final report

Project code: P.PSH.1125

Prepared by: William Harrington & Emily Harrington
Wi-Sky QLD

Date published: 29 October 2018

PUBLISHED BY
Meat and Livestock Australia Limited
PO Box 1961
NORTH SYDNEY NSW 2059

Integrated digital connectivity solution using long range wireless high-speed internet link to connect several adjacent properties (Stage 1 of 2)

This is an MLA Donor Company funded project.

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

Executive summary

Internet connectivity is critical to every modern business. Wi-Sky QLD is working together with Stanbroke and MLA on Project Downpour for the purpose of providing a high-speed internet connection on every one of its major stations in North West Queensland as an alternative to their current underperforming and unreliable service. Project Downpour will enable Stanbroke to move into the 21st century and gain a competitive advantage.

Currently, the only available internet service is Satellite NBN, which is over-subscribed and delivering an unsatisfactory internet service to the office and staff. Productivity is severely hampered due to unreliable speeds and frequent dropouts. Due to the sparse population of Australia, and in particular the pastoral rangelands, there is little commercial or government interest in meeting the connectivity requirements of large businesses such as Stanbroke.

With the rest of the world embracing technology and moving towards the Agricultural Technology boom, parts of Australia will be left behind. While costs like freight and distance to market are nearly impossible to solve we can bring the information of the world to the farm gate to increase productivity and reduce cost.

The next R&D phase will focus on a High-Speed Wireless Link System solution consisting of a network of wireless towers starting in from Cloncurry and running through to Miranda Downs will be built by tapping into Wi-Sky QLD's existing fibre optic connection that runs through the region.

The next stage of this project is proposed to evaluate changes in internet and technology use across the stations in terms of work and personal usage, specifically data use; download speeds; bandwidth; latency comparisons; reliability of service (including downtime). In addition, it is proposed that future work should evaluate and validate the potential benefits of connectivity, including safety, training and attracting people to the industry.

Table of contents

1 Background and purpose

1.1 Purpose

This project involves Stanbroke and MLA partnering with Wi-Sky QLD to evaluate and demonstrate how a connectivity system can work across adjacent properties and the ongoing monitoring of a long range wireless high-speed internet link to connect Stanbroke's properties (schedule subject to MLA and Stanbroke). Wi-Sky QLD was approached to design, construct and monitor the system starting in Cloncurry, North West Queensland then travelling north over 500kms to Miranda Station situated on the Gulf of Carpinteria to deliver internet speeds of up to 100Mb/s.

This project is especially timely as the decrease in service from the existing large telecommunication companies really hits hard in regional Australia compounded as the government drops the Universal Service Obligation guaranteeing nationwide access to a fixed copper line telephone services, an alternative for the red meat industry needs to be found.

This research project is platform technology which will allow Stanbroke to use industry specific data collection tools, improve safety and entice a whole new range of people to the red meat industry.

This platform technology ties in with the ever-increasing need for more information and better traceability demanded by our customers all over the world. Stanbroke have started investigating remote sensing technologies and better communications systems however the prohibitive speeds of the current internet systems do not allow for gains in efficiency. This link to both the outside world and within these properties will ensure long-term outcomes for not only the Stanbroke properties but for other stakeholders in the red meat industry.

1.2 Background

The only available data service for a large proportion of the red meat industry is through Satellite NBN, which is over-subscribed and delivering an unsatisfactory internet service to the office and staff. Productivity is severely hampered due to unreliable speeds and frequent dropouts. Due to the sparse population of Australia and in particular the pastoral rangelands the connectivity does not match the productivity of such large businesses, this increases costs and reduces system performance.

With the rest of the world embracing technology and moving towards the Agricultural Technology boom in productivity parts of Australia will be left behind. While costs like freight and distance to market are nearly impossible to solve we can bring the information of the world to the farm gate to increase productivity and reduce cost.

The solution is tapping into the existing fibre network, which runs from Singapore to Townsville that provides the whole east coast with high-speed internet and building a network to connect Stanbroke's stations. Stanbroke is in a unique position in that the fibre cable runs 30kms away from the most southern station and the topography north lends itself to a wireless link. The project plans to tap into the fibre link at Cloncurry QLD and build a network of 30 towers delivering internet speeds of up to 100mb/s to all homesteads, staff quarters and other major infrastructure such as yards and watering points.

This project will join the connectivity triangle of the station and staff to the rest of the world and then the stations infrastructure back to the rest of the world. This platform will allow the launch of web based training modules, remote monitoring technology, increase communications on farm and to the rest of the world, it's only the beginning. This project aims to offer a road map for what connectivity can do help producers by identifying their connectivity needs and most importantly sharing these learnings for broader industry adoption.

This project will enable Stanbroke to adopt innovative technologies that require bandwidth and connect the paddock and value chain to their homestead. As part of the project Stanbroke will identify future innovation opportunities for R&D, adoption of existing innovations and business improvement. The expected outcome of this project will increase staff productivity, tool efficiency and livestock control – delivering an immediate return on their solution by generating effective management and maintenance procedures in operations.

1.3 Benefits

By investing in the latest technology and modifying it to suit our conditions, Stanbroke seeks to guarantee safer working conditions for staff and commit to their future through innovation. Using new technology, such as Voice over Wi-Fi (VoWiFI), mobile coverage will be extended across the property and will deliver a platform for improved asset management, livestock control and condition monitoring. Stanbroke has requested the design of a WI-SKY solution, broadcasting the high-speed internet service from Cloncurry using a system of repeater towers to homesteads, cattle yards, watering points and out stations.

This state of the art network will not only provide the internet and mobile services across the property but also provide owners and stakeholders with reliable high-speed internet services to the homestead, connecting homes to the private network and creating an extension of the office network, enabling remote monitoring from the manager's property, or any other authorised location.

This connection will enable further education opportunities for staff and ensure distance education, which is the only school option available for rural and remote children, runs efficiently. Stanbroke will be able to attract and retain staff by having the ability to offer high-speed internet for personal use to reduce isolation.

1.4 Key Points

Table 1: Key Points of Project Downpour.

Item	Total
Number of stations	8
Number of towers	30
Total distance	657km

Other locations including outstations and yards will be added as needed through the project and invoiced on completion.

2 Methodology: System Design

Before commencing the Project Downpour, a full design for the anticipated network was completed. This design process included mapping to determine the requirements of the project.

2.1 Network Design

The network will be designed for full flexibility to ensure that Stanbroke can use the maximise the usage of the network to help its business move forward. Apart from providing high speed internet access, it will also be able provide connectivity to Stanbroke's corporate network to allow staff to work as if they are located in the head office in Brisbane.

2.2 Network Termination Point

All networks have a location that serves as a point where responsibility and ownership shifts to the next service provider. As the infrastructure build for Project Downpour will be owned by Stanbroke, a point needs to defined where the network ends. This point in Project Downpour will be a Wi-Sky QLD switch in the council rack in the council chambers. Everything from this point on will be owned and controlled by Stanbroke.

2.3 Network IP Ranges

There will be several networks built into Project Downpour to ensure security and performance. Wi-Sky QLD will work in conjunction with Stanbroke IT department to finalise the proposed details below (Refer to Table 2).

Table 2: Proposed Networks

Network	To be used by
Guest	Guests on properties
Staff	General staff
Corporate LAN	Management Staff
Network Management	Wi-Sky QLD

Stanbroke will be supplied with complete documentation of the network that any competent IT professional would be able to understand.

2.4 Network Tower Summary

The proposed Project Downpour network will consists of several individual links connected together. Each link is represented by a letter from A to E (Refer to Table 3).

Table 3: Individual links and number of towers proposed by Project Downpour

Link	Number of towers
Main Backbone (A)	18
Augustus Downs Link (B)	3
McAllister Link (C)	1
Glenore Link (D)	1
Miranda Link (E)	8

2.5 Wireless Link Performance

The performance of the complete wireless system has been simulated using industry standard software. The system has been designed to provide an average of 100mb/s total throughput 95% of the time, aiming for greater than 99% uptime (best effort).

The software to simulate the links is called Link Planner and is widely used to simulate these types of links (Refer to Figure 1). A separate link planner generated report detailing the performance of each part of the link will be submitted along with this report.

Figure 1: Link Planner software used to simulate the links, which are widely used to simulate these types of links.

2.6 Fibre Backhaul

The fibre backhaul will provide high speed connectivity to the network. Wi-Sky QLD will provide the service to Stanbroke at an initial 100mb upload/download speed. This connection can be increased in speed (for an additional cost) at any time if Stradbroke's requirements change.

2.7 Security

Security is a critical component of any network. Project Downpour will be secured in the following ways

2.7.1 Wireless Link Security

All wireless links will be secured using industry standard encryption. The links will all have separate passwords to ensure maximum security. These passwords will be provided to Stanbroke

2.7.2 Physical Security

All enclosures will be physically secured with locks to reduce the chances of tampering

2.7.3 Logical Security

All networks will be segregated to ensure that unauthorised parties do not have access to Stradbroke's corporate network. Wi-Sky QLD operate on the principal of limiting access to the network to only what is absolutely required to meet their responsibilities and as such will only have access to the management network of Project Downpour with no access to any of Stanbroke's networks.

2.8 Other uses for the Network

Connectivity is such a major issue in north west Queensland and it is very likely that other opportunities will arrive for Stanbroke to increase their ROI from this network.

3 Project Timeline

3.1 Milestones

Total length of the project is estimated to be around 31 weeks and is split into several milestones.

Table 4: Project Downpour Milestones

Milestone	Estimated completion time
Order and Deliver	6 weeks
Assembly and Configuration	3 weeks
Site preparations	8 weeks
Construction phase 1	2 weeks
Construction phase 2	8 weeks
Construction phase 3	4 weeks

3.1.1 Order and Deliver

After initial approval of the project, all required components need to be ordered and delivered to either their respective sites or a central location. Landholders will be contacted by Stanbroke to obtain the required permissions to install the required towers and Stanbroke will provide land access to the required sites as needed. The fibre optic cable connection will be ordered along with a temporary NBN connection for use while the main fibre connection is being provisioned.

3.1.2 Assembly and Configuration

After all required components have arrived at the appropriate location, construction of the solar power systems and configuration of the radio equipment will be performed. The aim will be assemble and configure the equipment in a central location to reduce the time that is required on site for towers that are not located on Stanbroke properties.

3.1.3 Site Preparation

From the initial go ahead, site preparation can begin immediately after permission is obtained from the landholder. Any required tracks and pads for the towers can be graded and cleared in conjunction with Stanbroke.

3.1.4 Construction phase 1

The first construction stage is to connect the first property to the main connection at the Council chambers. This will involve building a tower on a hill in Cloncurry and will require permission by Cloncurry council.

3.1.5 Construction phase 2

After phase 1 is connected, the second stage of construction is to connect the remaining stations with the exception of phase 3.

3.1.6 Construction phase 3

The final construction stage is to connect the remaining stations to the network. One repeater is mounted on the Normanton water tower and will require permission from Carpentaria Shire Council.

4 Equipment

There were several pieces of communications equipment needed to complete each tower to enable the wireless link to run.

4.1 Towers

4.1.1 Tower Design

The towers that we are planning are based on the tried and tested design developed by Wi-Sky QLD and will be deployed in three different heights. These heights are 9m, 12m and 15m depending on the requirements of the site. The towers are a lattice mast design selected for their strength and ease of installation (Refer to Figure 3).

The towers will predominately be solar powered. The solar system is designed to run each tower for approximately one week without any sun. The towers are stayed for maximum strength.

Each tower will have the following:

- Radio equipment as required
- Solar power system (or mains with battery backup if available)

Access and a cleared pad for the tower is required and Wi-Sky QLD will work in conjunction with Stanbroke to organise this.

Figure 2: Tower Design

4.1.2 Proposed Tower List

Each of the proposed tower locations will be inspected to confirm suitability and access and will require the appropriate landholder's permission (Refer to Table 5).

Table 5: Proposed towers will have the following details.

Tower	Tower Height
A0	15
A1	15
A2	15
A3	15
A4	15
A5	15
A6	15
A7	15
A8	15
A9	15
A10	15
A11	15
A12	15
A13	15
A14	15
A15	15
A16	15
B0	15
B1	15
B2	15
C0	15
D0	15
E0	15
E1	15
E2	15
E3	15
E4	15
E5	15
E6	15
E7	15
E8	15

4.2 Radios

The radios that provide the network connection are the most critical part of the design. Wi-Sky QLD proposes that the radios will be along the lines of the Ubiquiti Rocket ac Gen 2 RP-5AC-Gen2 (Refer to Figure 3).

Figure 3: Ubiquiti Rocket ac Gen 2 RP-5AC-Gen2.

4.3 Network Switches

Two network switches will be used along the system, depending on whether the tower is solar powered or not. These switches will be similar to the Netonix WISP Switch for solar powered towers and Ubiquity EdgeRouter for mains powered towers (See Figure 4).

Figure 4: Netonix WISP Switch and Ubiquity EdgeRouter.

5 Results and discussion

There are several individual actions that need to be undertaken to complete the project.

5.1 Landholders Permission

Permission will be required from external landholders, subject to final tower placement.

Stanbroke will obtain permission from the landholders to build the required towers. Wi-Sky QLD has a landholder access agreement that can be shared with Stanbroke to ensure that all access requests have a formal agreement that cannot be revoked without reason or notice.

Once land access is finalised Wi-Sky QLD will perform an inspection of each site to identify any potential issues. Wi-Sky QLD will comply with any requirements of the landholder before entering their property.

5.2 Station Installations

Every Stanbroke station in this project will be connected to the network by building either a tower near the station homestead or vertical mast on a tall structure such as a shed (Refer to Figure 5 for a typical house or shed installation). The radio equipment will be connected to a socket inside a designated building to provide access to the network. A small rack may be installed to contain a UPS to continue operating if mains power is lost.

If Wi-Sky QLD is requested to install networking equipment supplied by its IT company this will be as per a separate agreed quote after a site inspection.

Any WIFI could be configured as follows depending on Stanbroke's requirements. These networks would be centrally managed to allow full control by Stanbroke's IT department (Refer to Table 6).

Table 6: Sample WiFi configurations

SSID	Purpose
Stanbroke guest	Free WIFI for all visitors. It would be heavily shaped and have content filtering
Stanbroke staff	This network would be for non-management staff to access personal things such as social media. It would also have content filtering.
Stanbroke management	Network that provides full access to Stanbroke corporate network equivalent to the main office for station managers

Figure 5: Typical house installation.

6 Ongoing Management and Monitoring

Wi-Sky QLD will provide both a monitoring and management service to Stanbroke for this network for an initial period of three years, continuing indefinitely as agreed. This will include monitoring, basic configuration changes and consulting for simple changes or expansion of the network.

6.1 Data Results

Data will be most likely managed through UniFi and Cambium Networks, which are the network management and monitoring system used by Wi-Sky QLD. Wi-Sky QLD will collect a variety of data and statistics such as data usage and type of data, speed and reliability that can be analysed and used as a base for future projects of a similar nature.

6.2 Monitoring

The monitoring service provided by Wi-Sky QLD to Stanbroke will include:

- Automatic and manual monitoring of the status of the network
- Co-ordinating preventative management
- Identifying any issues if they occur and resolve the issue by following the problem resolution process

6.3 Maintenance

Wi-Sky QLD will work with Stanbroke to co-ordinate and if requested on a cost recovery basis perform an annual inspection of the network with the aim of ensuring maximum uptime.

This would typically include

- Cleaning the solar panels
- Looking for any damage to the tower including bird damage
- Load testing batteries

6.4 Problem Resolution Process

The network is expected to have some minor disruptions during the initial setup, however the continual monitoring of the system will aim to make these disruptions minimal and resolve them quickly. Any issue will be reported by the following process:

1. Fault reported by Stanbroke or detected by Wi-Sky QLD (whichever is first)
2. Wi-Sky QLD confirms fault
3. Notification of Stanbroke contact of issue
4. Exact nature of fault determined remotely
5. Plan put in place for fault to be rectified
6. Wi-Sky QLD, contractor organised by Wi-Sky QLD or Stanbroke employee under Wi-Sky QLD instruction travels to the site with hot spares to rectify fault
7. Fault rectified
8. Report provided to Stanbroke contact

6.5 Potential Faults

Weather is likely to be an issue that may cause possible outages. Unpredictable storms and wild weather may mean a loss of power or equipment damage. In cases of weather disruptions all reasonable steps will be taken to get the connection back up and running as soon as possible (weather and road conditions permitting).

Wi-Sky QLD have found that birds such as cockatoos, corellas and budgies can chew and damage cables. Although the cabling will be protected with an extra casing, it is still a possibility for them chew through over a long period of time.

Though not expected to be an issue, all equipment has a possibility of failing. This can be due to an existing fault from the manufacturer or human error in installation or the maintenance process.

6.6 Hot Spares

There will be several sets of spare equipment stored at agreed locations along the path of the network. These spares will be used in the event of any equipment failure to minimise downtime.

7 Conclusion

Project Downpour will enable Stanbroke to take advantage of modern technologies and provide the connectivity that is expected by staff. It will place Stanbroke in a strong position going into the future.

The project successfully achieved a detailed proposal including work schedule and costings for the Stage 2 connectivity solution. Specifically, a connectivity configuration is proposed across Stanbroke properties supplied by Stanbroke in conjunction with Wi-Sky.

The next stage of this project is proposed to evaluate changes in internet and technology use across the stations in terms of work and personal usage, specifically data use; download speeds; bandwidth; latency comparisons; reliability of service (including downtime). In addition, it is proposed that future work should evaluate and validate the potential benefits of connectivity, including safety, training and attracting people to the industry.

The next R&D phase will focus on a High-Speed Wireless Link System solution consisting of a network of wireless towers starting in from Cloncurry and running through to Miranda Downs will be built by tapping into Wi-Sky QLD's existing fibre optic connection that runs through the region.

8 Recommendations

The next stage of this project is proposed to evaluate changes in internet and technology use across the stations in terms of work and personal usage. This will include post-installation assessment of the following;

- Data use
- Download speeds
- Bandwidth
- Latency comparisons
- Reliability of service (including downtime).

While also monitoring improvements in functionality, identifying challenges, quantifying connectivity improvements and benchmarking to industry standards. It is predicted that productivity gains will be demonstrated by improved safety and faster response times, higher accountability for managers in regards to equipment, livestock, staff and other management practices, increased uptake of staff training and personal development as well as real-time industry and community feedback in areas where this is not currently possible.

In addition, it is proposed that future work should evaluate and validate the potential benefits of connectivity, including:

i) Safety
   - Increase the ability to make call from any point in which is connected to the network, if there is an emergency then all we need to do is get to a watering point and they can make a phone call for help.

- Similar if someone is hurt in a cattle yard (High Risk Area) it's a phone call to the homestead.
- GPS tracking of all equipment can be achieved with the network.

ii) Training

- Webinars and video conferencing will be able to roll out MLA training and initiates.
- Follow up training and re-watching of video content.
- Currently limited remote access to work on computers to fix problems. Fixing IT problems over the phones is tedious at best.
- If we have a problem we can YouTube it.
- Staff can study online upskill
- School of the air can run efficiently

iii) Attracting people to the industry

- Having the ability to offer high-speed internet to people attaches people to the regional areas.
- If people can Skype/Facebook/Whatsapp/Wechat their family or friends it can reduce isolation.
- Having a technological advanced business keep a different type of people engaged in their jobs.
- Having high-speed internet will allow ringers to get there camp draft entries in on time.