



## RURAL INFRASTRUCTURE BRIEFINGS

# Farmers Harvest Gigabytes with Broadband and Wireless Technology

These Briefings showcase different facets of the rural infrastructure industries: power, energy, and utilities; water utilities; and communications.

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### ***Connectivity and Clouds***

In the era of “big data,” farming is undergoing yet another technological revolution. This leap into the new age of farming includes, but extends far beyond, the latest GPS-guided farm machinery.

Along with the crops they grow, farmers are also harvesting data – mindboggling amounts of it as U.S. agriculture pushes faster into the information age. Precision agriculture technology today allows farmers to collect data on crop yields, fertility application rates, plant populations, soil moisture levels, plant health, crop maturity, weather conditions, insect damage and weed competition on every acre of every field. This wealth of data is collected real-time and transmitted via cellular and broadband networks to “the cloud,” and then to home computers or farmers’ hand-held mobile devices in the field to help farmers make better management decisions.

It’s been a quiet revolution, but one that has huge implications for farm productivity and profitability.

According to a 2014 survey of farmers by the American Farm Bureau Federation, precision agriculture has lowered farm expenses on seed, fertilizer and pesticides by an average of 15 percent, and raised crop yields by an average of 13 percent. More than half of the farmers in the survey reported that they plan to add new precision or data technology in the next two years.

The exponential growth of data-driven farm technologies is requiring farmers to continually upgrade their data plans with their cellular and broadband providers.

Jason Schielke, who manages information technology at a 30,000-acre corn and wheat farm in Colby, Kansas, says his farm today uses 30 to 40 gigabytes of data per month during peak usage in the fall as combines collect yield data at harvest and upload the information directly to the cloud. Their cellular data requirements today are quadruple what the farm used three years ago.

“Farming relies heavily on broadband wireless connectivity now. Every piece of equipment that we run collects data,” Schielke says. “We record every single nutrient or herbicide that we put down. Three years ago, we had to use memory cards or USB thumb drives to transfer that data. Now everything is being transferred via cellular network so it’s all going to a cloud, and every piece of equipment that we run is linked via cellular connection.”

The farm's 10 employees each carry smartphones and tablets with them at all times, enabling them to share to-do lists, locate machinery anywhere on the farm and even know when it's time to deliver seed to the field during planting season without having to make a call to the tractor driver in the field.

"If we have a guy loading a seed shuttle at the farm, he can pull up his phone and he knows what field the planter's on and the type of seed that's being planted on that field, and he doesn't have to call anybody. He can do it all on his own right there. It's all right at his fingertips," Schielke explains.

With the ability to retrieve all of the farm's information off the cloud at any time, Schielke says they can make important financial decisions directly from the field during peak work season.

"If you've got a smart phone or an iPad on you, you can have all the information you need to conduct business right on your hip," he says. "You can pull up your phone and find any spreadsheet you need to look at. I can even import yield maps on my phone or iPad via cellular connection."



Farmers are using environmental sensors, like John Deere's Field Connect system, to capture field data on moisture, temperature, wind speed and direction, humidity, rainfall, leaf wetness and solar radiation. The data is transferred to a website for the farmer to access on a computer or mobile device. (Image courtesy John Deere).

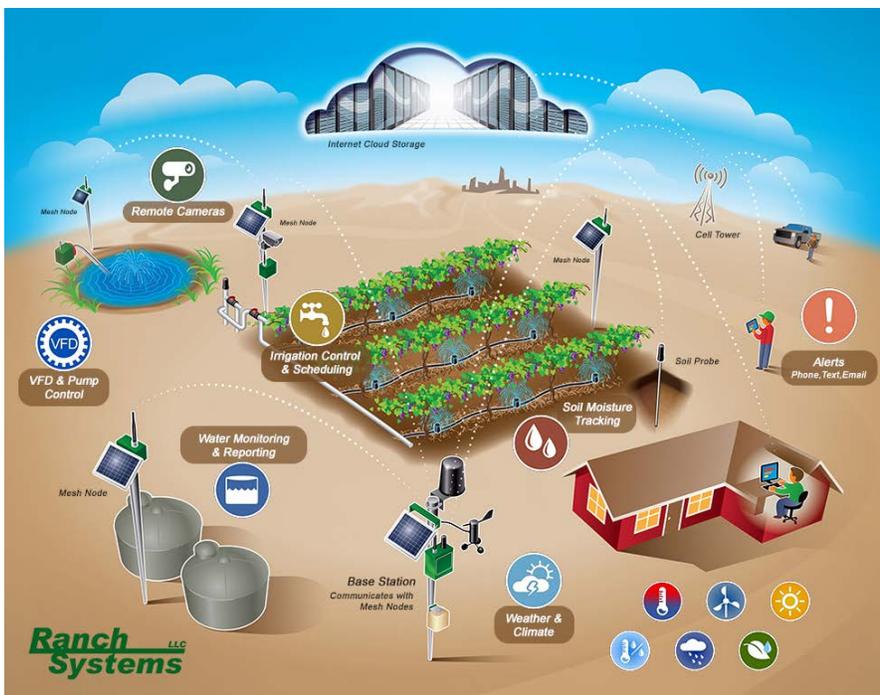
## Economics

Kevin Lauwagie, who farms 1,200 acres of corn and soybeans in Winthrop, Minnesota, also carries an iPad with him at all times. The ability to pull up field maps and find crucial information during the growing season, he says, has helped him boost yields on every acre of the farm while trimming production costs.

Becoming more efficient with every acre and every input cost is no minor issue, he says, especially with commodity prices having plummeted.

"I think you gain some efficiency because you know how to spend your money," says Lauwagie. "If you can pick up five or six bushels an acre, it may not seem like a lot, but because the value of commodities is low at this point in time, that can be the difference between a profit and a loss. There's not much room for error here."

Schielke agrees that having granular field information transmitted via a cellular network directly to a phone or tablet can help farmers keep control



Source: Ranch Systems, LLC

of their production costs and remain profitable despite the depressed agricultural economic climate.

“You use data for comparing yield trials or different fertilizer trials on the farm,” notes Schielke. “It helps you see the efficiency of what you’re doing. Did my 200-pound N (nitrogen) rate do as well as my 225-pound N rate? Being able to look at that data makes the farmer more efficient with his inputs. With times like right now – input costs are high and commodity prices are low – you don’t want to be throwing money away on things that you can’t show make a net return. People may argue they can’t afford that technology. But how can they not?”

### **Broadband Connectivity**

Shawn Olsen farms 3,000 acres of mostly corn and soybeans in Hayti, South Dakota, with his father and brother, and also runs a custom fertilizer application business on 20,000 acres. In the wide-open spaces of South Dakota, Olsen is able to pull up satellite pictures of his fields directly to his iPad to check crop health. Then, he shares those images along with fertilizer prescriptions with agronomists or his local cooperative elevator.

“I deal regularly with different agronomists and local coops and send and receive variable rate prescriptions,” Olsen says. “Or, if I’m looking up parts for a machine, it helps us communicate with dealerships. So being able to use the cellular network with my iPhone or iPad, for instance, helps us communicate better than we did six to eight years ago. Life has been simplified 10-fold, but data usage is increasing every year.”

Today, Olsen says he has a 15-gigabyte plan, which he estimates is double what he had three years ago.

Schielke adds that farmers use their cell phones exclusively these days for talking and texting rather than communicating via CB radios, two-way radios or walky-talkies. Moreover, armed with a smartphone and a tablet, he’s also spending much more time communicating via email.

“Email. I get tons of email. When I’m out on the tractor, I can answer emails with my smartphone,” Schielke says. “Today now with (GPS-guided) auto-steer, it frees you



*South Dakota farmer Scott Anderson, left, created the CashCow Farmer app that allows a farmer to see his farm’s financials on a smartphone or tablet from the field. (Photo by Lon Tonneson).*

up to do business that you need to be doing. You can multitask more easily.”

### **Farm records at your fingertips**

With farmers carrying smartphones and tablets with them to the fields, they’re able to access farm records, spreadsheets and field maps via apps that can remotely log into the computer at the home office, enabling them to analyze financials and logistics and make informed decisions in the field.

Having farm data at your fingertips has helped make field operations on Olsen’s farm in South Dakota more efficient and timely, he notes. The narrow window of opportunity that Mother Nature allows farmers to do fieldwork makes decision-making on-the-go that much more crucial.

“Logistically for our farms, we’re utilizing our time better,” Olsen explains. “It seems like we get smaller windows [of time] every year – planting dates, harvest dates and fertilizer application windows just get narrower. Since we’re able to use many different forms of data with cellular network coverage at our fingertips, it logistically helps manage that time better.”

Rather than checking every field in-person on a daily basis, Olsen has email alerts sent to his phone from the satellite system that’s monitoring his fields from the sky. The satellite imagery senses tissue color in the plants, and then alerts Olsen on plant health through email.

“You can monitor fertility through the summer and can tell if there’s a nutrient deficiency,” he explains. “We can get an alert once a week, once a day, whenever you want.”

Schielke, meanwhile, uses his phone and tablet to check the 66 center-pivot irrigation systems on the western Kansas farm. By using an app on his smartphone or tablet, Schielke says he can monitor every irrigation system remotely with information sent over the cellular network.

“Through the app on the phone or the tablet, you can see every pivot that we have,” he says. “You know its location, how fast it’s going, whether it’s on or off, and you know the water pressure all right from your phone through the app. You get a text if it shuts off or when the water pressure is low. On Sunday morning, I can just pull up my phone and check it in 30 seconds. Or, say you want to move the pivot but don’t want to drive out and do it manually. That can be done remotely.”

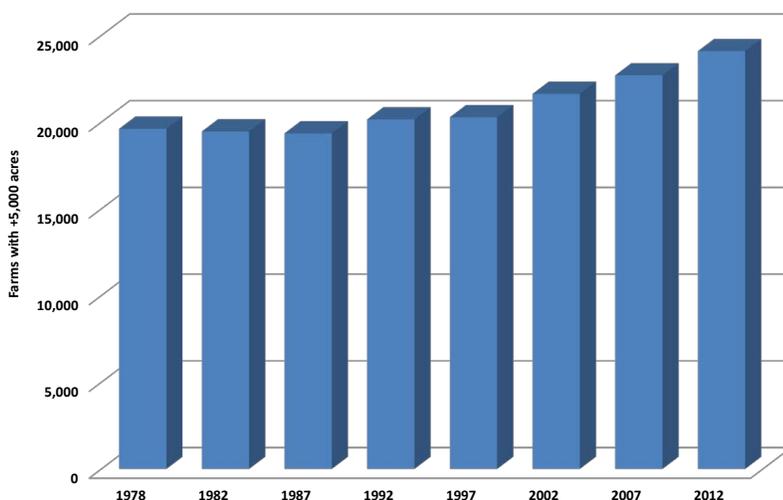
Schielke points out that the farm has saved untold miles on the farm’s pickups and reduced their fuel bill by cutting in half the number of trips around the farm to check sprinklers.

“We used to check sprinklers once a day. Now we do it three times a week,” Schielke says. “So even with just the fuel savings there, you could put a dollar value on that.”



Unmanned aerial vehicles (UAVs), or drones, allow farmers to scout fields with high-resolution photos. UAVs can be guided over a field via an app on a smartphone or tablet. (Image courtesy AgEagle Unmanned Systems).

### Exhibit 1: U.S. Farm Size Continues to Grow



Source: USDA

### Bigger Farms, Bigger Data

The trend toward bigger farming operations spanning larger geographical areas shows no sign of slowing down. According to USDA’s Census of Agriculture, the number of farms with more than 5,000 acres grew to 24,089 in 2012, up from 21,625 farms reported in the 1997 Census of Agriculture. (See Exhibit 1.)

With farmers commonly operating in multiple counties, states or even in other countries, the demand for remote monitoring technology with data moving through cellular networks is growing almost exponentially, explains Mike Bauer of Ranch Systems, LLC, a farm information management company based in Novato, California.

“We’re building demand for remote monitoring and control because farmers have all these geographically dispersed properties and they want to be able to see what’s going on,” Bauer explains. “They want to have access to information, and the trend is to put more and more devices in the field, and the cost of those devices and electronics is going down. So, the cost of the plan is going down, and the cellular network is the predominant network for collecting that data and getting it up into the cloud.”

Fred Harned, senior product manager at The Toro Company, a micro-irrigation firm in El Cajon, California, agrees that as farms grow in size and as technology drops in cost, demand for information management via cellular networks will continue to grow. Sensors that monitor crop and weather conditions from a remote location and allow a farmer to treat specific plants rather than an entire field will become increasingly common in the future.

“Sensors are getting smarter and lower cost, and producers are picking that technology up so they’re not running around from place to place,” he says. “It’s continuous consolidation in farming. But producers aren’t necessarily buying the farm next door. Sometimes it’s the farm two counties over. So there’s increased reliance on the ability to look at your phone and see what’s happening.”

Unmanned aerial vehicles (UAVs), or drones, are also a relatively new technology that’s dropping in cost and offering farmers benefits in the field. Today’s UAVs can be controlled with an app on a smartphone or tablet while providing images of fields from the sky to help farmers monitor crop health.

While satellites are limited to taking photos of fields on clear days with no cloud cover obstructing the satellite’s view, Schielke says a UAV can fly over a field to take pictures despite any overcast. On just one 160-acre field, Schielke says his drone will take more than 150 high-resolution pictures requiring huge amounts of data.

UAVs, though, can serve purposes beyond monitoring crop health, Schielke points out.

“Our neighbor’s cattle have gotten out and went through our corn, so we actually took pictures and gave them to the insurance company and they estimated how much damage the cattle did – all from a drone picture,” he says.

## **Concluding Thoughts**

Like GPS technology, wireless transmission of data for remote monitoring and control of technology in the field eventually will become ubiquitous, Harned says.



*With the aid of precision ag, farmers today now harvest gigabytes of data from the field with the information seamlessly transmitted to “the cloud” via a cellular network then to a computer or hand-held device for the farmer to analyze his farm’s productivity and profitability.*

The first step in the technological ladder of wireless data transfer is remote monitoring of fields, says Harned. The second step is remote control, followed by optimization and then automation.

The technology is already available for certain farm functions like irrigation to be managed in a closed loop system with no human involved, adds Bauer. Moisture sensors in the field can wirelessly transmit a signal over the cellular network to turn on an irrigation system, he says.

“The sensors are collecting information [on] moisture levels, water levels and well levels. It’s monitoring water pressure and conditions in weather, in soil, on the plant itself in different parts of the field,” he says. “If a soil moisture probe gets to a certain threshold and the soil’s too dry, it’ll turn on the irrigation. Now, that’s only on about 1 percent of the farms out there, but that capability is there.”

In the near future, Schielke says farmers like himself will be sending more data through wireless cellular networks as field maps continue to become more precise and accurate. Rather than collecting data on the acre scale, farmers will be collecting data on a much more granular scale, he says.

“We used to farm by field. Now we’ve narrowed it down to a grid of a few acres. You have companies that are already talking how you can manage your farm in a 10-foot by 10-foot area grid,” Schielke says.

For Lauwagie in Minnesota, there’s no turning back the clock on agriculture. Farmers will continue to benefit from reduced input cost and increased productivity with precision agriculture, he says, due to ever-growing usage of data empowering farmers with more informed decisions, and putting more demand on cellular networks for reliable and efficient transfer of bigger data.

“It’s an important tool out here in farming these days,” he says of data-reliant precision agriculture technology and the cellular networks that transfer the data. “We may think times were simpler back in the 1970s, but I don’t know how I could function without it anymore.” ■

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