Broadband Case Study: Allamakee-Clayton Electric Cooperative

Cooperative Profile

Allamakee-Clayton Electric Cooperative (ACEC) serves just under 10,000 electric members on 2,500 miles of lines across eight northeastern Iowa counties near the Wisconsin and Minnesota borders, principally in Winneshiek, Allamakee, Fayette and Clayton counties (see Figure 1). The total area served is 1,475 square miles. Fully 95 percent of ACMEC's member base is made up of farms and rural residential.

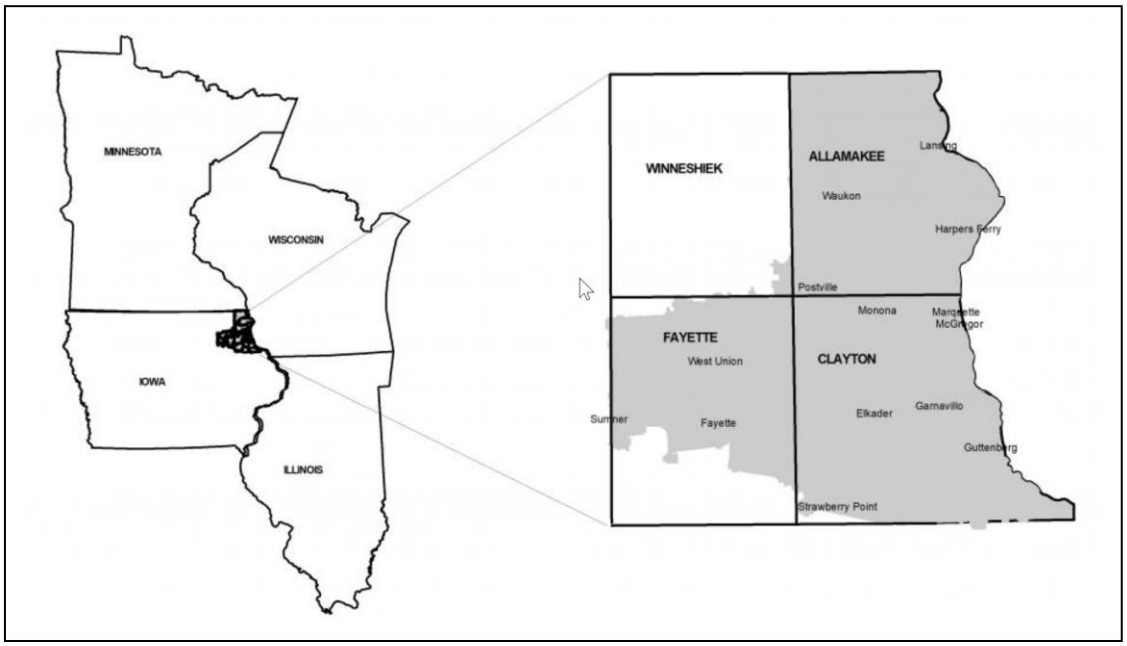

Figure 1. ACEC's electric membership area

The cooperative has been in the communications business for many years, initially as a DIRECTV franchisee and subsequently offering Viasat's satellite-based Internet access through the National Rural Telecommunications Cooperative (NRTC). At its peak, ACEC provided DIRECTV services to some 4,000 subscribers, a level of business attractive enough that the satellite company bought back the franchise.

Given the very low density of the area ACEC serves (only 4 customers per mile of line), it is not surprising that commercial broadband providers have been slow to expand there. Ironically, this reality was made apparent to the co-op by the geographic pattern of its satellite subscriptions — unserved/underserved communities were highlighted by dense clusters of satellite signups, indicating a lack of broadband alternatives. According to ACEC's former general manager Paul Foxwell, "We knew from our satellite-subscriber network that there was a need and the subscriptions were a demonstration of interest."

The co-op recognized, however, that while satellite service may serve the basic need for Internet access, it has speed and bandwidth limitations. ACEC thus began to explore the feasibility of offering high-speed broadband via a fixed wireless network. Upon successful completion of a wireless pilot project in January 2014, the co-op initiated a plan to strategically expand wireless broadband service. In 2014, the co-op received a boost in the form of a $1.45 million grant from the Federal Communications Commission's Connect America Fund (CAF) under the Rural Broadband Experiments Program.[1] Today, the cooperative's broadband unit, AC Skyways, serves some 500 wireless broadband subscribers off an expanding fiber backbone, while still maintaining about 360 satellite subscribers.

ACEC's approach to filling the gaps in broadband coverage in rural, northeast Iowa is based on demonstrated need and is scalable. It relies on hybridized network architecture and deploys last-mile wireless connectivity in a way that addresses community needs. It is a cost-effective strategy that brings acceptable Internet connectivity to those without affordable alternatives, or any alternatives at all.

Figure 2. Workers installing wireless broadband equipment on pole
Photo courtesy of Allamakee-Clayton Electric Cooperative

[1] The $1.45 million grant is being paid out over ten years. As the grant recipient, ACEC must certify that 85% of eligible census blocks are covered by the end of three years and 100% after five years.

Business Drivers of the Broadband Investment

The primary impetus for ACEC's investment in its hybridized fiber/wireless broadband network was, and continues to be, to serve members who lack affordable options to access the Internet with at least 25 Megabits per second (Mbps) download speed.[2] In Foxwell's eyes, the project is all about community development, "We heard from economic development professionals and employers that rural broadband access is critical to job creation, attracting workers, retention of our youth, and support of our seniors through services like telemedicine and telepharmacies." Internal business requirements such as AMI (advanced metering infrastructure) and Smart Grid have been less of a factor for ACEC thus far, although that is likely to change. According to Foxwell, "While we're moving toward advanced grid applications, our operational needs are currently met by separate RF (radio-frequency) and microwave systems."

Project Overview and Deployment Approach

ACEC commissioned an engineering study as the first step in evaluating its broadband technology options. While Foxwell recognizes that fiber may be the preferred broadband technology, the estimated cost of system-wide deployment of fiber-to-the-home (roughly $80 million) produced by the study exceeded the total value of electric plant (around $60 million) and thus was not a realistic option. The study did however recognize that building broadband connections between substations is required to support electric operations and that this investment can be leveraged. The co-op is currently planning to network its sixteen distribution substations.

Following its successful wireless pilot program, ACEC established an agreement with one of its local, independent telcos to enable connection to their fiber network, and positioned the telco to act as the co-op's Internet Service Provider (ISP). The co-op then built fiber extensions to its headquarters and a microwave tower owned by its power supplier Dairyland Power Cooperate (DPC). These created a wireless coverage area radiating several miles outward from headquarters. The co-op's strategy to deploy a hybrid communications network of last-mile wireless and middle-mile fiber was reinforced by the construction of this fiber backbone. As of April 2019, 37 miles of underground fiber are in place and ACEC is positioning itself to take advantage of partners' fiber assets wherever possible.

ACEC evaluated its communities' broadband needs using geographic information system (GIS) data to develop an overlay of satellite service subscribers on a map of the various communications carriers operating within its electric service territory — four independent telcos and two price-cap carriers.[3] Management saw this as more direct and potentially more accurate than relying on the FCC's broadband coverage assessments.[4] The overlay showed that the majority of ACEC's satellite subscribers were located in the price-cap carriers' areas, consisting mainly of DSL (digital subscriber line) service, which the providers appeared to have no plans to upgrade. In other areas, mobile/cellular was the only option. Using this information, ACEC developed a business plan for wireless deployment focusing primarily on the price-cap carrier areas. Areas of greatest need, and market potential, are indicated by the satellite

[2] The FCC's minimum standard is 25 Mbps download / 3 Mbps upload.
[3] "Price-cap carrier" refers to commercial communications providers that are rate-regulated.

[4] See for example: https://www.fcc.gov/reports-research/reports/broadband-progress-reports/2018-broadband-deployment-report

subscriber patterns. Where wireless coverage is challenging due to terrain or cost, satellite broadband continues to be offered.

Broadband Business Case

The cooperative has invested approximately $1.3 million to date in its fiber backbone with the CAF grant covering about a third of the cost. Annual operating cost of the fiber-wireless hybrid system in 2019 is budgeted at $836,000 with same-year budgeted revenues pegged at $530,000. Payback of the investment is expected to take an additional five to seven years or longer. In recognition of the relatively long time to recoup its investment, AC Skyways has slowed network buildout as it builds up its subscriber base. Management is optimistic and views the 500-subscriber level it has reached as a threshold toward improved financial performance by its broadband unit.

What about AC Skyways' "take-rate" (the percentage of premises enabled for broadband access that actually sign up for services)? Foxwell explains. "Unlike FTTH (fiber-to-the-home), where there is an exact count of the number of farms and homes passed, wireless is a bit more complicated due to the somewhat nebulous nature of the coverage. We do measure subscribers by township though, but even that isn't a very accurate measurement. In the township with the greatest coverage, we have a take rate of about 32 percent of the homes and businesses. In some other townships, the take rate is under 1 percent because we don't have much coverage established. So, using the number of farms and homes within each township and disregarding areas of relatively low wireless coverage, our take rate is 4.9 percent in Allamakee County and 1.6 percent in Fayette County (and less than 1 percent in Clayton County, where we have very little infrastructure installed). Based on those townships where I know we have pretty good coverage, I would estimate that we have a take-rate of about 12 percent, which sounds abysmal, but considering coverage issues including line-of-site interference due to trees or terrain, that may be realistic. That's one of the reasons our Viasat satellite Internet service is still an important part of our business."

Broadband Business Model

AC Skyways Broadband is an operating unit of ACEC. Four, full-time equivalents currently perform the work of the broadband unit and all are shared resources. Among these, two technicians split their time between broadband work and IT. The broadband department manager doubles as the co-op's operations manager. Current broadband expansion plans are to target only unserved and underserved communities within ACEC's electric service territory.

Network Architecture

ACEC's Foxwell describes the technology approach the co-op has adopted as "fiber to the section, wireless to the home." Its broadband unit is using an unlicensed frequency spectrum with its wireless equipment and has been quite pleased with the technology and the performance, which it says can meet the FCC's 25/3 standard for broadband service. While the wireless last-mile is line-of-sight technology,

the co-op has developed innovative ways to overcome challenges in its topography, which is fairly rugged, with hills, valleys, and a lot of trees.

Figure 3 illustrates one such approach, where AC Skyways crews set a 70-foot pole to serve as a "micro-repeater" site. Similar equipment has been placed on water towers, commercial radio towers, and grain elevators. As Foxwell says, "We are always on the lookout for good vertical property." RF interference has at times been an issue, however. AC Skyways has encountered vegetation issues, as well as interference from another wireless service provider on the unlicensed 2.4 Ghz band.

Figure 3:
AC Skyways crew installs a 70-foot pole for a new micro-repeater site
Photo courtesy of Allamakee-Clayton

The co-op's middle-mile fiber runs are, in contrast, 100 percent underground thus far. Given that the rural areas served are largely given to agricultural activities, there was concern that large agricultural equipment might snag overhead fiber and cause network outages. In addition to the 37 miles of fiber already in place, ACEC expects to connect to an additional 14 miles of overhead fiber in the form of OPGW (Optical Ground Wire) that its power supplier Dairyland Power Cooperative plans to deploy on its transmission system (see sidebar on the next page).[5] In short, the co-op's strategy is to connect state-of-the-art wireless technology to existing fiber networks where possible and to expand fiber when necessary.

[5] Optical Ground Wire (OPGW) is a type of cable used in overhead power lines. Such cable combines the functions of grounding and communications. An OPGW cable contains a tubular structure with one or more optical fibers in it, surrounded by layers of steel and aluminum wire. The OPGW cable is run between the tops of high-voltage electricity pylons. The conductive part of the cable serves to bond adjacent towers to earth ground, and shields the high-voltage conductors from lightning strikes. The optical fibers within the cable can be used for high-speed transmission of data, either for the electrical utility's own purposes of protection and control of the transmission line, for the utility's own voice and data communication, or may be leased or sold to third parties to serve as a high-speed fiber interconnection between cities. (Source: Wikipedia) https://en.wikipedia.org/wiki/Optical_ground_wire

Dairyland Power Cooperative to Provide Fiber Connectivity to Electric Distribution Members Using OPGW

For nearly fifty years, the microwave radio system at Dairyland Power Cooperative, ACEC's power supplier, has reliably served as the communications backbone for its operational needs. With rapidly increasing data requirements however, the microwave system is nearing capacity and lacks the flexibility to adapt to the changing business environment. Recognizing this challenge, Dairyland commissioned a formal feasibility study led by Power Systems Engineering, Inc. (PSE) to assess future communication requirements and evaluate the feasibility, comparative costs, and benefits of using fiber optics as the predominant communications backbone in the future. Performance and reliability expectations, scalability for future applications, FCC licensing risks, operation and maintenance, and costs were considered.

The feasibility study concluded that Dairyland's microwave system does not have the scalability to meet anticipated bandwidth growth over the next twenty to forty years. Dairyland has installed optical ground wire (OPGW) on transmission facilities on a limited basis for several years. The study recommended that Dairyland expand the installation and use of fiber for its core communications, while continuing to use microwave on a transitional basis and for select back-up routes and remote site connections. This strategy would support growing operational needs and, with the expected surplus fiber capacity, potentially help local economic development initiatives.

Dairyland is moving forward with the fiber expansion strategy. It began installing OPGW on nearly all transmission line builds and rebuilds beginning in 2019 and is currently in the planning and engineering phase of a system-wide implementation. This phase is expected to establish an 8- to 10-year deployment plan, prioritizing about 1,200 miles of fiber connectivity to Dairyland's generation facilities, transmission substations, and service centers. The vision is to ultimately provide fiber connectivity to all member-serving distribution substations connected to Dairyland transmission facilities, bringing total miles of fiber to approximately 2,200. The planning and engineering phase will also estimate annual financial requirements and address key installation and ownership issues such as fiber sharing, asset management, and cost recovery.

Throughout this work, an essential component will be engagement with Dairyland's member cooperatives on shared communication opportunities, including the joint use of Dairyland's fiber backbone for member cooperatives' operational needs and rural broadband initiatives.

– Sidebar courtesy of Greg Flege,
Director, System Operations
Dairyland Power Cooperative

Market Setting

As noted previously, several alternative sources of broadband service currently exist in parts of ACEC's area. One of the two price-cap carriers, Windstream, filed for bankruptcy in early 2019. The other, CenturyLink, has deployed some fiber and is marketing broadband services along the fiber route. AC Skyways does not see itself as a competitor to the four local telcos. In fact, one local telco leases dark fiber from the co-op.

Quantifiable Impacts on the Community

While it is too early to objectively measure specific effects of ACEC's broadband initiative in the communities served, anecdotal evidence suggests that impacts are already being felt. Expanded broadband access fosters home and college preparatory schooling, which is prevalent in rural, northeast Iowa. There is also the potential for growth in home-based businesses. Moreover, robotic applications in dairy and livestock operations and grain production depend on reliable, high-speed Internet access. Finally, some quality of life issues are also being addressed — broadband connectivity enables over-the-top TV programming streamed from the Internet.

Lessons Learned

In a talk he delivered at a Cooperative Finance Corporation Forum in 2016, Foxwell identified a series of lessons that ACEC had learned during its expansion into broadband services.[6] They are as follows, in his own words:

(1) First, don't underestimate the complexity involved. Telecommunications is vastly different from electrical operations in many respects, including regulatory requirements.

(2) Hire talented and experienced people for leadership. Having management with experience in the telco or broadband industry will help new and existing staff make a successful transition to the unique needs of the broadband business.

(3) Stay focused. It's easy to become distracted by other potential opportunities for expansion. Build to your core mission first.

(4) There are great synergies to be found with the right partners. Don't settle for second best. If one agreement doesn't work out as planned, look for better options.

(5) Broadband technology is a moving target, with performance increasing and costs decreasing. Also, continuously monitor bandwidth and transport costs. There are deals to be found.

[6] "A Scalable Approach to Broadband Deployment," delivered by Paul Foxwell as part of a pre-conference workshop at CFC Forum on Rural Broadband: Challenges, Opportunities and Lessons Learned, Seattle, Washington, 2016.

(6) And finally, as electric cooperatives, don't forget about the value that a broadband network can bring to system operations, especially in terms of Smart Grid applications like AMI and SCADA, and also the value for future Smart Home applications like NEST thermostats.

Why is this Case Important?

Previous case studies in this series have focused primarily, although not exclusively, on the experiences of electric cooperatives that have deployed 100 percent fiber. FTTH networks offer Internet access speeds up to 1 Gbps and appear capable of meeting the needs of the electric business and community members for the foreseeable future. However, ACEC's case shows that FTTH may not be the best fit for everyone. With an investment requirement that would have exceeded the total value of its electric plant by as much as $20 million, the cost of fiber broadband appeared prohibitive to ACEC's leadership. The approach they took instead, which former GM Foxwell refers to as "fiber to the section, wireless to the home," provides acceptable broadband speeds at far lower cost. As important for ACEC, this hybridized network architecture seamlessly complements the co-op's existing satellite service and allows the co-op to fill coverage gaps indicated by the pattern of satellite subscriptions themselves. It is a well-thought-through and scalable approach worth considering.

For additional information, contact:

Hollee McCormick
Executive Vice President/General Manager
Allamakee-Clayton Electric Cooperative
hmccormick@acrec.coop
Ph: 563.864.7611

Paul Breakman
Senior Director, Cooperative Organizational Development
Business and Technology Strategies
paul.breakman@nreca.coop
Ph: 703.907.5844

This case was researched and written by Eric Cody, Cody Energy Group: CodyEnergyGroup@gmail.com

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