

## Case Study

# RUGGEDCOM Network Infrastructure and Professional Services helps rural electric utility manage seasonal loads to improve service, costs and safety.

### Cuming County Public Power District



**Customer:** Cuming County Public Power District (CCPPD). Established in 1937 as part of the U.S. rural electrification program, the nonprofit CCPPD resells electricity from the Nebraska Public Power District.

**Challenge:** Latencies in gathering data from remote substations forced CCPPD to over-correct in balancing its grid loads, impacting customers and costs.

**Solution:** Siemens RUGGEDCOM wireline switches and routers, plus WIN WiMAX technology supported by a microwave backhaul ring. Professional services included a comprehensive site survey; an RF propagation study; RF-channel planning, system design; physical implementation; RUGGEDCOM NMS implementation; and one-year priority support.

**Results:** An extremely reliable and resilient, high-bandwidth wireless network, providing better customer service, labor and power cost-savings, plus greater lineman safety.

From 30,000 feet above rural northeastern Nebraska, the plains below appear as an endless array of green crop circles. These are farmers' fields that use center-pivot irrigation systems. Each system has a radial sprinkler arm, a pipe usually a quarter-mile long and raised above the crops on wheeled towers. The arm slowly rotates around a central hub containing a well and electric motor that drives both the arm and well pump, taking up to three days to irrigate an entire field. Water is drawn from the huge Ogallala Aquifer hundreds of feet below ground. Power comes from the local utility. In Cuming County, that's the Cuming County Public Power District (CCPPD).

Farmers with irrigation operations like these make up most of the CCPPD's 300 commercial customers. That's out of 4,000 total accounts across its 620-square-mile service area. According to General Manager Elwood Moore, the farmers' irrigation demands on the CCPPD grid peak in the summer growing season and are subject to a load-balancing program. "Of course, it depends on rainfall," he says. "The less there is, the more they must water. And the more we have to manage the load on our grid."

## Challenge: Latencies in gathering data from remote substations forced CCPD to overcompensate in balancing its grid loads, impacting customers and costs

Given that Cuming County gets just 75 percent of the U.S. average annual rainfall, its farmers must water their crops, mostly thirsty corn and soybeans, a lot. Added to their seasonal load on the CCPD's grid are the summertime air-conditioning demands by residents and local businesses, despite the county's relatively sparse rural population.

Moore points out that the CCPD offers discounted rates to irrigation customers who take part in its load-control program. Using SCADA telemetry through 12 remote substations, it monitors the power drawn by their systems and turns the systems off when their loads exceed pre-set limits. "A typical load in the summer is about 25 megawatts," he says, "and with our load-control program, we try to dial it back to about 70 percent of that."

The CCPD buys its electricity from the Nebraska Public Power District (NPPD). Like many utilities, the NPPD uses a progressive rate schedule to encourage conservation. "When heavier loads force us into higher-cost rates, it raises our power bill and those of our irrigation customers," says Moore. "It can increase their bills by as much as \$2,500 a year."

Technology Supervisor Monte Draper explains that the CCPD's wireless, low-bandwidth SCADA system suffered a lot of latency in transmitting data – up to 45 minutes. "We couldn't see real-time loads," he says. "We'd have to poll all of our substations to see what the loads are, then shut off enough irrigation wells to reach our pre-determined levels. Some guesswork was always involved, and we'd over-correct to play it safe. But this meant shutting down some wells unnecessarily and for longer than needed."

Draper adds that the load-balancing process required a CCPD employee to take hours each day to oversee the SCADA system's pre- and post-polling of the irrigation systems and substation load, plus do manual calculations. With just 18 employees – and eight of them linemen, out in the field – this chore was a considerable staff burden.

At the same time, Draper says that the CCPD's aging SCADA system faced a forced shutdown for two reasons. One, the U.S. Federal Communications Commission (FCC) narrow-banded the 450 MHz radio frequency system which would have meant replacing hundreds of radios; and, two, the system's software vendor announced it would end support for what the CCPD was using. "Clearly it was time or us to move on," he says.

## Solution: Siemens RUGGEDCOM wireline switches and routers, WIN WiMAX technology supported by a microwave backhaul ring, plus professional planning and implementation services.

About this time, the U.S. government made its existing Smart Grid Investment Grant (SGIG) program part of the American Recovery and Reinvestment Act of 2009. It provided funds to

cover half the costs of projects that would help modernize the nation's electric grid. The CCPD's need to upgrade its SCADA system certainly qualified. It applied with a neighboring utility that had similar requirements and together they won the funds needed.

The CCPD's new network architectural design came from the work of the Siemens RUGGEDCOM Professional Services team. Before specifying any components, they conducted a comprehensive site survey and an RF propagation study. These investigations helped their RF-channel planning and system design, which ultimately helped facilitate the implementation of both the physical network and the RUGGEDCOM Network Management System (NMS). The project also included one year of priority support.

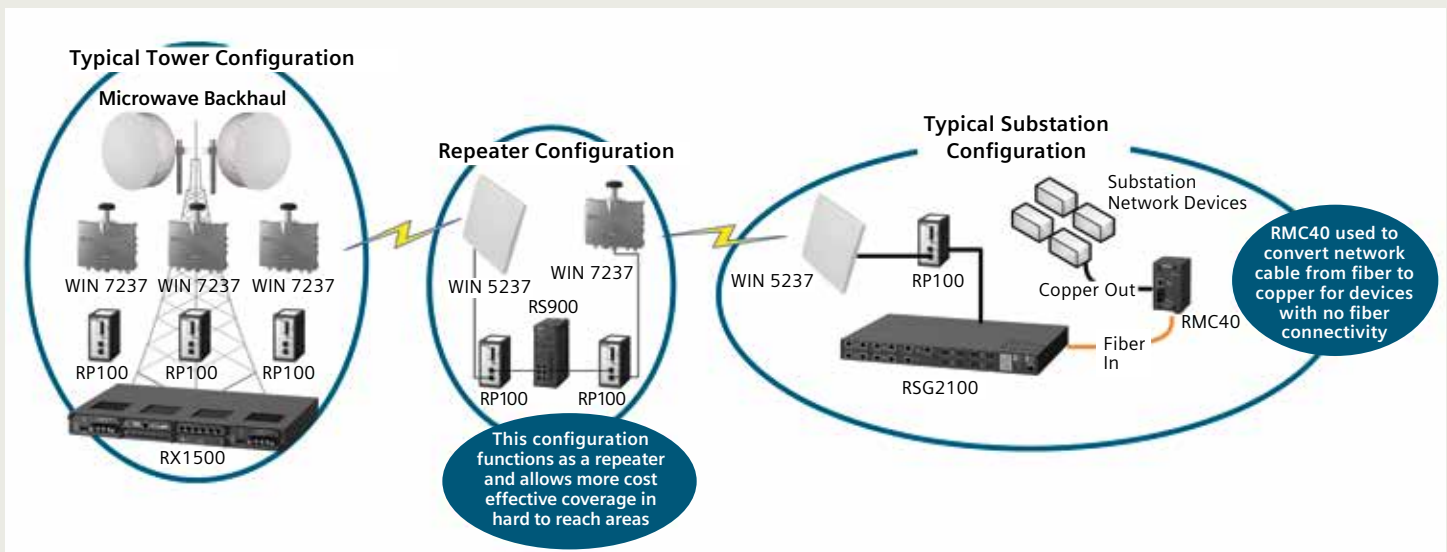
**RUGGEDCOM WIN reach and flexibility.** The backbone of the CCPD system architecture is a redundant, microwave backhaul ring on five 90-foot towers with throughputs of up to 200 Mbit/s. It's linked to each CCPD substation and the main office data center with a Siemens RUGGEDCOM RX1500 series integrated Layer 2 and Layer 3 switch and router.



Connected to the RX1500 are Siemens RUGGEDCOM WIN 7237 outdoor wireless base stations that comply with the IEEE 802.16e WiMAX standard. The CCPD obtained an FCC license to use the 3.65 GHz radio frequency, which is just one of nine spectrum options the WIN family offers.

The WIN 7237 utilizes MIMO technology to provide increased coverage capability and up to 40 Mbit/s throughput to the CCPD's substations, some as far away as 13 miles. To deal with the line-of-sight issues of low-lying substations, the CCPD installed repeater systems using RUGGEDCOM WIN 5237 subscriber units on the receiving end (interconnected with a WIN 7237 base station via a RUGGEDCOM RS900, a 9-port, Layer 2, fully managed Ethernet switch).

Each substation also has one of these subscriber units, along with a RUGGEDCOM RSG2100 19-port, fully managed fast/gigabit Ethernet switch to interconnect all the substation's various IEDs. For those devices needing copper connections, the CCPD installed a RUGGEDCOM RMC40, a 4-port, Layer 2, unmanaged Ethernet switch with up to 100 Mbit/s speeds.



Configuration of the CCPPD's microwave backhaul towers, WIMAX repeater stations and electrical substations.

Unlike most commercial broadband wireless gear, the standalone WIN 7237 base station doesn't require an Access Service Network (ASN) gateway that can cost up to \$100,000. It also complies with NERC-CIP two-factor mutual authentication, 128-bit AES encryption and message integrity protection using cipher-based message authentication code (CMAC).

To reduce cabling costs, all the RUGGEDCOM devices are powered via the RUGGEDCOM RP100 single-port 802.3xx Power-over-Ethernet (PoE) injector.

**Ruggedness built-in, not added-on.** "We chose Siemens RUGGEDCOM components because we knew all of its gear is utility-grade and up to the harsh outdoor conditions we have here in rural Nebraska," Moore says. "A lot of manufacturers will 'ruggedize' their standard products, but we know the reliability and durability of RUGGEDCOM products is designed and built-in, not added on."

In fact, the entire RUGGEDCOM portfolio is designed, tested and field-proven to operate in demanding conditions, such as high electromagnetic interference (EMI), temperature extremes and particulate pollutants. Every product is also put through Accelerated Stress Testing, comprising Highly Accelerated Life Testing (HALT) and Highly Accelerated Stress Screen (HASS). Both testing standards are designed to find defects before environmental conditions do. These tests are one of the reasons why Siemens can provide five-year warranties on everything from RUGGEDCOM's broad portfolio of network components.

**Results: An extremely reliable and resilient, high-bandwidth wireless network, providing better customer service, labor and power cost-savings, plus greater lineman safety.**

Draper reports that installation and commissioning of the Siemens RUGGEDCOM gear was fast and easy. Siemens trained the CCPPD linemen on the particulars of microwave base station and subscriber installation, who were then able

to install the equipment on the microwave towers and existing utility poles without any problems. "It was super-easy, pretty much plug-and-play," he says. "Establishing line-of-sight for the subscriber units was simply a matter of positioning them for maximum signal reception."



**Greater network visibility:** To monitor, configure and maintain all the Siemens RUGGEDCOM components across the microwave towers, 12 substations and repeater stations, Draper uses the RUGGEDCOM NMS network management software, which his team can access from any device with a standard web browser. With its auto-discovery capabilities, he has real-time visibility and notification of events, thresholds and alarms throughout the network. If necessary, he can do remote resets, which saves expensive lineman truck rolls.

With the Siemens RUGGEDCOM network, Moore and Draper can get – in real-time – a broad range of data about the CCPPD grid through each of its substations. This includes peak amps per phase, neutral amps, kW, kVar and power factor of each circuit and totals in each substation. "In addition, we monitor voltage and tap position of each regulator," Moore says. "We can also see the electronic breaker panel face plate, which gives us breaker status and fault current of any breaker trip and the number of operations."

**More productivity and cost-savings.** He adds that this realtime data feed has freed the person who used to manually monitor and manage the irrigation load control program. "It was very time-intensive and often tedious, so now we have that person doing other things that are more valuable to us," he says.

"Plus, with real-time data, we don't have any latency issues anymore. By taking out all the guesswork, we can be much more precise and don't have to over-correct, just to be safe in managing our grid loads. We can see what's happening on each of four circuits that connect to each substation.

"This is helping us be 10 to 20 percent more efficient in using our power supply, which translates to tens of thousands of dollars a year in savings to us. And that's not to mention our customers' savings."

**Hard-earned reputation.** Since the installation of the Siemens RUGGEDCOM network, Draper says that it has survived three major hail storms and a pair of tornados. One of the twisters was an EF4, one step down from the most violent rating on the Enhanced Fujita scale, and destroyed a small town in the next county. Although the winds knocked the microwave transmitters out of alignment, the Siemens RUGGEDCOM equipment was unaffected. "A lineman brought in one of the RUGGEDCOM base stations, because hail had shredded the cable and conduit going into it," he says. "But I plugged it in, and it worked just fine."

**Greater safety.** Moore is quick to emphasize that lineman safety is paramount, like it is at all utilities. He says that by reducing truck rolls with Siemens RUGGEDCOM's remote network management software, linemen have less reason to be working

on the CCPPD's energized lines. "That's where a lot of the RUGGEDCOM gear is located, so if we can do resets, reconfigurations and troubleshooting from here in the office, they're not put in harm's way," he says. "But if they do need to replace a unit, we can switch our breakers on that particular circuit to one-shot status. Then the RUGGEDCOM's easy plug-and-play installation means a lineman can do it in just a few minutes.



In the future, Moore and Draper envision many other services they could operate over the Siemens RUGGEDCOM WiMAX network's ample bandwidth. One example is having a WiFi hotspot at each substation, to have linemen and technicians information and communication access. Another is video surveillance. "Frankly, we have just scratched the surface of what we can do with this system," Moore says.

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