Broadband Set to Make Splash in Rural Agriculture

Starlink's LEO broadband service is set to have a big influence on rural communities and businesses and be a catalyst for the agriculture industry.

By David Daugherty / *FyberCorp*

Farmers in the U.S., aided by notable technology leaders such as John Deere and Starlink, the satellite internet constellation operated by SpaceX, are pushing ahead of the government to help solve one of the more pressing problems in agriculture today: the lack of broadband in rural markets. The FCC estimates that most of the rural U.S. (about 14.5 million out of 25 million premises) does not have broadband access. Though quite a bit of help is on the way – close to $50 billion in the new infrastructure bill is aimed at fixing rural broadband – many farmers are looking for more immediate solutions or at least solid interim solutions.

Broadband can accelerate or improve regional quality of life and economic development; the lack of broadband inhibits them and limits the tax base. Just ask any city manager in small, underserved markets – the lack of broadband is a significant detriment to retaining the workforce and attracting new regional employers. Conversely, introducing broadband in historically underserved markets tends to attract residents fleeing overcrowded, more stressful urban communities and improve property value. (See my previous article, "Small North Carolina Community Launches Network on its Terms," **Broadband Communities**, October 2019.)

Historically, the availability of broadband has been directly proportional to population density. In other words, ROI for investment and deployment is adequate in more populated areas and inadequate in less populated (rural)

markets. With the introduction of low-Earth-orbit (LEO) satellite service from Starlink, this is no longer the case.

The presence of Starlink's LEO service is a boon for rural communities and businesses and a catalyst for the agriculture industry. The positive impact on agriculture and workers will begin to reverse decades of neglect associated with the lack of broadband. Moreover, subsequent access to automation technology and artificial intelligence (AI) is already supporting innovation, less water and fertilizer use and other improvements in agriculture.

AUTOMATION AND AI IN AGRICULTURE

The 2020 World Population Data Sheet predicts that the global population will increase from 7.8 billion in 2020 to 9.9 billion by 2050, or roughly 26 percent. The United Nations Food and Agriculture Organization (FAO) estimates that people use approximately 10 percent of the global land surface to feed themselves. FAO historical data indicates that global cropland area per capita decreased a staggering 46 percent between 1961 and 2016. In summary, from 1960 to the present, the world population nearly tripled while total available cropland was diminished by half.

In 2019, the USDA estimated that manufacturing automation in agriculture would create upward of $47 to 65 billion in additional revenue. In other words, if broadband were available on farms at levels currently available

John Deere's access to converged communication solutions from Starlink/T-Mobile will combine the best features of cellular and satellite communications, providing fully redundant access to the internet in most global markets. This kind of broadband access is thought to be mission critical to feeding 10 billion people by 2050.

in urban areas, the U.S. could increase annual output by nearly 18 percent. This is timely given the impending global population explosion.

AI and automation will help farmers manage everything from crop selection and equipment maintenance to product transport, pricing and sale. However, real-time application of AI will require more robust broadband in the field – usually unavailable in most rural markets.

"AI will shift the human component of farming from manual labor toward management," says Al Savage, manager of the StarFire Network Group, which provides the GPS and satellite broadband links required for the current version of John Deere precision agriculture. "Farmers will have to teach the AI how to deal with new and changing conditions on the farm. In the past, for example, farmers would apply pest control and herbicides to the entire farm. AI will allow for a much more targeted application of chemicals, fertilizer and water. The net effect is a less expensive, more efficient use of water, chemicals and fertilizer."

Savage says current StarFire throughput is about 3/1 Mbps. "This will increase with the newer versions of obstruction detection," he says. When the tractor detects an obstruction, something in the vehicle's path, it sends a picture to an operator via cellphone. The operator can then decide what to do and send instructions back to the tractor. Video upload requirements

drive upload speed well below Starlink's current throughput capacity.

"From an AI perspective, there will always be some sort of human input for training purposes," notes Savage. "Let's say a certain type of weed keeps growing on a particular farm. The tractor is going about its business, taking snapshots and uploading them to its database. The owner will review the data and train the system on what kind of weed killer to apply."

STARLINK'S EMERGENCE
In the September/October issue, I explored the use of LEO Starlink satellites to deliver broadband in underserved markets in "Starlink Evolves as a DIY Broadband Model." Starlink, the brainchild of Elon Musk, has been in service for less than four years. In that time, it has deployed more than 2,500 LEO satellites and plans to launch more than 30,000 by 2027. Starlink currently serves more than 500,000 *global,* historically underserved subscribers. Starlink is hardly a panacea. But it is perfect for most rural areas, either as a permanent solution or while waiting for subsidized fiber.

Starlink's products include both residential and commercial services. Residential performance ranges from 30 to 200 Mbps download, and 10 to 60 Mbps upload anywhere in the world. Commercial services range from 300 to 500 Mbps download and 100 Mbps upload, well above the FCC's minimum 25/3 Mbps bandwidth standards.

To achieve this, Elon Musk and SpaceX have spent the last decade learning how to build cost-effective, reusable orbital delivery vehicles using manufacturing automation and AI first developed at Tesla.

Although not currently highlighted in Starlink's marketing material, agricultural automation and feeding the world's growing population is one of its most critical missions. On the other hand, John Deere is focused on the task at hand. The combination of products and services from these companies will revolutionize the business of agriculture, help feed a rapidly growing global population and minimize resource use.

JOHN DEERE'S STARFIRE
John Deere (the person) was born in Rutland, Vermont, on February 7, 1804. He started as a general repairman and blacksmith for the local community. Deere applied his blacksmithing skills to the production of plows. The resultant steel plow was a beneficial innovation for farmers tired of continually cleaning mud from cast iron plows. This innovation solved farmers' problems and significantly advanced agriculture science in the 19th and early 20th centuries.

John Deere (the company) first launched geostationary, Earth-orbiting satellites more than 20 years ago to enable precision agriculture and ongoing and preventive machine maintenance. This system, called StarFire, provides the

highly accurate navigation positioning data (down to centimeters) required for precision agriculture.

Deere's first fully autonomous tractor, announced at the 2022 Consumer Electronics Show (CES), combines Deere's 8R tractor; a TruSet-enabled chisel plow; a GPS guidance system; and new, web-based automation technologies.

Deere said its new combination would increase productivity and help address skilled labor shortages. The autonomous tractor uses six pairs of stereo cameras to identify obstacles and a "deep neural network" to manage movement. GPS technology keeps the tractor within field boundaries and ensures accurate navigation down to the inch.

The plan for 2022 has been to let a limited number of farmers use the autonomous system. During the initial rollout, Deere rented a complete tractor and chisel plow to a few dozen farm producers with steady internet connectivity interested in the technology.

Deere expects to eventually let farmers bring their tractors to be retrofitted with autonomous technology. It plans to support at least the past three years of tractors and may support older machines. Because John Deere tractors have had self-driving technology for decades, configuring them to be fully autonomous is relatively easy. It will take about a day to install the equipment and test a machine before a farmer can take it home to use in the field.

TEXAS AGRICULTURE

Texas is a good test case to understand the challenges facing agriculture. Sid Miller, Texas Commissioner of Agriculture, says the state has 127 million acres of farmland and is the largest producer in the U.S. "We have more than 75,000 farms with 350 acres or more," he notes. "Keeping pace with expected growth in the global population is a significant challenge for the agriculture industry. It will require massive improvements in productivity, automation technology, and access to high-speed internet throughout the state."

TOP 10 FARM PRODUCTION EXPENSES IN TEXAS	
1	Livestock and poultry purchased or leased: $5.8 billion
2	Feed: $5.2 billion
3	Hired labor: $1.7 billion
4	Supplies, repairs and maintenance: $1.3 billion
5	Fertilizer, lime and soil conditioners: $1 billion
6	Fuels and oils: $988 million
7	Seeds, plants, vines and trees: $855 million
8	Chemicals: $750 million
9	Interest: $724 million
10	Cash rent for land, and buildings and grazing fees: $576 million

Total Farm Expenses: $22.9 billion

Let's do the math. Automating agriculture production systems for only half the farms in Texas (37,500 farms) by 2050 will require the deployment of broadband and upgrading production systems on 125 farms per month for the next 25 years. This is a significant problem given ongoing supply-chain problems and the ROI associated with deploying new fiber infrastructure in the rural U.S. It isn't easy to imagine a scenario in which terrestrial infrastructure (additional fiber) could be deployed in time to help. It is much more likely that the hybrid application of existing fiber, LEO satellites, cellular communications and CBRS wireless can address immediate demand.

"The good news is that Texas has always been at the forefront of innovation in agriculture," Miller says, noting that the state is exploring innovations such as vertical farming. "These indoor facilities move food production closer to population centers and work 24/7. We are working with food distributors to incorporate food production systems into the supply chain. We are also providing the financial assistance required for acquiring broadband and automation technology in the field."

THINGS TO WATCH

The business synergy between SpaceX, T-Mobile and John Deere is alluring. SpaceX and T-Mobile, for example, will likely include a range of fully redundant LEO/cellular communication services. The ability to load balance between Starlink and cellular services will eliminate outages and help stabilize performance during peak use. The improved capability and throughput of Version 2 satellites and Tesla cellphones will forever change the vernacular in the communication industry.

John Deere just opened an Innovation Center in Austin, Texas – also home to the new Tesla corporate headquarters. This means John Deere will have access to Tesla AI and machine learning technology developed for autonomous vehicles.

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