Broadband Case Study: Sho-Me Power Electric Cooperative

Cooperative Profile

Sho-Me Power Electric Cooperative (SMP) is a generation and transmission cooperative that supplies power to nine electric distribution cooperatives serving 220,000 member-owners across 26 counties in south central Missouri. A number of outside municipalities also rely on SMP for delivery of power. The co-op's electrical network is comprised of 150 substations and some 1,800 miles of transmission lines. SMP and five sister Missouri generation and transmission companies (G&Ts) constitute Associated Electric Cooperative Inc. (AECI), as shown in Figure 1.

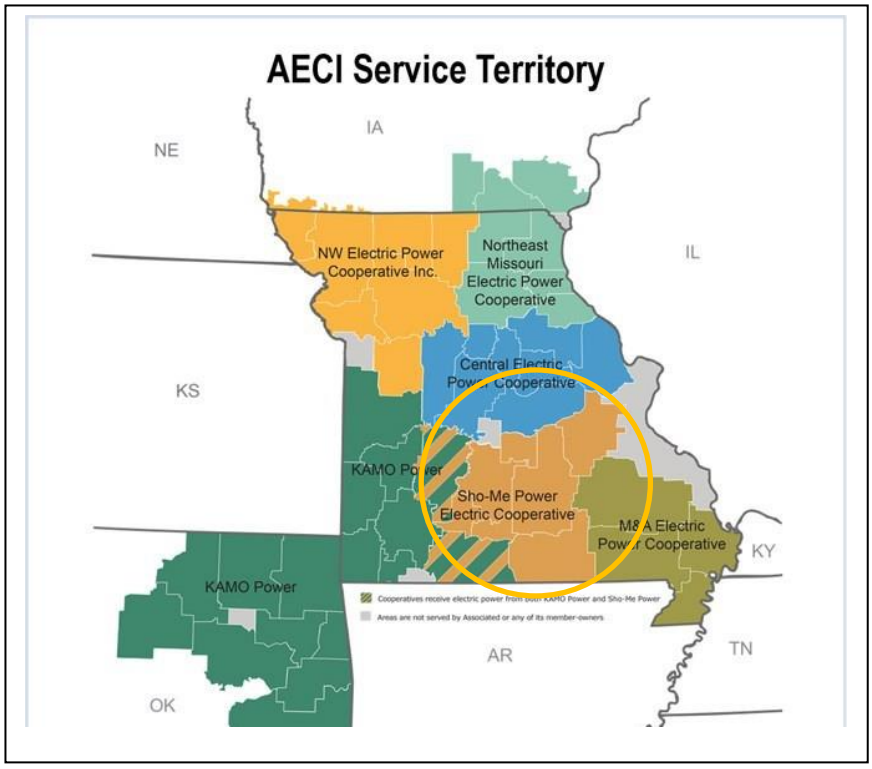

Figure 1.
Sho-Me Power Electric Cooperative and sister Missouri G&T cooperatives.
Map courtesy of AECI.

SMP began considering a fiber-optic network as one of several options to replace its 2 gigahertz (GHz) microwave communication system in the mid-nineties (see Business Drivers for a more detailed description of the situation). The cooperative considered several alternatives and concluded that fiber

broadband would be a safer investment offering higher reliability over the long-term. Several of its sister G&Ts reached the same conclusion. The resulting decision led to deployment of a statewide, fiber-optic network that meets the growing communication needs of Missouri electric cooperatives and brings high-speed Internet access to commercial and insitutional facilities (non-residential) that depend on it for their most basic requirements.[1]

Sho-Me's fiber network was part of a five-year initiative, MoBroadbandNow, launched by Missouri Governor Jay Nixon in 2009. The initiative sought to expand broadband accessibility to 95 percent of the total state population. SMP has responded to the Governor's call. The co-op's wholly owned subsidiary, Sho-Me Technologies (SMT), operates a fiber-optic network that currently extends more than 8,000 miles across most of Missouri. SMP is the first G&T cooperative to be featured in this NRECA broadband series.

Business Drivers of the Broadband Investment

Since 1994, the Federal Communications Commission (FCC) has conducted auctions of licenses for electromagnetic spectrum. One such auction in 1996 threatened to disrupt SMP's continued standing as primary licensee of the 2 gigahertz (GHz) frequency band that the co-op used for microwave communications with its substations and member cooperatives at the time.[2] This was not an imagined threat. As it turned out, the subsequent introduction of PCS (personal communications service) mobile phones did force SMP to vacate the 2 GHz frequency band.

In response to the uncertainty the auction created, the cooperative began investigating options for replacement of its microwave system. Among alternatives SMP considered were: (1) 6 GHz microwave; (2) telecom circuits leased from incumbent telcos; and (3) a fiber-optic network. Leased circuits were found to be less than 100% reliable, eliminating option 2. The costs of 6 GHz microwave and fiber-optic, the remaining options, were close. SMP management ultimately decided that fiber would be a safer, more resilient technology investment for the long-term.

Figure 2: Sho-Me Technologies worker installing spiral vibration dampeners on all dielectric self-supporting fiber cable.

Once its fiber-optic backbone was in place, SMP began receiving calls from school systems and banks that had facilities located along mainline fiber runs, which generally followed transmission lines. With the launch of SMT in 1997, the cooperative had a commercial business able to respond to such requests. Where the parent SMP did not have fiber on nearby transmission lines, SMT invested in underground fiber along road rights-of-way to meet customer needs, including those from outside SMP-served areas.

[1] The network also extends into Kansas, Illinois and Tennessee; however, these make up only small fractions of the overall fiber network.

[2] If SMP and other Missouri cooperatives became secondary licensees as a result of the auction they could have been required to cease their use of the spectrum if and when the successful bidder/primary licensee reported interference.

NRECA America's Electric Cooperatives

Project Overview and Deployment Approach

Construction of SMP's statewide fiber-optic network began in late 1997. In 2011, thanks to a $26.6 million grant from the National Telecommunications and Information Administration (NTIA) Broadband Technology Opportunities Program (BTOP), SMT added 500-miles of middle-mile backbone to its fiber-optic network. The grant award stated, in part:

> *"Sixty workers are diligently constructing the network to bring high-speed access to 100 community anchor institutions, including K-12 schools, community colleges, public libraries, health institutions, and various local governments. This middle-mile fiber backbone will enable distance learning and telehealth, enhance public safety applications, and expand opportunities for economic development across Missouri."*[3]

Since then, the network has continued to expand, adding as much as 4 percent annually as demand for the services grows. Mark Keeling, who serves as Chief Technology Officer of both SMP and SMT, describes the evolution in SMT's focus over time. "Initially, fiber construction projects were all driven by the need to replace traditional microwave, then by commercial projects. Now, we are looking at fiber replacement needs due to the age of the fiber." Keeling points out that adding splices to fiber over time causes attentuation and signal degradation. The strategy was to form an integrated network out of overhead fiber owned by SMP, underground fiber deployed and owned by SMT, fiber assets owned by SMP's member co-ops, and leased fiber. SMT lights and provisions the fiber-optic network as an integrated whole from its 24 x 7 network operations center (NOC). In total, SMT operates just over 8,000 miles of fiber-optic lines, of which it directly or indirectly owns nearly 60%. Table 1 provides a breakdown by ownership.

SMT's Fiber-Optic Network by the Numbers

	Fiber miles	Percent of Total
Owned by SMP (on overhead transmission infrastructure)	1,615	20.04%
Owned by SMT (underground)	2,066	25.64%
Owned by member co-ops (on distribution infrastructure)	1,016	12.61%
Indefeasible right-of-use (IRU) leased, dark fiber	3,362	41.72%
TOTAL	**8,059**	**100%**

Explanatory notes:
Sho-Me Power installed fiber optics on its transmission lines. OPGW or Optical Ground Wire is the method of choice because it allows the G&T to replace aged, static wires that have been hit by lightning over many years. The new conductor serves the same purpose, but with fiber optics inside. This conductor is located at the very top of transmission line structures. An alternative to OPGW is ADSS, or All Dielectric Self Supporting fiber optics, which is used as an under build on transmission and distribution lines.

Table 1. Breakdown of SMT Fiber-optic Network by Ownership Miles.

[3] https://www2.ntia.doc.gov/grantee/sho-me-technologies-llc

Broadband Business Case

The business justification for the initial, fiber backbone project was, as described earlier, replacement of SMP's 2 GHz microwave communications system. Further expansion of the network beginning in 2011 was largely subsidized by the aforementioned NTIA grant. Since then, growth of the fiber network, and testing of high-speed, wireless broadband, has been based on projected revenue streams, leading to an investment pattern that might be described as "organic."

SMT's business strategy has also evolved. Initially, potential customers with facilities located along fiber runs approached the company. Over time though, SMT has become more proactive in seeking new customers. The company has shown a willingness to construct new, underground fiber subrings (see Network Architecture for a description) into areas not served by SMP. The company currently has nearly 2,000 contracts in place with more than 300 business customers, producing annual revenues in excess of $30 million.

Broadband Business Model

SMT is a wholly owned, for-profit subsidiary of SMP. Neighborhood Wireless Inc. (NWi), another subsidiary which operates under SMT, was formed in 2017 to test a new technology approach that might ultimately enable entry into the residential broadband services market. Neither SMT nor NWi has actual employees. Of SMP's total employee base of 167, about 39 full-time equivalents perform tasks for SMT and another 3 perform tasks for NWi. How does this work in practice? All the individuals performing tasks for the subsidiaries work out of SMP's telecommunications department (comprised of 42 people) and charge their time to the companies. Field service technicians work out of four locations to handle fiber breaks and other network-related tasks. The fiber network operations center (NOC) is physically separate from electric operations, although it is also staffed by SMP employees charging their hours to SMT. On the financial side, SMT's margins are included in SMP's capital credit calculations.

Network Architecture

SMT's fiber-optic network is not classified as GPON (giagabit passive optical network), as is the case for most, if not all, of the other electric co-ops that have been profiled in this NRECA broadband series. SMT describes its network architecture as a ring topology, with almost 2,000 transport nodes across the state of Missouri as shown in Figure 3. In layman's terms, what SMP does is connect sub-rings into its fiber backbone, sometimes referring to the combination as "necklaces" due to its appearance when the network is shown schematically. SMT's total circuit count is around 4,700, including those used by SMP for internal communications. About 2,800 of the circuits are commercial.

With a point-to-point fiber connection, SMT provides business-to-business connectivity in a wide range of service types, including DS1, DS3 (Digital Signal or T-carrier bands-DS1 is the primary digital telephone standard used in the United States and several other countries), OC3, OC12, OC48 (optical carrier bands), and Ethernet scalable from 1 Mbps (megabits per second) to 10 GigE (Gigabit Ethernet).[4] The company operates several GigE rings across Missouri. The bandwidth inside each of

these rings is dedicated to Ethernet transport and divided into VLANs (virtual local area networks). Each customer is assigned to a private VLAN, which is carried via fiber optic cable to the customer location. Wavelength services[5] and dark fiber are also available in some areas. SMT utilizes Dense Wave Division Multiplexing (DWDM) equipment for express routes between major Points of Presence. This technology is available to SMT customers who require large pipes, such as other telecommunication carriers. These optical waves are available for upto 100 Gbps line rates.

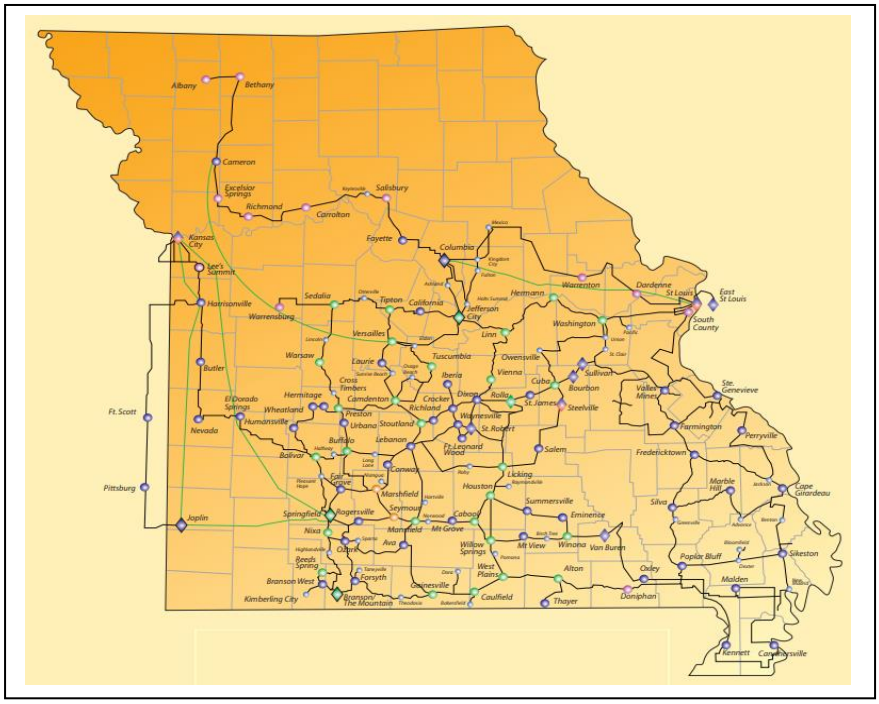

Figure 3.
Sho-Me Technologies Network Map.

Market Setting

In SMT's case, it is difficult to describe the competitive environment, since market incumbents (other major telecommunications carriers) are among the company's most important customers. According to the company, SMT is classified as a certified interexchange carrier by the Missouri Public Service Commission, providing advanced telecommunications capability with access to network architecture and a business model which utilizes a fixed access network as an infrastructure for enabling other service providers, fixed or wireless, to provide advanced services to the end user. In the company's own words,

> *"Sho-Me Technologies, LLC is interconnected with several other carriers and has Points of Presence in major "Telco Hotels" in Missouri cities like St. Louis, Kansas City, and Springfield. These interconnections create a pathway to anywhere in the world. Sho-Me Technologies, LLC is completely neutral and open to all service providers."*[6]

[5] A Wavelength Service is a large bandwidth connection providing high-speed Internet or data service delivered over lit fiber-optic lines. Source: https://www.itquotes.com/what-is-wavelength-service/
[6] https://shometech.com/about-us/advantages/

Many different businesses rely on SMT for their networking and Internet requirements. The five primary industry segments served are: Education, Healthcare, Government, Banking, and Cellular/Telecom carriers. If and when SMT enters the residential broadband market in a meaningful way, the question of market competition is likely to become more relevant. SMT has begun testing wireless technology that may extend its reach into the residential market space. Fiber services offered to business and institutional customers include point-to-point connectivity (Ethernet from 5 Mbps to 10 Gbps-gigabits per second), extended local area networking (with scalable bandwidths and line rates tailored to each location), and business-class, dedicated Internet access tailored to meet specific business needs.

Regulatory Issues

SMP and SMT have been carefully watched by many in the co-op community for a number of years as a class-action lawsuit challenged SMT's use of SMP's utility easements for commercial broadband activities. The parties in the case finally reached a settlement agreement in November 2018.[7] While the impact of the case on SMP was negative, the case spurred legislative action in other states that have lowered barriers and significantly improved the legal and regulatory setting for electric cooperatives wishing to extend broadband into unserved and underserved rural areas.

Measurable Community Support

NWi, SMT's wireless arm, is deploying what it calls "fast-fiber wireless solutions" to downtown business districts in Missouri. In late 2016, the company began enhancing its fiber network in downtown Houston, Missouri, with wireless access points in response to a request from Downtown Houston Inc., "which said businesses were hobbled by the lack of fast Internet service that is available to those in metropolitan areas and it hurt recruitment of businesses who might like to locate in Houston."[8] And in one, often-cited case, a Houston dental office had such a slow connection to the Internet that it was unable to download Microsoft upgrades for its office network without disrupting daily operations at the practice. By the end of its initial week of testing, NWi was able to demonstrate download speeds in excess of 100 Mbps, exceptionally fast for a wireless communication technology.[9] Businesses served off the upgrade are guaranteed 30 Mbps download speed by NWi.

Why is this Case Important?

Sho-Me Power's entry into broadband in 1997 with its for-profit subsidiary Sho-Me Technologies demonstrated that a statewide, largely wholesale model for providing broadband services was not only viable but could leverage other providers' attempts to reach unserved and underserved areas. Who are these other providers? Electric distribution cooperatives, incumbent telcos, cellular providers, Internet

[7] For details of the case and its impact on removal of impediments to broadband in rural areas, see: "Broadband and Legal Considerations— Sho-Me Power Class Action Recap and State Statute Updates," NRECA Legal Reporting Service, Volume 55, Number 1, January 2019.

[8] https://www.houstonherald.com/news/project-brings-high-speed-internet-to-downtown-houston-businesses/article_5af51de6-d75a-11e6-8589-93fe5fde6147.html

[9] For comparison, a July 2019 test of the LTE networks of eight major wireless carriers produced an average download speed of 32.4 Mbps. Source: https://www.tomsguide.com/us/best-mobile-network,review-2942.html

Service Providers, and sister G&T cooperatives. Perhaps even more importantly, SMP's experience in arguing for use of utility easements for broadband activities, while unsatisfying for the co-op itself, has led to a change in the way state legislatures view this new service, thus lowering barriers to more widespread broadband deployments.

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