Electric cooperatives with a Smart Grid vision tend to implement the components in pieces. Wake Electric deployed a supervisory control and data acquisition (SCADA) system and advanced metering infrastructure (AMI), and now there is interest in feeder and distribution automation. The non-profit rural electric distribution cooperative based in Wake Forest, North Carolina, realized that for its electric grid to be truly “smart,” it needed help establishing an efficient, reliable telecommunications infrastructure.

Established in 1940, Wake Electric is trusted to serve more than 35,000 members in seven counties, including Durham, Franklin, Granville, Johnston, Nash, Vance, and Wake. It operates just over 3,000 miles of transmission and distribution line, and for a cooperative, its density is relatively high with an estimated 12 meters per mile. To optimize its network infrastructure decisions, Wake Electric chose the services of the Siemens Smart Grid division, who conducted communications modeling and simulations using their Smart Grid Communications Assessment Tool (SG-CAT).

“Co-ops typically look at one application at a time, resulting in a hodgepodge of communications networking. We want our network to be future-proof. Our goal is to build it once, not twice.”

– Don Bowman, Manager of Engineering, Wake Electric

Modern approach to lasting goals
Efficiency has long been a goal of Wake Electric. In the 1980s, it incorporated load control switches into its operations, particularly for water heaters, to reduce power during times of peak electrical demand. In 2004, it implemented radio technology to enable monthly drive-by and meter reads. The processes were efficient, lean and progressive for their time, but they were still manual in the traditional sense. Over the past two years, Wake Electric has taken steps toward grid modernization.

Increase automation:
The utility needed to optimize the operation of its electricity distribution system and accommodate the trend toward automation. It sought to deploy smart metering and SCADA systems; feeder automation with fault location, isolation and restoration (FLIR) capabilities; distribution automation; and other opportunities as they become available.

Increase capacity:
The benefits of the drive-by meter reading technology allowed for the cooperative to recover its costs, but monthly meter reads had become insufficient. Wake Electric sought interval data on the meter reads, collected hourly rather than once per month. Since the utility’s existing systems was not suitable to stream granular data down to the second, it began exploring technology in the advanced metering infrastructure (AMI) space.

Answers for infrastructure and cities.
**Improve reliability:**
Wake Electric needed to ensure accurate, reliable communications with its members, but there were concerns about the sufficiency of low-bandwidth radios; the risk of standard modems, routers and switches occasionally getting surges or blinks; and the utility’s responsibility for controlling devices that can put people in harm’s way.

**Reduce demand:**
If Wake Electric was able to shape the load curve, it could save a considerable amount of money. The utility sought to achieve demand reduction through a combination of conservation, load control, and conservation voltage reduction, which entails lowering the voltage at the substation or feeder, without endangering members at the end of the line. Wake Electric is looking to enhance its SCADA system to monitor real-time data throughout the distribution system to measure and verify results of these programs.

**Control costs:**
The cooperative’s members don’t want to pay unnecessarly high rates. The cost savings attributed to grid modernization could be achieved more quickly if the proper communications infrastructure is defined and implemented upfront, rather than adjusted and corrected over time.

> “The cooperative built a high-quality electricity distribution system 80-90 years ago and it still works well, but it’s time to modernize. That’s how I explain the changes to our employees and members.”

– Don Bowman, Manager of Engineering, Wake Electric

**Technology considerations**
There was no backhaul method in place to support modern communications or the amount of data needing to be passed through the substation. A new communications technology mix was required, but Wake Electric didn’t know what kind or how much to build, or how big a communications pipe was needed. It did, however, realize that its communications requirements will continue to grow.

The utility needed to determine what its current system could handle and what changes were needed for the foreseeable future, and which technology was best, knowing that additional bandwidth will be needed over time.

However, it didn’t want to guess which approach to pilot or implement. Wake Electric had consultants and technology vendors offering generic recommendations for utility communication networks, but they lacked strategies to address the utility's specific asset and geographic topology.

Achieving Wake Electric’s vision required a comprehensive, customized telecommunications plan based on an evaluation of viable options – whether it be WiMax, WiFi, mesh, fiber or microwave. The utility needed assistance developing an effective communications strategy and roadmap, using sound technology choices that are justified with supporting evidence.

> “There are potential cost savings associated with grid modernization. We can’t afford to piece the network together over several years. Taking advantage of the benefits of the applications sooner works to our benefit.”

– Don Bowman, Manager of Engineering, Wake Electric

**Building upon a vision**
Wake Electric sought to build out its Smart Grid strategy. In 2010, a SCADA system was established to allow central monitoring and remote control of all the substations around the system. Public networks worked well for the SCADA proof of concept, but the utility wanted to ultimately move from public to fixed communications networks to optimize reliability. In addition, it had already chosen an AMI and began rolling out the updated, digital meters in 2011.

With additional Smart Grid applications on the horizon, Wake Electric needed to verify its communications strategy. Rather than consulting specialists in individual technologies, it sought a single source capable of comparing multiple available technologies. When Siemens introduced its SG-CAT tool as a means to holistically study the various options, Wake Electric chose Siemens to perform the communications study in addition to a feeder automation pilot with FLIR.

The study would involve modeling, simulating and documenting the precise network environment, including the service area's terrain, asset deployment topology and cross-cell interference in relation to specific application requirements. It would replace guesswork with hard data, for instance the ideal number and locations of base stations; minimum antenna types and heights; proper configuration or reconfiguration requirements; asset location decisions; application performance considerations; and which technology is the best fit given the circumstances.

**Iterative communications assessment**
The Siemens SG-CAT study kicked off at Wake Electric in November 2011 and it was completed in two phases. The first study was based on general locations and assumptions, and the findings were presented by Siemens in February 2012. By then, Wake Electric had learned of another potential location for the base station and wanted it and another technology tested in comparison. In addition, the new study used more accurate assumptions and refined scenarios and application requirements. The final findings were presented to the utility in April 2012.

Ultimately, Wake Electric learned that its existing AMI network is capable of also supporting fault current indicator monitoring and configurations of distribution automation, in certain locations. Based on the study, the utility chose to use the AMI network for portions of its distribution automation initiatives, and WiMAX for the FLIR pilot and backhaul communications. The study also pinpointed the best location to use for the pilot.
“The technical justification was important in solving our backhaul concerns. We needed that proof of concept in order to get us technology that is better, more reliable, and gives us more control.”

– Don Bowman, Manager of Engineering, Wake Electric

Study results supported decisive actions
The SG-CAT study was eye-opening for Wake Electric. Much greater detail was provided than originally expected, and the conclusions were clear enough to allow the backhaul technology to be selected and the pilot territory to be chosen with precision.

Wake Electric did not realize that its existing AMI technology was a viable option for some of their distribution automation (DA) initiatives until the SG-CAT study was performed. Nor did they realize that WiMAX was an optimum technology choice for backhaul communications and for the FLIR pilot. The study boosted the utility’s confidence in the current infrastructure’s ability to support some of the desired DA applications’ higher-bandwidth requirements. Choosing this technology extends the value of the utility’s metering investment.

The study provided both technical and cost/benefit justifications for Wake Electric to choose the optimum backhaul/backbone technology, including how the system will perform rather than just its subjective benefits. It incorporated a detailed, link-to-link analysis that illustrates how each backbone network point will communicate back to the Wake office.

The study showed which location was most feasible for deploying the feeder application pilot with adequate granularity and the required data transfer rate. It also revealed that the AMI technology may not be adequate for system-wide implementation, and that other options or a hybrid approach may be more technically and financially feasible for post-pilot locations and Smart Grid applications.

The SG-CAT study solidified the base station location decision by correlating a graphical view of the system map and density with the utility’s knowledge of expected growth and opportunities, and then laying the propagation study on top to maximize coverage and minimize technology costs.

Without Siemens’ findings, Wake Electric’s choice of technology and base station location would probably have been different and less reliable and efficient, potentially resulting in force-fitting or high replacement costs.

The study allowed Wake Electric to solve its communications questions first, before laying a new application on top. The SG-CAT is a useful, ongoing process for developing a comprehensive Smart Grid roadmap, designing the implementation and validating the model throughout deployment. It is also beneficial for evaluating and adapting to new scenarios as they occur, such as additional base stations or reclosers. This iterative, detailed analysis capability is unique to Siemens and its SG-CAT study.

“I’d recommend the SG-CAT study to other co-ops if they really want to know how the Smart Grid applications stack on top of one another. If they really want to future-proof their telecommunications, this is the type of study they’ll need.”

– Don Bowman, Manager of Engineering, Wake Electric

Wake Electric
- Founded – 1940
- Type – Non-profit rural electric cooperative
- Headquarters – Wake Forest, North Carolina
- Counties served – Durham, Franklin, Granville, Johnston, Nash, Vance and Wake
- Members – 35,000
- Employees – 50
- T&D line operated – 3,000 miles
- Member density – 12 meters per mile
- Website – www.wemc.com

Smart Grid project timeline
- 2004 – Radio technology for drive-by meter reads deployed
- 2010 – Grid modernization planning began; SCADA built and deployment began
- 2011 – AMI piloted and deployment began
- 2012 – Siemens SG-CAT final study findings presented; residential meter deployment completion
- 2012 – Feeder automation pilot with Siemens begins
- 2013 – Commercial meter deployment completion
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