# AGRI-TECH EXPERT WORKING GROUP

June 2021

Australian Broadband Advisory Council

Australian Broadband Advisory Council

## ACKNOWLEDGEMENTS

**This report has been prepared on behalf of the Australian Broadband Advisory Council (ABAC) by the Agri-tech Expert Working Group (AEWG). The AEWG includes the following people:**

### CO-CONVENORS

| | |
|---|---|
| **Andrea Koch** | **Principal Consultant, AgTech Ideation** |
| **Peter Waters** | **Consultant, Gilbert + Tobin** |

### MEMBERS

| | |
|---|---|
| **Nicole Curtis** | **CEO, Grower Group Alliance** |
| **Leighton Wilksch** | **Director & AgTechnologist, Agbyte** |
| **Peter Thompson** | **Farmer, Echo Hills Farming Company** |
| **Richard Heath** | **Executive Director, Australian Farm Institute** |
| **Christine Mulhearn** | **Assistant Secretary, Innovation and Consumers Branch, Department of Agriculture, Water and Environment** |

ABAC and the AEWG would like to express their sincere appreciation to everyone who contributed to this report. This includes the many people in the agriculture and agritech sectors across Australia who gave their time and shared their knowledge and experiences. Their input ensured that the report is reflective of the challenges currently faced by the agricultural sector in the adoption of digital technology.

We also received valuable assistance from nbn co, Telstra, Optus, TPG and other communications service providers, including agreement to follow up on some of the case studies we have used in this report.

# EXECUTIVE SUMMARY

Widespread adoption of digital agriculture is critical to lifting the value of Australian agriculture from $60 billion to $100 billion by 2030. The Australian Broadband Advisory Council (ABAC) established the Agri-tech Expert Working Group (AEWG) to consider how digital services can enhance productivity, identify barriers and encourage greater uptake of technology. As part of its work to date, the AEWG has also considered whether a 'connectivity threshold' exists in regional and rural Australia and, if so, the extent to which it is enabling or holding back the adoption of digital agriculture.

Connectivity to support digital agriculture is required across the entire farming operation, and not just at the homestead. Discussions with farmers in different sectors across the country have indicated that while there have been significant gains in connectivity, there is a persistent problem of inconsistent, unreliable or 'thin' coverage which means that the connectivity threshold for digital agriculture has not been achieved.

The main finding of our discussions is that across the country, beneath the broad brush strokes of mobile coverage and National Broadband Network (NBN) fixed and wireless networks, there are localised connectivity gaps on, across and between farms. We have called this patchiness 'salt and pepper connectivity'.

Salt and pepper connectivity is holding back online business and administrative functions, the full use of digital functionality on existing equipment, the use of digital technologies that need reliable and ubiquitous connectivity and is forcing costly offline work-arounds for farmers and agri-tech providers. It is also affecting regional economic growth by holding back online farm-based businesses and has particular social impacts on women and online learning for farm children.

Farmers and rural communities try hard to address the problems through advocacy and direct action. There is strong understanding of local telecommunications infrastructure and its inability to provide ubiquitous and

# EXECUTIVE SUMMARY

reliable service. In particular, there is a heightened awareness of the 14 kilometre boundary around towers that delineates the NBN fixed wireless service offering from the satellite offering, reflecting a general perception that the satellite service is inferior. Some farmers have resorted to quite ingenious but not ideal DIY solutions that stretch the boundaries of the fixed wireless network and boost mobile signals.

If the problem is salt and pepper connectivity, the ultimate goal has to be ubiquitous connectivity with broadband in the homestead, at the farm sheds and stock yards, across and between paddocks and 'on-the-move'. There is a growing range of applications across each of these scenarios that will rely on a range of different bandwidth and performance requirements. These are categorised as 'narrowband intermittent', 'narrow band always-on' and 'broadband always-on'. There is a mix of technology solutions across these categories that vary in relative utility, reliability and cost. While carrier fixed and mobile broadband networks can 'do everything', they are over-engineered for many agri-tech applications, and still won't necessarily solve the salt and pepper problem.

National carriers may continue to be the primary providers of connectivity in rural Australia, but their focus – in terms of both technology and business outcomes – is on serving premises and 'people on the move' along transport corridors. It is not reasonable to expect that the national carrier business models, even with stepped up 'push-pull' approaches from government, will solve what is essentially a local scale problem. As a result, what we have seen is the emergence of alternative approaches in the market, including farmers installing bespoke solutions, as well as a cohort of second tier retail service providers (RSPs) who are filling in the salt and pepper.

A range of Small and Medium Enterprises across the country are deploying connectivity solutions at a fraction of the cost of the main carriers. Some of these small networks operate as substitutes for the carrier network, others

# EXECUTIVE SUMMARY

extend the range of the carrier networks. A cohort of Australian and international companies offering Low Earth Orbit (LEO) satellite communication solutions is also emerging. These solutions range from low cost narrowband Internet of Things (IoT) technology, to 'always on' broadband coverage.

Two things are essential to turn this into a thriving multi-tiered market – access to fibre backhaul and access to spectrum. There are already promising developments on both. New and existing fibre network providers have announced plans for expanding the availability of high speed broadband and dark fibre backhaul services in regional areas. The Australian Communications and Media Authority (ACMA) is currently consulting on 6 GHz class licensing for Wi-Fi and private 4/5G applications. The Australian Government and a number of State and Territory Governments have announced further funding for telecommunications infrastructure in regional and rural areas. There is an opportunity to bring these developments together in a more planned, co-ordinated way to accelerate a shift in connectivity in regional and rural areas.

Solving salt and pepper connectivity, however, won't be enough to promote the adoption of digital agriculture. Our consultations also indicated the need for local ecosystems of digital skills across a stack of technical capabilities, including:

- **advice on connectivity options:** while a farmer will be well aware of the lack of mobile coverage, they may not have knowledge of, nor a way of finding out about, other viable connectivity alternatives
- **selection and installation of agri-tech solutions:** some apps like soil sensors can get by with narrowband intermittent coverage, such as from LEO satellites, terrestrial LoRaWAN, or mobile carrier's IoT networks: Others like in-cab harvester monitors require high quality, real-time connectivity delivered by mobile networks and private WIFI. And more advanced apps which use imaging such as automated weed sprayers need high bandwidth provided by mobile networks.

# EXECUTIVE SUMMARY

- **data aggregation and integration:** the real value in farm data collected by agri-tech apps is when it is integrated with other data, such as soil moisture data overlaid with harvest yield data, local area weather data etc. This will often require data correlation and integration skills to represent the integrated picture back to the farmer
- **digital agronomy/farm management decisions:** the digital output needs to be translated into changed farming practices. Farmers already draw on the advice of local agronomists, and increasingly they need to become 'digital agronomists'.

These skills are currently very thin on the ground and need to be close at hand for the farmer – waiting for a technician to drive hundreds of kilometres to fix a critical agtech application can affect crop or livestock value. Building these ecosystems will require efforts at the state/territory and national level, as well as the delivery of vocational education and training (VET) and university courses education services and digital demonstration farms aimed at developing and attracting digital capacity in and to regional and rural areas.

Critical to addressing salt and pepper connectivity and the issues outlined above is also recognition that problems are best solved by rural communities themselves. Australian farmers will embrace digital technologies, just as they have always innovated, in order to solve problems and when there is a clear value proposition. Once they know what is possible, rural communities will organise themselves to fill in the salt and pepper and drive adoption of digital technology.

Given that market innovation is occurring, the issue is how existing policy frameworks, at the state/territory and national level, could be reframed to support competition across the sector, including addressing barriers to entry for new providers and their ongoing sustainability, and to help rural communities build place-based connectivity.

The desired future state has three main elements:

- fibre highways across the country with back haul off-ramps into every rural community
- every rural town or area has a locally developed connectivity plan that connects their off-ramp to a range of place-based, locally supported infrastructure
- government investment to achieve this takes place within a long term, intergovernmental planning framework, and which is complementary to business investment.

The challenge is how to draw these policy, public funding and market trends together into a more co-ordinated and accelerated effort to address salt and pepper connectivity in the timeframes required to meet the industry's $100 billion goal.

# EXECUTIVE SUMMARY

**In order to achieve this designed future state, this report proposes nine potential actions across four themes.**

## Theme 1: Low hanging fruit

**relatively small adjustments to existing approaches that can help in the short term, such as:**

- NBN Co prioritises moving people from satellite on the 'outskirts' of its fixed wireless network by exploring technical ways and connection policies to 'soften' the 14km boundary for the fixed wireless coverage
- continue to provide and expand services such as the Regional Tech Hub, to enable farmers to better understand the full range of connectivity options they already have, including new RSPs. This may involve providing more resources for the Regional Tech Hub to take a wider educative role in skilling up farming communities and organisations on connectivity options.

## Theme 2: Create new foundations

**policies that set things up to solve salt and pepper connectivity for the long term:**

- Develop spectrum policy that promotes opportunities for innovative wireless solutions in rural and regional areas. Drawing on the experience with rural connectivity efforts in markets such as the UK and the US, to explore spectrum policy that promotes opportunities for low cost service delivery in rural and regional areas
- promote the availability of fibre backhaul to support alternative providers in rural areas. The combination of fibre and class licensed spectrum provides a very cost effective solution to provide broadband in sparsely populated areas
- NBN Co, and carriers generally, should be encouraged to explore technical solutions (such as software defined networks) which allow more 'heterogeneous networks' that interwork with lower cost, third party providers to extend the reach of the carrier networks.

## Theme 3: Create conditions for growth

**policies that enable the market and local communities to solve salt and pepper connectivity at local scales:**

- Enable local communities to realise their own connectivity infrastructure by removing regulatory barriers and promoting locally driven connectivity initiatives
- invest in ensuring that the 'stack' of knowledge and skills required to 'power' connectivity and digital agriculture is in place.

## Theme 4: Comprehensive Long Term Planning Framework

**a whole-of-government approach to connectivity:**

- Shift the weight towards involving local communities in regional specific assessment and planning processes to help ensure that local farming and community organisations are aware of funding from states, territories, and the Australian Government is coordinated and effective in improving telecommunications infrastructure in rural areas
- stronger coordination between Federal, State/Territory and Local governments to ensure investment in communications infrastructure are more aligned with the priorities in each regional and rural area, and possibly in co-funding key infrastructure projects.

# INTRODUCTION

## OVERVIEW

The Australian Government is supporting the agriculture industry to reach its goal of $100 billion in production by 2030.

Further, in their 2017 analysis of the economic benefit and strategies for the delivery of digital agriculture in Australia, the Australian Farm Institute determined that:

"If decision agriculture was fully implemented it would deliver an estimated boost to the value of agriculture of 25 per cent ($20.3 billion) and lift the Australian economy by an estimated 1.5 per cent ($24.6 billion)."[1]

A recent paper by the Bureau of Communications, Arts and Regional Research (BCARR) estimates that the additional economic benefit from digital technologies could be between $3.0 and $10.6 billion per year (in 2017–18 dollars) for the agricultural sector by 2029–30, which represents an additional boost to economic activity in agriculture of between 4.7 to 16.9 per cent by 2030.[2]

Widespread adoption of digital agriculture is critical to the achievement of the goal to grow the sector to $100 billion by 2030. Therefore, given the lead times required to get communications infrastructure in place to support the goal of ubiquitous broadband coverage, there is an urgency to the questions identified by the AEWG.

Australian Government
Department of Agriculture, Water and the Environment

**Through Ag2030**

**The Australian Government is setting the foundations for the agriculture sector to grow agriculture to $100 billion by 2030, ensuring Australian agricultural producers receive maximum returns for their hard work and are supported by vibrant rural and regional communities.**

October 2020

Source: https://www.agriculture.gov.au/ag-farm-food/ag2030

**The size of the prize from digital agriculture is $20.3 billion per annum and a lift of 1.5% to the Australian economy.**

1 https://www.crdc.com.au/sites/default/files/P2D%20Ecomomic%20impact%20of%20digital%20ag%20-%20AFI%20Final%20Report.pdf

2 https://www.communications.gov.au/publications/working-paper-economic-impact-ubiquitous-high-speed-broadband-agriculture-sector

# INTRODUCTION

The Australian Broadband Advisory Council, established by the Minister for Communications, Urban Infrastructure, Cities and the Arts, established the Agri-tech Expert Working Group (AEWG) to provide advice on ways to maximise the benefits of digital technology in Australian agriculture. **Co-chaired by Andrea Koch and Peter Waters, the AEWG is pleased to present this report, focused on answering three questions:**

## QUESTION ONE

Does a 'connectivity threshold' exist in regional and rural Australia where connectivity becomes an enabler of digital agriculture, rather than a drag on it?

## QUESTION TWO

If the threshold has not been crossed, what connectivity is required for digital agriculture to be put in place and what measures can be taken to get it in place?

## QUESTION THREE

If, or once, the threshold is crossed, what other measures would promote adoption of digital agriculture off the back of that connectivity?

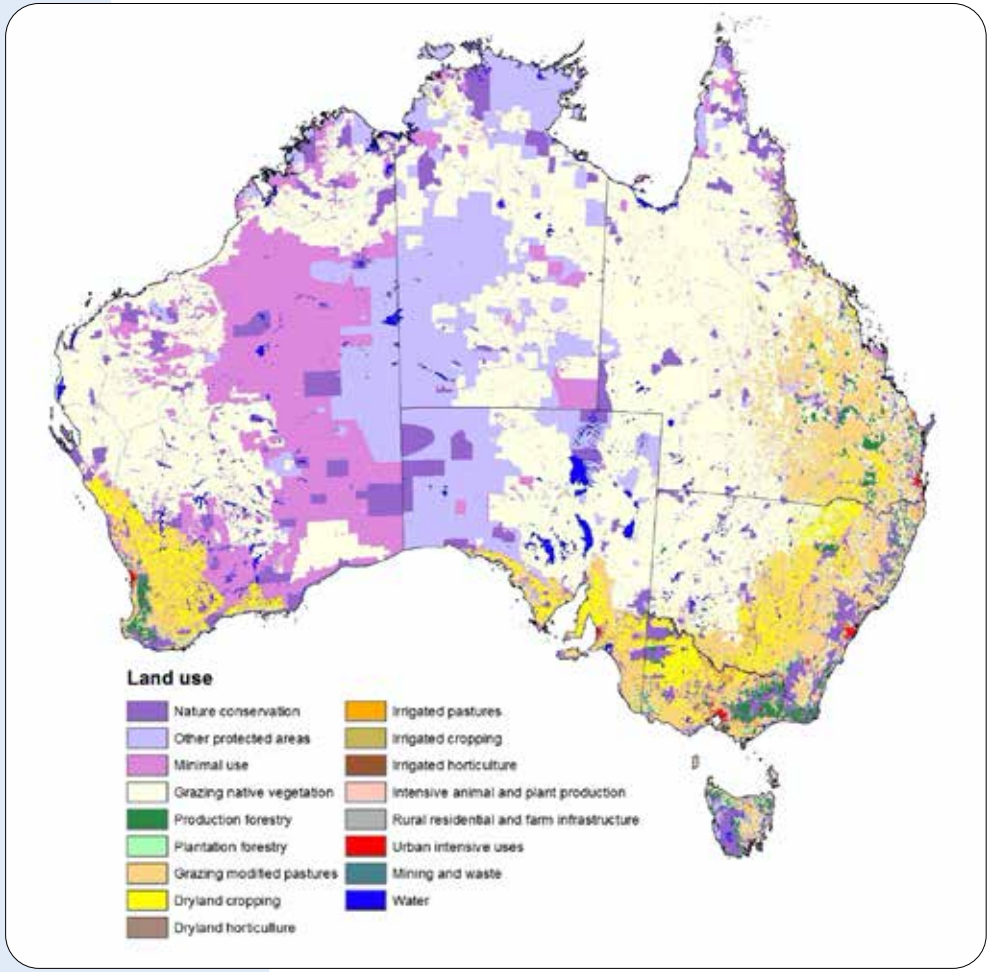
## METHODOLOGY

The research was qualitative. Members of the AEWG conducted video-based and face-to-face meetings across regional and rural Australia, including in northern New South Wales (NSW), the Victorian Mallee/Wimmera, and upper north South Australia, Esperance in Western Australia (WA), the Queensland Atherton Tablelands, and central NSW. We spoke with farmers, service providers, educators and researchers involved in the grain, sheep, cattle, wine and horticulture sectors.

While a thorough audit of connectivity in regional and rural Australia was beyond the scope of this review – a Regional Telecommunications review was undertaken in 2018 and another review has commenced – there was a consistent picture of connectivity issues which emerged during our discussions with farmers and farming communities. While the extent and quality of connectivity varied between each area, the experiences, patterns and frustrations associated with connectivity were very much the same.

That said, our assessment is more relevant to the areas of Australia which support intensive agriculture (horticulture and dairy along the coasts) and pasture/cropping (the 'crescent' from central Queensland through south-eastern Australia and to WA), as depicted in the Australian Bureau of Agricultural and Resource Economics (ABARES) map.

The connectivity issues in remote areas (the rangelands) are likely to be of a different character and magnitude. An examination of these areas was not feasible within the scope and timing of this report.




Source:Commonwealth Department of Agriculture: https://www.agriculture.gov.au/abares/aclump/land-use


# DISCOVERY

Australian Broadband Advisory Council

# QUESTION ONE

## Does a ‘connectivity threshold’ exist in regional and rural Australia where connectivity becomes an enabler of digital agriculture, rather than a drag on it?

# DISCOVERY QUESTION ONE

YES, there is a threshold. In the context of an individual farm, this threshold would be crossed when a farmer has:

- reliable connectivity across his or her paddocks sufficient to use connected machinery and sensors, which can vary from narrowband to broadband depending on how 'bandwidth intensive' the apps are
- reliable high speed, high quality (e.g. low latency) broadband at the house and office which allows the farmer to communicate with cloud-based apps that process and analyse the farm data and access banking and accounting services.

So far, the threshold has not been consistently or reliably crossed, and this is holding back the adoption of digital agriculture.

**CAUSE**

### Salt and Pepper Connectivity

Beneath the broad brush strokes of carrier and NBN fixed and wireless networks, there are localised connectivity gaps on, across and between farms.
We call this 'salt and pepper connectivity'.

**IMAPCTS**

Salt and pepper connectivity impacts the adoption of digital agriculture.
There are also wider economic and social impacts that exacerbate the drag on adoption of digital agriculture.

**EFFECTS**

Local communities are already trying to solve salt and pepper connectivity – their motivation and ability to mobilise around problem solving should be harnessed and enabled as part of the national approach The market is also solving salt and pepper connectivity by entry of innovative second tier providers, and this has significant policy implications for government programs, funding communications infrastructure, and existing regulatory service obligations that tend to be premised on connectivity solutions required of the carriers. These implications are addressed later in this report.

## CAUSE

### Salt and Pepper Connectivity

The carrier-based networks are essentially focused on connecting premises and road corridors. Beneath the broad brush strokes of connectivity provided by the national mobile carriers and NBN, there is considerable variability in connectivity, with localised patches of no or poor connectivity.

Connectivity required to support digital agriculture is often required across an entire farming operation, rather than just at the homestead. Therefore while significant gains have been made, there is an emerging problem of inconsistent, unreliable or 'thin' coverage which means that the connectivity threshold for digital agriculture has not been achieved across much of rural Australia.

The term 'salt (good connectivity) and pepper (poor connectivity)' resonates immediately with farmers and agtech providers who we have spoken with, and describes how one farm or section of a farm has good connectivity, but the neighbouring farm or another section of the farm does not. Both are within the same local area and most likely notionally served by the same NBN wireless tower or mobile tower.

We all experience salt and pepper connectivity driving along country roads when our call drops out – but we know that around the next bend we will come back into range again. Salt and pepper connectivity is an intermittent inconvenience in a car journey.

If a farm or part of a farm is in the coverage gap, however, it means that digital technology cannot work properly on that farm. If there is a lack of coverage at the homestead, the family is unable to undertake online schooling and work from home.

## CASE STUDY

### Mobile connectivity in Birchip

According to coverage maps, Birchip Victoria (VIC) has strong mobile coverage from Optus and Telstra. There was general acknowledgement from interviewees that connectivity in the region has improved over the last 2-3 years. For example, Optus announced in 2018 that it would spend $2 million to improve services in the Mallee. In 2020, Round 5 of the Mobile Black Spots Program included three new base stations in the Mallee.

However, beneath these broad brush strokes of connectivity, there is considerable variability in connectivity, with localised patches of no or poor connectivity (based on in-vehicle readings by Zetifi). Connectivity tends to be along transport corridors (i.e. not out in the paddock) and with small gaps ('pepper') along those corridors).


source: Telstra https://www.telstra.com.au/coverage-networks/our-coverage

source: Optus https://www.optus.com.au/about/network/coverage

Source: Provided by Zetifi

# DISCOVERY QUESTION ONE

## A placed-based problem

While this pattern of salt and pepper connectivity is common across the regions we visited, it manifests uniquely in each location due to geography and proximity to the local town.

Salt and pepper connectivity, in physical geography terms, is all about the local terrain of any one local community around or between small towns. The slightly hilly riparian landscape of Narrabri works the communications infrastructure very differently to the vast flat plains of the Victorian Mallee. The unique elements in any given landscape will alter signal strength, even down to the trees surrounding a farm house.

Salt and pepper connectivity, in human geography terms, is all about scale. Salt and pepper connectivity is experienced not at the national or state level or even local government area level, but at the local community level, with variability between neighbouring farms or even across an individual farm.

## Technology Agnostic

Salt and pepper connectivity is about the patchiness of existing connectivity – it isn't specific to any single technology or operator, but is more about the experiences of people in rural and regional Australia, where connectivity cannot be relied on from one area of the farm to the next. As such, the solution does not sit with any single technology or operator. However, many people we spoke to acknowledged that there continues to be a widespread view in rural and regional areas that connectivity is all about the coverage of mobile networks in general. As several people said to us, "many farmers think that if they cannot make a mobile phone call in their paddock, then they have no options for digital agriculture on their farm."

There is a dimension to salt and pepper connectivity which reflects gaps in knowledge in rural and regional communities about the technologies which are available to address their connectivity problems. This includes how different technologies can be combined together – such as on-farm Wi-Fi solutions in the paddocks coupled with a carrier-provided fixed or wireless solution serving the homestead or farm office.

A participant in the Wimmera South Mallee Regional Partnership's work on improving connectivity in the region said "initially we thought the problem and the solution was all about mobile coverage, but our experience on the ground has demonstrated that there are a range of technologies which are better suited to digital agriculture" (see Longerenong College case study below).

NBN Co summarised the following outcome for a series of roundtables it conducted with farmers in 2020[1]:

> *"Understanding connectivity, both availability and 'how to', and the various connection options available was a common discussion thread at both roundtables. Participants nominated this issue as a key barrier to adoption, particularly the need to improve the understanding of connectivity to the homestead versus the entire property. Ensuring primary producers better understood how to connect beyond the farm house, including the types of technology that can enable enhanced on-farm connectivity, would remove an identified adoption barrier."*

That said, salt and pepper connectivity is real, appears to be widespread and requires substantive market and policy responses if agriculture, and other aspects of economic and social life in regional and rural Australia, are to become 'digitally enabled'.

1 https://www.nbnco.com.au/content/dam/nbnco2/images/blog/nbn-future-of-farming-roundtables-report.pdf

## CASE STUDY
### Birchip Cropping Group

A study by the Birchip Cropping Group estimates that:

- poor mobile phone reception reduces farm profits by $2 per hectare
- poor internet coverage reduces farm profits by $3 per hectare
- combined, poor connectivity has the potential to reduce farm profitability by approximately $5 per hectare across the grain belt, equivalent to $15,000 per annum for the average (3000 hectare) Victorian grains property.

https://www.bcg.org.au/wp-content/uploads/2017/08/170804-Connectivity-report-fin.pdf

### NBN Satellite vs wireless and fixed coverage

NBN Co uses a combination of satellite, fixed broadband wireless and fixed line broadband (mainly fibre to the node incorporating utilising copper lines formerly owned by Telstra) services to supply broadband services in regional and rural areas, with a minimum download speed of 25 Mbit/s, and upload speeds of 5 Mbit/s. The recent BCARR working paper notes that:

> *"With the initial volume build of the NBN completed in 2020, Australia will be the only continent where every household and business has access to high-speed broadband services, with minimum peak wholesale download speeds of at least 25 megabits per second (Mbps). This gives businesses the opportunity to harness productivity benefits by reaching new markets, developing new products and services, and using new technologies that rely on broadband access (broadband-supported technologies)."*

In a country of Australia's vastness and low population densities outside cities and towns, satellite will continue to be a key part of a comprehensive connectivity solution. As we discuss below, the satellite sector is emerging as one of the most dynamic, if not disruptive, sectors in the communications industry, and Australia has valuable expertise and experience in the satellite sector, such as through the Space cooperative research centres based in Adelaide, SA.

The NBN satellite has delivered access to faster broadband for many people in rural Australia who previously had access to comparatively slower services over legacy technologies, such as extended Telstra copper lines. The Sky Muster services, with the mandated minimum speeds required of the NBN, are capable of meeting the needs of many rural customers. That said, there remain challenges around community perceptions about the reliability of the NBN Sky Muster service, although many we spoke to acknowledged that

there had been a continuing improvement in the service, including particularly during COVID-19.

The Australian Government's recently announced Regional Telecommunications Review will inquire into the adequacy of telecommunications services in regional, rural and remote parts of Australia, and will need to consider the role of satellite. Our focus instead is on NBN satellite as a platform for digital agriculture.

While satellite-based solutions have been deployed out in the field for some time, such as GPS steering for machinery, the main role of satellite is as the provider of connectivity between the farm house, office or work sheds and the Internet. A key challenge inherent to geo-stationary satellites is 'latency'. While this can be defined in different ways, latency is essentially the delay in a packet of data travelling from the customer's computer to the remote platform. In the case of a geostationary satellite, the packet has to make a round trip between the ground and the satellite located thousands of kilometres above the earth.

Many agri-tech applications are 'cloud-based', with the data collected on farm being uploaded, analysed and stored on a remote platform. Financial management programs are increasingly hosted remotely. Electronic bank transactions also involve real time access to the remote banking platform.

These cloud-based applications can be 'chatty', with a stream of messages backwards and forwards between the customer's computer and the platform to provide instructions, request confirmation, provide prompts to the customer and double check that messages received correspond with the messages sent. This stream of messages needs to happen in an quick, uninterrupted flow to make the cloud based app useable. For example, if the remote platform detects a delay, it can 'kick' the user out because it assumes that the delay is attributable to a breach in security. This requires the user to start all over again and re-enter the data.

# DISCOVERY QUESTION ONE

This was a commonly reported problem in use of the NBN entry level satellite service. NBN Co is aware of these challenges and has taken steps to resolve them. There is technology available which can ameliorate the latency and other service quality issues. NBN Co has developed and launched business grade satellite services which offer a higher grade of service which NBN Co says will make cloud based apps more useable for satellite customers, although those services are more costly than the entry grade product. NBN Co is also working with major cloud based providers to 'iron out' the design or configuration of apps to make them 'friendly' to satellite.

By contrast, our discussions with farmers within the NBN fixed wireless footprint confirmed that for the most part were able to run the farming and other businesses and home school from the farm house, including with the extra load during COVID-19 lockdowns.

In the regions we visited, there is a level of frustration and confusion about why some farms are connected by wireless while others 'just down the road' are served by satellite, sometimes when the NBN wireless tower can be seen on the horizon. The frustration around this issue is exacerbated by a keen awareness of the 14 kilometre rule. This means that even where part of a farm is within the 14 kilometre boundary (or close by), if the farm house is outside the boundary, NBN Co's standard connection policy means it will only connect using the homestead satellite service. While it might look like it to customers frustrated with their satellite service compared to the in-town wireless service, the 14 kilometre rule is not an arbitrary business rule applied by NBN Co, but is based on its assessment of optimal transmission distances and load factors for its wireless network. When deploying new networks, particularly of the scale and at the speed of the NBN rollout, carriers necessarily need to design their networks using standardised network models. However, at the customer level, the 14 kilometre rule has created the perception of a localised 'digital divide' between those who can get the wireless service, compared with those who can't.

Steps have been taken by NBN Co towards addressing the issues created by the 14 kilometre rule. As set out in the case study below, over time NBN Co has been more prepared to accept 'non-standard' connections which, in effect, 'stretch' the 14 kilometre rule for individual users who are prepared to invest in their own 'edge' communications infrastructure.

NBN Co also has created a $300 million regional co-investment fund, which it is using to co-invest with states, territories and local governments to deliver access to higher speed wholesale broadband services over the NBN to households and businesses in regional and remote areas of Australia. The fund is expected to assist in moving more regional areas from fixed wireless or satellite to a fixed line access technology.

## CASE STUDY

### DIY workarounds to stretch the NBN fixed wireless boundary

Being ingenuitive, farmers have worked out ways to stretch the 14 kilometre boundary.

In one example, a farmer put a shipping container with a mailbox on the part of their farm that is within the 14 kilometres line in which they installed equipment to retransmit the NBN signal to neighbouring farm houses.

NBN Co has come to allow 'non-standard connections', although it appears to be reluctant to proactively support more widespread adoption of this approach to stretch the boundaries of its fixed wireless network.

There could be regulatory implications, as farmers who invest in shared infrastructure to connect as a group to the NBN wireless service might be breaching the carrier licensing rules, although there is some flexibility when using class licensed spectrum.

## 'Farmers are learning how to bounce signals'

**Deanna, VIC**

Neil Lyon, Grain Central, https://www.graincentral.com/cropping/farmer-builds-own-on-farm-wireless-solution/

## IMPACTS

### Impacts on farmer adoption

Salt and pepper connectivity holds back the adoption of digital agriculture in four ways:

- by holding farming businesses back from operating basic online business and administrative functions (a form of commercial digital inequality)
- by disenabling the full and proper use of digital functionality that exists on equipment in which they have already invested
- by precluding farmers from new digital technologies that need reliable and ubiquitous connectivity (either broadband or narrowband)
- by making the workarounds time-consuming, expensive and 'clunky'.

### Impacts on agri-tech

Salt and pepper connectivity also detrimentally impacts agri-tech innovators and developers. Agri-tech providers have had to develop offline mirrors of their online services, to get around the connectivity constraints. These offline versions are needed so that a farmer can collect data from sensors or machinery in the paddock that doesn't have coverage on memory sticks or cards and then upload into the app back at the farm office.

> *"The lesson from our experience is that if you want to embrace digital agriculture – whether as a farmer or an agri-tech innovator – you cannot rely on the availability of carrier network coverage."*
>
> Emma Weston, AgriDigital

The need to use offline versions can undermine the value proposition of an agri-tech app for a farmer. The combination of using offline and online versions can be difficult for farmers to manage (with problems of data inconsistencies) and, most importantly, the farmer loses the benefit of real time management of machinery and resources through the app.

## CASE STUDY

### Cotton farmer in Narrabri

In the search of more water efficiency on his cotton farm outside Narrabri, Tony has invested $1.5 million in US-manufactured 'robot' lateral irrigators that which can operate at night.

The irrigators are equipped with onboard sensors connected via a mobile internet connection to servers in the US. If the irrigator encounters difficulties 'in paddock' which would result in water wastage, Tony can be sent an alarm on his mobile to wake him up and go out to the machine.

Tony's farm is located 15 kilometres from Narrabri (just outside NBN fixed wireless coverage) and 45 kilometres from a Telstra mobile tower, which is in direct line of sight of his farm – yet Tony has patchy coverage.

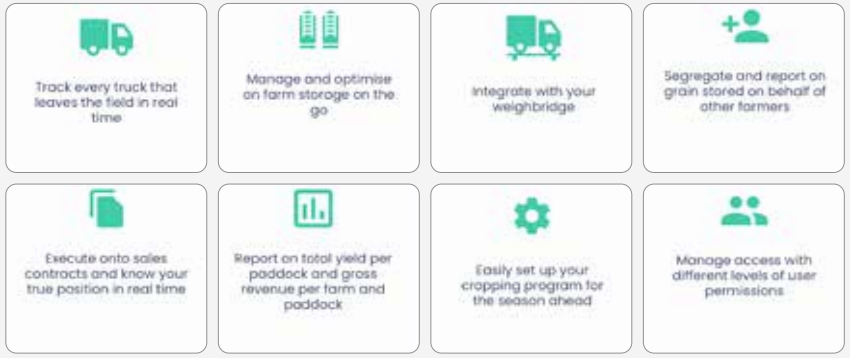
As a result, Tony cannot rely on the remote connected alarm system and has to manually check the machines during the night.

Tony estimates that the remote monitoring and control is effective for only 50% of the time or 50% of his property, with some shifting degree of unpredictability about where and when it works.


Valley Irrigation (US) https://www.valleyirrigation.com/

## CASE STUDY

### Agri-tech innovator who had to rebuild app three times




AgriDigital is digitising the grain supply chain, and is a world leader, supplying its platform to Australian, American and Canadian farmers.

**"We had to re-engineer three times to achieve the digitisation of basic analogue tasks and replacement of pen and paper in the paddock, because of network connection gaps, poor service and reliability issues – and the worst is that often farmers and other users think this is a problem in our product!"**

Emma Weston, CEO & Co-Founder, AgriDigital

**Mark 1:** Built an online-only version of its platform (farmers use mobile devices in the paddock) because real time data entry logically best optimises digitalisation of a supply chain. However farmers reported problems– features would work one day but not the next or not work at all – which AgriDigital found were connectivity-related.

**Mark 2**: Built a companion offline version that could be used in conjunction with the online version in areas where connectivity was poor. However, this solution proved unwieldy because farmers would not know whether the data had been uploaded already online or needed to be uploaded, and data synchronisation was unreliable and clumsy.

**Mark 3**: Went back to scratch and built an offline version as the primary platform – farmers have to periodically return to home base to upload data.

Cost – had to invest over $1 million in research and rectification costs and rolled out to market 6 months later than planned.

# DISCOVERY QUESTION ONE

## Economic impacts

Farm homesteads are often the location for more than just one business enterprise. Entrepreneurial rural people, often women, are seeking off-farm income through the establishment of new online businesses, from the farm. With the upturn in agriculture following the break of the drought, more young people who have left the farm to go to university are returning to country communities and bringing professional skillsets with them. The central importance of connectivity to enable these start-ups is the same from a farm location as it is from a city location, even if as simple as being able to run internet banking and online accounting (e.g. Xero).

Farm homesteads are also often the work place and home for employees. A number of farmers talked about the difficulties in attracting employees to work and live on the farm, as the lack of connectivity to stream video, game, and simply communicate online with the rest of the world can be a real disincentive.

This is a blind spot when network design for terrestrial wireless and fixed networks is based on 'density of households' or serving transport corridors. The wider beam of a satellite service can widen the scope of the 'economic potential' of connectivity, but as discussed above, there are also challenges, at least for some agri-tech apps, with satellite.

The economic potential of farms, beyond the farm business, is being impacted by connectivity problems. This impact flows on to the wider local community and if not addressed, will in turn impact the economic development of rural and remote regions.

The development of a digital services and skills ecosystem within a local community to support agri-tech on the surrounding farms will help support the use of digital services across other aspects of the community's economy and life, such as health and education, and promote the development of new businesses and employment in the community.

**A young couple have moved into the farmhouse down the road. He works as a nurse at the hospital in town, she is a registered psychologist. She wants to start an online practice from home but can't because there is no connectivity at the house.**

**Jess, 300 kilometres north of Adelaide, South Australia**

**What's the use of having ten large scale digital farms surrounding a town that has died? We need....in our town**

**Farmer, Birchip, Victoria**

# DISCOVERY QUESTION ONE

There is, of course, an important two-way relationship between connectivity and digital skills. The development of a vibrant digital ecosystem in a rural area will not occur unless and until the connectivity threshold has been crossed in that local community (i.e. until salt and pepper connectivity has been resolved). But equally, a 'build it and they will come' approach to putting in place the connectivity without a plan to nurture the development of the digital skills to exploit that connectivity is also likely to fail, or at least lead to a slower digital transformation that is needed to meet the national objectives for Australia's agriculture industries.

## Impact on women

Many farming businesses are family run, with one partner (quite often the wife) being responsible for the administration of the business. We have heard stories of women having to drive to the local town to get enough connectivity to do the banking, pay wages and bills.

Many farming women in the past earned off-farm income as teachers, nurses and allied health service providers. These professions are increasingly being delivered remotely, online.

## Social impacts

The social impacts of salt and pepper connectivity were heightened dramatically during the COVID-19 shut downs. We spoke with a number of farmers whose children were simply unable to receive schooling because the farm house connectivity was insufficient for them to conduct online schooling.

**During COVID, the kids 'schooling' was out in the paddock with me because it was impossible to get online for school. We realised during COVID just how far behind (in terms of connectivity) we are.**

**Tony, Narrabri, NSW**

**My wife waits until she is taking the kids to the pool so she can use the Wi-Fi in town to pay the wages and do the banking.**

**Andrew, Narrabri NSW**

Source: https://www.facebook.com/ladiesonthelandUNFS/

## EFFECTS

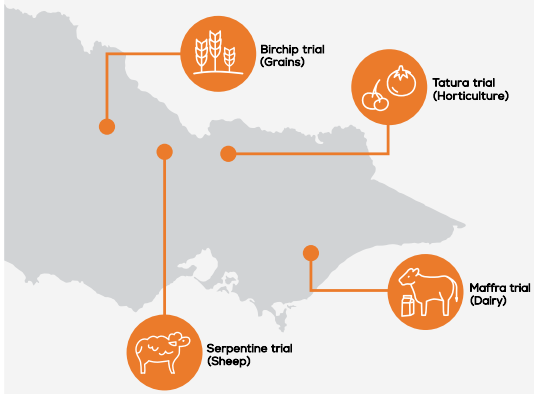
### High rural community engagement

Rural communities have responded to, adapted and sought to fix their connectivity problems, including practical and pragmatic problem solving at farm and community level (e.g. 'bouncing signals around'); pilot studies by farming system groups to work out solutions, e.g. BCG; and engagement in programs by states, territories and the Australian Government, such as:

- Australian Government Regional Connectivity Program
- NSW Regional Digital Connectivity Program
- NSW Connecting Country Communities fund
- Northern Territory (NT) 'Terabit Territory' Initiative
- Queensland (QLD) – Toowoomba Pulse Data Centre
- QLD Rural & Industry Development Authority grants
- Department of Primary Industries and Regions (South Australia) Agtech Demonstration Farms
- VIC Government – Gigabit State program
- VIC Government – Connecting Regional Communities Program
- VIC Government – IoT on Farms program
- WA Government – IoT DecisionAg Grant Program
- WA Govt Grainbelt Digital Enhancement Project
- Meat and Livestock Australia/National Narrowband Network Co (NNNCO) Agtech IoT Trial.

## CASE STUDIES

### Victorian IoT on Farms trial




The Victorian Government is currently conducting an IoT trial project on farms. The Government recognised that 'access to reliable network coverage is a key barrier to farmers adopting digital technology on-farm.' The program includes funding for the delivery of IoT network connectivity for the On-Farm IoT Trial.

The Government engaged NNNCo to roll out LoRaWAN (long range wide area network) across the four trial regions to support the deployment of IoT apps and devices on farms taking part in the trial. Participants in the IoT trial still need carrier provided connectivity at the farm house or office to connect to the LoRaWAN and to be able to use and process the IoT data, and this continues to be a problem.

Victorian Government https://business.vic.gov.au/grants-and-programs/victorias-on-farm-internet-of-things-trial

### Community Activism and Advocacy

Farmers are educating themselves about connectivity technology and infrastructure, and then activating to solve their local connectivity problems. Country people are often highly aware of their local connectivity infrastructure:

- most people we met could tell us where their local mobile or NBN wireless towers are; how many kilometres from the tower their farm is; the hills between them and the tower; and if they fall short of the NBN wireless footprint, how far they are into the satellite footprint
- when farmers install DIY solutions, like Yagi antennas to pick up and boost weak mobile signals, they have researched the exact angle at which the Yagi has to be slanted to align with the base station, and they know when the carrier has 'retuned' the base station and the adjustments they need to make
- increasingly they know the location of fibre running along railways, highways and pipelines in their local areas which, to their frustration, have no local connection or breakout points which would give the community access to high speed broadband or backhaul to support wireless infrastructure.

Advocacy groups including Better Internet for Rural, Regional and Remote Australia (BIRRR) established in 2014, and the Regional, Rural and Remote Communications Coalition (RRRCC) established in 2017, and the Australian Communication Consumer Action Network (ACCAN) are now important advocates for improving connectivity in rural and regional areas.

Their advocacy has led to Australian government funding for the Regional Tech Hub, a phone and internet help desk for rural Australians, which is being delivered in partnership by the NFF and ACCAN.

Some small communities who are more politically active and savvy about attracting public funding have achieved success resulting in significant upgrades to their local connectivity infrastructure. While this has led to valuable improvements in connectivity in certain rural areas, it also more difficult for Government to achieve a more consistent, planned approach across rural Australia. There is a place for making available more support, advice and resources to local communities to help them identify their connectivity needs and to shape proposals for grant applications to Government. We have seen consistently that local communities in rural areas have the motivation and drive to self-organise, advocate and activate in order to solve salt and pepper connectivity. Putting local communities at the heart of any policy solution and finding ways to inform and upskill them in determining what works best in their local terrain, and for their local economic development will be fundamental to achieving true place-based solutions.

## CASE STUDY
### Regional Tech Hub

The 2018 Regional Telecommunications Review found that there was a significant market for a simple platform aimed towards regional Australians to help them navigate digital technologies. The Regional Tech Hub has been established in response to the Regional Telecommunications Review's findings and is funded through the Australian Government's Stronger Regional Digital Connectivity funding package.

The National Farmers Federation was selected to develop and operate the Regional Tech Hub, working in collaboration with ACCAN, which hosts and runs the service.

Launched on 8 December 2020, the Regional Tech Hub establishes Connectivity Reports for people that provide advice on the best connection options available to them. This may involve advice on how to maximise carrier plans for connectivity or where there is no or poor connectivity, options to obtain connection.

The response from the market so far has been very positive. The Regional Tech Hub only launched in December 2020, and spent the first few months focussing on a backlog of connectivity report requests. Proactive advertising to raise awareness commenced in the second quarter of 2021.

Services such as the one provided by the Regional Tech Hub are an important component in ensuring that farmers can at least make the best use of what connectivity they currently have available to them, even if it won't always solve salt and pepper connectivity.

Australian Broadband Advisory Council

# QUESTION TWO

## If the threshold has not been crossed, what connectivity is required for digital agriculture?

# DISCOVERY QUESTION TWO

If the problem is salt and pepper connectivity, then the ultimate goal has to be, as the BCARR describes it, 'ubiquitous connectivity', or as NBN Co has put it, 'no paddock being left behind'. We have identified three key themes:


**DEMAND**

## Understanding the demand side

Articulating more specific use case scenarios on farms, and better matching the connectivity requirements of those use cases with a mix of connectivity technology options.

**SUPPLY**

## Matching the technology on the supply side

Matching the application to the right communications/connectivity technology
Realising that farmers have a range of connectivity options beyond voice, and that Voice ≠ Data.

**MULTI-TIERED MARKET**

## Multi-tiered market solutions

Salt and pepper connectivity will be solved through a broad mix of solutions. In addition to carriers building out with new technologies such as Category M1 (Cat M1) and 5G, we have seen a range of new approaches emerging in the market:

- farmers installing bespoke 'DIY' solutions
- a second tier of communication and technology providers entering the retail market
- new private fibre backbone infrastructure being built through regional areas.

## DEMAND

### Understanding the demand side

Connectivity requirements can vary across different settings on a farm. The priorities are:

- **in the farm house**
  (e.g. paying the bills, schooling children, running the online farm and/or a second online business enterprise)
- **in the farm yard** (e.g. security cameras on fuel tanks, sheds etc)
- **in and across paddocks** (e.g. soil moisture sensors, tank and trough monitors)
- **'on-the-move'** within paddocks, within farms and between farms and the nearby towns (e.g., farm vehicles, trucks to deliver supplies and collect animals, and robotic and autonomous machinery).

The connectivity option that is suitable for a particular application will depend on its bandwidth and performance requirements. There are three categories: narrowband intermittent, narrowband always-on, and broadband always-on.

### Narrowband intermittent

Only transmit small packets of data and only need to do so periodically, such as once a day.

**Used for:** Many sensor-type applications, such as soil moisture probes or water tank sensors

These agri-tech applications can be supported by narrowband wireless connectivity which does not need to be 'always on'.

The transmitter can 'wake up' to send the message, saving battery power, to a fixed wireless or mobile network receiver or when a low earth orbit satellite passes overhead.

**Latency:** It also will not be overly impactful on the digital app if, due to variable service quality, a particular packet of data is lost or delayed in transmission.

### Narrowband always-on

**Used for:** Where agri-tech app may not tolerate packet loss due to poor or slow service: for example:

- electronic weighing machine needs to be able to reliably transmit the full data for every animal that cross over the machine
- where an instruction needs to be sent to a pump to turn it off when the legally mandated maximum permitted water volume has been drawn from a river.

**Latency:** These agri-tech apps require 'always-on' connectivity which is highly reliable (i.e. has low latency and packet loss).

### Broadband, real-time

- **Used for:** Agri-tech applications that are data intensive, such as a video-based weed identification unit that needs to connect to the cloud or a video-enabled header in a harvester which a farmer can view and control remotely. These agri-tech apps require high speed broadband connectivity equivalent to the connectivity needed for video streaming services in the home.

**Latency:** Require low latency

## CASE STUDY

### Mixed farm and Precision Agriculture businesses, Upper North SA

Jess and Joe run 1800 hectares of cropping and 1200 self-replacing merinos at Booleroo Centre (280 kilometres from Adelaide) and Georgetown (175 kilometres from Adelaide). Using data and technology to improve efficiency is at the core of management decisions in their business. Joe has extensive knowledge of TopCon as a Beta tester and Jess worked with John Deere hardware and software for six years before starting Breezy Hill Precision Ag Services. Joe is also the local drone expert, and they have installed soil moisture probes and digital weather stations on the farm. Jess is a past President of the Society of Precision Agriculture Australia (SPAA). Jess and Joe are highly sophisticated adopters of digital agriculture, and industry leaders.

The business headquarters is at Breezy Hill Farm at the base of Mount Robert, 16 kilometres from Booleroo with line of sight to the Booleroo silo. Jess can see the local NBN wireless tower from her veranda, but Breezy Hill is outside the 14 kilometre boundary and is designated 'satellite'. The satellite provides inadequate service. Jess has looked at upgrading to Skymuster Plus, but says 'I'm not prepared to pay more per month to go from 65GB to 25GB...I am certain 25GB would not be sufficient to run house and business.'


Jess and Joe rely on Telstra 4G for connectivity. Jess runs the Precision Ag business on the mobile hotspot. This is highly frustrating and their plans for digital applications are being held back. Their priorities includes:

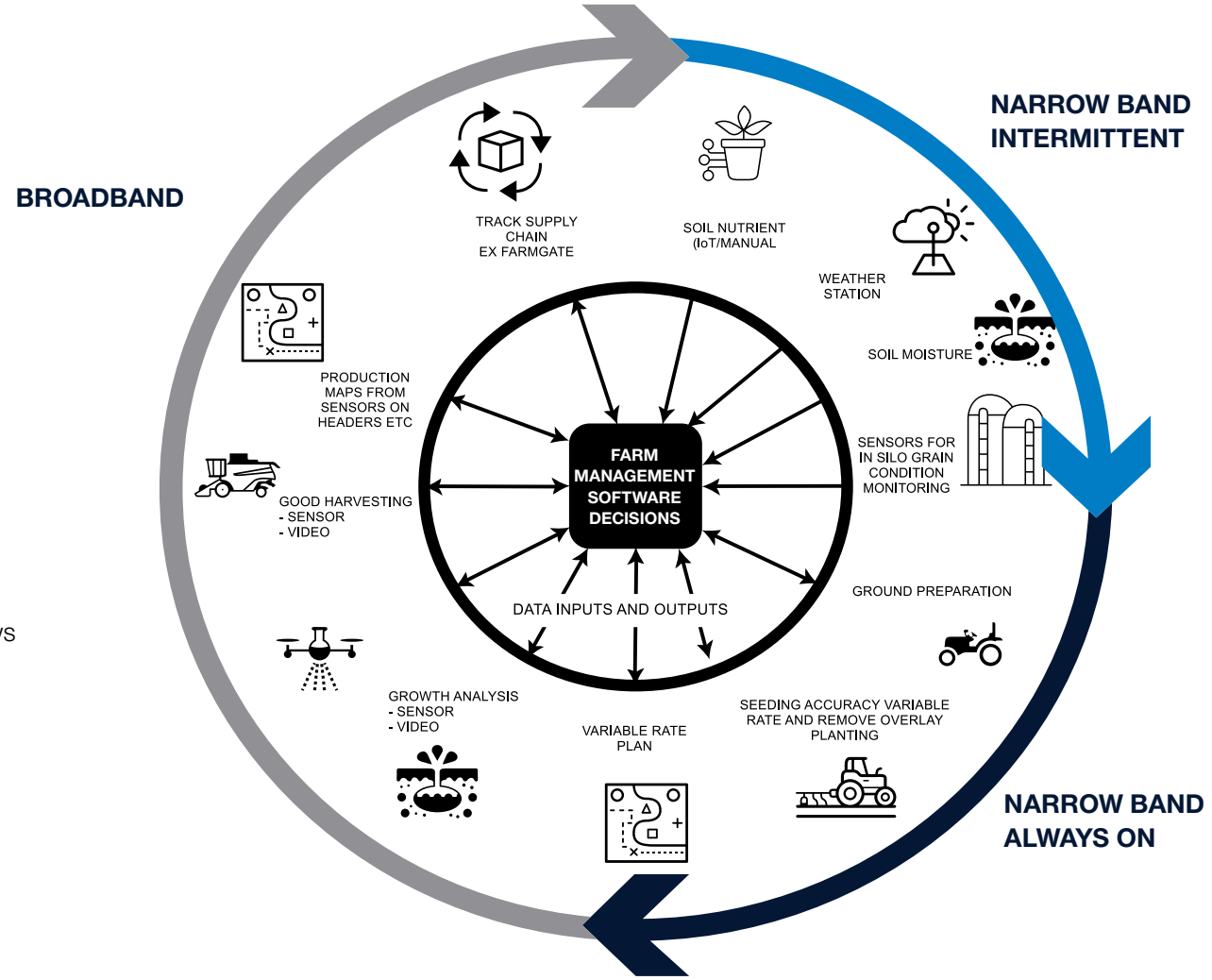
- decent Wi-Fi in the house to run the business, and provide video streaming for the family
- Wi-Fi extended to the farm yard, for a digital livestock weigh station
- interactive paddock based sensors across the paddock that will need 'always on' connectivity.

They have installed a LoraWAN gateway on Mt Robert as a community experiment to provide in-paddock connectivity in place of more expensive 3G/4G. Jess and Joe are prepared to co-invest in or pay for a wireless repeater to get NBN wireless to the farm, and has 12–13 other households lined up behind her. Fix this for Jess, you fix it for multiple other farms, identified by the yellow markers on the map.

## MATCHING THE TECHNOLOGY ON THE SUPPLY SIDE

### Matching the connectivity mix with the use case requirements

The diagram shows how these three categories of connectivity will come together across a farm business and ultimately provide all of the data inputs for digital farm management decision support. This diagram shows clearly how the three types of connectivity are essential across the range of on-farm use cases to enable true digital agriculture.




Source: Developed in collaboration with Connected Farms, with permission

# DISCOVERY QUESTION TWO

The table below shows that there is likely to be a mix or 'menu' of potential connectivity solutions, which will vary in composition and relative utility, reliability and cost between farms. While carrier fixed and mobile broadband networks can 'do everything', they are over-engineered for many agri-tech applications.

| TECHNOLOGY | PROVIDERS | NARROWBAND INTERMITTENT | NARROWBAND ALWAYS ON | BROADBAND |
|---|---|---|---|---|
| LoRaWAN | Meshed | YES | YES | NO |
| CAT M1 | Telstra[1]<br>Optus[2]<br>Vodafone[3] | YES | YES | NO |
| Low powered radio controllers operating in 'white space' (e.g. 900Mhz) | | YES | YES | NO |
| Fixed wireless using class licenced /white space spectrum | Zetifi<br>WiSky | YES | YES | YES |
| Fixed wireless using licensed spectrum | NBN | YES | YES | YES |
| 3G/4G/5G | Telstra<br>Optus | YES | YES | YES |
| Geo-stationary satellite (e.g. nbn co) | NBN<br>Other providers (e.g. Telstra) reselling other global satellite services (e.g. Iridium) | Battery power problems – higher orbit can require more powerful transmitter in ground devices | Latency problems | Latency problems |
| Low earth orbit satellites (LEOs) | Myriota<br>Fleet | YES | NO | NO |
| | Starlink | YES<br>(maybe costly solution) | YES<br>(maybe costly solution) | YES |

# DISCOVERY QUESTION TWO

## Getting the right mix of connectivity

**Voice ≠ Data**
**Agri-tech in the paddock ≠ mobile coverage**

While a farmer may be able to rely on narrowband, non-real-time solutions out in the paddock to collect and transmit data, they will still need access to high quality, reliable broadband services back at home or the office to receive and process the data.

A major farm equipment supplier commented that their farm machinery was designed to cope with salt and pepper connectivity by storing data on-board until the machine reconnected with the network, and that the main problem encountered by their users was poor connectivity to their mobiles to receive and view the data when out in their paddocks.

Any particular geospatial area (e.g. a paddock, a farm, a region), has a 'connectivity potential'. The more options for connectivity, the better the connectivity potential of the area is, and this will determine the types of digital services and applications that can apply to that area. Ideally, an area must have broad and narrowband connectivity options; however, these options must be matched to and fit for the purpose of what people want to achieve in that area.

It is possible, however, to mismatch the application with connectivity, which leads to over-engineered solutions, wasted money, and/or supressed demand. If farmers know what connectivity options are available across their farms, and what these connectivity options enable in terms of applications, they will be able to make more informed decisions about what agri-tech is possible for them and to cross the connectivity threshold for their farming business.

But there is also a risk in assessing connectivity requirements for agri-tech based on a 'snap shot' of current agri-tech applications. Future agri-tech applications are likely to be more data intensive and require bandwidths in the paddock. While narrowband connectivity suits applications which collect and send data, applications which involve remote control will more likely use video-based capabilities, such as video sensors of weeds and pests, running on autonomous vehicles, activating highly targeted amelioration; referred to as 'on-the-go' sensing and management. Over time, 'leaving no paddock behind' will require broadband.

## CASE STUDY

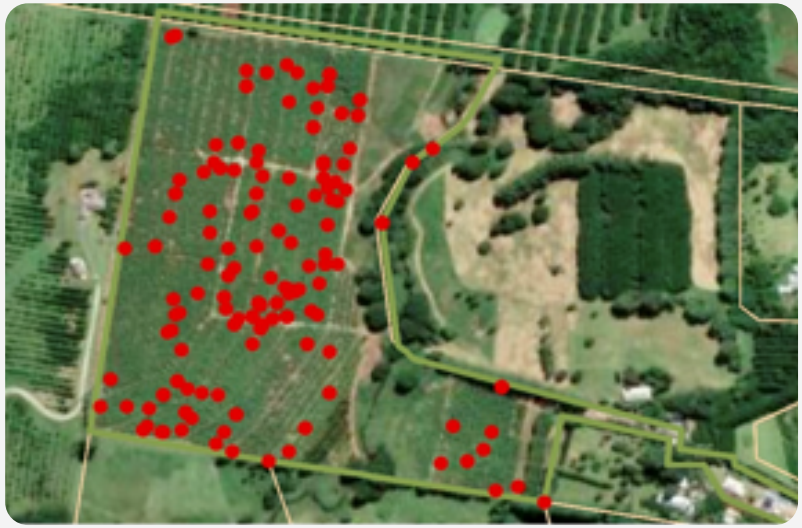
### Bunchy top disease in bananas

Banana bunchy top disease is caused by the banana bunchy top virus (BBTV). Banana leaves infected with BBTV have dark green streaks along the small veins on the underside of the leaf. The streaks consist of dots and dashes in a Morse code pattern which form J-shaped hooks where they join the midrib. Banana plants infected with BBTV rarely produce fruit. If fruit is produced it is small, deformed and unmarketable. Banana bunchy top virus is transmitted from plant to plant by the banana aphid (Pentalonia nigronervosa).

In its early stages, the symptoms are difficult to see to the untrained eye. Detection of bunchy top requires close inspection of banana plants in the field by an expert. It can be a slow and laborious process to identify individual inflected plants in a plantation. Early attempts to identify bunchy top by drone were unsuccessful.

The Australian Banana Growers' Council has developed digital tools to facilitate the inspection of plantations and a management strategy based on the extent of infection in plantations. Inspectors have a handheld device with GPS capability which enables them to accurately identify the location of an infected plant in a plantation and to digitally record data about the plant and the state of the infection.[1] The early generation Personal Digital Assistants will be replaced with a mobile phone app with mobile broadband connectivity which will allow real time uploading and downloading of data by the inspectors, including photos of the progress of the disease on each plant.

The information gathered by the inspectors allows an 'infection' map to be produced for each plantation, such as below. Plantations are ranked by the extent of bunchy top infection and then escalating control and quarantine measures are applied.



1 http://abgc.org.au/wp-content/uploads/2013/01/2m-project-continues-Bunchy-Top-fight.pdf

## MULTI-TIERED MARKET SOLUTIONS

Tier one carriers will continue to provide the mainstay of connectivity with national scale business models.

Governments have traditionally used a 'push-pull' approach to extend the coverage and quality of carrier networks in regional and rural areas, with mandatory service obligations (the 'push') such as

- the universal service guarantee that applies to Telstra
- NBN Co's Statement of Expectations, issued by shareholder ministers, which frames NBN Co's strategic direction

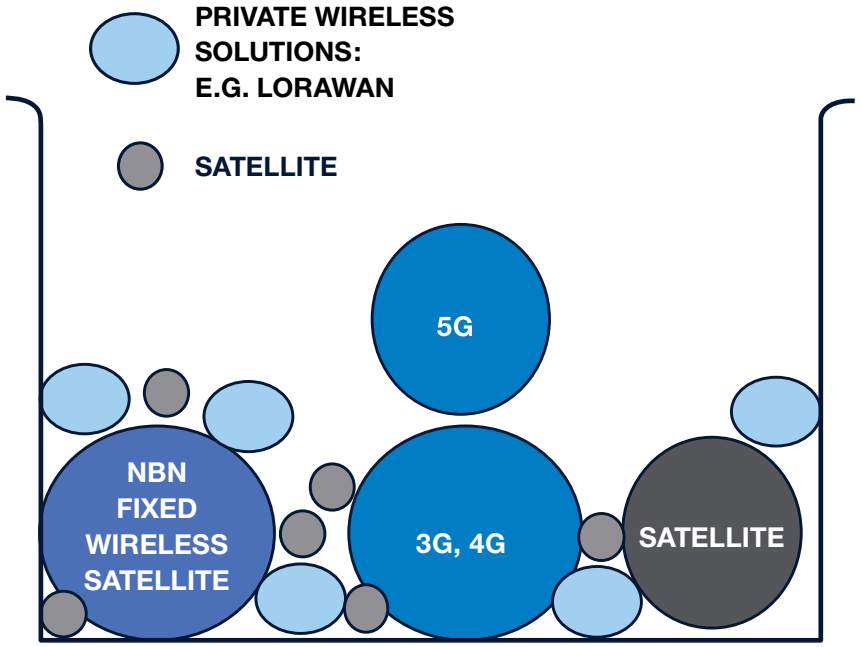
Government co-funding with carriers (the 'pull'), such as the Australian Government Mobile Black Spots Program.

While it is reasonable to expect that carriers should be continually looking for ways and opportunities to extend and deepen coverage, it is overly simplistic to both characterise 'salt and pepper' as failure in their network rollout and coverage, and to look to them alone to fix it.

Salt and pepper connectivity will be solved through a broader mix of solutions. In addition to carriers building out with new technologies such as Category M1 (Cat M1/NBIoT) and 5G, we have seen a range of new approaches emerging in the market:

- many farmers are installing bespoke DIY solutions, but these are expensive ($20-50,000 and require ongoing communication skills) to maintain and operate (which are in short supply)
- critically, there is a second tier of communication and technology providers entering the retail market to fill in the salt and pepper connectivity
- adding to this is a number of companies who are building new fibre backbone infrastructure through regional areas: e.g. Vocus and HyperOne.

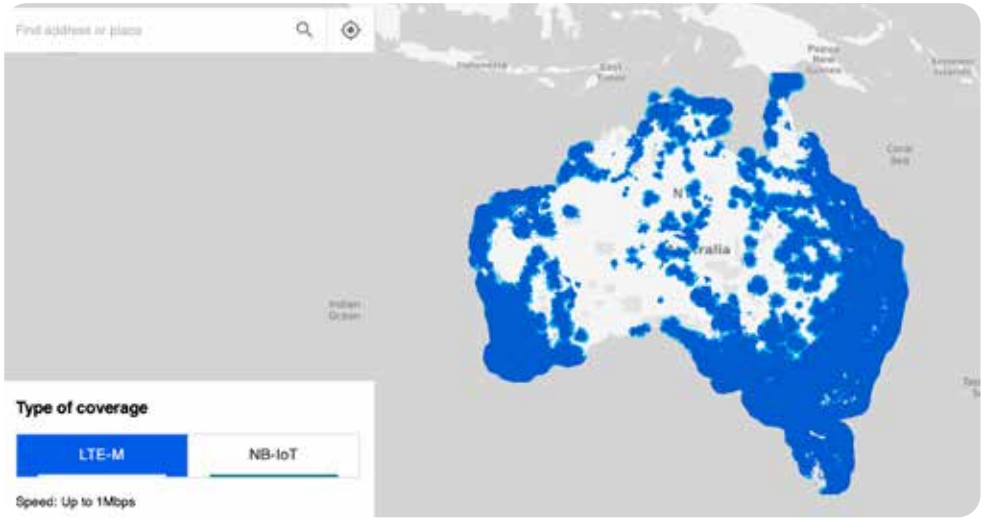
Given that market innovation is beginning to occur, the issue is how existing government policy frameworks could be reframed to better promote these market developments.

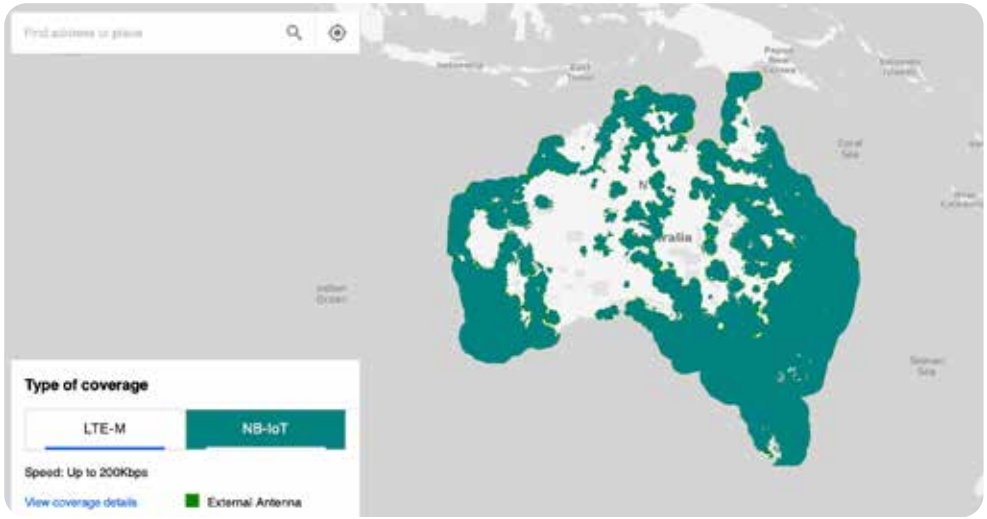


## CASE STUDY
### Telstra IoT Network

Telstra has deployed as part of its 3G/4G mobile network, two data connectivity services suited to IoT applications, Cat-M1 and NB-IoT. Cat-M1 is more for devices that are on the move that need hundreds of kilobits per second, whereas the NB-IoT are very small packets of information, such as from fixed sensors.

While transmitting from the same base station as the mobile voice and broadband service, the Cat-M1 and NB-IoT services have a substantially larger narrowband coverage area (up to twice the coverage of a handheld mobile phone in the same cell area). While the Telstra 3G/4G network covers approximately 2.5 million square kilometres, the Cat-M1 coverage is 3 million square kilometres and the NB-IoT is 4 million square kilometres.




Telstra https://www.telstra.com.au/coverage-networks/our-coverage

# DISCOVERY QUESTION TWO

### Carrier 5G

The mobile carriers are deploying 5G. The mobile operators' 5G rollouts include deployment in rural and regional Australia, although with coverage differences likely. 5G will support agri-tech applications that require broadband (such as high resolution video based automated weeding machines) and substantially larger number of IoT narrowband devices per kilometre – 4G can support thousands per square km, while 5G can support up to a million per square kilometre.

However, there are significant uncertainties around 5G deployment in rural communities:

- will 5G coverage be as extensive as the current 3G/4G coverage, or will coverage 'shrink'?
- will mobile network coverage continue to push outwards, or have the mobile networks reached their outer limits and if so, how will currently underserved areas be addressed?
- will the same salt and pepper problems arise with 5G as with 3G/4G and could they be worse given the different characteristics of 5G?

While the overall 5G deployment plans of each mobile carrier are yet to emerge (and in a competitive market are likely to be treated as confidential), 5G coverage (or combined 4G and 5G coverage) will not necessarily be less in terms of geographic reach or 'depth' than the current 3G coverage.

The 5G standard can be deployed using a mix of different radio frequencies. Broadly described as low, mid, and high band 5G, each has a different combination of range and depth or speed. Low band can deliver good speeds over longer distances, and is well suited for deployments in rural areas over not dissimilar sized cell site coverage areas to 3G and 4G. High band delivers ultra-fast speeds at the shortest distances, and mid band is in the middle on both speeds and distances. The Australian mobile carriers are currently deploying 5G in low bands, as well as planning deployments using higher bandwidths.

### Private 5G networks

The global 5G standards are being developed to support 'private 5G for enterprises' known as 3GPP Release 16. These standards aim to enable 5G to substitute for private wired Ethernet and Wi-Fi networks. Unlike a public 5G network, a private 5G network can be configured to a location's specific needs, such as an individual farm. While currently higher cost than Wi-Fi networks, private 5G network will provide high speed, secure and reliable connectivity capable of supporting more data intensive agri-tech applications out in the paddock. Private 5G networks can be deployed using class licensed spectrum. The availability of 5G private networks as a potential solution to 'salt and pepper' connectivity will be driven in large part by decisions about the spectrum which will be made available for them.

Australian service providers such as Connected Farms are already considering private 5G deployments as solutions to connectivity challenges on farms.

### DIY and bespoke solutions

The challenge of salt and pepper connectivity has led to 'grass roots' innovation within farming communities. This activity occurs at individual, group and community level. Larger farming operations that are actively pursuing the benefits of digital agriculture are no longer relying on carrier networks to provide connectivity and are investing large amounts in bespoke solutions which have a number of drawbacks, including:

- the capital and running costs of the equipment –e.g. a LoRaWAN system to cover farms of 1000 hectares can cost $20-50,000

- the need for technical and operating support. One university digital farm operator with a LoRaWAN covering 2000 hectares were surprised by the amount of time required to maintain the network – up to 2 person days per week. This included replacing cables damaged by birds and animals and regular replacement of batteries in sensors (which can quickly run down if the sensor is in a poorer coverage area and needs to keep retrying to transmit data until it gets through). This assistance needs to be on-farm or close at hand
- bespoke solutions do not add to the 'pool' of connectivity available for access by the community.

### Tier two retail providers

Grassroots innovation has paved the way for the scaling of some of the solutions to commercial level. We have found a cohort of SMEs across the country who are deploying connectivity solutions at a fraction of the cost of the main carriers. Sometimes these small networks operate as substitutes for the carrier networks, and in other situations they serve to extend the range of the carrier networks.

Some of these SMEs are community-driven initiatives that have been supported by states and territories, as well as other programs to address rural connectivity issues, such as:

- Pivotal Satellite/Stirling to Coast collaboration (funded by WA Govt)
- Birchip Cropping Group/Zetifi Pilot.

## CASE STUDY
### Howe Farms

Howe Farming Group is a second generation family owned company based on the Atherton Tablelands in North QLD, growing a range of horticultural products, including avocados, coffee, bananas and sugar cane. Howe has 12 farms located on the Atherton Tablelands, relying on irrigation with a network of connected water meters and controllers across their farms.

While the mobile carrier coverage maps shows good coverage on the Atherton Tablelands, Howe experiences patchy coverage across most of the farms.

Howe has installed its own radio communications network consisting of point-to-point links between the 12 farms to backhaul data from the water sensors and controllers from each farm to a central office. On each farm, they have installed a LoRaWAN system to support the infield sensors and controllers.

The total investment in this network now nudges $400,000. Howe has built and operates the system itself and also has to build much of the infield transmitting/receiving and controlling equipment itself. They have had to build up much of the technical expertise on a 'trial and error' basis over the years.

Their DIY solution has reached its capacity limits and installing more in-field sensors and more sophisticated agtech apps to go to the next stage of digital agriculture will require higher bandwidth services. The challenge they face is how to integrate their existing investment in infrastructure with a carrier solution.

Source: https://www.howefarms.com

## CASE STUDY
### Wi-sky

Wi-sky is a broadband provider building its own wireless local networks, using class licensed radiocommunications spectrum. Wi-sky was started by entrepreneurial farmer Jock Graham, following his 2015 Nuffield Scholarship during which he studied communication technology for rural Australia.

Wi-Sky towers typically support 5 to 40 customers under a co-funding model with those customers. Sites are solar powered and backhaul is via microwave links to other towers 'daisy chaining' them together which draw from a fibre connection point.

Wi-sky Infrastructure can be deployed for 2 per cent or less than the costs of carrier fixed or mobile wireless infrastructure.

Wi-sky identifies the lack of access to low cost fibre backhaul as one of the biggest challenges but the introduction of NBN Enterprise Ethernet services is helping overcome this challenge.

Others are commercial start-ups or RSPs who have pivoted into providing telecommunications infrastructure. These include:

- Zetifi (based in Wagga Wagga) – using the mobile networks as backhaul by boosting weak mobile signals to connect their wireless cells
- QCN Fibre(based in Brisbane) – connecting existing fibre through NBN Points of Interconnect from Goondiwindi to Cairns
- Connected Farms – which has a carrier licence and uses a range of on-farm and local area wireless solutions to provide connectivity.

Access to high speed backhaul is essential for these second tier providers to offer high speed connections. Some of them use a combination of fixed wireless and fibre backhaul or short 'hop' point to point radio links to fibre backhaul (e.g. WI-SKY and Connected Farms).

### Tier Two Carriers and Private Infrastructure Providers

In addition to new RSPs, a number of private wholesale providers have entered the market. These operators are forging a range of partnerships, both public and private, that will provide competition for fibre backhaul, Points of Interconnect for the RSPs in entering local markets, and provision for earth base stations for emerging satellite communications technologies.

Vocus has partnered with a number of governments to build fibre infrastructure in regional and rural Australia. For example, it has built open network fibre backbone with co-funding from the Australian Government in rural QLD, VIC and South Australia. It has also partnered with the Northern Territory Government in the Terabit Territory Project to build high speed backbone within the Territory and connecting the Territory to the rest of Australia and Asia[4]. Vocus has also partnered with Australian space start-up Quasar Satellite technologies and will provide 'ground-station-as-a-service' from its regional fibre network, in supporting the new Quasar technology through a range of LEO constellations,



including Australian start-ups Saber Astronautics, Fleet Space Technologies and Clearbox Systems.[5]

HyperOne plans a 20,000km fibre network capable of carrying over 10,000 terabits a second. The Hyperone network will include "off ramps" in regional and rural Australia. Bevan Slattery, the founder of HyperOne, has said:

> *"[The existing national transmission networks]...didn't address the digital divide in remote and regional Australia. That's why we are adding more than 1000 "on-ramps" in regional and remote Australia enabling underserved communities and remote areas a cost-effective way to access HyperOne...."*

Hyperone says its network will "unlock significant opportunities for investment in regional and remote communities that have historically lacked access to world class digital infrastructure."[6]

1 https://www.telstra.com.au/business-enterprise/about-enterprise/our-network/iot-coverage-map
2 https://www.optus.com.au/enterprise/accelerate/technology/how-narrowband-iot-can-help-your-business
3 https://www.computerworld.com/article/3479828/vodafone-turns-on-nb-iot-and-cat-m1-lte-m.html
4 https://www.vocus.com.au/news/vocus-to-deliver-20-terabit-internet-to-northern-territory
5 https://www.vocus.com.au/news/space-startup-quasar-takes-off-to-solve-satellite-data-challenge
6 https://hyper.one/

## CASE STUDY
### Zetifi

Zetifi uses a combined mobile Wi-Fi solution. The Zetifi wireless facility has a booster which can connect to a mobile network even though the signal is very weak (e.g. one bar) and transmits a WIFI signal, which the customer's device connects to (and then on to the mobile network). Zetifi offers its mobile/Wi-Fi in several solutions:

- a standalone tower: a prefabricated mast, cage, transmitting equipment, and solar power. The coverage, depending on local conditions, can be 2 kilometres. The facility can either provide an always-on signal (which consumes more power) or it can be a 'sleeper' facility which 'wakes up' when it detects a signal from a capable handset
- a vehicle-based solution: this equipment can sit on the rooftop of a vehicle or in the back of a vehicle if a larger more powerful unit is needed. The unit can have separate antennas to connect to more than one more network to provide alternatives to variable mobile coverage. The Wi-Fi signal allows in vehicle use while moving or can throw a signal around a stationary vehicle of 100ms or more. If the vehicle comes into range of a fixed Zetifi facility and the mobile network signal is weakening, the in-vehicle unit will hand over from the mobile network to the fixed Wi-Fi tower, and this can be done without the call dropping out.

Zetifi has essentially commercialised a DIY solution by:

- prefabricating the infrastructure: the fixed wireless facility is prefabricated, can be dropped off the back of a ute in a paddock, and made operational in an hour or so
- individuals can 'roam' on Zetifi facilities which others have installed through a registration and subscription model. For example, if a farmer has equipped his or her vehicle with a mobile unit, they are able to use any Zetifi fixed wireless facility which other farmers have installed in their farms as they drive past.

## OTHER MARKET INNOVATION

### New communication technologies and devices

In addition to innovation in carrier solutions, we are also seeing innovation in how connectivity is vertically integrated in devices and applications. There are a number of 'comm-tech' start-ups that are innovating around new communications technologies that will provide a new layer of connectivity into the mix.

### Satellite

Satellite communication technologies will be critical in filling the gaps in remote areas and rangeland pastoral and agricultural operations. Satellite services to date have been mainly delivered by means of geo-stationary satellites, such as NBN Sky Muster. As they are situated so far above the earth, these satellite solutions have some inherent challenges, such as latency and the ground equipment required to transmit and receive.

While technological improvements have mitigated some of these drawbacks, the next satellite revolution appears to be Low Earth Orbit Satellite (LEOs) constellations are now filling the skies. LEOs are situated much closer to the ground, allowing for improved service quality, including latency. As LEOs circle the earth rather than being parked in a geo-stationary orbit, the ground signal needs to be handed over seamlessly between LEOs as they pass overhead – hence the need for large constellations of satellites numbering the hundreds, if not thousands or tens of thousands in each fleet. There is a high level of anticipation around the market entry of Elon Musk's Starlink service, and some hope that Starlink can solve some of the salt and pepper connectivity issues across farms, but they are unlikely to provide a connectivity solution on their own.

Source: https://www.nbnco.com.au/corporate-information/media-centre/image-gallery/satellite-ground-stations

LEOs, as they are circling the earth at much lower orbits than geostationary satellites, can have fewer problems with latency and may be better able to support access to cloud based services from the home or office. Out in the paddock, LEOs may be able to support machinery that depends on a broadband connection, such as video-based sensing. However, as the cost of individual connections to Starlink could be comparatively high, these services will likely need to be combined with other connectivity solutions to support in-field agri-tech devices, such as soil sensors (e.g. use of a 'narrowband' LEO such as Myriota or a terrestrial wireless solution such as LoRaWAN).

It is also important to recognise the depth and pace of Australia's own innovation in satellite communications technologies. There are a number of Australian space tech start-ups who are competing with a range of innovative technologies, including Myriota, Fleet Space Technologies, Clearbox Systems and recently launched Quasar Satellite Technologies. These services are not necessarily a substitute for Starlink or vice versa: for example, while Starlink's plan is to provide high-speed broadband connectivity and to focus on home and business services, Myriota's LEOs are designed to support narrowband sensor products.

The work of the Satellite CRC in exploring the integration of LEOs and terrestrial mobile networks also could potentially provide another step change in connectivity in regional and rural Australia.

In addition to innovation in communications technology, is innovation in agricultural sensing technologies with built in communications capability.

### Bundled agri-tech solutions

In addition to this, we are seeing SMEs and agri-tech start-ups that are bundling connectivity solutions with applications and collaborating to develop 'plug and play' solutions. These include Goanna Ag, Myriota and LX Group. Interestingly, the $15 million VIC Government on Farm IoT trial has, in many cases, had to solve connectivity first in order for IoT devices to work on farm.

### Agri-tech developer workarounds

Agri-tech developers can attempt to solve connectivity problems faced by users by equipping their agri-tech equipment with a range of connectivity options.

Some agri-tech developers have found connectivity so patchy and so variable across different areas of rural Australia that they have designed their agri-tech equipment to be completely independent of carrier networks or utilise approaches such as edge computing (as opposed to cloud based processing of data) to reduce bandwidth requirements.

**Our clients know the value that comes from remote monitoring, but until now, the industry has been restricted by coverage and cost issues. We have been working toward a solution like this for over a decade, and thanks to our partnership with Myriota, have developed a game changing solution that will drive on farm efficiencies – particularly around water management and optimisation.**

**Tom Dowling,**
**Chief Operating Officer, Goanna Ag**

https://myriota.com/2019/10/30/case-study-smart-sensors-create-smart-water-management/

## CASE STUDY

### Australian Communications Technology Innovation

**LX - Australian Agtech Innovation**

LX is one of a number of tech engineering companies that are doing the hard work of designing and manufacturing 'field grade' communication devices that can withstand the harsh conditions of Australian weather. The LX IoT Core product is an IoT hardware platform that provides IoT communication capability that underpins third party applications.

LX has had to work through all of the issues of deploying hardware into agricultural landscapes, from weather and damage by animals, to the full range of 'salt and pepper connectivity' problems. They have designed the IOT Cores to be agnostic to any provider and with their 'born global' mentality have ensured that the devices can 'plug and play' in any rural or remote context.

LX is a participant in the Victorian Government's IoT on Farms trial, and has partnered with Longeranong College to provide IoT devices for the new Data Farm.

Source: LX Group https://lx-group.com.au/work/

## CASE STUDY

### Remote cattle weighing and monitoring

Regular weighing of cattle helps farmers decide when to sell cattle as well and optimise the feeding regime. Traditionally, weighing cattle is a manual and time-consuming process which requires yarding the cattle. There is a limit to how regularly data can be gathered, which limits the ability for farmers to accurately optimise their feeding regimes and the timing of sale to hit market targets for carcass weight.

Optiweigh is a connected in-paddock weighing device. Cattle are attracted to step into the device with a lick block or feed. Their front stand on a scale from which their total weight can be calculated. Their ear tag is scanned to identify the animal and the information is transmitted back to the cloud and can be access on an app on the farmer's phone. Optiweigh has identified connectivity as one of the main challenges in getting to market:

> "When the telcos work out where to put phone towers none of them seem to worry about cows needing to phone in with their weights....Cellular services in regional and rural Australia are very unreliable, so getting the right connectivity solution has been hard. We've trialled a range of options such as low power, wide area networks and different technologies around cellular. We've now got a solution where every unit has Wi-Fi and excellent 3/4G mobile coverage, and for areas where that isn't enough we have a satellite option."

Video applications, infra-red cameras could be used on these type of in-paddock devices to allow visual inspection and checking of the animal's health, However this would require broadband connectivity.

Source: Optiweigh https://www.optiweigh.com.au/

## CASE STUDY

### Thingc agricultural robots

Australian start up Thingc Robotics is developing low cost robots to undertake farm work, such as weed spraying. Thinc's robots are lightweight, electric-powered and designed with plug and play components. For navigation and applications such as precision spraying, the robot has an optical system on board.

Thingc's robots are controlled remotely by using a 900 MHz radio controller which can be plugged into the port of an iPad (these controllers are used in devices such as baby monitors).

900 MHz can have a range of 1–2 kms and can penetrate dense shrubs and other obstacles (although shortening the transmission range. Typically, 900 MHz is limited to supporting around 10-20 mb/s of net data throughput, and much less if you're pushing the envelope as to range, obstacles, or local interference. Thingc manages the data issue by processing data 'on-board' the robot.

Source: Rene Groeneveld, Future Farming https://www.futurefarming.com/Machinery/Articles/2019/11/Australian-thingc-Robotics-starts-trials-with-electric-robot-500603E/?fbclid=IwAR1kZmos6yiy1wzbXjK4HsbE35TEMpj4dtDKQrLeh4DO1Lm0y26XrP5LIMw

Australian Broadband Advisory Council

## QUESTION THREE

# If, or once, the threshold is crossed, what other measures would promote adoption of digital agriculture off the back of that connectivity?

# DISCOVERY QUESTION THREE

Australian farmers are prepared to embrace digital technologies, just as they have always innovated, in order to solve problems, and with a clear value proposition. Once they know what is possible, rural communities will have the motivation to organise themselves to fill in the 'salt and pepper', but many communities will need support in navigating the technologies, the options for solutions and the range of Government programs that provide funding, skills development and other support. We have identified two key areas to be addressed:

## Enabling rural communities

### Place-based solutions

Local ecosystems of digital skills and support are required:

- Building local ecosystems means building local community capacity
- Building farmer-centric solutions

### VET training, university courses and demonstration farms

These local ecosystems will in turn require state and national level coordination, VET and university courses and services, and digital demonstration farms to develop digital capacity in regional and rural areas.

## CASE STUDY

### Birchip Cropping Group (BCG)

The town of Birchip is located in the Mallee Country in Victoria. In early 2020, BCG conducted a survey of community members' experience of telecommunications services. Nearly 90 per cent of respondents said they were dissatisfied with their internet access service. Nearly 75 per cent of respondents mostly used their internet access service for business or education. A common complaint was that the poor quality of the service – either drop out or latency – prevented access to cloud-based services or services which would 'time out', such as cloud based accounting packages, online banking or remotely hosted applications of their employer. Comments included:

- "Delays, slow speeds, interrupted communications and lost labour all amount to lost money. On the one hand, you're losing productivity, output and sales, but you're also faced with wasted overheads and labour costs which can't be turned off because your internet connection has been disrupted".
- "When doing work education always cuts out and have to restart everything."
- "Banking and business contacts disrupted and weather radars accuracy failures are critical to our ongoing operation. Marketing livestock and grain reports cannot now rely on accurate and immediate information due to protected internet failure via NBN's sporadic availability."
- "Unable to view daily grain prices, couldn't sell or transfer grain, can't pay wages or accounts, can't access agronomists' recommendations, and couldn't do invoices."
- "I operate on a cloud based computer system, Internet service failures prohibit me from accessing stored data, generating contracts for clients, and sub-par Skype meetings which I partake in regularly. The internet outages affect me, my company and clients (other farmers)".

Birchip has a train line running through it and the Victorian Government rail operator, VicRail, has installed a fibre cable running alongside the track. The Birchip community has endeavoured to make a case to VicRail to 'open up' the fibre to provide direct fibre connections in town and to provide backhaul for wireless services in the surrounding area. However, they were unable to engage VicRail – they could not find an officer in VicRail who knew about the fibre and who would have authority to discuss the proposal with them: "we just went around in circles and have given up but it's so frustrating because the fibre is still there, running through our town on the way to somewhere else".

## PLACE BASED SOLUTIONS

### Developing local ecosystems of digital skills and support

While digital agriculture will not happen without addressing salt and pepper connectivity, driving adoption involves much more. Farmers also need the advice, skills and support needed to evaluate the value proposition of agri-tech, to deploy, operate and maintain agri-tech solutions and to assess and apply the outputs in their farm management practices.

These wider issues of adoption will be addressed by a Digital Foundations for Agriculture Strategy currently being developed by the Australian Government Department of Agriculture, Water and the Environment as part of the National Agriculture Innovation Strategy. While our focus is on connectivity, we have some observations on how the connectivity-related skills and support issues fit within the larger adoption picture.

https://www.agriculture.gov.au/ag-farm-food/innovation/national-ag-innovation-agenda#agtech-and-digital-foundations

### Building local ecosystems – Building local community capacity

As the BCARR says in its recent paper, many benefits of high-speed ubiquitous broadband require investment in additional infrastructure, technology and skills to realise the benefits. These areas of focus are summarised as follows:

- **availability:** whether the product or service enabled by high speed and ubiquitous broadband is available in agricultural regions
- **ability:** whether the consumer has the required skills/knowledge to use the product or service
- **affordability:** whether the consumer has the financial means to purchase the product or service.

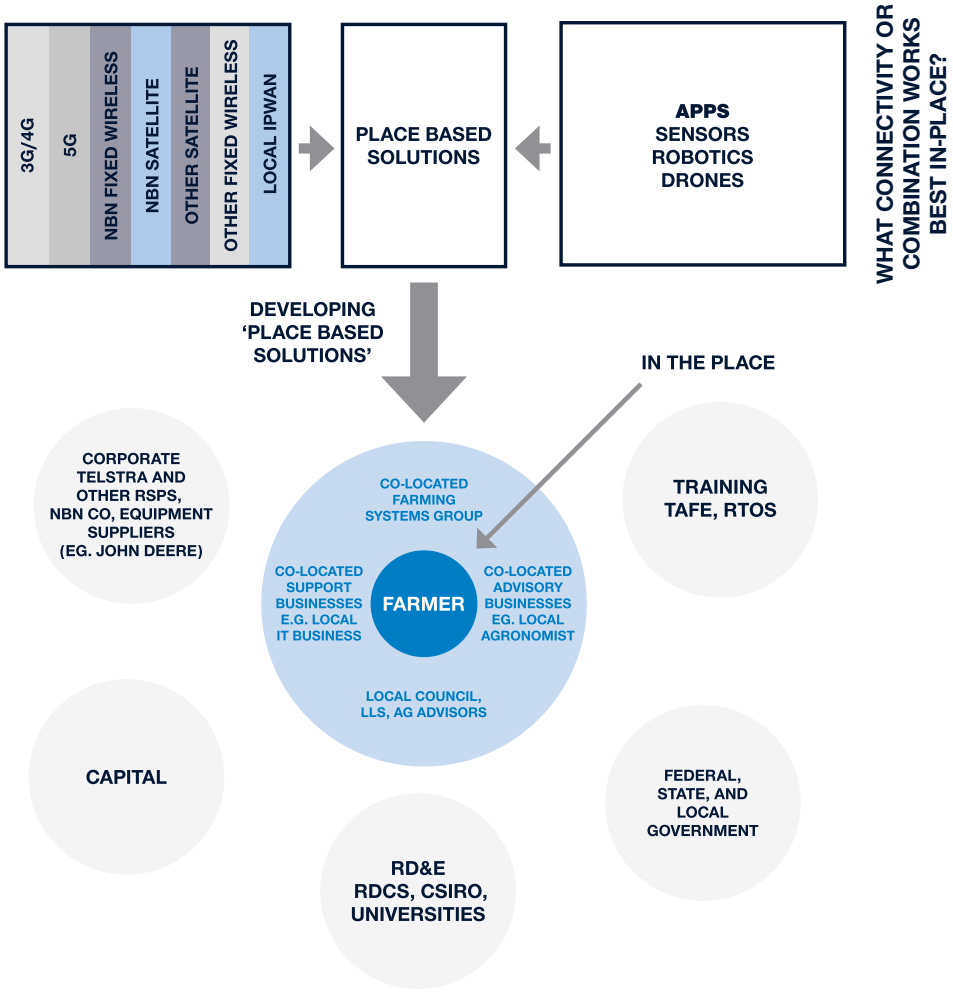
Skills and expert assistance were also identified as a priority in the roundtables with farmers conducted by NBN Co[1]:

> *"...participants identified the need for a trusted source of digital advice being available to primary producers, allowing them to sense-check their digital plans and to provide in-field technical support as the need may arise. Participants identified anecdotal concerns from primary producers about being sold products that were not fit for purpose – primary producers want their problems understood at a conceptual level before launching to solution or sales mode."*

1 https://www.nbnco.com.au/content/dam/nbnco2/images/blog/nbn-future-of-farming-roundtables-report.pdf

## BUILDING FARMER-CENTRIC SOLUTIONS

**What application (or integrated solution) provides best solution for local conditions, (including connectivity)?**




Just as addressing salt and pepper connectivity is a place-based problem requiring a place-based solution, the same applies to the externally provided services farmers require to support digital agriculture. To take a simple example, if a farmer depends on remote telemetry to control irrigation pumps on the farm, there is the risk of significant production loss if the technician has to drive hundreds of kilometres to fix the problem.

The development of local ecosystems to support agri-tech has broader economic and social value for rural communities. New businesses will emerge or existing businesses will find new opportunities. Expanded economic opportunities in rural communities may attract people to move there, helping to maintain their viability. The quality of life in rural areas will be improved through better education, health and support services which would emerge and be supported within these local digital ecosystems.

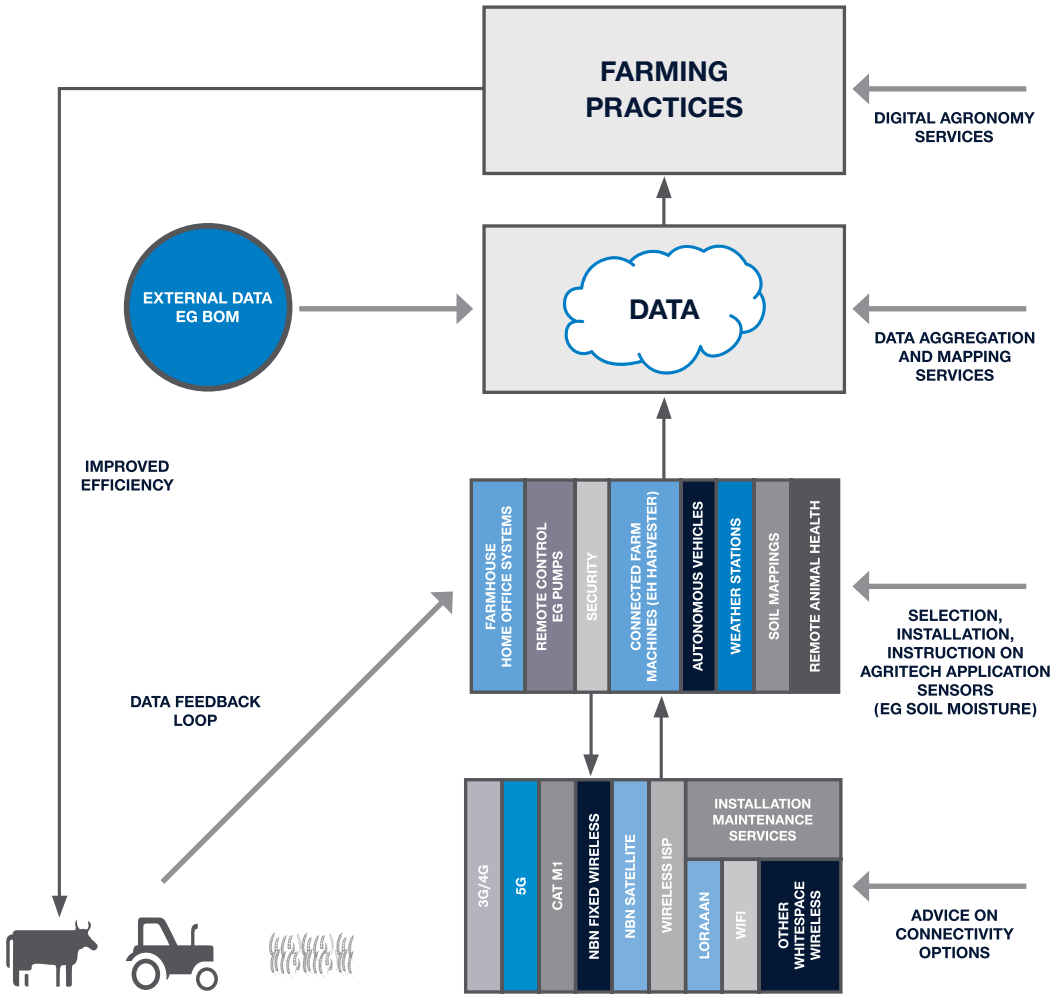
The emergence of these local ecosystems can be promoted by community leadership. Each area will have its own organisations that can lead community projects to determine the best mix of connectivity solutions for that community. It could be farming system organisations. It could also be local chambers of commerce, or local government.

We have seen this happening on the ground already, for example by BCG that has taken initiatives to experiment with alternative connectivity technologies, such as Zetifi's WIFI infrastructure. The next challenge the BCG has identified is supporting the development of local businesses to support digital agriculture.

But these pioneers also told us of the challenges they faced 'getting their head around' the connectivity issues and digital technology and that there were many 'false starts' or 'dead ends'. These local ecosystems will need support and input from outside the system, including government, to help with start-up, the existing agriculture R&D, and education infrastructure with skills development, training and innovation, and the corporate connectivity and agri-tech providers by inclusion in distribution chains.

# DISCOVERY QUESTION THREE

## Local ecosystems of digital skills and support




### The 'stack' of knowledge and skills required to 'power' digital agriculture

There are then questions about what is involved in each skill set: which of these skill sets can or should the farmer acquire or who else could provide them to the farmer; if externally provided to the farmer, can the same person provide the full range of support skills or will there be different providers at each layer of the digital skill stack; and do these service providers currently exist?

### Starting from the connectivity end of the skill stack:

**Advice on connectivity options:** As noted above, farming communities start with a good base of knowledge about the carrier network infrastructure in their area. If they are struggling with salt and pepper connectivity, they need advice on the options to address the problem and carrier networks may not necessarily be the optimal solution: other solutions include DIY solutions like LoRaWAN or solutions to 'stretch' the carrier coverage, such as Zetifi.

Carriers, RSPs, and communications equipment vendors can provide advice on connectivity solutions, but they will understandably focus on their own products and services. There is the additional problem that NBN Co is a wholesale-only business and cannot deal directly with end users about connectivity issues.

As farmers typically will have a range of connectivity options – each with their own advantages and disadvantages – they would benefit from independent advice to help them choose the best connectivity solution for the agri-tech applications they are considering using.

As we discuss below, the Regional Tech Hub, a joint initiative of the Australian Government and the NFF provides an example of independent advice to rural consumers.

# DISCOVERY QUESTION THREE

**Ongoing connectivity 'trouble shooting':** One of the main advantages of a carrier-provided connectivity option is that ongoing operation and maintenance will be the carrier's responsibility and at its cost. If the farmer uses a DIY solution to solve the connectivity problems, he or she will need access to trouble shooting support.

There appears to be a shortage of these skills. Often people with these skills come from a military background where they were responsible for field radiocommunications. Some are gifted amateurs – one large farming business said it was lucky to have found a 'radcoms savant' who was the only person who knew how to operate and maintain their network. Others with these skills travel long distances to service installations on farms and have no capacity to take on new clients.

Agri-tech and connectivity providers are trying to find solutions to this skills gap. Zetifi's solution is to use a combination of in-build tools which allow remote monitoring and problem solving and upskilling existing local trade people, mainly electricians, to provide a level of 'first hands' maintenance. Thingc Robotics is building its robots with simple, low cost 'plug and play' components which can be readily replaced by the farmer. LX have designed its technology to provide 'in a box' solutions – i.e. shipped as ready to install.

**Advice on agri-tech applications:** There is a rapidly growing range of agri-tech applications and agri-tech suppliers. The agri-tech suppliers have a range of different business models – some sell the digital application (or farming equipment embedded with digital applications) and provide only limited ongoing support. Others have a subscription model – software as a service or infrastructure as a service. Some are cloud-based and aggregate the data from many farms to provide the farmer with comparative output, while others provide desktop software for an individual farmer to process his or her own farm's data. Farmers will need to make choices about what will deliver the best value for them.

As we have discussed, there is an inter-relationship between the choice of agri-tech applications and connectivity. The type of available connectivity may constrain the choice of agri-tech applications and if salt and pepper connectivity is an issue, the agri-tech application that delivers best value to the farmer will drive the type of connectivity solution the farmer needs to put in place to solve the problem. Advisers need an understanding of both sides of the app and connectivity equation.

Again, each agri-tech vendor can provide advice on its own products and the connectivity needed but a farmer may require independent advice to choose between options.

# DISCOVERY QUESTION THREE

**Integrating and mapping the data sets:** The value of data is when it is correlated or overlaid with other data to identify trends or relationships. This can take many forms. Data from the one farm can be drawn together – soil moisture data with data from irrigation pumps and ultimately with cropping harvest data to help more efficiently manage water use. On-farm data can be overlaid with data from external public sources, such as the Bureau of Meteorology, to understand the impact of climate and climate change. Data from one farm can be compared with data from surrounding farms to benchmark performance. When pooled in very large amounts, data can be used by artificial intelligence to identify trends that humans might not see.

Processing and presenting data in this way is a specialist skill – that of the 'data scientist'. It is not a skill which farmers have or could be expected to have. They need to understand what the output is saying, but not themselves generate that output.

Many other businesses utilise data science skills, and agriculture has to compete for access to those skills. However, there are a number of data specialists who are focused on agriculture, most often associated with universities that offer courses and have research capabilities in precision agriculture; but also in small consultancies and precision ag platform and service providers.

**Translating agri-tech output in changed farming practices:** Farmers need to be able to take the data outputs from the agri-tech applications deployed on their farm and understand what it means for their current farm management practices and how to change those practices. Expert advice on farm management has traditionally been the role of agronomists.

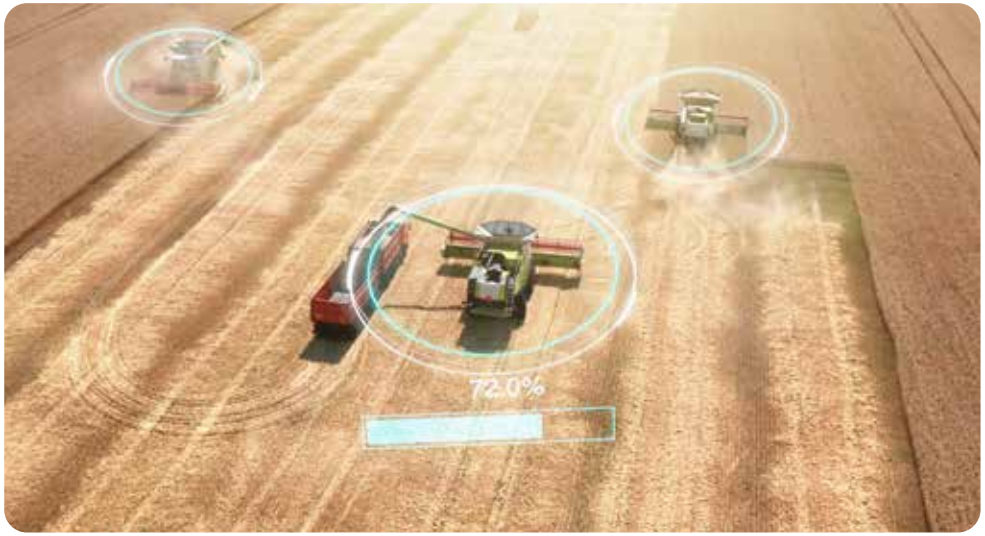
## VET, UNIVERSITY COURSES AND DEMONSTRATION FARMS

Tertiary institutions, RDCs and state/territory governments have established demonstration farms for digital agriculture that will be critical in building capacity and skills. These include:

- UNE Smart Farm in Armidale, NSW
- University of Sydney Digital Farm in Narrabri, NSW
- Longeranong DATA Farm in the Victorian Mallee
- PIRSA Agtech demonstration farms.

These demonstration farms provide a space for collaboration with commercial solution providers and an important testing ground for identifying and solving connectivity problems, and sharing knowledge and expertise.

Importantly, digital agronomy is now a recognised skill set. From December 2020, the National Register on Vocational Education and Training, a joint initiative of the states, territories and Australian Government lists as a course 'digital agronomy skill set' which includes a compulsory component in 'interpret and use agricultural data', though it is not clear from the register of training organisations if this skill set is yet being offered.




## CASE STUDY

### Longeranong College

Longerenong College, located outside Horsham in VIC, has established a Data Farm which has the twin missions of (a) providing an environment in which agronomy students can be taught about use of agri-tech and (b) providing and outreach program for farmers in the surrounding area to educate them about agri-tech. It will showcase the latest technologies and machinery, and is supported with funding from the Victorian Government. More than 30 projects, 250 devices and 500 sensors combine to create the future of agriculture. More than 30,000 daily data points will create insights to enhance decision making on-farm. Using best in class smart farming technologies and IoT products, the data collected on the farm will be aggregated and displayed across dashboards within a 'spaceship command style' learning environment.

The Data Farm grew out of broader community-based initiative. The Victorian Government has established 9 regional partnerships with regional communities, including the Wimmera Southern Mallee partnership. The regional partnerships conduct annual workshops to identify social and economic priorities in the region, which are provided to the Victorian Government to fund projects.

Several years ago, the Wimmera Southern Mallee partnership identified related priorities of improving connectivity through the region and promoting digital agriculture off the back of that improved connectivity. As a result, the Victorian Government funded the Agriculture Technology Innovation, Development and Extension program (AgTIDE). The AgTIDE partners currently include BCG, one of the oldest and most successful farming system groups in Australia, Longerenong College, Melbourne University, Skillinvest and LX who are providing IoT devices.


Australian Broadband Advisory Council

# DISCUSSION

# DISCUSSION

NBN Co has described the policy objective for connectivity in rural Australia as 'leaving no paddock behind'. We agree, but this begs a number of questions about what form or type of connectivity is needed, who provides the connectivity, and how is it funded?

### Will continued expansion of carrier networks solve the salt and pepper connectivity problem?

The carrier networks are not, of course, static in the extent or depth of their coverage. The ACCC identified strong facilities-based competition between the mobile operators which is driving continued deployment in regional and rural areas to expand and deepen coverage.[1]

The carriers have realised the opportunity of digital agriculture, for example:

NBN Co has formed a regional development and engagement unit (nbn Local) and has appointed a Head of Segment – Agriculture. In September 2020, NBN Co published the Connecting Australia report on agriculture and stated that:[2]

> *"Our focus is on providing access to broadband services to help enable the agriculture sector to get the most from the opportunities available. To help Australian farmers take full advantage of the digital opportunity we are collaborating closely with the agricultural sector to design connectivity solutions that support these emerging technologies. This is all about helping to enable success, and we want to go beyond improving productivity and growth on the farm to see improvements to community wellbeing across regional Australia as well."*

As discussed above, Telstra has deployed Australia's largest IoT network and has been promoting its use for digital agriculture. Telstra has teamed with state governments on a number of agricultural and rural IoT projects.[3]

Optus also has deployed an IoT network, which it promotes for use to support agri-tech.[4]

Globally, Vodafone is a leader in IoT services, including in agriculture. Vodafone also actively participates in the Australian Government Mobile Black Spots Program.[5]

This means that incrementally some of today's salt and pepper connectivity will be replaced by more consistently good coverage. Why does salt and pepper connectivity exist in the first place?

While carriers should be encouraged to continue expanding their network coverage, including through programs such as Mobile Blackspots, in developing policy solutions to address salt and pepper connectivity it is important to recognise that the national scale business models of the mobile carriers and NBN Co don't work at local scale between small towns. The carrier networks – by technology they deploy and the business cases they use to decide where to deploy – are understandably focused on a minimum scale. The NBN fixed line and fixed wireless networks are focused on connecting concentrations of premises and the mobile networks are focused on connecting people on the move along transport corridors. Connectivity in paddocks or between sparsely distanced homesteads outside towns will be a continuing challenge for the main carriers.

Government intervention to expand the reach of carrier network coverage has typically used a 'push/pull' approach:

- regulatory obligations mandating service provision ('the push'), such as the Universal Service Obligation which currently applies to Telstra and the NBN Co's Statement of Expectations, through which the Shareholder Ministers set the NBN's mission
- government funding ('the pull'), such as the Mobile Black Spots Program and the Regional Black Spots Backhaul Program.

A review of these measures is beyond the scope of this review, but clearly this intervention has achieved improved coverage. However, while it can be 'pulled and pushed', the underlying challenge the carriers confront of scale remains.

The business cases of the carrier networks inevitably means they will be focused on connecting premises and transport corridors, and then where there is a minimum density. Mandated supply and rollout obligations ('the push'), in effect, stretch the carrier business model to serve otherwise uneconomic areas by requiring other customers, through explicit or implicit cross subsidies, to cover the costs. Government funding programs ('the pull') stretch the carrier business model by the taxpayer contribution to network rollout which otherwise would not occur. But there must come a point where it is inefficient, unreasonable and potentially distorting to competition and private investment to stretch the carrier business model too far in solving low scale issues for which those business models are not adapted.

As we have discussed above, the carrier networks, particularly the mobile networks, also are 'over-engineered' for many agri-tech applications. Mobile network infrastructure, with its capability to support roaming, intercell handover and now high speed data services, is expensive to deploy.

For these reason, AEWG is of the view that, while an important part of the answer, the carrier networks will not provide a complete answer to the connectivity issues which hold back adoption of digital agriculture, and certainly not within the timeframe needed to meet the industry's ambitious '$100 million GVP by 2030' goal.

### What about the role of the second tier providers?

The emergence of second tier retail providers like Wi-Sky and Zetifi arguably demonstrate that the market is performing as it should by incentivising new entrants to identify and fill the gaps left by the carriers. However, these second tier providers identify a number of hurdles or challenges which they face in scaling up their solutions across regional and rural Australia.

The second tier providers need access to two key inputs, which together provide a powerful, low cost solution in rural areas:

- fibre backhaul
- spectrum.

### Input 1: Second tier providers need access to fibre backhaul

Access to fibre, dark or lit, as backhaul is essential if second tier providers are to supply high speed internet services in their localised areas of service.

While there is, no doubt, a lack of fibre in regional and rural areas, there also seems to be quite an amount of fibre already in place but which is 'locked up' for various reasons. Fibre may have been deployed by government departments or agencies, but they are focused on using it for their own purposes and not for wider community access or as a commercial product.

There are some market developments which suggest more fibre backhaul will become available in regional and rural areas. Some state/territory utilities have recognised the potential to provide wholesale connectivity services as backhaul in regional areas using spare fibres in their networks: for example, Yurika telecommunications, part of Queensland Energy.[6] Telstra's new InfraCo development is now offering dark fibre services on a wholesale basis.

A stronger political direction to Government Business Enterprises (GBEs) to make spare fibre available in regional areas is needed, but there are also

challenges. While it is frustrating for communities to see fibre running through their towns or local areas 'on the way to somewhere else', there are technical and cost challenges to 'opening up' existing fibre. There may be existing 'break points' in current intercity fibre runs which pass through rural and regional areas, such as at repeater stations which are located every 50–80 kilometres, which could be re-engineered to provide points of interconnection. 'Retrofitting' existing Government, utility or private carrier fibre runs is part of the answer to the rural backhaul challenge, but unlikely to be most of the answer.

The prospective deployment of new large sale national fibre networks provides an opportunity to build more connection points or 'off ramps' into the design of these fibre networks, potentially providing a more cost efficient solution than retrofitting existing fibre networks. As noted above, we are seeing significant private investment in fibre across the country, specifically because there is a demand there that is not currently being met, by companies such as HyperOne and Vocus.

### Input 2: Second tier providers need access to spectrum

Spectrum is a scarce resource and needs to be carefully managed to avoid between providers and users to avoid interference and restricting innovation. But because rural and regional areas are more sparsely populated, there can be more flexibility and scope for localised wireless solutions.

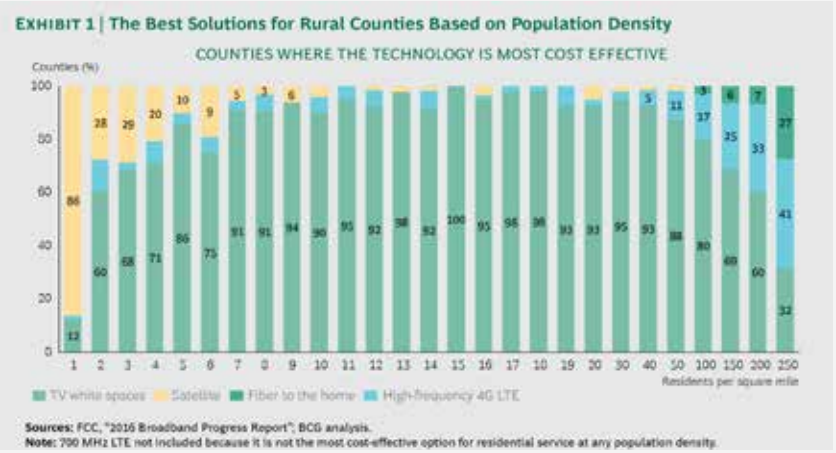
Several overseas jurisdictions, notably the UK[7] and the US[8], have taken spectrum management measures to support innovative wireless solutions, particularly in rural and regional areas. This includes use of 'white spaces' which refers to frequencies that are allocated to a service, e.g. Digital Terrestrial Television, but are not being used locally, so can therefore be used by other radio services and applications. Spectrum also may be made available on a class licenced basis which facilitates use by smaller operators.  Where there is some TV 'whitespace' in Australia, class licensed spectrum is more likely to be best candidate for second tier operators deploying wireless access networks in rural and regional areas of Australia.

## Case Study

### Microsoft's view of use of whitespace spectrum[9]

Microsoft's Rural Broadband Group argues that "the most cost-effective approach to closing the digital divide for the 19.4 million people in rural areas in the United States lacking broadband access is to rely on a mixture of available technologies (a 'kit approach.")

Based on a study by the Boston Consulting Group, Microsoft reached the view that TV whitespace plus Wi-Fi would be the most economical solution in counties with a population density of 2-200 people per square mile (or 2.5 square kilometres) allocated under its national spectrum plans.



# DISCUSSION

Of course, the spectrum available in each country to support 'whitespace' or class licence usage will depend on how spectrum is allocated under its national spectrum plan. However, the US and UK experience illustrates the power of combining fibre backhaul and class licensed spectrum in addressing connectivity gaps in rural areas which may be sub-scale for the carrier networks.

The ACMA is currently consulting on 6 GHz class licensing for WIFI and 4/5G applications. However, as the ACMA itself notes, it is taking a more conservative approach than overseas regulators.[10] This conservatism lies less in the total amount of spectrum available under class licences than in the restrictions which apply under the class licences. Higher power ratings for transmission equipment under class licences would allow a larger coverage area, without necessarily escalating the risks of interference in regional and rural areas compared to the constraints in urban areas.

### The need for community-led initiatives

Salt and pepper connectivity is better solved by community-lead or involved programs.

First, the problems are place-based:

- agricultural activities vary between regions, from broad acre grain farming in the wheat belt, to cotton farming on the Western Plains, to horticulture in Northern QLD and orchards in the Murrumbidgee Irrigation Area
- the extent and depth of connectivity also will vary between different regions.

Second, the solutions will be more effective with local inputs:

- local communities best understand the range of needs and priorities for connectivity across their region
- local communities have detailed knowledge of the existing communications infrastructure in their area
- local communities are highly motivated to seek solutions to their connectivity challenges and care prepared to co-invest in solutions
- local involvement in assessing connectivity solutions may help breakdown the current negative cycle of mismatched expectations, frustration and poor communication between carriers and local communities.

Promoting agri-tech uptake through such as approach would be consistent with the successful trend which the Australian Council of Learned Academies (ACOLA) report identified in technology adoption.[11]

> *"Since the 1970s, there has been a global shift away from the traditional top down model of technology transfer to participatory extension methodologies that encourage information flows, adult learning principles and stakeholder participation. Future farmers are likely to want more control over information, and hence engagement is a critical element of information provision and education. These trends may facilitate extension services that are 'demand-pulled' rather than 'science-pushed'. The increased use of farmer groups has become one of the defining features of new 'bottom up' forms of agricultural extension."*

The need to view connectivity through a wider regional development lens. The broader economic value and contribution from improved connectivity must be understood.

First, if connectivity is solved for agriculture, it will also be solved for the broader aspects of local and regional economies. As we have noted above, farm houses often support more than one business, and women's economic opportunity in regional and rural Australia is now represented by online businesses. An improved connectivity platform will support not just agri-tech, but also improved delivery of health and education services.

# DISCUSSION

Second, while digital agriculture cannot occur without improved connectivity, other resources and skill sets are required in local communities to support farmers in the uptake and ongoing use of agri-tech. Agri-tech also provides an opportunity to develop new businesses or expand existing businesses into new lines of activities: as one person said to us, 'we need new types of businesses in our town'.

There are already are emerging 'local innovation ecosystems', at different stages of development, such as those lead by farming system groups in Victoria, South Australia and Western Australia. The members tend to do this 'on top of their day job' and can be pressed to push successful place-based solutions to non-member farmers in the area.

Overall, what we have is a nascent 'telcotech' industry that is far deeper than is currently recognised or covered by Government policy frameworks. All of this activity must be accounted for and leveraged as part of the wider solution to solving the problem of salt and pepper connectivity, but also in the ultimate aim of ubiquitous broadband connectivity across paddocks – no paddock left behind.

The best approach for building a local digital ecosystem may differ between areas. For example, local councils or chambers of commerce also may provide leadership.


1 https://www.accc.gov.au/regulated-infrastructure/communications/mobile-services/domestic-mobile-roaming-declaration-inquiry-2016
2 https://www.nbnco.com.au/corporate-information/media-centre/media-statements/annual-boost-to-agriculture
3 https://www.zdnet.com/article/telstra-launches-iot-pilot-in-queensland-to-gather-more-accurate-weather-data/
4 https://www.optus.com.au/enterprise/accelerate/technology/innovation-in-unexpected-industries-farming-drones-and-big-data
5 https://www.vodafone.com/business/news-and-insights/blog/gigabit-thinking/how-iot-is-transforming-industrial-and-agricultural-businesses#:~:text=And%20because%20water%20use%20and%20crop%20yields%20are,previously%20too%20inaccessible%2C%20remote%20or%20numerous%20to%20connect.
6 https://www.yurika.com.au/telecommunications
7 https://www.ofcom.org.uk/__data/assets/pdf_file/0034/68668/tvws-statement.pdf
8 https://www.fcc.gov/document/fcc-increases-unlicensed-wireless-operations-tv-white-spaces-0
9 https://www.microsoft.com/en-us/corporate-responsibility/airband
10 https://www.acma.gov.au/consultations/2021-04/rlan-use-5-ghz-and-6-ghz-bands-consultation-122021
11 The Future of Agricultural Technologies, September 2020, at p.62: https://acola.org/hs6-future-agricultural-technologies/

Australian Broadband Advisory Council

# DESIRED FUTURE STATE

# DESIRED FUTURE STATE

The desired future state articulates the outcomes required to solve salt and pepper connectivity and provide the full suite of connectivity technologies and services that will enable full adoption of digital agriculture. There are three aspects to the desired future state.

## FIBRE HIGHWAYS ACROSS THE COUNTRY WITH BACK HAUL OFF-RAMPS INTO EVERY RURAL COMMUNITY

**“We need fibre highways with more stops”**

As we have already seen, the market will innovate to meet the demand for connectivity in rural areas, to support digital agriculture. This cannot happen without sufficient backhaul capacity. We need fibre ‘highways’ across the country, with off-ramps into every rural community, to provide the backbone of backhaul that fuels market and technology innovation.

## EVERY RURAL TOWN OR AREA HAS A LOCALLY DEVELOPED CONNECTIVITY PLAN, THAT CONNECTS THEIR OFF-RAMP TO A RANGE OF PLACE-BASED, LOCALLY SUPPORTED INFRASTRUCTURE

**“The people in each place will drive their place-based solution”**

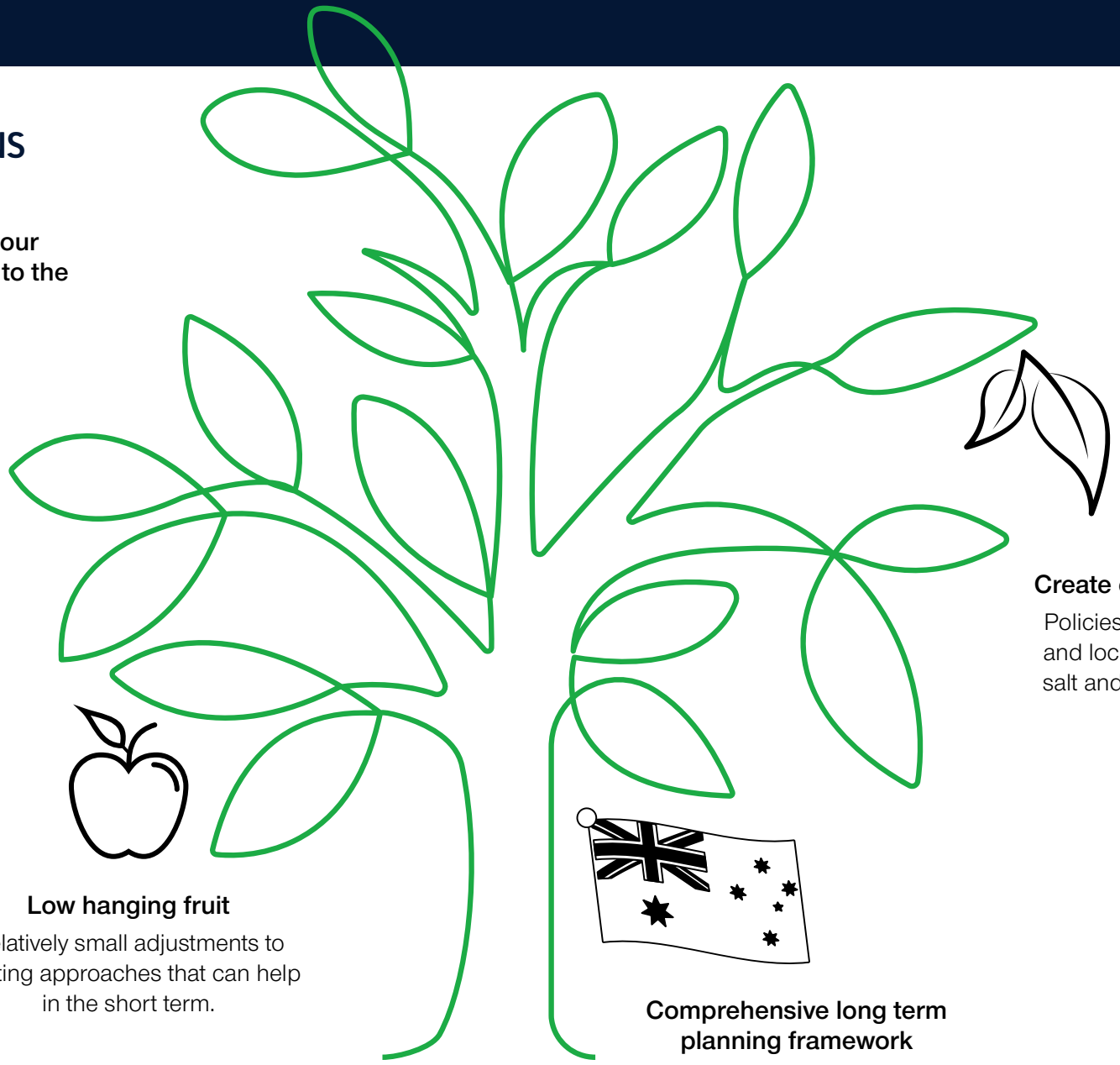
Salt and pepper connectivity gets solved at the local scale, so at the end of each rural off-ramp, will be a purpose designed mix of connectivity solutions, championed and supported by local people – individuals, businesses and organisations.

## GOVERNMENT INVESTMENT TO ACHIEVE THIS TAKES PLACE WITHIN A LONG TERM, INTER-GOVERNMENTAL PLANNING FRAMEWORK

To support market innovation, government policy frameworks will be reframed to reset and future proof rural digital connectivity. This may require a complete rethink about the regulatory obligations mandating service provision and Government funding programs, to ensure a strong, innovative rural telecommunications and digital infrastructure.

## POTENTIAL SOLUTIONS

**We have determined nine potential solutions across four themes that will contribute to the desired future state.**



### Create new foundations

Policies that set things up to solve salt and pepper for the long term.

### Low hanging fruit

Relatively small adjustments to existing approaches that can help in the short term.

### Comprehensive long term planning framework

Whole-of Government approach to connectivity.

### Create conditions for growth

Policies that enable the market and local communities to solve salt and pepper at local scales.

# DESIRED FUTURE STATE

## LOW HANGING FRUIT

### Relatively small adjustments to existing approaches that can help in the short term

**1** **NBN Co should prioritise moving people from satellite on the 'outskirts' of its fixed wireless network by exploring technical ways and connection policies to 'soften' the 14km boundary for the fixed wireless coverage**

- While the rapid rollout of the NBN may have necessitated 'one size fits all' rules, with the network now deployed, it is time for NBN Co to work with RSPs in rural areas on finding solutions which 'stretch' the boundaries of the NBN wireless footprint to migrate customers from the less satisfactory NBN satellite service
- We recognise that NBN Co has already taken steps in the direction by adopting a 'non-standard' connection policy in rural areas, but we would encourage NBN Co to more proactively search out opportunities to migrate satellite customers to wireless, such as by setting this as a priority for the current $300 million regional co-investment. That said, there will be limits to how far an NBN wireless cell can be stretched or loaded without affecting the service of other users connected to the NBN.

**2** **Continue to provide and expand services such as the Regional Tech Hub, to enable farmers to better understand the full range of connectivity options they already have, including new RSPs. This may involve providing more resources for the Regional Tech Hub to take a wider educative role in skilling up farming communities and organisations on connectivity options**

## CREATE NEW FOUNDATIONS

### Policies that set things up to solve salt and pepper connectivity for the long term

**3** **Develop spectrum policy that promotes opportunities for innovative wireless solutions in rural and regional areas**

- Spectrum policy is complex and ultimately as the main carrier networks will continue to be the primary providers of wireless services for some time, spectrum policy should not prejudice the deployment of those networks. However, as the UK and US experience shows, spectrum policy could be more specific to the conditions, challenges and opportunities in localised areas within regional and rural Australia
- This could include giving consideration to spectrum policies which provide more flexibility and scope for wireless innovation in regional and rural areas, including private 5G networks
- The ACMA has taken some steps towards more spectrum flexibility through class licensing, but this should be part of a broader picture which provides carriers, second tier providers, backhaul providers and communities with a more integrated approach to solving rural connectivity issues.

# DESIRED FUTURE STATE

**4** **Promote the availability of fibre backhaul to support alternative providers in rural areas – the combination of fibre and class licensed spectrum provides a very cost effective solution to provide broadband in sparsely populated areas**

- Encourage public owners of existing fibre to be opened up for POIs and off-ramps. This may involve:
- taking stock of the existing fibre owned by governments and GBEs, so that there is in one place a database of the available non-commercial fibre
    - this in turn may require a breaking of the 'siloed' approaches in which individual government agencies fund fibre to support facilities within their portfolios, such as schools or hospitals, by mandating requirements for community-wide access
    - It may require encouraging State and Territory Governments to reframe the mandate of government business enterprises so that they are not operating with a narrow 'rate of return' criteria when it comes to considering whether to open up their fibre
    - It may also involve encouraging inclusion of fibre build as a standard requirement in all major infrastructure projects in regional and rural areas, such as when building roads and rail projects, on the basis that the incremental costs are likely to be much lower than with a standalone fibre build
- Access to fibre owned by the private sector carriers is a more complex issue, and there are existing regulatory frameworks to address access issues. However, there are signs of market forces could drive the availability of more active backhaul and dark fibre in regional and rural areas, which the Australian Government could seek to both facilitate and harness towards meeting the objective of ubiquitous connectivity
- We recommend that the Government consider how to encourage private fibre owners to open up POIs and off-ramps. Work in the planning stages with new operators who are providing back bone fibre, by maximising the POIs e.g. HyperOne, Vocus but also other new infrastructure entrants. This might be as simple as using the proposed regional planning approach we have recommended to identify aggregate demand across a region, or identifying the best locations for 'off ramps'
- It might also involve Government co-funding providing financial support to meet the costs of adding 'off ramps' or connection points to existing fibre which runs through communities and for the construction of branch lines out into rural areas. The Australian Government's previous Blackspot Backhaul program to financially support the deployment of major fibre routes in rural and regional areas provides a template, but having addressed the major missing routes, such a program needs to focus on fibre at the local level.

**5** **NBN Co, and carriers generally, should be encouraged to explore technical solutions which allow interworking with lower cost, third party providers to extend the reach of the carrier networks. 'Software defined networking' allows the integration of different network architectures and technologies. This creates opportunities for more "heterogenous networks" to emerge, moving away from the traditional model where the carrier supplies an end-to-end service (retail or wholesale) on its network infrastructure. While there are complex issues involved, there are opportunities for complementary approaches between the tier 1 and tier 2 providers that can maximise the reach of network coverage in regional and rural areas**

## CREATE CONDITIONS FOR GROWTH

### Policies that enable the market and local communities to solve salt and pepper connectivity at local scale

**6** **Enable local communities to realise their own connectivity infrastructure by removing regulatory barriers and promoting locally driven connectivity initiatives**

- Focus government assistance for connectivity on locally led projects. This could include:
  - promoting and encouraging co-invest models between carriers and users or groups of users. As a cautionary note, there is, of course, an issue here of fairness between rural and urban communities: residential and business customers in areas with carrier coverage get access to connectivity without having to make a capital contribution. That said, rural communities are prepared to be pragmatic about contributing to the connectivity challenges they face
  - as noted above, such solutions need to be folded into the carrier connection policies (as NBN Co eventually did through its non-standard connections policy) to ensure that the network is not overloaded or services of other customers are impacted. But these models could be promoted for carrier and customers alike by eliminating regulatory barriers to these small area networks (i.e. so neighbours building a small local network do not need a carrier licence) and incentivised by tax policies, such as instant write-offs.

**7** **Invest in ensuring that the 'stack' of knowledge and skills required to 'power' connectivity and digital agriculture is in place**

- In addition to the connectivity technology and infrastructure, there will be a straight out human resource requirement, skilled workers who can advise, install, support and maintain agri-tech solutions
- These skills need to be developed in local communities to ensure they are close at hand, driving adoption and ensuring support is available when things go wrong. The support advice and skills ideally should be available independently of the connectivity service providers and the agri-tech providers
- The development of these skills will support digital transformation more broadly in regional and rural communities, including in health and education. This provides opportunities for the growth of new local businesses
- It will also require the expansion of training programs at regional providers such as Longeranong College in Victoria, and encouraging an ongoing focus on embedding digital skills into existing courses.

## COMPREHENSIVE LONG TERM PLANNING FRAMEWORK

### Whole-of Government approach to connectivity

**8** **Shift the weight towards involving local communities in regional-specific assessment and planning processes to help ensure that local farming and community organisations are aware of funding from states, territories, and the Australian Government is coordinated and effective in improving telecommunications infrastructure in rural areas**

# DESIRED FUTURE STATE

- Government funding may be continued for blackspots and rural and regional infrastructure program and should be based on transparent priorities e.g. bushfire resilience, transport corridors, increasing network densification of areas for economic development
- However, a much wider framework that encompasses the technological and private sector innovation at local scale, should be put in place to ensure a wide range of solutions that rural communities can access and potentially co-fund. The key elements of this new approach would be:
  - a process for involvement of communities in the region in the assessment of communications 'gaps' and strategies to address. Where possible, existing regional or local consultation 'architectures' should be used, which are usually established and supported by the state and territory governments (e.g. the Regional Partnerships in Victoria)
  - providing local communities with the resources and expert advice they will need to participate in this process. Local communities, particularly less densely populated local government areas or regions, will need the resources, financial support and expertise to undertake this exercise. By way of example, local communities could be assisted in planning by a small government funded support team consisting of a telco engineer/network planner, a regional economic planner and a community organiser. This could be established as one or more teams to work across rural Australia. A useful first step would be to pilot this approach in one or two regional areas
  - funding should also be open to a broader range of connectivity solutions than fixed and mobile carrier network infrastructure.

**9** **Stronger coordination between Federal, State/Territory and Local governments to ensure investments in communications infrastructure are more aligned with the priorities in each regional and rural areas, and possibly in co-funding the key infrastructure projects. With commitment from all levels of Government, a community level planning approach may provide a focused way of achieving that co-ordination. This may require not only information sharing and agreed priorities between Federal, State/Territory and Local Governments, but also establishing a single 'funnel' through which local communities can make applications for funding**

- This more systemic, region-based approach, including relying on a broader set of technology and provider solutions, may require a repointing regulatory obligations mandating service provision, NBN Co's Statement of Expectations and government programs, to ensure a strong, innovative rural telecommunications and digital infrastructure. This will not necessarily be straightforward given the interwoven regulatory, policy and commercial issues involved. Specific recommendations for change are beyond the scope of this study, and will most likely be addressed by the forthcoming Regional Telecommunications Review.
- Whilst the problem – 'salt and pepper connectivity' – is clearly articulated, the solutions are multi-layered and multi-disciplinary.
- Solving salt and pepper connectivity will require policy responses and programs that support tier two start-ups at the wholesale and retail levels, targeted training and education across the tertiary and VET sectors, and recognition of connectivity as a critical enabler of digital agriculture.