The future of farming, with 5G: Agritech lessons from 5G RuralDorset

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Based on McKinsey & Company research $500bn will be added to the agriculture industry globally by 2030 by correctly implementing connectivity infrastructure.

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According to Ofcom's 2021 Connected Nations report c.79% of the UK had 4G coverage in 2021. This contrasts coverage of 99% to urban premises. The challenge of reaching the last - mainly rural - 20% remains.

As part of its remit, the 5G RuralDorset project, led by Dorset Council, looked at how the agricultural sector could benefit from increased 5G connectivity and transform rural communities and businesses.

We spoke with Digby Sowerby from Wessex Internet, lead partner for the agriculture side of the project, about his experience of how next generation rural connectivity can transform UK farming, and to share his lessons of how 5G can help farmers here, and around the world.

What does agriculture connectivity look like today?

Digby: To date, connectivity has helped agriculture advance in two main ways. Firstly, solutions such as Real Time Kinematics (RTK) - where a local base station links in to satellite or a 4G network - have been widely adopted to provide auto-steering for tractors and improve positioning and accuracy of drilling and cultivating. This helps increase crop yields and reduce inefficiencies around the farm.

Secondly, 4G has enabled farmers to use mobile devices in the field as well as providing backhaul of telematics data from tractors. This allows dealers to be able to conduct remote maintenance on vehicles and farmers to be able to communicate with their teams across the farm. However, coverage here is patchy and technology is not advanced.

Challenges for now

As agriculture transitions into a new technological era – the use of tractors and combines having largely been the same since the steam revolution – computerisation, automation, and therefore appropriate connectivity infrastructure, is vital.

4G is designed for downloading data, not uploading, and cannot provide enough bandwidth to support next generation agricultural technologies.

The upload and real-time challenges we're trying to solve are illustrated in the case of using drones and robotic vehicles on farms:

Currently, robots and drones are beginning to be used on farms for scanning fields. They are flown or directed around the field, taking high resolution images of the crops. With these images, farmers can understand where crops might be deficient in nutrients or where weeds, disease or pests exist. Using this information farmers can treat these areas more precisely, using less chemicals and fertiliser (prices of which have tripled in the past year).

Partners on the project, Small Robot Company (SRC) and Hummingbird Technologies, share the same problem - they can't upload their image data from the field. This means that it usually takes days before the images can be passed back to the farmer (SRC have even had to use the postal system to send hard drives to colleagues with the best internet connection). This is not only costly but it prevents true automation in the field and scalability of the technology. With 5G, transferring field image data from the field in near real-time becomes possible, enabling the farmer to make on the spot decisions about what actions need to be taken.

Intrepid Mind's Willis Automated Tractor

To overcome coverage and cost challenges that mid-band 5G could pose in the short-term, the team at 5G RuralDorset think 5G 'hotspots' could provide the answer. These could act as a single point on the farm where autonomous vehicles could offload data on a private network for either local processing or connection back to the internet.

This democratising of options – not all or nothing; you don't have to have full 5G coverage across your whole farm, just one specific place on site – is something worth giving thought to and could apply to a variety of sectors.

NB-IoT and mid-band experiments

At the three farm trial sites in Dorset, we looked at using project partner Vodafone's NB-IoT network and deploying our own mid-band (n77) 5G network.

With NB-IoT, we're looking at individually small amounts of data from sensors across the farms, to collect data on weather, stored grain temperatures, soil health, and even temperature or humidity for cattle – it's remarkable that heat stress in cows alone costs the UK economy £94.6m annually.

The project's connected cow initiative enabled improved animal welfare and better understanding of cattle behaviour as well as providing locations of animals, thereby preventing rustling.

NB-IoT offers the potential for marginal gains which add up - from reducing waste in the grainstore to reducing electricity and water use. These devices can also alert farmers to water leaks or fuel theft which again compounds to deliver long-term benefits.

With mid-band 5G, we're looking further ahead, with larger amounts of data being uploaded. This means that farmers can have a hugely more detailed understanding of their farm with the ability to treat crops on a 'per plant' basis. The upload speeds mean that automated vehicles can send image data back to base, can speak between each other and can change tasks based on the environment around them or under direction from the farmer.

'Per plant' farming means that the automated vehicles can treat every single plant individually. And so if a scanning machine recognises a disease on leaf 'B3' on plant X1094 another machine can come and apply fungicide on that very leaf.

The efficiencies of uploading data from the ground, in real-time, and connecting with other vehicles on the farm cannot be understated. Imagine the combine telling the automatic tractor "Meet me in this location in two minutes for emptying", or the weather changing unexpectedly and vehicles automatically adapting or going to charge.

Mitigating mast issues

The entry level outlay for many farmers – when they will not see a return on investment for potentially years – can be off putting. But in addition to the above '5G hotspot' approach, there are a couple of additional learning points that may be of use for other projects and trials to consider.

NB-IoT especially has to be a low-cost option, and can be a gateway to other conversations about mid-range connectivity, once proven. IoT can be the precursor of mid-band 5G as the data needs to be collected first before it can be acted on.

Mid-band 5G mast cost c. £50,000 and provides coverage over c. 38 hectares. This might seem low to industry and we have done this by using low cost alternatives, such as the re-use of existing

infrastructure. However, this isn't always possible and the cost is heavily reliant on the site specificities. For a private farm network, this doesn't necessarily seem cheap to farmers.

Fit for farming?

There are four main learning areas that we've found from the 5G RuralDorset trials.

1) The agritech market is young

There are many NB-IoT devices out in the market, but none that we have found produced in the UK. Additionally, there are only a couple of NB-IoT devices which are designed for farms. Much more needs to be done to build fit-for-farm solutions here with easy interoperability between hardware and systems.

Automated tractors and drones will take over from traditional farm machinery over the next ten years and mid-band 5G is currently the only quasi-compatible connectivity solution on the farm. Deploying a mid-band 5G network now however will not work with current technology on the market. Connectivity providers need to work hand-in-hand with the agri-tech sector to deliver a thought-through solution.

2) Interoperability will be key

With multiple sensors and a wide array of data, how things communicate with each other is important. After issues with different systems trying to talk to each other, we developed our own IoT platform and back-end to decipher the outputs from devices in the field.

Agriculture has a history of systems not talking and data being siloed by large players. The new era of farming needs companies to be open and a data ethics piece in place.

3) Technology needs to be fit for the farm

If you are in a field, in the middle of nowhere, this is very different to challenges within a factory or urban setting. In our trials, sensors in the field only lasted a week before cows tried eating them, other IoT sensors got too dirty or waterlogged and stopped working, and in most cases we had to create makeshift solutions to make them robust enough to deal with the environment. So be prepared to have to make some adaptations yourself; it turns out that for all the technology, duct tape can be your best friend to get the product to be fit for farming!

4) Power is still an issue

We found that IoT devices don't last long out in the field - if the cow hasn't already knocked it off its shelf, the battery has probably died. The same issue is found right across the board with drones and automated robots still currently limited. Batteries are heavy and deteriorate in the cold weather.

This has led to an extension of the project with Vodafone – creating a new type of IoT device, with an integrated SIM and standard interface for sensors. This has reduced power consumption from

50 milliamps (standard IoT device) down to 3.5 microamps and will help solve some of the power issues we see in IoT.

Power is also an issue for mast sites. Getting power across a farm can be expensive and should be considered alongside fibre installation.

Bringing farmers along on the journey

Wessex Internet started out because our founders' farms couldn't get decent connectivity. The company as an internet provider – now with full fibre in Dorset, Somerset, Wiltshire and Hampshire – came from our frustrations as farmers, and we therefore understand the challenges and opportunities intricately.

We know the challenges first-hand and have the right connections in our region to have open conversations about the opportunities and expectations of the tech.

I'd recommend finding the right person or people to open dialogue with potential end-users, who can speak the language and 'hold their own' in the markets and locations that will become end users.

Data security surprise

Through the trials farmers highlighted a worry with third-party data use. Many large machinery companies charge farmers extortionate amounts for access to their own data, as it is uploaded directly away from that farm, to the companies' servers.

As a result, many farmers are attracted to data centre systems physically on their farm, enabling greater control of how their data is used. With local data centres, data can be shared on a case-by-case basis, with the potential to bring in additional revenue for farms. It's another thing to consider and fully understand the implications of before you make any firm decisions.

The full report of the 5G RuralDorset project will be released soon. Visit 5G RuralDorset for more information.