

final report

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Connectivity Evaluation and Design

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Executive summary

This project, focused on assessing the state of adoption of information, communication, technology (ICT) across large scale beef producers in the Blackall-Tambo, Longreach, Barcaldine and Murweh Council areas of Queensland.

Field Solutions Group (FSG) engaged with 44 large scale beef producers over a period of 6 months from September 2019 to conduct a survey to assess their current usage of technology, levels and methods of connectivity and future needs and plans to employ technology to achieve greater productivity.

In the course of engaging with the participants, FSG was able to identify key areas of limitation due to poor telecommunications infrastructure and access namely :

- Limited access to quality reliable voice and data communication services
- Limited deployment of farm telemetry, monitoring and herd management systems
- Little or no implementation of disaster recovery and business continuity plans
- Attraction and retention of staff including young families to live on properties with little or no access to remote schooling, social, entertainment and other connected services.

The survey highlighted that 75% of respondents received limited or no mobile coverage on their properties, making communications difficult and inefficient. With almost 60% relying solely on Satellite connections for their internet access, only 28% of respondents felt their connectivity to the internet was sufficient to support their business and personal needs and plans.

The project's primary objective was to **to design and propose solutions to deliver connectivity to the general area, and to the specific properties assessed, taking into account the property owner's needs, plans and objectives and designing and costing a realistic connectivity solution.**

FSG designed a solution which leverages its existing network in the area, which already reaches over 30% of the respondents and which would enable the immediate deployment of "on-farm" connectivity. In addition, we identified that an investment of \$2.7M would provide access to every property in the survey by extending the existing FSG network to reach each of the farm gates. FSG then conducted detailed surveys of each respondent's property and designed a personalised connectivity plan and proposal for each of them.

The result is a roadmap which, if implemented, would enable each respondents to

- receive reliable business grade internet to the various locations on each property thereby improving communications between various homes and work areas.
- receive reliable, high quality voice services from the various locations on each property and in 3 of the cases throughout the property with a full mobility solution to improve voice communications and safety in the event of natural disasters .
- implement remote monitoring and telemetry systems in line with their individual needs improving efficiency by reducing the need for physical travel to distant parts of the property for visual checks and rapid response to potential issues.
- implement disaster recovery and resilience to ensure business continuity in the event of system failure or natural disaster
- performant access to internet based business systems, personal, education and entertainment services which are especially important during times of lockdown such as we have experienced in the first half of 2020.

Table of contents

1	Background	4
2	Project objectives.....	4
3	Methodology.....	4
3.1	Survey	5
3.2	Future leaders.....	5
3.3	Site Surveys.....	6
4	Survey Results	6
4.1	Demographics.....	6
4.1.1	Internet Connection.....	6
4.1.2	Mobile Phone and on-farm comms	6
4.1.3	Data collection, software	7
4.1.4	Analyzing data	7
4.1.5	Other uses for the Internet	8
4.1.6	Voice	8
4.2	Summary of common identified issues and opportunities.....	8
4.3	Provision true broadband internet connectivity.....	9
4.3.1	Proposed Solution	10
4.4	Property Wide Network Design	10
4.4.1	Proposed Solution	11
4.5	Deployment.....	11
4.6	Technical Solution Design.....	12
5	Conclusions/recommendations.....	14
5.1	Opportunities	14
5.2	Adoption	14
5.3	Format of surveys	14
6	Key Messages	14
7	Bibliography	15

1 Background

Economic modelling has shown that digital agriculture could increase the Gross Value of Production by \$20.3 billion (a 25% increase on 2014-15 levels). When digital agriculture, which relies on connectivity, is fully implemented in Australian beef and sheep meat sectors, the estimated potential benefit to the economy is \$5.5bn Leonard, et.al (2017).

A self-assessment tool was designed to target large scale Queensland Beef producers in the Blackall-Tambo, Longreach, Barcaldine and Murweh Council areas to ascertain their current connectivity, method of connection and knowledge of potential agricultural technology that could be implemented to achieve greater productivity.

The survey was conducted over a period of a month with 44 farmers in the designated areas.

Following the assessment of the responses, detailed site surveys were conducted to identify the individual needs of producers and complete “property connectivity plans” were designed and presented.

2 Project objectives

This project engaged 40 primary producers in the beef producers sectors in a process to understand

- their current adoption of ICT (information, communication, technology)
- the benefits derived therefrom
- their views of expanding usage and the perceived benefits thereof
- what if any blockers exist to achieving those objectives.

Having identified a lack of adequate, reliable connectivity as a key reason for a lag in the adoption of new technologies and ICT in general, our key objective was **to design and propose solutions to deliver connectivity to the area, and to the specific properties assessed, taking into account the property owner’s needs, plans and objectives and designing and costing a realistic connectivity solution.**

3 Methodology

The methodology employed to engage with the participants was :

1. A questionnaire to evaluate current adoption, usage and limitations of technology.
2. An onsite assessment of the existing communications at site and a review of the issues / limitations to business processes and performance related to IT systems.
3. A solution design phase including costing for specific properties
4. A report outlining a road map to implement increased connectivity and technology solutions to increase business productivity and ability to innovate.

The design study allows accurate best-case designs for the installation/investment of new telecommunications equipment.

Field Solution personnel travelled to sites and conducted in person surveys to document existing services and processes, end user needs (what capabilities will be established once connectivity is improved), and to outline the infrastructure required to enable business improvement and innovation on farm.

During that process, community and thought leaders were identified and invited to work alongside our FSG staff to learn more about the application of IT to their businesses to create an informed local advocacy for the implementation of digital agriculture on farm and a local knowledge resource for other producers to collaborate with and learn from.

3.1 Survey

FSG identified and engaged 44 producers in the Blackall-Tambo, Longreach and Barcaldine Council regions.

FSG designed a survey which was to be completed electronically but was found to be too difficult to achieve any engagement in that manner, ironically partly because electronic access is extremely slow in many of the targeted areas. It was therefore opted to visit each producer and have one of our team members conduct the survey in person.

FSG compiled the results and identified future leaders who expressed willingness to engage in further research and community leadership as it relates to the adoption of connectivity and technology.

3.2 Future leaders

Three individuals were identified as “future leaders” who have elected to remain anonymous for the purpose of this report.

Their profiles included :

- Property sizes between 11 and 35k hectares with operations predominantly focused on protein sectors and some cereal grains and plant protein
- Over 4 on property locations requiring connectivity
- Some experience with on farm technologies including IoT
- Clear 24 months plans to introduce or expand certain technologies in their business operations and households on their properties with a view to achieve productivity benefits including
 - o Enhanced property wide or near property wide communications (voice and data)
 - o Deployment of additional monitoring devices including telemetry sensors and cctv for video feeds
 - o Introducing or expanding the use of electronic identification and herd management technologies

Having completed the surveys (Milestone 2 and 3) , FSG invited the future leaders to partake in the detailed on site surveys which proved to be a difficult scheduling exercise (in some cases certain owners were reticent to openly discuss or share some of their plans with others as well). Hence, the future leaders did not partake in the onsite surveys except their own.

In going through the process of the on site surveys and seeing the results of desktop studies, the future leaders, and several other owners, commented that they had gained a greater understanding of the various factors influencing the cost and quality of connectivity, as well as the differences

between, mobile wireless internet (which over 27% still solely relied on), fixed wireless and satellite based connections relative to the proposed uses of that connectivity.

FSG were able to introduce technologies such as property wide Private LTE solutions for example, as an extension to a business internet service which whilst requiring substantial investment, does procure the opportunity for ubiquitous voice and data access throughout a property.

3.3 Site Surveys

FSG proceeded to conduct on-site surveys by revisiting each site to better understand each property and the goals of the producers and identify of major goals and blockers. We also conducted desktop analysis to work out designs which would best meet those goals and designed proposed solutions.

The result was 41 site designs (presented in Milestone 5) outlining the approach to providing various levels of connectivity to each of the properties.

4 Survey Results

4.1 Demographics

100% of respondents were from the Blackall-Tambo, Longreach and Barcaldine Council regions, have been in the Agricultural Industry for an average of 34 years and 36% of those involved in running the farm have a university degree.

95% of the respondents operate a Beef (63%) or Beef & Sheep mixed farm representing a total of 933,150 hectares and with income derived entirely from livestock.

The respondents together represent 68,735 beef cattle and 139,120 sheep and have on average been in the agricultural industry for over 34 years, who overwhelmingly agreed that Internet connectivity was either important or extremely important (88.6%) to their business .

4.1.1 Internet Connection

59% of the respondents are connected to the internet via nbn™ Sky Muster™, while 27% only have Mobile phone connectivity and only 6.8% enjoy fixed wireless. Only 28% of the respondents reported being satisfied with their home and office internet connection, while 29% reported being reporting dissatisfied with their service.

With existing installations, 32% of respondents reported doing their own installations (or their family or employees) while 60% used their telecommunications providers.

4.1.2 Mobile Phone and on-farm comms

75% of respondents reported having little or no mobile coverage across their farm while only 4.5% reported having full coverage. Most respondents did not have any on-farm telecommunications infrastructure (80%) while 75% of those do expect to implement such infrastructure in the next 5 years.

4.1.3 Data collection, software

The top 4 most commonly collected livestock information is financial data (95%) Individual or herd production data (86%) ,on-farm weather data (45%) and water use and quality (16%), each of which was regarded as extremely useful for helping to make management decisions.

99% of respondents reported using financial management software while 27% of respondents reported that they also use precision agriculture data management software.

56% of respondents felt it would useful (23% extremely so) to collect additional farm management data to make better decisions, and 33% felt it could greatly improve profitability, and 50% felt it could great increase efficiency.

4.1.4 Analyzing data

In 41% of cases, the farmers reported that they analyze and interpret the data themselves while 46% reported using their accountant. While 40% of respondents find working with 2 or more data sets (such as soil and weather) to be hard or extremely hard.

The majority of respondents (90%) reported that they are willing to explore more technological opportunities which can contribute to increased profits but 70% felt support for digital architecture technologies was poor, and such investments did not provide a good return.

Of the Agricultural Information gathered, Financial Data and herd production data was amongst the most gathered and utilized with weather and pasture mapping.

Soil mapping	4.55%
Pasture/vegetation mapping	36.36%
Individual or herd production data	86.36%
Individual or herd feeding data	18.18%
On-farm weather station data	45.45%
Financial data	95.45%
Veterinary medicine data	2.27%
Water use/quality	15.91%
None	0.00%

Methods of gathering the information currently varies immensely from visual assessments and manual records (over 90%) requiring time consuming travel across properties, to limited deployment of digital sensors (such as LoRa based solutions) and/or cameras digitally reporting the information back to centralised data stores.

The adoption of those solutions is small and impeded by the lack of widespread connectivity which is often limited to proximity to the main household or compound, hence excluding the more distant assets where remote monitoring is most valuable and desirable.

The majority of respondents understand the benefits that a fully connected property could deliver specifically if it enabled the deployment of remote sensors for telemetry, monitoring and herd management, but many remain sceptical that it is achievable in a cost and time effective manner.

4.1.5 Other uses for the Internet

97% of respondents reported using Social Media, 100% for general browsing and 93% for accessing government services, 75% for education and study and 45% for streaming (Netflix). While only 27% used the service for VOIP calls, but 73% felt their current internet connection did not adequately allow them to use their connection as they wished and 37% felt their current connection and capacity, limited their ability to attract and retain staff.

4.1.6 Voice

Unanimously, respondents were disappointed with existing connectivity options in the area, citing that in spite of perceived significant investment by traditional providers, basic mobile connectivity was still missing and extremely spotty. They felt the opportunity to leverage property wide connectivity using technologies such as wifi-calling would alone be of immense, however, the cost for individual properties remains a barrier except in certain circumstances (3 of the respondents).

Of the 44 respondents, signed up as part of Milestone 2, and who partook this assessment, 100% of respondents expressed in interest in participating in the proposed on farm surveys and assessments (hence also fulfilling the requirements of Milestone 3: “Identify 40 producers for site visits to assess on-site geography, conditions and on-farm deployment options”).

4.2 Summary of common identified issues and opportunities

Table 1 below outlines the keys areas respondents have expressed as needs which are currently unachievable or partly unachievable because of poor or sub-standard connectivity or other technology related challenges.

Need / Application	Current Situation	Blockers	Solution
Voice / Video conferencing	75% of respondents get limited or no mobile coverage. Broadband connectivity is currently insufficient to reliably support voice connection.	<ul style="list-style-type: none"> • Limited access to reliable bandwidth • Little or no access to mobile service • Satellite services latency 	<ul style="list-style-type: none"> • Provision Business grade internet connectivity to replace satellite and residential grade fixed wireless services.
Farm telemetry	Only 25% of respondents use any form of telemetry and the balance almost unanimously feel that more data would make them more efficient and profitable.	<ul style="list-style-type: none"> • No connectivity intra property. • Where data uploads are required (for analysis of data sets for example) bandwidth limitations, especially for uploads is a limitation. • Insufficient clarity on capabilities of the technology and requirement 	<ul style="list-style-type: none"> • Provision Business grade internet connectivity to replace satellite and residential grade fixed wireless services. • Property wide network design and implementation • Education on the capabilities and application of telemetry

			systems, analytics and analysis systems.
Business continuity and disaster recovery	Only 15% of respondents utilize any form of offsite data backup and none had any sort of business continuity or back up plan in the event of a total loss of digital assets such as a fire destroying the office	<ul style="list-style-type: none"> • Limited upstream bandwidth • Limited satellite upstream capability • Cost of peak data on satellite services. 	<ul style="list-style-type: none"> • Provision Business grade symmetric internet connectivity to provide adequate upload capability. • Education on Cloud and DR solutions.
Staff attraction and retention	Over 30% of respondents felt that their access to adequate	<ul style="list-style-type: none"> • Limited access to reliable bandwidth 	<ul style="list-style-type: none"> • Provision true broadband internet connectivity allowing better quality access to standard business and entertainment applications.

Table 1- Challenges and opportunities

4.3 Provision true broadband internet connectivity

At the heart of each of the issues encountered is a fundamental lack of quality connectivity. The first priority is therefore the expansion of networks to provide each producer better connectivity options.

The qualifying factors for this requirement are:

- to offer potential customers the choice of a variety of **connections of up to 1Gbps** symmetric connections to their property
- From our respondent pool, the average expected does not exceed a requirement is a 100/100Mbps connection, although larger properties with a higher density of users have been designed to use up to 500mbps.
- to offer Quality of Service capabilities to prioritise voice traffic and other specialised applications where required
- to create an infrastructure from which other services such as mobile (4G) and other radio based services can be delivered from.
- to offer the option of a true, property wide coverage using technologies such as Private LTE to extend data and voice services with both fixed and full mobility capabilities.

This opens up the opportunity for each property to:

- deliver high quality **voice and data** throughout throughout the property and across all devices
- expand IoT deployments in line with business requirements and take advantage of real time data feeds
- implement disaster recovery and resilience systems

- Attract and retain staff by offering all on-property residents reliable and performant internet, home schooling tools, social media, and video streaming capabilities with little or no data caps.

4.3.1 Proposed Solution

- **30% of respondents' properties are already on-net with Field Solutions** i.e. FSG could provide connectivity to farm gate today for all properties located in the corridor identified by the green corridor in the image 2 below.

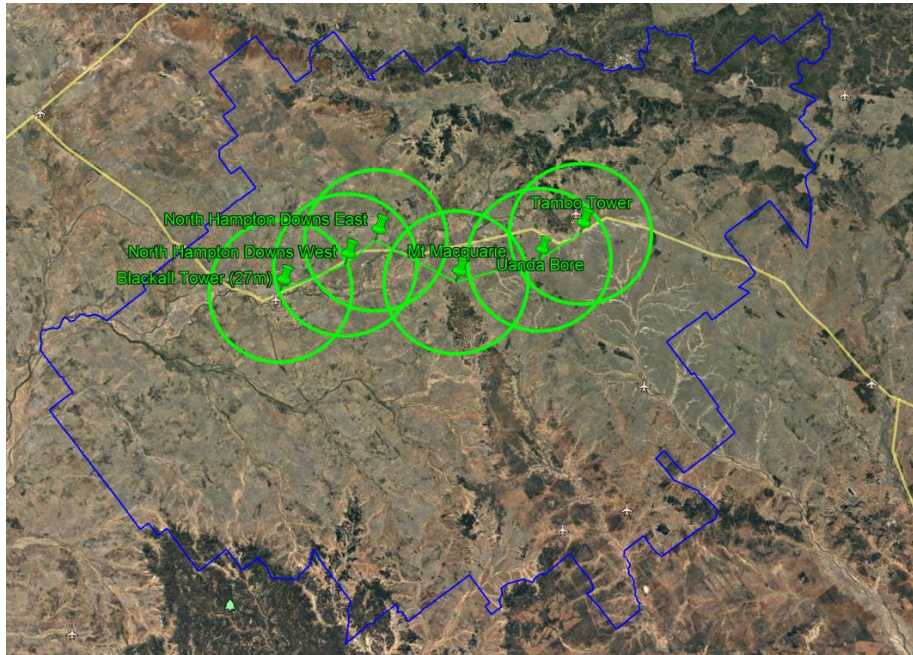


Table 2 Field Solutions - On-net capability – Blackall-Tambo March 2020

- Additional coverage of surveyed properties can be achieved by constructing additional links of 10-14 towers (subject to access rights and detailed RF design) which together would provide coverage to all the respondents' properties as well as over 90%+ of the population of the surveyed areas.
- **Capital cost of such a project is circa \$2,773,000**

4.4 Property Wide Network Design

Once connectivity is achieved to the farm gate, the next requirements is to deliver connectivity to various parts of the property. This includes various homes, sheds, storage facilities, water bores, troughs, and animal pens.

The qualifying factors for this requirement are :

- to deliver a property wide connectivity plan
- to identify the technology(ies) best suited to deliver to the needs of the specific property and business

4.4.1 Proposed Solution

For each property, we identified the requirements and designed a property wide network considering:

- Size of the property and distribution of assets – the average size of our respondent’s properties was **10,870 ha**.
- Number of structures requiring connection (average 6)
- Requirement for mobility
- Bandwidth requirements (**average 68mbps**)

Figure 2 below shows the distribution of the on-property network implementation cost based on number of locations to be included and whether property wide mobility was identified as a requirement.

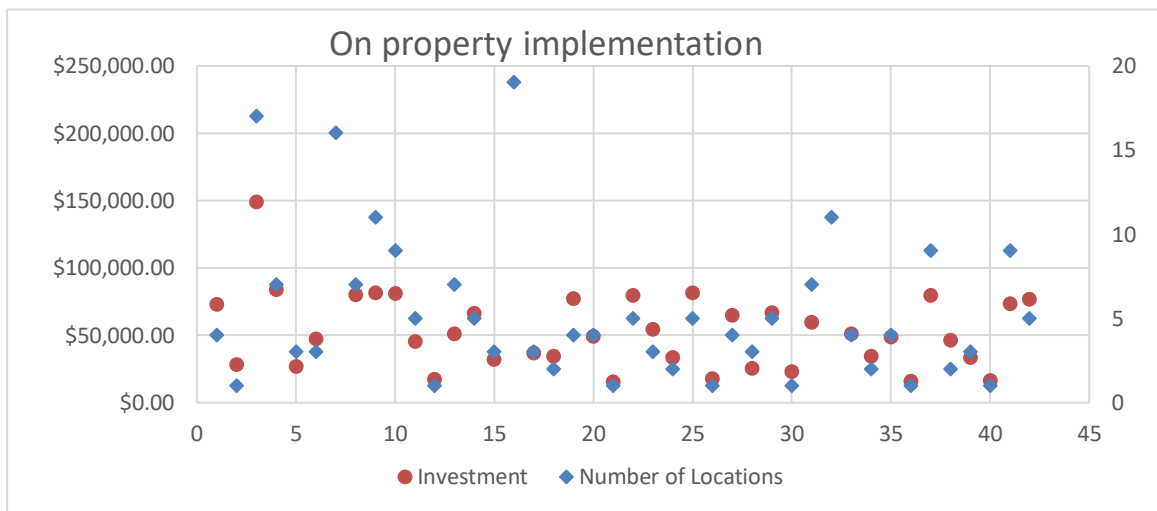


Figure 1 On-Property Implementation cost distribution

With average bandwidth requirements of 118mbps, the average monthly cost starts as low as \$299/month and averages \$960. This is skewed by the top 8 properties requiring bandwidth of between 250 and 500mbps without which the average bandwidth requirement is **68mbps**.

In summary, the average number of locations across all surveyed properties was 11 with 6 locations requiring connectivity, and investment averaged **\$52,650** for properties who did not require a full-property mobility solution and increased to **\$190,952** for properties with full mobility coverage.

It is important to stress that the effectiveness of on-property network is heavily, not to say entirely dependent on the delivery of broadband connectivity as outlined in 4.3.

4.5 Deployment

FSG presented the findings to the respondents and the response can be categorised as follows :

- For the 11 “on-net” customers who could in effect begin immediate implementation of an on-farm solution, over 80% expressed a need and willingness to do so within the next 3-6 months. This includes 1 (33%) who expressed a need for full mobility.

- For the balance where a solution cannot be immediately committed due to lack of infrastructure, 64% expressed that they would proceed if the necessary infrastructure was available, including 2 (66%) who expressed a need for full mobility. Of the balance, 16% felt the costs were too high to justify at this point while the balance were unsure.
- Overall, the respondents felt they had learned a lot through the process and were now clearer on the possibilities and capabilities available to them. The vast majority (over 87%) felt that they would benefit from achieving their full property connectivity plan in place within the next 2 years.

4.6 Technical Solution Design

FSG’s proposed solutions combines every aspect of connectivity which are described below :

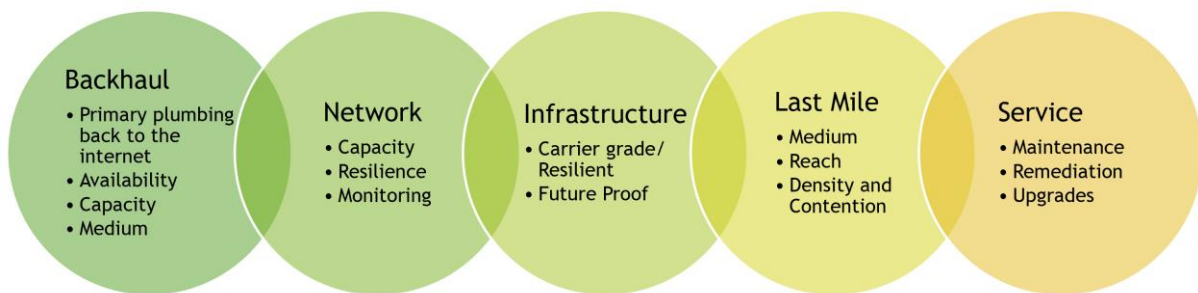


Figure 2 Components of Field Connectivity

Backhaul: is the primary internet pipe and we leverage resilient fibre infrastructure to provide both capacity and performance from major carriers.

FSG’s Network is built to offer optimal uptime and performance as well as removing single points of failure.

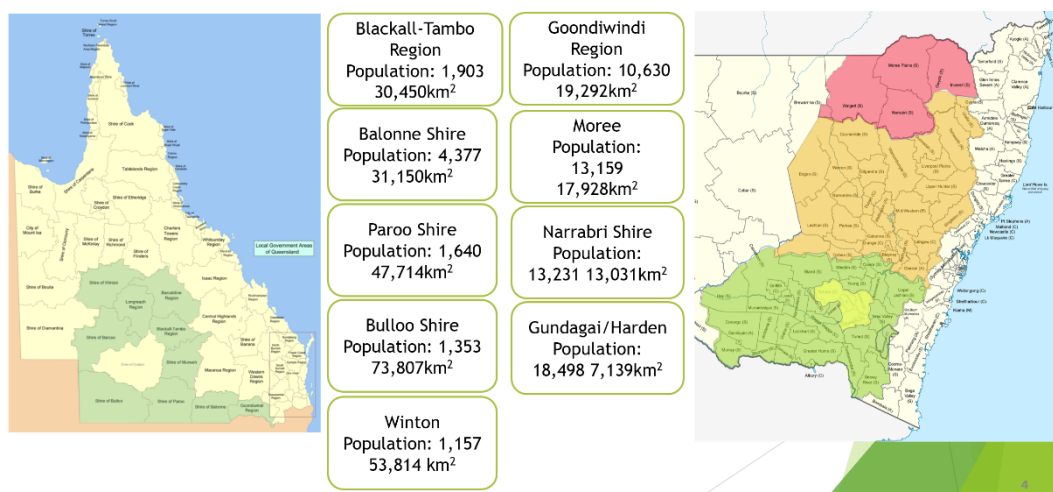


Figure 3 Field Solutions Network examples

The [Field Solutions Regional Australia Network](#) (RAN) is the rural and regional infrastructure backbone Field Solutions builds and operates to transport backhaul from its source in regional centers to our target areas. Figure 3 illustrates some of the areas where FSG RAN is already deployed.

Of relevance to the target area of this survey is our phase 1 network shown in Table 2 above which illustrates the above concept. The 5 towers we built form the initial backbone connecting the towns of Blackall and Tambo. Backhaul is sourced at either or both ends from resilient networks. Each tower in the network services a radius of up to 25Kkm forming a corridor 25km wide between the towns and any property within that corridor is immediately reachable. Any property outside of that corridor can be reached by extending the network from any of the PoPs along the route as discreet projects.

In addition subsequent phases will see the backbone extended (phase 2 has already been approved to proceed) to ultimately extend connectivity to the entire shire as shown below :

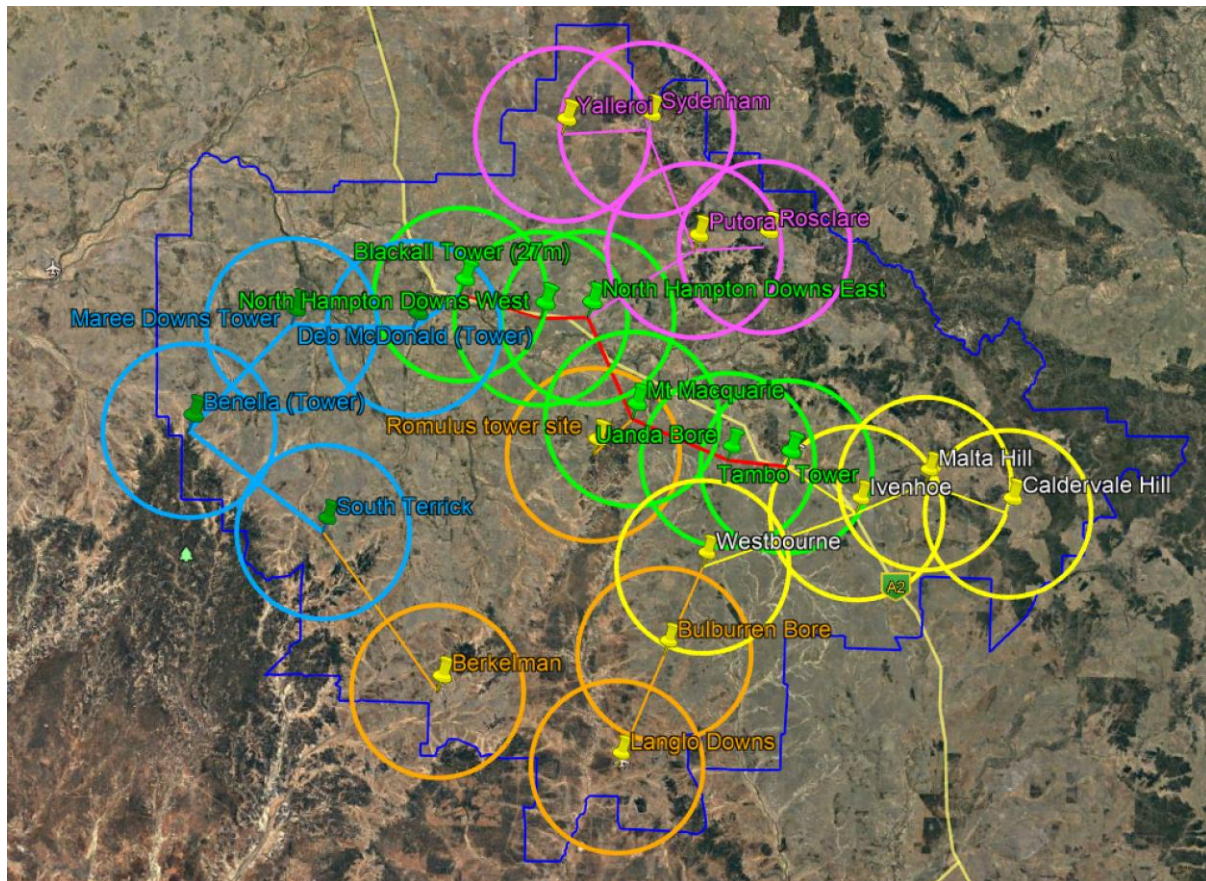


Figure 4 Shire Wide Connectivity plans for Blackall Tambo Shire

The “last mile” is the ultimate delivery medium to the consumer property. Given the remoteness of the majority of our clientele, the typical delivery of connectivity to the farm gate is achieved using licensed (or in some cases unlicensed) fixed wireless or Private LTE technology and can achieve speeds of up to 1/1Gbps (in some cases speeds up to 10Gbps can be achieved).

The former allows us to bring connectivity to a primary point of ingres on the property (primary connection) and distribute it from there to other points on the property in a point to point topology,

servicing sheds, pump stations and other important locations. From there Wifi can be used to further propagate the signal around each of those locations.

Differently to “point-to-point” wireless solutions, our Private LTE solution is able to provide coverage across an area thus it is an ideal solution for larger properties who wish to leverage several work locations, mobility solutions and distributed sensors (IoT) solutions.

5 Conclusions/recommendations

5.1 Opportunities

Respondents expressed that primary objectives listed below would be enabled and/or improved by access to reliable, true on-farm broadband. Over 85% felt the investment levels were justifiable in improved efficiencies and cost savings.

- Voice and Video Conferencing
- Farm Telemetry
- Business Continuity
- Staff attraction and retention

Intangible benefits such as social benefit for home studying, access to online entertainment also came up as key benefits.

5.2 Adoption

The respondents communicated they had learned a lot through the process and were now clearer on the possibilities and capabilities available to them. The vast majority (over 87%) felt that they would benefit from achieving their full property connectivity plan within the next 2 years.

5.3 Format of surveys

Our future leader’s feedback that the process was invaluable for the respondents but felt that they could not dedicate the time needed to partake at the level of detail we and they may have liked. It was generally felt that instead, briefing and review sessions were a more effective use of time.

6 Key Messages

It is evident that the target group of this project does not enjoy adequate access to internet connectivity and has not seen the benefits that newer connected technologies can deliver. As a result, many of the respondents have understandably not stayed on top of those developments and can be sceptical that they are achievable.

From FSG’s own work with Local and State government agencies, observed in the area is notion for how vital residents to clearly communicate their needs and issues to their local council members.

FSG have seen tangible, positive results with working councils in Blackall-Tambo, Balonne, Bulloo, Paroo, Barcaldine, Winton and Goondiwindi councils who have driven new investments and created projects aimed at improving shire wide connectivity in partnership with companies like ourselves.

It is also vital for individual farmers as it is for any business, to have a clear, documented ICT plan to ensure that at most basic level, their business is secured from a key business data perspective, has data backup and disaster recovery systems and procedures, and a clear plan 3-year rolling on how it will adopt and deploy technology.

This should includes how owners and operators will remain in touch with evolution in the Ag-tech sector and how these may affect or benefit their specific sector in the future. This aligns to MLA's wider strategy to support industry make decisions informed through data and insights where connectivity can enable more producers with access to data and feedback on animal performance to inform production decisions.

7 Bibliography

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