Farm Scale Wi-Fi – the future of data for WA grain farmers

The key aspect of this project was to examine the various connection methods possible for on farm data connection.

As a basic background of data connection there a few things to consider. Firstly, the connection type. A direction connection via a cable or optic fiber is generally the best option always, provided you are close to the phone exchange! This is why ADSL internet connection packages are only available within several kilometers of the phone exchange. Generally, this is due to the old copper line servicing your land line telephone not being able to carry the data required by a modern internet connection once you go beyond a cable length of around 5km. For on-farm connection, this option quickly disappears from choice for WA grain growers.

The next connection option is to go wireless. Wireless data connection can be multiple types and various radio frequencies. This ranges from mobile phone network connections, NBN fixed wireless and satellite connections.

In extreme basic terms, a wireless transmission puts data into packets and transmits them between devices via radio waves. From time to time, for a number of reasons (local topography or atmospheric conditions) data packets are lost or corrupted and then need to be resent. If packets are continually resent over a set time, the connection 'times out" and is lost.

The key variation of types of wireless connections is the signal frequency and strength (volume). High frequency wireless connections traditionally are suitable for excellent data through put over short distances and can pass through objects, e.g. Wi-Fi. Low frequencies transmissions traditionally travel long distances but only with limited data capacity and can be easily interfered by objects. While these basic rules mostly apply, the new 4 and 5G technology is re-writing some of these rules as wireless technology rapidly evolves.

A wireless connection's reach and reliability is also affected by the transmission strength. Certain frequencies are "licensed" by the Australian Communications and Media Authority (ACMA). An example of this is a mobile phone network where essentially they can 'turn up the volume' and allow signals to reach much further with less error rates. The ACMA also has certain frequencies set aside for free to air data connection equipment, however this signal strength is limited below a certain level.

Given the geographical isolation of rural Australia the wireless connection options can be summarized as follows:

NBN Interim Satellite - The current NBN interim satellite technology is adapted technology which was not necessarily designed for a data service. This highlights a key problem with Satellite technology. Once launched, its hardware technology is set, physical upgrades are simply not possible.

The current NBN interim service is also symptomatic of other classic satellite issues. Firstly, it is slow, this is simply due to the time taken for data packets from your computer to travel up to the satellite then back to the grounding station and into the internet connection. Being a reasonably long way up in the atmosphere means the time taken for the signal to travel up and back causes delay, or "latency" in the connection. Compounding this slowness is the congestion caused when an excessive number of users draw on the satellite at once. This is called "contention" and the oversubscription to the NBN interim satellite service has been an ongoing demonstration of this problem. To add to this; cloud cover also will also effects satellite signal performance.

Uncontended Satellite service

This is a satellite service where a dedicated band width is set aside for a prescribed user. Optus in particular offers services like this to mine sites in isolated locations where no land line connection is in place. While this service still has the latency issues of satellite the dedicated band width controls the likely contention amongst users.

While still a reasonably slow service, this option may offer the potential to bulk buy data connections and then reselling to a dedicated number of individual farms to limit contention. Optus has working examples of this in NZ as well as the mining industry. The new NBN service launched in 2015 will more than likely be an improvement on this type of service due to it being newer technology hardware on the Satellite…. however, the NBN service may quickly fill up slowing it with increased contention rates.

Sky Muster NBN satellite service

This is the new technology NBN satellite launched in late 2015. This satellite has some specialist dedicated data transmission technology which will make it far better than previous satellite connections.

The satellite system will employ some ten satellite grounding stations acting as gateways to then access the connection back to optic fiber. Combined with this, the data transmission beams will have focused on geographical areas to spread the connection over multiple transmitters. Ultimately this combination of technology is aimed at limiting the congestion currently associated with satellite services and basically the whole NBN release outside the city and larger towns sits with Sky Muster. Long term, as traffic increases on the Sky Muster service, more than likely we will start to experience some form of contention. According to NBN this is won't be any time soon, however in the Eastern states where you have higher user density some people are expecting this to be experienced within the first 2 years of start date.

3/4G Mobile network connections

Mobile phone networks have some key advantages in terms of data connection. Being a land based terrestrial design, means low latency rates of signal and au upgradable network design.

The ease of connection of mobile devices as well as mobile network data routers has supported strong growth in this method of connection. From this project's work, SEPWA found that in early 2015, 60% of farm businesses currently use the 3/4G data network as their business internet connection. Anecdotal evidence from the wider wheat belt region is that this is by far the most popular method of on farm data connection.

The key aspects of this type of connection is signal reliability and monthly data restrictions.

The data restrictions are an ongoing cause of agitation for farm offices as data requirements ramp up beyond the allocated 20GB per month. As an outcome of this project, SEPWA has been able to start discussions with Telstra about developing specialist products for farm connections beyond this data amount. This is a work in progress.

Signal strength affects error rates of data packets and this is a key driver of connection performance. Most farms are now using the Telstra boosters in houses or sheds with directional Yagi antenna to improve connection. Conversely, the use of illegal phone repeater units are common in regional WA, and they significantly adversely affect network performance.

While the State and Federal mobile phone black spot funding has been a game changer for regional phone and data connection, it does not represent a long term fix for the spiraling data needs of regional Australia. The current business model of Telco's

(Telecommunication Companies) delivery along with subsidies by Government is neither sustainable nor viable for expansion over the sparsely populated agricultural regions of WA. This is a pending issue which government is slowing realizing, largely due to the agitation of this project.

There are also rapid advancements in 3,4 and 5 G wireless data technology by multiple mobile phone network manufactures around the world. New technology is allowing greater segregation of frequency to facilitate multiple channel transmissions and increased data throughput. To choose a best bet for data connection, 3,4 and 5 G technology offer the greatest potential and genuine landscape reach.

The reason mobile phone signal has landscape reach is because the signal volume is in a licensed spectrum range and it can be transmitted at higher power levels. Mobile phone spectrum allocations are highly contested under an auction system with the ACMA. The big Telco's fight it out to buy geographical footprints of phone frequency allocation worth millions of dollars to the federal government.

Only in remote locations (such as mine sites) is there no phone company who has already purchased that 3/4G frequency range for that location. In the agricultural regions however frequencies are generally already all sold to Telcos and 3/4G release would require the incumbent Telco. This means it would be virtually impossible for rural people to set up alternative data networks using 3/4G technology without having Telco buy in. Combined with this, any network needs a backhaul connection of the consolidated subscriber traffic, once again implicating a buy in from a Telco.

When considering the agricultural region of WA, Telstra has the main frequency allocation while Optus and Vodafone have a mixed allocation of geographical footprints.

3/4G network towers are prone to natural disasters such as bush fires and power cuts. The November 2015 fires in Esperance highlighted the limited battery life of towers and venerability of the 3/4G networks, particularly when managed from afar.

Fixed wireless

Fixed wireless was chosen by NBN as a method to distribute data connection in smaller towns and the outer proximity regional centers. Fixed wireless uses a focused antenna to directly transmit the radio frequency between the subscriber user and the hub tower. The hub NBN tower will either be connected direct to the optic fiber or have a microwave link to another tower which will be on optic fiber. Once consolidated at the main tower, data connects via the NBN fiber network. The microwave backhaul technology is a dedicated wireless link between 2 fixed points that allows high data through put. These can be licensed or free to air radio frequencies depending on the location and application. (Mobile networks also use this technology in specific locations)

Fixed wireless is by far the most 'independent' type of data connection type as much of this type of equipment is available off the shelf in the free to air frequency range. All you need is good backhaul connection and in theory you could build your own fixed wireless network across the landscape. In populated areas the free to air frequency range may be prone to interference, however in a rural setting more than likely this would be minimal and users would experience a good connection.

There are several examples of startup companies across Australia who use a dedicated fiber connection (NBN or other) to purchase bulk data access and then re-sell this as service to subscriber users via a fixed wireless delivery.

SEPWA did test fixed wireless equipment in the course of the COGGO project and found some key aspects:

- There needs to be trained personnel on the ground to install, tune and maintain the fixed wireless network.
- Both subscriber and base station units must be stationary and finely tuned to ensure proper connection.
- The equipment could reliably reach around 10km for data transmission and possibly much further with specialist installation and tuning. With this distance reach you would need a network of hop towers linked by microwave backhaul to provide any sort of reasonable coverage footprint.

Accessing a reasonable data wholesale package for consolidated backhaul in regional locations is a key factor of any fixed wireless network. While technically feasible, (i.e. there's optic fiber junction at many mobile phone towers) a limited number of service providers means wholesale prices are rarely competitive.

Of a technology delivery type, fixed wireless is by far the most empowering for users to take charge of their data connection and economically co-contribute to deployment. The DIY style that has sprung up in many other parts of the world could start to improve many regional businesses connections, as long as you can find backhaul.

Backhaul, the elephant in the room

Access to optic fiber (OF) for backhaul is the ideal solution for any terrestrial based wireless network. In the case of the 3/4G networks this is generally sorted by the presence of optic fiber at the base of the mobile phone tower or a microwave backhaul link from one tower to another with OF connection.

Despite OF transecting much of the wheatbelt there is only limited access to OF infrastructure in regional centers and mobile phone towers. Generally speaking, the regional mobile phone tower OF junctions has been courtesy of the State and Federal Black spot funding. While NBN is set to provide this type of connection in the future SEPWA could only seem to provide 2 "points of Interconnect" in the vicinity of WA grain growers. These are Geraldton and Katanning.

During the course of this project, SEPWA has become aware of several local businesses that have developed in servicing regional telecommunications from these OF connection points of Geraldton and Katanning.

Going Forward

Although the budget of this COGGO project is completely exhausted, SEPWA has continued to work on this topic. SEPWA sees telecommunications as a key aspect of building successful grain growing businesses for the future and recognizes there is no simple or quick fix to the spiraling data needs of modern agriculture.

Currently there is significant buzz around smart agriculture and on farm data streamlining. While these gadgets and technology may bring productivity gains to WA grain growers, the single biggest immediate gain for WA grain grower's technology adoption is fast and reliable internet connection. The built in connection assumption level of even the most conservative applications struggle in a rural environment.

Going forward a decade, more than likely robotic applications will offer efficiency gains as well as new methodologies in crop management. Under no circumstance can this technology be utilised unless there is fast reliable connection to the machines while operating in the paddock. Already we are seeing backhaul data connections restricting the potential development of driverless machinery in the mining industry.

Combined with the pending data connection need, this project has highlighted a significant skills vacuum in information and communications technology (ICT). During the data testing phase of this project SEPWA was able to access remote support over the phone to test basic functionality of the fixed wireless equipment. Going forward there will need to be

people on the ground in regional locations that can provide in field service for ICT equipment.

It is with some regret that we conclude this COGGO project acknowledging we have still a long way to go in solving the telecommunication's issue in rural and regional Australia. As a high labor cost economy, WA grain farmers are tied to technology for efficiency gains into the future. Going forward technology will not be stand-alone machinery, but interactive and connected information flows, the data connection is imperative.