final report

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Getting Connected: Pathways for Improving Connectivity for our Feedlot Industry

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Abstract

The purpose of B.FLT.8009 is to identify the connectivity requirements of Australian feedlots. This includes defining the current use and availability of communications infrastructure in supporting the Australian lot feeding industry, identifying the future requirements of the industry, and the connectivity requirements, to support emerging technologies.

The project team includes Premise Agriculture and Professor David Lamb from the University of New England. The team have completed site visits to 11 feedlot businesses, across Queensland, New South Wales and Victoria, to develop connectivity case studies for the feedlot sector. These case studies showcase the current levels of connectivity across a range of feedlot businesses. This report presents the findings of these case studies, as well as a technical assessment reviewing the current internal and external connectivity options, potential telecommunication providers, and possible emerging technologies available to the feedlot sector. A range of connectivity solutions, unique for each feedlot business involved in the case studies, has been provided.

The "Getting Connected" technical assessment and case studies have been designed to assist operators in assessing their own needs and identify potential solutions.

Executive summary

Connectivity is improving across Australia (86% of Australian households had internet access in 2014-15 (ABS 2016)), and education curriculums, business offerings and government resources are all being transformed for internet-savvy users. However, the requirements of rural and regional families and businesses can be different to their urban counterparts; it is well known that agricultural producers experience limited to no mobile phone coverage beyond regional centres and transportation corridors (Lamb 2017).

A substantial proportion of Australian feedlots are located away from regional centres, which means that these operations need to consider external connectivity options, including, Local Area Networks (LANs), Wireless Local Area Networks (WLANs), Wide Area Networks (WANs); Landline (ADSL and ADSL2+), mobile and cellular devices; satellite communications options, National Broadband Network (NBN) and bonded broadband. Additionally, emerging technologies will require feedlots to have a high level of connectivity, with many technologies requiring on-the-go-connectivity to allow data-supported decisions.

Based on this information, the purpose of this project was to identify the connectivity requirements and education needs of Australian feedlots. This includes the availability and usage of communications infrastructure (phone, internet, etc), and the future requirements of this infrastructure to support possible emerging technologies. An understanding of current and future connectivity needs will assist operators make informed choices when investigating new technologies for their feedlot.

The specific project objectives for B.FLT.8009, "Getting Connected: Pathways for improving connectivity for our feedlot industry", include:

1. Determine requirements of feedlots for internet and phone connectivity both now and into the future (in view of increasing automation); and
2. Identify and communicate the range of connectivity solutions available to feedlots which maximise internet and phone connectivity in regional and remote locations.

These project objectives were achieved in three main stages:

1. Developing case studies,
2. Identifying connectivity requirements and solution providers, and 3. Developing a "Getting Connected" technical assessment document.

To begin this project, 11 feedlots were interviewed, and case studies created. The feedlot businesses were of differing sizes to provide a well-rounded understanding of the telecommunication requirements of the Australian feedlot industry. Interviews centred around the business' current connectivity requirements (and their impediments) in the office, paddock, vehicles and pens, and the business' future anticipated requirements. As a result of these interviews, it was found that the overall connectivity of a site can be broken-down into:

- External connectivity (i.e. reception from nearby phone towers);
- Internal site connectivity (on-site mobile and internet reception); and
- Utilisation of available infrastructure and integration with modern technologies.

The aim of the case studies was to improve industry awareness of connectivity solutions and assist operators assess their needs and identify potential solutions.

After the completion of Stage 1, the project team had a unique insight into the telecommunication requirements and desires (currently and into the future) of small and large Australian feedlots. Stage 2 focussed on reporting the connectivity requirements needed to support current and new technologies available to feedlots and the range of solution providers available to the feedlot sector. To anticipate the future connectivity requirements required to support possible new technologies for the feedlot sector, a range of telecommunication solution providers were investigated and interviewed, and a list of potential providers compiled. Three of these, the QUANTIFIEDAG Biometric Sense Tag, REDI automatic disease detection and animal identification system, and Manabotix bunk scanner, were investigated in greater detail and interviews were conducted with the developers or distributers of these products.

Stage 3 of the project involved creating a "Getting Connected" technical assessment document. The aim of this document is to empower Australian lot feeders with an understanding of their current and future connectivity needs. This will help them make informed choices when investigating new technologies for their feedlot. Based on findings from Stages 1 and 2, the technical document includes a review of the current internal and external connectivity options, potential telecommunication providers, and possible emerging technologies, available to the feedlot sector.

Overall, the findings suggest that:

- Fixed wireless NBN, or an uncontested point-to-point link, provide external connectivity which is usually considered to be 'good';
- Feedlots which have installed a fibre cable connection to key operational areas (i.e. mill tower, hospital or induction sheds), or have a Wi-Fi 'bubble' over the operational areas or the entire site, have adequate internal connectivity;
- Whilst infrastructure upgrades are expensive, real, tangible, cost savings can be made by accessing and implementing connectivity solutions currently available;
- Technical expertise available to feedlot operators is lacking (for connectivity and technologies); and
- Current connectivity on most sites will be challenged with handling the new, possibly emerging, technologies.

Feedlot operations are increasingly reliant upon external connectivity because:

- Of centralised management, external supply chain (commodities, stock transactions) and/or financial/resource management (e.g. accountants, business support).
- They are generating increasing amounts of data (and set to generate even more with emerging technologies); and
- They are utilising more sophisticated connected tools which require off-site support.

External connectivity must be reliable because:

- It is often time critical, and
- It must carry increasing amounts of data.

The key recommendations from B.FLT.8009 are:

For feedlots

Avoid relying upon the mobile network for critical/large volume data movements.

For Internet Service Providers (ISPs) and Network operators

Offer suitable data packages commensurate with the way feedlots operate; and

Offer multi-point NBN satellite connectivity options.

For technology developers

Avoid reliance upon centralised/cloud based servers that rely upon 'hot' external connectivity.

For MLA

Continue to implement education programs.

On Australian feedlots, business and lifestyle can be inextricably linked, and a lack of connectivity restricts education, social cohesion and daily business. If feedlot operators have the capability, through education, to make informed decisions for accessing the most cost-effective, reliable, method of connectivity, there will likely be economic and social benefits.

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1 Background

Families and businesses across Australia are looking for a reliable and affordable internet connection. However, the requirements of rural and regional families and businesses can be different to their urban counterparts. Australian feedlot operators are no different from any other sector; many are family owned businesses, and business and lifestyle can be inextricably linked. A lack of connectivity restricts education, social cohesion and daily business.

Internet connectivity is improving across Australia (86% of Australian households had internet access in 2014-15 (ABS 2016)), and education curriculums, business offerings and government resources are all being transformed for internet-savvy users. However, those who are not connected suffer more substantially as more people become connected. This gap may be thought of within Australian borders, but the same logic may also be applied when considering global competitiveness. With 74% of Australian beef and veal exported in 2015-16 (MLA 2016), we cannot expect to remain competitive on a global platform when ranked 50th for internet speed (11.1 Mbps, although there has been a 26% improvement since the previous year) (Akamai 2017).

In his review of challenges and opportunities to support a digital agricultural future, Lamb (2017) examined, at the farmer level, the impact of farm connectivity on farm operations. Spanning 15 major sectors (as covered by each of the RDCs, including MLA) the review identified three primary 'wake-up calls' if we hope to see a digital agriculture future for Australia:

(1) policy and infrastructure configuration that reflects the needs of producers for access and data speed;
(2) the need to join the dots between producers who have connectivity challenges and would-be solution providers who better need to understand what producers require; and
(3) of absolute critical importance, educating producers around what is on offer to them.

Lamb (2017) estimates two-thirds of Australian properties are within 10 km of mobile infrastructure, which poses opportunities for the marketplace to offer solutions that augment, compliment or simply fill the gaps for what our major network operators can offer. Similarly, there is a growing marketplace of second-tier telecommunication providers offering connectivity solutions to producers. But education is key. In a survey of 1,000 Australian producers conducted during 2016-2017 (Zhang et al. 2017), more than half admitted to knowing little or nothing about connectivity options available to them. More than half rely upon the mobile network (where available) as their primary means of connecting to the internet. The NBN offers fixed wireless (~ 14 km radius of urban centres) or Sky Muster access to remote consumers, yet producers are reporting declining connectivity performance as (fixed wireless) towers and satellites become more heavily subscribed.

Whilst the majority of Australia's 450 registered feedlots are located in the vicinity of cattle and grain supplies (ALFA 2017), and likely major transportation corridors, it may be assumed that a large proportion are located *more than* 10 km from regional centres, due to potential land use conflicts. It is well known that agricultural producers experience limited to no mobile phone coverage beyond regional centres and transportation corridors (Lamb 2017). In 2017, the Australian Competition and Consumer Commission (ACCC) elected not to mandate domestic mobile roaming (ACCC 2017) which could have positively impacted on mobile network expansion across our agricultural regions. This

means that feedlot operators, like every other Australian producer, will need to consider external connectivity options, for example:

- On-farm radio networks: Local Area Networks (LANs);
- Wireless Local Area Networks (WLANs);
- Wide Area Networks (WANs);
- Landline: ADSL and ADSL2+;
- Mobile and cellular devices;
- Satellite communications options (i.e. low earth orbit satellites and geostationary satellites); NBN (all forms);
- Bonded broadband; and
- Other emerging technologies which may impact on-farm telecommunications.

Additionally, emerging technologies will require feedlots to have a high level of connectivity. Some of the most valuable resources are those which are not confined to the main office, with many technologies requiring on-the-go-connectivity to allow data-supported decisions.

Based on this information, the purpose of this project is to identify the connectivity requirements and education needs of Australian feedlots. This includes the availability of communications infrastructure (phone, internet, etc), and the future requirements of this infrastructure to support possible emerging technologies, i.e. driverless trucks and electronic cattle monitoring tags. An understanding of current and future connectivity needs will assist operators make informed choices when investigating new technologies for their feedlot.

Recommendations from this report will act as a guide for possible future investment, to allow for smooth business operation and more data-supported decisions, to be made on site. Eleven lot feeders have been selected to develop case study examples which may be used to improve industry awareness of connectivity solutions. This information, in addition to demographic data already collected by MLA, will assist in deciding how future work should be conducted to improve awareness of technology in the Australian feedlot industry.

2 Project objectives

The project objectives for B.FLT.8009, “Getting Connected: Pathways for improving connectivity for our feedlot industry”, include:

1. Determine requirements of feedlots for internet and phone connectivity both now and into the future (in view of increasing automation).
2. Identify and communicate the range of connectivity solutions available to feedlots which maximise internet and phone connectivity in regional and remote locations.

3 Methodology

The project objectives were achieved in three main stages:

1. Case studies

The project team included Premise Agriculture and Professor David Lamb from the University of New England. An initiation meeting between MLA and the project team kick-started this project.

As part of Stage 1, the project team visited 11 feedlot businesses to develop connectivity case studies for the feedlot sector. At the project initiation meeting it was decided that, MLA Feedlot Project Manager, Dr Joe McMeniman, would place an article in the Australian Lot Feeders' Association (ALFA) newsletter, 'Around the Pens', to request participants in the study (

PROJECT: INTERNET AND PHONE CONNECTIVITY

MLA Project B.FLT.8009 seeks nine feedlots in QLD, NSW and Victoria to participate in case studies to improve internet and phone connectivity in their operations. We are seeking feedlots with poor connectivity or those that want to utilise technology with high data speed/volume requirements. Visits will occur in February and early March. Assessments are free of charge will occur by an independent researchers Dr. Kimberley Wockner (Premise), and Dr. David Lamb (UNE). A range of possible solutions will be recommended to each feedlot. Interested feedlots please contact 0437 547 176 or email: kimberley.wockner@premise.com.au

Fig. *1*).

PROJECT: INTERNET AND PHONE CONNECTIVITY

MLA Project B.FLT.8009 seeks nine feedlots in QLD, NSW and Victoria to participate in case studies to improve internet and phone connectivity in their operations. We are seeking feedlots with poor connectivity or those that want to utilise technology with high data speed/volume requirements. Visits will occur in February and early March. Assessments are free of charge will occur by an independent researchers Dr. Kimberley Wockner (Premise), and Dr. David Lamb (UNE). A range of possible solutions will be recommended to each feedlot. Interested feedlots please contact 0437 547 176 or email: kimberley.wockner@premise.com.au

Fig. 1*:* MLA request for participants in ALFA newsletter, 'Around the Pens' (Issue number 246).

Seven feedlots expressed interest in participating in this study via the ALFA newsletter request. Four additional feedlots contacted Premise Agriculture independently for inclusion in the study. In total, 11 feedlots have been interviewed for B.FLT.8009, as listed in Table *1*. At the request of MLA, all feedlots involved in B.FLT.8009 have been deidentified.

Table 1: Feedlots interviewed for B.FLT.8009.

Feedlot Category	Identifier	Location
Small[1]	S1	NSW
Small[1]	S2	VIC
Small[1]	S3	QLD
Medium[2]	M1	QLD
Medium[2]	M2	NSW
Medium[2]	M3	NSW
Large[3]	L1	QLD
Large[3]	L2	QLD
Large[3]	L3	QLD

[1] Small: < 1,000 SCU

Large[3]	L4	QLD
Large[3]	L5	VIC

[2]Medium: 1,001 – 10,000 SCU

[3]Large: > 10,001 SCU

The feedlot businesses were of differing sizes to provide a well-rounded understanding of the telecommunication requirements of the Australian feedlot industry. Discussions between the project team and feedlots were around the business' current connectivity requirements (and their impediments), in the office, paddock, vehicles and pens, and the business' future anticipated requirements. As a result of the interviews, case studies were developed to improve industry awareness of connectivity solutions and assist operators assess their needs and identify potential solutions.

2. Identification of connectivity requirements and solution providers

After the completion of Stage 1, the project team had a unique insight into the telecommunication requirements and desires (currently and into the future) of small and large feedlots in regional Australia. Stage 2 focussed on reporting the connectivity requirements needed to support current and new technologies available to feedlots and the range of solution providers available to the feedlot sector. This stage involved two separate sets of interviews for:

- the identification of future connectivity requirements to support possible new technologies applicable to the feedlot sector. Interviews were conducted to investigate QUANTIFIEDAG Biometric Sense Tag, REDI automatic disease detection and animal identification system and Manabotix bunk scanner, further; and
- the identification of a range of solution providers. The project team spoke with a number of telecommunication solution providers, and a list of additional possible suppliers are contained in the attached technical assessment.

3. Final report

An overarching goal of this project is to empower Australian lot feeders with an understanding of their current and future connectivity needs, to help them make informed choices when investigating new technologies for their feedlot. To do so, a "Getting Connected" technical assessment document has been created. The technical document includes a review of the current internal and external connectivity options, potential telecommunication providers, and possible emerging technologies, available to the feedlot sector.

The "Getting Connected" document is presented as an attachment to this MLA final report. The case studies and 600-word magazine article are also attached.

4 Results

4.1 Case Studies

Eleven feedlots expressed interest in participating in this project; all feedlots were interviewed, and case studies created. As per MLA's request, all feedlot participants have been deidentified in the case studies. The case studies are provided in Appendix 1 of this document.

4.2 Identification of connectivity requirements and solution providers

Stage 2 focussed on reporting the connectivity requirements needed to support current and new technologies available to feedlots and the range of solution providers available to the feedlot sector. To anticipate the future connectivity requirements to support possible new technologies applicable to the feedlot sector, interviews were conducted to investigate the QUANTIFIEDAG Biometric Sense Tag, REDI automatic disease detection and animal identification system and Manabotix bunk scanner. This information is presented, in greater detail, in Section 6 of the "Getting Connected" document in Appendix 2.

A large number of telecommunication solution providers exist. For the purpose of this project, three providers are discussed in greater detail, and a list of other potential providers is included in the attached "Getting Connected" document (Appendix 2).

4.3 Final report

Case studies (Appendix 1), the "Getting Connected" document (Appendix 2) and 600-word magazine article are included with this MLA final report.

Based on findings from Stages 1 and 2, the technical document (Appendix 2) includes a review of the current internal and external connectivity options, potential telecommunication providers, and possible emerging technologies, available to the feedlot sector. The case studies (Appendix 1) aim to improve industry awareness of connectivity solutions and assist operators assess their needs and identify potential solutions.

5 Discussion

5.1 Case Studies

Premise and Prof. Lamb have interviewed 11 businesses and discovered that the reason for feedlot connectivity, or more usually the lack thereof, is different for almost every site. The overall connectivity of a site can be broken-down into:

- External connectivity (i.e. reception from nearby phone towers);
- Internal site connectivity (on-site mobile and internet reception); and
- Utilisation of available infrastructure and integration with modern technologies.

External Connectivity (Table 2)

External connectivity (Table 2) is a measure of how well an operation can be connected to the outside world. Interviews suggest that, whilst only poor external connectivity is generally available, the

majority of feedlots have found a way to utilise the external connectivity available to meet their basic needs. Even so, Feedlots M1, M2 and L2 (Table 1) are particularly constrained.

Internal Connectivity (Table 3)

Internal connectivity (Table 3) is a measure of how well the individual components of a feedlot are connected together. In general, internal connectivity was found to be deficient. Three feedlots, S3, L3, L4 and L5, were assessed as having adequate or good connectivity for site operations, by having a fibre cable connection to key operational areas (i.e. mill tower, hospital or induction sheds), or a WiFi 'bubble' over the operational areas or the entire site.

Maximising Use of Available Infrastructure/Technology (Table 4)

Infrastructure upgrades are expensive, and interviews suggest significant investment is required to meet connectivity desires. However, some operators are not making full use of their available resources (*Table 4*). This was particularly true for feedlots with good connectivity to the outside world, but poor connections internally. Feedlot connectivity could go beyond basic mobile or Wi-Fi coverage, and be integrated with modern technologies, which are able to provide real cost savings to the operation. For example, M3 noted they spend $4.5 million per year on purchasing grain commodities. Computer programs have been developed to show when feed stocks are low, or when to buy grain. M3 believe such programs may result in significant cost savings, and this would help justify the costs of expensive infrastructure upgrades.

Table 2 External Connectivity Considerations

Feedlot	Rating	Justification
S1	Adequate	Connectivity appears appropriate for current operations, though is not future-proof.
S2	Adequate	External connectivity speeds are generally adequate for current operations, however, future desires cannot be met.
S3	Good	External data access is via NBN fixed wireless.
M1	Needs improvement	M1 is connected via a mobile data link which supplies unreliable data speeds (<1 to 20 Mbps).
M2	Needs improvement	The current external 2.4 GHz link does not provide suitable connection speeds. This is currently being upgraded to a more powerful 5 GHz link.
M3	Adequate	External data access is via NBN fixed wireless, and considered 'good' though speeds fluctuate during weather events. This may be because there are additional users using the connection.
L1	Good	Connectivity is via an optical fibre link which provides fast and reliable internet and email access.
L2	Needs improvement	The current two Next-G connections are often lost and shut down.
L3	Adequate	Connectivity is generally adequate, although there are reliability issues and internet speeds can be slow.

L4	Adequate	Currently, staff report unreliable internet speeds throughout the day. However, upgrades to external connectivity have begun.
L5	Good	Connectivity is via a private microwave link which works well.

*Rating: Needs improvement, adequate, good

Table 3 Internal Connectivity Considerations

Feedlot	Rating	Justification
S1	Needs Improvement	Over-reliance on paper records, and the feedlot has trouble synchronising data to the office (i.e. for DigiStar).
S2	Needs improvement	There is no onsite connectivity between the office and key operational precincts.
S3	Adequate-Good	Internal connectivity is via a directional Wi-Fi link to the crush/hospital. USBs/paper still used to transfer some data.
M1	Needs improvement	Internal connectivity is facilitated by Wi-Fi, although this can be unreliable and mobile coverage is poor.
M2	Needs improvement	The external 2.4 GHz link connects to an internal ADSL+2 link, which is only achieving ADSL speeds.
M3	Needs improvement	No onsite connectivity between offices and key operational precincts.
L1	Needs improvements	Paper records are principally used
L2	Needs improvement	Fibre links and Wi-Fi routers are used for internal operations. These can be unreliable throughout the day.
L3	Adequate	There is a fibre loop between the office and key operational facilities. This generally provides good connectivity, although the Pen-Wi-Fi systems are not fully operational.
L4	Adequate	Internal data movements are facilitated by Wi-Fi, although speeds can be unreliable.
L5	Good	Connectivity is via a high speed fibre link and 5 GHz Wi-Fi links.

*Rating: Needs improvement, adequate, good

Table 4 Maximisation of Existing Infrastructure

Feedlot	Rating	Justification
S1	Needs improvement	The feedlot has access to time saving software programs such as FY3000, Digi-Star and eLynx, although these are underutilised and there is a shortage of technical expertise on site. Some programs, i.e. Digi-Star, cannot be fully utilised due to infrastructure constraints.
S2	Needs improvement	External connectivity should be able to support improved connectivity onsite. S2 will need to assess their operation and the risk of running a paper based business.

S3	Good	Operator is continually looking to improve efficiencies and update. Has plans to reduce reliance on UHF, USBs and paper.
M1	Needs improvement	Existing infrastructure should be utilised to provide better mobile and Wi-Fi coverage on site.
M2	Needs improvement	Existing telecommunications infrastructure at M2 (6.7 km away) needs to be better utilised. M2 feedlot are currently carrying out improvements to their operations.
M3	Needs improvement	Good external connectivity is not being effectively utilised as internal feedlot operations do not have sufficient Wi-Fi access.
L1	Needs improvement	L1 appears to have good external connectivity, although internal data collection is mostly paper based, which could be improved.
L2	Needs improvement	Faster and more reliable phone and internet connectivity would be desirable.
L3	Adequate	Infrastructure could be better utilised by accessing an existing optical fibre network and by improving Wi-Fi connectivity in pens.
L4	Adequate	Current connectivity is adequate, although improvements are underway to supply a more secure and faster internet connection.
L5	Good	Significant investment has been made to supply good connectivity in a regional area. Staff report minor issues, and more advanced technologies, such as driverless feed trucks, are being investigated.

*Rating: Needs improvement, adequate, good

Overall, the case studies suggest that:

- Fixed wireless NBN, or an uncontested point-to-point link, provide external connectivity which is usually considered to be 'good'.
- Feedlots which have installed a fibre cable connection to key operational areas (i.e. mill tower, hospital or induction sheds), or have a Wi-Fi 'bubble' over the operational areas or the entire site, have adequate internal connectivity.
- Whilst infrastructure upgrades are expensive, real, tangible, cost savings can be made by accessing and implementing connectivity solutions currently available; and

- Technical expertise available to feedlot operators is lacking (for connectivity and technologies).

5.2 "Getting Connected" technical assessment

The "Getting Connected" document is provided as a technical assessment of the current internal and external connectivity options, potential telecommunication providers, and possible emerging

technologies, available to the feedlot sector. The purpose of this document was to arm Australian lot feeders with an understanding of their current and future connectivity needs and help them make informed choices when investigating new technologies for their feedlot.

Findings suggest that current connectivity on most sites will be challenged with handling the new, possibly emerging, technologies. For example, based on the interviews for this project (which we assume is a representation of the feedlot industry), the average feedlot operator utilises a data package with 8 - 10 Gb of data per month. This compares to the requirements of REDI tags, which is 100's of Gb per month.

5.3 Meeting B.FLT.8009 objectives

The project objectives for, "Getting Connected: Pathways for improving connectivity for our feedlot industry", include:

B.FLT.8009 Objective	Was Objective Met?
1. Determine requirements of feedlots for internet and phone connectivity both now and into the future (in view of increasing automation).	Yes, as a result of 11 visit to feedlot businesses, of varying size and location, the requirements of feedlots currently, and into the future, has been adequately addressed.
2. Identify and communicate the range of connectivity solutions available to feedlots which maximise internet and phone connectivity in regional and remote locations.	Yes, a wide range of internal and external connectivity solutions, applicable to Australian feedlots have been identified. This information has been communicated via a, "Getting Connected", technical assessment, and 11 case studies.

6 Conclusions/recommendations

Feedlots are increasingly reliant upon external connectivity because:

- Of centralised management, external supply chains (commodities, stock transactions) and/or financial/resource management (e.g. accountants, business support);
- They are generating increasing amounts of data (and are set to generate even more with emerging technologies); and
- They are utilising more sophisticated, connected, tools which require off-site support.

External connectivity must be reliable because

- It is often time critical; and
- It must carry increasing amounts of data.

6.1 Key Recommendations

6.1.1 Feedlots

Avoid relying upon the mobile network for critical/large volume data movements.

Contention rates of mobile networks varies over time. They are typically highly contended, which means data speeds can vary considerably during the day. Feedlots should avoid emphasis on using mobile network connectivity for critical data movements (with exception of small-sized 'IoT' type data movements from weather stations, troughs etc).

Feedlots should consider NBN connectivity, as available through satellite (Skymuster), fixed wireless or fibre (if available). Failing this, feedlots are encouraged to consider uncontended links such as 'private' microwave links to points of presence (POP) where onwards backhaul capability will offer improved reliability.

6.1.2 Internet Service Providers (ISPs) and Network operators

Offer suitable data packages commensurate with the way feedlots operate

Data usage is set to increase by as much as (and possibly more than) ten-fold (~ 10 Gb/month → ~100 Gb/month) as new cloud-based technologies such as animal monitoring systems appear in the marketplace. This will cause issues for feedlot operators around data shaping (network operators and ISPs). Data packages and policies need to be configured to support the nature of feedlot data operations.

Offer multi-point NBN satellite connectivity options

Animal-based monitoring technologies will generate huge amounts of data in the pens. In cases where broadband gateways are located at homesteads/offices, this may mean operators have to transport large data volumes across their feedlot precincts. NBN access is granted on a single address basis- ie one per address. With increasing numbers of WiFi data links appearing across feedlots this may create internal radio congestion issues. Ideally multi-point NBN connections allows feedlots to send data, directly from multiple locations, to the cloud.

For technology developers

Avoid reliance upon centralised/cloud based servers that rely upon 'hot' external connectivity.

Technologies that generate large amounts of data should, as a bare minimum, avoid reliance upon 24/7 'hot' links to the cloud and centralised algorithms. If unavoidable, such systems should include compatibility and/or capability for on-site data storage. Preferably the technology should include edge-of-cloud analytics capability, therefore avoiding the need to move large amounts of data offsite. Any algorithm-based calibration and/or validation should take place onsite with the capability to provide command and/or software-firmware update and/or code manipulations externally (as required by the technology provider).

For MLA

Continue to implement education programs.

The majority of feedlots indicated a desire to better understand how to get connected, both externally and internally. This could be facilitated by travelling roadshows (educational 'How to' masterclasses) targeting the enabling of technologies. Examples include, 'How to set up a WiFi link from your office to your sheds?'; or 'How to set up radio-linked Digi-Star?'.

7 Key messages

The key communication message that Australian feedlot operators can focus on, is educating themselves on the various internal and external connectivity options available to their operation, and how to maximise the infrastructure and technology they currently utilise.

On Australian feedlots, business and lifestyle can be inextricably linked, and a lack of connectivity restricts education, social cohesion and daily business. If feedlot operators have the capability to make informed decisions for accessing the most cost-effective, reliable, method of connectivity, there will be likely economic and social benefits.

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9 Appendix

9.1 Case Studies

9.1.1 S1 – NSW

9.1.1.1 Background Information

S1 is located approximately 300 km from Sydney, NSW. The property totals 6,346 acres and contains pasture, irrigation areas and a beef cattle feedlot. The feedlot has a licenced capacity of 1,000 head. The facility custom feeds crossbred Wagyu cattle which are largely destined for the export market. S1 are open to the idea of expanding in the future, though no plans are underway.

S1 are relatively happy with their current connectivity, although they would welcome connectivity improvements that are within their budget.

9.1.1.2 Current Data Movements On-Site

Office/Administration/Personnel

- In office ○ Internet and phone
  Office connectivity is considered 'fit for purpose', although internet response can be slow and moving parts on webpages can be delayed. Computers in the office operate from a Wi-Fi connection and all data is stored on the server.
  - ○ Payroll & HR
    All accounting in handled out of Sydney and no 'big' data is sent from the feedlot. There are no HR processes carried out on site. All leave information is provided via email to head office.

- Out of office ○ Mobile phones
  Staff use mobile phone in preference to radios.
  - ○ Vehicles
    There are no additional boosters in vehicles. There is Digi-Star capability in the tractor (which pulls the feed unit), though this is not being used.

- Trouble shooting ○ Trouble shooting is initial managed by staff on-site, before contacting an IT consultant in Dubbo. S1 would ideally like to identify a local IT company with knowledge of the feedlot sector and what infrastructure would provide them with the best connectivity for their operation.

Feed Mill, Yards and Pens

Elynx feedlot software and Digi-Star are both on-site however neither are being used to their full capacity. There is no power at the cattle handling facility. All induction data is recorded directly onto a laptop which is transferred via Wi-Fi to the server. Elynx feedlot software is on the server, however the Sydney office cannot access any reports, as the upload from S1 is too slow.

S1 have Digi-Star scales but cannot find anyone in the area with technical expertise to connect them to server. They are currently using bunk call sheets for feeding.

Remote vision cameras are located on the outer ends of the property and record data by motion detection. These cameras are used for security, although they are not linked up to the server.

Automatic Weather Station

The feedlot does not have a weather station. Weather data from the Bureau of Meteorology is used and cattle are closely monitored.

Pumping and Irrigation

Water bores or pumps are not electronically monitored / metered.

9.1.1.3 Current Technology for Site Connectivity

A summary of key internal and external connectivity at S1 Feedlot is given in Figure 2.

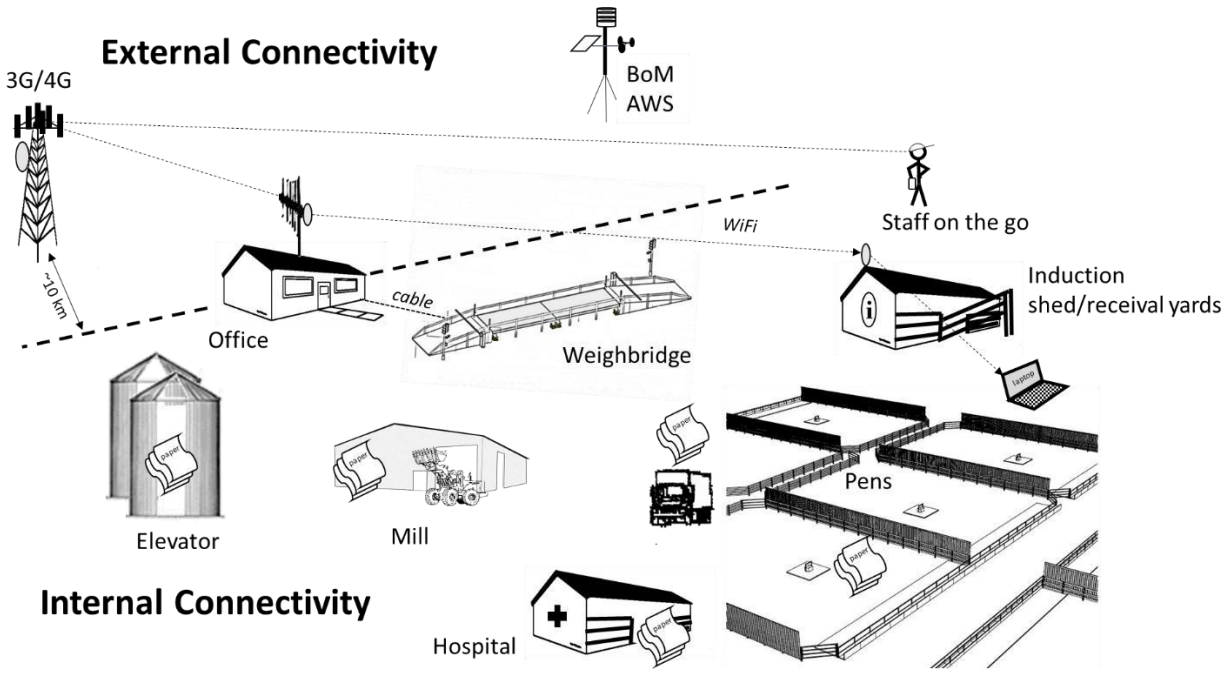


Figure 2 External and internal connectivity at the S1 Feedlot.

9.1.1.4 External connectivity:

Data
The primary means of external data access is from the Main Office/House via directional antenna to the nearby mobile phone tower (Yagi antenna) to a nearby town (~10 km). See Figure 3 (a).

A Wi-Fi router in the main office is used to connect tablets and smart phones via hotspots. See Figure 3 (b).

(a)

(b)

Figure 3 (a) External mobile network tower link from office (Yagi). Antenna on left is for Wi-Fi link to sheds. (b) Wi-Fi router inside office to enable desktop/tablet use.

The feedlot relies upon the BoM AWS and access is facilitated via internet access (via mobile network link above).

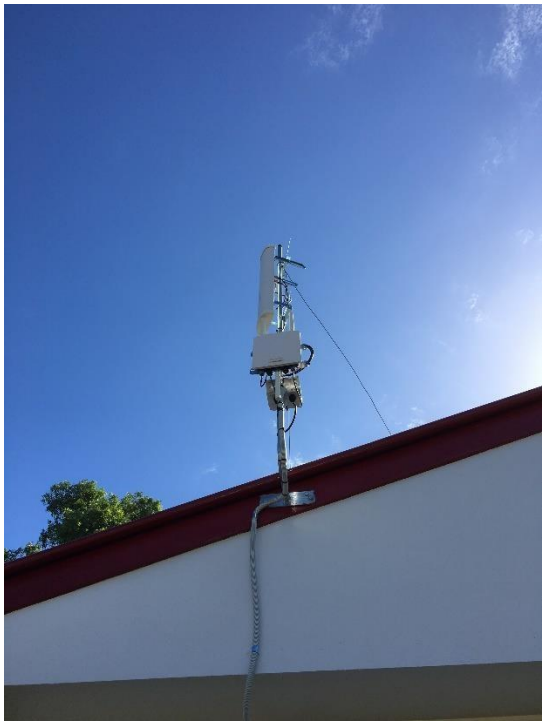
Voice
Mobile phones are the primary means of staff communications used, with stable mobile signal over the farm and feedlot precinct.

Other None.

9.1.1.5 Internal connectivity:

Data movements between the Office server and feedlot precinct (100-200 m away) is facilitated by directional Wi-Fi (Figure 4).

(a)



(b)

(c)

Figure 4 (a) view from feedlot sheds back to office (~ 100 m away) with shed-office link visibly on the respective roofs. (b) directional Wi-Fi link on office roof (towards shed) and (c) combination Wi-Fi link and hotspot antenna on feedlot shed.

A MOXA (www.moxa.com) 'box' facilitates an ethernet (cable) connection (within shed) from Wi-Fi booster to scales and NLIS panel reader.

Both the tractor and truck have UHF radios.

9.1.1.6 Business Impacts

S1 Feedlot currently have no oversight on feeding and feed usage, and are likely experiencing financial losses due to excess feed usage and errors. S1 are not using Digi-Star and eLynx software

systems to its full potential, because of the additional connectivity infrastructure required to make them operational. An IT consultant, with an understanding of the feedlot industry, would be a great resource for S1.

9.1.1.7 Future Connectivity and Technology Desires

Short-term

S1 would like to collect real-time cattle weight and feed usage data. They understand that the collection of real-time data would require significant infrastructure upgrades, and this is currently being assessed.

Other short-term goals include the construction of an automatic weather station (AWS), remote monitoring for tanks, pivots and pumps, and motion detector cameras which send a photo to the main office. This service is currently unavailable due to poor mobile phone service.

Long-term

S1 have no long-term connectivity goals. They are a smaller operation, and have difficulty seeing the financial returns for many emerging technologies.

9.1.1.8 Recommended Solutions for Connectivity

External connectivity - Investigate NBN fixed wireless or satellite as alternatives to mobile network (Skymuster). With a reliable mobile network, consider installing AWS.

Internal Connectivity - Consider activating Digi-Star via radio links from tractor/mill to feed truck. There are also edge-of cloud remote camera surveillance systems that operate on the mobile network.

9.1.2 S2 - VIC

9.1.2.1 Background Information

S2 constructed a 1,000 Standard Cattle Unit (SCU) in October 2016. The feedlot is approximately 200 kilometres from Melbourne. The feedlot is partially covered, with the roof covering the area at the front centre of each pen.

S2 have a desire to improve their technology integration on-site and are hoping to implement some improvements in the near future.

9.1.2.2 Current Data Movements On-Site

Office/Administration/Personnel

- In office ○ Data

  S2 tried to install a fixed NBN wireless connection, although reception was poor, even with a Wi-Fi booster. Poor reception was attributed to interference from surrounding trees (redgums), and operations now rely on reception from a Skymuster Satellite dish. S2 are happy with this service.

  - Payroll & HR

Paper records are used by HR and payroll. Finance utilises MYOB (online version).

- Out of office ○ Mobile phones

  Mobile reception is poor (1-2 bars) and coverage is patchy, although the closest town is only located a short distance away (6 km). SMS communication is the main way to keep in touch with staff due to unreliable mobile reception. An iPad is used within the office which has its own mobile booster and Wi-Fi hotspot. The feedlot uses Activ8me from Skymuster to supply 60 Gb data per month at a cost of $55. S2 are happy with this, although reception is still limited.

  - Radio
    S2 are not keen on communicating via UHF radio for privacy reasons. Radio is also problematic for troubleshooting, as connectivity is poor.

  - Cars, vehicles, feedtrucks
    There are no boosters within vehicles and reception is generally poor.

  - Yards
    All operation within yards are paper based. This includes collection of data for the National Livestock Identification System (NLIS), which is labour intensive.

  - Staff accommodation
    Apart from the family living at the main house, there are no additional staff living on site

- Trouble shooting
  IT issues are currently solved in-house. Troubleshooting issues on-site is difficult with patchy mobile reception.

Feed Mill, Yards and Pens

Feed mixes are manually formulated for the feed mill. All other notes are also completed manually, including feed records, NLIS records and recordings of incoming and outgoing cattle.

Programs Elynx (FY3000, StockaID) and Digi-Star are not currently in use. S2 are open to training, although they are also aware that some of their staff may not have the skills/interest to adopt new technology.

Automatic Weather Station

There is no automatic weather station (AWS) on site. Weather data is sourced from a nearby Bureau of Meteorology (BOM) site. A heat monitoring / warning system (http://chlt.katestone.com.au/) has been set up to provide alerts, based on weather conditions at the nearby site.

Pumping and Irrigation

The feedlot pumps water directly from a nearby river. The bank height is 25 m, and the pressure has to be constantly monitored to ensure sufficient water reaches the feedlot, which is over 1 km away. Troubleshooting issues with the pump, over the phone, is difficult with patchy mobile reception. Increased pump capacity would be desirable, although the electricity connection is only single phase, and this limits pump size.

9.1.2.3 Current Technology for Site Connectivity

A summary of key internal and external connectivity at S2 Feedlot is given in Figure 5.

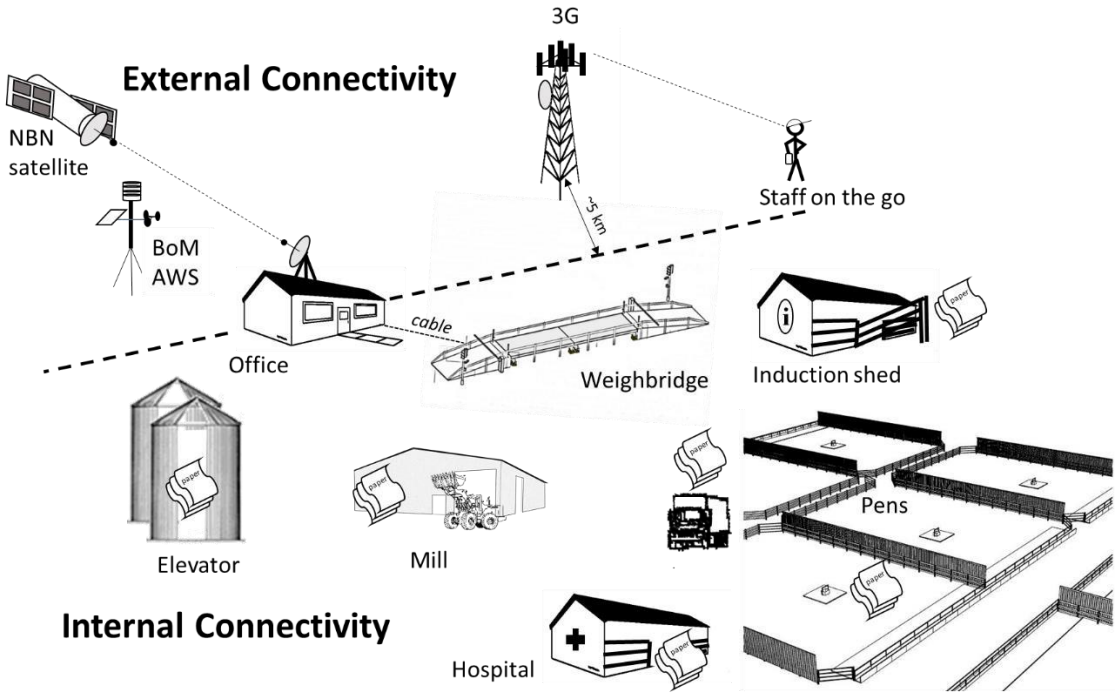
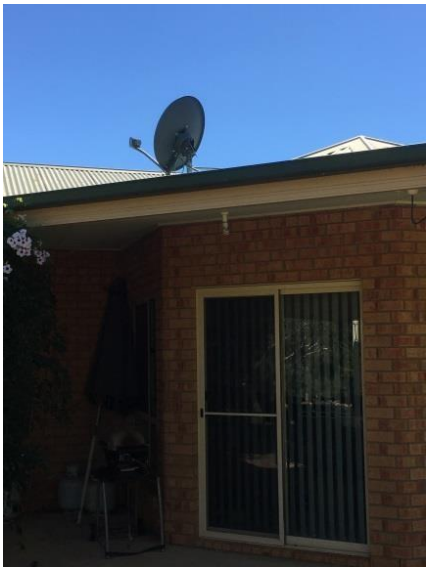


Figure 5 External and internal connectivity at the S2 Feedlot.

9.1.2.4 External connectivity:

Data

The primary means of external data access is from the Main Office/House via NBN Sky Muster satellite. A Wi-Fi router is used to connect tablets and smart phones via hotspots. External data speeds are generally 'fast' although staff experience degraded performance during heavy rain/storm events.



(a)

(b)

Figure 6 (a) External satellite NBN dish and (b) high speed office hotspots facilitate use of online paddock management (e.g. AgWorld) and auction tools.

The feedlot relies upon the nearby BoM AWS and access is facilitated via internet access (via NBN satellite).

Voice
Mobile phones are the primary (and preferred) means of staff communications used, with patchy mobile signal over the farm and feedlot precinct and intermittent data speeds experienced. Mobile access cannot be relied upon at critical locations, including the nearby water pump. A mobile cell booster is used in the Office precinct.

Other None.

9.1.2.5 Internal connectivity:

There is no onsite connectivity between Offices and key operational precincts, including the onsite generator used to power the feedlot operation.

9.1.2.6 Business Impacts

There is a risk in running a paper based business and record keeping could be improved by entering data electronically. Common feedlot software programs (i.e. FY3000, StockaID, Digi-Star) are also not employed, and this results in reduced record keeping and potential lost earnings when purchasing feed or formulating rations. These technologies have been considered, although S2 are worried that the education level of staff is limited, and they don't want to introduce too many new technologies which staff may not take well too. The busiest time of the year is one week before audit. Whilst their current system works well, S2 concede that preparation for the annual audit could be easier if they were to use an automatic record keeping system.

9.1.2.7 Future Connectivity and Technology Desires

Short-term

S2 feedlot is not sure where to start with improving feedlot connectivity. Immediate goals are to increase mobile reception to the whole site although they are yet to navigate this process. S2 use a software package called Agworld to maintain their cropping records for their farm. This software is installed on an iPad and can be used offline, and then resynchronised with a Wi-Fi connection back in the office. S2 love using this program and desire a similar program for cattle management. S2 would like to install surveillance cameras for security and the monitoring of essential infrastructure, i.e. gauges, troughs, generators and pumps.

Long-term

At this stage, S2 are focussed on their short-term goal of improving their site connectivity. S2 enjoy working and interacting with their cattle and have a preference for this over the 'blue sky' technologies currently on offer.

9.1.2.8 Recommended Solutions for Connectivity

External connectivity – In those areas (for example water pump) where the mobile reception is poor, one option to consider is erecting a mobile booster at the edge of the river bank, directing the boosted signal into the lower-lying pump location.

Internal Connectivity - The feedlot and farm precinct is relatively flat. Consider 2-way LPWAN (900 MHz) links to remotely monitor (and possibly control) an external generator (sole power source to feedlot precinct) and water pump. The latter may be served by directional Wi-Fi (as short range) and may require a 'hop' as pump is positioned below steep river bank. Consider Wi-Fi link to Induction shed/Mill to support activation of live record keeping system (e.g. tag reader/weights at induction).

9.1.3 S3 – QLD

9.1.3.1 Background Information

S3 is located approximately 150 km from Brisbane, QLD. The property is approximately 1800 acres and contains pasture, irrigation areas and a beef cattle feedlot. The feedlot has a licenced capacity of 1,000 head. The feedlot feed their own cattle which are destined for Woolworths and the domestic trade market.

For their size, S3 is an exceptionally well-connected, tech-savvy, entity. Nonetheless, they are continually on the lookout for connectivity advancements to improve their efficiencies and production.

9.1.3.2 Current Data Movements On-Site

Office/Administration/Personnel

- In office ○ Data

  S3 has wireless NBN. S3 consider their internet access is adequate and does not hinder their internet usage. A complete download of data to their server is done every night.

  ○ Payroll & HR

  Leave requests are all made verbally and records are managed by the office manager. All accounts are managed in-house at S3, which acts as the business' head office.

- Out of office ○ Mobile phones

  Mobile reception is considered to be good, with 3G and 4G connection. However, it slows down when there are a lot of people utilising it. There is a mobile booster in the office. Staff are issued with a phone and tablet; phones are used to provide a hotspot to the tablet out in the paddock.

  - Radio
    UHF radios are in all vehicles at S3.

  - Cars, vehicles, feedtrucks
    There are no boosters within vehicles. Phones provide adequate coverage.

  - Yards
    All operation at the crush is recorded onto a fixed computer (connected via Wi-Fi to the office). All hospital pulls are done manually with pen and paper and entered at the office.

  - Staff accommodation
    There are two additional houses which utilise the office connections. Mobile reception is patchy in the main house.

- Trouble shooting
  As a first attempt, IT issues are currently managed in-house. An IT and radio technician, located in the nearby major towns (within 100 km), are both available to trouble-shoot over the phone, and will visit S3 if required.

Feed Mill, Yards and Pens

Feed mixes are computer formulated for the feed mill. All other notes are also completed manually, including computerised feed records, NLIS records and recordings of incoming and outgoing cattle.

Bunk Management System (BMS), StockaID and Digi-Star are currently in use. Currently Digi-Star is used with a USB stick, but will soon go wireless.

Automatic Weather Station

There is an automatic weather station (AWS) on site which is connected via cable to the office. S3 utilise EnviroData, which can be accessed via the internet server.

Pumping and Irrigation

The pumps and pivots on S3 are currently checked daily. Currently all information is collected, and retrieved, via a SIM card, however the pumps and pivots on S3 are checked daily. S3 would like to get wireless monitoring for their pump stations (eGauge) so they can manage and monitor their energy.

9.1.3.3 Current Technology for Site Connectivity

A summary of key internal and external connectivity at S3 Feedlot is given in Figure 7.

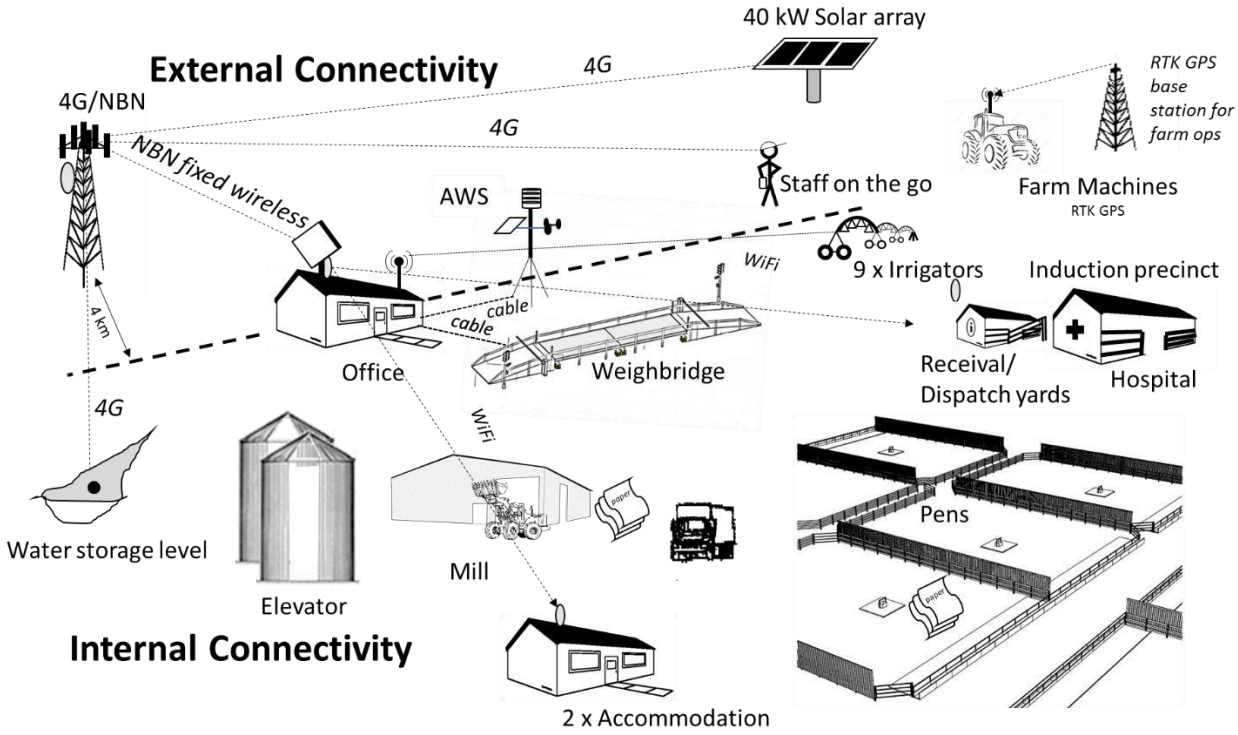


Figure 7 External and internal connectivity at the S3 Feedlot.

9.1.3.4 External connectivity:

Data

The primary means of external data access (internet and cloud) is from the Main Office via fixed wireless NBN (4G/NBN tower ~ 4 km away). In addition to serving the operational/business needs of the feedlot/backgrounding operation, the office also serves as headquarters for a range of other business located around Australia. The onsite server is also the main business server. External connectivity is a critical part of servicing the need of multiple businesses operating elsewhere. In the Main Office a Wi-Fi router is used to connect Office desktops and staff laptops. External NBN connectivity is considered 'good'.

Mobile phone reception is also considered 'good' across the entire feedlot although mobile phone reception inside the accommodation buildings (located away from the Main Office) is patchy. Staff on the go are provided with tablets through which they operate their internet access using hotspots created from their mobile phones or in the Main Office hotspot. The data plan is a 'pooled' plan across multiple staff.

A water level monitoring system is operating on the main water storage which is linked via mobile sim card (i.e. 4G). Likewise, a 40 kW solar array has recently been installed and is monitored (egauge) via mobile network connectivity.

Voice

For staff on the go, the mobile phones (with good reception) are the principal means of contact.

Other

A Trimble RTK base station is mounted on the Elevator for various precision agriculture operations involving farm machinery.

9.1.3.5 Internal connectivity:

Data movements between the Office and the crush/induction/hospital facilities is facilitated by directional Wi-Fi link. For example, at induction a suite of measures including tag ID, weight, animal length, breadth and height are all measured and linked to the Office server. There are approximately 40,000 animals that move through this system per year.

DigiStar operating between the Mill and Feed vehicles/loader is facilitated by USB data, paper records and wireless transfer.

The Trimble RTK base station mounted on the Elevator is linked to field vehicles via radio link.

Nine pivot irrigators, running on the Valley system, all run on UHF (cell call) radio links directly back to the Office. This can be accessed by staff (mobile and tablet) via an internet site. The operators consider multiple radio links to be a problematic part (i.e. maintaining 9 radio links) of their irrigation management.

The automatic weather station (AWS) is also linked into the office server directly by cable and staff access the weather data via Envirodata website (via staff tablets/mobile phones), Figure 8.

Figure 8 Automatic Weather Station

9.1.3.6 Business Impacts

Currently S3 are aware that 1.5 hours is spent daily checking all their operation's pumps, pivots and troughs. S3 believe that their accuracy and efficiency in feeding can be improved.

9.1.3.7 Future Connectivity and Technology Desires

Short-term

In the short-term, S3 are working toward ensuring their entire property is Wi-Fi accessible. They feel that this connectivity would give them a better stability in their connectivity; they could stop 'being a slave to data cards'.

S3 would love to be able to read water and pivot meters live. The continual monitoring would allow them to know if they should be slowing down pumping because of low water.

S3 also believe that Wi-Fi would allow them to achieve greater accuracy and efficiency in feeding.

Long-term

In the long-term, S3 are interested in pursuing: -

Ear-tags;

- Walk-over weights at water troughs;
- Steeringless tractors
- A satellite to show dry matter in paddocks to indicate how long beasts can remain in the paddock before they begin to lose profitability;
- Individual beast identification during backgrounding (can only be achieved with greater productivity).
- Dry matter pasture monitors on pivots; and - GPS fencing to allow better cell grazing.
-

9.1.3.8 Recommended Solutions for Connectivity

External connectivity - Nil

Internal Connectivity - Consider activating Digi-Star via radio links from tractor/mill to feed truck. Consider expanding Wi-Fi links to include water monitoring devices and reduce reliance upon mobile network sim cards.

9.1.4 M1 - QLD

9.1.4.1 Background Information

M1 is located 300 km from Brisbane, QLD, and has a capacity of 6,000 SCU. Approval has been granted to expand the feedlot to 20,000 SCU, and the first stage of expansion will commence in 2019. M1 predominantly feed cross-bred steers for the domestic market, Angus and Wagyu cattle destined for export markets and custom feed up to 2,000 head.

M1 has a desire to improve their connectivity around the property and increase the reliability of their connection with their head office.

9.1.4.2 Current Data Movements On-Site

Office/Administration/Personnel

- In office ○ Data

  Office staff tend not to website 'browse' as webpages (particularly those with moving sections) cannot open.
  M1 use Dropbox to share office data with the head office. The feedlot "drops" the appropriate documentation into various folders (e.g. finance, HR/personel etc) for head office to collect. However, various arms of the business all use the common dropboxes which causes a drag on data usage ie every time anyone from any location uses Dropbox, everything is re-synched.

  - Payroll & HR

    Payroll and HR (i.e. daily timesheets and leave requests) are completed manually with pen and paper, scanned and placed into the appropriate Dropbox folder for head office to access and process. If Dropbox has difficulty uploading, the document will be emailed.

- Out of office ○ Mobile phones

  Mobile phone calls regularly drop out and staff need to return to the office to use the land line to return the call. Mobile phone batteries go flat very quickly as the phone is constantly searching for a signal.

  The mobile broadband modem in M1's office is usually restarted by the office manager every morning. Service (speed and reliability) is usually good in the morning but progressively slows down till mid-afternoon. Often the system needs to be rebooted two or three times in the afternoon. Sometimes if the system hasn't been rebooted and it is too slow, all data (i.e. trucks leaving site via the weighbridge) will need to be recorded with pen and paper and recorded into the system later.

  - Yards

    Cattle pulls are manually recorded on paper, and then entered on the server at the end of the day.

  - Staff accommodation

There are currently two houses on site and each has its own Cell-fi booster. There are currently only two staff living on-site, although this is likely to increase with the forthcoming feedlot expansion to 20,000 head.

- Trouble shooting
  Currently, the onsite office manager and an external consultant (AusLogic) are responsible for troubleshooting all connectivity problems. Generally for computer updates, a visiting IT consultant sets up smartphone hotspot to gain Wi-Fi to the necessary computer.

- Feed Mill, Yards and Pens
  M1 feedlot collects data from the feed mill and cattle yards, and uses the following software programs:

- Elynx (FY3000 and StockaID) ○ Run from M1's onsite server, linked via Wi-Fi to the office server ○ Generally works well, and the recording of live data is possible.
- Digi-Star ○ Radio-linked to the mill and yards, and linked to the server via Wi-Fi.
    - Digi-Star can be slow at some times of the day, but generally works well. M1 have experienced some Digi-Star cross-talk with neighbours, however once the aerial was moved at M1, the problem was resolved.
- Automatic Weather Station
  M1's automatic weather station is modem based and only accessible through a webpage login (M1 use both DataCash by Pacific Data systems and Heat Load Data by KateStone). M1 cannot access their weather station directly, or view in real-time, with current connectivity. Their current solution is to receive an email daily with the data from the previous 24 hours.

- Pumping and Irrigation
  The farm uses Trimble RTK for GPS navigation on the lateral irrigator which works well. The base station aerial is mounted on the feed mill. The lateral irrigator runs with AgSense which provides automatic updates (by email). This is an effective program, although the phone app for AgSense is unreliable on site due to poor mobile service.

9.1.4.3 Current Technology for Site Connectivity

A summary of key internal and external connectivity at M1 feedlot is given in Figure 9.

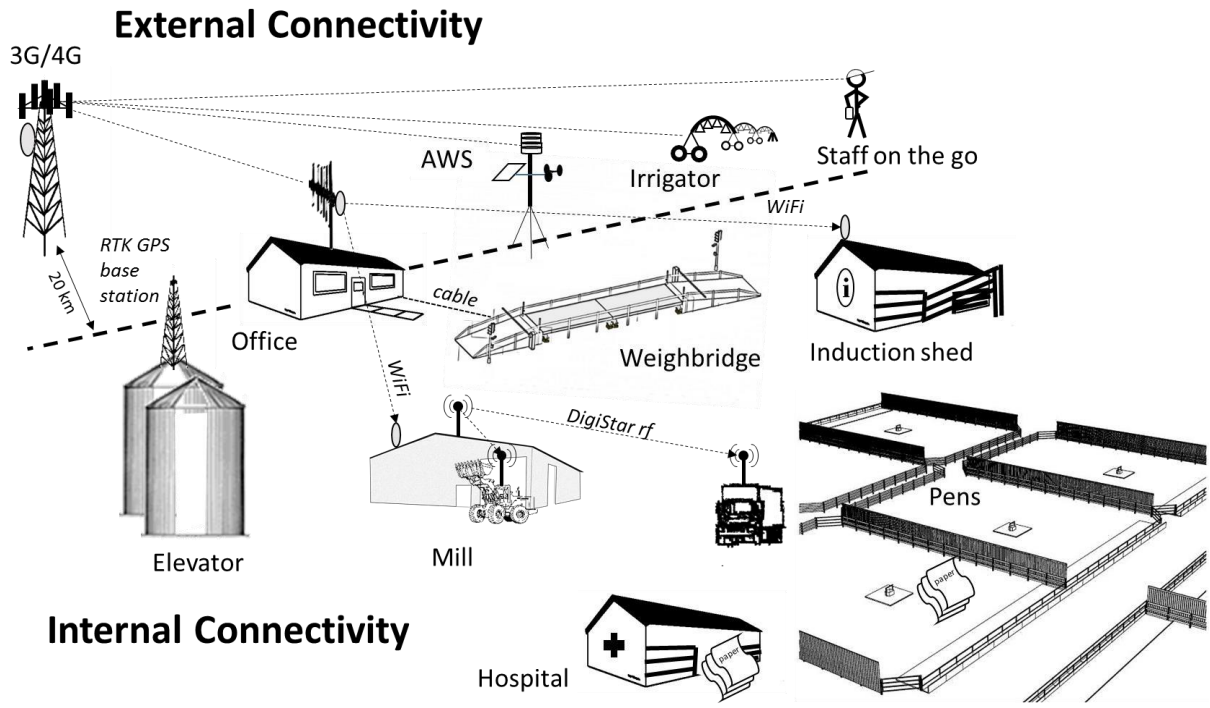


Figure 9 External and internal connectivity at the M1 feedlot.

9.1.4.4 External connectivity:

Data

The primary means of external data access is from the Main Office via a mobile phone link (directional antenna) to 3G/4G tower at a nearby town ~ 20 km away. A Wi-Fi router is used to connect Office desktops. External data speeds can be fast in morning (~10-20 Mbps), then slower during day (<1 Mbps) (and the link is usually downgraded to 3G).

Figure 10 Snapshots of various office links facilitating external access to the mobile phone tower.

The automatic weather station (AWS) is also linked externally via mobile modem (mobile tower). The lateral irrigator runs on 'Ag Sense' via a mobile modem.

Voice

For staff on the go, Cell-fi extenders give good voice access when in vicinity of the Office, Mill, Induction and Hospital precincts but staff cannot utilise their mobile phones elsewhere. Management relies on mobile phone for contacting buyers and this effectively limits movement to that around Cell-fi precincts. Cell-fi also locks the user into a particular network operator which limits their ability to seek alternative data/voice plans.

Other

A Trimble RTK base station is mounted on the Elevator for various precision agriculture operations.

9.1.4.5 Internal connectivity:

Data movements between the Office and key operational locations is facilitated by directional Wi-Fi.

Figure 11 DigiStar operating between the Mill and Feed vehicles is facilitated by radio link direct to the Mill and Livestock section.

9.1.4.6 Business Impacts

Business impacts include reduced staff productivity, and constrained connectivity infrastructure for the feedlot expansion. The collection of live data is crucial for heat load events, although this is currently very problematic and will need improvement.

Staff are often unable to take or make calls outside the office and phones often run flat when searching for a signal. Staff may return to the office 10-20 times per day to return missed calls, and this can result in lost business, especially for staff missing trade calls when buying cattle. The mobile network connection into the office is also error prone, and typically needs to be restarted each morning. The signal speed progressively slows down during the day and can become easily overwhelmed during critical workflow times. This often requires the recording of manual records, which then need to be manually entered into the system, causing reduced productivity and double handling errors.

Future Connectivity and Technology Desires

Short-term

Currently, M1 would simply like to have a faster, more reliable connection to improve the functionality of their existing tech onsite. This specifically includes:

- A reliable mobile phone coverage at yards and outside of mill so staff can receive timecritical calls in-situ, without needing to return to the office. This may involve the investigation of Cell-fi for vehicles (although reception will be restricted to the vehicle location);
- Reliable network access into the farm office;
- Access to live date from their weather station;
- Telemetry to remotely monitor pens, troughs, pumps and irrigation; and
- There are plans to expand the feedlot to 20,000 head so M1 need to address onsite connectivity for the future accommodation camp.

Long-term

The business is interested in investigating technologies such as automated-driving feed trucks, selfpropelled pen scrapers and a collection of animal metrics to assist with cattle drafting and scanning body frames. However, M1 are tentative to rush into adopting these technologies and feel there may need to be an industry initiative to promote these long-term options.

M1 believe it is important for humans to regularly interact with their animals, so are tentative about ever adopting too much automation on site.

9.1.4.7 Recommended Solutions for Connectivity

External connectivity – The limited mobile signal strength is already being enhanced at key precincts using cell boosters. The main options are to increase the number of boosters around the site or investigate the establishment of a private cell network, for example as offered by companies such as Pivotel[2] (http://www.pivotel.com.au/). Alternatively, the operators should investigate NBN fixed wireless or satellite (Sky Muster) as alternatives to mobile or private cell network.

Internal Connectivity - Consider 2-way LPWAN (900 MHz) links to remotely monitor (and possibly control) water infrastructure.

9.1.5 M2 - NSW

9.1.5.1 Background Information

The M2 Feedlot is owned by a local stock and station agency and was conceived in 2004 and built in 2006. The location is approximately 400 km from Sydney, NSW.

The feedlot has an operating capacity of 10,000 head and a throughput of 32,000 head (2014). Currently connectivity is patchy, and it is hoped that connectivity at the feedlot will soon be improved by a proposed 5 GHZ link to the neighbouring town which is expected to deliver 200 Mbps upload and 200 Mbps download speeds.

[2] Mention of Pivotel is purely on the basis of providing an example to readers and should not be taken as an endorsement of any particular product or service.

9.1.5.2 Current Data Movements On-Site

Office/Administration/Personnel

- In office ○ Internet and phone

  M2 feedlot have a monthly data usage of 18 Gb, which includes the office and two business mobile phones. Internet connectivity is generally poor and patchy (webpages with moving sections cannot be opened) although it can work well on some days. Communication is generally via radio and phone, although radio doesn't work in all areas.

  ○ Internal connectivity

  M2 feedlot have an optical fibre connection between the office, mill and two inductions sheds. All data collected is held on the secure server on-site. The optical fibre network has a point to point 2.4 GHz connection into the SES Building located 6.7 km away. This connection is linked via ADSL, although an ADSL2 connection would be preferred. Connection speed is suitable for National Livestock Identification System (NLIS) data, although MYOB software doesn't work well. ○ Payroll & HR

  Payroll leave sheets are via pen and paper and are then manually entered into the system. MYOB is used for finance, and all MYOB files are sent to an accountant in Dubbo. These files are problematic to send via email, so DropBox is used instead. It may take an hour to upload files into DropBox, and during this time everyone is 'hands off', otherwise the connection may be lost. This is generally done early in the morning before the majority of the workers arrive for the day.

- Out of office ○ Mobile phones

  Mobiles work everywhere on site and connectivity using the Telstra network is considered good. There is a direct link to a nearby town mobile tower and mobile boosters are not required.

  ○ Cars, vehicles, feedtrucks

  Communication within vehicles is via radio or mobile.

  ○ Yards

  Connectivity with the yards is slow, even with assistance from local IT company, AusLogic, who set up the optical fibre network on site.

- Staff accommodation ○ The manager lives onsite and has a Wi-Fi connection to his house, via the feedlot office. Internet speed in the office noticeably slows when all the occupants of the house are home and using the internet.

- Trouble shooting ○ Trouble shooting is first handled onsite by the feedlot manager. If problems cannot be resolved, IT company AusLogic is engaged. AusLogic can provide remote IT support, although if the Wi-Fi drops out, site staff need to travel to the SES building (~10 km away) to reset the modem.

Feed Mill, Yards and Pens

The following programs are used on site:

- Elynx (FY3000, StockaID) ○ Used within the induction/hospital shed. Data is recorded directly into the computer which is connected via Wi-Fi to the office.

- Digi-Star ○ Digi-Star is fully utilised and used for feed mixing and the distribution of feed. A computer is located in the mill and linked via fibre back to the office.
- Feedbunk
    - Feedbunk is used in conjunction with Digi-Star to aid in bunk management.

Pen riders use pull sheets for the identification of sick cattle. These sheets are given to the office for entering into the system. There are risks of data entry errors, although this isn't considered to be a major issue.

Automatic Weather Station

There is an automatic weather station (AWS) on site. Access to the weather station data is via WeatherMation (mobile SIM card), and staff can access data remotely using a smart phone. The University of Queensland also has a separate whether station on site which collects data via KateStone. M2 Feedlot can also log in and access this weather station data.

Pumping and Irrigation

There is a bore pump 'Mill pump' which supplies water to a 70 ML dam on-site. This is a critical piece of infrastructure, and if the pump fails, and email, SMS and auto-phone call is made.

9.1.5.3 Current Technology for Site Connectivity

A summary of key internal and external connectivity at M2 Feedlot is given in Figure 12.

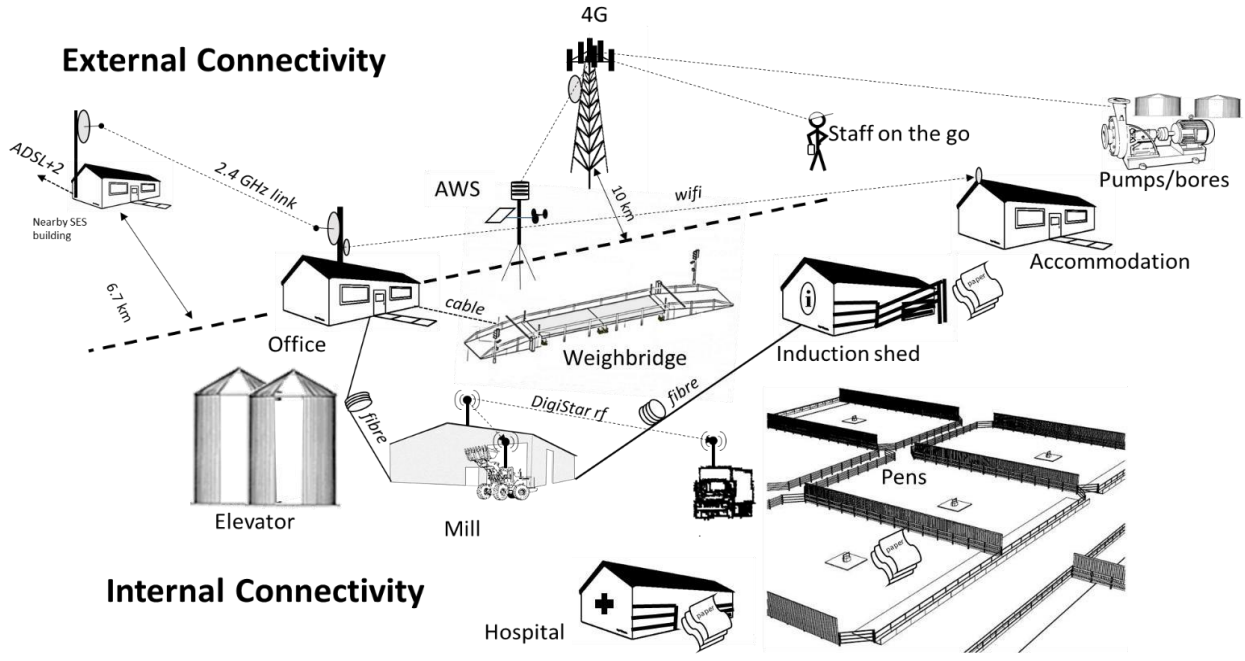


Figure 12 External and internal connectivity at the M2 Feedlot.

9.1.5.4 External connectivity:

Data

The primary means of external data access is from the Main Office via 2.4 GHz link to the SES building (approximately 10 km away) and then into the network via the existing ADSL+2 link. The ADSL+2 link, which is currently not fully functioning i.e. achieving ADSL speeds, is the ratedetermining link. Speeds fluctuate which is likely due to the ADSL link and occasionally when a storm hits the vicinity of the SES building, staff need to drive in and reset the modem box. There are

plans to upgrade the Office link to a more powerful 5 GHZ link (expecting 200/200 Mbps) and the consultant is currently sorting out replacing the ADSL+2 link to the SES building with NBN Fibre to node (FTTN). Again this FTTN link, while rated at 100/100 Mbps is likely to provide 50-75 Mbps up and down.

(a) (b)

Figure 13 External 2.4 GHz link from (a) Office to (b) SES building.

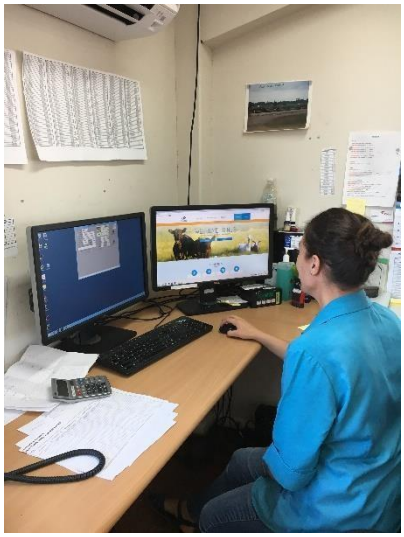


Figure 14 External data speeds are observed to fluctuate during the day. Many critical data transfer operations are undertaken at night when the connectivity is 'more reliable'.

The automatic weather station (AWS) is also linked externally via mobile modem (4G mobile tower) and data can be accessed using mobile phones.

Figure 15 Weatherman AWS linked via mobile network (4G tower in ~ 10 km away)

Voice

For staff on the go, mobile phones are used, linking to the 4G tower (~ 10 km away). Good data speeds (>20 Mbps) are experienced, particularly in the morning.

Figure 16 4G tower located ~ 10 km away.

Other

The primary bore pump 'Mill pump' which feeds into the 70 ML dam, and onwards to the pens' watering system, is linked via mobile phone network. Staff are notified via email/SMS and 'auto phone message' when a fault occurs.

Figure 17 70ML storage dam (foreground) and Mill pump (background) linked to an alert system via the mobile phone network (4G tower ~ 10 km away).

9.1.5.5 Internal connectivity:

Primary data movements between the Office and key operational locations is facilitated by a fibre loop connecting the Office to the two induction sheds and the Mill.

Figure 18 Fibre network and server cabinet servicing the M2 Feedlot.

Mill

Digi-Star operating between the Mill and Feed vehicles is facilitated by radio link and directly to the Office via the fibre loop.

Weighbridge

The Weighbridge weighing and camera monitoring system is linked via fibre back to the office.

Staff Accommodation
The manager lives onsite with an internal Wi-Fi connection from the Office to the house. Household usage often competes with Office usage on the external network connection.

9.1.5.6 Business Impacts
Slow internet connectivity and unreliable Wi-Fi connections are a risk to the business. The optical fibre connection is running at reduced capacity and is troublesome for uploading MYOB data onto DropBox. Wi-Fi connections frequently drop out and this requires a 10 km drive to the SES building to reset the modem. Wi-Fifi connection speeds are poor, and StockaID is only accessible on a laptop, which needs to be plugged in.

The owner of the business lives in town and also has limited connectivity. Due to these limitations, they are only sent the most vital data (i.e. feed records) and they typically don't get sent any other information, which can limit their understanding of business operations.

9.1.5.7 Future Connectivity and Technology Desires
Short-term

M2 feedlot plans to upgrade the current point to point 2.4 GHZ ADSL optical fibre cable connection to a more powerful ADSL2 connection. This connection will provide a 5 GHZ link (expecting 200/200). Specific connection details are currently being sorted, such as NBN fibre to node access to SES building. The fibre to node (FTTN) is supposed to be rated 100/00, although M2 feedlot are hopeful of 50-75 MB/s.

More reliable and faster internet will support the short-term goal of allowing a tablet or some other electronic device to record data directly from the pens. The owner has also purchased a drone and seeks to use it more frequently for taking photographs at the feedlot.

Long-term
The ultimate goal for M2 would be to install a NBN fixed wireless connection. This is not an immediate possibility, and may take some time to realise. An alternative option is to set up a NBN satellite connection, which M2 are currently looking into.

9.1.5.8 Recommended Solutions for Connectivity
External connectivity - Develop a broadband link, in the newly-installed microwave link, from current PoP (i.e. avoid reliance upon ADSL landline at town-end of private link). Alternatively investigate NBN fixed wireless (if available in nearby town) or NBN satellite as alternatives.

Internal Connectivity - Nil

9.1.6 M3 - NSW

9.1.6.1 Background Information
M3 Feedlot is located approximately 300 km from Melbourne ,Victoria.

M3 Feedlot is a covered feedlot producing long fed (≈400 days on feed) cattle for the Japanese export market. The feedlot was opened in 1989 and has a current pen capacity of 3,000 standard cattle units (SCU).

Internal connectivity at the property is patchy and can be problematic. There is a desire to improve connectivity at the property, and this may result in substantial cost savings, particularly for feed purchase and storage.

9.1.6.2 Current Data Movements On-Site

Office/Administration/Personnel

- In office ○ Internet and phone

  M3 is well connected externally via a Telstra 4G connection from a nearby tower. There is also a fixed wireless NBN connection into the office from the nearby town.

  - Internal connectivity
    - Internal Wi-Fi connectivity is patchy and is reported to drop out from time to time. This is ostensibly due to the environment of closely spaced sheds and covered pens which interferes with the Wi-Fi transmission (requiring line-ofsight; refer to the discussion of Fresnel zone in Appendix 2). Poor internal wireless network connectivity necessitates lots of data to be manually collected using pen and paper. This data then needs to be transcribed into the system which results in double handling and errors.
  - Payroll & HR
    - All payroll and HR documents, including induction, leave and timesheets are completed manually.

- Out of office ○ Mobile phones

  On-site mobile phone reception is generally good, although reception is often lacking from within the grains shed. The closest mobile phone receptor is from the Telstra tower on the other side of a nearby town.

  - Cars, vehicles, feed trucks

    Digi-Star is used in tractors, although not to its full capacity as internal wireless network connectivity is poor; data is read off the screen and recorded on a piece of paper.
  - Yards

    Wi-Fi is not available within cattle yards, and staff use mobile devices or UHF radio to communicate. All data collected from within the yards is written down manually. This includes:
    - National Livestock Identification System data (i.e. weight updates)
    - Temperature data from within covered sheds
    - Data collected by pen riders (i.e. pulls)
    - Feed data (the weight of feed dispensed is recorded on feed sheets)

- Trouble shooting ○ M3 are currently solving their

connectivity issues in-house, or by phoning Telstra for assistance and advice. They will then source an 'off-the-shelf' fix. They are seeking to increase their capacity for internal assistance.

Feed Mill, Yards and Pens

Digi-Star scale heads are used on tractors, but this is not linked to the office due to the challenges of establishing reliable internal wireless network connectivity (due to the environment of closely spaced sheds and covered pens which interferes with the Wi-Fi transmission (requiring line-of-sight; refer to the discussion of Fresnel zone in Appendix 2).

Automatic Weather Station

M3 have an automatic weather station which is located next to the office and it is connected via cable directly into a desktop computer. This set-up allows for live readings to be taken, and the information is used within the yearly environmental monitoring report. A Wi-Fi connection would be preferred, although this is currently not possible.

Pumping and Irrigation

There are two bores located on the property, and these are checked every 6 hours, day and night, and more often when temperatures are high. M3 would be interested in having an app to monitor bore levels, and this would reduce double-handling.

9.1.6.3 Current Technology for Site Connectivity

A summary of key internal and external connectivity at M3 feedlot is given in Figure 19.

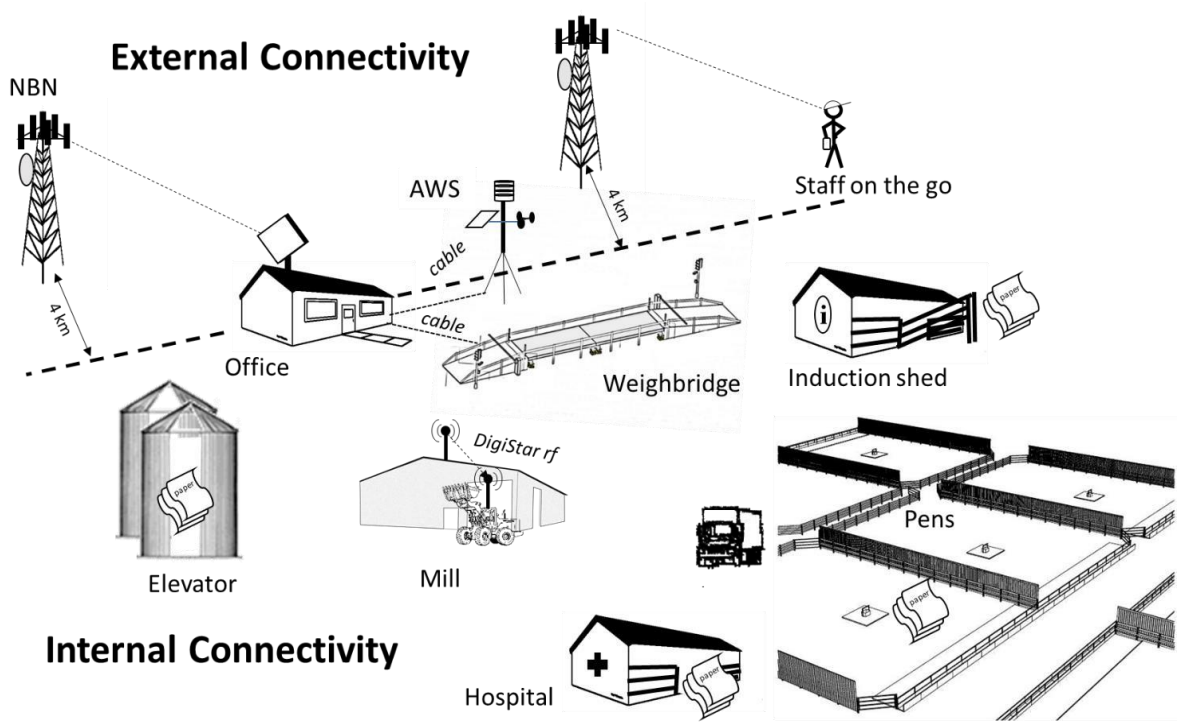


Figure 19 External and internal connectivity at the M3 feedlot.

9.1.6.4 External connectivity:

Data

The primary means of external data access is from the Main Office via NBN fixed wireless into a nearby town, approximately 4 km away. A Wi-Fi router is used to connect Office desktops. Initial weak Wi-Fi signal around the office precinct was rectified using a 'NETGEAR PowerLINE WiFi' connector[3] to transmit Wi-Fi through walls (via integral office power loop). External data speeds are generally 'fast' although staff experience fluctuating (and declined) speeds during hot weather (~ 40 °C days) and degraded performance during heavy rain/storm events.

[3] Mention of this connector brand is purely on the basis of providing an example to readers and should not be taken as an endorsement of the any particular product or service.

nearby NBN/4G tower

4G signal (near Offices)

Outside (direct to tower)

Internal Wifi link to other rooms in Office building

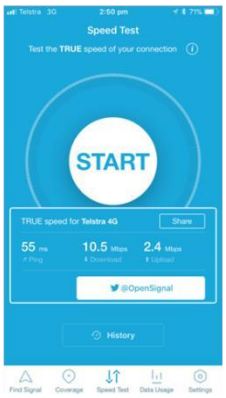


Figure 20 Snapshots of various external/internal links

Automatic Weather Station
The AWS is linked directly into the office using cable.

Voice
For staff on the go, UHF and mobile phones are used (with strong signal and fast data speeds of ~ 10 Mbps/2Mbps) generally experienced using smart phones.

Other None.

9.1.6.5 Internal connectivity:

There is poor onsite internal wireless network connectivity between the office and key operational precincts. DigiStar is operating on the tractor, facilitated by a radio link, between the Mill shed and the tractor but this is not linked to the office.

9.1.6.6 Business Impacts

Poor onsite connectivity is costing M3 money. The greatest impacts are likely for grain purchase and storage. M3 spend $4.5 million per annum on grain commodities, and improved software programs showing when stocks are low, or when to buy, may lead to significant savings. M3 have quantified that money could also be saved for the automatic recording of induction and cattle weight data for the NLIS. This would reduce double-handling of data for manual entry, and this may lead to yearly savings of some $20,000.

Poor connectivity is also impacting the business through the continual manual monitoring of bore levels, and temperature data within covered sheds. Automatically controlled retractable roofs would reduce labour and monitoring requirements.

9.1.6.7 Future Connectivity and Technology Desires

Short-term

M3 are seeking to improve internal connectivity, although they are not sure how to go about this. They do not have any IT skills in their workforce; they are using computers straight out of the box. M3 have a preference for building their internal IT skill set, and may investigate the hiring of IT personnel.

M3 is seeking to link existing software programs for the autonomous collection of data, for example, a Digi-Star link to the office, although they are unsure how to do this. They are also seeking an outside security gate with camera linked to the office.

Long-term

M3 are seeking to make a number of major connectivity improvements, although they do not want to become over-reliant on technology, or impose technology requirements onto all of their staff.

M3 are principally seeking improved internal wireless network connectivity between the office and key operational precincts. This improved coverage would support new software, such as creating a fully automatic, controlled environment for indoor cattle pens. For example, sensors within the pens will detect the temperature. This pen data, combined with the AWS data, will allow the program to decide when to open or close the pen roof. It is expected that this could be completed within the next two years. M3 understand that cattle, particularly larger animals, are heat sensitive, and are aiming to be best practice in their management (M3 Holsteins are exported to China at a weight of 750 – 800 kg).

Improved connectivity may also provide a marketing advantage, as Chinese clients are currently seeking a video set-up, which would allow them to watch cattle within the feedlot 24/7. Internet capacity is currently not adequate to support a set-up such as this.

9.1.6.8 Recommended Solutions for Connectivity

External connectivity - Nil

Internal Connectivity - Consider activating Digi-Star via radio links from tractor/mill to feed truck. Consider Wi-Fi link to Induction shed/Mill to support activation of live record keeping system (e.g. tag reader/weights at induction). Optical fibre connectivity.

Consider installing LPWAN (900 MHz) links to include water monitoring devices and shade/climate control system currently under development.

9.1.7 L1 - QLD

9.1.7.1 Background Information

L1 is located 200 km from Brisbane, QLD, and has been operating since 1989. The feedlot currently has a licenced capacity of up to 25,000 standard cattle units (SCU) and has 18,500 SCU of built capacity. The site predominantly feeds British-based cattle on 100 - 150 day grain-fed programs, and provides custom feeding services for clients targeting both domestic and export markets.

While the site currently has good external connectivity, provided through a fibre optic cable, L1 are looking to increase internal connectivity for improved operations performance.

9.1.7.2 Current Data Movements On-Site

Office/Administration/Personnel

- In office ○ Internet and phone

  The office has 2 land lines, although these are regularly struck by lightning, rendering them temporarily inoperable. Internet speed is acceptable. Desktops appear to have WiFi connectivity, although Wi-Fi connection is poor and patchy. The L1 server is not heavily used and is located off-site at head office approximately 100 km away.

  - Internal connectivity
    - Although internet and phone connectivity appear adequate, internal connectivity is lacking, and everything is paper-based, with all data currently being collected on paper. There are remnants of previous technology on display (i.e. cameras), although these are expensive to install or update. The operations manager is keen on improving connectivity and investigating new technologies.

  - Payroll & HR
    - Payroll is paper-based and all leave information is recorded manually. Details are then entered into a spreadsheet and emailed to the head office where they are saved within the system. There is a honesty system for timesheets.

- Out of office

  UHF is used all of site (all trucks, people, mill, office, workshop). In addition:

  - Mobile phones
    - Mobile phone network (3G) for staff phones.
  - Cars, vehicles, feedtrucks
    - GPS is employed on farm tractors and this is connected through a RTK satellite connection. ○ Yards

        - All data within cattle yards is currently recorded using pen and paper. This data is entered manually into an in-house program, and backed-up on the server. There is the potential that L1 are undercharging clients due to poor data collection.
    - Staff accommodation Data not available

- Trouble shooting
  IT issues are first examined on-site by the office staff. If these can't be resolved, the head office IT staff are contacted for assistance.

- Feed Mill, Yards and Pens ○ Elynx (FY3000, StockaID)
        - In the process of being installed.
        - Data is currently collected via USB and brought to the office for entry. This manual system of data collection affects commodity stocktake, and may also result in incorrect feed mixing.
        - Currently implementing FY3000 (mill data is currently put on a USB and brought to the office)
    - Digi-Star
        - Digi-Star is also in the process of getting installed. This system is not being taught to staff 'on the ground', and they do not currently have a true understanding of the program.
    - FileMaker
        - L1 built their own program for data management, although this will be replaced with the Elynx suite of programs.
- Automatic Weather Station
  The on-site weather station is linked via a modem to the University of Queensland Gatton campus. The university accesses this data for a heat load index study. In return for participating in this study, L1 can access the weather station data via the WeatherMation webpage login.

- Pumping and Irrigation
  Pumping and irrigation is generally carried out manually, although some pivots can be remotely stopped and started by the farm manager.

9.1.7.3 Current Technology for Site Connectivity

A summary of key internal and external connectivity at L1 Farms Feedlot is given in Figure 21.

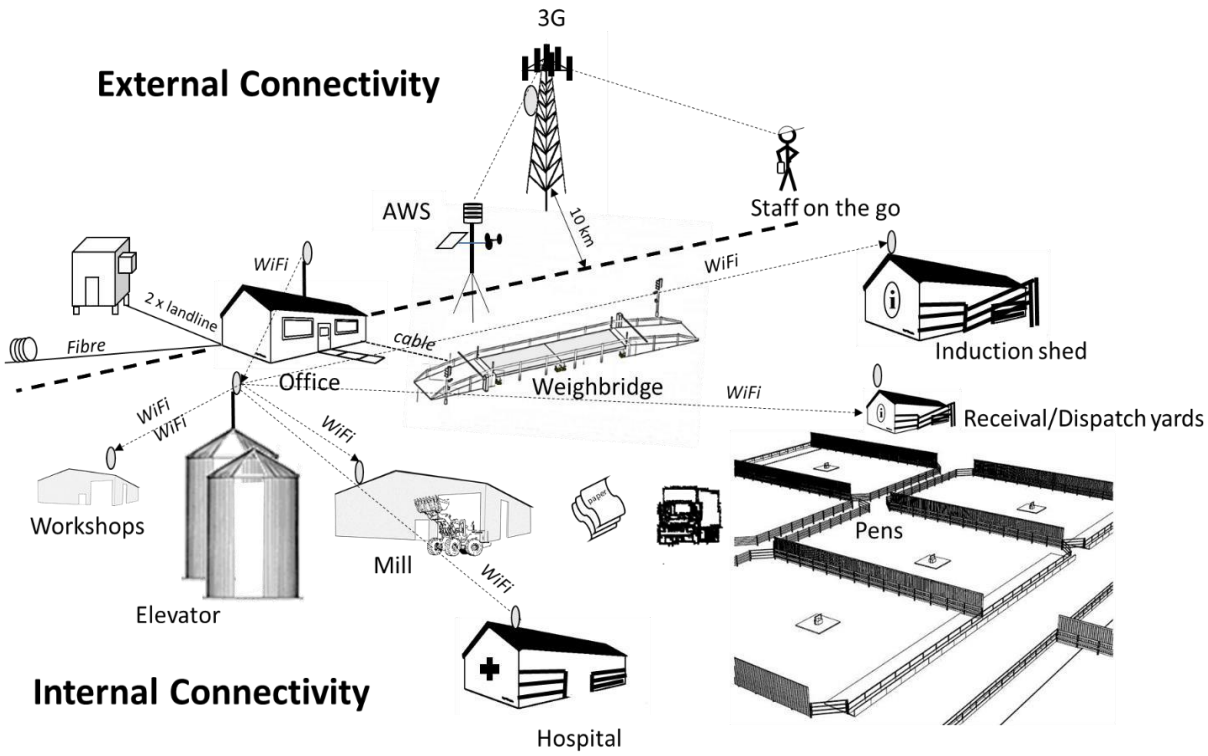


Figure 21 External and internal connectivity at the L1 Feedlot.

9.1.7.4 External connectivity:

Data

The primary means of external data access is from the Main Office via 50 GHz optical fibre link, providing fast and reliable internet and email access

The automatic weather station is connected via an external modem, running 'Weathermation', which is also accessed via the internet.

Voice

For staff on the go, mobile phones are used, linking to the 3G tower approximately 10 km away. Staff consider mobile access to be 'adequate'. Staff also use UHF (internal).

Other None

9.1.7.5 Internal connectivity:

An internal Wi-Fi link runs from the Main Office to the Elevators and then multiple Wi-Fi links connect the Mill (inside), Workshops, Hospital, Receival/Dispatch and Induction sheds. Paper records are the principal means of managing bunk calls although Digistar is currently being set up.

The Weighbridge weighing system and associated camera is linked to the Office via cable.

9.1.7.6 Business Impacts

Currently all data collection at L1 is paper-based and is entered into the system by office staff. There are quality assurance concerns with the manual entry of data. L1's Operations Manager is actively seeking more advanced connectivity solutions. Previous set-ups have focused on an internal 'build it yourself culture'. However, moving forward, off-the shelf products are now considered to be the more effective option. L1 are seeking to operate at 'best practice' and this includes their data management. They believe they may potentially be losing money due to poor data entry systems.

There are concerns with implementing new technologies at L1 as staff are generally not considered digitally literate, and there are challenges with being able to use technology and gaining the best use out of it. There are also concerns that increased technology use will reduce the need for staff to handle cattle. Cattle handling is considered important as this helps to keep cattle calm and acclimated, and this may help reduce future stresses. L1 is seeking to make incremental connectivity improvements, rather than making major changes, which may reduce staff morale.

9.1.7.7 Future Connectivity and Technology Desires

Short-term

In the short-term, L1 are seeking to catch-up to industry best practice, and this requires a reduced reliance on paper records.

Short term improvements include implementation of the following products:

- eLynx (FY3000, StockaID)
- Digi-Star ○ Trucks will soon all be connected to Digi-Star for full site connectivity. Staff training in the effective use of Digi-Star should be implemented.
- Introduction of a new timesheet 'scanning system' to reduce data handling and reduce the ability to 'fudge' work hours.
- Water meters
- Pivot telemetry

These technologies are considered to deliver improved customer service and traceability. The cost of these upgrades are considered easily recoverable as 50 % of cattle are custom fed, and clients are likely being undercharged for their feed bill (i.e. due to the collection of paper records).

Long-term

Future technologies which may be considered by L1 include the following:

- Meters/sensors for water levels, pumping activity, truck energy efficiency and real time desktop overview
- Commodity analysis, i.e. feed quality testing through NIR
- Water quality testing
- Scanning bunks for bunk calling
- Scanning pens for manure and manure quality
- Cattle scanning for meat quality ○ Ultimately develop a tool to indicate glycogen levels
- Growsafe type feed monitoring
- Pen inventory (again raising issues of transfers not being recorded properly). □ Video surveillance for OH&S, theft, biosecurity

L1 is reluctant to become the first adopter of these technologies (above), although they are interested in exploring them further. Technology not currently being considered is cattle smart tags.

These cost $19 per head for single use as batteries only last for 1 year. L1 do not see the value proposition for this technology and believe that this doesn't beat a good pen rider.

9.1.7.8 Recommended Solutions for Connectivity

External connectivity - Nil.

Internal Connectivity - Consider activating Digi-Star via radio links from tractor/mill to feed truck. Consider 2-way LPWAN (900 MHz) links to remotely monitor (and possibly control) water infrastructure.

9.1.8 L2 - QLD

9.1.8.1 Background Information

L2 is located 150 km from Brisbane, Queensland, and commenced operations in 1970. With a capacity of 10,000 head, L2 feeds a diverse range of cattle to suit a series of markets. Up to 50 % of the cattle on feed are cross-bred cattle (bred within their own supply chain), and the remaining 50 % comprise a combination of custom-fed cattle which may be fed for short or long-term grainfed markets.

As of 2017, the feedlot has applied to expand their facility to 21,000 head. This proposed expansion, combined with an increasing need for accurate, real-time, data has pressed the business for improved connectivity infrastructure.

9.1.8.2 Current Data Movements On-Site

Office/Administration/Personnel

In office

- Internet and phone

  External internet connectivity is via two Next–G (Telstra) mobile connections for backup/redundancy. These dual connections are not considered to have increased internet speeds and were not designed for this purpose. The connection to the server is often lost and shuts down. It is believed that this is due to the connection configuration, with the server being located in the office 'behind the connection'. If headquarters lose connectivity, the server cannot be accessed. The central server hosts mainly data, such as livestock records.

  L2 have 7 landlines. Phone lines frequently fail after wet periods (i.e. after an inch or more of rain) and they can take up to two weeks to be repaired.

- Internal connectivity

  The site contains a fibre optic loop. All hardware has recently been renewed three years ago and there is a backup server on site. This server is not backed up to the cloud as internet reliability is poor.

- Payroll & HR

  Paper forms are used by HR and payroll. These forms are entered into spreadsheets and emailed to the Warwick office for entering into the system. There is an honesty system for timesheets, and all leave requests are submitted on paper.

- Simple radio (Uniden).

This links cameras back to the office, and makes sure trucks are sitting properly on the weighbridge and other points of 'interest'.

Out of office

- Mobile phones

The site enjoys a 'good mobile connection' with 4G. There is a Telstra mobile booster with Wi-Fi routers at key buildings on site, including the office,
lunchroom and machinery workshop (47 up/7 down). All management staff use smart phones, and staff on other properties (away from the feedlot) use satellite spot trackers or satellite phones to communicate (i.e. while mustering).

- Cars, vehicles, feedtrucks

Vehicles have a John Deere modem link connection and are also connected to Greenstar. Flashcards are used to move data. It is possible for live data to be accessed through 'John Deere Links' to identify if the machinery is being operated, although this requires an internet connection. GPS technology is supported by an RTK base station located on high ground with radio links to John Deere machines.

- Yards

Feedlot yards have a fibre loop for data collection. There are a couple of outlying yards which do not have access to this technology, and they rely on laptops which work offline. The session data is uploaded upon return to the office. Currently all pen data is recorded manually and entered later.

- Staff accommodation

There are 13 houses on site, and all connections are privately managed. Staff accommodation contains a fibre loop connection.

- Trouble shooting

When landline services are lost, Telstra is contacted, and their solution is to provide mobile phones until connectivity is restored. This may take up to two weeks, and this is considered impractical for office staff who host 7 landlines.
If the office staff are unable to fix an IT issue, they contact an external IT consultant for trouble shooting and the management of IT issues.

Feed Mill, Yards and Pens

Connectivity is particularly important for the feed mill, yards and pens as cattle are custom fed. This requires the sending of data (i.e. total ration, ration composition, weight gains, photos etc) via email.

The following programs are in-use at L2:

Elynx (StockaId, FY3000)
Digi-Star
Beef Tracker

Automatic Weather Station
The automatic weather station (AWS) uploads data to Katestone daily at 3-5am. The AWS is cable linked back to the office for the collection of data. Data cannot be remotely accessed and data for the day is uploaded at the office.

9.1.8.3 Current Technology for Site Connectivity
A summary of key internal and external connectivity at L 2 is detailed below in Figure 22.

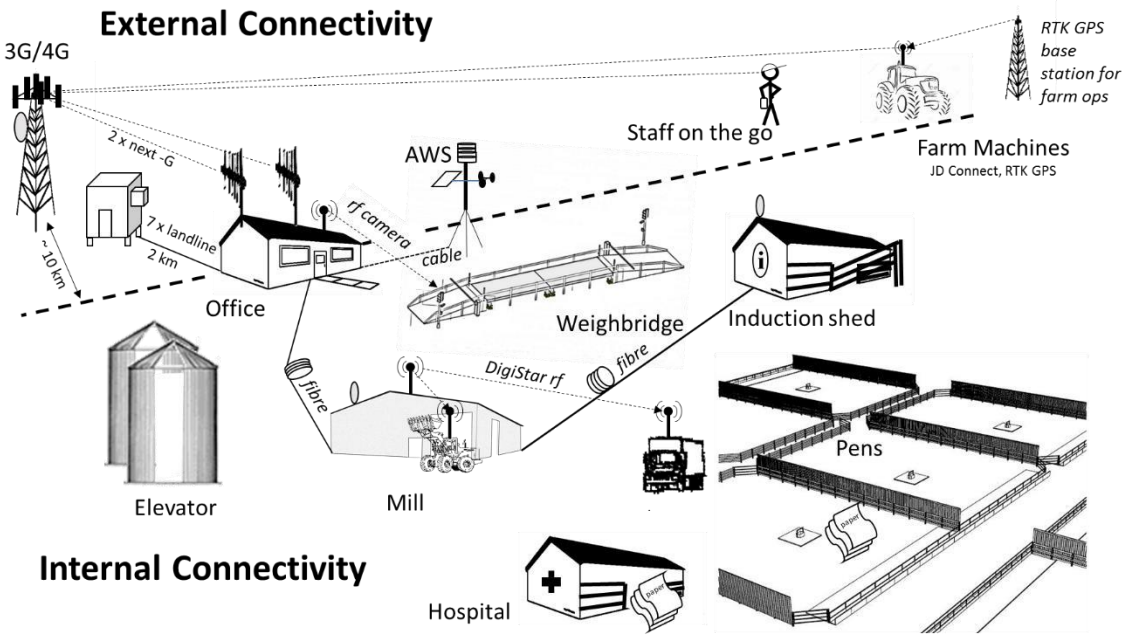


Figure 22 External and internal connectivity at the L2 Feedlot.

9.1.8.4 External connectivity:
Data
The primary means of external data access is from the Main Office via two Next-G mobile network links. The dual connection is for backup/redundancy purposes (as the Office hosts, onsite, the server that services not only the feedlot but also related businesses off site).

There are a number of mobile boosters on site with Wi-Fi routers at key buildings, although staff still experience declining connectivity speeds during the day.

Voice
For staff on the go, mobile phones are used, linking to the 3G/4G tower ~ 10 km away. Staff consider mobile access to be 'good'. The Office also has seven landlines to the nearby ADSL/ADSL+2 exchange (approximately 2 km away).

9.1.8.5 Internal connectivity:

Primary data movements between the Office and key operational locations is facilitated by a fibre loop connecting the Office, Mill, Feedbunks and Crush.

Digi-Star

Digi-Star is operating between the Mill and Feed vehicles is facilitated by radio link direct and directly to the Office via the fibre loop.

Weighbridge

The Weighbridge weighing system is linked to the Office via cable, and rf (wireless) links are used to provide camera vision to key areas including the weighbridge.

AWS

The AWS is linked internally to the Office via cable

Managers House

The manager lives onsite with an internal Wi-Fi connection from the Office to the house. Household usage often competes with Office usage on the external network connection.

9.1.8.6 Business Impacts

The business is constrained by its ability to access information directly without the double-handling of information. Key risks include:

Slow and variable internet speeds (i.e. poor all day functionality)

During periods where the IP address is lost, or where the connection drops out, the business remains disconnected from other sites and clients. Internet connection is unreliable, and internet speeds fluctuate throughout the day, i.e. slow internet speeds in the afternoon (i.e. 3 pm). Slow internet speeds give a lack of confidence in connectivity stability to set up cloud data handling systems.

Limited direct access to data

Without direct access to files, reporting accuracy is limited and the business pays an additional cost due to double-handling. Due to slow internet speeds, data is often received via email, and this requires manual re-entry.

The business is restricted in accessing information displayed on high-content web pages. There is a requirement for internet connection between all sites and to allow other sites to login and access data remotely (VPN).

Additional roles in Brisbane (i.e. new finance/accounting role) will leverage software connections to L2 which will slow down the data going onto the server. These unreliable connections will pose a risk of losing the link between the financial person in Brisbane and the financial records on the local server. This will effectively shut down the financial system.

Mobile and phone data

Rain causes the land-line to drop out, which causes the IP address to ‘become lost’. This may take up to 2 weeks to restore connectivity.

Data usage

L2 are currently receiving penalties for exceeding data usage and have a dedicated staff member monitoring usage at the end of the month

9.1.8.7 Future Connectivity and Technology Desires

Short-term

L2 would like to have faster and more reliable phone and internet connectivity. In the short-term, they envisage to have server capacity offsite to access information directly, rather than via email. Landlines also need upgrading to ADSL/ADSL 2+ for improved reliability.

L2 are in the process of setting up new accounting software, and their finance person (who will operate the software) will be based in Brisbane. The accounting platform should ideally sit in the cloud, although this is only possible with improved connectivity.

L2 are in discussions with March IT to look at a wireless internet link to Dalby (utilising the new point to multi-point system that has been installed at L4, on their feed mill). This link shall be 30 M up/down, and will cost $1800 per month, with a $30,000 - $40,000 initial setup cost to L2. An NBN network is expected to be available in 2019.

Long-term

L2 are interested in the following future technologies:

Real time data rather than double handling
Cloud back-up of data (currently not possible due to unreliable internet connections)
DEXA feedback – decision making tools, and how it may encourage live animal scanning and sensing
GPS guidance on trucks/cattle location
Animal diagnostics (i.e. useful for training, acclimation, autopsies or uploading vision of remote telehealth to vets)
RTK GPS for vehicle tracking
GPS bunk sweeper
Automated feed trucks
Pen cleaning technology
Water sensors
Reviewing energy requirements and efficiency metrics
Energy efficiency technologies for vehicles
Motor usage and optimisation technology for feed mills
Geomapping of feedlots
Pen inventory tags
REDI tags for the identification of sick livestock. L2 perceive this technology to potentially be high risk, and do not want to be the first users of this. They have some concern about cost and data strain on system due to the amount of data being transmitted.

9.1.8.8 Recommended Solutions for Connectivity

External connectivity - Investigate NBN satellite (Skymuster) as alternative to mobile network (bearing in mind existing discussions around possible private link).

Internal Connectivity- Consider 2-way LPWAN (900 MHz) links to remotely monitor (and possibly control) water infrastructure.

9.1.9 L3 – QLD

9.1.9.1 Background Information

L3 is located 200 km from Brisbane, QLD and is at a current capacity of 30,000 SCU.

L3 has a need for a reliable, fast external connection to improve the quality of connectivity for their staff living onsite and their exchange of data with their head office.

9.1.9.2 Current Data Movements On-Site

Office/Administration/Personnel

- In office ○ Data

  Internet and phone connectivity is considered to be slow in the office. Fibre optic cable speed test results for the two offices on site are shown below:

  - Office 1 – 49 ms, 2.7 Mbps down and 731kbps up
  - Office2 – 2.0 ms, 1.6 Mbps down and 724.5Kbps up

  ○ Connectivity On-Site

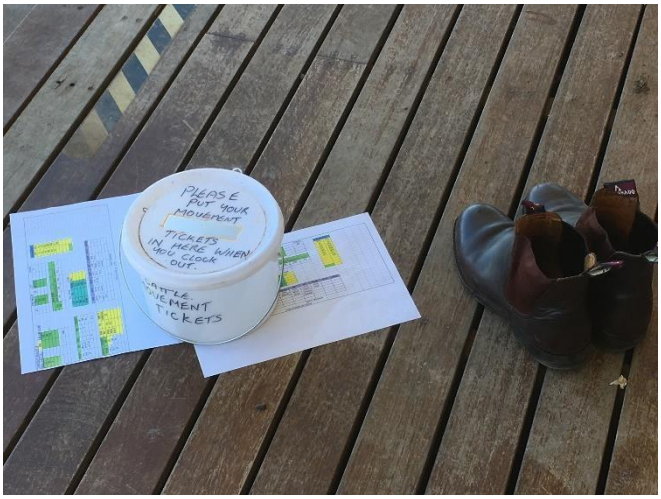
  L3 has four external Next-G modems (two in the offices and two on the elevator). All modems are directed to the nearest major town, which is located approximately 50 km away. The site has 1 satellite connection (Iterra) and other devices are supported by Next G. The feedlot is a heavily cluttered environment and has a 2.4 GHz wireless connection, which is good, but heavily used and congested. Internet congestion has required managers to ask workers to switch of their personal Wi-Fi devices (i.e. phones) to free up internet access. Currently the two-way radio is the main way of keeping in contact with staff on-site.

  The company manages a number of other feedlots, backgrounding facilities and cropping areas. Three of these properties are connected via satellite (~ 512 kb/s up/down) at a total cost of approximately $13,000 per month. The remaining properties are connected via Next G for an approximate total monthly cost of $2,000.

  Currently, staff would not consider holding a meeting via video-link, as would need to 'kick everyone else off' their connection.

  ○ Payroll & HR

L3 use iLeader for their document management, HR and internal information management systems. Sometimes L3 cannot access the software and the required documents need to be printed, manually completed and sent to head office as an email. They are routinely unable to access the latest version of a policy. BundyPlus is used to manage employee timesheets, and a similar manual completion is often required.



- Out of office ○ Mobile phones

  Mobile phones have good connectivity and cell boosters in the office and camps improve reception to 3 - 4 bars (the increase in bars is only between the booster and the mobile phone, they are not "Telstra bars"). Wi-Fi is fully functional and L3 are hoping to integrate this with VoIP.

  - Cars, vehicles, feedtrucks

    L3 use Elynx; they have an RTK GPS base station for on farm tractors. Another two vehicles are set up with GPS trackers (Next-G modem) as well as Volvo and Komatsu tractors (feed mill/mixers) for performance monitoring (by brands). Communication is via Wi-Fi or radio.

  - Yards

    Feedlot yards have a fibre loop to the main sheds and yard points. A quad of four Wi-Fi have been installed at the pens, but are not yet fully operational.

  - Staff accommodation

    There are approximately 40 people living on site at the 'camp'. Staff use their own mobile phones for data connectivity and often install their own personal boosters. There is a booster at the camp with speed test results of 61ms, 2.6 mbps down and 1.2 mbps up. Staff who are studying need to leave site to access the online portion of their course (i.e. download university lectures).

    The manager's house is located five minutes drive from the office. Before L3 improved connectivity on-site, a mobile phone call could not be made. Now, mobile phone calls are possible, but it is required to be within 10 metres of a booster. Internet is now faster, but not overly reliable. Often emails cannot be accessed if too many occupants are using the internet.

- Trouble shooting

  Connectivity discrepancies are managed between staff in the head office, and staff at L3. The head office headquarters employs five IT staff, with a manager. These staff visit and service all sites, and IT operations are entirely run in-house. March IT service the incoming internet hardware located at the feedmill, including the Wi-Fi link back to the office.

Feed Mill, Yards and Pens

FY3000, StockaID and Digi-Star are currently used at L3. Usage data is unavailable.

Automatic Weather Station
L3 has an automatic weather station (AWS) on site. This is connected via separate modem and accessed via WeatherMation. Katestone is accessed for heat stress forecasting.

Pumping and Irrigation
There are 2 bores located on-site. All water bore meter data is accessed on the computer at the feed mill.

9.1.9.3 Current Technology for Site Connectivity

A summary of key internal and external connectivity at L3 Feedlot is given in Figure 23.

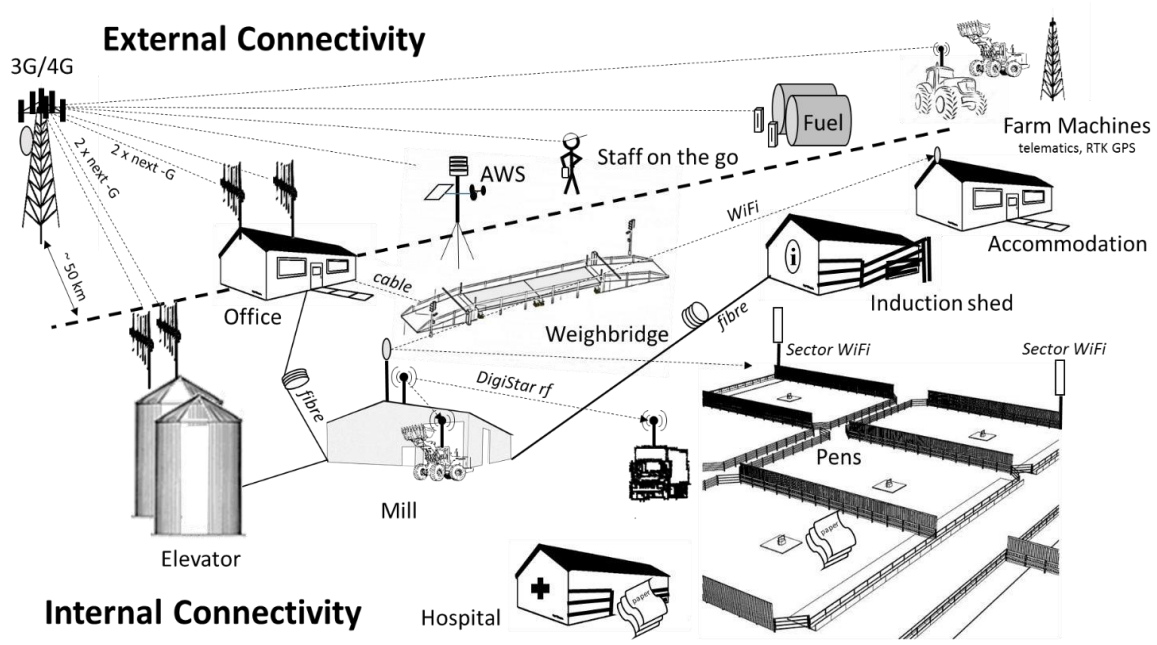


Figure 23 External and internal connectivity at the L3 Feedlot.

9.1.9.4 External connectivity:

Data
The primary means of external data access is from the Main Office via 4 x next-G mobile network links (two located on the office and two on the elevator) to the mobile tower at a nearby town, approximately 50 km away. The dual connection is for backup/redundancy and to improve speed.

There are a number of Cell-fi mobile boosters e.g. office with Wi-Fi routers, at key buildings to provide Wi-Fi access in the vicinity and mobile boosters in the vicinity of staff quarters to allow staff to use their private mobile phone data plans (some accommodation is linked via internal Wi-Fi from the Mill).

Fuel Point

The fuel point is linked via a mobile modem (running the web-based package 'Datafuel') to monitor fuel usage and inventory.

AWS

The AWS is connected via external modem, running WeatherMation. Staff experience declining connectivity speeds during the day.

(a)

(b)

(c)

Figure 24 External connectivity. (a) Main Office with dual next-G antenna/modems, (b) dual antenna on top of elevator, and (c) the mobile tower at a nearby town approximately 50 km away.

Voice

For staff on the go, UHF radio is used. Mobile phones can be used only within 10 metres of a booster. Mobile phones link to the 3G/4G tower (~ 50 km away) and utilise the internal Cell boosters where possible.

(a)

(b)

Figure 25 (a) Staff 'camp' and (b) Dining area, both with Cell-fi mobile boosters providing enhanced mobile phone reception for staff use.

Other

There are a number of farm and feedlot machines running telematics (modem link).

An RTK base station is located on a high point, with radio links to various farm machines to facilitate precision agriculture operations onsite.

9.1.9.5 Internal connectivity:

Primary data movements between the Office and key operational locations is facilitated by a fibre loop connecting the Office, Mill, Feedbunks and Crush. This includes the pens where Wi-Fi sector antenna have been installed to facilitate tablet-based data movements. At this stage the pen Wi-Fi system is not fully operational with reliance currently upon paper records.

Digi-Star operating between the Mill and Feed vehicles is facilitated by radio link direct and directly to the Office via the fibre loop.

Figure 26 Digi-Star system in operation.

The Weighbridge weighing system and associated camera is linked to the Office via cable.

The manager lives onsite with an internal Wi-Fi connection from the Mill to the house. Household usage often competes with Office usage on the external network connection.

9.1.9.6 Business Impacts

L3 have good internal connectivity to transmit live data sessions within the feedlot because of substantial investments. However, they are restricted by the reliability of external connectivity in document sharing and accessing online resources. This lack of external connectivity restricts feedlot operations.

Internet is very unreliable, particularly during high data use periods. L3 staff have difficulty loading high content sites, and this limits educational opportunities. This potentially impacts the desire of younger staff to keep working at L3 for the long-term.

9.1.9.7 Future Connectivity and Technology Desires

Short-term

Short-term connectivity desires for L3 include:

- Supply-chain level data – from breeding to processing, to allow feed-forward mechanisms (60% cattle on feed are internal cattle), and allow feedback from carcass grading data;
- Capability to have cattle sellers login to a webpage and have the ability to book in cattle deliveries and access performance data (currently completed via email); and
  Camera installation to monitor isolated areas of site.

Long-term

Long-term plans are to plug into an optical fibre network, which is supposedly running as an aerial on the nearby HV lines, ~ 8 km down the road. It is planned that this optical fibre link will support a P-MP microwave dish for camp communications, and this may also provide point-to-point to service neighbours. This plan is considered very expensive, and it may cost $250 k to access the existing fibre loop. At each connect point between fibre runs there is an access point, although these are approximately 30 km apart.

L3 are striving for a fully integrated operation, with all data flowing into and through a common communications system. Currently all scheduling is done via email and all accounts are run out of Brisbane and this often requires double entry. The same data is sometimes manually entered two or three times, which causes errors.

Long-term connectivity desires for L3 include:

- "Bluesky GPS" for pen cleaning and feed truck operation (this includes feeding and monitoring of truck driving practices on-site – ie training can result in better driver techniques, resulting in cost savings).

9.1.9.8 Recommended Solutions for Connectivity

External connectivity - Investigate NBN satellite (Skymuster) or private link to nearby PoP (fibre), as alternative to mobile network.

Internal Connectivity - Consider 2-way LPWAN (900 MHz) links to remotely monitor (and possibly control) water infrastructure.

9.1.10 L4 - QLD

9.1.10.1 Background Information

L4 Feedlot is located 150 km from Brisbane and has had a licensed capacity of approximately 16,000 Standard Cattle Units (SCU) since 1995. The feedlot is a custom operation and is run in conjunction with a 2,000 hectare grazing and farming operation.

L4 have just begun the process of upgrading their on-site connectivity by installing a dual pole 4G antenna on top of the Mill tower. L4 are constantly on the look-out for new technologies to trial to improve the ease and efficiency of daily tasks. L4 staff are receptive to new technologies.

9.1.10.2 Current Data Movements On-Site

Office/Administration/Personnel

- In office ○ Internet and phone
    - The internet speed and reliability changes during times of the day. Generally, internet and email tasks can be completed. Landline phones are available in the office, although these may be replaced once mobile reception becomes more reliable.
    - All data is saved on a terminal server which is backed up every night, with snapshots taken during the day. Other systems have been trialled, including a

shared database which was unable to handle the volume of data collected and a Phoenix cloud which often wouldn't work.

- Payroll & HR
  - Request forms (for leave) are done on paper and entered into the system.
  - Have electronic card in-card out timesheet, which also assists with OHSE on-site to account for everyone. If, at the end of a day, a card is still left, ring the person and find out where they are.
  - L4 is looking to use an app for HR, WHS and the training register in the future.

- Out of office ○ Mobile phones
  - Staff collect a mobile phone at the beginning of the day. These phones can be used for data collection, photos and calls on-site. WhatsApp is installed on all phones so that data can be used to make phone calls. Phones are returned at the end of the day, therefore, all data collected and photos taken during the day remain on-site.

- Cars, vehicles, feedtrucks
  - Data not available.

- Yards/Pens
  - Staff record data electronically (using their phones) which connects in the pens to the cloud.

- Trouble shooting ○ Trouble shooting is provided initially by the manager on-site. L4 also work with SBS Systems who maintain their server in Brisbane, and more recently March IT who have installed their new mill tower infrastructure.

Feed Mill, Yards and Pens

The following programs are used on site:

- Elynx (FY3000 and StockaID) is used during cattle induction and can be accessed at any time. During induction, all animals are electronically scanned and information is added to the animals file (i.e. sex, treatment, breeder information).
- Digi-Star can be accessed remotely at any time

Automatic Weather Station

The automatic weather station is connected via mobile modem and data is accessed via the Weathermation website.

Pumping and Irrigation

All bores are installed with flow meters. Pumps cannot currently be remotely controlled, although L4 are working on this.

9.1.10.3 Current Technology for Site Connectivity

A summary of key internal and external connectivity at L4 Feedlot is given in Figure 27.

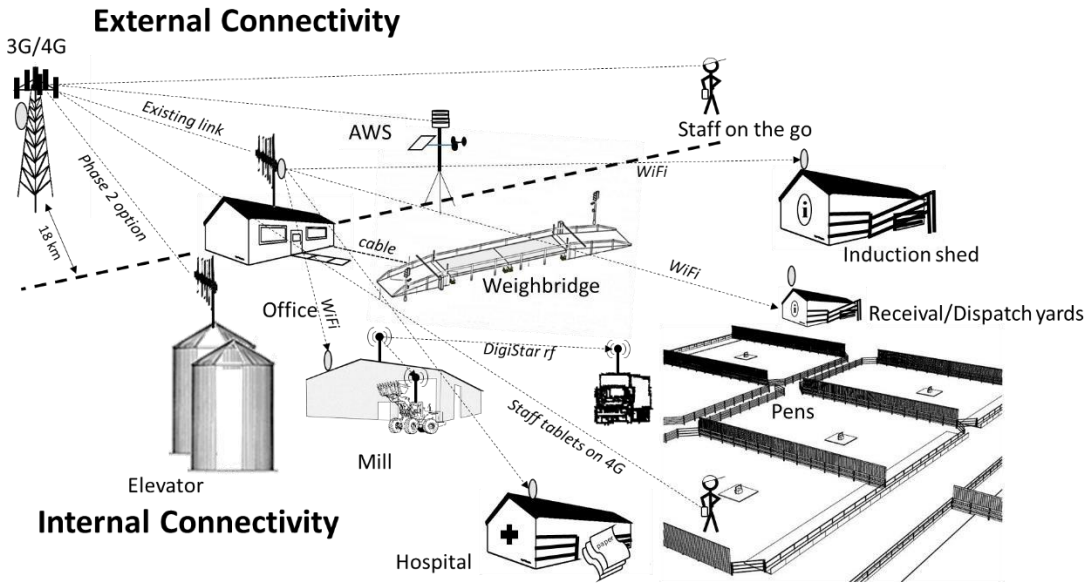


Figure 27 External and internal connectivity at L4.

9.1.10.4 External connectivity:

Data

L4 have recently begun working with March IT to upgrade their connectivity. With March IT's assistance, L4's primary means of external data access is now delivered to the main office via directional antenna linked to a fibre service in Dalby. The data service delivers a dedicated 30Mbps Upload / 30Mbps Download with unlimited data usage. This service is delivered with a 99.9 % Service Level Agreement (SLA) but engineered to achieve 99.9999 % uptime based on average atmospheric conditions for the region. The secondary means of external data access is from the Main Office via directional antenna linked to the 4G tower located approximately 18 km away.

Up until these changes, staff reported unreliable speeds throughout the day. Examples include 0.5 Mbps up/0.7 Mbps down ranging up to 18 Mbps down/22 Mbps up.

The office antenna has recently been replaced by a dual pole 4G antenna mounted on top of the Mill tower (at a height of 28 m compared to the original 4 m height achieved from the Office building), Figure 28.

Figure 28 New antennae on top of mill tower.

Voice
For staff on the go, all routine voice communications via mobile phone or UHF. Mobile connectivity is reported as patchy. Senior staff, in particular those who rely upon mobile phone connectivity, report overall poor performance.

Office voice relies upon landline.

Other
None

9.1.10.5 Internal connectivity:

L4, working with March IT, has recently installed a Wide Area Wi-Fi (WAWIFI) network. It is an unlicensed microwave data network using a 5Ghz band. Four, 90 degree, sector antennas are installed at the top of the mill tower providing a 360 degree coverage area for distributing the signal throughout the property. Four property locations have a subscriber module installed which is wired to an indoor or outdoor Wi-Fi access point.

Before these updates, primary data movements between the Office and key operational locations, including the Induction shed, Hospital, Receival/Dispatch yard and a laneway scanning system, were facilitated by Wi-Fi from the Office. The system operated on a terminal server system.

Figure 29 Internal point to point links utilises Wi-Fi operating from the Office. The various receivers show the 'history of connectivity' at L4.

Pen riders use tablets with 4G modems and information is recorded using a cloud-based record system (Microsoft OneNote). Effectively data is exchanged via external connectivity to the cloudbased server. Initial trials using Wi-Fi (internal connectivity) for the tablets proved unreliable. Pen riders also take photos on their tablets (e.g. animals) for future reference.

Digi-Star
Digi-Star operating between the Mill and Feed vehicles is facilitated by radio link.

Weighbridge
The Weighbridge weighing system and associated camera is linked directly to the Office via cable.

9.1.10.6 Business Impacts

L4 believe they cannot run a business without sustainable internet access. They need connections with the outside world; if they aren't receiving emails, they cannot generate income.

9.1.10.7 Future Connectivity and Technology Desires

Short-term

L4 has a number of innovations they are investigating in the short-term:

- An app for HR, WHS and a training register. ○ Truck positioning via GPS.
- A fibre connection to the nearest tower to provide a more secure and faster internet connection (top speed 300-400 mb per

second). ○ Improved Wi-Fi reliability would also be good, and this would allow L4 to reduce the number of landlines they require in the office.

Long-term

L4 are accessing the following technology options:

- Cattle Tags
  These may be considered for monitoring, although there is a lack of information to suggest that these tags shall improve the ability of pen handlers to perform their work.
- Stocktake System
  An improved stocktake system for cattle which may include photo recognition. This may also detail animal movement. For example, how many times a day do cattle travel to watering troughs, or how often do they feed. Information gathered suggests that feeding once a day may be preferable over twice a day.

9.1.10.8 Recommended Solutions for Connectivity

External connectivity - Investigate NBN satellite (Skymuster) or private link to nearby PoP (fibre), as alternative to mobile network. To improve mobile phone connectivity (patchiness), use extenders around key precinct areas to improve reception at key locations.

Internal Connectivity - Consider 2-way LPWAN (900 MHz) links to remotely monitor (and possibly control) water infrastructure.

9.1.11 L5 - VIC

9.1.11.1 Background Information

L5 is located in Southern Australia, and has a legal capacity of 20,000 standard cattle units (SCU) and an approximate carrying capacity of 17,500 SCU. All cattle are British breeds, and the feedlot has an approximate turnover of 70,000 SCU per annum, making it one of the larger feedlot operations in Australia. L5 are continually seeking to improve their internal and external connectivity, and are investigating a number of emerging technologies which may be used on site. They don't see digital literacy as a problem, and believe that many staff members would be willing to try new things.

9.1.11.2 Current Data Movements On-Site

Office/Administration/Personnel

- Data
  Staff are happy with their external connectivity. L5 invested in a private microwave link which operates well. This system has a microwave at the top of the mill, with a receiver at the feedlot, and another receiver in a nearby town. They also have a back-up 3G connection with Telstra, in case anything goes wrong with the microwave link. The microwave link requires an expert to repair, and the link was previously offline for three days after it was damaged by a storm. The main office at L5 has its own server room which supports email, web browsing and video conferencing. The original 3G link was poor and wouldn't have supported video conferencing.

  External connectivity is so good that it appears less error prone than connectivity at the Company headquarters, where all systems are run on a central database.

The site also has a wireless connection which has drastically improved. The initial version was called Wireless A, which was poor. This was upgraded to Wireless B, which was a bit faster, and the facility is now running a system called Wireless N, which is a lot faster and has increased data capacity.

- Payroll & HR
  All payroll and HR for full time staff is completed electronically. Timesheets are completed online, through individual logins and biometric finger print scanners. Safety training is logged electronically after first being recorded manually.

- Out of office ○ Mobile phones
  The site has good mobile phone connectivity, although only leading hands are able to use mobiles to reduce the risk of distraction in the workplace. Senior staff with mobiles use the Telstra service; reception is patchy within office buildings but good outside.
  - Cars, vehicles, feedtrucks
    Radio is fitted to all vehicles as a form of communication. ○
  Yards
    There is a fibre connection to the mill office, which supplies a wireless connection to the hospital and induction shed.
  - Staff accommodation
    There is no staff accommodation on site.

- Trouble shooting
  L5 has its own IT specialist on-site, which is a big asset to the team, and this has reduced reliance on the IT helpdesk, in the companies head office.

Feed Mill, Yards and Pens

The following programs are used by L5:

- Elynx (FY3000 and StockaID) ○ Used during cattle induction
- Digi-Star ○ For feed management – happy with connectivity

Minimal manual records are taken. These records are restricted to pen riders, who record pulls on pull sheets, and maintenance workers who manually record maintenance activities (i.e. trough cleaning and pen scraping). All manual records are entered into spreadsheets at the office, and this system is not considered to be a significant business risk.

Automatic Weather Station
L5 uses a Davis automatic weather station (AWS). This is connected wirelessly to the console in the main office. Data is then sent to a PC, where it is available in 30 minute intervals. Data is also uploaded to the KateStone and Davis websites, where it is available online and can also be accessed on mobile phones using the Davis app.

Pumping and Irrigation
Water bores used to have sensors, although these have not been replaced following flood damage. Bore and dam levels are now checked daily.

9.1.11.3 Current Technology for Site Connectivity

A summary of key internal and external connectivity at L5 is given in Figure 30.

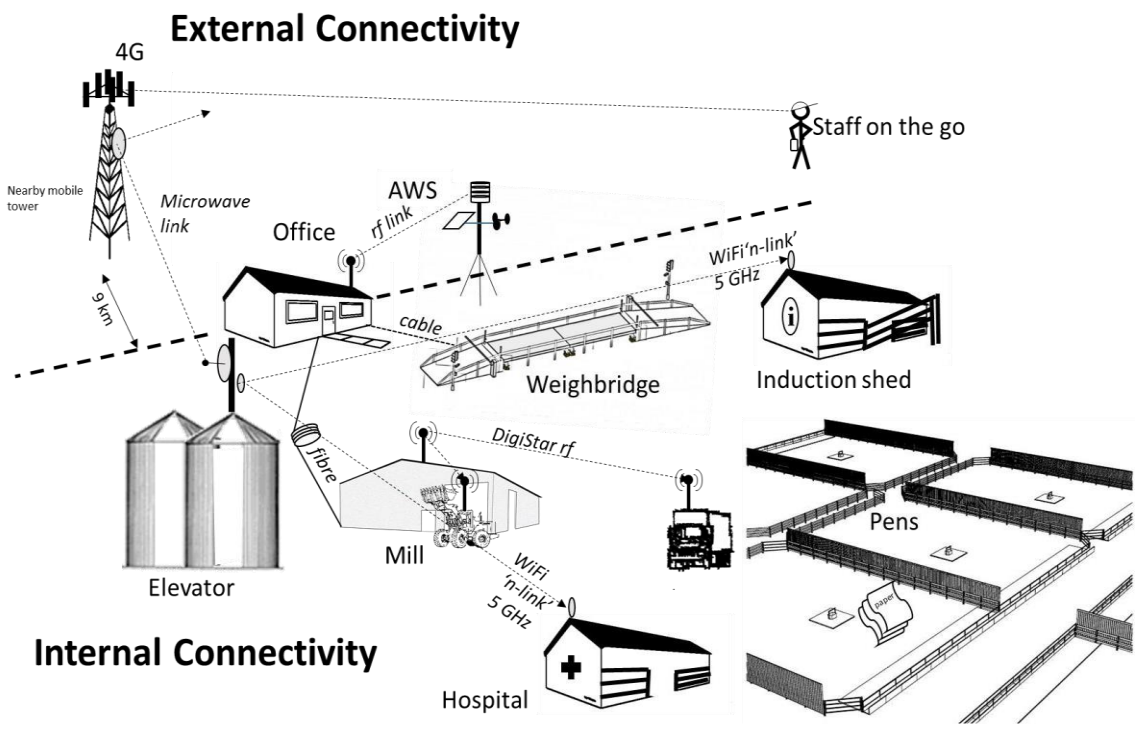


Figure 30 External and internal connectivity at L5.

9.1.11.4 External connectivity:

Data

The primary means of external data access is from the Main Office via fibre to the Mill tower and then via microwave point-point link to nearby Telstra/Optus tower approximately 9 km away.

The Feedlot had previously utilised a direct 3G link to the same tower (Yagi antenna on Office building) but this proved unsuitable for video conferencing and other high-speed applications.

Figure 31 External connectivity. The microwave point-point link from the top of the Mill tower.

Voice

For staff on the go, all routine voice communications with workers is via UHF radios. Those senior staff with mobiles use the Telstra service. Staff report that mobile reception is patchy within the office building but generally 'good' outside.

Other
None

9.1.11.5 Internal connectivity:

Primary data movements between the Office and key operational locations is facilitated by a fibre loop connecting the Office to the Mill tower and thence to the Hospital and induction shed via 5 GHz 'Wifi-n' links.

Figure 32 Internal point to point links utilises Wi-Fi operating at the higher bandwidth 5 GHz frequency.

Digi-Star

Digi-Star operating between the Mill and Feed vehicles is facilitated by radio link directly to the Office via the fibre loop.

Weighbridge

The Weighbridge weighing system and associated camera is linked directly to the Office via cable.

AWS

The Davis AWS is connected via radio link directly to a console in the Office which can be read directly on a desktop (30 mins sampling interval). The software uploads data to KateStone and Davis websites and it is thence also available via external internet access. The web data can also be accessed and read on mobile phones using the Davis weather app.

9.1.11.6 Business Impacts

Connectivity at The Feedlot is good, and business risks are relatively minor compared to similar operations. However, the microwave link doesn't operate during power failures, and this poses a risk for all office communications. Overall, this is considered to be a moderate to minor business risk, as feedlot workings will largely continue unhindered, although external connectivity to Brisbane headquarters may be lost. The site also has a back-up Telstra 3G connection available for this purpose.

9.1.11.7 Future Connectivity and Technology Desires

Short-term

The Feedlot are keen to install a number of minor connectivity improvements, including:

- Security cameras, including the installation of cameras to cattle pens and handling facilities ○ The current system limits the number of security cameras as they take up too much bandwidth.
- Installation of sensors on bores ○ These were previously installed, though they were damaged during recent floods. Water level sensors would reduce the requirement to check bore levels daily. **Long-term**

The main long-term goal for the feedlot is the introduction of connectivity to feedlot pens. It is thought this will increase reliability and cattle throughput.

The following connectivity programs/solutions have also been considered by The Feedlot:

- Cameras to monitor pens
  Cameras would be connected to an internal network and would initially be for security and for the handling areas. This data would be held on an internal network.
- Driverless feed truck
  The Feedlot like the idea of driverless feed trucks to avoid errors in feeding the wrong pens.
- App to access Elynx (StockAid and FY3000) on phone.
- Wireless hotspot and wireless to pick up radio
- App for bunk call (currently done via pen and paper)
- Drone for counting or camera for counting at receival ramp. Can re-watch and slow-down the frames for checking.

9.1.11.8 Recommended Solutions for Connectivity

External Connectivity - Nil

Internal Connectivity - Consider 2-way LPWAN (900 MHz) links to remotely monitor (and possibly control) water infrastructure. There are also edge-of cloud remote camera surveillance systems that operate on the mobile network.

9.2 “Getting Connected” Technical Assessment

Please see attached document – Appendix 2.

9.3 Magazine Article

Connectivity is improving across Australia; 86% of Australian households had internet access in 201415 (ABS 2016). However, the requirements of rural and regional families and businesses can be different to their urban counterparts. It is well known that agricultural producers experience limited to no mobile phone coverage beyond regional centres and transportation corridors (Lamb 2017).

A substantial proportion of Australian feedlots are located away from regional centres, which means that these operations need to consider external connectivity options, including, Local Area Networks (LANs), Wireless Local Area Networks (WLANs), Wide Area Networks (WANs), Landline (ADSL and ADSL2+), mobile and cellular devices, satellite communications options, National Broadband Network (NBN) and bonded broadband. Additionally, emerging technologies will require feedlots to have a high level of connectivity, with many technologies requiring on-the-go-connectivity.

Based on this information, we identified the connectivity requirements and education needs of Australian feedlots. This included the availability and usage of communications infrastructure (phone, internet, etc), and the future requirements of this infrastructure to support possible emerging technologies. An understanding of current and future connectivity needs will assist operators make informed choices when investigating new technologies for their feedlot. The project team included Premise Agriculture and Prof. David Lamb, from the University of New England.

We interviewed 11 feedlots and developed case studies for each. In addition, we prepared a technical assessment document entitled “Getting Connected”. Feedlot participants included small, medium, and large operations to provide a well-rounded understanding of the telecommunication requirements of the Australian feedlot industry. Interviews centred around the business’ current connectivity requirements (and their impediments), in the office, paddock, vehicles and pens, and the business’ future anticipated requirements. As a result of these interviews, it was found that the overall connectivity of a site can be broken-down into:

- External connectivity (i.e. reception from nearby phone towers);
- Internal site connectivity (on-site mobile and internet reception); and
- Utilisation of available infrastructure and integration with modern technologies.

An overarching goal of this project was to help Australian lot feeders to understand their current and future connectivity needs - to help them make informed choices when investigating new technologies for their feedlot. Publication of “Getting Connected” on the MLA website will facilitate delivery of this message to the feedlot community.

Findings from this project indicate that feedlot operations are increasingly reliant upon external connectivity because:

- Of centralised management, external supply chain (commodities, stock transactions) and/or financial/resource management (e.g. accountants, business support).
- They are generating increasing amounts of data (and set to generate even more with emerging technologies); and
- They are utilising more sophisticated connected tools which require off-site support.

As a result, external connectivity must be reliable because:

- It is often time critical, and
- It must carry increasing amounts of data.

The key recommendations from B.FLT.8009 are:

For feedlots

Avoid relying upon the mobile network for critical/large volume data movements.

For Internet Service Providers (ISPs) and Network operators

Offer suitable data packages commensurate with the way feedlots operate; and

Offer multi-point NBN satellite connectivity options.

For technology developers

Avoid reliance upon centralised/cloud based servers that rely upon 'hot' external connectivity.

For MLA

Continue to implement education programs.

On Australian feedlots, business and lifestyle can be inextricably linked, and a lack of connectivity restricts education, social cohesion and daily business. If feedlot operators have the capability, through education, to make informed decisions for accessing the most cost-effective, reliable, method of connectivity, there will be likely economic and social benefits.