UHF Radio Modem Supports Computerized Irrigation Control

High-performance forward error correction extends the range for radio modems, giving manufacturers of systems using computer control over wireless links more flexibility with product designs.

By Robert White, Director of Sales and Marketing, RF Neulink

Competitive, modern crop production on irrigated land demands that growers make the most of available equipment, water and time. Remote, computerized control of common pivot irrigation systems relies on wireless communications. As essential as a wireless communications link may be, it remains out of sight and out of mind for the grower, whose focus is on the crop, not the radio.

"We never market a radio or a cellular device," said Reece Andrews, a Product Manager with Lindsay Sales and Service, LLC. "We market FieldNET™, a program of information, control, convenience and labor savings. The fact that it's going to take a UHF telemetry radio, a spread-spectrum device or a cellular modem is in the background."

FieldNET dealers may give a grower a choice of whether to use a system with UHF radio, spread-spectrum or cellular, but the choice normally is based on coverage and cost, not the wireless technology. "Growers have the dealer quote it different ways so they see what it takes to build out their telemetry operation and decide what's best for them. The radio or the cellular is a means to an end," Andrews said.

UHF radio can be the preferred choice because of its superior range. Where spread-spectrum has a maximum power of 1 watt, Andrews said, the UHF option offers a 5-watt radio. "UHF is about three times the cost of either cellular or spread-spectrum," he said, "but with UHF, the customer owns the system and has no monthly access charges" as with cellular.

"In some areas of the country, the growing season is as short as four months, but the grower could be paying for the cellular access all year," Andrews said. "With radio, the operating cost is minimal and they can send as much data as they want. With cellular, the more you use it, the more it costs, depending on the plan. Also, irrigation is seasonal in most areas. You get further south and you might have someone who has a winter crop as well and a growing season year round, but that is more the exception than the rule. In Nebraska and the Midwest, the irrigation season is four months of the year, so large growers tend to prefer radio over the cellular cost year round."

Pivot irrigation systems move in a circle, yet some fields are rectangular. An arm at the end can extend to the corners and retract along the sides. A GPS receiver at the end of the arm provides more accuracy for the pivot position than a sensor at the pivot point.

RF Neulink, a division of RF Industries, provides Lindsay Sales and Service, LLC with radio modems that send and receive data to and from the field. The FieldNET product allows computerized scheduling and controlling, and the data controls how much water to dispense and when. The pivots have weather stations to sense conditions in the field. It is helpful, for example, to avoid irrigating when it's raining. Water is a valuable commodity, and that would be a waste of resources.

The fields themselves can be miles away from the control point, whether that is an office or farm house where the grower wants to monitor and change the settings on the irrigation systems. Traditional narrowband radio delivers a strong signal to the rigs. The UHF narrowband radios in the FieldNet product offer higher data rates than most radio modems in the frequency band. They are licensed on conventional channels in the 450 MHz to 470 MHz range. At six ounces, the small modem is easy to integrate in products that have to be small and compact.

Forward error correction gives the radios their higher throughput and greater range. Some bytes of information are included within each message as an algorithm that summarizes the data being sent. The algorithm allows a parity check or integrity check and allows a mathematical algorithm at the receiving end to detect where any errors may have been introduced. The algorithm can correct a message with up to 25 percent errors. The effect is to extend the range, maintaining the quality of the data over a greater distance.

RF Neulink uses a proprietary variant of Reed Solomon error correction, which originally was developed for data sent to Earth-orbiting satellites and manned space vehicles. Data sent over a long distance would accumulate errors.

An early version of the RF Neulink product achieved a channel gain of 3 to 4 dB with forward error correction, a comparison figure based on how much power increase would be required to achieve the same improvement in range. Not all forward error correction is equal.

With the current product, the channel gain is 8 to 9 dB, and work is progressing on a unit with 10 to 12 dB of channel gain. A 5-watt unit with 10 dB of channel gain from forward error correction would be the equivalent of a 50-watt unit with no forward error correction, so the difference is considerable.

Some modem users, such as the military, do not want to sustain the same power level and increase the range. Instead, they want to sustain the same range and decrease the power level. The reason is to preserve battery life and decrease the weight of portable units. Forward error correction liberates the user from the need for high-power transmitters to go the distance. It is possible to build powerful radio modem transceivers that weigh less than half a pound. That's important when the user must carry battery packs in the field.

Another attribute that system designers often find advantageous is that with forward error correction, performance degradation isn't linear anymore. It drops off suddenly. The abrupt drop-off can be helpful with cell site designs and other infrastructure with multiple sites. An engineer can more accurately predict where the edge of the signal performance curve would be. It doesn't fall off in slow, 2 to 3 db increments. It will fall off by 10 to 20 dB quickly. Armed with that knowledge, a design engineer can incorporate some innovative system designs.

When designing sites with frequency reuse patterns, an engineer has to take possible interference between sites into account. With forward error correction, it is possible to turn down the power, push the cells out farther and create an abrupt end at the edge of the pattern.

At Lindsay Sales and Service, LLC, using the radio modem in the FieldNET application is simple. In addition to the modem, all the company needs to provide is an antenna and an antenna and serial cable. The FieldNET controllers already have a 12-volt power supply. The radio is small enough to fit inside the FieldNET enclosure, which has a knockout on the bottom for cable access.

With remote control and data communications, FieldNET can turn the irrigation on and off, adjust the amount of water applied and create irrigation plans. The pivot may cover more than one crop, so based on where the pivot is in the field, for example, it may apply more water to the corn than to the beans. The water flow could be based on a calendar or a schedule. The irrigation might be set to begin on a Monday at 8 p.m. and to shut off 8 a.m., and then wait until 5 p.m. to turn back on because electricity supply might be subject to load management with cheaper rates from 5 p.m. to 8 a.m.

An important function provides notice to the grower if the pivot has any type of shut down or operational changes. FieldNET sends a text message to a phone or makes a phone callout to give notice of what pivot has shut down and why.

To be assured the pivots are operating properly, growers might have to drive around and visit the fields twice a day. The remote control allows them to do other things. It reduces the labor from 50 to 70 percent and also reduces wear and tear on vehicles. The remote control is especially important during the heat of the season when it is critical to keep the system going. It might be 12 to 24 hours before they visit the system again. If the pivot shuts down, FieldNET notifies the grower right away.

At certain times of year, the pivots are making large circles and taking as much as three days to make a complete circle. It isn't possible to irrigate a zone, such as a yard. The slower the pivot turns to put more water down, the longer it takes. If the irrigation gets behind schedule because of a breakdown, part of the crop could be damaged by heat stress.

With radio modems using high-performance forward error correction, manufacturers such as Lindsay Irrigation can offer users of computerized remote control systems an option for wireless links that extend the range and coverage while saving the end user the recurring cost of cellular service.