final report

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High speed wireless link (with solar infrastructure) evaluation pilot (Qld Beef Producer: Case Study)

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Abstract

Internet and connectivity are one of the biggest issues currently facing the rural and regional communities of Australia. With regional Australia contributing to nearly a quarter of Australia's small businesses and employing one in three Australians, it is extremely difficult to get access to the same level of connectivity as in major cities. It is crucial that these communities be given the same connectivity opportunities as their urban counterparts to be able to run their businesses and to enable them to grow.

A Qld Beef Producer Station is a small enterprise business that has limited connectivity capability and capacity due to the lack of adequate and reliable internet service. With over 60,000ha of land and up to 8000 head of cattle, the internet is needed daily as a tool for communications and services to help in running the business. However, lack of connectivity has reduced their ability to grow and invest in technology to innovate.

A High-Speed Wireless Link System consisting of a network of wireless towers starting in Richmond and running through to the Qld beef producer's station was built tapping into Wi-Sky's existing fibre optic connection in the town of Richmond.

To ensure the success of the project several simulations were run to establish the best path of the towers and the most suitable equipment and tower design. The optimal design was five towers with radios, batteries, solar panels, brackets and cabling along with other equipment were required to cover 138kms between the network origin and end. There were several existing towers which saved on installation costs and time and the other towers had the same installation process of sourcing a site, erecting the tower, attaching the equipment and setting up the connections. Installation was successfully completed and tested in June 2018.

The overall objectives of the project was to evaluate and demonstrate how a connectivity system can work in parallel with Skymuster. The pilot demonstrated how this parallel system provides a wider connectivity solution than just Skymuster in isolation. The project evaluated a pilot connectivity solution, which has been installed at a Qld Beef Producer Station, over several testing quarterly phases and provide quarterly reporting for a two-year period on the following:

- Data used (when, peak, what used for)
- Bandwidth (Aiming for 40mb up and down, can be more)
- Speed (max, min, average, ideal) (Latency comparison)
- Reliability of link including down time
- Benefits of video instead of tank levels etc
- Additional value adoption

This project has demonstrated that it is possible to build a wireless network to a remote cattle station. Furthermore, it is also possible to do so cost-effectively and reliably. The equipment that is now available on the market is able to handle the harsh outback environment and perform admirably. The benefits from this project for the Qld beef producer were not only to increase business productivity and communications, but also improve quality of life for staff being able to better access educational, social and health resources.

Executive Summary

This project provides a case study developed of the connectivity solution and the outcomes of the testing and evaluation period for MLA website (at the end of the installation and commissioning phase and then updated again at the end of the two years). Over the course of the project, the performance of the system has been mostly consistent with what was anticipated, with some minor disruptions due to weather, one major disruption during the North Queensland flooding event in February 2019 and some other uncontrollable factors. The Qld beef producer has also been able to introduce new remote monitoring technologies while providing their staff with connectivity.

A majority of the disruptions were due planned and unplanned Ergon planned power outages. This further reinforces/supports the need for a solar powered solution being more favourable due to less uninterrupted supply of power. During Ergon power outages, once we become aware of them it is easy to run a generator at the tower site to restore connectivity along the line.

This project has demonstrate that it is possible to create a simple, reliable and low-cost wireless link that can deliver significant benefits to beef producers throughout Australia. The project also measured and compared the benefits of Wi-Sky QLD to a standard Sky Muster NBN connection. A snapshot of connectivity data usage breakdown was collected automatically based on actual real time usage for the evaluation of the project and data was summarised monthly and presented in the reports.

It is clear from the measurement and monitoring of data usage that it will be challenging to interpret the data in ways to convert this type of data into business improvement & profitability metrics that can be reported on more broadly. This is evidenced by the fact that there were wide and varied views shared amongst the MLA Connectivity Group on the way the dashboard categories might be interpreted, in terms of business usage and/or social applications. The provider (Wi-Sky) was invited to speak at the MLA's Digital Forum (Red Meat 2018 on 23rd November). There was an opportunity at Red Meat 2018 industry forum to start to share these experiences & deriving benefits from establishing connectivity and what types of business improvement problems that were being solved by enhanced connectivity (See Appendix 3). It is expected that by customising & re-classifying the "data traffic" categories associated with red meat production over time is a good place to start to derive more useful meaningful data.

This project has demonstrated that it is possible to build a wireless network to a remote cattle station. Furthermore, it is also possible to do so cost-effectively and reliably. The equipment that is now available on the market is able to handle the harsh outback environment and perform admirably.

This project has also demonstrated the need for high speed internet connectivity for a cattle stations with existing satellite services simply not being adequate. It is not enough to simply say "they don't need streaming services like Netflix" - how can they able to attract and keep staff if they cannot provide what is considered a basic service in the city?

The benefits from this project for the Qld beef producer were not only to increase business productivity and communications, but also improve quality of life for staff being able to better access educational, social and health resources.

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1 Background

1.1 Scope & purpose

With the owners located in Sydney, it is essential for the station to have an internet service that was fast and reliable to allow communication with the station managers regarding daily operations. Telemetry, Cloud Services and Mapping are just some of the key components of a Qld Beef producer Station's business that relies on an internet connection. For operations to improve, the network needed to be capable of handling further use. The owners also require high speed connectivity when they are located at the Qld beef producer's station to continue managing their other businesses.

Having a suitable service was also critical for educational purposes. With children currently attending the school of distance education, the managers and their families needed a service that could support the school's requirements, in particular video conferencing, so that they were able to stay together and not lose valuable time spent travelling or living away for the children's education. Health and social access were also important for the station and the staff to ensure retention and general wellbeing.

The station was already connected to NBN Sky Muster (Satellite) but the service was inadequate for their needs. It lagged, was unreliable, was slow to upload, and didn't have enough data for use during business and school hours. See Table 1 for Sky Muster's biggest and smallest plans available.

Table 1: Sky Muster's biggest and smallest plans available.

Plan	Cost	Upload Speed	Download Speed	Peak/Off-Peak	Latency
Biggest Sky Muster Plan: **Fastest Standard 300GB**	$130 p/m	Up to 5MB/s	Up to 25mbps (average speed of 17MB/s at night)	150GB/150GB	>500mS
Smallest Sky Muster Plan: **Faster Standard 85GB**	$34.95 p/m	Up to 1MB/s	Up to 12MB/s (average speed of 8MB/s at night)	15GB/70GB	>500mS

After much consultation with the Qld beef producer's management and armed with local knowledge of the Wi-Sky service and its unprecedented accomplishments throughout the local area, it was proposed to Wi-Sky Qld to build a high-speed wireless network to leverage the existing system and connect the station more efficiently.

The undertaking and success of this project would enable similar projects around the area to take place and further produce benefits to not only the local community but also the Australian agriculture industry. By objectively measuring the connectivity needs of a typical cattle station in northern Australia, valuable data can be collected and used to find technology-based solutions for common problems. See Table 2 for Wi-Sky QLD's biggest and smallest plans available.

Table 2: Wi-Sky QLD's biggest and smallest plans available.

Plan	Cost	Upload Speed	Download Speed	Peak/Off-Peak	Latency
Maximiser	$330 p/m	Up to 60MB/s	Up to 60MB/s	N/A	< 50mS
Standard	$160 p/m	Up to 40MB/s	Up to 40MB/s	N/A	< 50mS
Minimum	$110 p/m	Up to 20MB/s	Up to 20MB/s	N/A	< 50mS

This project involved the creation of a pilot connectivity solution and provide quarterly reporting for a two-year period on the following:

- Data used (when, peak, what used for)
- Bandwidth (Aiming for 40mb up and down, can be more)
- Speed (max, min, average, ideal) (Latency comparison)
- Reliability of link including down time
- Benefits of video instead of tank levels etc
- Additional value adoption

1.2 Project objectives

The overall objectives of the project will evaluate and demonstrate how a connectivity system can work in parallel with Skymuster. The pilot will demonstrate how this parallel system provides a wider connectivity solution than just Skymuster in isolation.

This phase of the project will evaluate a pilot connectivity solution that has been installed at a Qld Beef producer station and provide quarterly reporting for a two-year period on the following:

- Data used (when, peak, what used for)
- Bandwidth (Aiming for 40mb up and down, can be more)
- Speed (max, min, average, ideal) (Latency comparison)
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- Additional value adoption

At the conclusion of the project there will be a case study developed of the connectivity solution and the outcomes of the testing and evaluation period for MLA website (at the end of the installation and commissioning phase and then updated again at the end of the two years).

2 Methodology

The Qld Beef producer pilot connectivity solution was evaluated over the period of the project on the following key functionality attributes:

- Data used (when, peak, what used for)
- Bandwidth (Aiming for 40MB up and down, can be more)
- Speed (max, min, average, ideal) (Latency comparison)
- Reliability of link including down time
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Data usage was collected using two systems, Wi-Sky's internal ISP management system that records data usage and using a Unifi USG to breakdown the internet traffic into categories.

2.1 System Design

Before commencing the Qld Beef producer Station high-speed wireless link project, a full design for the anticipated network was completed. This design process included mapping and site inspections to determine the following steps needed to meet the requirements of the project. These were:

1. Select the correct wireless path for the project
2. Design towers that will be used to mount the network equipment on
3. Choose equipment that can provide the required speed
4. Create the network to ensure privacy and optimum performance

This resulted in being able to create a complete wireless path and a list of components required to make the link. The system design had the following key design features and statistics (See Table 3):

Table 3: Wi-Sky's connectivity solution key design features and statistics.

Total number of Towers	5
Total link distance	138km
Total batteries	8
Total radios	10
Expected latency	20mS
Number or Ethernet switches	6

2.1.1 Wireless Path

The correct wireless path was critical to get the required performance. To provide the best connection, a path going from the township of Richmond through to the Qld Beef producer's station was created. After several simulations, the following path as seen in Figure 2 was decided as the final wireless link path. The wireless link was simulated using industry standard tools to evaluate its performance.

An elevation profile over the path of the wireless link, as seen in Figure 1 was also assessed to show the geography of the land to allow for the most successful tower placement.

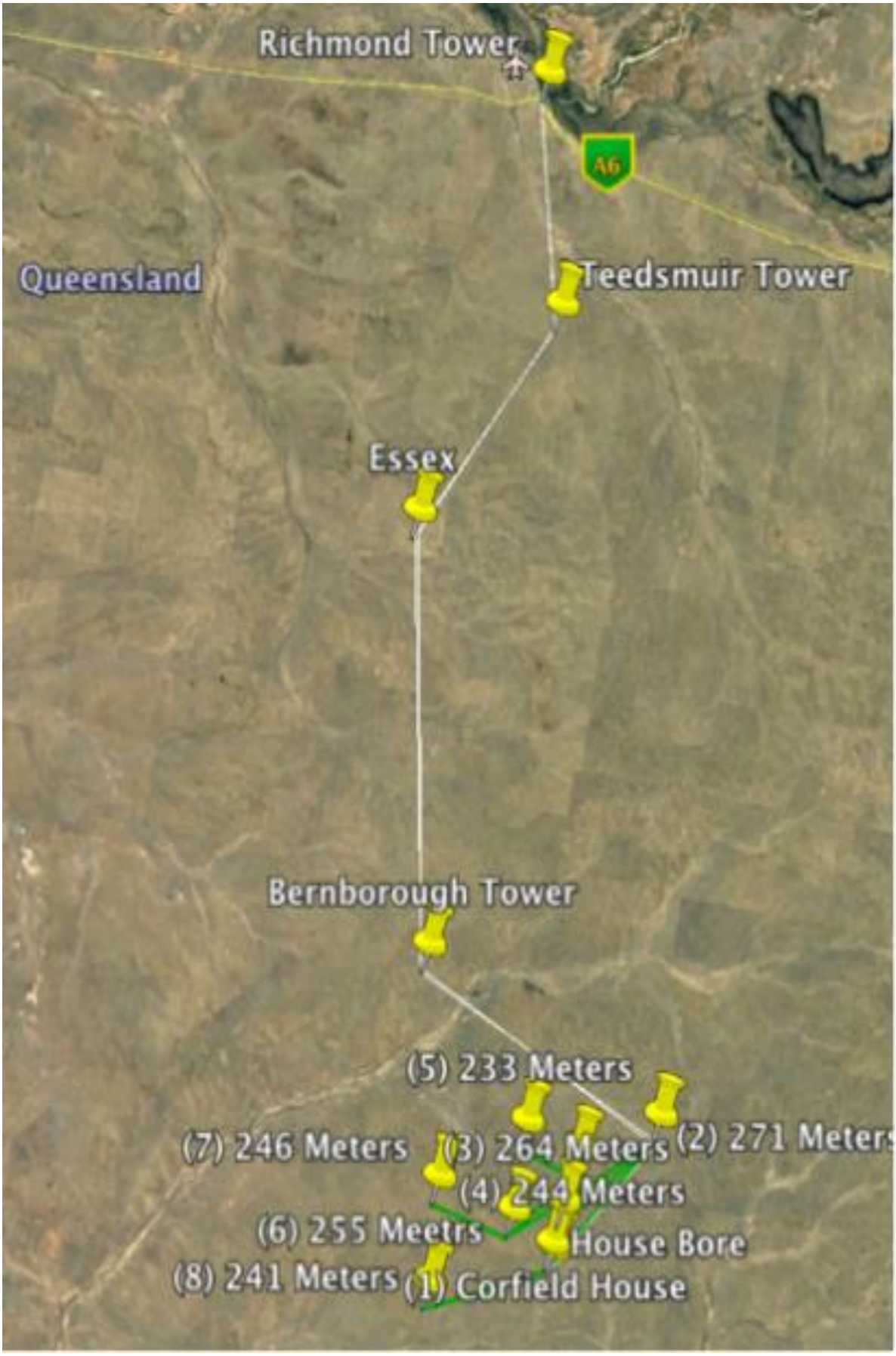

Figure 1: Site map showing the final path of wireless link at a Qld Beef Producer's Station.

Figure 2: Wireless link elevation profile.

2.1.2 Tower Design

To provide the connectivity to the station for this project, five towers were required to cover the distance between the network origin and end. Based on experience gathered through the daily operation of Wi-Sky QLD, the best design for towers in this instance are three or four legged towers such as the tower pictured in Photo 1. These towers were sourced as part of each tower installation.

Photo 1: An example of the connectivity tower design.

2.1.3 Richmond Water tower

The Richmond Tower was already part of Wi-Sky's existing infrastructure and so this tower only needed one new radio facing south towards the Tweedsmuir Tower and to be connected to a network switch in Wi-Sky's data rack (See Photo 2).

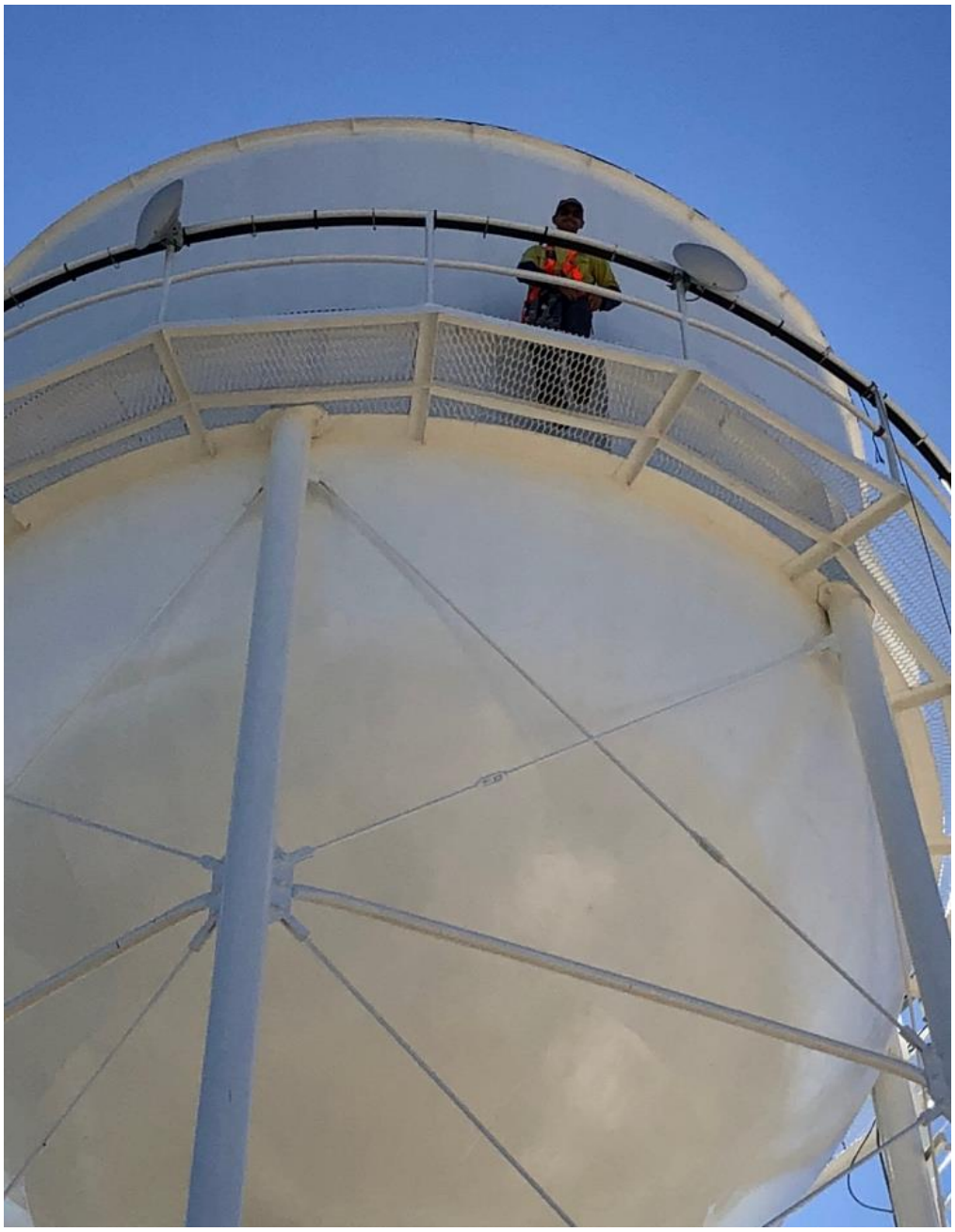

Photo 2: Water Tower in Richmond.

2.1.4 Tweedsmuir Tower

The Tweedsmuir Tower is a stand-alone solar powered tower that will connect north to Richmond and south to Essex Tower. The tower has two x 160aH batteries, a solar regulator and one 250-watt solar panel. The radio equipment will be connected by a Netonix switch (See Photo 3 and 4).

Photo 3: Site before the Tweedsmuir tower was constructed and commissioned.

Photo 4: Final alignment of dish commissioned on the Tweedsmuir tower pointing towards Essex.

2.1.3 Essex Tower

The Essex Tower is a mains powered tower that will connect north to Tweedsmuir Tower and south Bernborough Tower. The tower will be powered via mains power at the Essex Station homestead and the radios will be connected by a Ubiquity Edge router (See Photo 5).

Photo 5: Final alignment of dish commissioned on the tower located at Essex.

2.1.4 Bernborough Tower

The Bernborough Tower will connect north to Essex Tower and south east to the station's Tower. The tower will be mains powered at the Bernborough Station homestead with the radios connected via a Netonix switch (See Photo 6 and 7).

Photo 6: Tower under construction at Bernborough.

Photo 7: Final alignment of the Bernborough

2.1.5 Tower

The station's Tower is a stand-alone solar powered tower that will connect to Bernborough Tower and to the Qld Beef Producer Station homestead which will have Cambium ePMP 200 radio on it (See Photo 8). The tower has two x 160aH batteries, solar regulator and one 250-watt solar panel. Radios were be connected by a Netonix switch.

Photo 8: Tower construction at station.

2.2 Equipment and specifications

There were several pieces of communications equipment needed to complete each tower to enable the wireless link to run. Refer to Table 3 for equipment required for each connectivity tower installation for a description of each of the required equipment used for each connectivity tower solution.

The radios that provide the network connection are the most critical part of the design. There are two different types of radios that were used for this project.

Table 3: Equipment required for each connectivity tower installation.

Equipment	Description	Specifications
Ubiquiti PowerBeam 5AC 620 radios	Used for links shorter than 20km.	
Cambium ePMP 200 radios	Used for internal links on Qld Beef producer Station	
Ubiquiti Rocket ac Gen 2 RP-5AC-Gen2 with 34dBi antenna radios	Used for links greater than 20km.	
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 the Netonix WISP Switch for solar powered towers and Ubiquity EdgeRouter for mains powered towers.	 

2.3 Network Design

The final network design was established after consultation with Wi-Sky. To ensure that performance can be monitored and reported on, all data was routed via a network VLAN on Wi-Sky's infrastructure VLAN, 303.

Each of the devices on the network also has their own IP address (refer to Table 4).

Table 4: IP address setting for each of the connectivity tower solutions at the beef producer station.

Tower	Device Name	Type	IP Address
Richmond	Richmond to Tweedsmuir	Ubiquity PowerBeam 5AC 620	10.70.1.108
	To Richmond	Ubiquity PowerBeam 5AC 620	10.70.100.21
	Switch	Netonix WISP Switch	10.70.100.11
	To Essex	Ubiquity Rocket ac Gen 2 RP-5AC-Gen2	10.70.1.115
Essex	To Tweedsmuir	Ubiquity Rocket ac Gen 2 RP-5AC-Gen2	10.70.1.122
	Switch	Unifi EdgeRouter	10.70.100.12
	To Bernborough	Ubiquity Rocket ac Gen 2 RP-5AC-Gen2	10.70.1.121
Bernborough	To Essex	Ubiquity Rocket ac Gen 2 RP-5AC-Gen2	10.70.1.235
	Switch	Netonix WISP Switch	10.70.100.17
	To Tower	Ubiquity Rocket ac Gen 2 RP-5AC-Gen2	10.70.1.238
Tower	To Bernborough	Ubiquity Rocket ac Gen 2 RP-5AC-Gen2	10.70.1.240
	Switch	Netonix WISP Switch	10.70.100.18
	To House	Ubiquity PowerBeam 5AC 620	

2.4 Additional Installations

On April 11 2019, a standard Wi-Sky QLD installation was completed at Narollah Station, which was purchased and joined to the Qld Beef producer Station. An Ubiquiti PowerBeam 5AC 620 radio was installed to face the radio on the station's Tower to provide internet to the main house. The connection directly connected the two homesteads and allow files sharing and print from both locations.

2.5 Telemetry

A decision was made by the Qld beef producer's management after the installation of their Wi-Sky connection to deploy a telemetry system over the entire station. Eight uSee IP based tank sensors were installed (See Photo 9). In addition, WIFI was installed at every tank so that calls can be made in case of an emergency. The installation of this system would not be possible without the high speed Wi-Sky backhaul (See Site map at Appendix 1 showing the strategic locations of uSee tank sensors).

Photo 9: uSee IP tank monitor with camera and WIFI.

3 Results and discussion

3.1 Performance of System

Data was collected, stored and managed through UniFi and Cambium Networks, which are the network management and monitoring system used by Wi-Sky QLD. Data was also collected and analysed through Splynx, an ISP management system Wi-Sky Queensland uses to manage their customers and network.

Data that was collected as part of the evaluation test cycle included:

- Data Usage
- Bandwidth
- Speed
- Reliability
- Measurement & Monitoring: Dashboard

Technical input provided on the dashboard and interpretation of the impacts of data usage and applications the data was used for.

3.2 Data usage

One of the aims of this project was to gain an understanding of what data is being used. Through the use of a USG (Unifi Security Gateway), deep packet inspection was performed allowing a breakdown into different categories of data usage (See Figure 3). The removal of data limits at the beef producer's station has meant that the individual users have choose to do what with the internet without any restrictions.

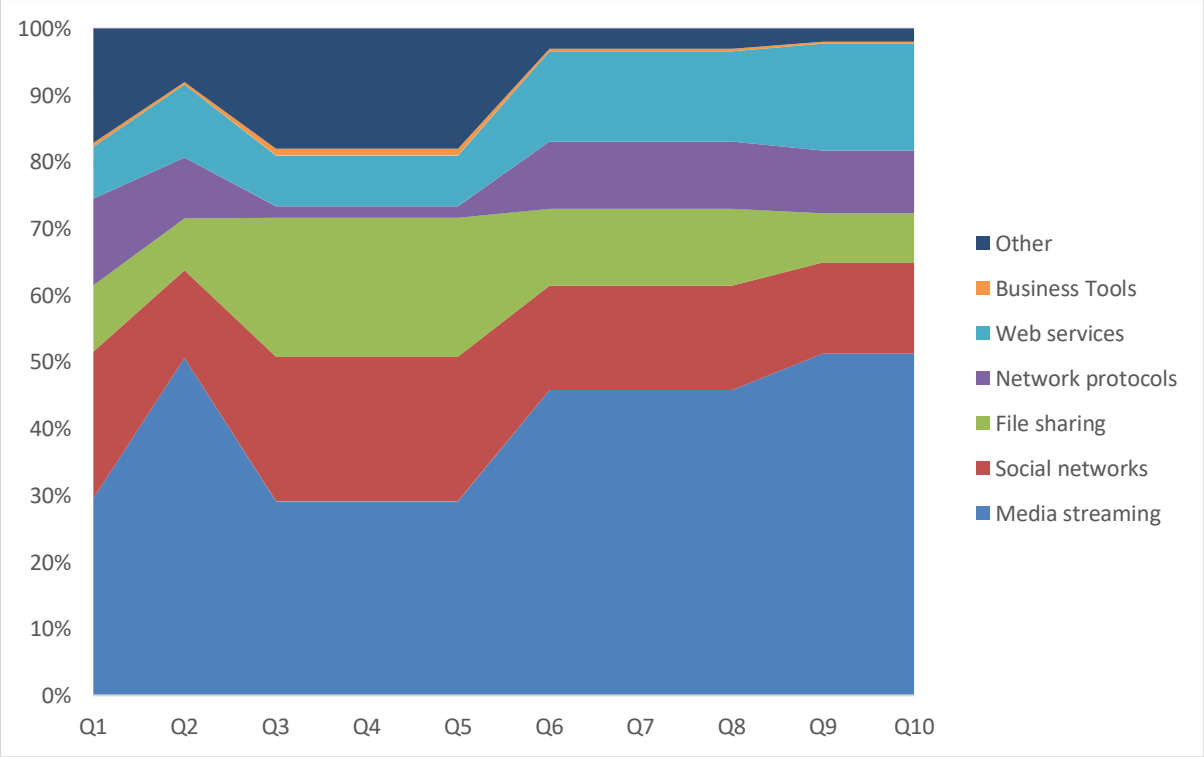

Figure 3: Internet data breakdown for the Qld beef producer's station.

It is easy to see that video streaming is the largest consumer of data. By offering unlimited data consumption to staff, the beef producer has found it easier to attract staff. This is viewed by the managers as a competitive advantage.

Beef producer uses an average over the year of 523gb/month however this has significantly increased throughout the year as more and more cloud-based services are beginning to be integrated into the business. This averages out to about 17.5gb/day. The breakdown of this data usage is shown in the graphs below (See Figures 4 & 5 for the most recent quarterly testing period).

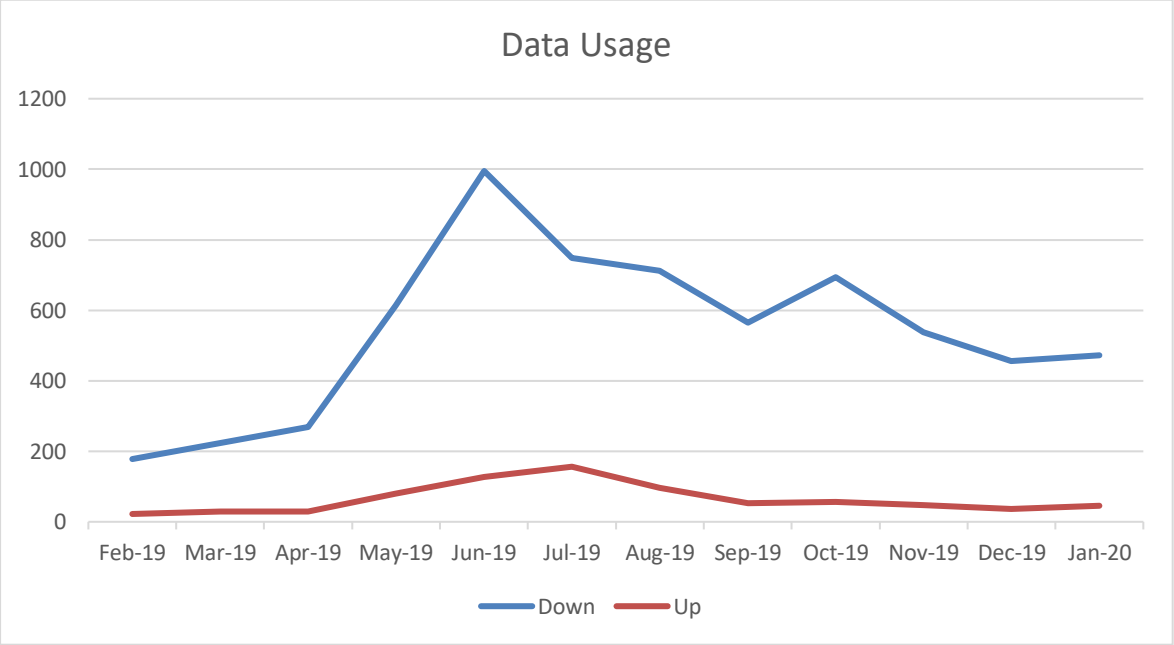

Figure 4: Estimated data usage amount per month for Corfield (16 November 2019 to 15 February 2020).

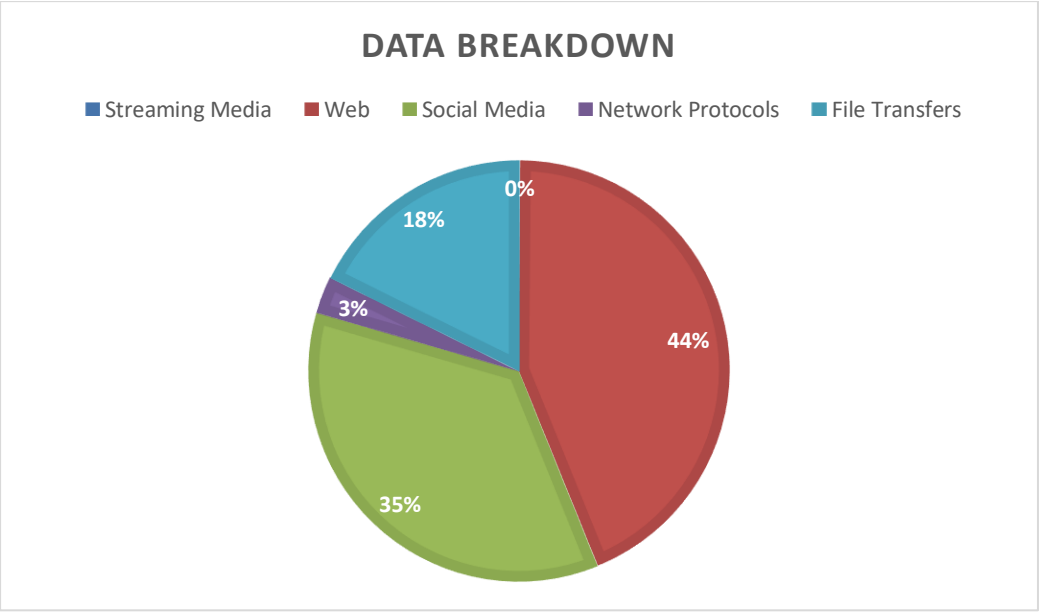

Figure 5: Estimated data usage by type and amount per day for Corfield (16 November 2019 to 15 February 2020).

3.3 Data Consumption

Over the periods of the project where data was being collected (608 days), the Qld beef prodcuer used a total of 8,878gb download and 1,190gb upload. This averages out to over 14.6gb per day download and 1.95gb per day upload (See Figure 6 and 7).

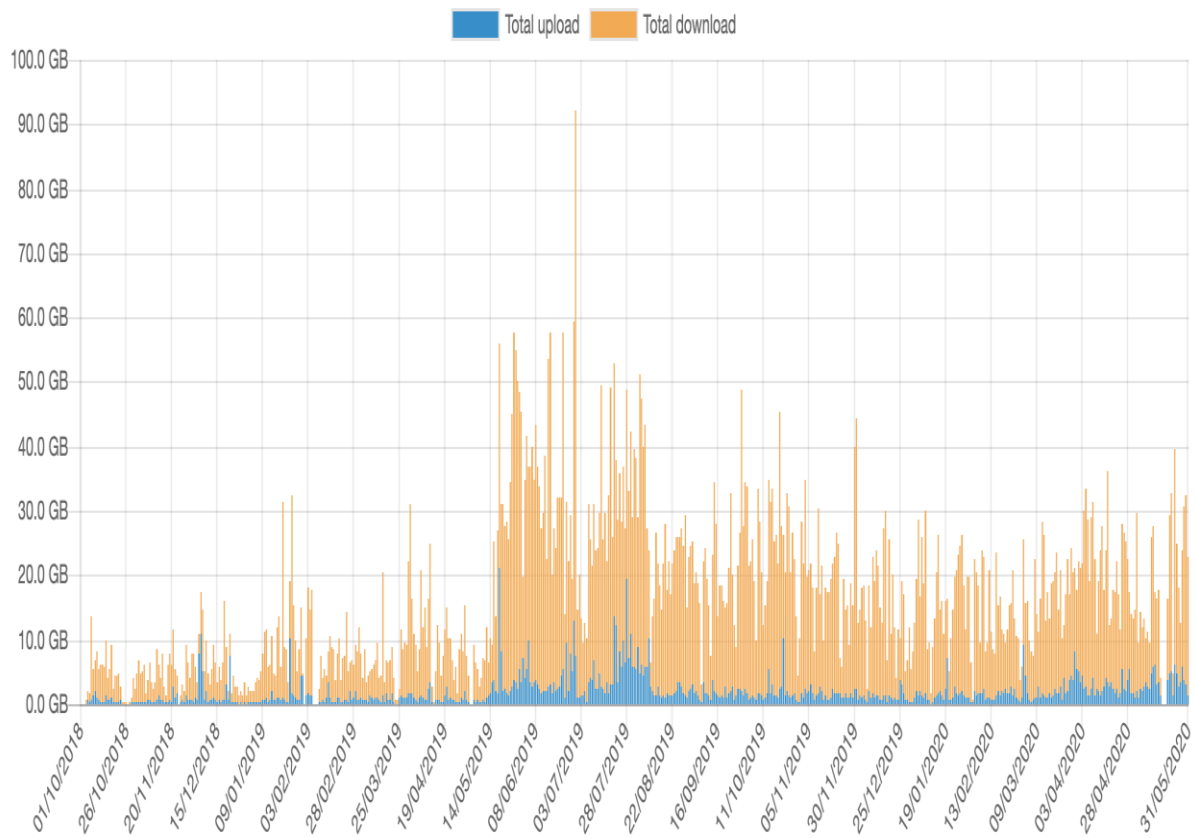

Figure 6: Data usage throughout the entire evaluation over two years.

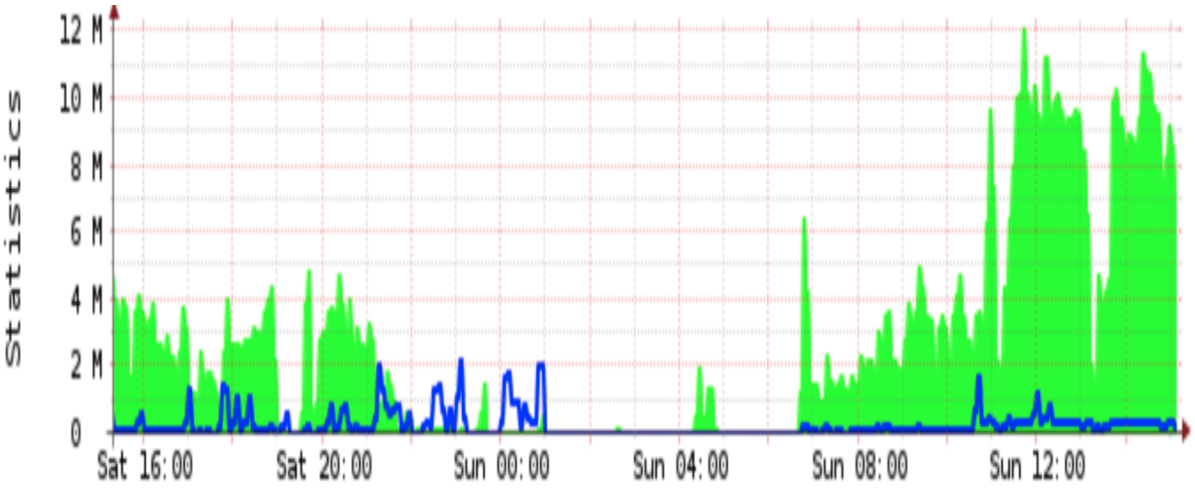

Figure 7: Typical daily data usage at the Beef producer station.

The highest metred plan Skymuster plan that is available at the time of writing would provide 150gb download during peak times and another 150gb during off peak times (7am to 1am). Assuming that data is consumed during NBN's peak hours (as evidences by the figure below), this would give the producer approximately 15 days of usage before they are fit with extremely expensive excess data fees.

In this case, the fear of getting charges these fees had a material effect on their internet usage before this project was started.

3.4 Bandwidth

The current plan the Qld beef producer has selected is Wi-Sky QLD's Minimum for properties and has remained unchanged for the duration of the project i.e. $110 per month (See Table 5).

Table 5: Monthly payment plan at the Qld beef producer's station.

PLAN	DOWNLOAD SPEED	UPLOAD SPEED	DATA ALLOWANCE	PRICING INC
Minimum	20 MB/s	20 MB/s	Unlimited	$110/month

3.5 Speed

Over the period of the project, the wireless link to the station produced the following average link speeds (see Table 6).

Table 6: Downlink Speeds of various connectivity tower solutions.

Link	Signal Strength	Downlink Speed	Uplink Speed
Richmond Towns to Tweedsmuir Tower	-50/-49	234MB	255MB
Tweedsmuir Tower to Essex Tower	-58/-59	129MB	132MB
Essex Tower to Bernborough Tower	-66/-66	229MB	248MB
Bernborough Tower to Tower	-64/-63	189MB	186MB
House	-75/-75	40MB/s	40MB/s

This performance is in line with expectations. This allowed the speeds of 20-40MB/s to be consistently made available to the Qld beef producer's station.

This performance is in line with expectations although due to the distance between Essex and Bernborough and the station and Bernborough, speeds were limited to only 63mb. This allowed the speeds of 20-40MB/s to be made available to the beef producer's station.

3.6 Reliability

The network as expected over the quarters have experienced a handful of Planned and Unplanned Ergon Energy disruptions which can sometimes be monitored through the Ergon Outage Finder (https://www.ergon.com.au/network/outages-and-disruptions/power-interruptions/outage-finder), however these have had no noticeable impact on the service with the exception of when the power supply is cut off from the homestead.

3.6.1 Outages

Any outages that did occur in the wireless link typically were resolved in less than 24 hours. The following outages occurred (See Table 7):

Table 7: Data outages & system failure.

Date	**Cause of problem**	**Outage Length**
02/02/2019	Major damage to a Wi-Sky tower from major flooding event	One day
10/03/2020	Major power outage in North West Queensland including Richmond	Four hours

Overall, the average uptime of the wireless link to the beef producer's station was estimated at 99.5%. This is roughly consistent with the performance on the NBN Skymuster service.

3.7 Existing Skymuster connation

After much discussion, it was agreed with the Qld beef producer to keep their existing Skymuster connection over the duration of the project to evaluate if the service would be used in conjunction with the Wi-Sky connection and as a backup. Over the period of the project, the connection was only ever used during the short periods that there was a Wi-Sky outage. It was determined that their data usage patterns had changed so much that a Skymuster connection was no longer adequate for their needs.

3.8 Measurement & Monitoring Data Usage

3.8.1 Types of Data and Traffic

The following information is continuously being logged for this project:

- Average gigabytes used per day, week and month
- Upload and Download
- Type of data
- Type of device and gigabytes uploaded and downloaded

There are several categories of traffic information that can be collected, monitored and measured for the station's connectivity solution (See Figure 8).

1. Streaming Media
2. Social Network
3. Web
4. Network Protocols
5. File Transfer
6. Business
7. Security Update
8. Instant messaging
9. Bypass Proxies and Tunnels
10. Mail and Collaboration
11. Network Management
12. Voice over IP
13. Stock Market
14. Private Protocol
15. Remote Access Terminals
16. Games
17. P2P
18. Unknown

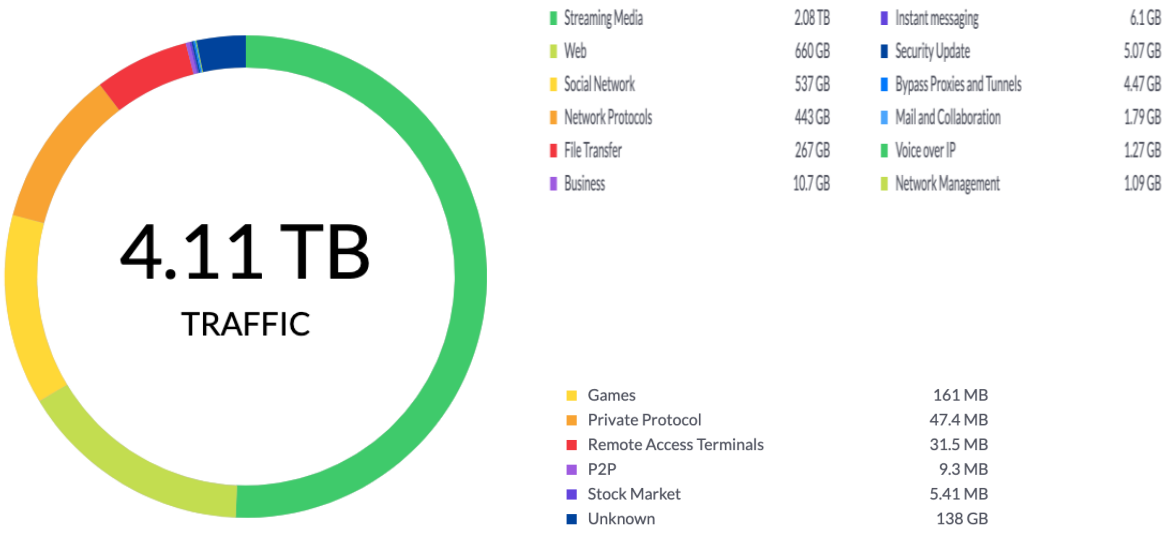

Figure 8: An example of the generic data traffic categories from initial data capture at the Qld beef producer's station (approximately 108 days between November and February).

Traffic categories for approximately July 2019 to February 2020 (See Appendix 2).

Quarter 7 testing period has been consistent with what was anticipated. The performance of the system has been consistent with what was anticipated with some minor disruptions due to weather and other uncontrollable factors. The Qld beef producer has also been able to introduce new remote monitoring technologies while providing their staff with connectivity.

3.8.2 Date usage by user

The graph below displays a breakdown of data usage for the larger users (See Figure 9).

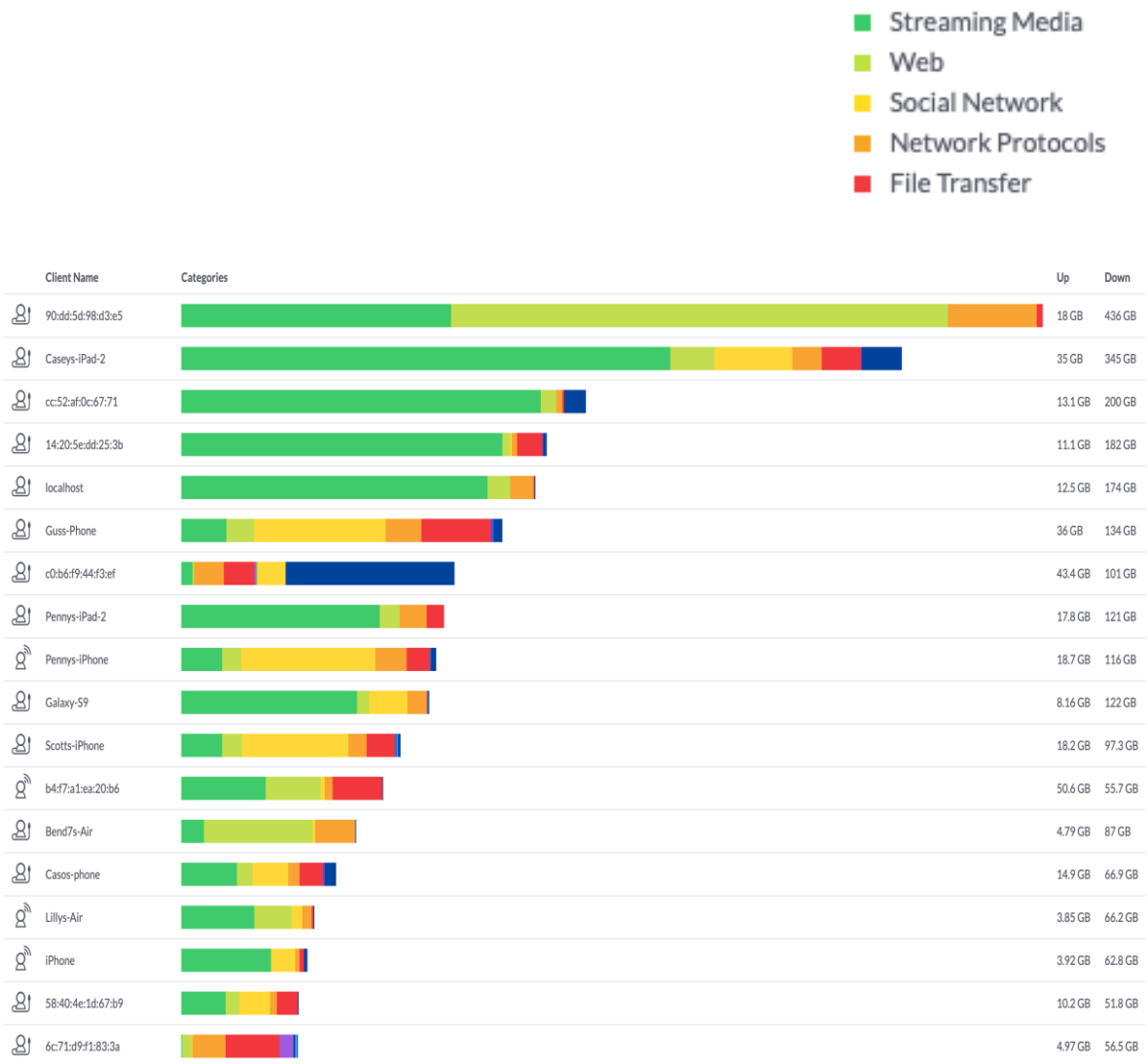

Figure 9: Breakdown of data usage for the larger users.

As you can see, there are two users that use almost twice as much of the other users. The largest data usage is video streaming. The availability of this service has made it significantly easier to attract staff and it is seen as a significant business advantage.

4 Conclusions and recommendations

4.1 Conclusions

The overall objectives of the project was to evaluate and demonstrate how a connectivity system can work in parallel with Skymuster. The pilot demonstrated how this parallel system provides a wider connectivity solution than just Skymuster in isolation.

The project evaluated a pilot connectivity solution, which has been installed at the Qld Beef producer's Station, over several testing quarterly phases and provide quarterly reporting for a two-year period on the following:

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This project has also demonstrated the need for high speed internet connectivity for a cattle stations with existing satellite services simply not being adequate. It is not enough to simply say "they don't need streaming services like Netflix" - how can they able to attract and keep staff if they cannot provide what is considered a basic service in the city?

4.2 Recommendations

It is clear from the measurement and monitoring of data usage that it will be challenging to interpret the data in ways to convert this type of data into business improvement & profitability metrics that can be reported on more broadly. This is evidenced by the fact that there were wide and varied views shared amongst the MLA Connectivity Group on the way the dashboard categories might be interpreted, in terms of business usage and/or social applications. The provider (Wi-Sky) was invited to speak at the MLA's Digital Forum (Red Meat 2018 on 23rd November). There was an opportunity at Red Meat 2018 industry forum to start to share these experiences & deriving benefits from establishing connectivity and what types of business improvement problems that were being solved by enhanced connectivity. It is expected that by customising & re-classifying the "data traffic" categories associated with red meat production over time is a good place to start to derive more useful meaningful data.

The conclusion was that caution to be exercised when reviewing the various data usage dashboard categories.

The following initiatives are recommended for future quarterly evaluation testing cycles:

- Collecting more frequent meaningful data to be more statistically relevant.
- Input required from MLA's connectivity group to assist with establishing methodology in the future to start to convert data traffic data into more meaningful profitability business improvement data. It is anticipated that in the first instance that customising & re-classifying the "data traffic" categories associated with red meat production over time will be required.
- Consult initial P2D connectivity report and putting this data up against the finding there for further benefits of connectivity to producers.
- At the conclusion of the project there will be a case study developed of the connectivity solution and the outcomes of the testing and evaluation period for MLA website (at the end of the installation and commissioning phase and then updated again at the end of the two years).
- Consideration of counting socialised and business improvement benefits in future evaluations, considering :
    - While connectivity is generally considered an enabling technology platform, the tangible benefits are likely to be derived from the application used as a result of having a reliable connectivity solution. The benefits & impacts of connectivity are derived from how and what the data is used for.
    - The challenge with this data provided from the usage dashboard as presented is that it is difficult to derive the context of the usage of data (i.e. for business and/or social).

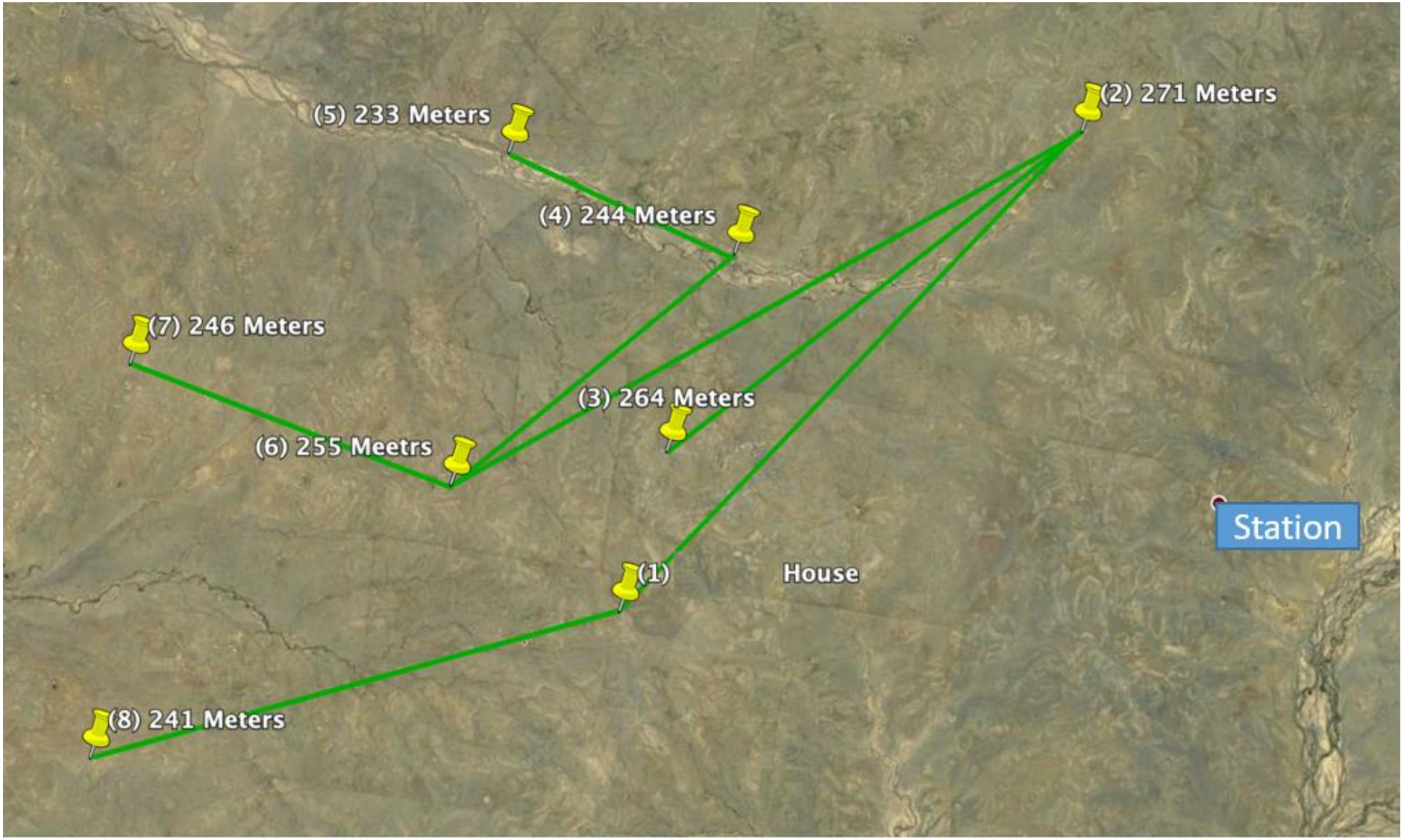
5 Key messages

The key messages are:

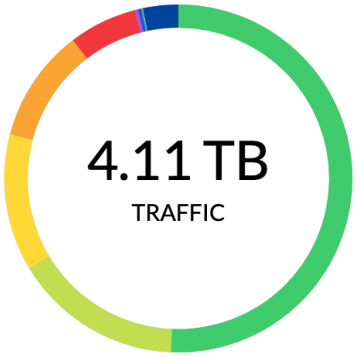
- Internet connectivity is a must have for any beef producer
- Existing Skymuster services are generally inadequate, especially for larger producers
- Fixed wireless systems are a cost effective and practical solution to this problem

6 Appendix 1

6.1 Site map showing locations of uSee tank sensor



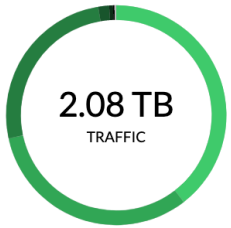
6.2 Appendix 2 - Traffic categories for approximately July 2019 to February 2020



Streaming Media	2.08 TB	Instant messaging	6.1 GB	Games	161 MB
Web	660 GB	Security Update	5.07 GB	Private Protocol	47.4 MB
Social Network	537 GB	Bypass Proxies and Tunnels	4.47 GB	Remote Access Terminals	31.5 MB
Network Protocols	443 GB	Mail and Collaboration	1.79 GB	P2P	9.3 MB
File Transfer	267 GB	Voice over IP	1.27 GB	Stock Market	5.41 MB
Business	10.7 GB	Network Management	1.09 GB	Unknown	138 GB

Overview Apps Users

Media streaming services



Netflix	842 GB
iTunes	685 GB
Youtube	550 GB
MP4	34 GB
Web Streaming	11.9 GB
Vimeo	4.7 GB
Unknown / Other	5.31 GB

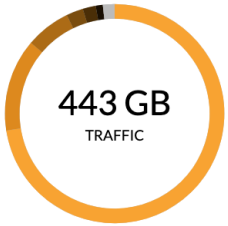
Web services

Akamai.net	481 GB
Apple.com	52.8 GB
Amazon CloudFront	14.9 GB
Google Play	13.4 GB
HTTP	13.4 GB
QUIC	10.1 GB
Unknown / Other	74.7 GB

Social networks

Facebook	324 GB
Instagram	202 GB
Pinterest	10.3 GB
Twitter	729 MB
LinkedIn	182 MB
WordPress	69.1 MB
Unknown / Other	37.5 MB

Network protocols



HTTP Protocol over TLS SSL	322 GB
SSL/TLS	60.5 GB
Google APIs(SSL)	29.4 GB
Google User Content(SSL)	11 GB
IMAP4 Protocol over TLS SSL	8.51 GB
Lets Encrypt	4.6 GB
Unknown / Other	7.68 GB

File sharing services and tools

Web File Transfer	116 GB
iCloud	98.5 GB
OneDrive	47 GB
Dropbox	3.83 GB
FTP Applications	676 MB
SoundCloud	221 MB
Unknown / Other	2.02 MB

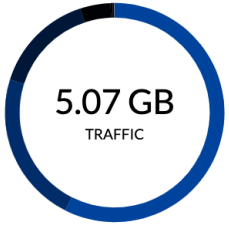
Business tools

Microsoft Office	10.7 GB
Microsoft Office 2013 license	18.3 MB
Limelight	15.1 MB
Office Sway	403 KB
Microsoft OS license	183 KB
Skype for Business	112 KB
Unknown / Other	116 KB

Instant messengers

WhatsApp	3.69 GB
Snapchat	0.98 GB
Apple iMessage	737 MB
MSN	539 MB
UcTalk	166 MB
TextMe	10.1 MB
Unknown / Other	14.5 MB

Security update tools



Microsoft Windows Update	2.91 GB
Norton	1.14 GB
Avast	781 MB
McAfee	232 MB
Google Update	16.4 MB
Apple	12.2 MB
Unknown / Other	2.45 MB

6.3 Appendix 3 - Sample of Usage Breakdown from the Qld Beef Producer's Station for the reporting period

App Name	Up	Down	Active Users
Netflix	30.8 GB	811 GB	0
iTunes	27.5 GB	658 GB	0
Youtube	32.3 GB	517 GB	0
Akamai.net	18.2 GB	463 GB	0
Facebook	19.2 GB	305 GB	0
HTTP Protocol over TLS SSL	32.9 GB	289 GB	0
Instagram	13.6 GB	188 GB	0
Unknown	51.4 GB	64.9 GB	0
Web File Transfer	5.15 GB	111 GB	0
iCloud	60.5 GB	38 GB	0
SSL/TLS	31.9 GB	28.6 GB	0
Unknown (Web services)	47.2 GB	7.88 GB	0
Apple.com	34.3 GB	18.5 GB	0
OneDrive	43.2 GB	3.82 GB	0
MP4	1.23 GB	32.8 GB	0
Google APIs(SSL)	24.8 GB	4.64 GB	0
Amazon CloudFront	565 MB	14.4 GB	0
Google Play	822 MB	12.6 GB	0
HTTP	1.68 GB	11.7 GB	0
Web Streaming	523 MB	11.4 GB	0