does not exist at the location or does not deliver the required access speeds.

In regional and rural areas where large businesses have been established, for example mines, enterprises have often deployed their own connectivity through use of tailored, complex, private network solutions.

From a Digital Inclusion perspective, the Australian Digital Inclusion Index (ADII) 2020³ rates WA second against other states and territories - behind ACT and ahead of NSW and Victoria. There is however a significant differential between the Perth and south-west regions and the Other WA regions, as defined in the ADII. The major differences occur across all three of the ADII rating areas:

- Access - internet access and internet data allowance
- Affordability - relative expenditure and value of expenditure
- Ability - attitudes, basic skills, and activities⁴.

WA Government Activity and Initiatives

Various WA State Government departments and Government Trading Enterprises have initiated a broad range of activities and initiatives in and around digital connectivity for the residents and businesses of WA as well as internal Government operation.

- The Office of Digital Government is leading the digital transformation of the WA Public Sector, including procurement reforms (GovNext-ICT 2015 program) and cyber security.
- The Department of Primary Industries and Regional Development has taken the leadership role in the Commonwealth Government's Regional Connectivity Program (RCP) and the Mobile Black Spots Program (MBSP), as well as delivering the Digital Farm Grants Program that has awarded \$13.3m in co-investment grants to address last mile access in regional WA.

¹ Source: National Mobile Black Spot Database of Reported Black Spot locations

² Also referred to as FTTx, HFC and FW in the report

³ Measuring Australia's Digital Divide; The Australian Digital Inclusion Index 2020

⁴ Source: ADII 2020 Web tables

- The State's utilities have undertaken programs to improve cyber security for critical infrastructure and have deployed access technologies or engaged with third party providers to connect to sensor/control devices.
- The emergency services are commencing the development of a shared mobile radio network to serve the operational communications needs of the emergency services.
- WA's Department of Jobs, Tourism, Science, and Innovation (JTISI) conducts the role of lead-agency for State-significant projects, which includes the development of specific digital connectivity requirements to serve the project's needs, such as the Square Kilometer Array and R&D and Innovation precinct, where upgraded digital connectivity infrastructure could be used to serve local community and businesses.

Summary of Digital Connectivity Demand

Based on the analysis conducted, the evolution of the digital connectivity demand in WA (in terms of coverage – service area, access speed – bandwidth, capacity – data volume and number of users supported, performance – latency and reliability) is characterised by:

- Increased mobile and fixed coverage and capacity in and around the urban areas to address population and urban area growth, with mobile coverage infill required in areas of low to poor coverage,
- Significantly increased mobile and fixed access speeds in and around urban areas due to the adoption of data-hungry applications (virtual/augmented reality, autonomous vehicles), and changes in working practices, as seen in the COVID pandemic,
- Access to higher-speed mobile and fixed connectivity services in regional and rural areas to support social, business, and economic development and equity (e.g., on-line media streaming, education, access to government digital services, tele-health, cloud business services, social media),
- Increased mobile coverage and capacity along main arterial and regional highways and roads and places of interest to support social, business, and economic development needs on the move (e.g., business operation and administration, supporting tourism, autonomous vehicles, and transport management for goods),
- Improved performance of fixed (Satellite) and mobile services in regional and remote areas to support the adoption of low latency applications (such as voice, video conference, virtual/augmented reality, real time control applications),
- Increased coverage of fixed and mobile services in regional and remote areas to support an increased deployment of IOT capabilities to increase productivity (e.g., agriculture) and management/security of critical infrastructure (such as power and water utility networks),
- Increased capacity to connect large volumes of IOT devices deployed within urban areas for domestic, smart city and smart utility purposes,
- Resilient coverage and capacity across the State for use by Public Safety and Emergency services in times of incident and disaster, and
- Increased number of 'pockets' of high-speed digital connectivity to service specific industry development and economic diversification, such as industry precincts, mines, carbon neutral energy production sites and key enterprise locations (e.g., Square Kilometre Array).

Figure 2 illustrates some of the applications that are driving the demand evolution in terms of the bandwidth required and the need for low-latency networks.

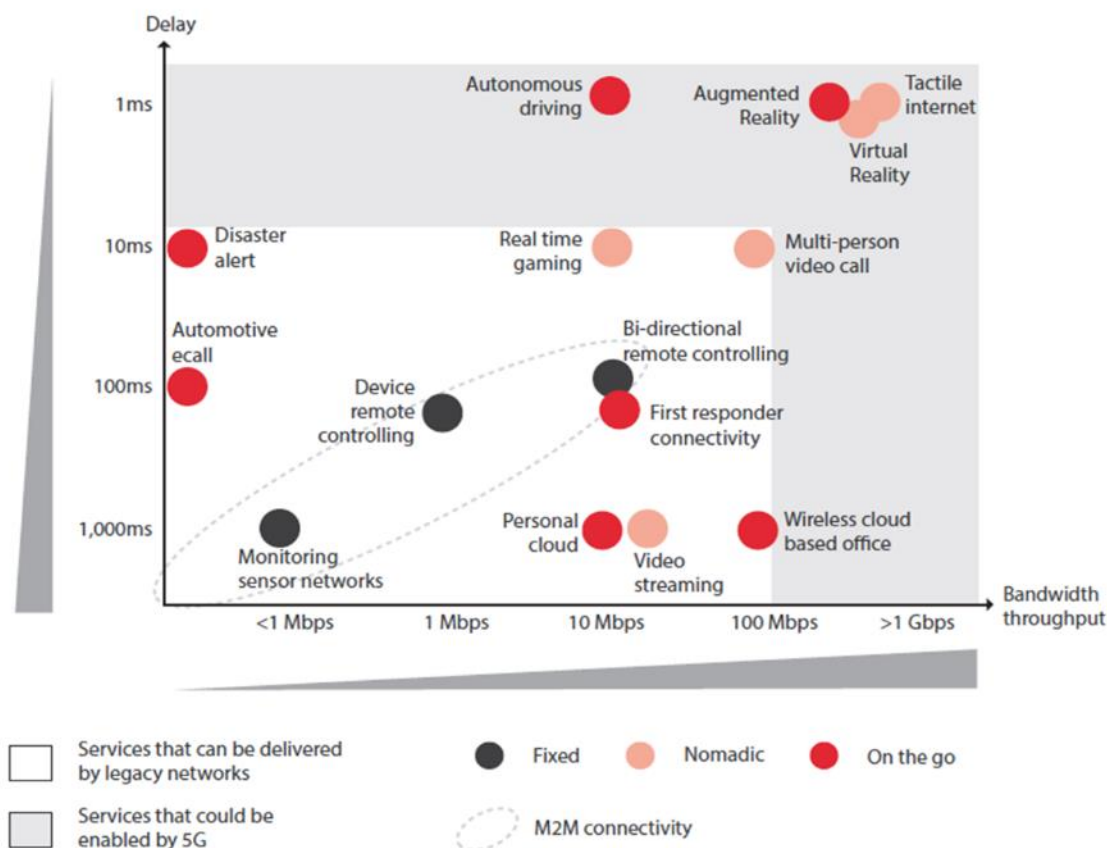


Figure 2 Application Bandwidth and Latency Requirements (Source: GSMA Intelligence)

The fixed line bandwidth requirements for residential and small business in Australia have been estimated by the Australian Government Bureau of Communications and Arts Research⁵ (BCAR). The BCAR research shows that 95 per cent of Australian households had bandwidth demand of 24 megabits per second (Mbps) or less in 2018, and this is forecast to increase to 56 Mbps or less in 2028. Average monthly household data downloads are forecast to rise from 199 gigabytes in 2018 to 767 gigabytes in 2028. This represents a compound annual growth rate of 14 per cent over the forecast period.

This increase in bandwidth and data demand is forecast to be driven by video streaming in higher resolution formats, such as 4K and 8K television. Increased adoption of streamed gaming and virtual reality will add to this demand, while compression technology, which reduces data requirements, is expected to partially offset the growth in bandwidth demand.

For small business, the BCAR estimates that 95 per cent of Australian small businesses (those with fewer than 20 employees) had bandwidth demand of 24 Mbps or less in 2018. This is forecast to rise to 37 Mbps or less in 2028. Small business bandwidth demand will also be driven by video streaming, file transfers and web browsing. Industries that provide WiFi as a service, such as education and accommodation, are forecast to have the greatest bandwidth demand due to internet usage by non-employees.

From a mobile coverage perspective, the demand for increased coverage is chiefly driven by either the need to address the mobile black spots, as identified as part of the Federal Government

⁵ Australian Government Bureau of Communications and Arts Research Demand for fixed line broadband in Australia 2018-2028 Fact sheet July 2020

Mobile Black Spots Program, or to expand the coverage footprint to cover the areas of population and urban growth that will arise in the State.

Industry forecasts and insights cite that the average mobile speed is expected to more than triple to 43.9 Mbps. It is expected that the 5G speeds in the 2023 timeframe will be 13 times higher than the average mobile connection.

This view demonstrates that whilst digital connectivity throughput demand is generally met in the metro and regional urban areas of WA, and therefore supported for the large proportion of the WA population, there is a large geographic area of WA where the demand is not met.

Summary of Digital Connectivity Supply

The current state of digital connectivity supply for nbn fixed services and mobile (3G and 4G) technologies, modelled by Grex based on publicly available information, is shown in Figure 3. This shows a number of key features:

- Concentration of the higher speed nbn fixed capabilities (FTTx, HFC) within metro, and regional urban areas;
- The deployment of nbn Fixed Wireless in regional towns and South-West of the state;
- The prevalence of nbn Satellite services across regional and remote WA; and,
- Mobile coverage centred on the population centres with partial coverage of transport routes.

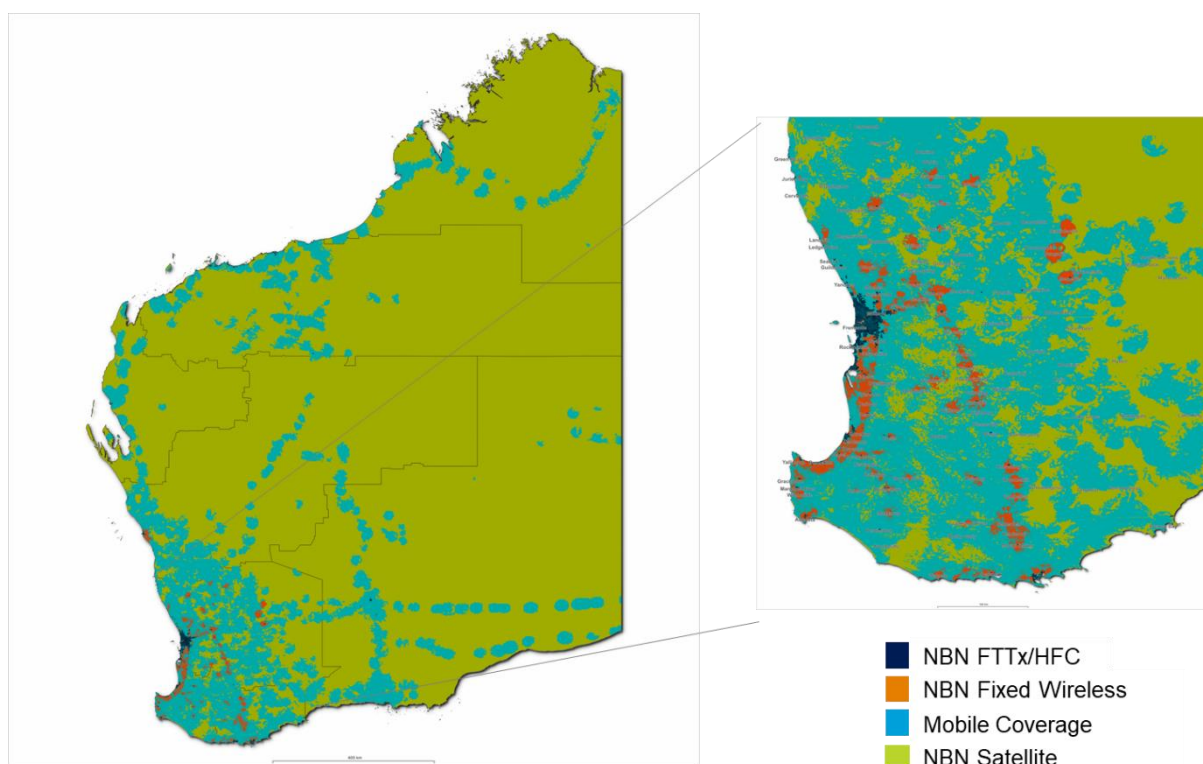


Figure 3 State-wide Summary of Fixed and Mobile Coverage within WA (including South West WA insert)
(Source: Grex based on RFNSA data)

There are a number of industry developments that are either in progress or planned to occur that will further increase the supply of digital connectivity capability across the state. These include:

- nbn Co's announced \$4.5B network upgrade program. Under this program nbn Co will:

- spend up to \$3.5bn to make nbn's highest wholesale speed plans available to 75 percent of households and businesses, moving FTTN customers to FTTP, further investing in HFC solutions and providing an uplift for FTTC connected customers.
 - Increase in-home speeds for FTTN users.
 - Spend up to \$700m in collaboration with industry to help deliver enhanced digital capabilities.
 - Making business-grade fibre services more accessible and affordable for small and medium businesses in 240 business fibre zones. 18 business fibre zones have been identified in metro WA and 5 in regional WA - Albany, Bunbury, Busselton, Geraldton, and Margaret River.
 - Spend up to \$300m in co-investment with governments and local councils to improve access for rural and regional communities, with a focus on migration from satellite or fixed wireless to fixed line technologies.
 - nbn will also improve the technology choice program to make it more cost effective for residential and business customers to change access technologies.
- Fixed – Regional Connectivity program to address regional connectivity. The Federal Government recently announced (April 2020) \$90.3m funding for 81 place-based telecommunications infrastructure projects across regional, rural and remote Australia. The projects include new and improved mobile voice and data coverage, fixed wireless and fibre broadband services, and improved microwave and fibre backhaul capacity. The commitment will leverage over \$90m in additional funding from state, territory and local governments, telecommunications providers, regional communities, and regional businesses. 16 projects were awarded in WA.
- Fixed – Low Earth Orbit (LEO) satellites. A number of LEO satellite network operators are active either deploying, trailing or offering commercial LEO satellite services. Beta trial have commenced for a limited number of 'first-come, first-served' customers offering speeds of between 50Mbps to 150Mbps.
- Mobile – 5G deployment. Mobile Network Operators have commenced the roll-out of 5G networks across the country, using low- and mid-band spectrum.
- Mobile – Mobile blackspots. The Australian Federal Government has indicated the intention to launch a Mobile Black Spots Program round 6 of funding to address mobile blackspots. As noted previously, some 300 of the original 2,000 mobile blackspots identified by the 2018 Department of Primary Industries and Regional Development, Telco Investment Prioritisation Study (TIPS) have been addressed through the previous 5 rounds of Federal Government funding. As with the previous funding rounds, it is expected that this round 6 process will require the State Government, local government, and industry to collaborate to prepare a co-investment proposal.

Conversely, there are market changes that will impact the supply side, such as the decommissioning of the 3G mobile networks that will create supply issues and incur costs for entities such as the utility providers for operational control and supervision and workforce management.

Summary of Digital Connectivity Gaps

The gap analysis between the demand and the supply indicates that the evolving digital connectivity demand for major metro/regional population centres in the South West and along the coast areas of the State should be met. In the areas of WA where the fixed access services are constrained by the available technology parameters or there is limited or no mobile network coverage and/or capacity, the demand may only be partially met today and the ability to meet the increasing demand expectations could lessen over time without technology uplift and investment.

Digital Inclusion Gaps - Affordability and Ability

According to the Australian Digital Inclusion Index 2020 report, the Affordability and Digital Ability gaps between Perth and Regional WA ('Other WA') are continuing and not showing signs of being resolved (see Figure 4 and Figure 5). Some key demographic groups (low-income quintile, not in labour force, non-secondary educated, aged 65 years+, indigenous and disability groups) show increased levels of disadvantage.

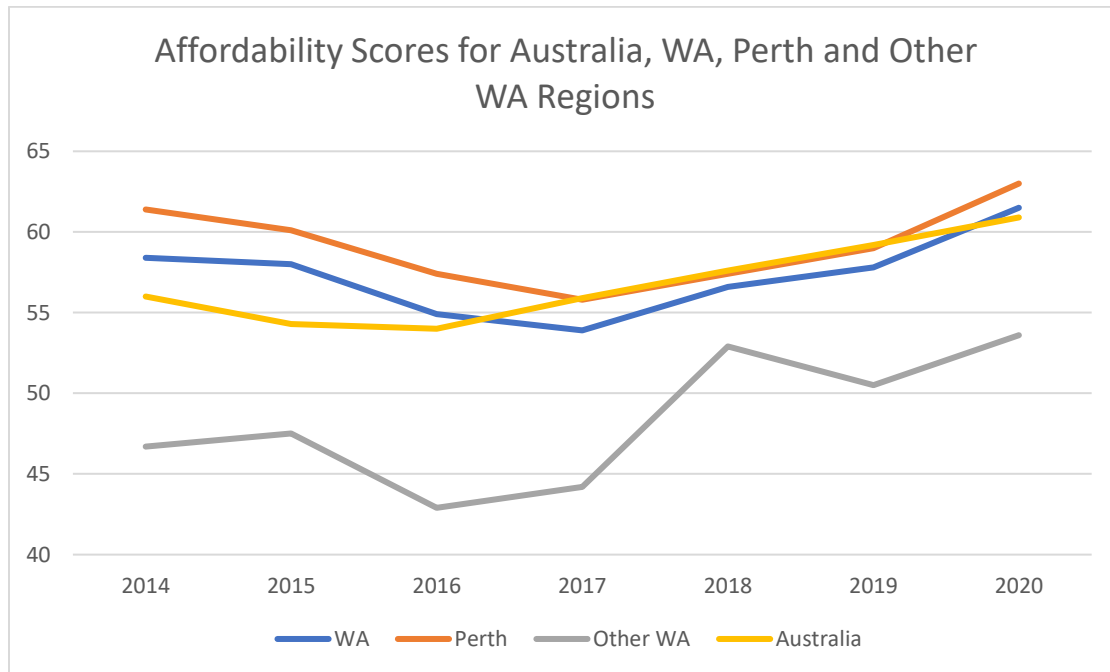


Figure 4 ADII Affordability Trends for WA, Perth and Other WA (Source: Grex based on ADII Report 2020 data)

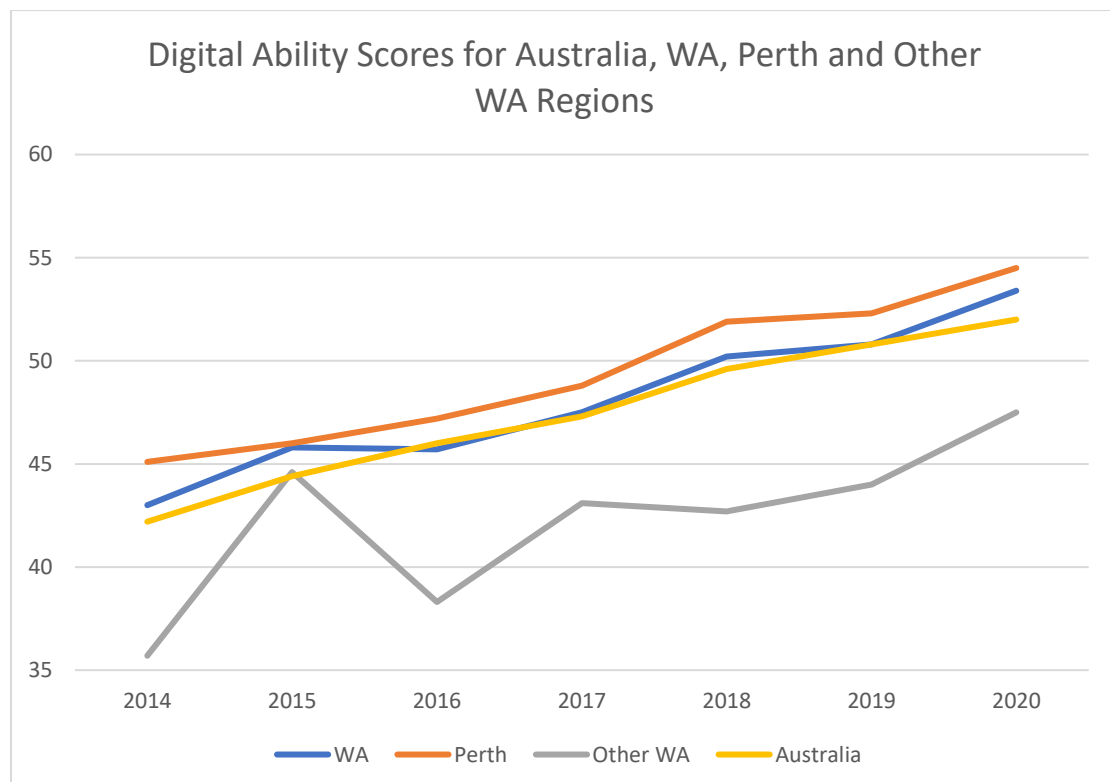


Figure 5 ADII Digital Ability Trends for WA, Perth and Other WA (Source: Grex based on ADII Report 2020 data)

Consequences – The Benefits of Improved Connectivity and Closing the Digital Divide in WA

As a consequence of addressing the digital connectivity, adoption and ability gaps, there are a number of benefits that Grex has analysed that may not be realised if closing of the digital divide is not achieved.

Opportunities

As a consequence of the analysis conducted, the draft recommendations put forward to IWA for consideration in developing the recommendations to be carried forward to the final SIS are summarised in Figure 6. The opportunities have been developed to leverage a wide range of potential commercial, technology and delivery levers for Government beyond the simple 'Government invests' approach:

- The broad understanding, by the Government Departments and Agencies, of the issues and a willingness to support the improvement of connectivity across the State;
- The existing Commonwealth and State Government programs, initiatives, activities, and engagements;
- Government participation in solving the digital divide issue through using its powers and assets, including data sharing;
- Government's aggregated procurement spend and adjacent procurements;
- The market's capability and willingness to participate/co-invest in addressing the digital divide issue;
- Alternate technology solutions and innovation opportunities; and,
- Best practice investment assurance

Partner and Collaborate
<i>Opportunity 1 – Collaborate with Commonwealth and Other State Governments to advance Digital Connectivity in WA</i>
Opportunity 1.a – A whole of government engagement and relationship framework to work and collaborate with the Commonwealth Government
Opportunity 1.b – A whole of government engagement and relationship framework to work and collaborate with Other State Governments
<i>Opportunity 2 – Collaborate with the major Australian Service and Network Providers to advance Digital Connectivity development in WA</i>
Opportunity 2.a – A whole of government collaboration with nbn
Opportunity 2.b – A whole of government collaboration with Mobile Network Operators on the development of the mobile networks within WA.
Opportunity 2.c – A whole of government collaboration with emerging Low Earth Orbit and Medium Earth Orbit Satellite access providers
Opportunity 2.d – A whole of government collaboration with Local Wireless Access providers to deliver area specific last mile solutions
Opportunity 2.e – Collaboration with key Industry Sectors to support diversification of the economy in regional and remote areas.
<i>Opportunity 3 – Collaborate with Industry Peak Bodies and Academic institutions to create and maintain a forward-looking digital connectivity vision and demands and needs analysis.</i>
<i>Opportunity 4 – Increase achievement of digital connectivity outcomes and value for money from Government's co-investment in digital connectivity programs</i>
Opportunity 4.a – Co-investment delivery methodology
Opportunity 4.b – Program and projects benchmarking

Governance and Oversight
<i>Opportunity 5 – Cross-Government co-ordination and management of digital connectivity</i>
Opportunity 5.a – Cross-government governance and oversight

Opportunity 5.b – Blueprint for Digital Inclusion
Opportunity 5.c – Benefits Management
Opportunity 5.d – Investment Assurance

Policy and Supporting Capability
<i>Opportunity 6 – Commit investment to develop digital connectivity</i>
Opportunity 6.a – State-wide digital connectivity policy
Opportunity 6.b – Investment Policy
<i>Opportunity 7 – Increase Government participation in the development of digital connectivity through access provided to Government assets and infrastructure</i>
Opportunity 7.a – Asset Access and Co-location policy
Opportunity 7.b – Asset Access and Co-location Data and Collateral
<i>Opportunity 8 – Increase Government participation in the development of digital connectivity through support to Digital Security.</i>
Opportunity 8.a – Whole of state digital security policy for critical infrastructure aligned to the national cyber security strategy and the Security Legislation Amendment (Critical Infrastructure) Bill 2020.
Opportunity 8.b – Digital Security Support
<i>Opportunity 9 – Increase Government participation in the development of digital connectivity through Leverage of Government Procurement</i>
Opportunity 9.a – Leverage Government procurement of digital connectivity infrastructure and services.
Opportunity 9.b – Leverage existing infrastructure projects
Opportunity 9.c – Leverage non-telecommunications infrastructure

Transformation Enablement
<i>Opportunity 10 – Reduce barriers to adoption</i>
Opportunity 10.a – Access to Government sites
<i>Opportunity 11 – Increasing digital connectivity awareness and adoption in key groups</i>
Opportunity 11.a – Awareness and Support Campaign
<i>Opportunity 12 – Increasing the digital connectivity skills and capabilities within WA</i>
Opportunity 12.a – Regional and Remote Digital Skills Gap
Opportunity 12.b – Targeted Skills development within the Indigenous Community
Opportunity 12.c – Improving digital literacy in regional, rural, and remote.
<i>Opportunity 13 – Develop and share digital connectivity knowledge in WA to encourage innovation and commitment</i>
Opportunity 13.a – Leveraging the existing Government Data Analytics and Data Sharing Framework
Opportunity 13.b – Sharing data inside and outside of Government
Opportunity 13.c – Modelling and tracking digital connectivity improvements.
<i>Opportunity 14 – Environment for fostering innovation and supporting adoption</i>
Opportunity 14.a – Innovation Hubs
Opportunity 14.b – Support to applications for Proofs of Concept and Trials

Figure 6 Summary of Draft Recommendations included in the Grex Report (Source: Grex)

2. Introduction

Following an extensive process of consultation and review, IWA intends to release a draft 20-Year State Infrastructure Strategy (“SIS”) in mid-2021.

Addressing the following ten sectors (Figure 7), the SIS will be a best in class and first of its kind review for WA to outline the State's significant infrastructure needs and priorities.



Figure 7 SIS Priority Sectors (Source IWA)

The SIS will recommend significant projects, programs, or other options such as policy reforms, to meet the State's infrastructure needs and priorities.

Digital and telecommunications infrastructure (together referred to as “digital connectivity” in this Report) is one of the ten sectors identified by Infrastructure WA in both its Discussion Paper⁶ and the Consultation Outcomes Report following broad consultation with industry and the community.

Supporting IWA’s approach to date, the analysis set out in this Report identifies digital connectivity as a sector and as an enabler across all of the other nine priority sectors identified by IWA.

In addition, digital connectivity is analysed across WA generally and more specifically within each of the 10 regions (Perth and the nine Regional Development Commission areas as shown in Figure 8).

⁶ “A Stronger Tomorrow: State Infrastructure Strategy Discussion Paper”, Infrastructure WA.



Figure 8 WA Regional Development Commission Areas (Source: IWA)

2.1 Purpose of this Report

Using the methodology described in Section Digital Connectivity Assessment Methodology, the following is assessed:

1. What digital connectivity is required within the twenty-year period to support the State Vision of:

“Western Australia (WA) is a sought-after place to live, work, study and invest, with infrastructure improving productivity and equity, and unlocking industry growth that leverages the State's advantages and diversifies its economic base.”

2. What is the scope of current and planned telecommunications network and infrastructure providers?
 - Attributes of technical digital connectivity,
 - Capabilities required to enable and maintain current and future demand,
 - Current and proposed capabilities (fixed and mobile), and
 - Current geographic coverage of supply across WA.
3. What is the demand in WA based on national and global measurements?
4. What are the current and potential identifiable gaps in digital connectivity and capability at a technology level and geographically?
5. What options and opportunities are available to close these gaps, and how can Government play a role in this process?

2.2 Methodology

GreX has conducted both desktop research and market analysis to develop an understanding of the existing key characteristics of the State. A large component of this process was a benchmarking process against recommendations in the SIS.

Relevant stakeholders were engaged, including:

Government Departments:

- Office of Digital Government, Department of the Premier and Cabinet
- Department of Primary Industries and Regional Development
- Department of Jobs, Tourism, Science, and Innovation
- Department of Fire and Emergency Services

Government Trading Enterprises:

- Horizon Power
- Water Corporation
- Western Power

Telecommunications Network and Service Providers:

Other stakeholders were approached to participate in the process but either declined or did not respond. Stakeholder inputs received via the previous SIS related consultations, including the responses to the SIS Discussion Paper of June 2020, were also incorporated.

3. Digital and telecommunications – context in WA

3.1 WA Market Review

The Australian digital connectivity market comprises:

- telecommunications network owners/operators, dominated by a small number of tier 1 organisations operating national fixed and/ mobile networks and services, and tier 2 service providers operating limited national or regionally focused networks and services.
- An increasing number of global, national, and local data centre owners and content providers.

With the recent completion of the nbn network rollout to provide the last mile access for fixed broadband and voice services, most broadband services (by volume, particularly for residential users in WA) are delivered using FTTN, FTTC, FTTP or HFC technology in metro areas.

In regional WA, nbn access is provided using Fixed Wireless and Satellite technology. By geography of the State, the nbn satellite service (Skymuster) has the largest coverage footprint, whilst fixed technologies cover most of the population.

The nbn access services are handed off to the Retail Service Providers at one of the 15 nbn Points of Interconnect (POIs) located within the state. The POIs are mainly concentrated in the South-West of the State and Regional nbn POIs are present in Geraldton and Katanning.

From a mobile coverage perspective whilst there is good coverage in metro areas and regional population centres, there are 1750⁷ registered mobile blackspots across the State. Of these registered blackspots, approximately 1350 are located in outer regional, remote, and very remote locations.

Given this number of blackspots, there are large areas of regional and rural WA where fixed service is the only broadband connectivity option for residential and small to medium sized businesses (including those businesses operating in the agriculture and tourism sectors).

In regional and rural areas where large businesses have been established, for example mines, enterprises have often deployed their own connectivity through use of tailored, complex, private network solutions.

3.2 WA Regions

Key economic indicator data was provided for each of the 9 Regional Development Commission (RDC) areas and Perth (see Figure 9). The data was extracted from WA Economic Profile, April 2021, developed by the Department of Jobs, Tourism, Science, and Innovation.

This broad data provides an indication of the prosperity of each region, Figure 9, the potential communication user populations and an indication of the ability to pay for services that would inform and incentivise digital communications investment from commercial network and service

⁷ Source: National Mobile Black Spot Database of Reported Black Spot locations

providers.

Region	GRP (\$m) 2019-20	GRP per capita (\$m)	GRP per worker (\$m)	Population 2019-20	Local Jobs Dec 2020
Kimberley	3,200	0.09	0.22	36,054	14,843
Pilbara	57,300	0.91	1.52	62,841	37,657
Gascoyne	1,600	0.17	0.35	9,262	4,537
MidWest	9,500	0.18	0.39	52,769	24,361
Wheatbelt	7,400	0.10	0.19	73,690	39,005
Peel	10,300	0.07	0.17	146,239	62,081
South-West	14,900	0.08	0.16	181,801	91,162
Great Southern	4,100	0.07	0.13	61,351	31,677
Goldfields-	21,900	0.41	0.79	53,914	27,817
Perth	186,100	0.09	0.18	1,985,640	1,014,588

Figure 9 Regional Development Commission Economic Data (Source: Grex based on JTSI provided data)

3.3 Digital Inclusion

The Australian Digital Inclusion Index (ADII) 2020⁸ rates WA second against other states and territories - behind ACT and ahead of NSW and Victoria with a score of 64.1, which is higher than the previous years' assessments (61.3 in 2019, 59.8 in 2018 and 55.0 in 2014)

Key contributors to this score include increased:

- Broadband connections - more than 60% of Western Australians have a fixed broadband connection.
- Increased data allowances on fixed and mobile service packages contributing to improved value for expenditure.
- Updated pricing plans offering greater value.
- Increased basic skills assessment and increased online activity.

There is a significant differential between the Perth and South-West regions and the Other WA regions, as defined in the ADII. The difference range (for the 2020 ADII report) in rating is between 5.7 to 8.4 depending upon the region. The major differences occur across all three of the ADII rating areas:

- Access - internet access and internet data allowance
- Affordability - relative expenditure and value of expenditure
- Ability - attitudes, basic skills, and activities.

3.4 State Government Activity and Initiatives

The various WA State Government departments and State-owned enterprises (such as the power and water utilities) have initiated a broad range of activities and initiatives in and around digital connectivity over recent years both for the residents and businesses of WA as well as internal Government operation.

3.4.1. Department of the Premier and Cabinet, Office of Digital Government (ODG)

The Office of Digital Government is leading the digital transformation of the WA Public Sector. This program covers 5 main areas:

- Cyber Security,
- Online Services,

⁸ Measuring Australia's Digital Divide; The Australian Digital Inclusion Index 2020

- Data Sharing and Analytics,
- IT procurement reforms, and
- Digital Inclusion.

Network and data centre security is an important topic. As described below ODG has a number of initiatives in place to align with cyber security trends and policies under its Whole of Government Digital Security Policy (2017). This should also be read in conjunction with the Australian Cyber Security Centre (ACSC) Essential 8⁹.

The WA State Government has made a \$34.7m investment in its ongoing leadership of digital reform. ODG published a Digital WA ICT strategy¹⁰ for the period 2016-2020, that provided an overarching strategy for delivering efficient, reliable ICT services that support exceptional public services.

ODG's initiatives Include:

- The GovNext-ICT 2015 program. This is a procurement reform approach that is supporting the transformation from and approach of individual ownership of ICT infrastructure to one of on-demand consumption. GovNext-ICT aims to simplify and connect government systems by re-locating 60 physical data centres into pay-as-you-go, secure cloud services, creating a single, unified network, and modernising telecommunications. The mandatory GNICT2015 Common User Agreements, covering Telecommunications Services, Network Infrastructure Solutions, Data Centres and Associated Management Services and IT servers and Data Storage Devices, came into effect in 2017 and has an initial 5-year term, with an option for a further 5-year extension. ODG provides oversight of the Government telecommunications expenditure and maintains the high-level industry relationships with key service providers.
- Digital Inclusion Blueprint¹¹. ODG have developed a Blueprint for a digitally inclusive state in draft form. This blueprint sets out a vision and approach for making WA a digitally inclusive state, focused on four priority areas - connectivity, affordability, skills, and design. The activities identified as part of the Blueprint have not received funding at this stage.
- Data Analytics and Sharing. ODG has created a data and analytics group. The group's role is to enhance and support agency capabilities, data sharing agreements and to provide guidance and facilitation between agency groups in creating easily consumable data sets and secured data sharing. The group also provides analytics capability for whole of government data sets.
- Cyber Security. ODG developed the Whole of Government Digital Security Policy in 2017 which provides direction for public sector agencies in adequately managing their digital security risks. ODG has identified 5 areas for agencies to focus and report on progress and maturity. ODG provides operational assistance to agencies to support their management of cyber security. ODG has also implemented a security centre to protect critical infrastructure assets through direct input to increase the certainty on the security risk to those assets.

3.4.2. Department of Primary Industries and Regional Development (DPIRD)

In addition to its leadership role in the Commonwealth Government's Regional Connectivity Program (RCP) and the Mobile Black Spots Program (MBSP), both discussed further in Sections

⁹ <https://www.cyber.gov.au/acsc/view-all-content/publications/essential-eight-maturity-model>

¹⁰ Digital WA: Western Australian Government Information and Communications Technology Strategy 2016-2020.

¹¹ Digital Inclusion in Western Australia

3.5.1 Regional Connectivity Program and 3.5.2 Mobile Blackspot Program respectively, DPIRD has invested in providing rural and regional communications through two programs:

1. Digital Farm Grants

The Digital Farm Grants program provides funding for last-mile solutions for agribusinesses in agricultural and pastoral regions that lie outside the current or planned nbn fixed wireless and fixed line footprint. The goal is to improve business and agricultural productivity by providing enterprise-grade digital connectivity for regional WA, recognising that connectivity was identified as a major issue.

A third round of the grants, totaling \$6.3m, was awarded in January 2021 with the intent of boosting connectivity and last mile solutions for digital farming. Prior rounds granted \$7m to 7 projects supporting 1,400 farm businesses from Kimberley to the Great Southern. Grant values ranged between \$260,000 to \$660,000 and were awarded to a range of service providers.

A key issue to be resolved in further fostering the uptake of digital farm practices is the ownership of data and data sharing. There are a number of different positions being taken by various parties, such as the farmers wanting to retain ownership of data whereas, vendors/providers are seeking to also own the developed data and sell back to the farmers. An open data policy has been defined.

DPIRD is also assessing the potential impact that may result with the availability of connectivity services from Low Earth Orbit (LEO) satellite services to deliver last mile solutions for agribusiness.

2. Micro Grants

Smaller investments have been announced in areas such as Northern Goldfields, where \$1m total investment has been announced to enhance broadband services as part of a pilot project. Further proposals are currently being sought for fixed and satellite technology.

Grants were funded from a \$22m Agricultural Telecommunications Infrastructure Fund¹² which enables grants to be awarded for up to \$500k on a matching co-contribution basis for capital costs.

Both of these programs provide grants for co-investment. The ownership and management of the developed assets are the responsibility of the service provider.

DPIRD is looking how to support diversification of the economy in the regions. Australia, and WA in particular is well placed to support global innovations in areas such as food technology or large-scale computing using carbon neutral power. However, to develop these kinds of markets there will need to be major consideration for substantially increased connectivity capacity into the regions (including the potential benefits of availability of edge data centre facilities).

In 2017, DPIRD undertook an audit of available infrastructure, which identified Government infrastructure that is potentially available for access (land/easements, towers, optical fibre, buildings). DPIRD has also looked into how Community Resource Centres could be leveraged to deliver a range of digital capabilities including remote health care, digital literacy and education, social enterprise, and enterprise grade internet access.

¹² WA Media Statement: 19/01/2018 Connecting the farm: grants to drive 21st agriculture jobs.

Two other areas of focus for DPIRD in how to facilitate digital connectivity in regional areas are the use of Citizen's Broadband Radio Service (CBRS) and dynamic spectrum allocation.

DPIRD is fully engaged with nbn on the nbn Upgrade Program announced in 2020. Discussions on the co-investment required are being progressed both with nbn and internally within the WA State Government.

3.4.3. State Utilities

The utilities engaged in preparing this Report's findings have programs and initiatives looking at how adopting digital technology can transform their respective businesses.

Primary focus areas are how to use digital technology in regional and rural areas to improve safety for field workers in regional and rural areas, enhance productivity in the field and support deployment of IoT smart devices and data collection for control and machine learning/analysis purposes.

Cyber Security is also a major focus for the utilities and other government departments driven by the Security Legislation Amendment (Critical Infrastructure) Bill 2020.

The *Security of Critical Infrastructure Act 2018* currently covers specific entities in the electricity, gas, water, and ports sectors. The Security Legislation Amendment (Critical Infrastructure) Bill 2020 seeks to expand the scope of the Act to include critical infrastructure entities in a wider range of sectors including: communications; financial services and markets; data storage or processing; defence industry; higher education and research; energy; food and grocery; health care and medical; space technology; transport; and water and sewerage.

The reforms will introduce:

- A Positive Security Obligation including the provision of information for the Critical Infrastructure Asset Register, Risk Management Plans, and cyber incident reporting, which can only be activated for a sector following consultation with affected entities;
- Enhanced Cyber Security Obligations for the most critical entities (systems of national significance); and
- Government Assistance to respond to cyber-attacks on critical infrastructure in a cyber emergency.

For the most part, the utilities in WA rely on connectivity from third party commercial service providers. The availability of low cost, low latency, low speed, reliable services for connecting IoT/sensor devices and SCADA devices can be a challenge due to cost and service coverage. The potential price benefits from leveraging aggregated government procurement volumes have not been an available option and separate procurement exercises have been undertaken.

Similarly, whilst the utilities engage with a number of government departments across a range of Business-As-Usual activities, such as emergency response plans, and specific major projects, there is little by way of engagement with other departments for broader, strategic planning or leveraging combined communication capability requirements/opportunities to increase commercial leverage or benefits realisation to increase the viability of business cases.

An issue faced by the utilities is that the control of the technology used to serve the remote devices is under the control of the 3rd party provider. With the upcoming proposed shutdown of the 3G mobile network, there are a large number of devices that will need to be migrated to an alternate technology. This incurs time, cost, and risk penalties for the utility.

Horizon Power has deployed wireless mesh network technology to support its smart meter roll-out. However, the wireless mesh network does not support all of the IoT use cases. Horizon is also looking at alternate access technologies such as LoRaWAN (long range wide area networks) technology, which it also sees as an enabler for smart city applications such as smart street lighting and has the potential to be a shared access resource with service providers of 5G services.

Water Corporation is looking to how it can implement an IoT strategy to develop its Operational Technology strategy and improve asset data and status. The Water Corporation has implemented smart metering across part of the State. To support its field force, recent projects have looked at how vehicles can be used as connectivity hubs. Satellite services are used as a back-up service for safety management.

Western Power resells access to its fibre and has been active in the market for some time, with a commercial team established to look at the commercialisation of assets. Western Power owns a vast majority of the fibre used compared to the other utilities in the state, noting that there remains a large amount of microwave transmission equipment used within the network and that fibre deployment is not necessarily ubiquitously deployed along power transmission routes. Its asset base is documented via its Asset Management Plan that is updated and published each year.

Western Power's footprint extends across the Southwest quarter of the state with 'tendrils' of coverage out towards Kalgoorlie. It has advanced its investigations into looking at and developing the strategy for mesh interconnected grid, distributed generation sources and standalone power source areas. This approach will have a significant impact on the communications with the potential move from centralised control to de-centralised regions and autonomous/ semi-autonomous power supply/demand management.

An initiative under investigation by Western Power is the decentralisation of talent into the regions, based on the future architecture and the resulting reduced need for power transmission lines. However, this is dependent upon the availability of reliable, high bandwidth connectivity services to support this relocation of workforce.

3.5 Commonwealth Government Initiatives

There are two main Commonwealth Government Initiatives associated with the development of Digital Connectivity particularly related to the regional areas: the Regional Connectivity Program and the Mobile Blackspots Program.

3.5.1 Regional Connectivity Program¹³

The WA Government has committed up to \$10m to support in co-contribution for WA bids under the Commonwealth Regional Connectivity Program valued at \$83m. This program was established as a response to the 2018 Regional Telecommunication Review¹⁴ conducted by the Commonwealth Government in 2018.

Bids for the funding were invited for submission in November 2020. The outcomes from the evaluation were announced in April 2021¹⁵, and summarised in Figure 10.

¹³ WA Govt Media statement: 19/08/2020 Funding to further strengthen regional connectivity.

¹⁴ <https://www.communications.gov.au/publications/2018-regional-telecommunications-review-getting-it-right-out-there>

¹⁵ Australian Government, Department of Infrastructure, Regional Development and Communications, Regional Connectivity Program – funded projects, 23rd April 2021

Project name	Technology type	Location	Project description
Jigalong Community Wi-Fi and Telephone Service	Satellite Broadband	Jigalong	The project will deploy a fully managed public satellite Wi-Fi and VoIP telephone solution to the Aboriginal community of Jigalong. The service will provide pay-as-you-go data and voice connectivity to the community, supporting business opportunities in the tourism sector, the operations of the Jigalong Community Incorporated, and access to essential services such as telehealth, education, and government services.
Kalumburu Community Wi-Fi and Telephone Service	Satellite Broadband	Kalumburu	The project will deploy a fully managed public satellite Wi-Fi and VoIP telephone solution to the Aboriginal community of Kalumburu. The service will provide pay-as-you-go data and voice connectivity to the community, supporting business opportunities in the arts sector, the operations of the Kalumburu Aboriginal Corporation, and access to essential services such as telehealth, education, and government services.
Radio Access Network: Shire of Halls Creek	Fixed Wireless Broadband	Halls Creek Shire	The project will construct a fixed wireless network to deliver reliable, high speed broadband services and public Wi-Fi to the remote Aboriginal communities of Balgo (Wirrimanu), Billiluna (Mindibungu), Mulan and Ringer Soak (Kundat Djaru) located in the Shire of Halls Creek in the East Kimberley region of Western Australia. The network will provide improved connectivity to support access to online learning resources for the schools in these communities, as well as the uptake of new business technologies by local small businesses.
Central Wheatbelt Connectivity Backhaul	Fixed Wireless Broadband	Central Wheatbelt	The project will deploy a fixed wireless network across the Central Wheatbelt region of Western Australia. The network will provide improved connectivity to support the uptake of new agricultural and business technologies by local primary producers and other businesses, as well as enabling improved residential access to essential services such as telehealth and education.
R.A.N (Regional Australia Network): Wireless Wheatbelt Project—Central Midlands	Fixed Wireless Broadband	Central Midlands	The project will deploy a fixed wireless network in the Dalwallinu, Moora and Wongan-Ballidu Shires within the Central Midlands sub-region of the Western Australian Wheatbelt. The network will provide improved connectivity to support the uptake of new agricultural and business technologies by local primary producers and other businesses, as well as enabling

Project name	Technology type	Location	Project description
			improved residential access to essential services such as telehealth and education.
Frankland River 4G Network	Mobile Voice & Data	Cranbrook Shire	The project will deploy a Pivotal 4G LTE 'ecoSphere' network in the Frankland River region of Western Australia. The network will provide improved broadband and mobile connectivity to support the uptake of new agricultural and business technologies for local primary producers and wine tourism businesses, as well as enabling improved residential access to essential services such as telehealth, education services and emergency communications.
South Stirling 4G Network	Mobile Voice & Data	Albany	The project will deploy a Pivotal 4G LTE 'ecoSphere' network in the South Stirling region of Western Australia. The network will provide improved broadband and mobile connectivity to support the uptake of new agricultural and business technologies for local primary producers and other businesses, as well as enabling improved residential access to essential services such as telehealth, education services and emergency communications.
Halls Creek Satellite to Fibre to the Premise Technology Change	Fibre Broadband	Halls Creek	This proposal will upgrade the nbn access technology in the town of Halls Creek from Sky Muster satellite to Fibre to the Premises. The upgrade will provide improved broadband connectivity to support the delivery of essential services, such as skills training, education and health services to the town and surrounding areas, as well as supporting business opportunities in tourism, mining, and civil construction.
Bidyadanga	Mobile Voice & Data	Lagrange	The project will upgrade the capacity of the existing Telstra 4G base station in the Bidyadanga Aboriginal community. The upgrade will provide improved mobile connectivity to support growth opportunities in small business and tourism, as well as enabling increased residential access to essential services such as telehealth, education services and government services.

Project name	Technology type	Location	Project description
Caiguna	Mobile Voice & Data	Caiguna	The project will upgrade antenna equipment and backhaul capacity at the existing Telstra 3G base station in the small roadhouse community of Caiguna to provide Telstra 4GX and Internet of Things coverage to the area and along the Eyre Highway. The upgrade will provide improved connectivity to support the delivery of tourism, accommodation, hospitality, and retail services at the roadhouse.
Cave Point Lighthouse	Mobile Voice & Data	Torndirrup	The project will deploy a Telstra 4G macro cell base station on the Cave Point Lighthouse, a popular tourist attraction within the Torndirrup National Park with limited mobile coverage. The new base station will provide improved mobile coverage to support the safety and amenity of visitors at the site and surrounding National Park, particularly through increased access to emergency communications.
Cocklebiddy	Mobile Voice & Data	Cocklebiddy	The project will upgrade antenna equipment and backhaul capacity at the existing Telstra 3G base station in the small roadhouse community of Cocklebiddy to provide Telstra 4GX and Internet of Things coverage to the area and along the Eyre Highway. The upgrade will provide improved connectivity to support the delivery of tourism, accommodation, hospitality, and retail services at the roadhouse.
Condingup	Mobile Voice & Data	Condingup	The project will upgrade the coverage and capacity at the existing Telstra 4G macro cell base station at Condigup. The new base station will address a coverage gap outside of the main township and will provide improved connectivity to support the operations of local businesses and community facilities, as well as enabling increased residential access to essential services.
Coral Bay	Mobile Voice & Data	Coral Bay	The project will upgrade the capacity of the existing Telstra 4G macro cell base station at the holiday resort town of Coral Bay. The upgrade will provide improved mobile connectivity to support the expected growth of the local tourism industry, as well as enabling increased residential access to essential services such as telehealth and education services.

Project name	Technology type	Location	Project description
Cygnnet Bay	Mobile Voice & Data	Cygnnet Bay	The project will deploy a Telstra 4G small cell base station at Cygnnet Bay, a popular tourist location on the Dampier Peninsula. The new cell will provide improved mobile connectivity to support the operations of local pearling, marine research, and tourism organisations, as well as enabling increased residential access to essential services such as telehealth, education, and government services.
Greenbushes-Boyup	Mobile Voice & Data	Catterick	The project will deploy a Telstra 4G macro cell base station in the Catterick locality near Greenbushes in Western Australia. The new base station will provide improved mobile coverage to support the uptake of agricultural and business technologies by primary producers and other local industries, as well as enabling increased residential and commuter access to essential services and emergency communications along two major sub-regional roads.

Figure 10 April 2021 Regional Connectivity Program Awards for WA

3.5.2 Mobile Blackspot Program

As part of its 2018 Telco Investment Prioritisation Study (TIPS), over 2,000 locations were identified in WA as being mobile blackspots. Through analysis, 539 of these locations were shortlisted. This identified a potential funding requirement for approximately \$500m. There was a further prioritisation of the sites conducted and this identified 350 sites. The WA Government made a \$20m co-investment commitment with a further \$20m after the election.

Through the various rounds of Mobile Black Spots program funding, in total 303 WA sites were provided funding across the program phases as follows:

- Round 1: 130 sites
- Round 2: 78 sites
- Round 3: 6 sites
- Round 4: 26 sites
- Round 5: 63 sites

Round 6 of the program is in planning and will be addressed once Round 5 is completed. The sites that are likely to be included in this round are hard-to-reach sites. Additional State Government co-investment will be required.

3.5.2. Other Government Departments

3.5.2.1 Jobs Tourism, Science, and Innovation (JTSI)

The Department of Jobs Tourism, Science and Innovation serves the R&D and innovation ecosystem and holds responsibility for developing the space sector. It also conducts the role of 'lead agency' for State-significant projects.

A lack of connectivity is a key issue to developing and maintaining businesses in these sectors. Similarly, a lack of STEM based skills and support to businesses adopting the digital capability is equally disruptive.

Investment programs have been advanced to deliver high speed connectivity to industry parks and precincts - such as the \$20m investment for robotics and automation.

JTSL's perspective is that co-investment by Government is likely to be required to incentivise further private enterprise investment in digital connectivity in regional areas, and that this investment needs to be supported by a range of 'softer' measures to promote the adoption and uptake. These include the development of data sharing frameworks and standards, data analytics, investment in trial test beds (such as the digital innovation hub) and promotion of digital connectivity awareness and attitudes (such as the Scitech re-development).

3.5.2.2 Department of Fire and Emergency Services (DFES)

DFES supports a number of incident types and has an organizational structure that reflects its focus. This imposes constraints and requirements on how the DFES communications are structured and enabled. This includes layered data collection and analysis to support incident detection and prevention, e.g., the use of weather sensors, and decision making.

DFES currently operates an analogue mobile radio network that is separate to the WA Police's digital trunked radio network. The DFES and WA Police networks have different radio coverage footprints and there is insufficient capacity for all services to share one network currently.

The DFES radio communications constitutes some 30 percent of the overall operational communications requirements. There is significant focus on the smart phones and apps using commercial networks. The use of commercial networks means that if there is a crisis, such as a bushfire, in and around a regional centre the increased volume of users may result in restricted services for the emergency personnel, either due to congestion in the backhaul transmission network or over the air interface. A consequence of the use of commercial networks is that the DFES is not in control of the technology used to deliver the services and significant effort is expended in managing upgrades and technology change-outs. The impending 3G shut down in 2024 has the potential to be another example of this.

Key features for DFES operational communications are resilience and accessibility during times of crisis. Therefore, communications assets that are either sub-terranean or in the stratosphere are attractive.

The emergency services are examining the potential migration to a Public Safety Mobile Broadband solution. There is an intention to conduct a trial, subject to finalisation of contracts.

The WA Government has announced a \$60m investment in the first part of a multi-stage project to build State-wide shared radio network advanced operational communications for WA's emergency services¹⁶. The first stage of the investment will support the replacement of mobile handsets and site works to enable co-location of agency communications equipment onto a reduced number of sites.

3.5.2.3 Department of Education

The Department of Education has announced¹⁷ a \$130m contract extension for the provision of internet services to schools. The contract will provide benefit to 350,000 students and give a 20-times boost to the capacity available to each student, teacher, and other school staff. The contract

¹⁶ WA Govt Media statement 10/12/2020

¹⁷ WA Govt Media Statement 11/12/2020

includes a \$30m investment in backhaul capability and local exchanges. These upgrades will provide further benefit to local communities and government agencies in regional towns and provide connectivity upgrades at 200 schools.

3.6 nbn Upgrade Program

In September 2020, the Commonwealth Government and nbn jointly announced¹⁸ details for a \$4.5bn upgrade to network.

The national program plans to:

- Spend up to \$3.5bn to make nbn's highest wholesale speed plans available to 75 percent of households and businesses, moving FTTN customers to FTTP, further investing in HFC solutions and providing an uplift for FTTC connected customers.
- Increase in-home speeds for FTTN users.
- Spend up to \$700m in collaboration with industry to help deliver enhanced digital capabilities.
- Making business-grade fibre services more accessible and affordable for small and medium businesses in 240 business fibre zones. 18 business fibre zones have been identified in metro WA and 5 in regional WA - Albany, Bunbury, Busselton, Geraldton, and Margaret River.
- Spend up to \$300m in co-investment with governments and local councils to improve access for rural and regional communities, with a focus on migration from satellite or fixed wireless to fixed line technologies.
- nbn will also improve the technology choice program to make it more cost effective for residential and business customers to change access technologies.

The WA Government (via ODG and DPIRD) has been engaged with nbn. The critical issue is the level of State funded co-investment required to improve the regional and rural access. The Options and Opportunities in Section 12 explain how government can engage with nbn to leverage any co-investment funding and align this with current initiatives and applications under the Commonwealth's RCP program.

3.7 Regulatory environment

3.7.1 Commonwealth

The majority of the telecommunications laws and regulations are legislated by the Commonwealth, with the principal legislation under the Telecommunications Act. However, this is supplemented by:

1. Parts XIB and XIC of the CCA (please refer to section 14 in relation to Part XIC of the CCA);
2. the Telecommunications (Consumer Protection and Service Standards) Act 1999 (Cth) (the TCPSS Act);
3. the Telecommunications (Interception and Access) Act 1979 (Cth); and
4. the Radiocommunications Act, which is analysed further in section 13 below.

Referred to as "Telecommunications Laws" below.

The regulators who are responsible for the regulation of telecommunications in Australia are ACMA and the ACCC.

¹⁸ Joint Media Release: \$4.5 billion NBN investment to bring ultra-fast broadband to millions of families and businesses and create 25,000 jobs.

Regulation

The Telecommunications Laws regulate carriers and service providers (carriage service providers and content service providers) either through self-regulated industry codes or through industry standards¹⁹ set by ACMA under either Part 6 of the Telecommunications Act or Part 6 of the TCPSS Act (where most carriers and carriage service providers are required to become members of the Telecommunications Industry Ombudsman scheme).

In addition to industry codes and industry standards, Part 21 of the Telecommunications Act applies technical standards to facilities used in telecommunication networks, interconnection of facilities, customer equipment and customer cabling.

In addition, the Radiocommunications Act governs radio emissions within Australia through a licencing regime applied to the transmission of radiocommunications within Australia, defining radiocommunications to include radio emissions, or reception of such emissions, for the purpose of communicating information between persons and/or things.

The Radiocommunications Act:

1. prohibits all radiocommunications (other than in emergency situations) unless they are licenced under Chapter 3 of the Radiocommunications Act; and
2. imposes offences relating to substantially interfering with, disrupting or disturbing radiocommunications.

Under the Radiocommunications Act, there are 3 broad types of licences that apply to radiocommunications devices (transmitters as well as receivers). These are:

1. **spectrum licences**, authorising the use of radiofrequency spectrum space, being a part of the radiofrequency band within a specified area;
2. **apparatus licences**, for specific equipment and categorised according to the type of service (e.g., fixed, land mobile or broadcast);
3. **class licences**, permitting the operation of particular devices and equipment the subject of the class licence, without the need to apply and pay for that licence (e.g., for wi-fi end points, mobile phone handsets and other low power devices).

ACMA is responsible for managing and allocating the use of radiocommunication spectrum within Australia, with the aim of maximising the utility of this finite resource. ACMA uses instruments that govern the use of each frequency band, how spectrum may be assigned, and the management interference between services. These include:

1. at the highest level, the Australian Radiofrequency Spectrum Plan 2017;
2. frequency and administrative band plans that specify the purpose for bands or reserve spectrum for particular uses;
3. determinations that specify, in respect of each frequency band the subject of spectrum licensing, what would constitute 'unacceptable interference'; and
4. Radiocommunications Assignment and Licensing Instructions (or RALIs) that provide advice on frequency assignment and co-ordination procedures for various frequency ranges, both intra-service types (fixed, mobile, and narrowcasting) and inter-service types, particularly for co-ordination of services with radio astronomy facilities and satellite services.

¹⁹ Examples of industry standards set by ACMA include in relation to telemarketing calls and international mobile roaming.

In addition to the licensing regime, the Radiocommunications Act contains offences relating to interfering with radiocommunications.

Competition law

In addition to the above legislative and regulatory environment applying to telecommunications infrastructure, the Telecommunications Access Regime in Part XIC of the Competition and Consumer Act sets requirements for owners of significant telecommunications infrastructure to provide third party access seekers to services. This is designed to serve the long-term interests of end users of such services, referred to in this Report as the “users”. The ACCC oversees this aspect.

Amongst the specific provisions under Part XIC, there is a process to facilitate reasonable access to significant telecommunications infrastructure for access seekers to then on-supply carriage services.

Whilst this Report does not provide detailed legal background, this additional aspect of the Commonwealth legislative regime for telecommunications infrastructure illustrates how the elements of market environment has formed as described in Section 3.1 WA Market Review above and Section 7 Telecommunications Infrastructure Supply – Overview of Current State below. There is reliance on owners of significant infrastructure by smaller providers throughout Australia, and this reliance becomes more essential as the amount of infrastructure reduces outside the capital cities and into WA regional areas.²⁰

Other relevant legislation and regulation

Other instruments applicable to the telecommunications infrastructure market in Australia include regulation of land access, where the Telecommunications Act provides telecommunications carriers with powers to access land to, for example, install telecommunications infrastructure (including facilities deemed “low impact”).

Environmental legislation (Environmental Protection and Biodiversity Conservation Act 1999) impacts the rollout of new or operation of existing telecommunications infrastructure.

3.7.2 State legislation

Whilst the main legislation is set by the Commonwealth, WA State legislation and regulation significantly impacts any telecommunications network design, construction, and operation.

This Report sets out Options and Opportunities related to facilitation of some of the outcomes sought to support the SIS Vision as they relate to the setting of policy, regulation and in rarer instances legislation.

WA’s Department of Jobs, Tourism, Science, and Innovation (JTSI) conducts the role of ‘lead agency’ for State-significant projects and has been engaged as part of the preparation of this Report.

JTTSI’s support in initiating the Opportunities described in this Report will be crucial, not only for their knowledge and involvement in encouraging broad investments and innovation in WA but also as part of its role as concierge in the approvals process under the many environmental regulations that would need to be complied with as part of any current, emerging, or future rollout of new telecommunications infrastructure in WA.

²⁰ There is a set of regulations administered by the ACCC relating to the “declaration” of services to which these smaller operators are seeking access under the relevant “Standard Access Obligations” under Part XIC, including the “Domestic transmission capacity service declaration” (DCTS) which relates to the backhaul market, a particularly important element in the delivery of regional telecommunications services.

Whilst there is no State-based legislative land access regime that would assist telecommunications market participants in rolling out new telecommunications infrastructure, it will be attractive to telecommunications operators to deal with one Government landowner representative as opposed to numerous landowners when long-distance regional networks are built. As part of the implementation of any integrated plan across the State, we suggest that Government entities such as Water Corporation and the power utilities work together to audit all land they own and make this available in a coordinated manner to any telecommunications operators wishing to roll out new network, particularly in regional areas.

An example of this occurring in other jurisdictions is NSW's Government Telecommunications Act (2018). This legislation gives the NSW Telco Authority (responsible for the rollout of emergency services connectivity infrastructure in NSW) powers to access land and assets. It provides a clear framework so that the role of the Telco Authority as the expert provider of public safety operational communications is clarified and supported throughout NSW. By modernizing the legislating and operating framework to prepare NSW for the adoption of future technologies, the Act promotes state-wide public safety radio network integration by enabling seamless delivery of NSW's Critical Communications Enhancement Program. This leads to reduced costs and provides a framework to avoid infrastructure duplication where possible as new technologies are deployed.

4. Digital Connectivity Assessment Methodology

4.1 Overall Approach

The approach to completing the Digital Connectivity Assessment review is shown in Figure 11. This steps through the pathway between the Inputs and the Options.

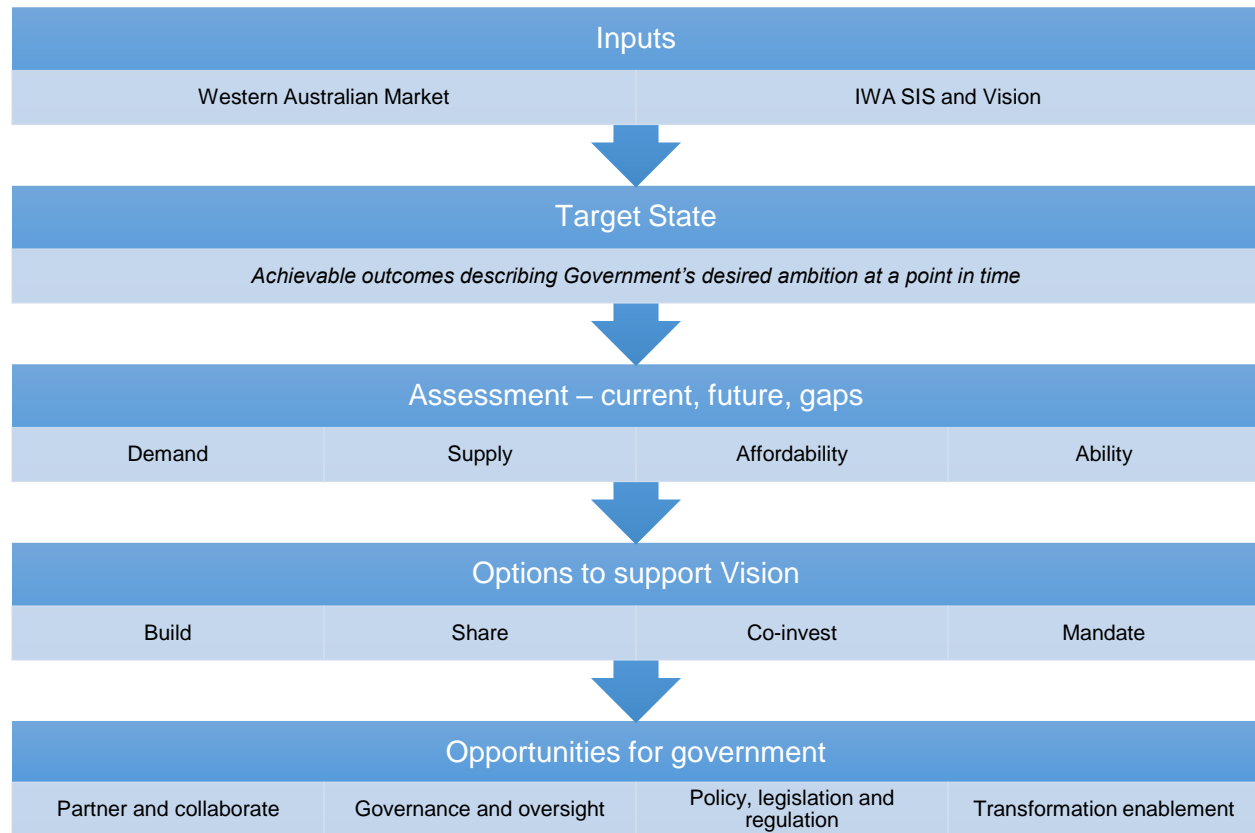


Figure 11 Analysis Methodology (Source: Grex)

4.2 Inputs and Target State

Inputs were considered from two perspectives:

- The market environment of Western Australia
- The work completed (to-date) to develop the IWA SIS, including the six SIS opportunity areas, 10 market sectors and the SIS Vision statement.

A summary of the inputs considered as part of the whole assessment process is provided in Figure 12. This included collateral provided by IWA, WA State and Commonwealth sources, Industry and Academic Institution studies and from interviews with WA Government Departments and major industry players.

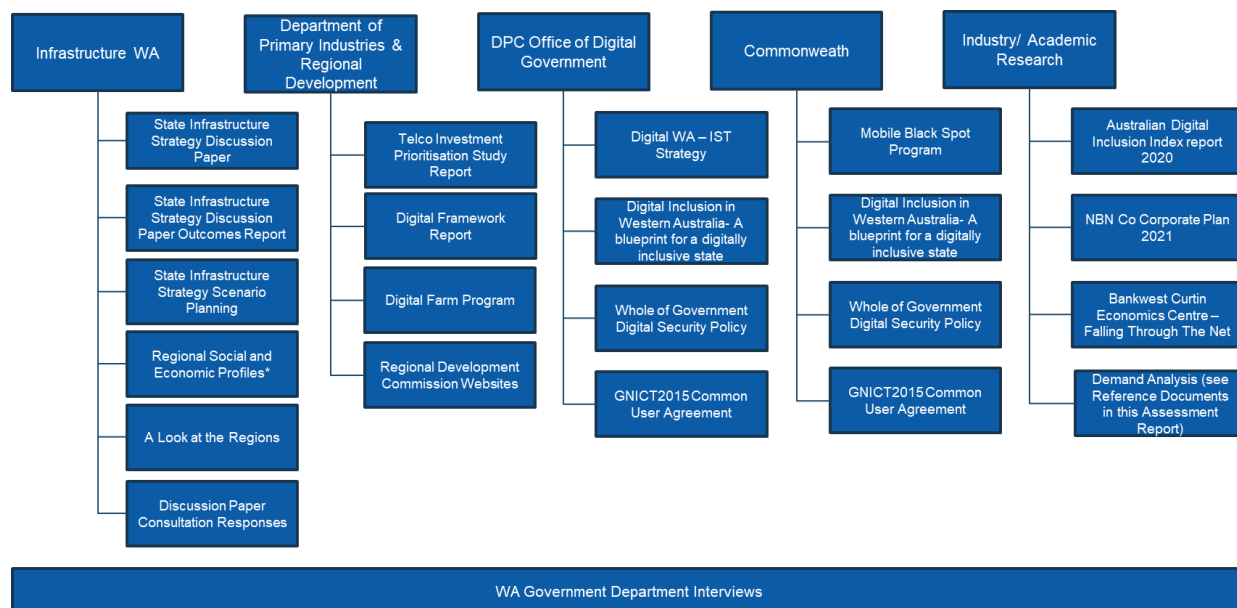


Figure 12 Inputs considered during preparation of the Report (Source: Grex)

The WA market perspective provided a view on what has been achieved in the market (current state) and the market opportunities and constraints that can accelerate or inhibit the demand and supply of digital connectivity in future. Set out below in Figure 13 is further detail of the analysis used to establish the Options to support the Vision.

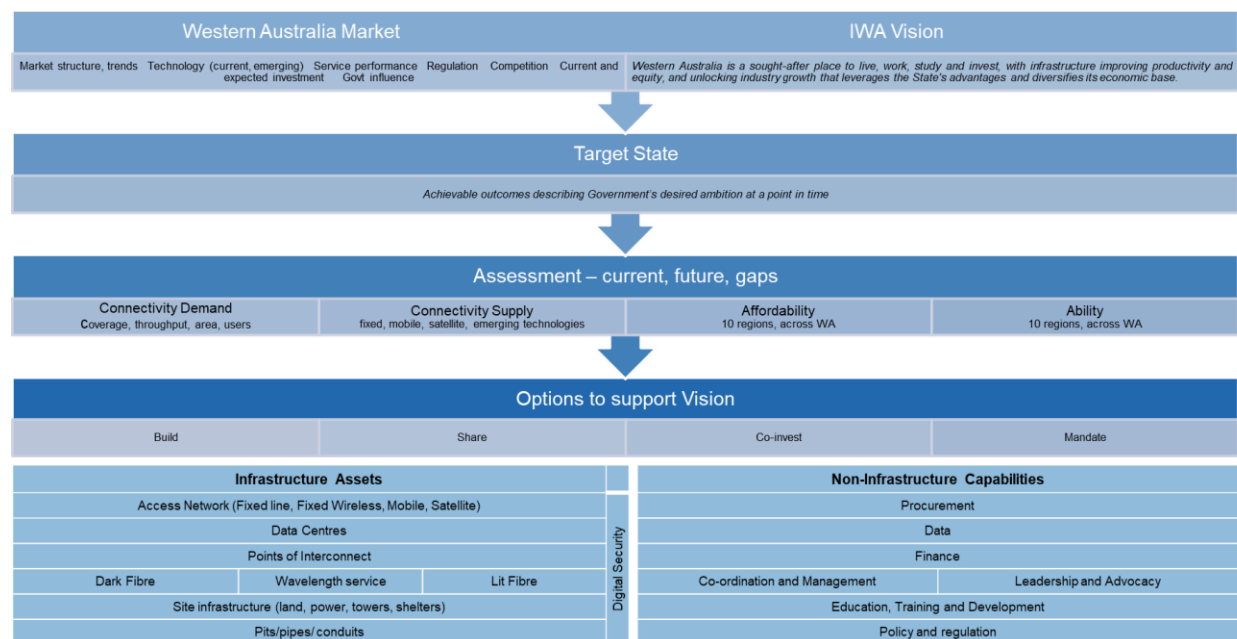


Figure 13 Expanded view of the Assessment review Methodology – Options to support the Vision (Source: Grex)

For consideration by IWA in formulating its SIS recommendations, Opportunities have been identified to establish support for any recommendations made by IWA in the draft and final SIS, as set out below - Figure 14:

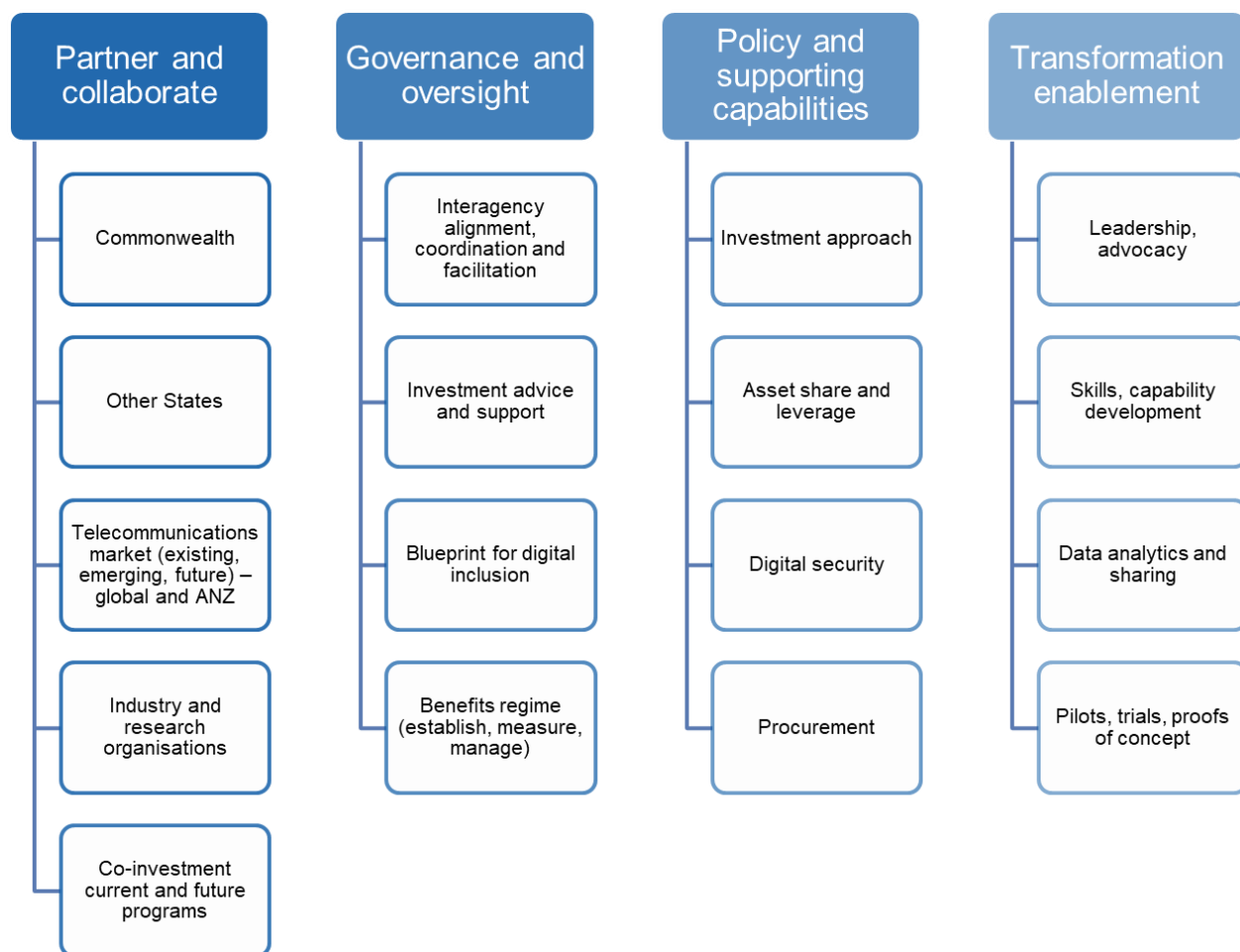


Figure 14 Opportunities identified in this Report to support the Vision (Source: Grex)

The SIS perspective provided a forward-looking view of where the WA State Government wants to develop the infrastructure to support digital connectivity in the State, also considering the underpinning, enabler role that digital connectivity plays across all of the focus market sectors within the SIS.

Having analysed the WA market environment and added in the IWA SIS Vision, a target state has been established through a set of achievable outcome statements that describe the WA Government ambitions for digital connectivity (see Section 5 Target State).

4.3 Gap Analysis

The third stage of the methodology process is the gap analysis.

A key component of this stage was to assess the digital connectivity demand and supply, see Figure 15. This was a technical level assessment of the digital connectivity coverage and throughput demand and supply capabilities at both the current state and future state.

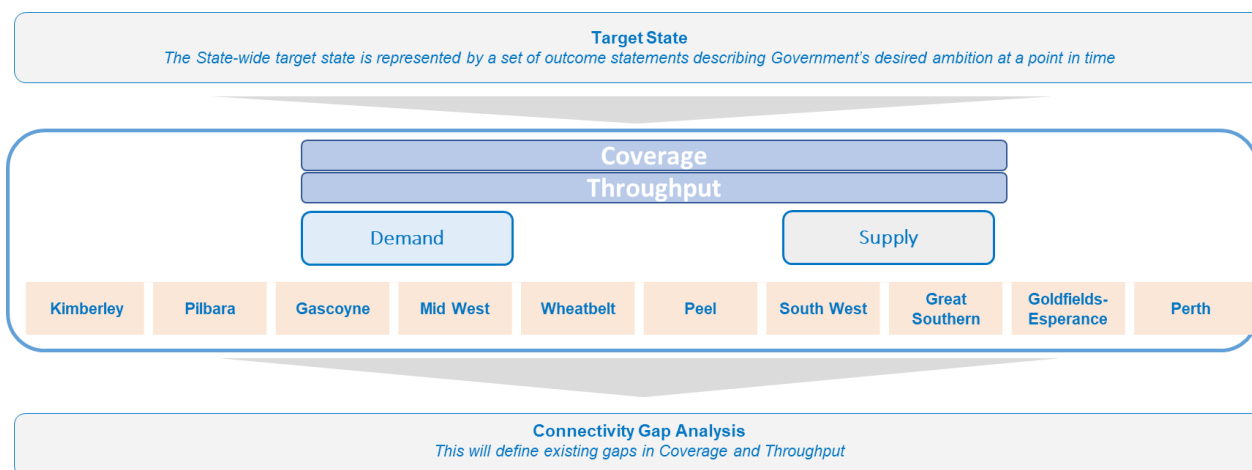


Figure 15 Connectivity Gap Analysis Methodology (Source: Grex)

The current state assessment was conducted by examination and modelling of known and publicly available network and technology information, such as the technology information published by nbn detailing what technology (HFC, FTTx, Satellite and Fixed Wireless) services which area and mobile network radio propagation information available from references such as the ACMA database that enabled modelling of mobile coverage.

Emerging demand was determined by analysis of the trends for applications and services based on national and international trends. Emerging technologies to support current supply (the ability of the telco industry to meet the demand) was assessed. This ability to supply was assessed based on the SIS Discussion Paper responses from major industry players, interviews with industry players and forecasts based on publicly available data for upcoming technologies, such as Low Earth Orbit satellites.

The analysis was conducted at an individual region level for each of the 9 Regional Development Commission regions and Perth. This demand and supply assessment is discussed in Sections 6-8 of this report.

Whilst the principal focus of the gap analysis was identifying gaps between the connectivity demand and supply, analysis also included consideration of Affordability and Digital Ability factors. Affordability broadly looked at the relative expenditure on digital connectivity and the value from expenditure. Ability looked at the skills to use digital connectivity and the uptake of services. Both factors are primary components of the Australian Digital Inclusion Index that provides an ongoing annual indicator of the digital connectivity services available and how services are adopted and used. The ADII report has been issued each year since 2014 and provides an ongoing assessment of digital inclusion at national, state, and regional levels and across a wide range of demographic groups.

The inputs included in determining the gap analysis are set out in Sections 9 and 10.

4.4 Options

The fourth stage of the process was to identify the set of strategic options that WA State Government might employ to intervene with to fill or mitigate the identified gaps. As shown in Figure 13 above, the intervention approaches span a wide range of possibilities, ranging from government investing in the build, ownership, and operation of assets, through collaborating with industry (either by providing in-kind or financial support) to develop infrastructure assets, and to enabling industry to achieve outcomes via its policy and legislative capabilities. These approaches can be applied to both infrastructure assets and non-infrastructure capabilities.

IWA, and other government departments, had expressed some considerations to take account of when considering different options. These included:

- A preference for co-investment with industry rather than sole government investment in build, own and operate type programs for infrastructure.
- To leverage the re-use of existing government and private industry assets/infrastructure rather than over-build
- Availability of telecommunications capability for the nation is a Commonwealth Government accountability.

Whilst these are stated preferences, which drives more towards the options to Share, Co-invest and Mandate options, it does not preclude the Build option. These factors would need to be duly considered in detail as options of any business case analysis conducted for a particular initiative.

As part of the Options available, consideration is also given to whether the development of infrastructure assets and/or non-infrastructure capabilities of Government can be leveraged to resolve a specific gap. A solution for a given gap issue might require the development of assets and the leverage of non-assets, such as leveraging government procurement panels and problems, to provide a holistic solution.

4.5 Opportunities

Stage 5 of the process collects the potential options and allocates to categories of opportunities, which are potential areas of activity to inform IWA's recommendations for the SIS, see Figure 13. The categories of opportunity are defined as:

1. **Partnership and Collaboration**, creating:
 - an engagement and relationship environment by which State Government achieves outcomes with other stakeholders:
 - a. Commonwealth and other State Governments
 - b. Service and network providers,
 - c. Industry peak bodies and academic institutions
 - a delivery environment to achieve efficient and effective realisation of the funded and co-funded programs.
2. **Governance and Oversight**, establishing:
 - cross-government executive management and oversight to co-ordinate across government and industry initiatives and programs
 - management and assurance of the investment assessment process for digital connectivity opportunities and committed programs.
 - a blueprint for the development of digital connectivity across the State
 - a benefits management framework to plan, track, provide consistency and report on forecast and realised benefits.
3. **Policy and Supporting Capabilities**, enabling industry and government initiatives to operate efficiently and effectively by leveraging the State Government's powers and resources in:
 - Government's investment commitment
 - asset access and sharing
 - digital security
 - Government procurement
4. **Transformation Enablement**, supporting the increased adoption of digital and telecommunications technology through:
 - Government's leadership and advocacy for adopting digital connectivity.

- skills and capability development
- data analytics and sharing
- trials and proof of concepts, further funding for initiatives underway and successfully implemented (e.g., DPIRD digital programs).

5. Target State - Outcomes

The target state is defined as the desired state of WA's digital connectivity infrastructure. It has been expressed as a set of outcome statements that describe WA Government's ambition at a point in time.

The outcome statements have been derived from the understanding of the WA market environment and the SIS Vision Statement. Seven statements have been defined and are shown in Figure 16.

Vision Statement	
<i>Western Australia is a sought-after place to live, work, study and invest, with infrastructure improving productivity and equity, and unlocking industry growth that leverages the State's advantages and diversifies its economic base.</i>	
Reduced the digital connectivity demand and supply gap in regional and rural areas	('PLACE TO LIVE, WORK AND STUDY')
Reduced the Australian Digital Inclusion Index ratings differential between Metro (Perth) and "Other WA"	('EQUITY')
Investments have been made in digital connectivity for remote communities	('PRODUCTIVITY' ; 'DIVERSIFIED ECONOMIC BASE')
WA Government has actively participated with private industry and Federal Government to develop and facilitate digital connectivity improvements within WA	('LEVERAGES THE STATE'S ADVANTAGES')
Digital Connectivity Infrastructure has enabled productivity gains in WA	('UNLOCKING INDUSTRY GROWTH'; 'PRODUCTIVITY')
Digital connectivity supports the strategic investment in Smart, Safe and Secure locations for Residents, Businesses and Government in WA	('SOUGHT AFTER PLACE TO LIVE, WORK AND STUDY'; 'PRODUCTIVITY')
The State's Digital Connectivity transformation is governed and the benefits to the Western Australian residents, business and Government are measured and reported	('WESTERN AUSTRALIA'; 'EQUITY')

Figure 16 Target State Outcome Statements (Source: Grex)

Note: within Section 12 of the report, reference labels (A-G) for each of the outcomes are used to align identified opportunities to the outcome(s) supported.

Beyond the initial 4-year period, the Report identifies ongoing Options and Opportunities and a broad framework to measure, adjust and incorporate new Opportunities to support the SIS Vision.

The blue text relates to the relevant component of the SIS Vision statement.

The key themes of the outcomes are for digital connectivity to:

- be equitably accessible across the State,
- support and foster WA as a sought-after place to live and work,
- support an increase in productivity, and
- unlock industry growth and economic diversification.

6. Digital Connectivity Demand

6.1 Context

In 2017, the Australian Government Productivity Commission defined telecommunications as fundamental to any modern society²¹.

Digital connectivity is a critical component of any thriving economy, and its role is becoming increasingly pivotal in the delivery of economic and social outcomes.

Rising uptake of disruptive and social and economic transformative technologies results in a steady increase in demand for connectivity.

Sufficient and timely investment in fixed and wireless infrastructure by the telecommunications industry, as well as all levels of Government is required to ensure that connectivity can continue to support economic growth and positive social outcomes.

Based on the analysis conducted, the demand evolution for digital connectivity (in terms of coverage – service area, access speed – bandwidth, capacity – data volume and number of users supported, performance – latency and reliability) in WA is characterised by:

- Increased mobile and fixed coverage and capacity in and around the urban areas to address population and urban area growth, with mobile coverage infill required in areas of low to poor coverage,
- Significantly increased mobile and fixed access speeds in and around urban areas due to the adoption of data-hungry applications (virtual/augmented reality, autonomous vehicles), and changes in working practices, as seen in the COVID pandemic,
- Access to higher-speed mobile and fixed connectivity services in regional and rural areas to support social, business, and economic development and equity (e.g., on-line media streaming, education, access to government digital services, tele-health, cloud business services, social media),
- Increased mobile coverage and capacity along main arterial and regional highways and roads and places of interest to support social, business, and economic development needs on the move (e.g., business operation and administration, supporting tourism, autonomous vehicles, and transport management for goods),
- Improved performance of fixed (Satellite) and mobile services in regional and remote areas to support the adoption of low latency applications (such as voice, video conference, virtual/augmented reality, real time control applications),
- Increased coverage of fixed and mobile services in regional areas to support an increased deployment of IOT capabilities to increase productivity (e.g., agriculture) and management/security of critical infrastructure (such as power and water utility networks),
- Increased capacity to connect large volumes of IOT devices deployed within urban areas for domestic, smart city and smart utility purposes,
- Resilient coverage and capacity across the State for use by Public Safety and Emergency services in times of incident and disaster, and
- Increased number of ‘pockets’ of high-speed digital connectivity to service specific industry development and economic diversification, such as industry precincts, mines, carbon neutral energy production sites and key enterprise locations (e.g., Square Kilometre Array).

²¹ Telecommunications Universal Service Obligation - Australian Productivity Commission Inquiry Report No. 83, 28 April 2017 (released 19 June 2017) – referred to as “TUSO Report” in this report.

6.2 Approach to Demand Assessment

As the following sections demonstrate, demand for both bandwidth and volumes of data are increasing, across both mobile and fixed services.

Locations which cannot support fast, reliable internet connections are rapidly becoming less desirable and challenged in terms of participating in the changing economic and social environment.

As with reliable electricity, water and telephone services, fit-for-purpose business, residential and leisure premises are assumed to have robust internet connections.

This section analyses the factors which are driving the increase the requirement for data consumption and the extent to which they are doing so i.e., to present a high-level analysis which is both quantitative and qualitative.

Below is a list of common applications and scenarios:

- Internet/web browsing
- Video and audio streaming e.g., Netflix, YouTube, Spotify, Apple Music, Apple TV, iView
- Email
- Social Media e.g., Twitter, Facebook, WhatsApp, Instagram
- Voice (over IP) calls
- Remote working (cloud-based work and collaboration tools)
- VPN and Digital Security
- Desktop video conferencing
- Point of Sale payment systems and ATM.
- Banking
- Digital Government Services (employment opportunities, benefits, licencing, tax, social services)
- Distance Education
- Teleconferencing - video calling
- Teleconferencing - telehealth
- Myriad mobile phone applications
- Instant messaging
- Online video gaming
- Remote network and utility infrastructure monitoring and control
- Cloud and data analytics
- Security cameras e.g., Amazon Ring for residential users
- Safety surveillance and alarms, e.g., video monitoring of sick, elderly, and vulnerable
- Security cameras, Police officer bodycams and street-cams
- Virtual and Augmented Reality
- Internet-of-things (IoT) connected devices.
- Data and File transfer
- Accounting and Finances
- HR services
- Procurement and Logistics management
- Access of cloud or data centre hosted applications.

6.3 Demand Characteristics

From a technical perspective, internet demand can be characterised by 4 key factors:

- Bandwidth/connection speed (Mbps)
- Volume of data (GB)
- Delay/latency (ms)
- Coverage & availability – including “depth” of coverage.

Figure 17 provides a representation of bandwidth and latency requirements for a number of key applications that are applicable across residential, small, and medium enterprise and business and government sectors.

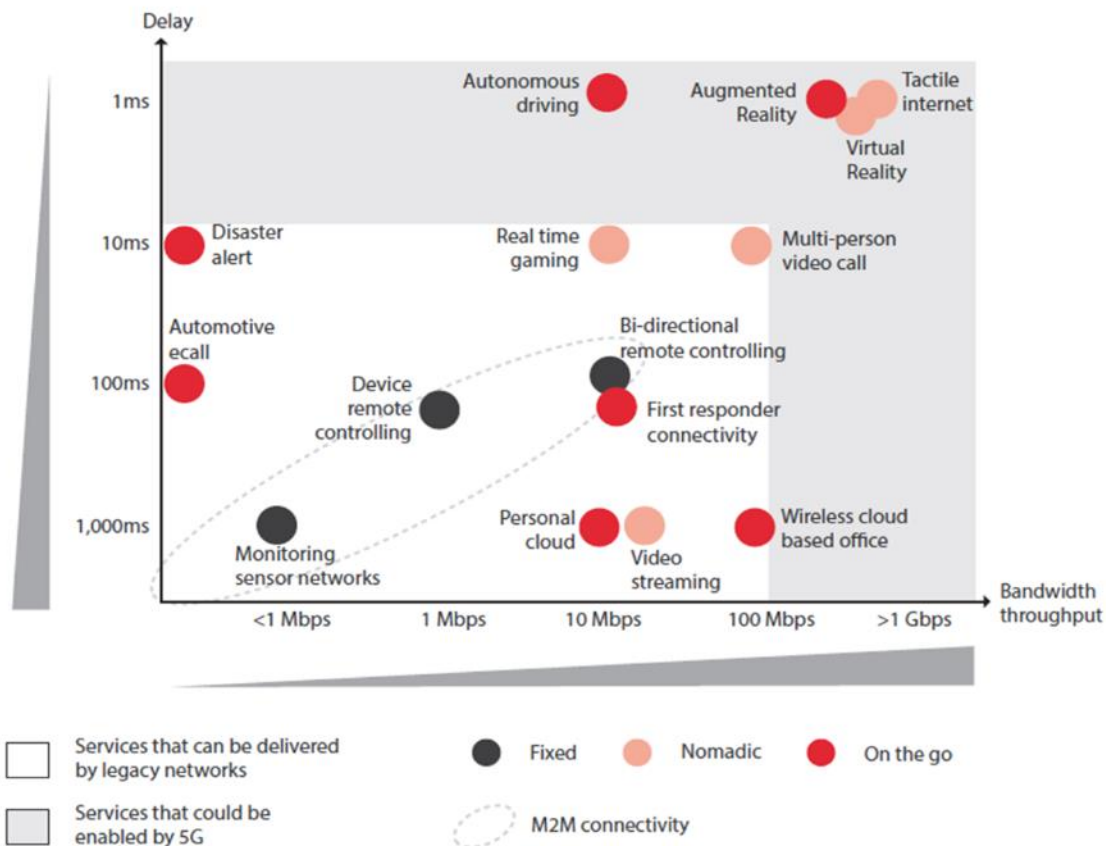


Figure 17 Application Bandwidth and Latency Requirements (Source: GSMA Intelligence)

Depth of coverage relates to the ability for multiple users to have ‘usable’, concurrent access. For example, an area with mobile coverage that only supports one user at a time to be able to access the available bandwidth would be very restrictive for other mobile users in the same area. All the users want to be able to access when they need/want to. Similarly in the fixed line service domain, only having access to high bandwidth in the early hours of the morning or a satellite service which suffers from periodic or extended outages due to climatic conditions would be equally restrictive.

Bandwidth vs Data Demand

Bandwidth is the rate at which data is transferred, while data demand is the volume of data used by a device or application over a period of time.

From a fixed line perspective, bandwidth requirements to meet demand from 95 per cent of households in Australia are estimated, by the Australian Government Bureau of Communications and Arts Research, to more than double over the decade from 24 Mbps in 2018 to 56 Mbps in

2028²². In comparison, the fact sheet reports that the average household data demand is estimated to nearly quadruple from 199 gigabytes per month to 767 gigabytes over the same period. The higher growth rate for data demand reflects a continuation of two key trends - increased time spent online and the use of more data-hungry applications, such as 8k video.

6.4 Overlapping Applications - Peak Bandwidth Demand

Bandwidth requirements depend on the intensity of application use at a point in time. This intensity will vary over the course of the day.

For the average household there is a busy period where online activity peaks in the evening between 4pm and 11pm, when more people are at home using internet applications.

The busy period for a premise determines its peak bandwidth requirements, when there is a greater likelihood that a person is undertaking single or multiple online activities, and that multiple people within a household or small business are online at the same time during this period, Figure 18 .

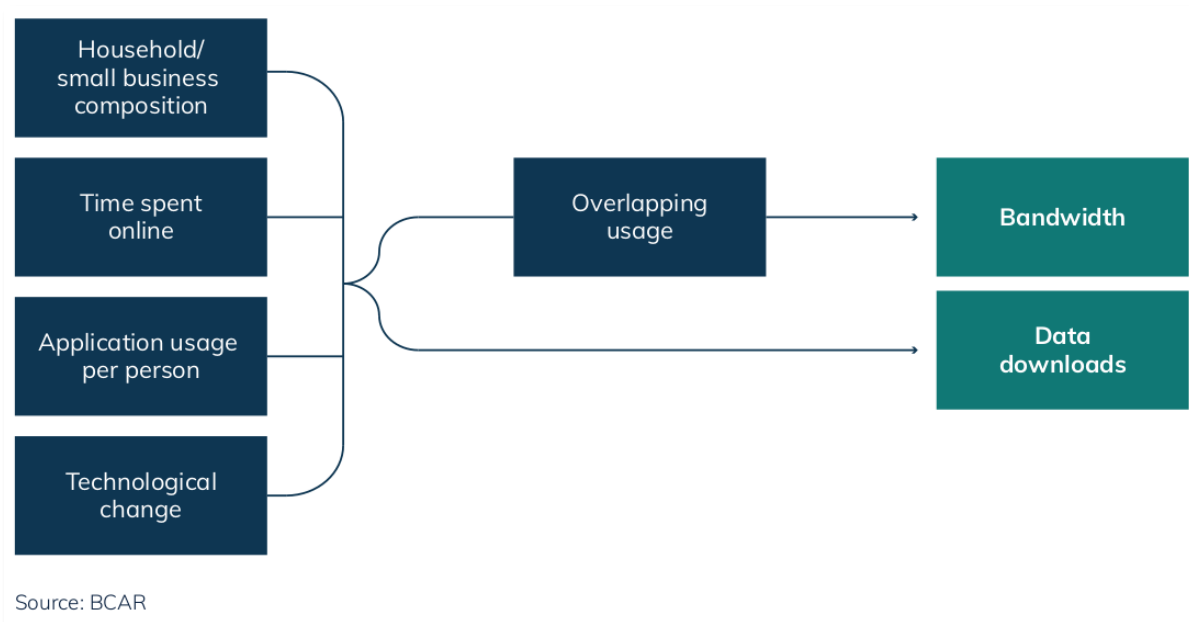


Figure 18: Applications with concurrent usage increases bandwidth demand but not data volume (Source: Bureau of Communications, Arts and Regional Research)

An indicative household's bandwidth requirements are shown in Figure 19 below to illustrate that peak bandwidth requirements are driven by the overlapped use of applications.

The same logic applies to business and Government users though with a peak shifted towards working hours away from early evening.

The Statutory Infrastructure Provider regulations has the goal of ensuring all premises can access broadband speeds of at least 25/5.

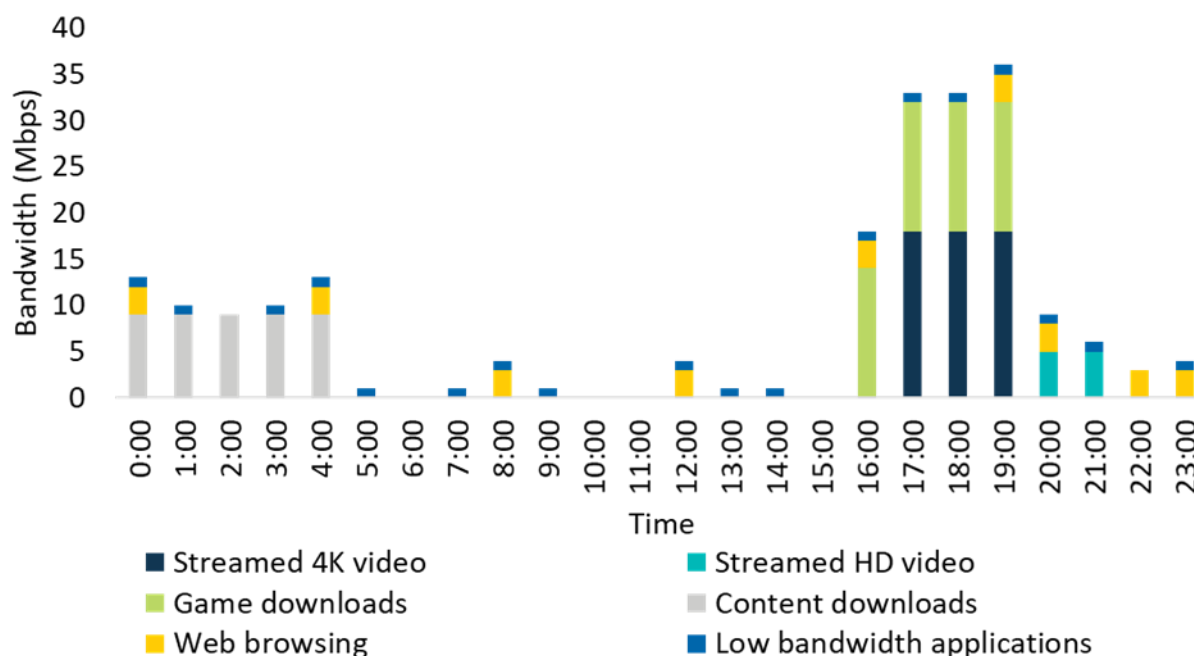


Figure 19 Indicative Household Demand Across the Day (Source: Bureau of Communications, Arts and Regional Research)

6.5 Devices and Applications

Desktop and laptop computers were the main devices consuming data in the average home, but more recently mobile phones and Smart TV have eclipsed these devices in terms of data usage, in part, due to the data-intensive nature of video content often consumed on them.

The increase in multi-device users, the propensity for each device to consume more data and the expansion in the types of device that are able to consume data that previously could not, for example a wifi connected refrigerator, coffee machine, air conditioning system or TV, are all factors driving ever increasing demand for data in Australia.

While there are some factors reducing demand including more efficient compression algorithms for high quality video (one of the single largest uses of data) and efficient spam filters in place at major email providers, the overwhelmingly prevalent direction of data usage is “up”.

Applications (and operating systems e.g., Windows) themselves are getting larger as are the frequent updates with new features and security fixes. Almost all of these updates are downloaded and installed without a second thought, all-consuming data.

6.5.1 Internet of Things (IoT)

This category includes an expanding range of everyday connected devices such as video doorbells, smart televisions, domestic solar panel monitors, smart speakers and household appliances within the residence as well as increasing number of devices deployed in the wide area for sensing and control purposes.

It was estimated in 2018 that the average household has 9 IoT devices which is now forecast to increase to an average of 44 devices by 2028²³ and that IoT devices and connections are expected to contribute almost 20 percent to the global growth in data traffic between 2016 and

²³ Australian Government Bureau of Communications and Arts Research Demand for fixed line broadband in Australia 2018-2028 Working paper July 2020

2022. Forecasts suggest there will be almost 30 billion connected devices in the world by 2022, of which around 18 billion will be related to IoT²⁴.

Outside of the residence, IOT devices for controlling street lighting, traffic flow, smart agriculture, management of utility networks are becoming more and more commonplace. An example is Horizon Power's implementation of smart metering. In addition, WA Water Corporation has implemented a smart metering deployment within part of the state and DPIRD has implemented several hundred weather stations to support smart agriculture.

Whilst IoT devices are not generally bandwidth intensive the cumulative effect of all these increases is to raise the bandwidth usage floor.

6.5.2 Video and multimedia

Industry estimates suggest that video, gaming, and multimedia traffic will make up to a significant percentage of all traffic by 2022, as a consequence of increases in IP video traffic, gaming traffic, and virtual and augmented reality traffic

These applications do not have just high-volume data consumption but have bandwidth requirements for satisfactory performance, sometimes more depending on specific application and use case.

6.5.3 Vehicular use

Whilst widespread or truly autonomous vehicles are some ways into the future, infrastructure to support for such services cannot be rolled out overnight.

The significant progress made by companies already carrying public, fare paying passengers and car manufacturers mean that this area can no longer be categorised as future technology.

Advances in complementary technologies such as Lidar are, of course, key to autonomous vehicles but reliable access to updated traffic conditions, severe weather event or bush fire information as well as the ability for an office based "supervisor" to remotely take control of the vehicle under dangerous or unusual conditions are also important. In turn, these features rely on low latency mobile internet with wide coverage including, but not limited to, remote areas. Long haul, driver-less trucks would be rendered useless without such infrastructure support and the benefits, including reduced driver fatigue and trucks that do not require rest breaks, will be lost.

The inability to track emergency service vehicles especially in remote areas remains a concern, the solution to which also relies on widespread mobile coverage.

6.6 Mobile Demand

Access Speed

Cisco's Annual Internet Report (2018-23)²⁵ cited that (globally), the average mobile network connection speed in 2018 was 13.2 Mbps. This average speed was expected to more than triple and will be 43.9 Mbps by 2023. These speeds are based on relative proportions of 2G, 3G and 4G users among the connections across the time period, rather than being driven by specific application usage. It is expected that the 5G speeds in the 2023 timeframe will be 13 times higher than the average mobile connection.

²⁴ Infrastructure Australia. The Australian Infrastructure Audit 2019

²⁵ Cisco Annual Internet Report (2018-2023), 2020

The Cisco report also identifies a key trend in terms of supporting Machine to machine (M2M) connections, with the global connections expected to grow from 1.2 billion in 2018 to 4.4 billion in 2023 (30% CAGR).

Coverage

From a coverage perspective the demand for increased coverage is chiefly driven by:

- the need to address the mobile black spots, that have been identified as part of the Federal Government Mobile Black Spots Program and documented in the Mobile Black Spots register.
- expanding the coverage footprint to cover the areas of population and urban growth that will arise in the State.

6.7 Fixed Line Broadband Demand

For the purposes of this Report fixed line broadband users will be considered in 2 categories:

- Residential and small to medium sized business, and
- Enterprise and Government

In general, specific demand information of the enterprise and industry sector is specific to the individual business and is maintained as confidential information by the providing service provider. Whereas, for the residential sector, there is a significant amount of research and study conducted in residential broadband trends and behaviours.

6.7.1 Residential and Small Business Demand – Fixed line broadband

6.7.1.1 Residential Demand

The main driver of demand (especially downlink) for residential users has been video entertainment and the trend towards higher definition HD (1080p) and UHD (2160p aka 4K) from Standard Definition (720p).

Video streaming is of course not the only factor driving increased demand. Gaming and the previously mentioned Internet of Things devices are all putting pressure on existing infrastructure.

This pressure is widely recognised, and the market is responding. nbn's \$4.5bn Upgrade Program seeks to bring 75 percent of the network being 1Gbps capable by the end of 2023.

In July 2020, the Federal Government Department of Infrastructure, Transport, Regional Development and Communications' Bureau of Communications, Arts and Regional Research (BCAR) issued a Working paper²⁶ which updated its previous 2018 demand for fixed line broadband in Australia report.

Probability analysis of bandwidth demand drivers yields the following estimates of peak household bandwidth demand (see Figure 20):

- 50 per cent of households had peak bandwidth demand of 14 Mbps in 2018 or less and will demand 29 Mbps or less in 2028.
- 90 per cent of households had peak bandwidth demand of 22 Mbps or less in 2018 and will demand 48 Mbps or less in 2028.
- 95 per cent of households had peak bandwidth demand of 24 Mbps or less in 2018 and will demand 56 Mbps or less in 2028.

²⁶ Australian Government Bureau of Communications and Arts Research Demand for fixed line broadband in Australia 2018-2028 Working paper July 2020

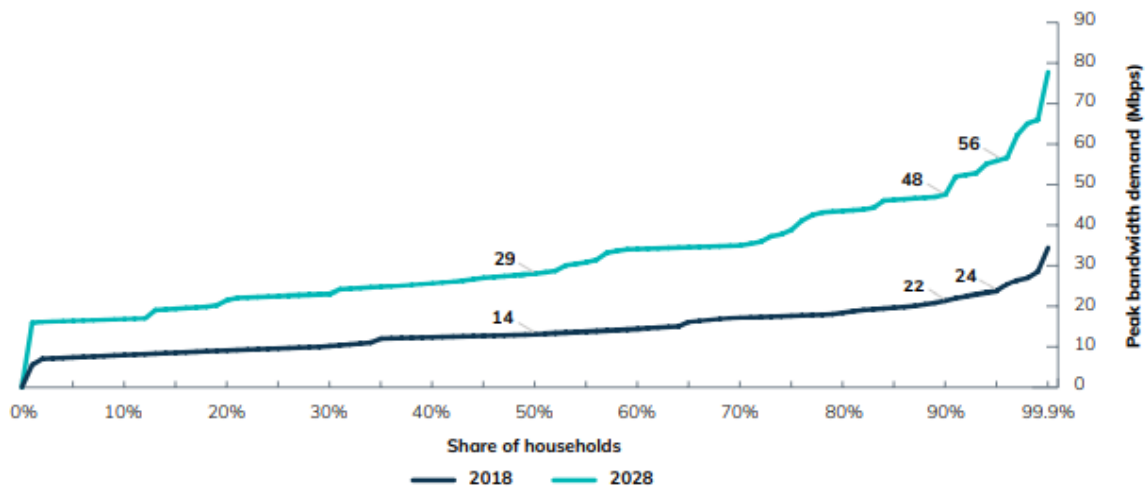


Figure 20 Distribution of household peak bandwidth (Source: Bureau of Communications, Arts and Regional Research)

The main drivers of increased broadband demand over the forecast period are higher resolution video streaming and game downloads.

6.7.1.2 Small Business Demand

The BCAR report estimates that 95 per cent of Australian small businesses (those with fewer than 20 employees) had bandwidth demand of 24 Mbps or less in 2018. This is forecast to rise to 37 Mbps or less in 2028.

Whilst the data requirements of some small and medium sized businesses e.g., local retailers or tradespeople, might see only marginal growth driven through use of point of sale equipment, web advertising or on-line stores the needs of others such as graphic designers, content providers and independent video game developers will rise more significantly as many of their tools of trade are cloud hosted SaaS (Software as a Service) applications.

Small business bandwidth demand will also be driven by video streaming, file transfers and web browsing. Industries that provide WiFi as a service, such as education and accommodation, are forecast to have the greatest bandwidth demand due to internet usage by non-employees.

The emergence of whole new types of employment like professional video gamers (as can be found on Twitch and other game streaming services), social media “influencers” and online traders of stocks, shares, precious metals, and crypto currencies also drive non-enterprise internet use.

6.7.2 Enterprise and Government Demand

6.7.2.1 Enterprise Communications

The evolution of enterprise communication solutions for example from PSTN (traditional telephone land line) to VoIP (Voice over IP) services, unified communications, video conferencing and collaboration tools, as well as increasing use of cloud or data centre hosted applications are all driving increased internet use.

This increased use brings with it an implicit dependency. An internet outage at an enterprise location or its associated data centre is not simply an inconvenience, in many cases it means a complete halt to productive work.

Resilience and reliability of internet supply as well as disaster recovery options such as the ability to fall back to a satellite connection or an independent second provider of landline services is

essential if productivity is to be maintained. This means that multiple vendor/technology options are required where businesses operate, whether in urban areas such as Perth or more regional population centres.

This situation is analogous to the “depth of coverage” issues experienced by a single user. When a single user experiences loss of service because of a congested internet pipe or an oversubscribed mobile tower they experience issues, such as drop-outs. When an enterprise or data centre has its land line cable cut by roadworks or a flood or fire occurs at a network aggregation point, business productivity can drop significantly.

New and internet connected technologies, especially IoT, also offer opportunities outside the office.

- Data collection and analysis of soil conditions by in-ground sensors can inform decisions about, or automation of, irrigation,
- Remote sensors can be installed along riverbanks providing a constant stream of data that can be analysed and trends or warning signs recognised,
- Smart sensors on traffic lights can be used to monitor traffic and shift timing and/or sequencing of those lights to improve traffic flow. Those same sensors can gather data on volumes and types of vehicles. This data can be used when deciding the best time of day or day of week to repair roads or where upgrades might offer the most benefit.

All of these opportunities require internet coverage to get the data from the sensor to the data centre. Further connectivity is needed to give the analyst and subject matter experts access to that data and the tools used for analysis.

6.7.2.2 Government Communications

Government communications can be considered from two perspectives; its internal “enterprise” communications and operational communications (e.g., private mobile radio for public safety, emergency services and utilities).

The enterprise communications are evolving via the whole-of-government transformation from individual ownership of ICT infrastructure to consumers of on-demand, consolidated services. The supporting GovNext-ICT approach aims to simplify and connect government systems by re-locating 60 physical data centres into pay-as-you-go, secure cloud services, creating a single, unified network, and modernising telecommunications. This will increase the demand for reliable high speed internet services across all government sites in the State to access cloud-based services and enable efficient, effective digital government services to the State.

The operational communications are equally undergoing a transformation, increasing the reliance on smart phone/app-based communications. Whilst the voice based mobile radio provides essential connectivity for command and control, the use of the smart phone/apps and body worn video provides situational context and data for decision making. These applications require significant bandwidth and with the possibility for significant numbers of personnel in the same locale, a key requirement is for priority access in times of network congestion.

7. Telecommunications Infrastructure Supply – Overview of Current State

The current state view was determined as the baseline for assessing the potential improvements in digital connectivity to support WA’s Vision and achieve the Target State.

This assessment of current state has been developed through:

- Review of current IWA prioritisation of digital connectivity initiatives,
- Review of current state telecommunications business models (i.e., how consumers and businesses currently address their digital connectivity needs), and
- Review of current state digital connectivity infrastructure (fixed and mobile) through geospatial analysis and stakeholder engagement.

Telecommunication infrastructure included in the assessment can be broadly categorised as:

- Fixed networks (nbn's multi-technology mix across fixed, fixed wireless and satellite together with any other fibre networks identified)
- Mobile networks (3G, 4G)
- Other (non-nbn) satellite technologies (e.g., Low Earth Orbit, LEO, satellites), and
- Data centre infrastructure and supporting services.

Infrastructure assessed is limited to:

- Publicly available information (or information otherwise provided to IWA by network providers) and,
- For the purposes of assessing supply of digital technology and telecommunications to WA, only those technologies currently available in WA.

7.1 Overview of Current State Supply

At a whole of state summary level, Figure 21, shows the extent of the current digital connectivity supply for the nbn technologies and roll-out and mobile coverage, as modelled by Grex based on the publicly available information.

This shows a number of key features:

- Concentration of the higher speed fixed capabilities (nbn FTTx, HFC) within metro, and regional urban areas;
- The deployment of Fixed Wireless in regional towns and South-West of the state;
- The prevalence of Satellite services across regional and remote WA; and,
- Mobile coverage centred on the population centres with partial coverage of transport routes.

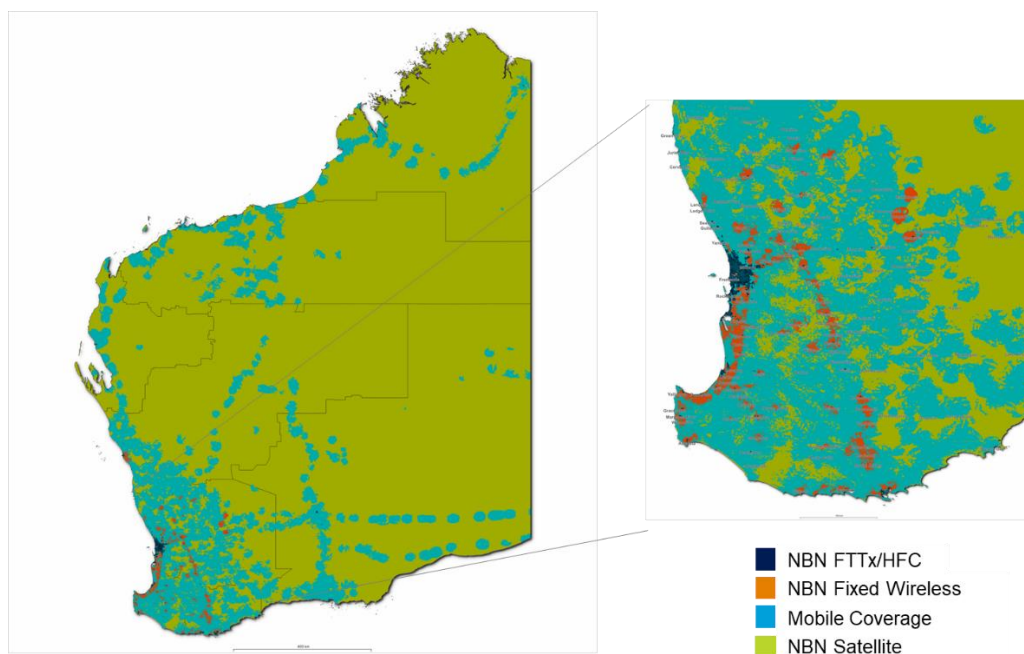


Figure 21 State-wide Summary of Fixed and Mobile Coverage within WA (Source: Grex based on nbn and RFNSA data)

Significant changes to the Australian telecommunications landscape are expected over the next 5-10 years. The digital divide between metro and regional/remote areas will be an area of increased focus across the country. Supply will be driven by maturing 5G, introduction of 6G, broader deployment of LEO satellites, the evolution of edge data centres and security, increased smart city/IOT adoption and more fibre deployments to end-users.

7.2 National Broadband Network - nbn

The nbn was established to deliver Australia's first national, wholesale-only, open access broadband network to all Australian homes, schools, and businesses. nbn is required under its Statement of Expectations to make download data rates (and proportionate upload rates) of at least 25 Mbps to all Australian premises and at least 50Mbps to 90 per cent of fixed-line premises as quickly as possible. Within WA, Grex's analysis shows that nbn covers 90% of residential premises. Further details on the extent of the technology coverage are given in Section 9.2.

Under existing Federal Government policy, nbn has had the flexibility to choose which technology should be rolled out in an area, making optimum use of available infrastructure to keep costs down and deliver fast broadband to Australia as soon as possible. nbn has completed its initial build using a range of technologies (multi-technology mix). The multi-technology principles mean that most residential and business users would receive one of the following access technology methods:

- Hybrid Fibre Coaxial (HFC) cable,
- Variants of fixed technologies, which are defined in Glossary and range from FTTP to FTTN,
- Fixed Wireless; and
- Satellite networks

nbn currently offers different speed tiers across its multi technology mix access technologies, Figure 22. The percentage of premises expected to be serviced with their respective access technology type and enabled broadband speeds is shown below³.

- 12/1Mbps (downlink/uplink), 25/5Mbps, 50/20Mbps and 100/40Mbps across all fixed line access technologies i.e., FTTP, FTTN, FTTB, FTTC and HFC with the exception of HFC and FTTP enabled to provide higher download speeds of 250Mbps and 1Gbps;
- 12/1Mbps, 25/5Mbps and 50/20Mbps for Fixed Wireless served areas; and
- 12/1Mbps and 25/5Mbps for Satellite served areas.

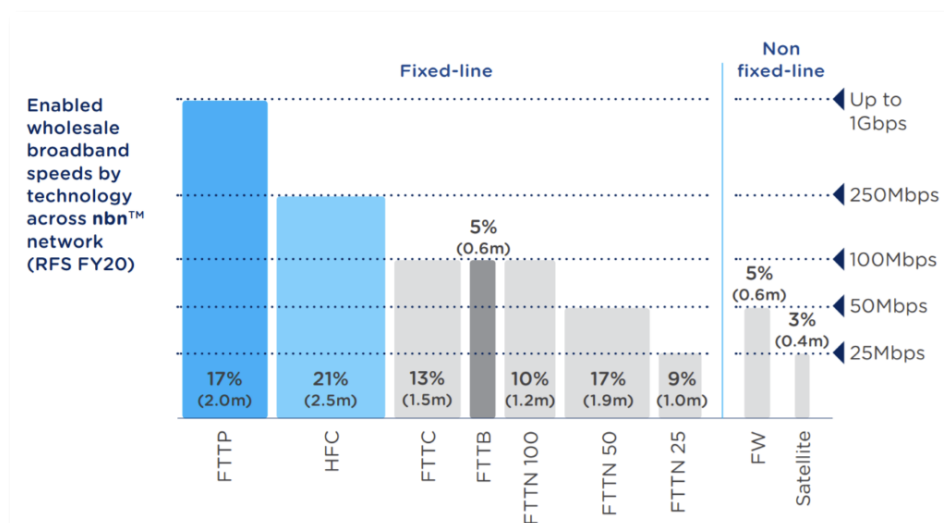


Figure 22 Current network enabled speed (Source: NBN Co)

Having completed the initial build, nbn is now focused on the next stage in the planned evolution of the nbn network with an investment plan of additional \$4.5 billion of funding to accelerate network investments over the next three years. The plan is expected to deliver targeted and demand-driven investments and has three components²⁷:

- \$3.5 billion to make nbn Co's highest wholesale speed plans available, as demand arises, to up to 75 per cent of households and businesses in the fixed-line network by 2023 (and up to 68 per cent in the total network)
- Up to \$700 million in a package of initiatives to collaborate with industry to help deliver enhanced digital capabilities supporting business innovation, productivity, and growth.
- \$300 million to establish a dedicated fund from which the Company can co-invest with governments or local councils to continue to improve broadband services for Australia's rural and regional communities.

In Section 12, an Opportunity for Government to work with Commonwealth is identified. Co-investment discussions with nbn should continue and be coordinated across Government departments to assess the impacts of the upgrade programs being undertaken and the ability for Government to leverage the \$300 million investment fund allocated by nbn as described above.

7.3 Commercial Telecommunications Infrastructure – Mobile

Australia has three mobile operators. Mobile usage is growing quickly, driven by reduced data consumption costs and greater competition. However, the resources to meet the demand is not unlimited. As traffic increases, mobile operators have three levers to meet demand: technology efficiency, spectrum, and the number of sites.

The Next Generation Mobile Networks Alliance has defined the following requirements for 5G:

- data rates of tens of megabits per second for tens of thousands of users;
- data rates of 100 Mbps for metropolitan areas;
- 1 Gbps simultaneously to many workers on the same office floor;
- several hundreds of thousands of simultaneous connections for wireless sensors;
- spectrum efficiency significantly enhanced compared to 4G;
- improved coverage and signaling efficiency; and
- significantly reduced latency relative to 4G.

²⁷ NBN Co Corporate Plan 2021

In other words, it has the potential to improve mobile performance at several levels. The main benefits of 5G technology are likely to be speed of delivery (bandwidth) and a reduction in latency compared to 4G networks. There is much promise in 5G, the real-world improvements will be more apparent after these new networks have had time to mature.

At the most basic level 5G is 4G but faster. However, this is an oversimplification, and two points are often either overlooked or conflated in relation to 5G technologies:

- a) There are essentially 2 “standards” of 5G being “5G – sub 6” and “5G - millimeter wave” depending on the frequency of carrier wave used. Both are true “5G”, but they have widely different characteristics from a user point of view. Some devices are “sub-6 only” whereas others support both “sub-6” and “millimeter wave”. The same applies to network equipment including radio towers.
- b) Sub-6 5G performance is broadly comparable to 4G. From a user perspective it is almost indistinguishable. It can be used/treated exactly as any user would use 4G, indoors, rainy weather, phone-in-the-pocket using Bluetooth headphones etc. Millimeter wave 5G *can* be fast however it is very sensitive to not having direct line of sight to a radio tower, it has a much shorter range and can be blocked by a hand over the “wrong” part of the device or when in a pocket. Being indoors or inclement weather cause performance to degrade.

7.4 Satellite Technologies

Satellite technologies are traditionally constrained in terms of the bandwidth speed (both up and down), data quotas as well as the delays or latency – this means they are not well suited to certain applications, in particular voice, video telephony/conferencing, video streaming, wireless cloud based office, augmented/virtual reality, autonomous driving. Examples of the bandwidth and latency requirements are shown in Figure 17. These constraints impact certain business users and users of Government services (e.g., education and health).

A typical voice or video telephony call requires <150ms one-way latency. Latency can be defined in several different ways, but in general it is the time it takes a bit of information to traverse a network from its originating point to its final destination. The time needs to be doubled if the latency for a round trip is being calculated.

Although the speed of light cannot be physically changed, satellite network operators can choose to deploy satellites at different altitudes which directly impacts the latency⁸. The graphic below shows the typical operational altitude of three different satellite systems with their respective one-way latency values (not round-trip).

There are currently over 2000 satellites orbiting the Earth. They are generally deployed in low, medium, or geostationary orbits.

- *Geostationary Earth Orbit (GEO) satellite:* A satellite system that sits high (36,000 km) above the Earth’s surface aligned with the equator. It appears stationary as it orbits the Earth at the same speed as the Earth rotates. nbn Satellite broadband service, known as Sky Muster™ is supplied over the GEO satellites.
- *Medium-altitude Earth Orbit (MEO) satellite.* Most notably used for navigation including the GPS, GLONASS and Galileo fleets which are positioned at an altitude between 19,000 and 24,000km. Other examples include the Copsas-Sarsat and MEOSAR search and

rescue program which detects emergency distress beacons and Capricorn Space who operate ground segment capability.

- *Low Earth Orbit (LEO) satellite:* A satellite system that is closer to the Earth's surface than a geostationary or medium altitude satellites (up to 2,000km) and can transmit data with lower latency. Multiple LEO satellites are often used to form a constellation.

Over the last decade there has been an unprecedented increase in the number of satellites (particularly LEO) launched and over the medium-to-long term the industry expects this trend to continue.

LEO satellites may also provide additional backup for mobile backhaul as well as WiFi hot-spots in regional and remote areas of WA.

7.5 Internet of Things (IoT)

IoT applications have highly diverse needs for network connectivity, reliability, security, latency, data rate, mobility, and battery life. While the overall amount of network data traffic generated by IoT devices will be small, the signaling traffic they generate will grow hugely and will place new demands on network control plane capacity.

There is a wide range of available connectivity technologies running over licensed and unlicensed spectrum. Each offers its own performance characteristics to serve IoT applications. No single technology will be able to serve all the diverse performance needs of all IoT use cases. Operators face the challenge of which connectivity technologies to adopt in order to meet the diverse demands of this huge variety of IoT applications.

There are a number of open standard and proprietary technologies employed to deliver IoT capability.

8. Analysis of Supply

8.1 Region by Region Supply Analysis

In terms of the process for addressing each of the regions, the process adopted was to start with the geography and assess local government boundaries, and assess the users driving demand across premises (Geocoded National Address File G-NAFs), ABS population, business, and government points of presence. A G-NAF is a geocode using longitude and latitude co-ordinates along with state, suburb, street, and number details to identify a premise.

Each of the 10 regions is set out in detail in Appendix 1. , the example approach to Gascoyne is set out below. Figure 23 sets the general area parameters.

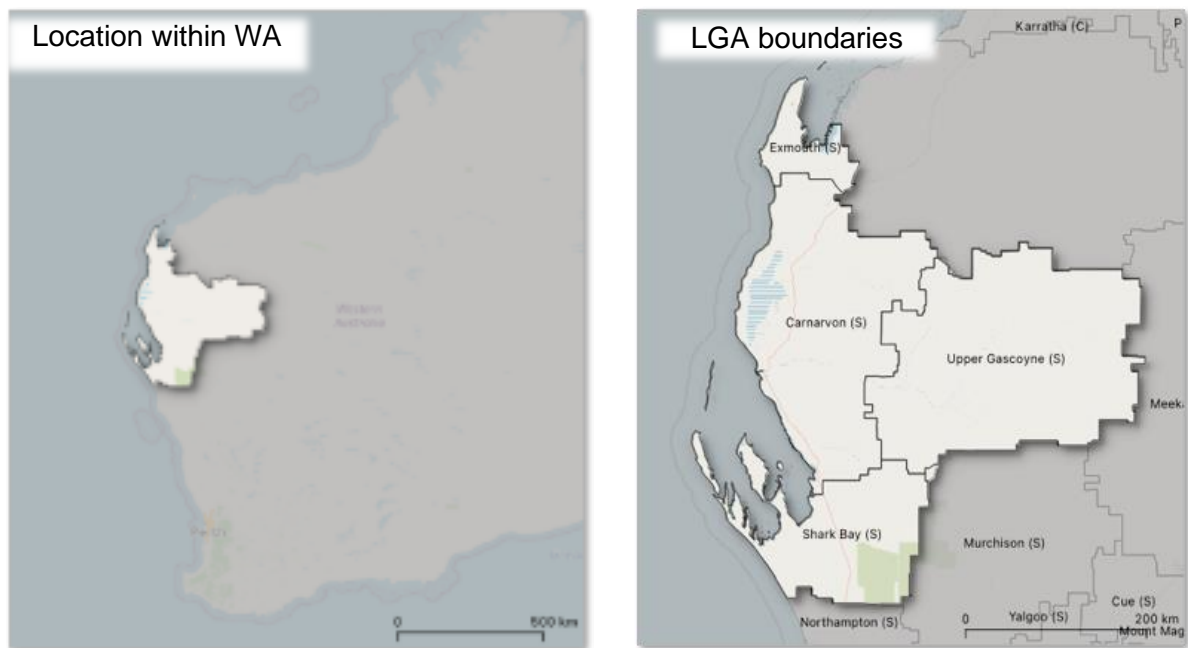
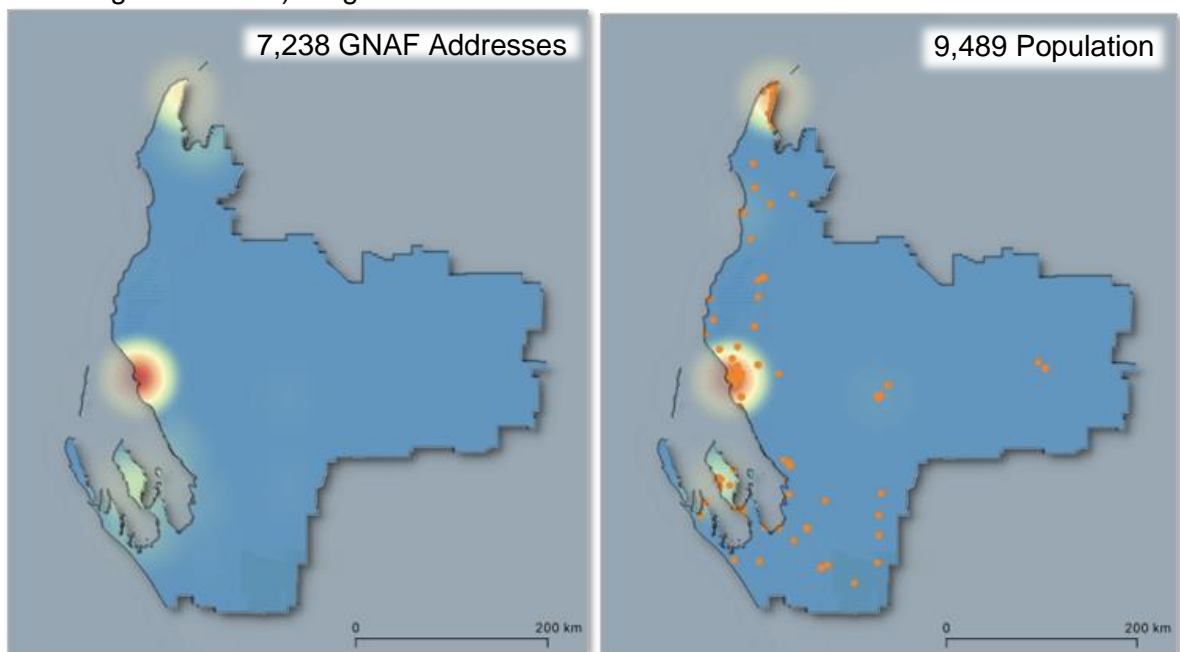


Figure 23– Gascoyne – location and LGAs²⁸ (Source: Grex)

In Gascoyne, located in the north-west of WA, there are over 7,000 GNAF premises which would potentially be served by fixed and mobile technologies, with just under 10,000 people concentrated in 2 main areas and over 2,000 businesses spread throughout (many of which would be farming businesses) - Figure 24.



²⁸ Source: Australian Bureau of Statistics (July 2019) Australian Statistical Geography Standard (ASGS): Volume 3 - Non ABS Structures

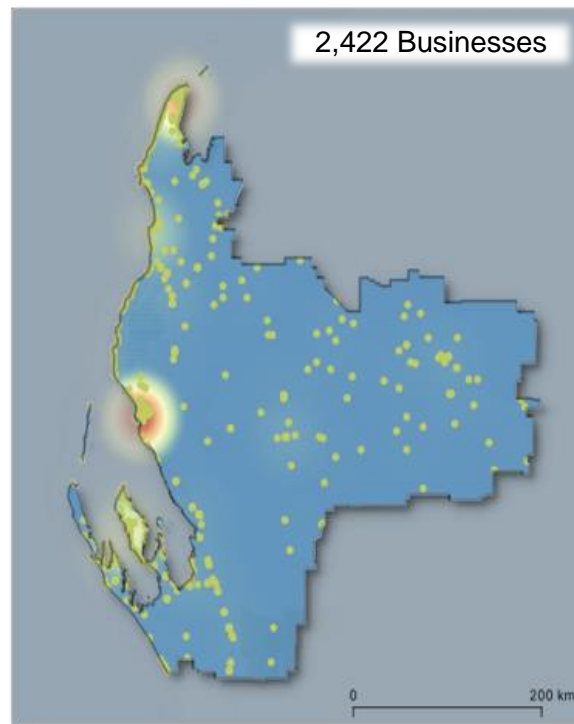


Figure 24– Gascoyne – Premises,²⁹ Population³⁰ and Businesses³¹ (Source: Grex)

Once user types are assessed, each area is analysed according to the three broad types of telecommunications network infrastructure:

- Fixed networks (nbn’s multi-technology mix across fixed, fixed wireless and satellite together with any other fibre networks identified)
- Mobile networks (3G, 4G)
- Other (non-nbn) satellite technologies (e.g., Low Earth Orbit satellites).

For Gascoyne, the analysis of fixed networks illustrates a concentration of fixed technologies around the main communities, with a preponderance of satellite technology covering the rest of the region.

Using ACMA databases for publicly available information, the modelling as conducted by Grex, illustrates a similar concentration of mobile coverage around main community centres.

Across all mobile networks, each region is analysed to identify mobile blackspots against total coverage area of all mobile network operators. This enables us to identify the extent of mobile coverage issues across each region (Figure 25).

²⁹ Source: G-NAF, May 2020

Incorporates or developed using G-NAF © Geoscape Australia licensed by the Commonwealth of Australia under the Open Geocoded National Address File (G-NAF) End User Licence Agreement.

³⁰ Source: Australian Bureau of Statistics (July 2016) Australian Statistical Geography Standard (ASGS): Volume 1 - Main Structure and Greater Capital City Statistical Areas.

³¹ Source: Precisely, 2020.

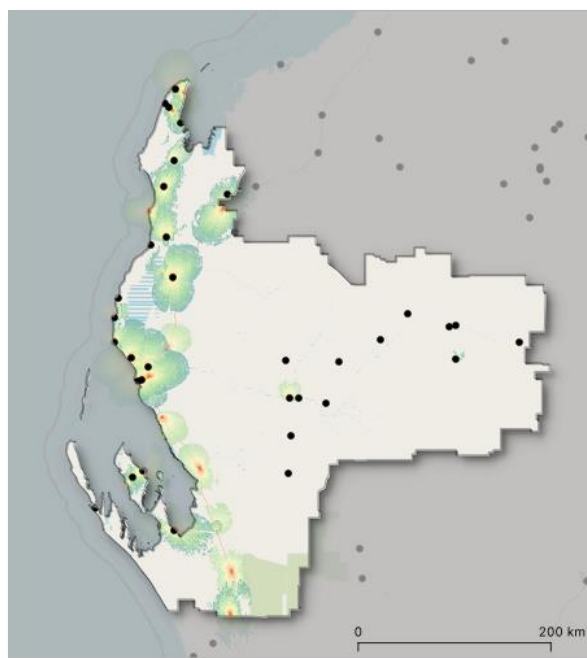


Figure 25 Gascoyne Overview – aggregated mobile coverage and blackspots³² (Source: Grex based on RFNSA data and mobile black spots register data)

8.2 Themes across the 10 regions

As expected, areas such as Gascoyne with its lower population densities have fixed and mobile coverage following the main community centres.

However, there is a difference amongst areas in how fixed technologies and mobile technologies (especially) have been deployed.

Whilst population and premise figures are low compared to Perth, areas such as Kimberley and the Mid-West enjoy broader seams of coverage than other regional areas:

However, as described in Section 3.5.2 Mobile Blackspot Program, there remains a preponderance of mobile blackspots. These blackspots, and the analysis of available coverage and speeds by area across the regions (in Section 9 Gaps in Digital Connectivity) illustrates the issues regional WA faces and the impediments to growth and investment through a lack of connectivity.

Perth enjoys coverage across all broad technology types given its larger population.

Perth also enjoys access to an extensive and recently deployed set of submarine cable networks together with the presence of a number of global and national data centre operations.

Numerous terrestrial and submarine optical fibre transmission routes land in Perth and then are deployed east from Perth across the State. Figure 27 shows the main terrestrial routes within the State and across the Regional Development areas, based on available published data³³. Currently there are four international submarine cable routes terminating in Perth, see Figure 26.

Three of these cables connect to Singapore (SeaMeWe3, Indigo West and Australia-Singapore Cable) and the fourth is the Oman-Australia Cable, due to commence service in December 2021

³² Source: Department of Infrastructure, Transport, Regional Development and Communications (2021).

³³ WA Digital Infrastructure Atlas

(Figure 26). There are also 2 national submarine cables, one that links Perth with Sydney via the Great Southern Bight and the second that connects Port Hedland with Darwin (Figure 26).

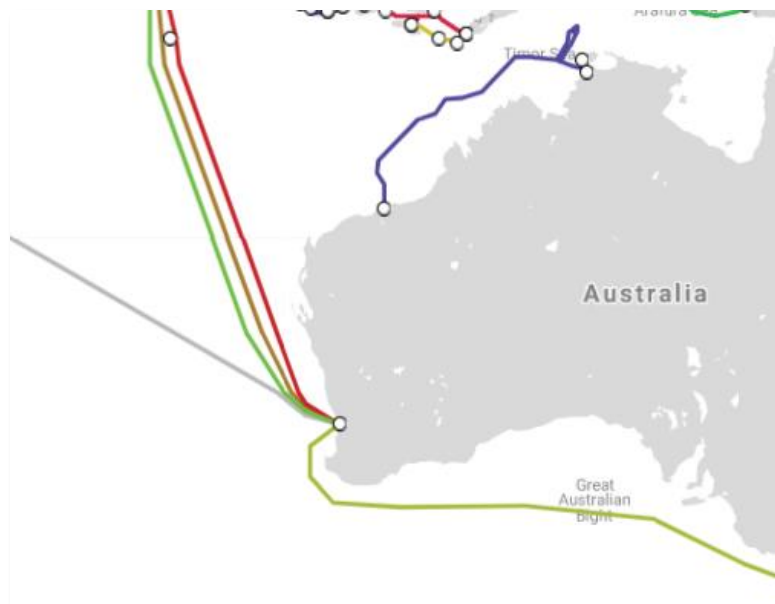


Figure 26 Submarine Optical Fibre Routes for Western Australia (Source: Submarineablemap.com)

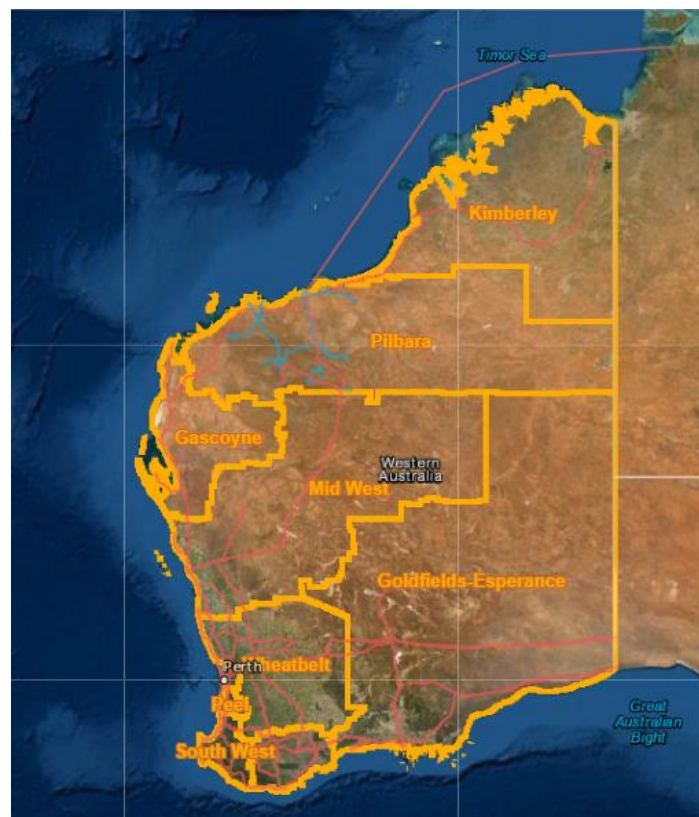


Figure 27 Approximate Optical Fibre Routes Within Western Australia (Source: WA Government: Digital Infrastructure Atlas)

8.4 Other networks outside nbn and the mobile operators

The current landscape is also subject to constant change and development. New technologies are being deployed such as LEO satellites and there is a growing market for the deployment of inter-state and intra-state fibre transmission and backhaul technologies.³⁴

Recently commercial, global services have become available including coverage in WA with pre-order sign-up already available with anticipated activation date of “mid-2021”. Initially there will be limited numbers of users but with more satellites launched every month this restriction will ease over time as the ultimate goal number of satellites is reached. This will eventually provide broadband speed coverage for parts of every region.

In addition, DPIRD has been supporting extensive deployments of technologies through its Digital Farm Grants program (Figure 28). As the list of providers indicated in the figure illustrates, there is an extensive market of telecommunications participants offering services using a variety of technologies (fixed wireless predominantly).

The Options and Opportunities in this Report suggest ways in which these projects and technology deployments (submarine cable into inland transmission to deliver more capacity to support networks such as those being supported by DPIRD above) can be brought together across Government and leveraged in a coordinated way, with the Vision for the State supported throughout.

From an emergency services perspective, there are both analogue and digital private mobile radio networks operated by the emergency services within the State. Whilst these are not pervasive networks across the State, they do provide a potential for enabling the sharing of infrastructure and co-location with mobile and local wireless access networks.

³⁴ Announcements such as those in relation this week to the HyperOne network together with recent initiatives such as WA SuperNet are just two examples.

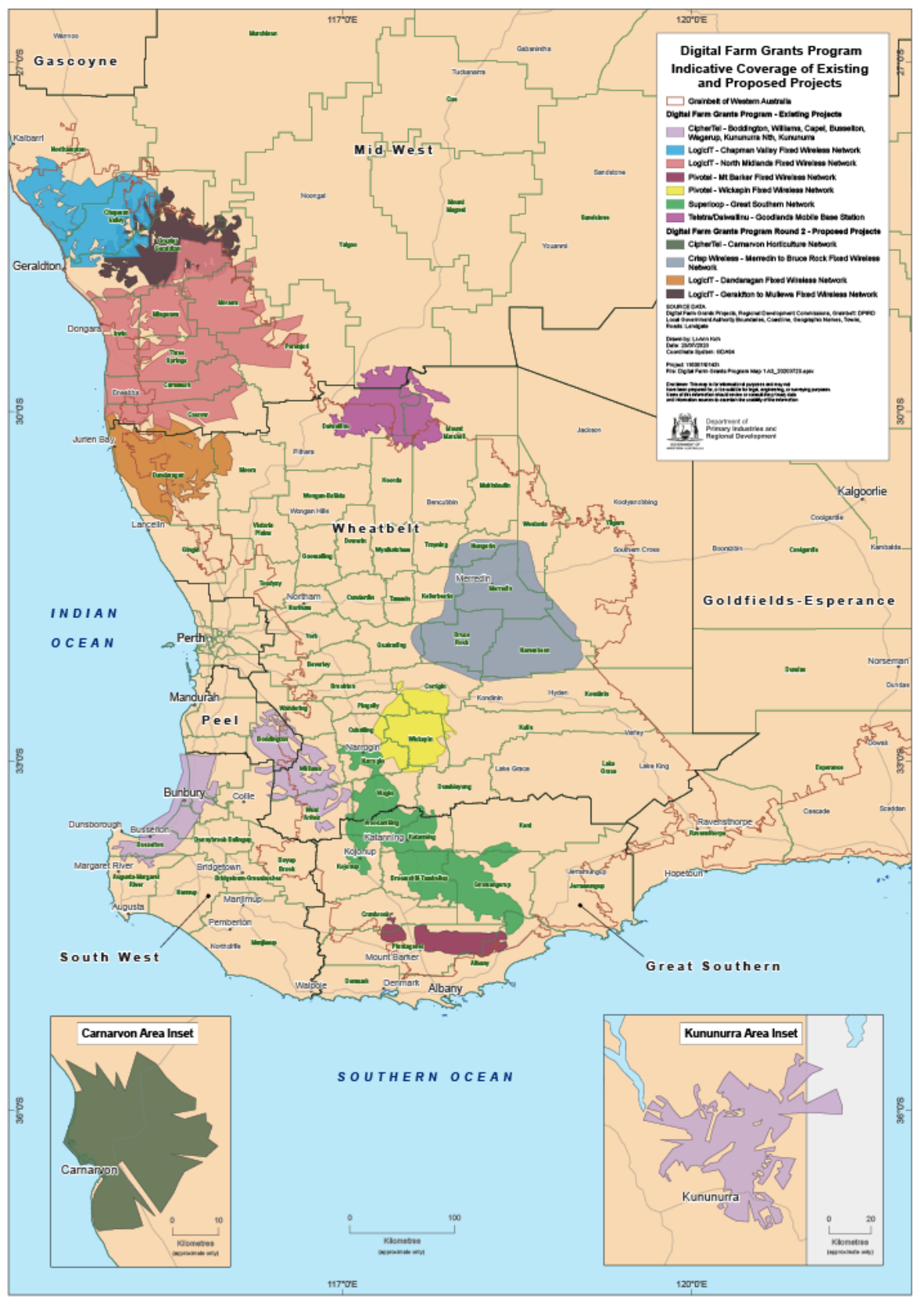


Figure 28 DPIRD Digital Farm Grants Program Map 1 (Source: DPIRD)

9. Gaps in Digital Connectivity

9.1 Summary

The gap analysis between the demand and the supply indicates that the evolving digital connectivity demand for major metro/regional population centres in the South-West and along the coast areas of the State should be met. In the areas of WA where the fixed access services are constrained by the available technology parameters or there is limited or no mobile network coverage and/or capacity, the demand may only be partially met today and the ability to meet the increasing demand expectations could lessen over time without technology uplift and investment.

9.2 Fixed Technologies (nbn)

nbn's fixed line technologies coverage supports a large proportion of residential premises across metro and regional WA.

An analysis of the geographic areas across all 10 regions illustrates that there are large portions of the WA geography covered by nbn's fixed wireless and (especially) satellite technologies.

9.3 Mobile technologies

There is a similar theme in relation to coverage by the combined mobile network operators. Coverage is strong within population centres but by area there are gaps in coverage as denoted in the mobile black spots register.

9.4 Bandwidth Gaps

As we describe in Section 6, the number of users requiring speeds above 25/5 will increase steadily over time. This will apply to both residential as well as business users.

Technologies delivering 30 Mbps met the bandwidth demands for 99 percent of residential households in 2018 but by 2028 it is estimates that significantly fewer households will have their demand satisfied by this bandwidth.

9.5 Emerging technologies

Along with the technologies already deployed in regional areas, and upgrades to existing mobile networks and nbn (plus further rollout of the mobile blackspots programs), new technologies are emerging which may fill the throughput gaps identified above, particularly in the regional parts of WA.

The trial speeds currently experienced in the USA and Canada illustrate the capability of the LEO satellites downlink speeds ranging from 60 to 120Mbps.

Commercial LEO satellite capacity is available now albeit with limited numbers with some operators and with others in beta-testing phase.

10. Affordability and Ability

Specifically for WA, Figure 29 sets out the findings of the most recent Australian Digital Inclusion Index (2020) report (ADII)⁸ in the WA regions assessed. As illustrated below, there is a large focus applied to the "Other WA" region that represents the regional, rural, and remote communities and businesses³⁵, and which represents the vast majority of the State by geography.

³⁵ Note that the ADII adopts a different regional structure for its analysis compared to the Regional Development Council boundaries referenced elsewhere in this Report.

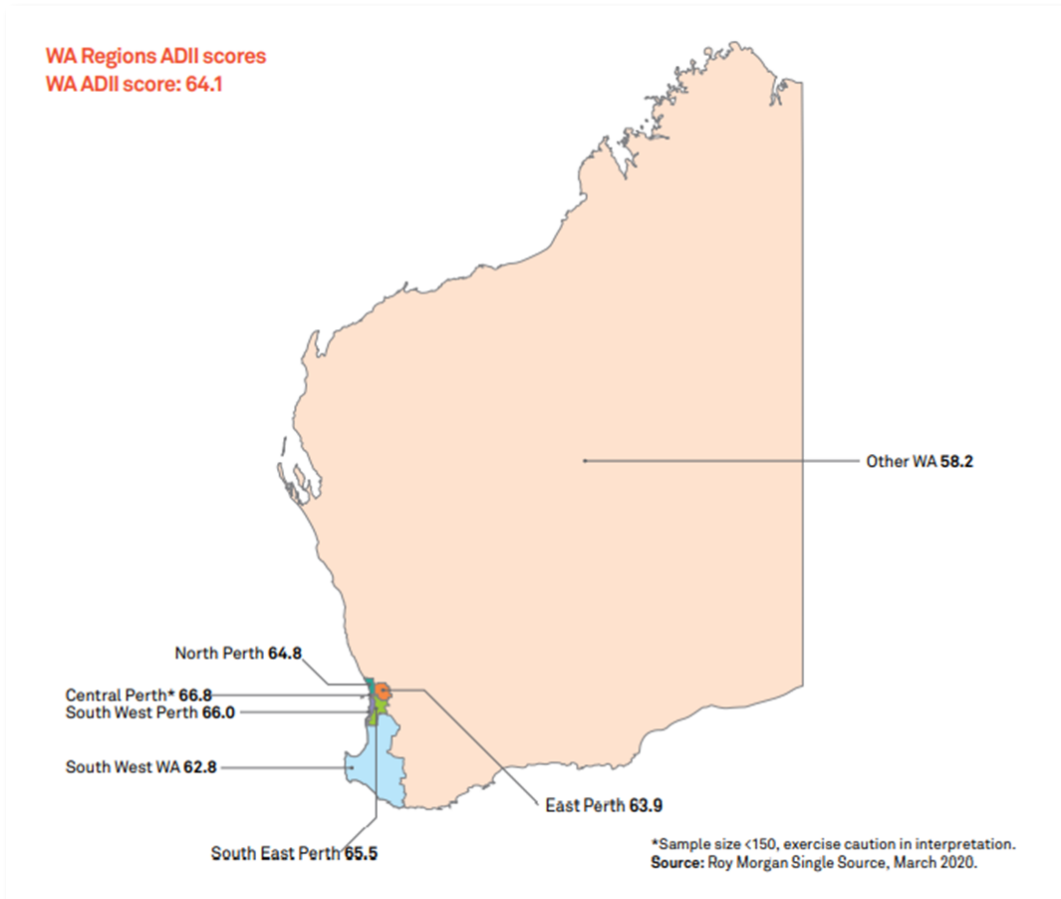


Figure 29 ADII Regional Areas for Digital Inclusion Measurement and Analysis (Source: ADII Report 2020)

Current trends in the 2020 ADII show improvements in WA across the measures (Overall ADII rating, Figure 30 Affordability rating, Figure 31; Digital Ability rating, Figure 32)

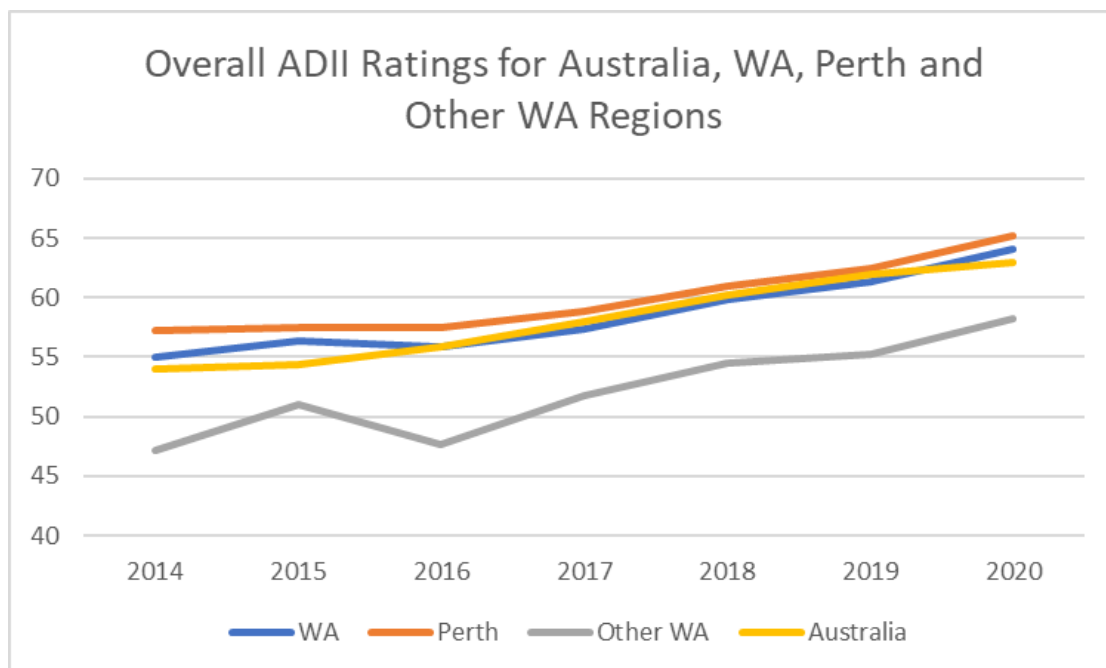


Figure 30 Overall ADII Rating Trends for Australia, WA, Perth and Other WA (Source: Grex)

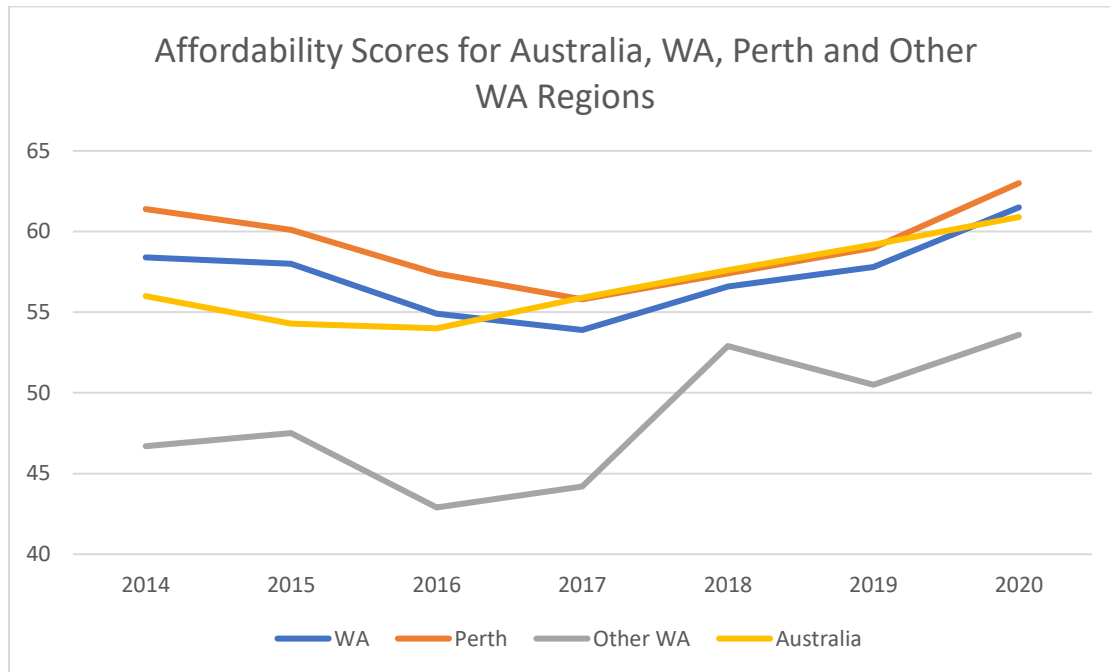


Figure 31 ADII Affordability Trends for Australia, WA, Perth and Other WA

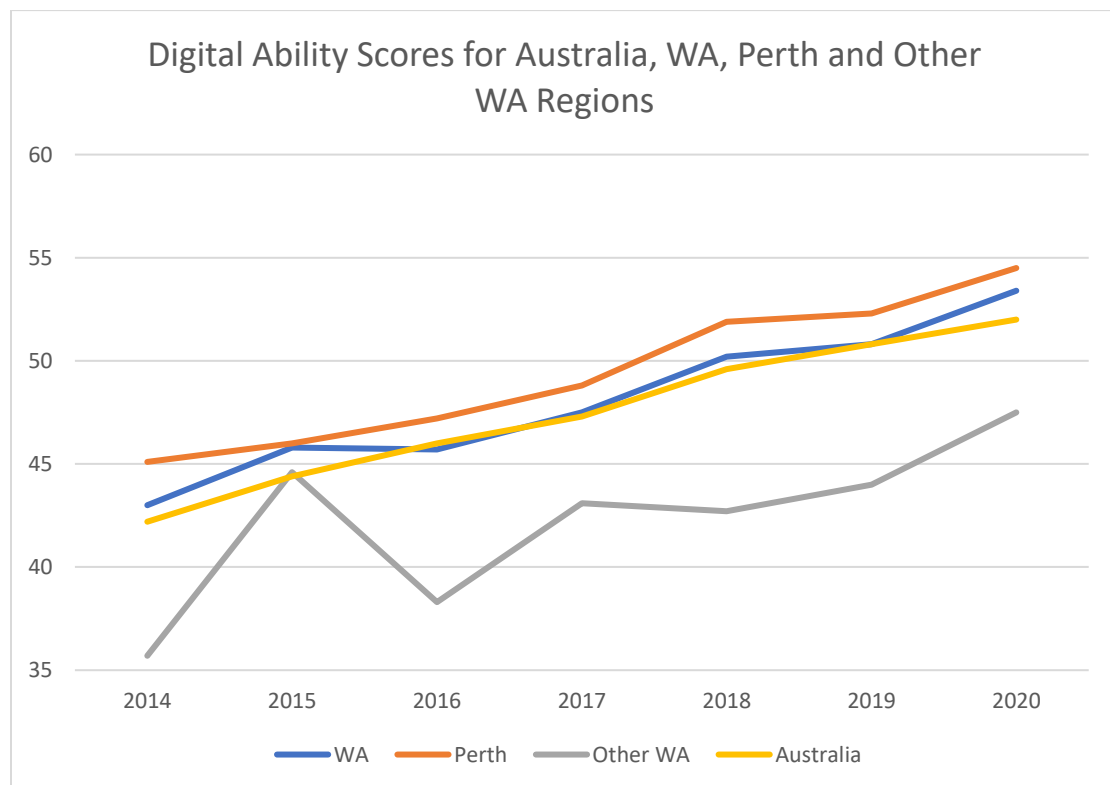


Figure 32 ADII Digital Ability Trends for Australia, WA, Perth and Other WA

As a set of overall trends, across the 2014 to 2020 period, WA has remained close to the overall ADII rating for Australia with some movement above and below the rating. There has been a

positive and progressive improvement across the Affordability and Digital Ability ratings throughout the state. Perth tracks at or above the national average. However, there remains a persistent gap between the ratings for Perth and the Other WA region which also pulls the statewide average down.

The downturn in affordability around 2014/2017 was attributed to the decrease in Relative Expenditure (share of household income spent on internet access), but that was offset to a degree by an increase in the Value of Expenditure (total internet data allowance per dollar of expenditure).

A more detailed assessment of the Affordability and Digital Ability elements based on a review of the 2020 ADII report and other inputs, such as the NBN Co Corporate Plan 2021 is provided below.

The measures used to assess Affordability and Digital Ability are defined in the ADII report as:

Affordability has two components:

- Relative Expenditure: share of household income spent on internet access.
- Value of Expenditure: total internet data allowance per dollar of expenditure.

Digital Ability has three components:

- Attitudes: including notions of control, enthusiasm, learning, and confidence
- Basic Skills: including mobile phone, banking, shopping, community, and information skills.
- Activities: including accessing content, communication, transactions, commerce, media, and information.

10.1 Affordability

The findings and observations from the assessment are summarised in Figure 33 below:

Group	Statement	Source
Overall	WA ranked 3rd for Affordability nationally behind ACT and NSW compared to 6th in the previous year	ADII 2020 Report
Overall	Other WA was the lowest Affordability rating against all regions, both in terms of Relative Expenditure and Value of Expenditure.	ADII 2020 Report
Income	The Q5 income quintile rating for Relative Expenditure was only 12.5% compared to the next highest of 27.8%.	ADII 2020 Report
Income	Q5 overall rating is 34.8% vs Q1 of 77.7% and Q3 of 58.7%	ADII 2020 Report
Employment	The Unemployed group's Relative Expenditure rating of 39.6% was significantly lower than that of the employed (61.3%); also noting that the Value of Expenditure rating was the approximately the same.	ADII 2020 Report
Employment	The Not in Labour Force group rated a little higher than unemployed (noting that a) the unemployed group was a small sample, and this is not a consistent trend over the annual assessments period)	ADII 2020 Report
Education	Tertiary educated users rated higher than secondary educated users which is turn rated higher than non-secondary educated	ADII 2020 Report
Age	The 65+ and 14-24 age groups rated approximately the same for Affordability; both lower than the other age ranges	ADII 2020 Report
Disability	The Disability group rating shows sizeable gap to State average (noting that very low sample)	ADII 2020 Report
Value for money	NBN Co introduced a 12/1 entry level package for more affordable broadband plans	NBN Co Corporate Plan 2021
Value for money	NBN Co provided a 10-15% overhead allowance for downstream delivery on most wholesale speed tiers by NBN to allow RSPs deliver closer to maximum theoretical wholesale download speeds	NBN Co Corporate Plan 2021

Figure 33 Affordability Findings and Observations (Source: Grex)

10.2 Digital Ability

The findings and observations from the assessment are summarised in Figure 34 .

Group	Statement	Source
Overall	Building digital confidence to use the internet safely and securely is important for enhancing digital inclusion Nationally, the Digital Ability score has increased in each year since 2014. Although more Australians are engaging in a range of basic and more advanced internet activities, there remain significant attitudinal barriers to effective participation on the internet. While the COVID-19 restrictions may have made the benefits of digital technologies more obvious, it is important to address the anxieties or skepticism that many Australians have about using digital technologies.	ADII 2020 Report
Overall	WA ranked as second nationally overall behind ACT (53.4% vs 55.7%) for Digital Ability. The national average is 52%	ADII 2020 Report
Overall	WA ranked 4th for attitudes, 2nd for basic skills and 2nd for activities	ADII 2020 Report
Overall	The state-wide Activities rating shown a steady increase over ADII reviews (34.9% in 2014 to 48.5% in 2020), but other WA areas always lagged	ADII 2020 Report
Regions	Other WA (ADII region) rated as lowest overall Digital Ability (47.5% compared to WA average of 53.4%). Highest are Perth and Central. Very low sample size	ADII 2020 Report
Regions	The Digital Ability rating for Other WA rated the lowest across all 3 components	ADII 2020 Report
Age	77.7% of the 65+ age group access the internet, but Ability Rating is low 35.4%, impacted heavily by low activities rating	ADII 2020 Report
Age	The 50-64 age group rating for Digital Ability is below that of all younger age groups; but ahead of the 65+ group	ADII 2020 Report
Age	The Digital Ability rating in the 14-24 age bracket is lower than those in the 25-34 and 35-49 groups as a consequence of the activities	ADII 2020 Report
Age	The top rating for Digital Ability remains for the 25-34 age group	ADII 2020 Report
Education	The Digital Ability rating for those with tertiary education is above that for secondary educated (52.6%)	ADII 2020 Report
Education	The Digital Ability rating for those with less than secondary education is the lowest (38.4%) and 14.2ppt below that of Secondary. This is a consistent trend over the ADII measurement period 2014-2020.	ADII 2020 Report
Indigenous	82% of Indigenous Australians access the Internet (compared to 89.4% for whole of WA), with an average Digital Ability rating on 48.8% (compared to 53.4%) across WA (Note: a very low sample size)	ADII 2020 Report
Disability	The Disability group rating has shown Improvement over the ADII measurement period 2014-2020. (Note: very low sample size)	ADII 2020 Report
Income	The lowest income earning quintile Q5 falls 14.6ppt below the average WA for Digital Ability	ADII 2020 Report
Income	The Income group quintile Q4 for the falls 9.7 ppt below the average WA for Digital Ability	ADII 2020 Report
Employment	The Unemployed group ratings in 2020 below that of employed. Previously a mix of above and below over the period of the ADII measurements. (Note: low sample size)	ADII 2020 Report
Employment	The Not-in-Labour-Force group lags significantly behind both employed and unemployed groups (18-20 ppt) and has done so consistently over the period of the ADII measurements.	ADII 2020 Report

Activities	Real-time video streaming continues to be the most common use of data across Australia, representing approximately 45 per cent of downstream application traffic volumes per nbn network traffic data	NBN Co corporate Plan 2021
Activities	More than three million Australians attended telehealth consultations between March and April 2020	NBN Co corporate Plan 2021
Activities	Post-COVID-19 it is expected that remote work will become 80 per cent more common in a wide range of occupations, which is likely to increase job opportunities and stimulate regional and rural economies	NBN Co corporate Plan 2021

Figure 34 Ability Findings and Observations (Source: Grex)

10.3 Affordability and Ability Gaps Summary

Based on the assessment conducted, Figure 35 details the consolidated gaps that should be addressed as part of the broader Digital Connectivity Strategy.

Area	Gaps
Affordability	<p>Cost of accessing the internet for select groups; such as the regional area users, low-income quintiles, not in the labour force, disability, 14-24 age range and 65+ age range groups.</p> <p>Enabling more value for data allowances for select groups; such as the regional area users, lower income quintiles, less than secondary education, Indigenous Australians, and 65+ age group.</p>
Ability	<p>Attitudes development for select groups, such as the regional area users, lower income quintiles, not in the labour force, less than secondary education, disability, and 65+ age group.</p> <p>Basic Skills development for select groups, such as the regional area users, lower income quintiles, Not in the Labour Force, less than secondary education, disability, Indigenous Australians, and 65+ age group.</p> <p>Activities related development for select groups, such as the regional area users, lower income quintiles, Not in the Labour Force, less than secondary education, disability, and 65+ age group.</p> <p>Skills and development for supporting IT in regional areas and small business.</p> <p>The skills and facilities to foster the convergence of emerging technologies is creating new market value and displacing existing products and services</p>

Figure 35 Affordability and Ability Gap Analysis (Source: Grex)

11. Consequences for WA – connectivity gaps, digital inclusion

As a consequence of addressing the digital connectivity, adoption and ability gaps, there are a number of benefits that Grex has analysed that may not be realised if closing of the digital divide is not achieved.

11.1 Structure of the telecommunications market in WA

Regional WA relies on the available access networks in the regions (provided through the nbn, mobile networks or regional access networks) and the backhaul transmission from these regional locations/points of interconnect back to data centres in Perth and from there to the rest of the world (via submarine international cable networks) to deliver internet, and other connectivity, services.

As described, there are a variety of fixed and mobile access communications technologies being utilised by across regional WA, with a number of these technologies providing service capabilities that either do not provide the coverage, match capacity demand, or provide intermittent or unreliable service (for example, mobile blackspot areas and satellite coverage). State Government has also co-invested in creating access network capability in certain areas (an example being the Wheatbelt) to provide connectivity for specific purposes such as Smart Ag and Digital Farms. In addition to this, there has been significant investment by private industry to provide digital connectivity to service its own needs (for example mining companies laying optical fibre alongside private rail networks to service mines and camps).

There are a number of Telecommunications operators that provide backhaul transmission, but the market is dominated by a handful that have very extensive optical fibre networks that cover a broad area of the country, and in particular all of the nbn Points of Interconnect and major regional towns. Typically, the operators use optical fibre-based networks to provide the required (aggregated) capacity. Depending upon the access technology, the regional end of the backhaul link could be mobile at a mobile site, a regional access network node or an nbn Point of Interconnect. The scale of the backhaul transmission capacity required from that point is dependent upon how many users are concentrated through the access network and if and what contention rules have been applied by the access provider. The network end of the backhaul link is typically a data centre within Perth metro, that enables further aggregation of bandwidth and access to private and public cloud applications.

Aside from the connection of backhaul networks to access networks in regional WA, the recent evolution and revolution of applications and emerging services known as 'hybrid cloud'. Hybrid cloud is a cloud computing environment that uses a mix of on-premises, private cloud, and third-party, public cloud services with orchestration between the two platforms to deliver services. This has instigated and prompted the emergence and global market deployment of 'Edge' data centres, to-date there has been very little investment and deployment of this infrastructure and facilities in regional WA.

Edge data centers are small data centers that are located close to the edge of a network. They provide the same devices found in traditional (metro based) data centers, but are contained in a smaller footprint, closer to end users and devices.

The 'Edge' data centre is not a replacement for the major metro data centres, these facilities provide an extension and enhancement to the digital network connectivity by enabling and facilitating the efficient delivery of content and the facilitation of 'edge' compute – this enables and makes available current and future applications that demand a significant amount of bandwidth, require rapid response times and/or are latency-sensitive as well as support the access technologies that are able to exploit this type of infrastructure Internet of Things (Smart Regions),

5G technology. Globally there has been a recent rapid rise in hybrid cloud deployments and this has resulted in the de-centralisation of computing architecture - edge computing.

A benefit of an 'Edge' data centre is that it is able to facilitate data processing at or near the source of data generation. Given the high cost to connect back to metropolitan areas from regional and remote parts of Australia, other State governments have established projects to bring content closer to the edge of regional and remote areas, including through the establishment of edge data centres. By lowering latency and reducing costs to connect back to metropolitan areas, these initiatives are attempting to open regional towns up to the same products, services at the same prices and quality to their metropolitan equivalents.

The Commonwealth established NBN Co in 2009 to construct and operate a fixed broadband "access network" across Australia. As part of the nbn service, connectivity to these 'access networks' are provided via 121 points of interconnect (POIs) across the country, with 15 in WA. These nbn PoI's provide locations for Retail Service Providers to connect with the nbn to access the residents and businesses within the local area. However, this connection to the nbn access network is only part of the required components to provide internet within the local region e.g., in the case of regional WA, these sites do not connect back to Perth – it is a requirement of the service provider to establish and manage the connection from these regions back to Perth.

This means that irrespective of the technology being rolled out in these 121 'catchment' areas around the country, retailers of nbn products and services must either build their own backhaul fibre, utilise their own built transmission networks or lease space on other operators' fibre transmission. In many cases, these other operators of optical fibre transmission are also large retailers of nbn products and services. This reliance on the larger operator's backhaul networks also applies to alternative access (non-nbn) technologies used to deliver connectivity such as fixed wireless, mobile and other fibre-to-the node/premises/building networks outside of the nbn rollout.

This reliance on existing fibre transmission networks gives current owners an advantage over other providers who do not own and operate these networks, impacting commercial viability for smaller players in areas that have low user density or demand and reduced competition resulting in lower pricing/value pressure to benefit the end consumer.

As set out in Section 3.7, the ACCC regulates access to these backhaul networks owned by the major network operators. The ACCC released a Domestic Transmission Capacity Service final access determination (DTCS FAD) calculator in 2016 which utilises zones, distances, and bandwidths to calculate the regulated wholesale prices. The DTCS declaration was reviewed in 2019, with the varied service description coming into force from 1 January 2020.

Some of the prices paid by smaller telecommunications operators and retailers, although regulated by the ACCC, illustrate the increased cost to serve users of digital connectivity in regional WA. Backhaul is an added cost to service regional WA users with connectivity which telecommunications providers do not have to incur in metropolitan Perth.

Further note on market dynamics

Any network investment or upgrade requires significant capital investment by telecommunications providers. Providers make network investment decisions based on potential market size (revenue pool), deployment costs (dictates return on investment) and the ongoing costs of connecting and serving customers.

Even if there is a profitable opportunity for a telecommunications provider in regional WA, it will inevitably be assessed against metropolitan investment opportunities. Metropolitan investment

is almost always a more attractive way to maximise the long-term value of capital investment, coordinate network investment and link to existing infrastructure. The coverage statistics elsewhere in this Report illustrate how networks have followed population centres throughout the State.

The revenue pool in metropolitan Perth is large (1.8 million people) and highly concentrated with approximately within 4,479 km². The revenue pool in regional WA is much smaller and scattered across 2,522,465 km².

An additional cost consideration for market participants (telecommunications operators and utilities) when making investment decisions is regional WA's increasing reliance on backhaul transmission networks to connect to data centres in metropolitan areas. This connection allows access to infrastructure essential for accessing applications and emerging services such as:

- low latency, Gigabit ethernet to support remote operations,
- secure, private network links between branches of the same business,
- business to business supported services such as Unified Communications (voice and high-definition video), e-invoicing, data exchange, and
- Cloud connection.

The cost of building the infrastructure that allows provision of backhaul transmission capacity is easily distributed across metropolitan markets as an incremental, per-connection charge. The diluted nature of regional markets makes cost distribution and recovery impossible, driving up the cost of connecting and serving regional customers.

Ultimately, lack of existing infrastructure, high capital costs and lower population density in regional WA makes it an unattractive investment option for telecommunications providers, and an expensive market for users, unless government assists with the provision of infrastructure on which there is no commercially viable return.

12. Options and Opportunities

The single most pressing issue apparent to Grex from the findings of the ADII on digital inclusion, the analysis of the connectivity available across WA and the increasing demand for connectivity across all user types is that there are many areas of WA which are either underserved or unserved entirely by digital connectivity and associated technology.

Added to this are the findings from the inputs provided by Government departments which illustrate that there is a broad understanding of these issues and a willingness to support the improvement of connectivity across the State. Many beneficial projects and initiatives are already underway, from DPIRD's digital farm and grants initiatives through to ODG's GovNext ICT 2015 procurement reforms.

The social and economic issues around digital divides and poor access to and understanding of digital technologies are already well understood and captured in Section 10 Affordability and Ability.

The myriad of benefits experienced through access and use of digital connectivity set out in Section 11 also demonstrate that digital connectivity is a key enabler across all sectors. It is a crucial area to support IWA's Vision for the State.

The question arising from the above is how does Government improve connectivity within the current telecommunications market and regulatory structure in WA to maximise the economic, social and productivity benefits connectivity can bring?

To answer this question, Grex has undertaken the analysis in Sections 6 - 9 of this Report, following the methodology described in Section 4 to produce the range of Options available to Government to assess its ability to become more actively and efficiently involved in connectivity initiatives across the State. This is summarized in Appendix 1.

From these Options, designed across categories for Government to pursue, numerous Opportunities are suggested, all of which are aimed at supporting the Vision through improved approaches to the market, within government and with communities (particularly in regional and remote areas) in the digital and connectivity sector³⁶.

³⁶ Further detail underpinning the analysis of Options into Opportunities to support the Vision is set out in Appendix 1.

OPPORTUNITY CATEGORY

PARTNER AND COLLABORATE

Vision Statement
Western Australia is a sought-after place to live, work, study and invest, with infrastructure improving productivity and equity, and unlocking industry growth that leverages the State's advantages and diversifies its economic base.

[Years 0-4 Horizon]

- A. Reduced the digital connectivity demand and supply gap in regional and rural areas ('PLACE TO LIVE, WORK AND STUDY')
- B. Reduced the Australian Digital Inclusion Index ratings differential between Metro (Perth) and "Other WA" ('EQUITY')
- C. Investments have been made in digital connectivity for remote communities ('PRODUCTIVITY'; 'DIVERSIFIED ECONOMIC BASE')
- D. WA Government has actively participated with private industry and Federal Government to develop and facilitate digital connectivity improvements within WA ('LEVERAGES THE STATE'S ADVANTAGES')
- E. Digital Connectivity Infrastructure has enabled productivity gains in WA ('UNLOCKING INDUSTRY GROWTH'; 'PRODUCTIVITY')
- F. Digital connectivity supports the strategic investment in Smart, Safe and Secure locations for Residents, Businesses and Government in WA ('SOUGHT AFTER PLACE TO LIVE, WORK AND STUDY'; 'PRODUCTIVITY')
- G. The State's Digital Connectivity transformation is governed and the benefits to the Western Australian residents, business and Government are measured and reported ('WESTERN AUSTRALIA'; 'EQUITY')

Opportunity 1 – Collaborate with Commonwealth and Other State Governments to advance Digital Connectivity in WA

Opportunity 1.a – A whole of government engagement and relationship framework to work and collaborate with the Commonwealth Government

Includes:	Telecommunications development in regional and rural areas (Regional Connectivity and Mobile Black Spots)
	Alignment to national Digital Security strategies and practices
	Consultation on Commonwealth digital connectivity legislation and regulation.
Supports Outcomes:	A, B & D

Opportunity 1.b– A whole of government engagement and relationship framework to work and collaborate with Other State Governments

Includes:	Joint initiatives in Digital Connectivity trials and deployments
	Sharing knowledge and best practice
	Collaboration on consultations from Commonwealth Government.
Supports Outcomes:	D

Opportunity 2 – Collaborate with the major Australian Service and Network Providers to advance Digital Connectivity development in WA

Opportunity 2.a – A whole of government collaboration with nbn

Includes:	Establishing clear co-investment criteria and requirements for nbn technology upgrades and indicative timings of these upgrades in metro, regional, rural, and remote areas. Initial focus on high value agricultural areas, business precincts, public interest premises, and the regional tourism sector.
	Co-Investment programs to secure further Regional Connectivity programs funding from the Commonwealth Government.
	Further detailed engagement across Government departments with nbn to assess the positive impacts of the nbn \$4.5bn upgrade program together with how WA can best leverage the \$300m con-investment fund established by nbn in late 2020.
	Co-investment program to upgrade high priority regional and remote areas served by satellite services

	Independent measuring of the performance of satellite services in regional and remote areas to better understand where problems may lie in the supply chain that negatively impact on end-users.
	Existing data limits for services be reviewed with the aim of increasing data limits across the board.
Supports Outcomes:	A, B, D & F
Opportunity 2.b – A whole of government collaboration with Mobile Network Operators on the development of the mobile networks within WA.	
Includes:	Establishing clear co-investment criteria and requirements for addressing Mobile Black Spots and improving overall mobile coverage and capacity through the Commonwealth Government Mobile Black Spots Program and other opportunities
	Co-Investment programs to secure further Regional Connectivity and Mobile Black Spots programs funding from the Commonwealth Government.
	Other co-investment programs with network and service providers to address mobile network coverage and capacity digital connectivity gaps in regional and remote areas.
	Development of open access backhaul opportunities.
	Independent measuring of the performance of coverage and capacity improvements as they are realized to better understand where problems may lie in the supply chain that negatively impact on end-users.
	Existing data limits/allowances for mobile plans to be reviewed with the aim of increasing data limits across the board.
Supports Outcomes:	A, B, D & F
Opportunity 2.c – A whole of government collaboration with Low Earth Orbit and Medium Earth Orbit Satellite access providers	
Includes:	Establishing clear investment criteria and requirements in using LEO/MEO satellite services to address digital connectivity gaps in regional and remote WA.
	Identifying further co-investment opportunities to address fixed and mobile digital connectivity gaps in regional and remote areas.
	Independent measuring of the performance of coverage and capacity improvements as they are realized to better understand where problems may lie in the supply chain that negatively impact on end-users
	Existing and proposed data limits/allowances for access plans to be reviewed with the aim of increasing data limits across the board.
Supports Outcomes:	A, B, D & F
Opportunity 2.d – A whole of government collaboration with Local Wireless Access providers to deliver area specific last mile solutions	
Includes:	Continuation of the Digital Farms and Micro Grants co-investment programs to identify and enable solutions for digital connectivity gaps in regional and remote areas, for specific issues such as Smart Ag IOT.
	Independent measuring of the performance of coverage and capacity improvements as they are realized to better understand where problems may lie in the supply chain that negatively impact on end-users
Supports Outcomes:	A, B, D & F
Opportunity 2.e – Collaboration with key Industry Sectors to support diversification of the economy in regional and remote areas.	
Includes:	Identification of the opportunities and specific digital connectivity requirements to support new and emerging industries in regional and remote areas (e.g., robotics and automation, super-computing, carbon neutral energy production)

	Identification of the co-investment requirements and potential benefits that can be derived for the local and surrounding areas.
Supports Outcomes:	A, B, D & F

Opportunity 3 – Collaborate with Industry Peak Bodies and Academic institutions to create and maintain a forward-looking digital connectivity vision and demands and needs analysis.

Includes:	Digital connectivity evolution trends and requirements as input to the Digital Inclusion Blueprint State, regional, national, and international research, and insights
Supports Outcomes:	E, F & G

Opportunity 4 – Increase achievement of digital connectivity outcomes and value for money from Government's co-investment in digital connectivity programs.

Opportunity 4.a – Co-investment delivery methodology

Includes:	A sector wide program and project delivery methodology for Government co-investment projects Standardised delivery project governance, risk management and progress achievement/KPIs.
Supports Outcomes:	D & G

Opportunity 4.b – Program and projects benchmarking

Includes:	Establish and maintain a project cost database to support cost benchmarking for new project proposal analysis and tracking of in-flight projects.
Supports Outcomes:	G

OPPORTUNITY CATEGORY

GOVERNANCE AND OVERSIGHT

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[Years 0-4 Horizon]

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- G. The State's Digital Connectivity transformation is governed and the benefits to the Western Australian residents, business and Government are measured and reported ('WESTERN AUSTRALIA'; 'EQUITY')

Opportunity 5 – Cross-Government co-ordination and management of digital connectivity

Opportunity 5.a – Cross-government governance and oversight

Includes:	<p>Governance structure and delegated authority</p> <p>Informed strategic decision making and direction on digital connectivity development.</p> <p>Defined KPIs and structured progress monitoring and reporting process</p> <p>Integrated risk management process</p> <p>A formal environment to share knowledge and best practice between departments.</p> <p>Commitment to participate – Charter of engagement</p>
Supports Outcomes:	G

Opportunity 5.b – Blueprint for Digital Inclusion

Includes:	<p>Formalize and maintain a Blueprint roadmap for the evolving digital connectivity requirements.</p> <p>Develop and maintain Blueprint delivery plans, including KPIS and achievement metrics.</p>
Supports Outcomes:	G

Opportunity 5.c – Benefits Management

Includes:	<p>Benefits management strategy for identifying, tracking, and reporting on digital connectivity benefits.</p> <p>Benefits assessment guideline for assessing digital connectivity benefits.</p> <p>Social and economic benefits baseline for digital connectivity across the State.</p> <p>Benefit management assignment.</p> <p>Benefits tracking and reporting.</p>
Supports Outcomes:	E & G

Opportunity 5.d – Investment Assurance

Includes:	Independent investment assurance process, with defined roles and responsibilities for managing digital connectivity investment opportunities.
Supports Outcomes:	E & G

OPPORTUNITY CATEGORY POLICY AND SUPPORTING CAPABILITIES

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Opportunity 6 – Commit investment to develop digital connectivity

Opportunity 6.a – State-wide digital connectivity policy

Includes:	Digital connectivity objectives and service targets
	Government commitment to support and develop capabilities within the State.
	Assigned ownership, roles, and responsibilities for governing and oversight for the State-wide digital connectivity development.
Supports Outcomes:	A, B, C, D, E, F & G

Opportunity 6.b – Investment Policy

Includes:	Government commitment to multi-year co-investment funding to improve regional and rural broadband and mobile services in areas of economic, social, and public safety significance, particularly in areas where mobile services are not available/insufficient or served predominantly by the Sky Muster satellite service or where specific high volume, low-capacity needs exist (e.g., Smart Ag IOT).
	Place-based investment approach.
Supports Outcomes:	A, B, C, & F

Opportunity 7 – Increase Government participation in the development of digital connectivity through access provided to Government assets and infrastructure

Opportunity 7.a – Asset Access and Co-location policy

Includes:	Asset Access and Co-location intent, objectives, and service targets
	Assigned ownership, roles, and responsibilities for governing and oversight for the Asset access and co-location
Supports Outcomes:	D

Opportunity 7.b – Asset Access and Co-location Data and Collateral

	Inventory of the Government assets relating to digital connectivity.
	Accessible and shared database of Government assets to which access is enabled, including assets established for Public Safety and Emergency Services communications.

	A framework for enabling access to and co-location with Government assets
Supports Outcomes:	D

Opportunity 8 – Increase Government participation in the development of digital connectivity through support to Digital Security.

Opportunity 8.a – Whole of state digital security policy for critical infrastructure aligned to the national cyber security strategy and the Security Legislation Amendment (Critical Infrastructure) Bill 2020.

Includes:	Digital Security intent, objectives and KPIs
	Assigned ownership, roles, and responsibilities for governing and oversight for Whole of State Digital Security
Supports Outcomes:	D & F

Opportunity 8.b – Digital Security Support

Includes:	Centralized support function to support Government Departments, Government Trading Enterprises, and industry in meeting the requirements of the Security Legislation Amendment (Critical Infrastructure) Bill 2020
Supports Outcomes:	D & F

Opportunity 9 – Increase Government participation in the development of digital connectivity through Leverage of Government Procurement

Opportunity 9.a – Leverage Government procurement of digital connectivity infrastructure and services.

Includes:	Digital connectivity as an evaluation criteria in any procurement of telecommunications infrastructure to improve sharing and connectivity, including Public Safety and Emergency Services Communications
	Leverage assets, service volumes and conditions procured by Government, such as via the GNICT 2015 scheme. to enable benefits for the community.
	Conditions to facilitate open access to new assets and infrastructure
Supports Outcomes:	D

Opportunity 9.b – Leverage existing infrastructure projects

Includes:	Opportunities to improve digital connectivity within existing infrastructure projects should be explored
Supports Outcomes:	D

Opportunity 9.c – Leverage non-telecommunications infrastructure

Includes:	Consideration of digital connectivity in the procurement of non-telecommunications infrastructure (where relevant). An example of this could be transport projects where digital connectivity could be facilitated through the procurement of IoT sensors.
Supports Outcomes:	D

TRANSFORMATION ENABLEMENT

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- G. The State's Digital Connectivity transformation is governed and the benefits to the Western Australian residents, business and Government are measured and reported ('WESTERN AUSTRALIA'; 'EQUITY')

Opportunity 10 – Reduce barriers to adoption

Opportunity 10.a – Access to Government sites

Includes:	Government and industry work together to reduce or eliminate cost barriers for people to access Government services sites e.g., unmetered data.
Supports Outcomes:	A, B, C & D

Opportunity 11 – Increasing digital connectivity awareness and adoption in key groups

Opportunity 11.a – Awareness and Support Campaign

Includes:	Media and awareness campaigns to targeted groups for social and business benefits. Regional Communities of Practice to advocate for and support adoption of digital transformation.
Supports Outcomes:	A, B, C & D

Opportunity 12 – Increasing the digital connectivity skills and capabilities within WA

Opportunity 12.a – Regional and Remote Digital Skills Gap

Includes:	Develop and maintain region specific Affordability Digital Ability data set to assess and prioritize issue hotspot areas and provide a baseline for skills development.
Supports Outcomes:	B, C, F & G

Opportunity 12.b – Targeted Skills development within the Indigenous Community

Includes:	A targeted Indigenous Digital Inclusion program with a focus on access, affordability and digital ability be developed in partnership with Indigenous communities.
Supports Outcomes:	B & C

Opportunity 12.c – Improving digital literacy in regional, rural, and remote.

Includes:	<p>Developing an online technology ‘hub’ to provide independent and factual information to help support people to build up the skills to solve telecommunications issues</p> <p>Deploying technical advisers on a short-term basis across regional, rural, and remote Australia to provide on-the-ground support to help people get connected and stay connected, using technologies that are suitable to their individual needs</p> <p>Encouraging the agriculture sector to provide industry-specific advice about the Internet of Things and other digital applications that will drive productivity gains in the sector</p>
Supports Outcomes:	B, C, D & E

Opportunity 13 – *Develop and share digital connectivity knowledge in WA to encourage innovation and commitment*

Opportunity 13.a – Leveraging the existing Government Data Analytics and Data Sharing Framework

Includes:	<p>Digital connectivity specific data collection and modelling capability.</p> <p>Defined data sets and outputs to support the digital connectivity governance, benefits management, and service performance tracking</p>
Supports Outcomes:	G

Opportunity 13.b – Sharing data inside and outside of Government

Includes:	Enable sharing of digital connectivity specific data between departments and between Government and industry.
Supports Outcomes:	D

Opportunity 13.c – Modelling and tracking digital connectivity improvements.

Includes:	Ongoing model for digital connectivity demand and supply.
Supports Outcomes:	G

Opportunity 14 – *Environment for fostering innovation and supporting adoption*

Opportunity 14.a – Innovation Hubs

Includes:	Investment in innovation hubs across the State to support evaluation, assessment and education of digital connectivity applications, opportunities, and benefits.
Supports Outcomes:	D & F

Opportunity 14.b – Support to applications for Proofs of Concept and Trials

Includes:	Process to evaluate proposals, funding allocation and support of Proof of Concepts and trials
Supports Outcomes:	D

13. Glossary of Terms

The below glossary of terms is set out to explain a number of terms used in relation to both established telecommunications technologies such as mobile, but also the more recent developments and terminology being used in relation to both the rollout of the nbn and applications which are driving demand over the currently available networks supplying digital connectivity in WA.

3G Third generation mobile technology. Uses broadband to support both a voice channel and internet protocol-based video and data services.

4G Fourth generation mobile technology. Uses enhanced broadband to support internet protocol-based voice, video, and data services. Also known as long term evolution (LTE).

5G Fifth generation mobile technology. There is currently no agreed definition or standard for 5G technology.

Access network the 'last mile' of a telecommunications network that connects end users.

Asymmetric Digital Subscriber Line (ADSL) ADSL is a type of DSL broadband communications technology used for connecting to the Internet. ADSL allows more data to be sent over existing copper telephone lines (POTS), when compared to traditional modem lines.

Backhaul typically refers to the mid-to-long-distance transport of data from a series of disparate locations back to a more centralised location. This transport may involve some level of concentration (also referred to as fibre transmission and/or backhaul).

Bandwidth refers to how fast data flows through the path that it travels to your computer. It is usually measured in kilobits, megabits, or gigabits per second.

Bits and Bytes A unit of storage measurement - a byte is made up of 8 bits. All information is stored as bits and bytes, which determine the size of the document, picture, video clip etc. that you may wish to download or send via email.

Broadband is a term used to refer to 'always on' high speed Internet. In the past, broadband services and technologies were defined in terms of a capability to transfer information at higher rates than traditional dial-up services. Today broadband is more commonly associated with the speeds equal to or greater than those provided by Asymmetric Digital Subscriber Line (ADSL), that is, a minimum download speed of 265 kbps and minimum upload speed of 64 kbps.

Carrier is an owner of a telecommunications network unit that is licensed by the ACMA to supply carriage services to the public.

Class licensed spectrum is used by the ACMA to manage **spectrum** used by services which employ a limited set of common frequencies using equipment under a common set of conditions. Class licences authorise users of designated segments of spectrum to operate on a shared basis without any license fees.

Contended / Uncontended is typically used to explain the telecommunication provider's service. Un-contended infers that "It's all yours, there's no-one else to share the service with, so the subscriber will get the same speeds no matter what." "Contended means that there are multiple subscribers sharing bandwidth so the more people that are connected to a contended service results in the longer it takes to up and download as everyone is sharing

Fibre A fibre optic tube containing strands of glass that transmit data in the form of light. Fibre enables data transmission at the fastest possible rates.

Fibre to the Building (FTTB) All types of **nbn** network connections that utilise a physical line running to the premises are considered fixed line connections. An **nbn** Fibre to the building (FTTB) connection is generally used when we are connecting an apartment block or similar types of buildings to the **nbn** network. In this scenario, we run a fibre optic line to the building communications room - we then use the existing technology in the building to connect to each apartment. The fibre node in the building communications room is likely to take the form of a secure cabinet. Each cabinet will allow the **nbn** network signal to travel over the optic fibre, to the existing network technology present in the building.

Fibre to the curb (FTTC) A network technology where fibre is deployed from the point of interconnection to the individual junction box in the street outside each property. A short run of copper then carries the signal to the premises.

Fibre to the Node (FTTN) An **nbn** fibre to the node (FTTN) connection is utilised in circumstances where the existing copper network will be used to make the final part of the **nbn** network connection, from a nearby FTTN cabinet or micro-node to your premises. The fibre node is likely to take the form of a street cabinet. Each street cabinet will allow the **nbn** network signal to travel over optic fibre from the exchange to the cabinet and connect with the existing copper network to reach your premises.

Fibre to the Premises (FTTP) An **nbn** Fibre to the premises connection (FTTP) is used in circumstances where an optic fibre line will be run from the nearest available fibre node to your premises. FTTP also requires an **nbn** network device to be installed inside your home. This device requires power to operate and can only be installed by an approved **nbn** Installer or service provider.

Fixed service A telecommunications service supplied to a fixed location, typically a premise. It can be transmitted via fixed line or wireless technologies.

Fixed line service A fixed telecommunications service supplied via a fixed line.

Fixed wireless A network technology which uses a radio access network to supply a fixed service.

Geostationary satellite A satellite used in telecommunications that sits high above the Earth's surface aligned with the equator. It appears stationary as it orbits the Earth at the same speed as the Earth rotates.

Gigabytes (GB) One billion bytes of information. **Gigabits per second (Gbps)** is rate of data transfer. 1 Gbps = 1000 Mbps.

Kilobits per second (Kbps) Bits per second (bps) is a common measure for data transmission speed. The speed in bps is equal to the number of bits transmitted or received each second. kbps is kilobits per second is one thousand bits per second.

Latency Or delay refers to how much time it takes for data to get from one designated point to another.

Low Earth Orbit (LEO) satellite A satellite system used in telecommunications that is closer to the Earth's surface than a geostationary satellite and can transmit data with lower latency. Multiple LEO satellites are often used to form a constellation.

Megabyte (MB) Megabyte is the term used to describe a unit of data. Most Internet access plans operate on an allowance of data being downloaded and/or uploaded. This allowance is usually measured in MB or GB (Gigabytes). One Megabyte is equivalent to about one million bytes. In current usage, that is a small amount of data. A 20- to 30-page document containing only text can be about 1 MB in size. Photos from digital cameras (depending on how they are saved) can be 2 or 3 MB each. A short video clip can be anywhere from 4 to 8 MB in size.

Megabits per second (Mbps) A megabit per second (Mbit/s or Mb/s or Mbps) is a unit of data transfer rate equal to 1,000,000 bits per second.

Medium Earth Orbit (MEO) satellite A satellite system used in telecommunications that orbits between the geostationary and low earth orbit satellites at an altitude from 19,000 to 24,000Km

Mobile service A telecommunications service supplied to a mobile point.

nbn The Commonwealth Government Business Enterprise tasked with building the national broadband network.

nbn Satellite A satellite broadband service supplied by **nbn**. Now supplied over the long-term satellite service (known as Sky Muster™ and Sky Muster II™).

Point of Interconnect (PoI) The connection point that allows retail service providers (RSPs) and wholesale service providers (WSPs) to connect to **nbn** access capability.

Premises Otherwise referred to as **G-NAFs** means the individual dwellings classified by the Commonwealth Department of Industry, Innovation and Science in its PSMA Geocoded National Address File.

Retail Service Providers (RSPs) The retail network service providers and application/content service providers are those that provide services to end users and have a direct customer relationship with the end users. Wholesale service providers do not have this relationship.

Satellite Common in rural and remote areas, broadband satellite uses a home radio link and radio dish to bounce a signal off a satellite and down to an earth station. It is used for fast Internet access and sometimes phone calls. One-way satellite connections utilise a satellite link to download data to the broadband user and a standard telephone connection for uploading data back to the Internet. Two-way satellite connections use the satellite link to both upload and download information.

Spectrum The bandwidth of a communications system (often associated with mobile telephony networks, but also used in reference to fixed telephony and broadband networks), expressed in terms of the frequency it can carry (for mobile spectrum, this is radiofrequency).

Transmission network The portion of a telecommunications network that comprises the intermediate links between the core network and the access network.

WiFi A small scale wireless network technology. Typically supplied within a premise or in a designated public area.

Wireless While the specific technology used to provide wireless broadband services varies, each service provider uses radio frequencies to transmit and receive data between their customers and a local transmission point. Normally, this requires a number of base stations, similar to mobile phone towers, which transmit to customers who have a small transmitter/receiver connected to their computers or other digital devices.

Appendix 1. Options into Opportunities

Summarised below are the process steps 4 and 5 described in Section 4, going through the process of mapping the identified gaps, from the gap analysis in methodology step 3, against the Government's options for build, share, co-invest or mandate infrastructure and non-infrastructure solutions to fill the gaps.

The process considers the potential opportunities for addressing those gaps against each of the options, noting that any one gap could be addressed by multiple options and opportunities. The selection of a preferred option would be subject to an investment appraisal including consultation with the market to assess and evaluate the relative merits of each option.

In the other example, a gap associated with Digital Ability, there is not a realistic option for Government to address the gap via the creation or development of new or existing infrastructure. However, there are a number of options and opportunities that could be considered from a non-infrastructure perspective, these include:

- building and maintaining a regional IT support organisation to support regional areas or small businesses, or,
- creating and sharing data on skills shortages and gaps and making this available to encourage and support industry in developing support solutions, or,
- co-investing with IT support organisations to augment existing capability in areas currently not supported, or,
- mandate the provision of IT skills training and development in further and vocational education centres in regional and rural areas.

The gap-to-option mapping process is repeated for each identified gap from the Digital Connectivity Demand and Supply, Affordability and Digital Ability gap analyses.

The process then consolidates and groups the identified opportunities. The grouping is considered at two levels:

- by Opportunity Area (Partnership and Collaboration, Governance and Oversight, Policy, Legislation and Regulation and Transformation Enablement), and,
- Focus group per Opportunity Area.

This last stage of mapping provides the insights for IWA from which it can consider and derive SIS recommendations, including making a conscious, informed decision not to follow up on any given option.

As a final element, the section also summarizes how the opportunity areas support the target outcomes.

The following table represents the gaps identified in the Gap Analysis conducted across Connectivity Demand and Supply, Affordability and Digital Ability and the Government's options to address those gaps via candidate opportunities.

Area	Key Gaps	Infrastructure or Non-Infrastructure Opportunity Available?	Build	Option Share	Co-invest	Mandate
Digital Connectivity Supply - Fixed	As described in Section 6, in 2018 technologies delivering 30 Mbps met the bandwidth demands for 99 percent of residential households but by 2028 a significantly reduced percentage of households will have expected demand satisfied by this bandwidth.	Infrastructure	✓		✓	✓
		Non-Infrastructure	✓		✓	✓
Digital Connectivity Supply - Fixed	A large proportion of WA is covered by nbn satellite services. LEO satellites are coming online.	Infrastructure	✓		✓	✓
		Non-Infrastructure	✗			
Digital Connectivity Supply – Fixed (Wireless)	DPIRD's initiatives mainly deal at the access technology level. Bringing these together and exploring backhaul/transmission options to develop low cost, open access backhaul transmission leveraging opportunities such as the recently announced HyperOne initiative would enable greater capacity to these and more access network operators.	Infrastructure	✓		✓	✓
		Non-Infrastructure	✓		✓	✓
Digital Connectivity Supply – Mobile	Remote, low population areas significantly impacted by lack of coverage and capacity	Infrastructure	✓	✓	✓	✓
		Non-Infrastructure	✓		✓	✓
Digital Connectivity Supply – Mobile	Large number of coverage Mobile Black Spots across the State.	Infrastructure	✓		✓	✓
		Non-Infrastructure	✗			
Digital Connectivity Supply – Data Centres	Availability of today's data centre capability outside of Perth area	Infrastructure	✓		✓	✓
		Non-Infrastructure	✓		✓	✓
		Non-Infrastructure	✓		✓	✓

Area	Key Gaps	Infrastructure or Non-Infrastructure Opportunity Available?		Build	Option		
					Share	Co-invest	Mandate
Affordability	Enabling more value for data allowances for select groups, such as the regional area users, lower income quintiles, less than secondary education, Indigenous Australians, and 65+ age group.	Infrastructure	✗				
		Non-Infrastructure	✓		✓	✓	✓
Digital Ability	Attitudes development for select groups, such as the regional area users, lower income quintiles, not in the labour force, less than secondary education, disability, and 65+ age group.	Infrastructure	✗				
		Non-Infrastructure	✓		✓	✓	✓
Digital Ability	Basic Skills development for select groups, such as the regional area users, lower income quintiles, Not in the Labour Force, less than secondary education, disability, Indigenous Australians, and 65+ age group.	Infrastructure	✗				
		Non-Infrastructure	✓		✓	✓	✓
Digital Ability	Activities related development for select groups, such as the regional area users, lower income quintiles, Not in the Labour Force, less than secondary education, disability, and 65+ age group.	Infrastructure	✗				
		Non-Infrastructure	✓	✓	✓	✓	✓
Digital Ability	Skills and development for supporting IT in regional areas and small business.	Infrastructure	✗				
		Non-Infrastructure	✓	✓	✓	✓	✓
Digital Ability	The skills and facilities to foster the convergence of emerging technologies is creating new market value and displacing existing products and services	Infrastructure	✗				
		Non-Infrastructure	✓	✓	✓	✓	✓

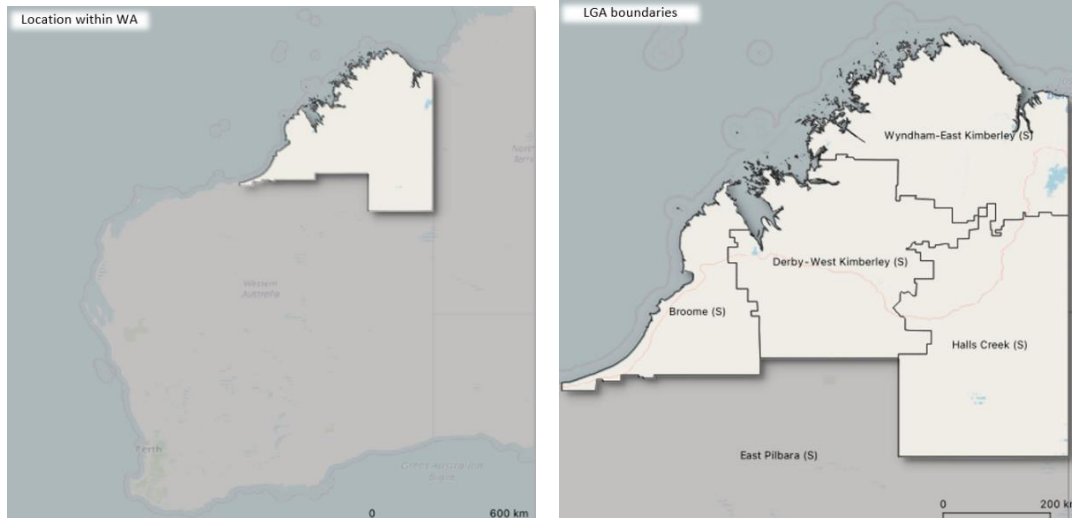
Figure 36 Gap to Option and Opportunity Mapping

Appendix 2. Region by Region digital connectivity – current state

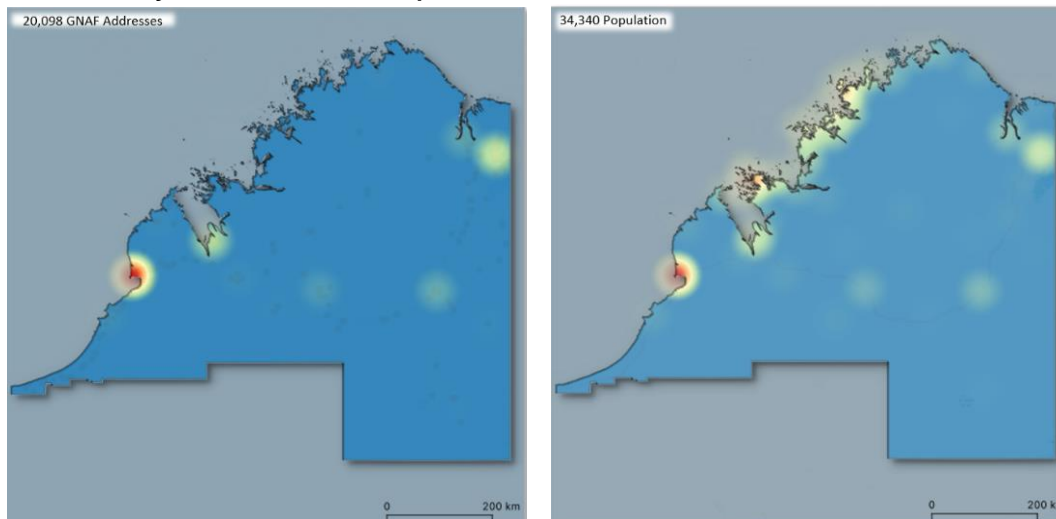
NOTE: All coverage estimates contained in this appendix are modelled by Grex based on publicly available information and are indicative only.

Kimberley

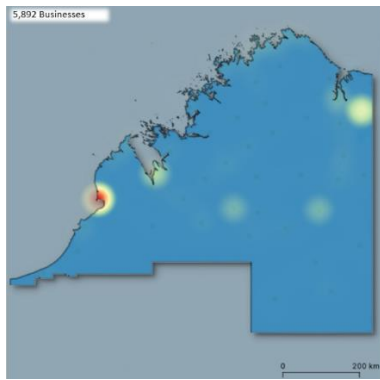
Kimberley: Location within WA and LGA Boundaries



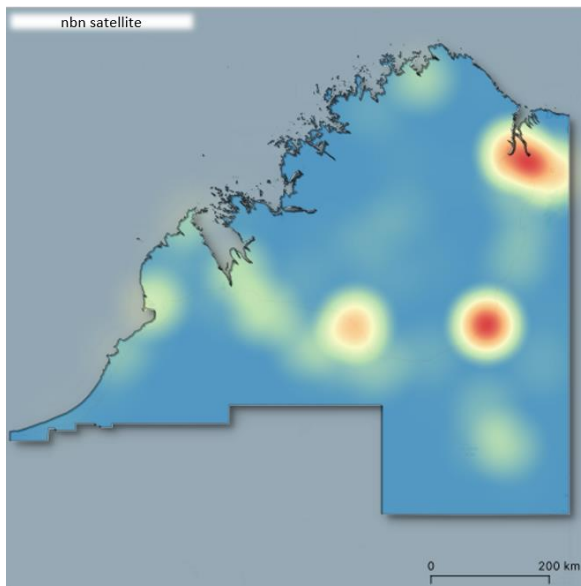
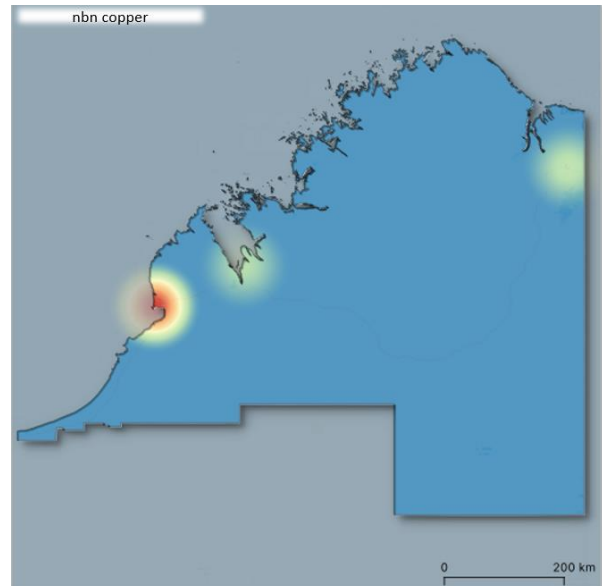
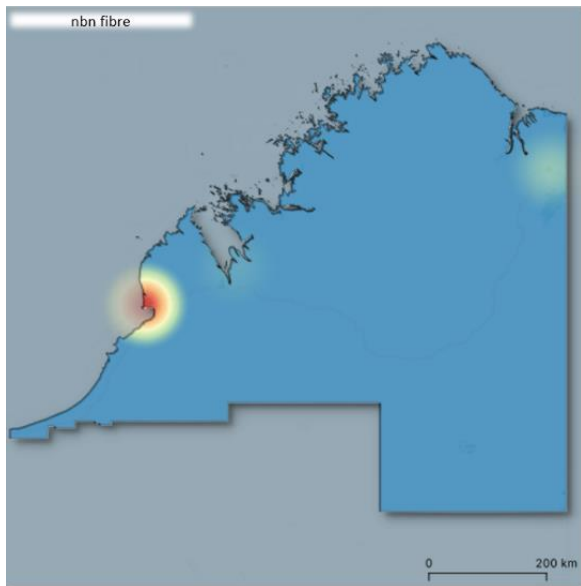
Kimberley: Premises, Population and Businesses



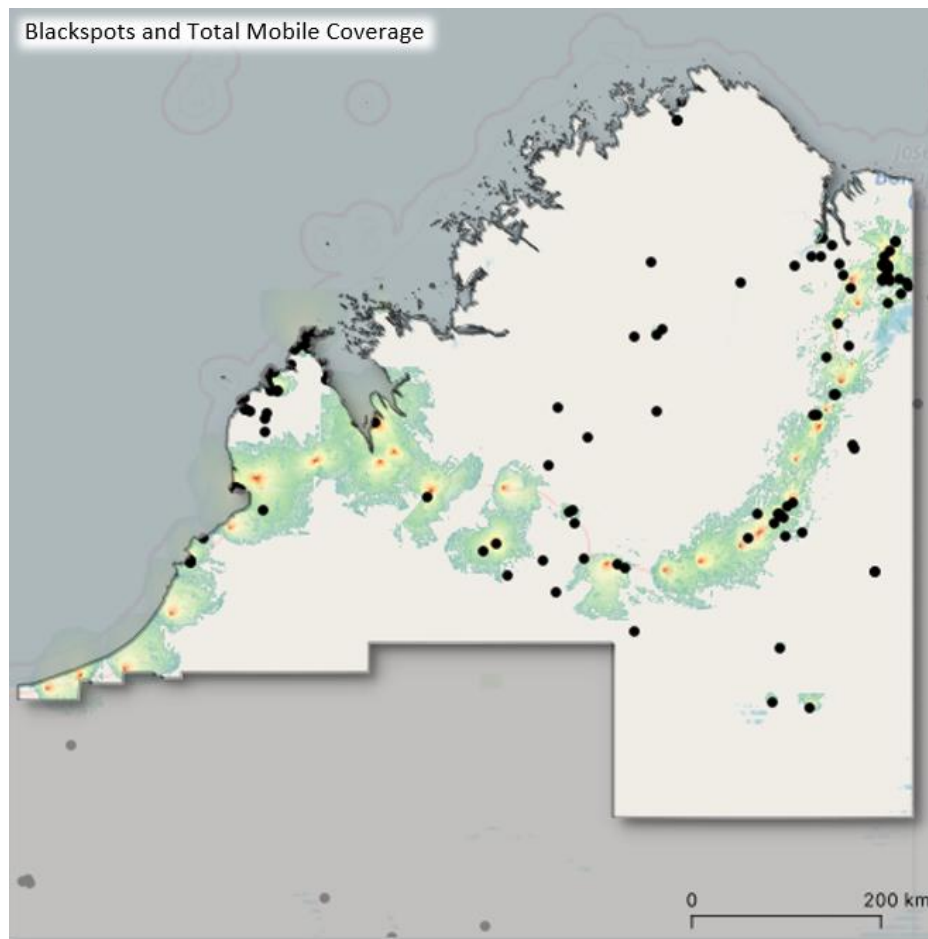
Note: A discrepancy was seen between the ABS census and GNAF data. GNAF showed no addresses in the Kimberley coastal areas, which have indigenous communities that are recorded in the ABS census.



Kimberley: nbn Coverage by Technology

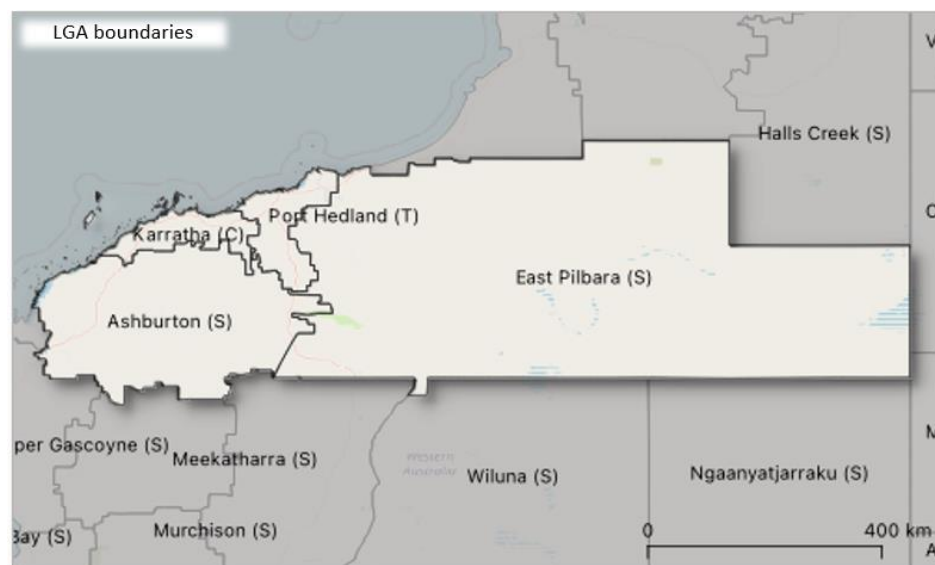
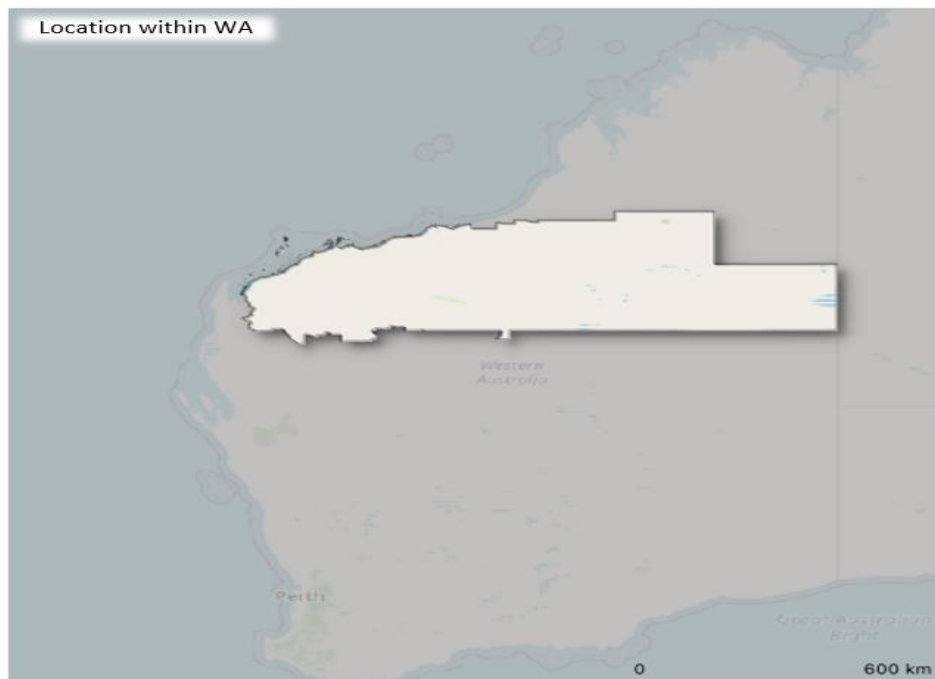


Kimberley: Blackspots and Aggregate Mobile Coverage

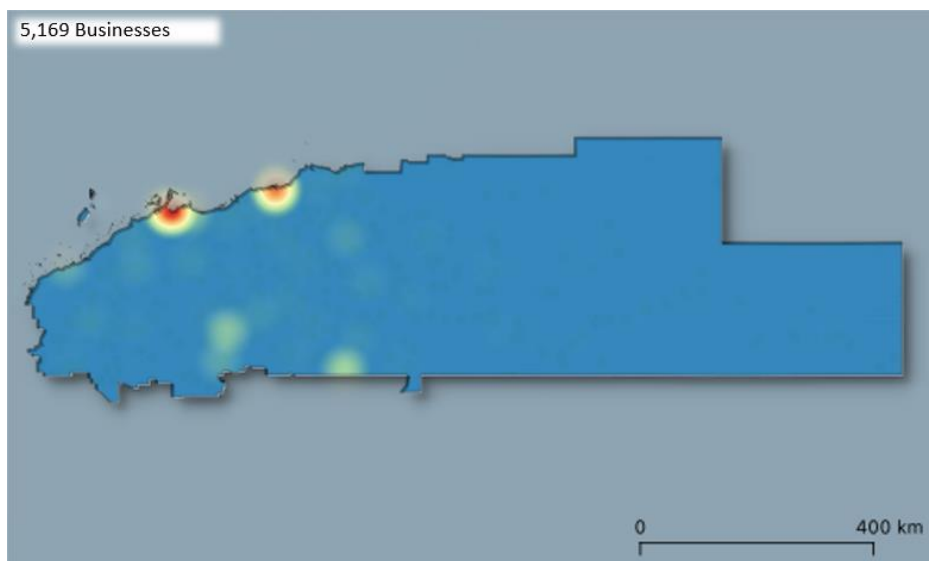
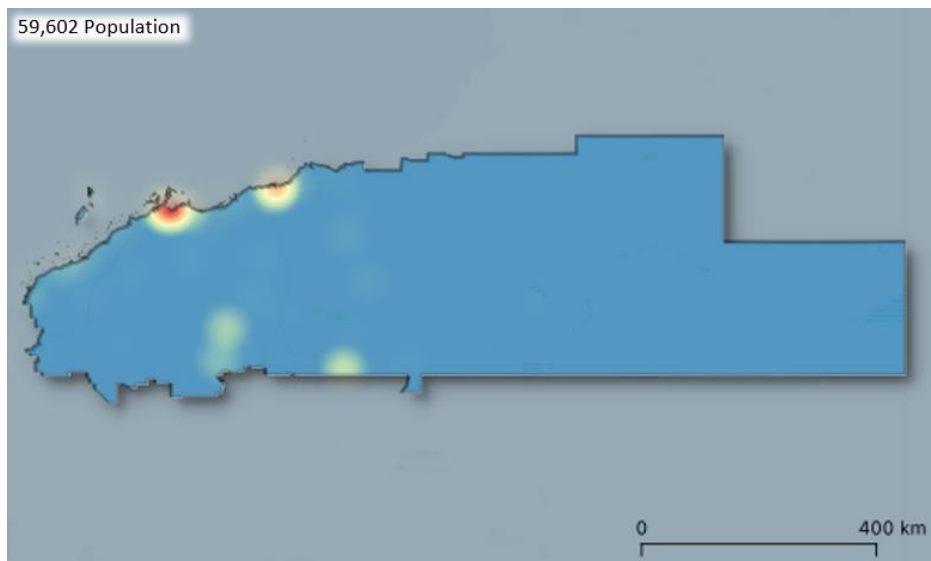
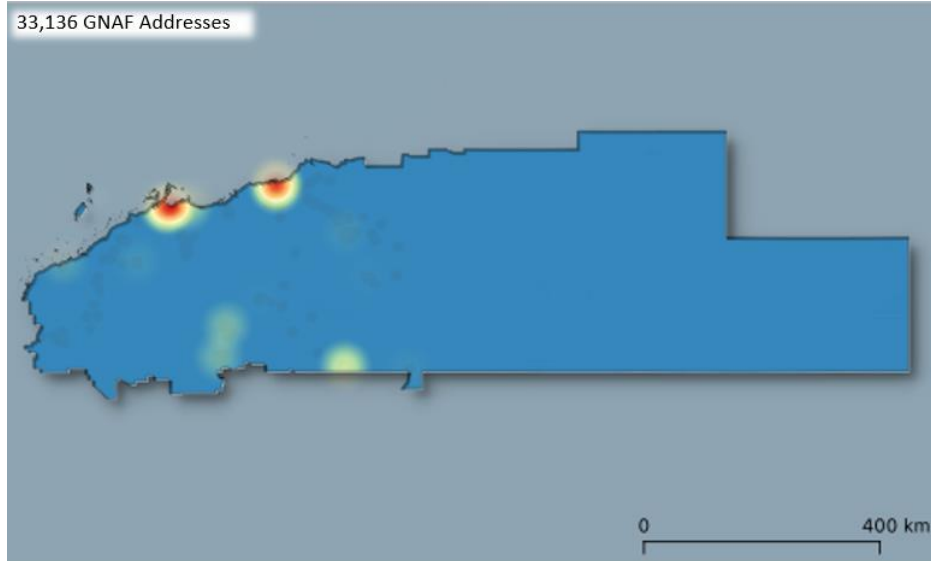


Pilbara

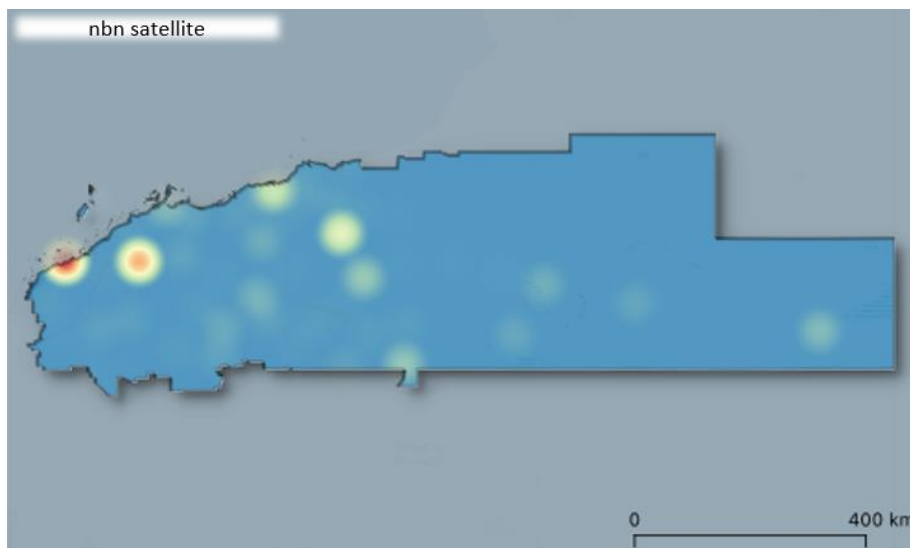
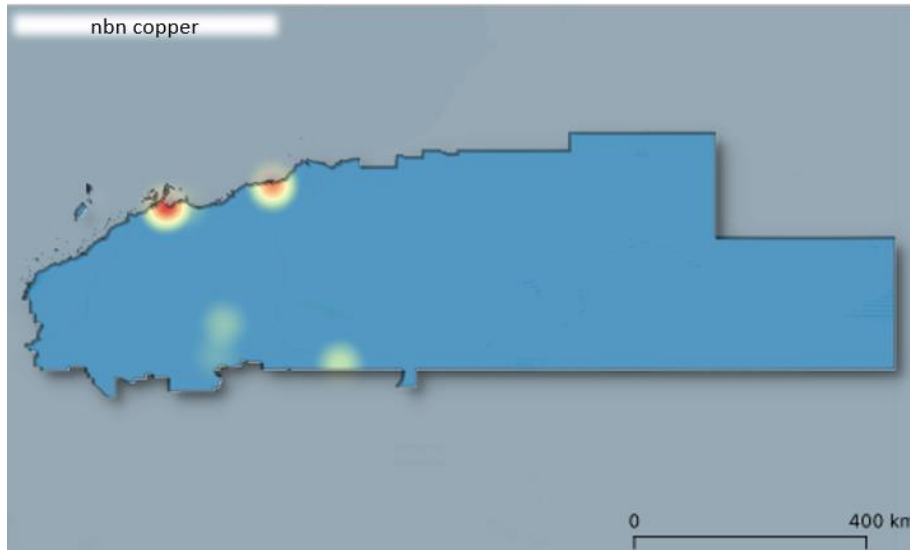
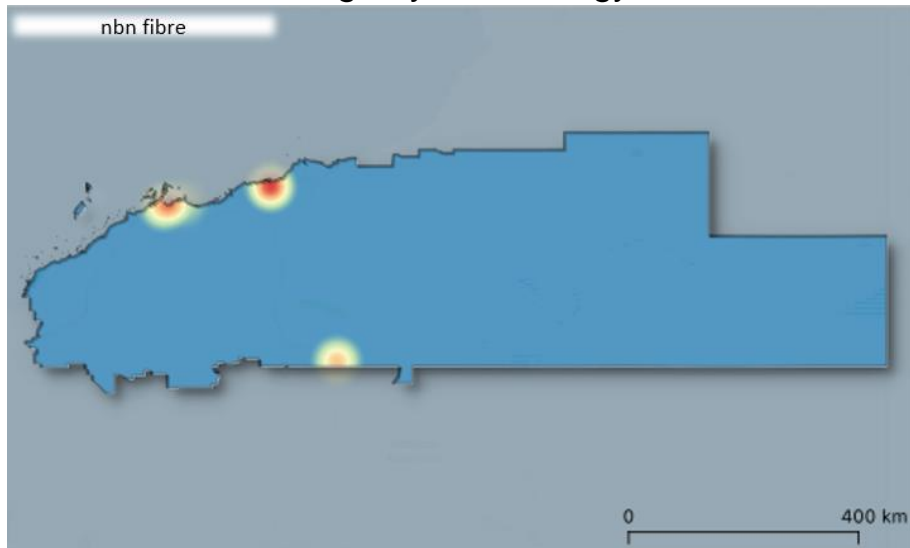
Pilbara: Location within WA and LGA Boundaries



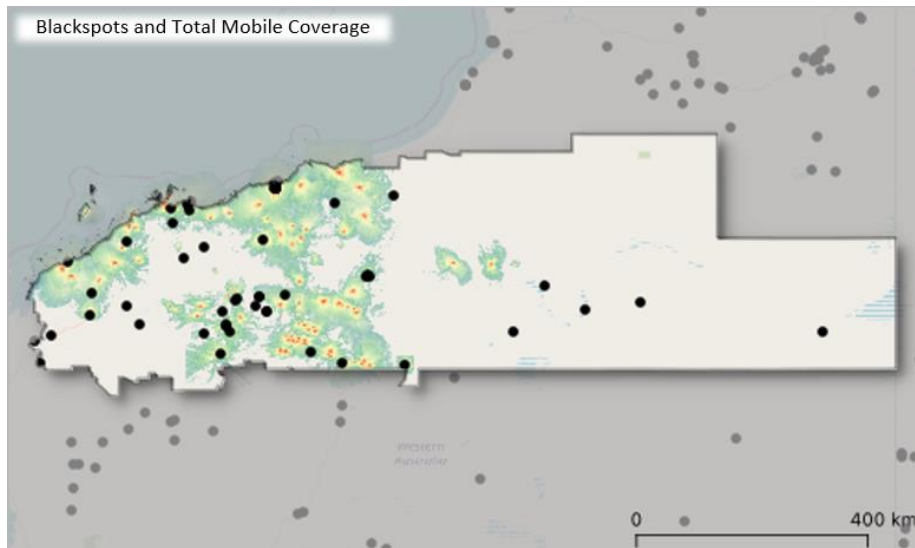
Pilbara: Premises, Population and Businesses



Pilbara: nbn Coverage by Technology



Pilbara: Blackspots and Aggregate Mobile Coverage

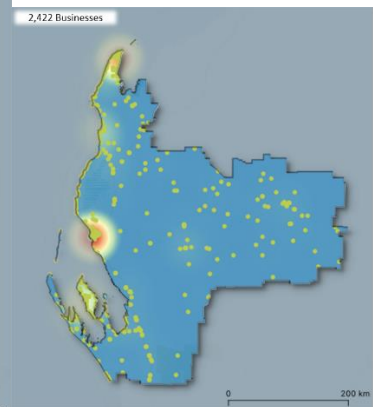
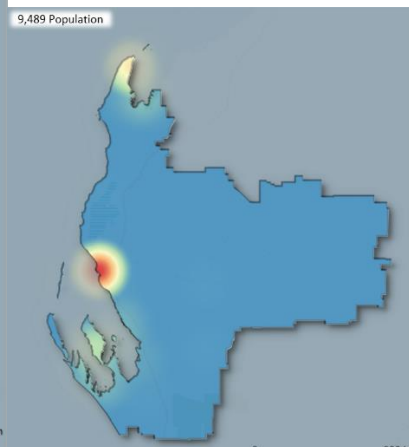
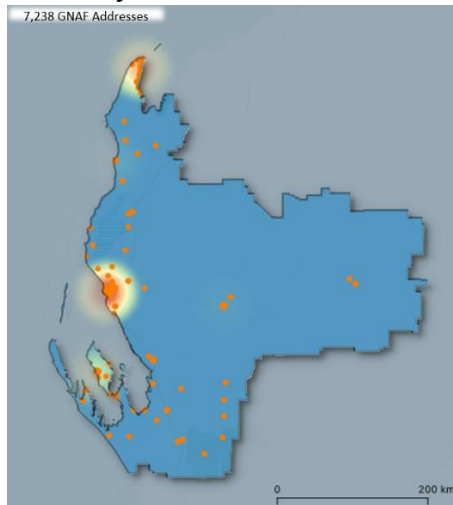


Gascoyne

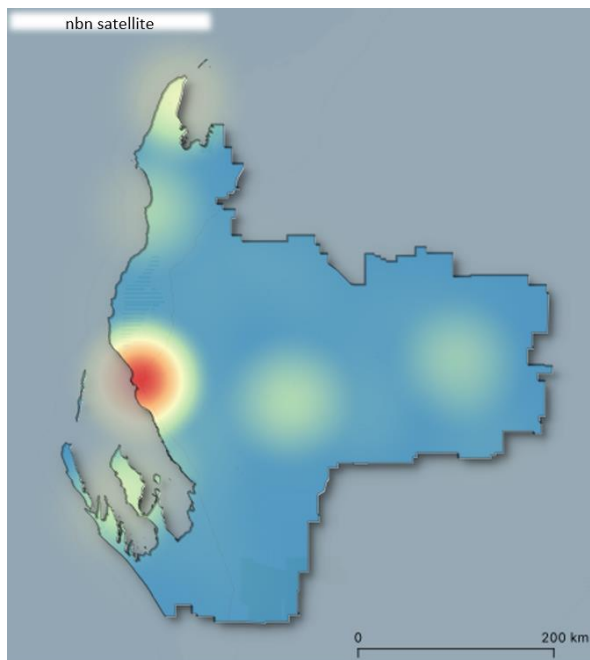
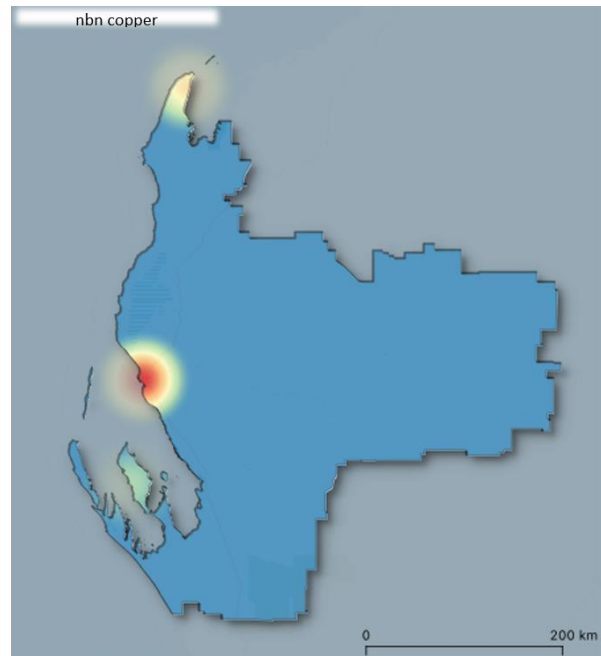
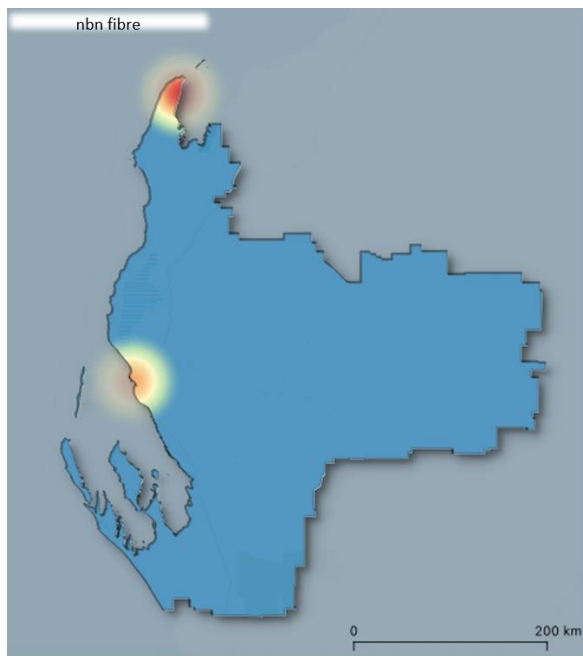
Gascoyne: Location within WA and LGA Boundaries



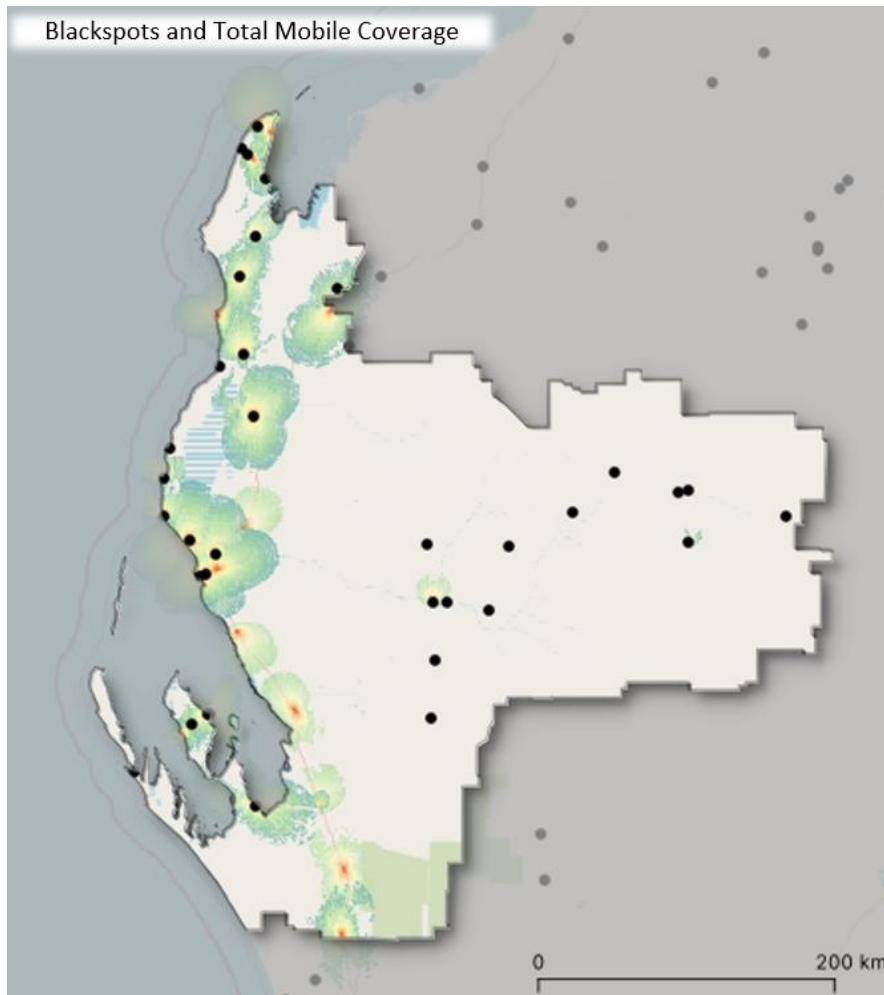
Gascoyne: Premises, Population and Businesses



Gascoyne: nbn Coverage by Technology

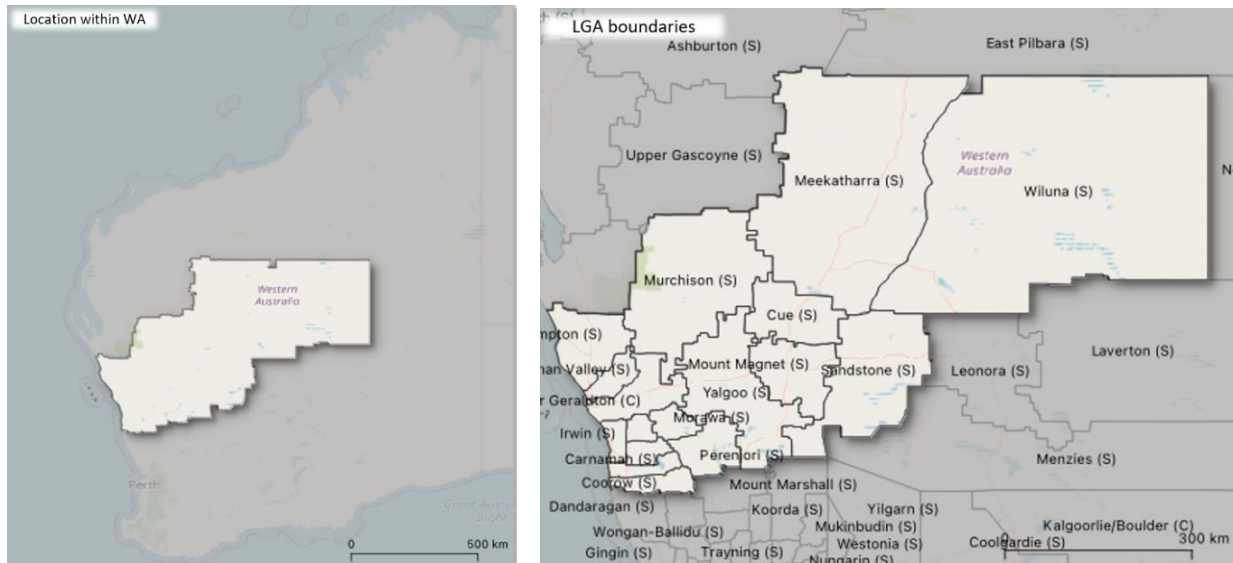


Gascoyne: Blackspots and Aggregate Mobile Coverage

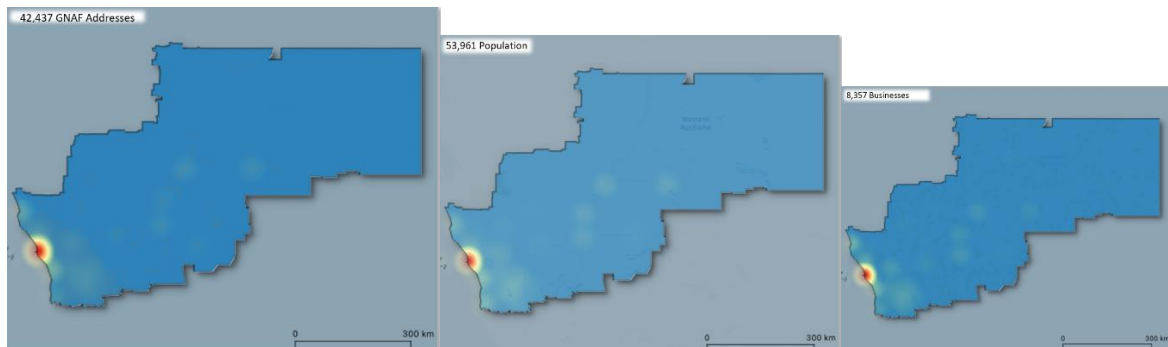


Mid-West

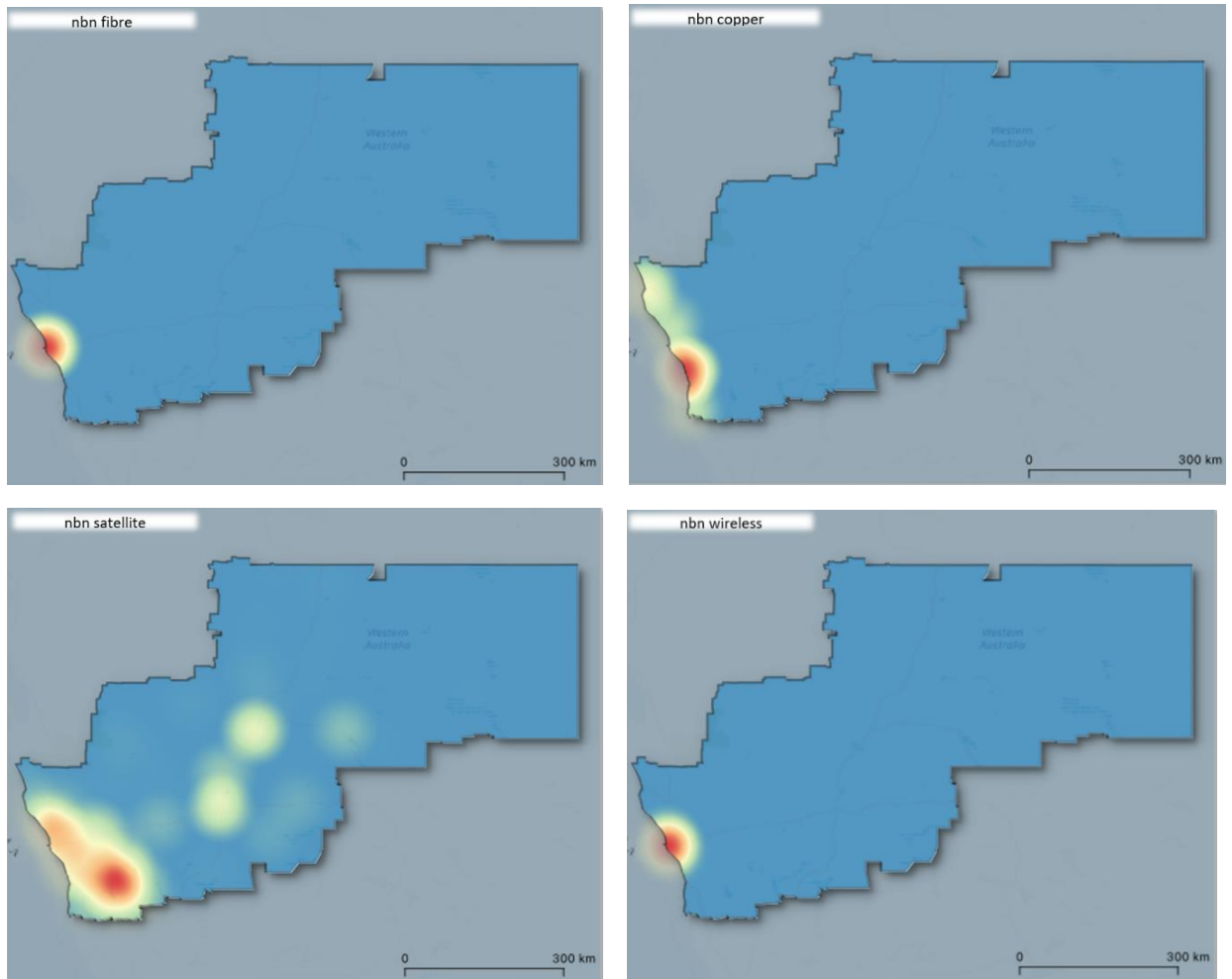
Mid-West: Location within WA and LGA Boundaries



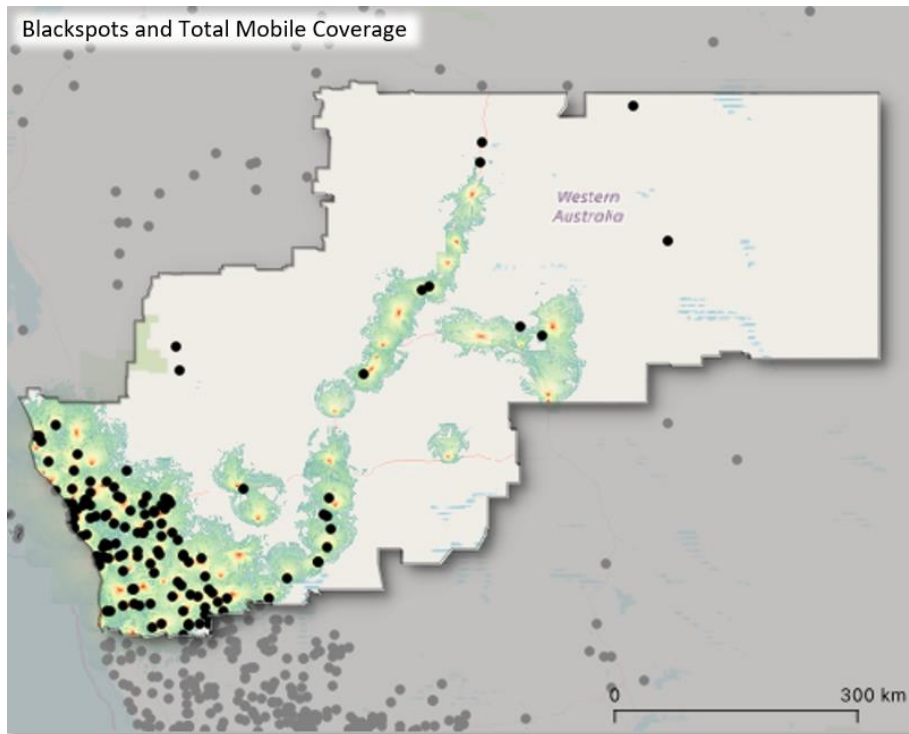
Mid-West: Premises, Population and Businesses



Mid-West: nbn Coverage by Technology

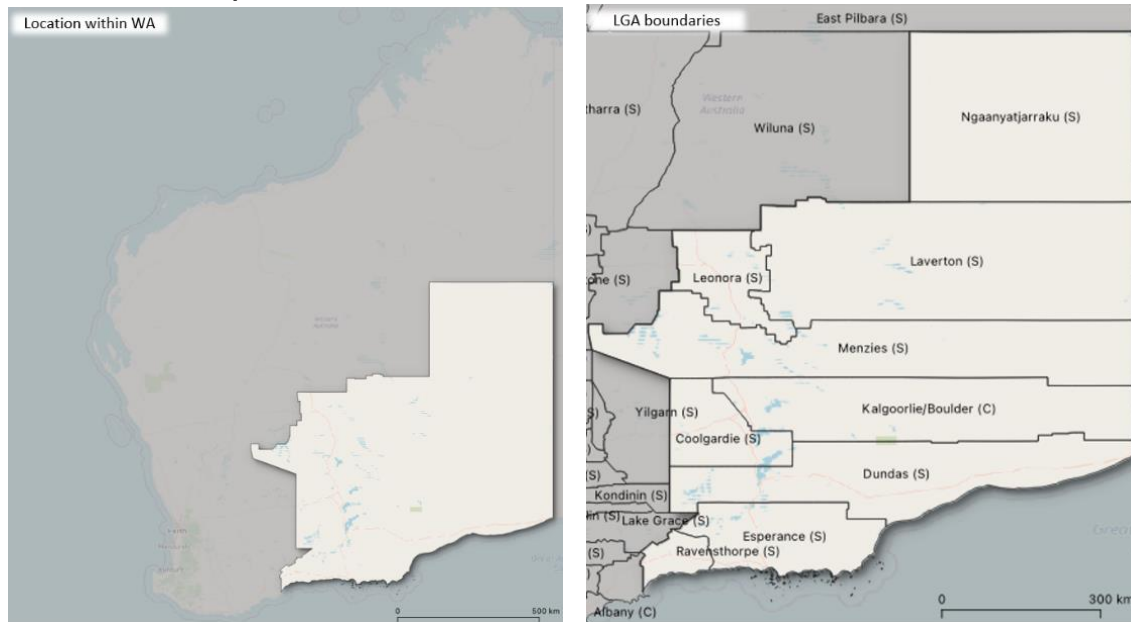


Mid-West: Blackspots and Aggregate Mobile Coverage

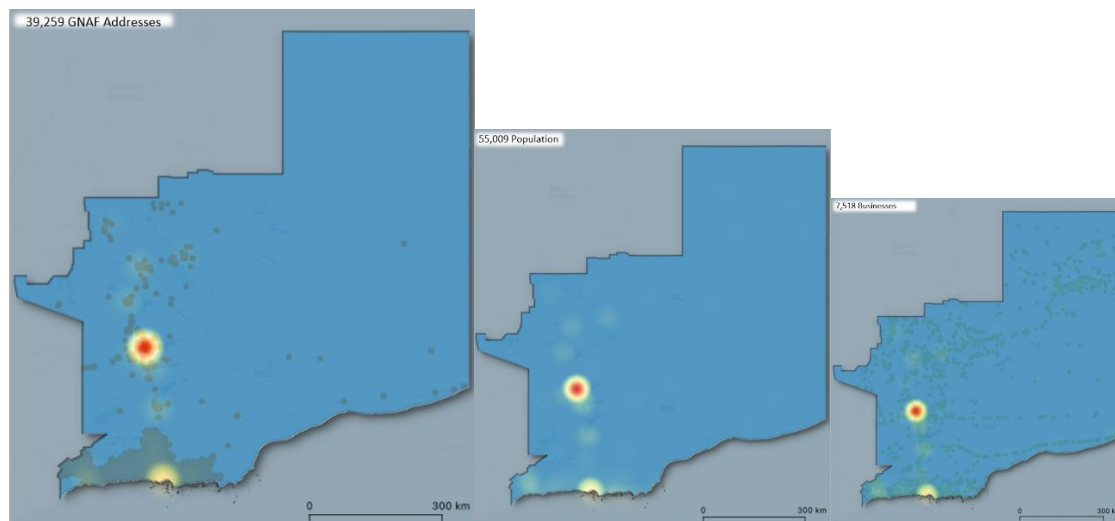


Goldfields Esperance

Goldfields-Esperance: Location within WA and LGA Boundaries

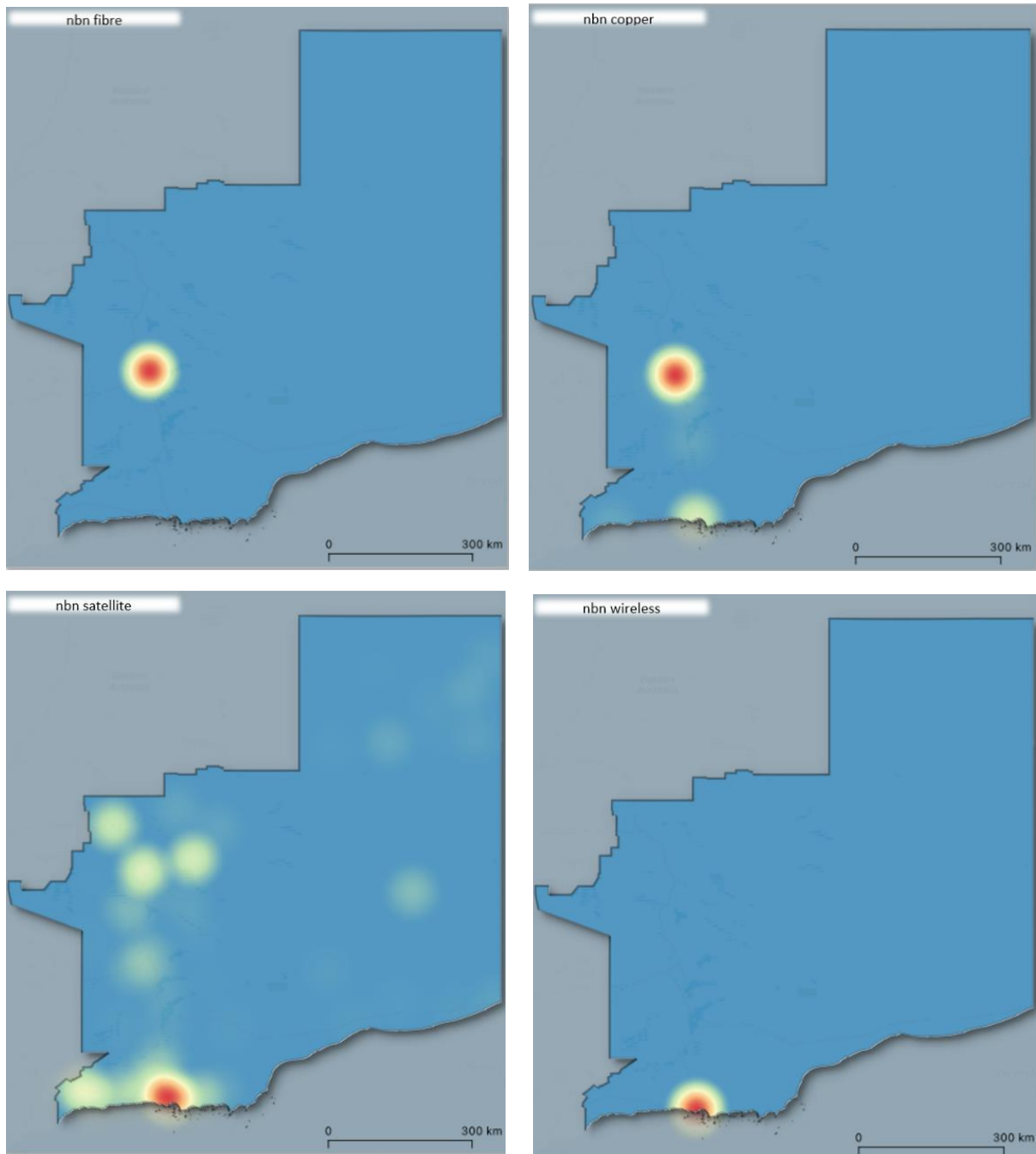


Goldfields-Esperance: Premises, Population and Businesses

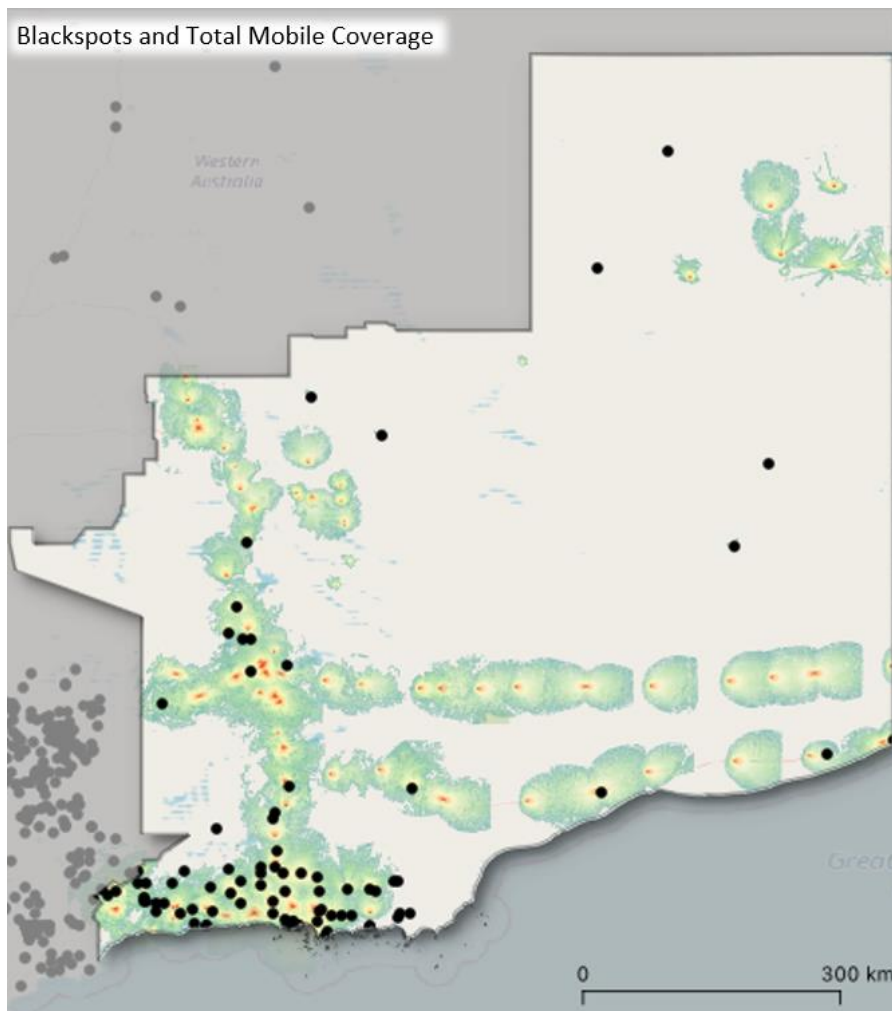


Note: A discrepancy is seen between the ABS census and GNAF data. The Tjuntjuntjara Community shows no GNAF address, but 184 people and 42 dwellings are recognized by 2016 ABS census (also, many NBN satellite connections)

Goldfields-Esperance: nbn Coverage by Technology

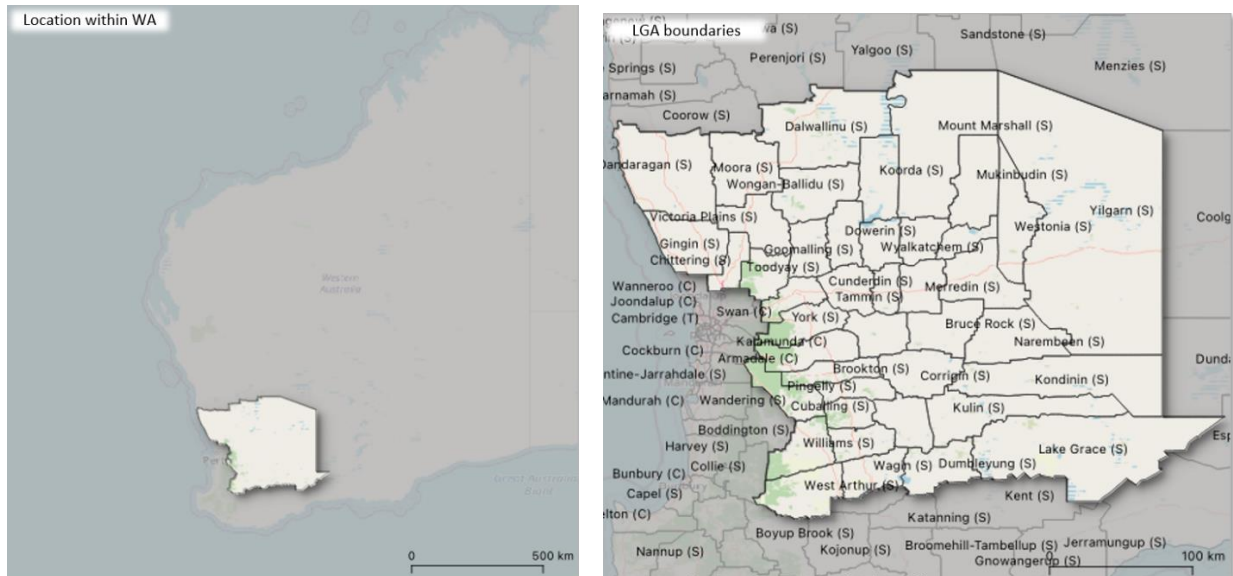


Goldfields-Esperance: Blackspots and Aggregate Mobile Coverage

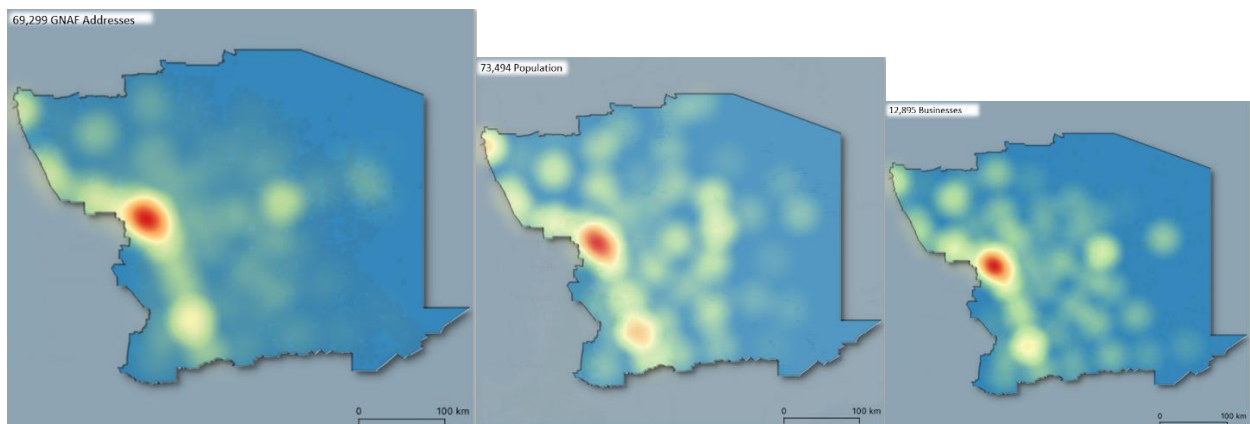


Wheatbelt

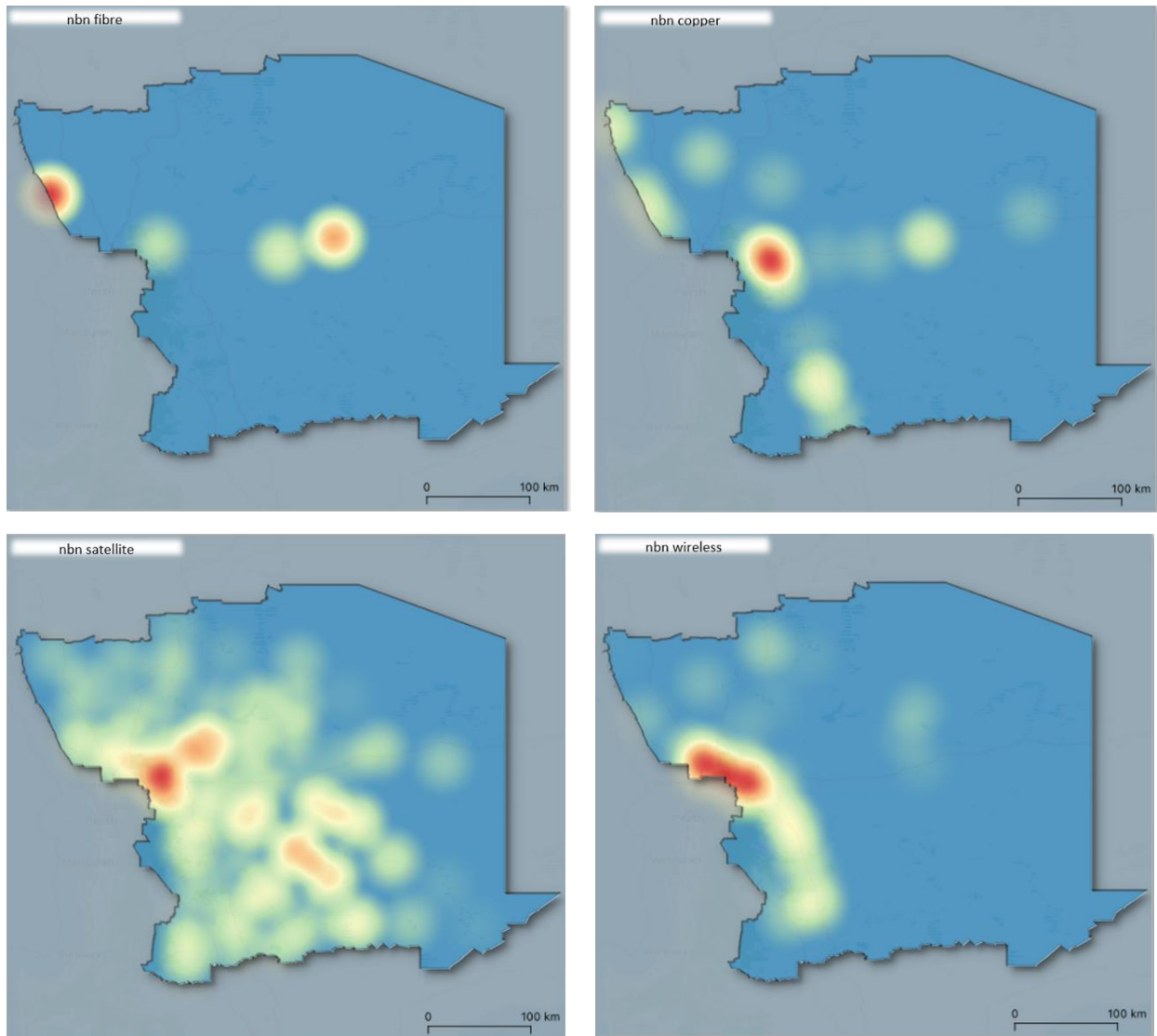
Wheatbelt: Location within WA and LGA Boundaries



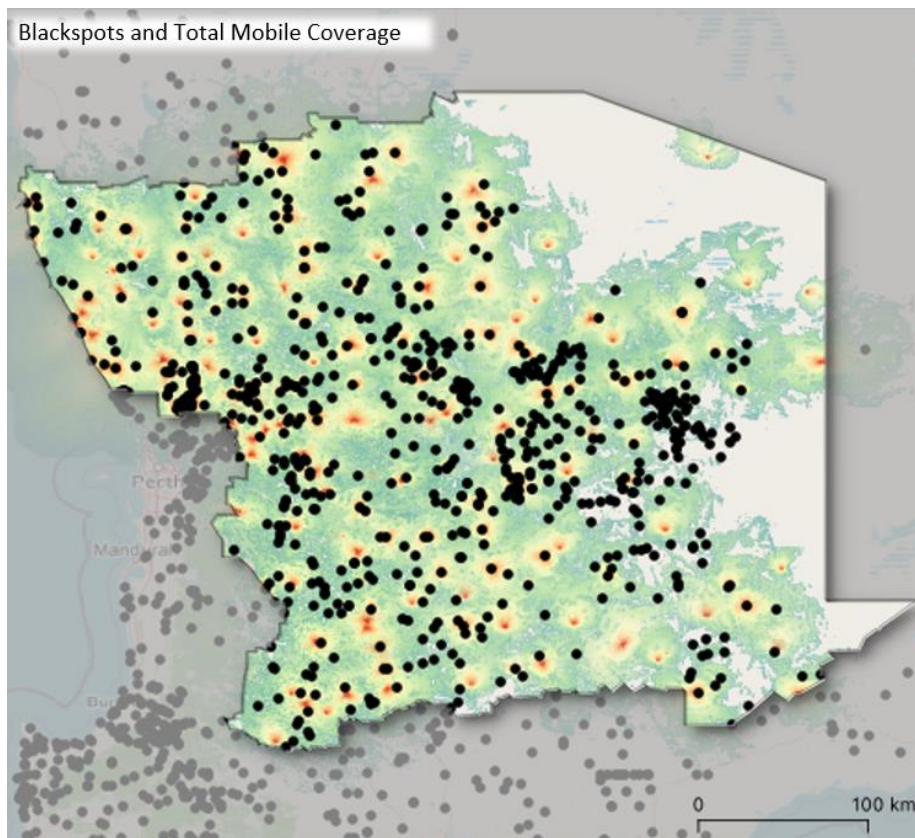
Wheatbelt: Premises, Population and Businesses



Wheatbelt: nbn Coverage by Technology

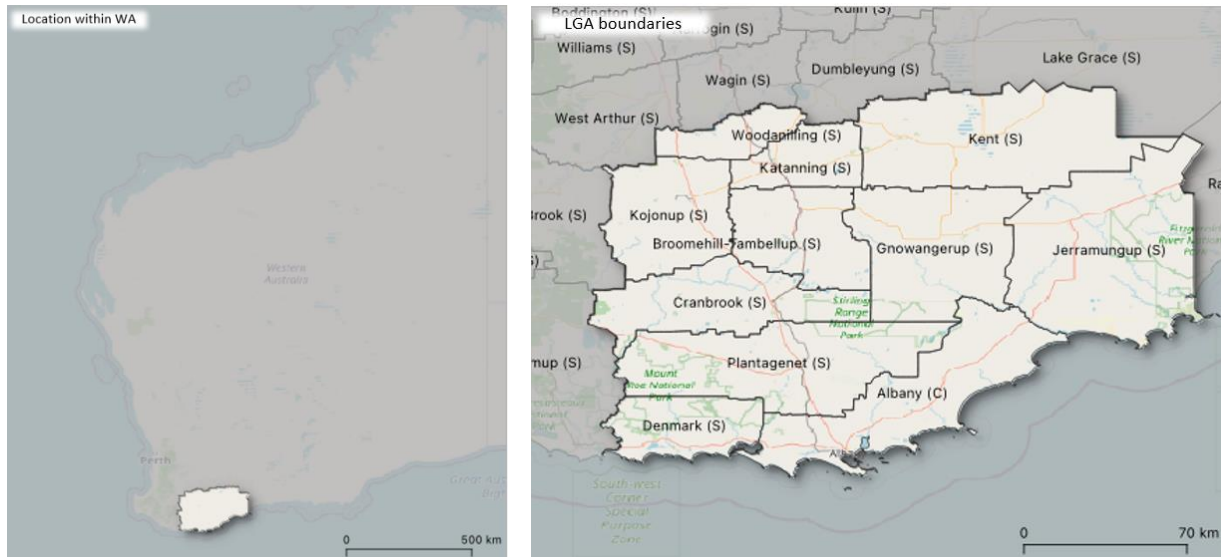


Wheatbelt: Blackspots and Aggregate Mobile Coverage

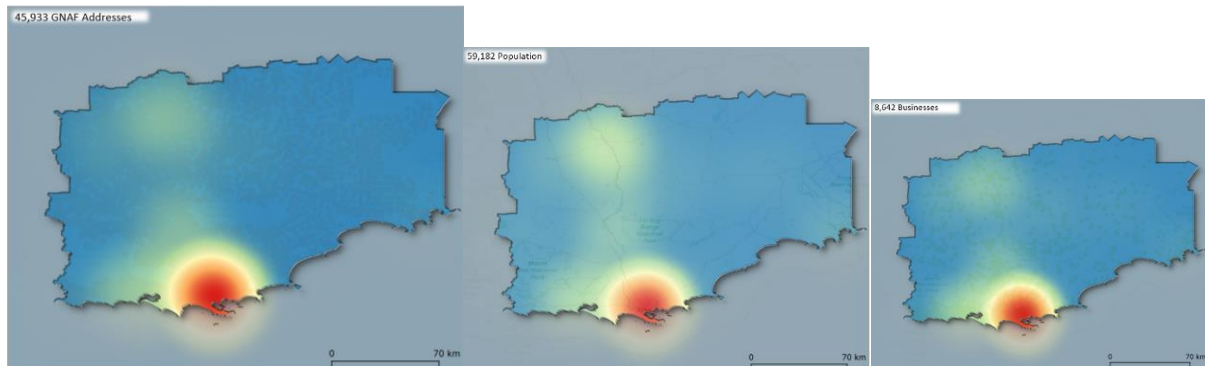


Great Southern

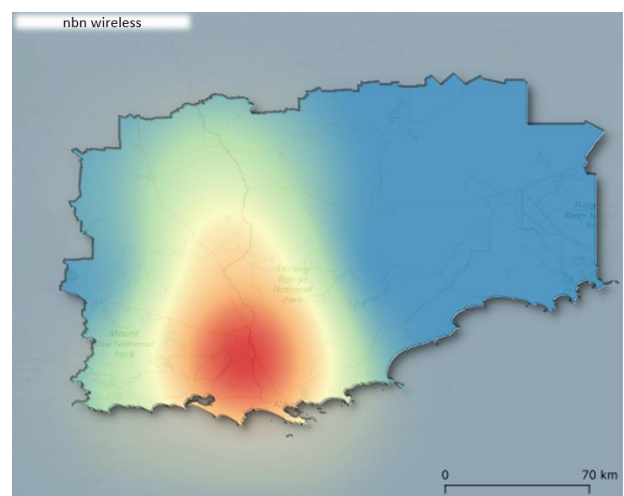
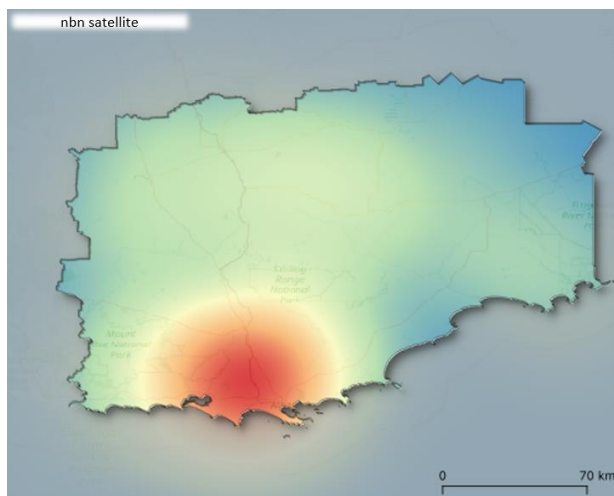
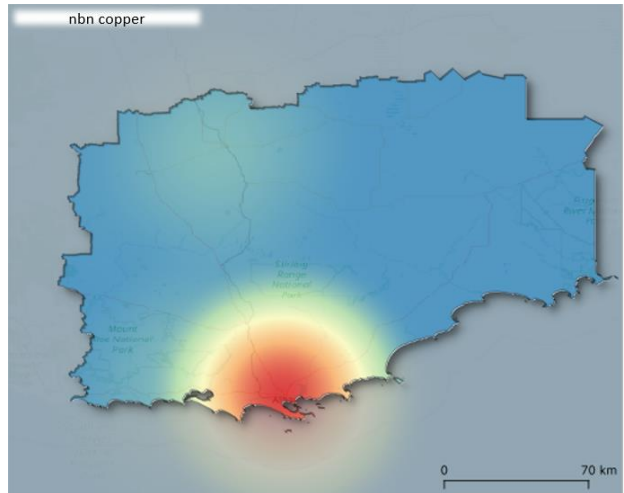
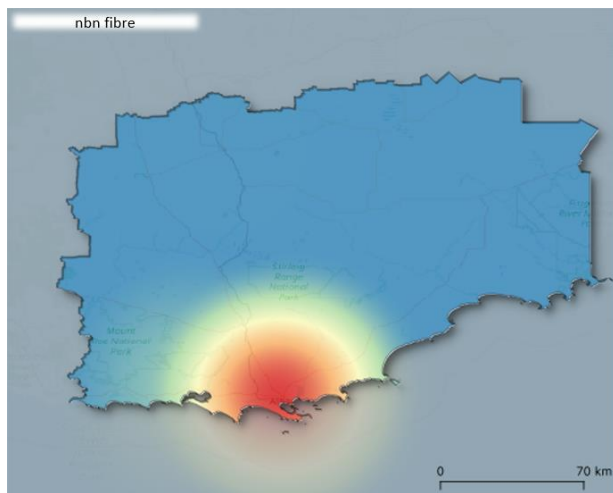
Great Southern: Location within WA and LGA Boundaries



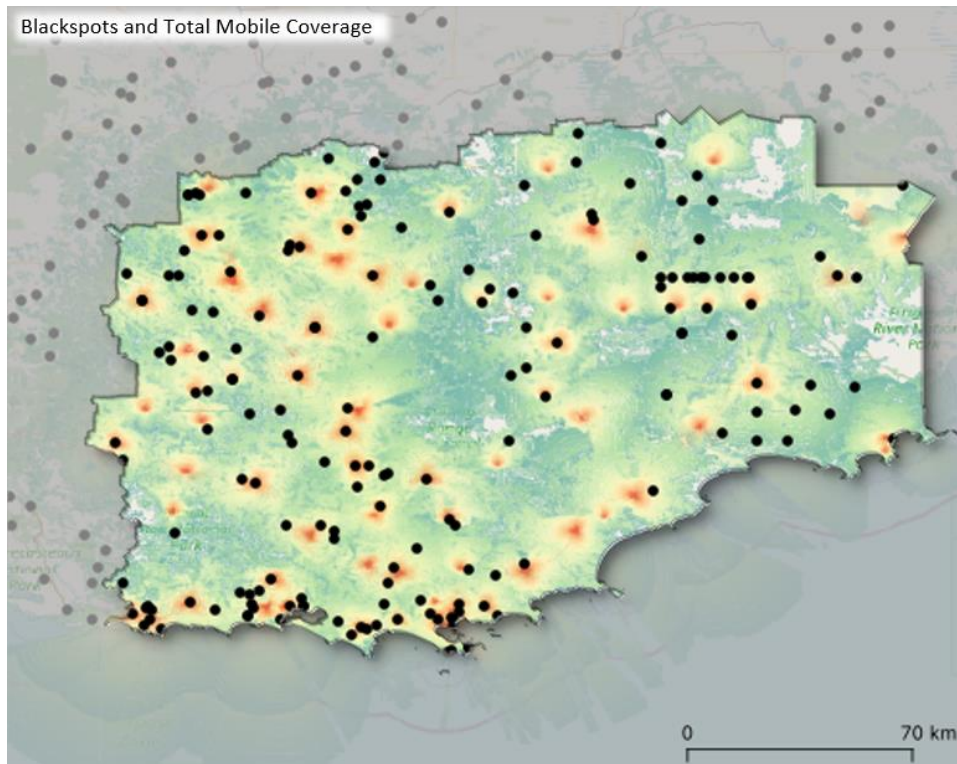
Great Southern: Premises, Population and Businesses



Great Southern: nbn Coverage by Technology

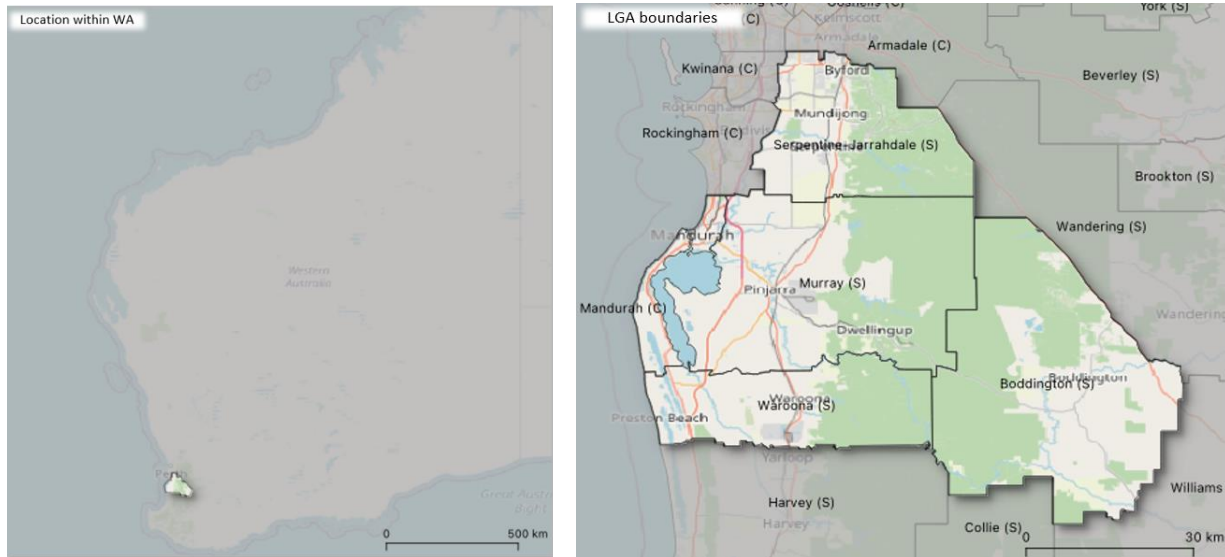


Great Southern: Blackspots and Aggregate Mobile Coverage

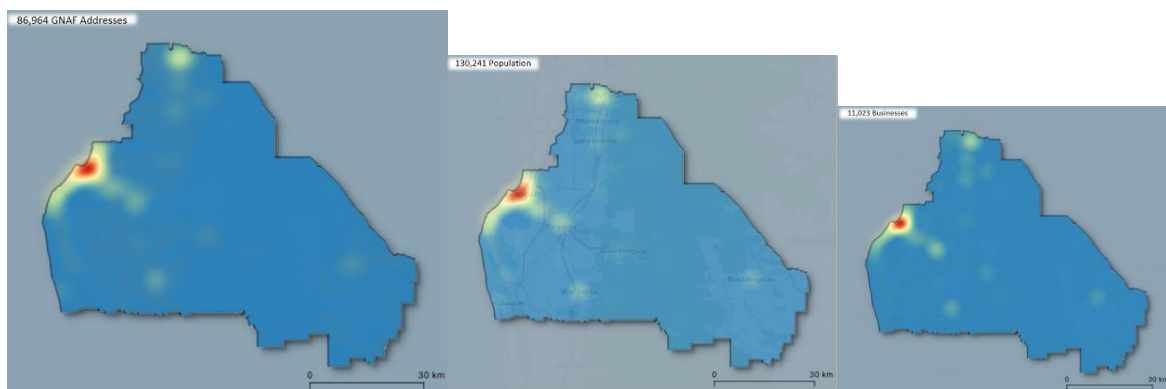


Peel

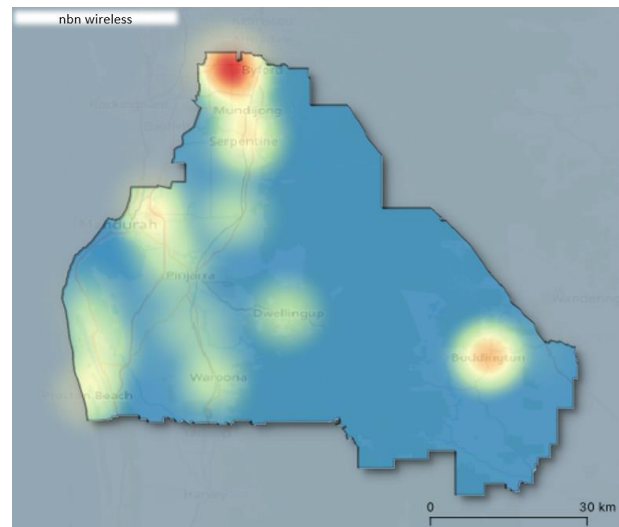
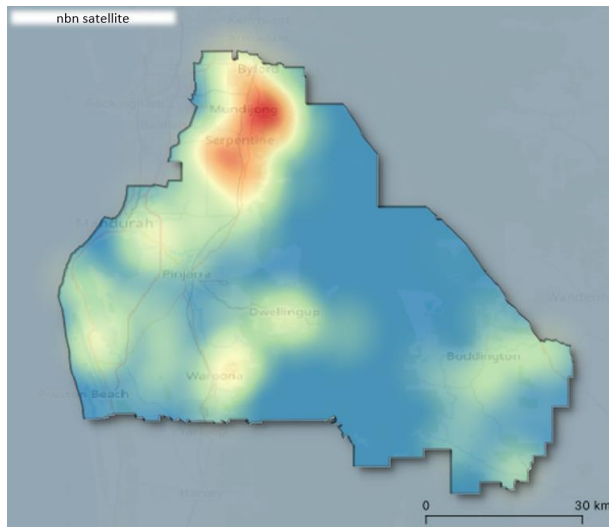
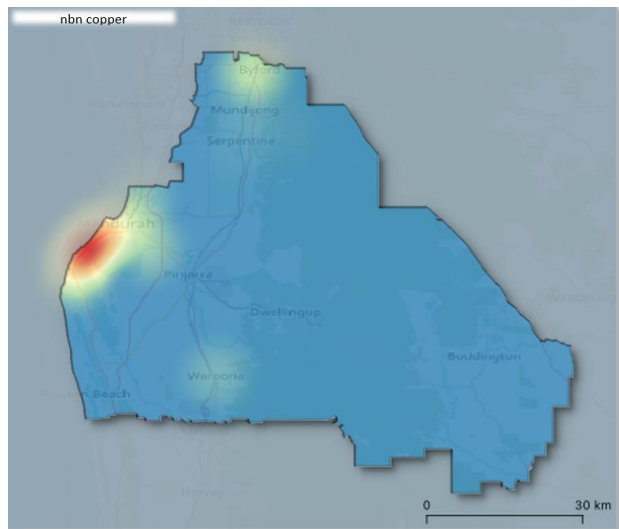
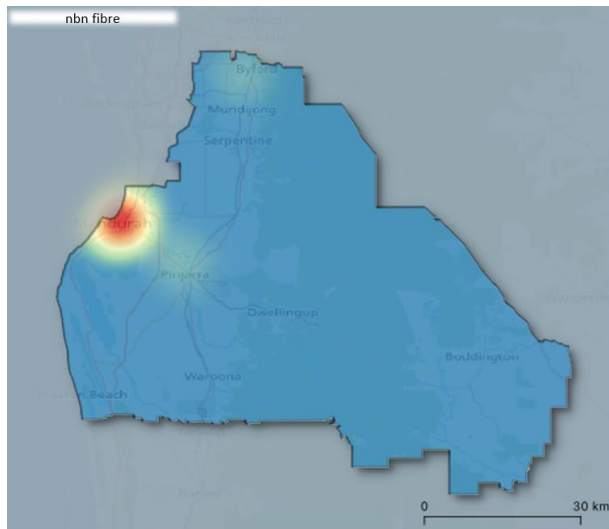
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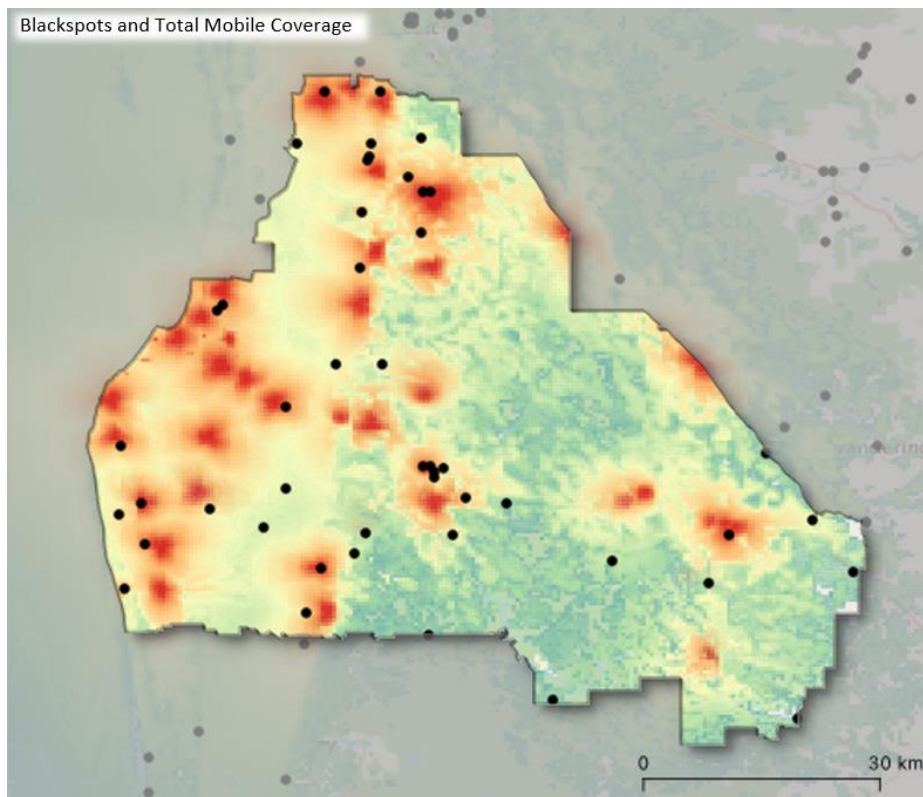
Peel: Premises, Population and Businesses



Peel: nbn Coverage by Technology



Peel: Blackspots and Aggregate Mobile Coverage

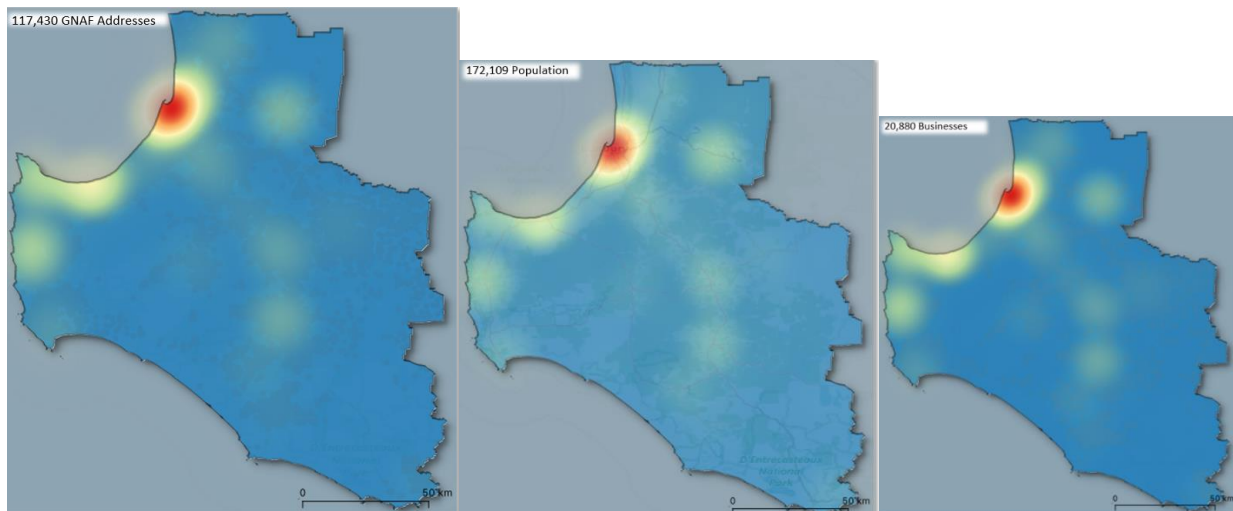


South West

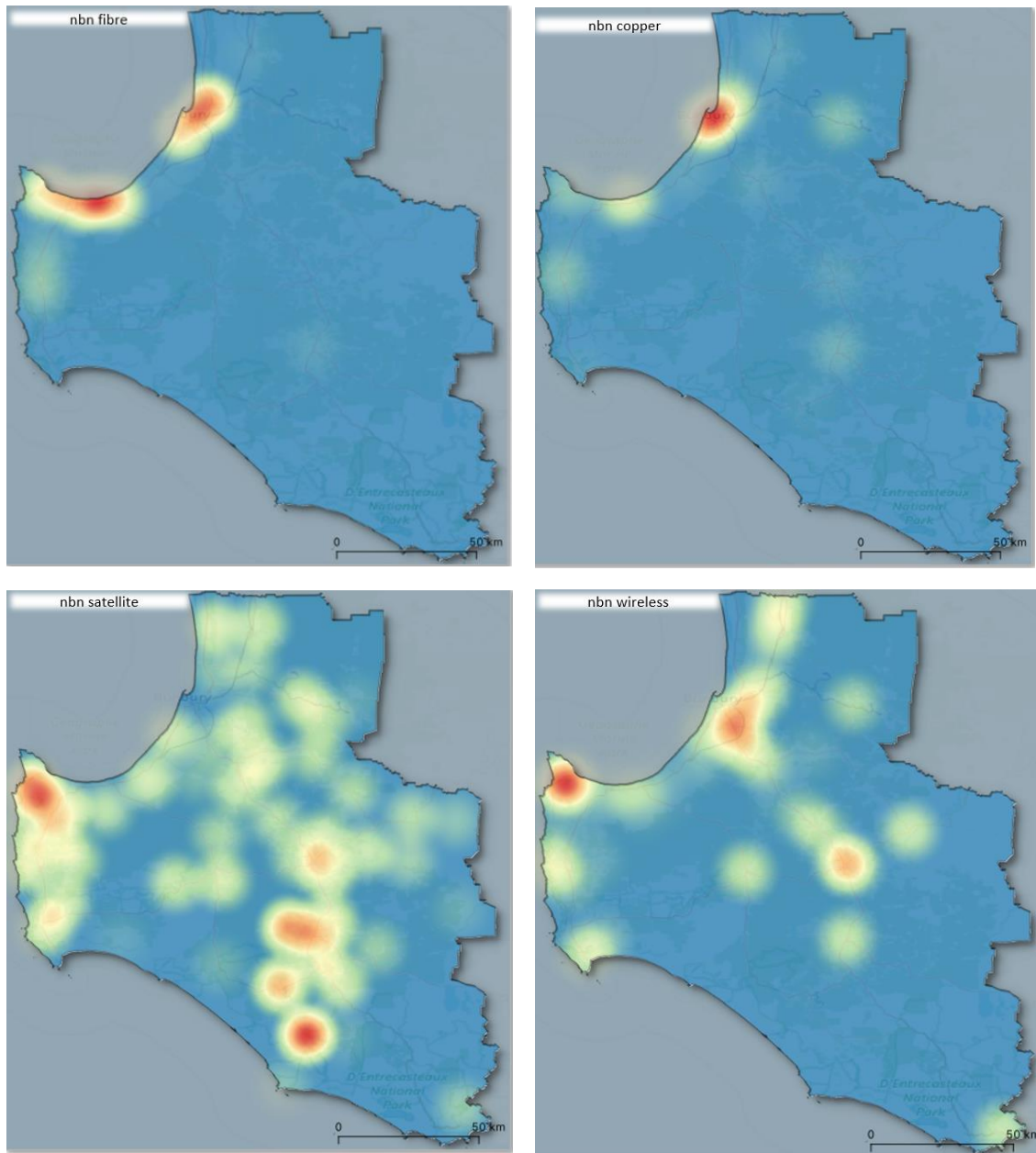
South West: Location within WA and LGA Boundaries



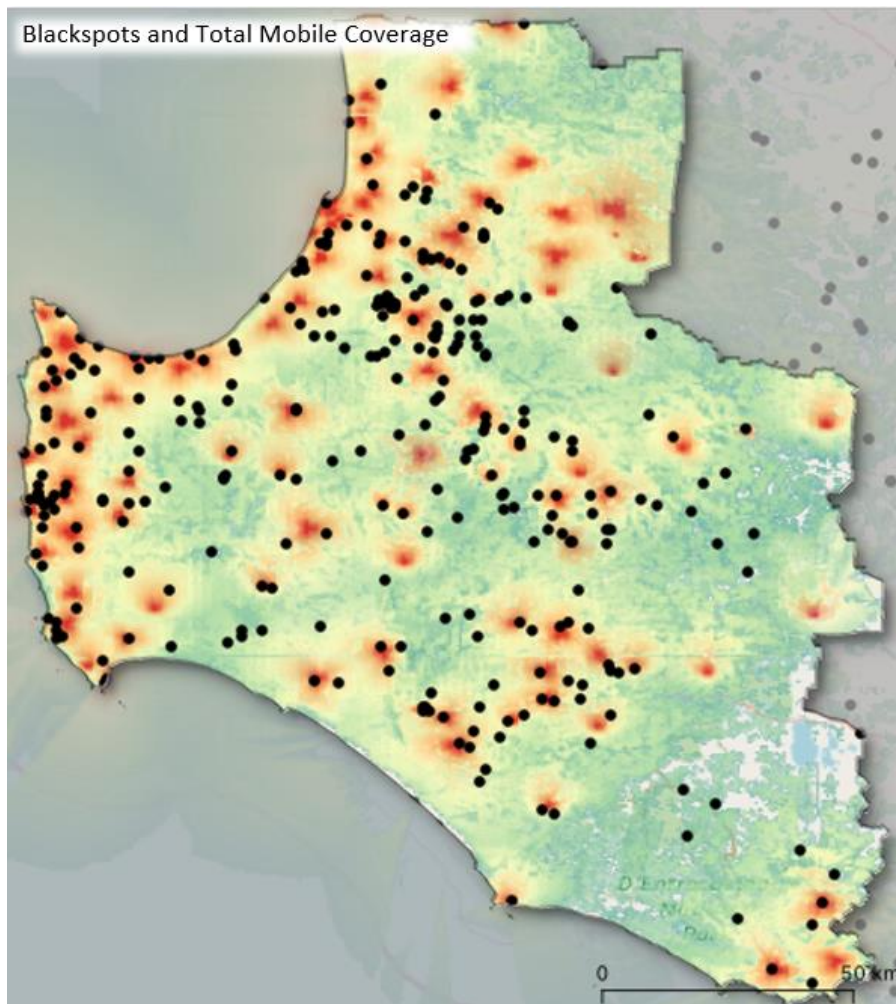
South West: Premises, Population and Businesses



South West: nbn Coverage by Technology

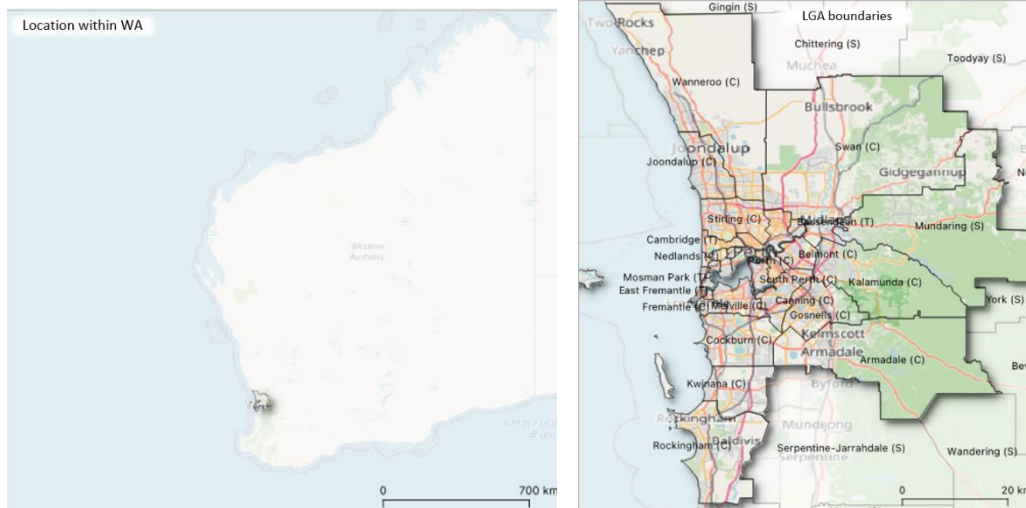


South West: Blackspots and Aggregate Mobile Coverage

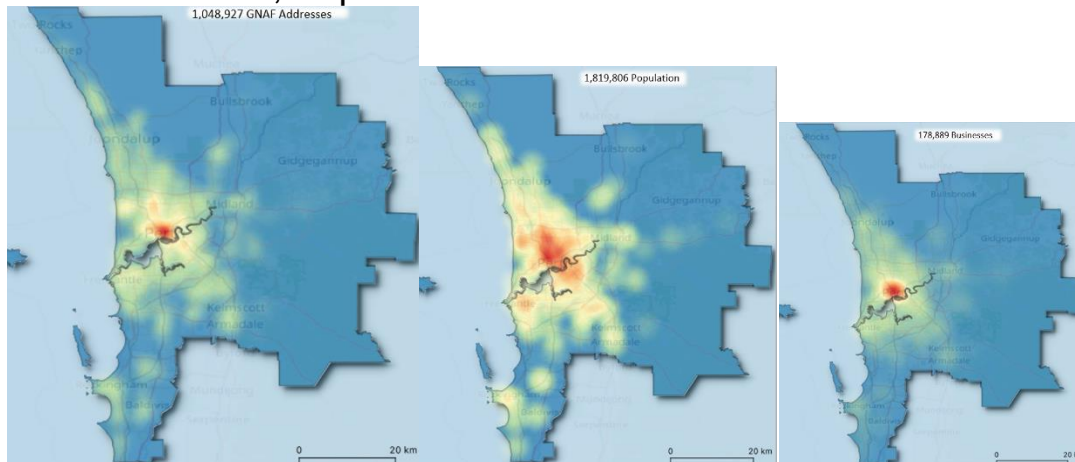


Perth

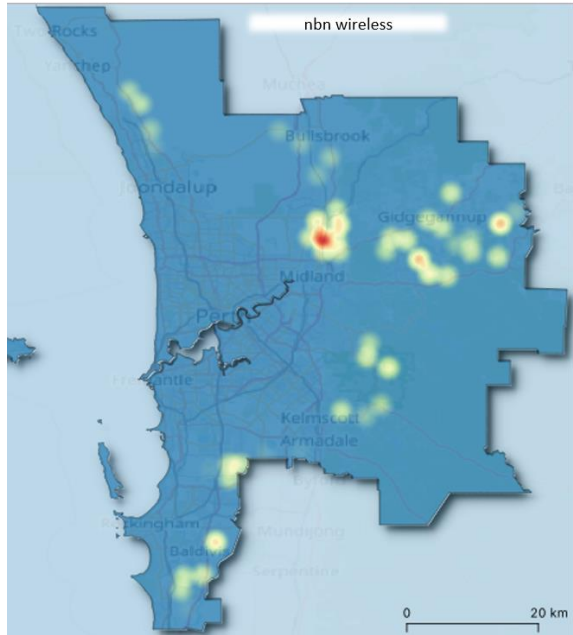
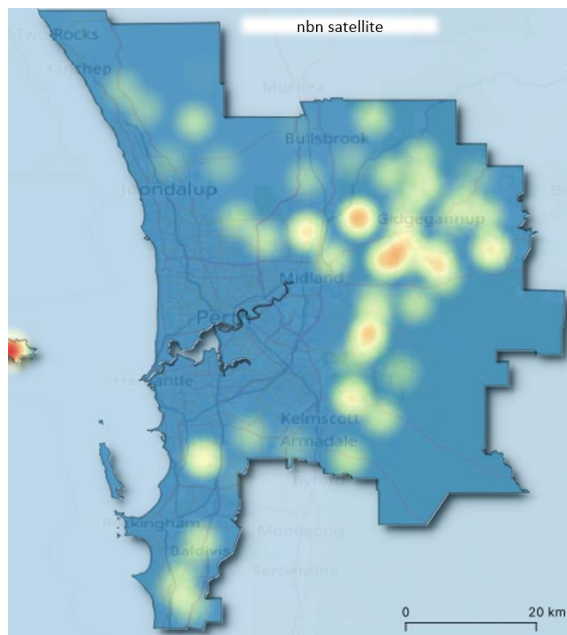
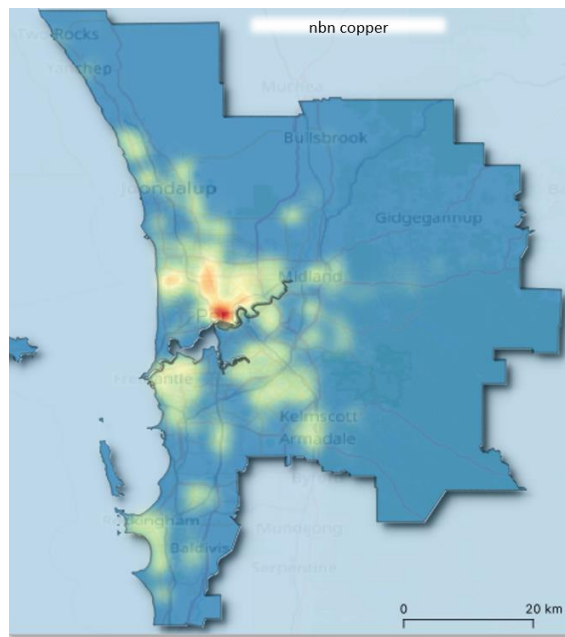
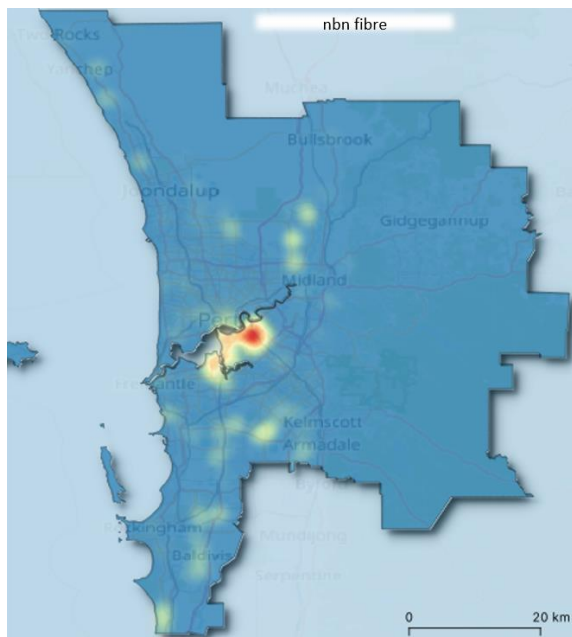
Perth: Location within WA and LGA Boundaries



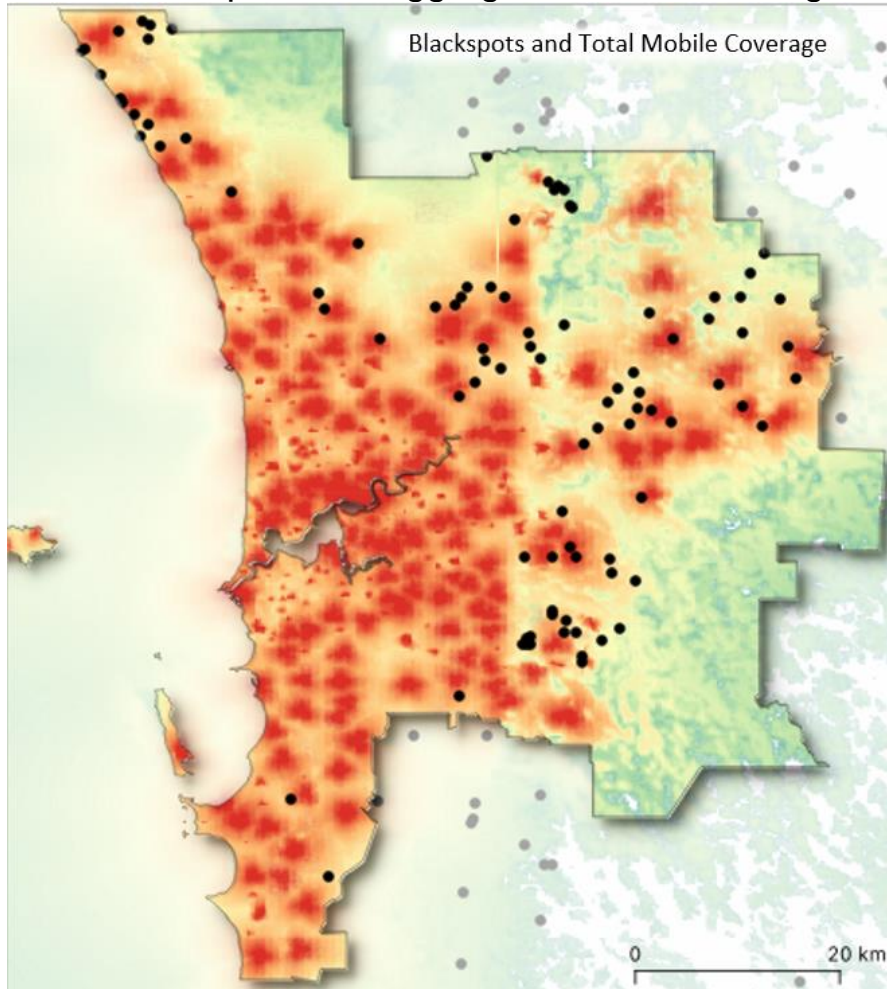
Perth: Premises, Population and Businesses



South West: nbn Coverage by Technology



Perth: Blackspots and Aggregate Mobile Coverage



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