



Rural Broadband
Consortium

case study

Scattered Farmhouse Environment
- Local Steward Business Model

1 INTRODUCTION


The C Spire Rural Broadband Consortium is exploring how the injection of 3rd parties into an operator's rural broadband business model might enhance the feasibility of broadband deployment in rural markets. C Spire (the Operator), in conjunction with a local steward, deployed a fixed wireless access network with wireless backhaul to serve a handful of scattered farmhouses in rural Mississippi in order to evaluate the feasibility of one type of 3rd party engagement model. This case study describes the fixed wireless deployment with a local steward business model and the results.

2 MARKET DESCRIPTION

The C Spire Rural Broadband Consortium is exploring how the injection of 3rd parties into an operator's rural broadband business model might enhance the feasibility of broadband deployment in rural markets. C Spire (the Operator), in conjunction with a local steward, deployed a fixed wireless access network with wireless backhaul to serve a handful of scattered farmhouses in rural Mississippi in order to evaluate the feasibility of one type of 3rd party engagement model. This case study describes the fixed wireless deployment with a local steward business model and the results.

FIGURE 1:
Scattered Farmhouse Overview





Many rural customers are trapped in a similar situation where reliable, high-speed service is not available, and the number of ISPs is limited or nonexistent. These market conditions lead to a consumer that is unable to be connected, unable to receive a connection that meets broadband standards, or pays an unreasonable price for a slow connection. Much of the market discussed in this case study is considered underserved for several of the reasons explored below.

Typically, lower population densities require more capital and operational expenses in order to serve the same number of customers as in higher density population centers. The proposed service area is rural because it has a population of fewer than 500 people per square mile [1], however, the customers that wanted coverage were in relatively close proximity to each other compared to the other households in the market. This allowed the potential service area to be reclassified as semi-rural, which partially mitigates the higher cost of capital and operational expenses per consumer.

The area where the customers wanted service was densely covered by trees. Even in urban markets, tree density can lead to reliability or coverage issues for wireless solutions. Due to the rural nature of the service area and dense tree coverage, the Operator's existing wireless and wireline infrastructure was limited.

The families in the proposed coverage areas already paid a significant amount for internet services each month and were willing to pay that same amount, if necessary, for faster speeds. This is not always the case for customers in semi-rural markets, however, a readiness to pay the same amount or more for enhanced service should not be dismissed.

The complexity of the solution required a significant number of man hours for design, which might explain why other potential solution attempts for the area were dismissed early in the process. However, once the design for this location was completed, it was found that this same type of installation could be replicated thus reducing the number of design hours needed in the future for similar installations. If a process can be easily replicated once designed, the relative cost per consumer decreases because specific design elements can be applied to the next similar project.

3 TECHNOLOGY OPTIONS

There are many technology options available to provide broadband to rural environments; finding the right option is both a market morphology fit [2] and an economic one. Figure 2 shows the basic access technology options considered: 1) direct fiber (wireline) to each consumer house and 2) fixed wireless access to each consumer house with either fiber or wireless backhaul to the access tower. A technology option shown that is not yet available but can be considered in the future is LEO (Low Earth Orbit) satellite.¹

¹ Lower Earth Orbit (LEO) Satellite: Telecom network using satellites in low earth orbit. LEO Satellite's orbit between 310-620 miles above earth, unlike traditional satellites, which orbit around 22000 miles above earth.

- **DIRECT FIBER CONNECTION**

- o Existing fiber assets are in the area approximately 0.2 miles from the property
- o **Pros** - High speed, reliable, and a long useful lifespan
- o **Cons** - Expensive to bore approximately 0.63 miles to connect every user

- **MACRO FIXED WIRELESS ACCESS**

- o Existing Operator fiber fed macro tower is 1 mile from the desired service area
- o **Pros** - Reasonably high speed and reliability, and low cost
- o **Cons** - Requires direct line of site (LOS) to each structure

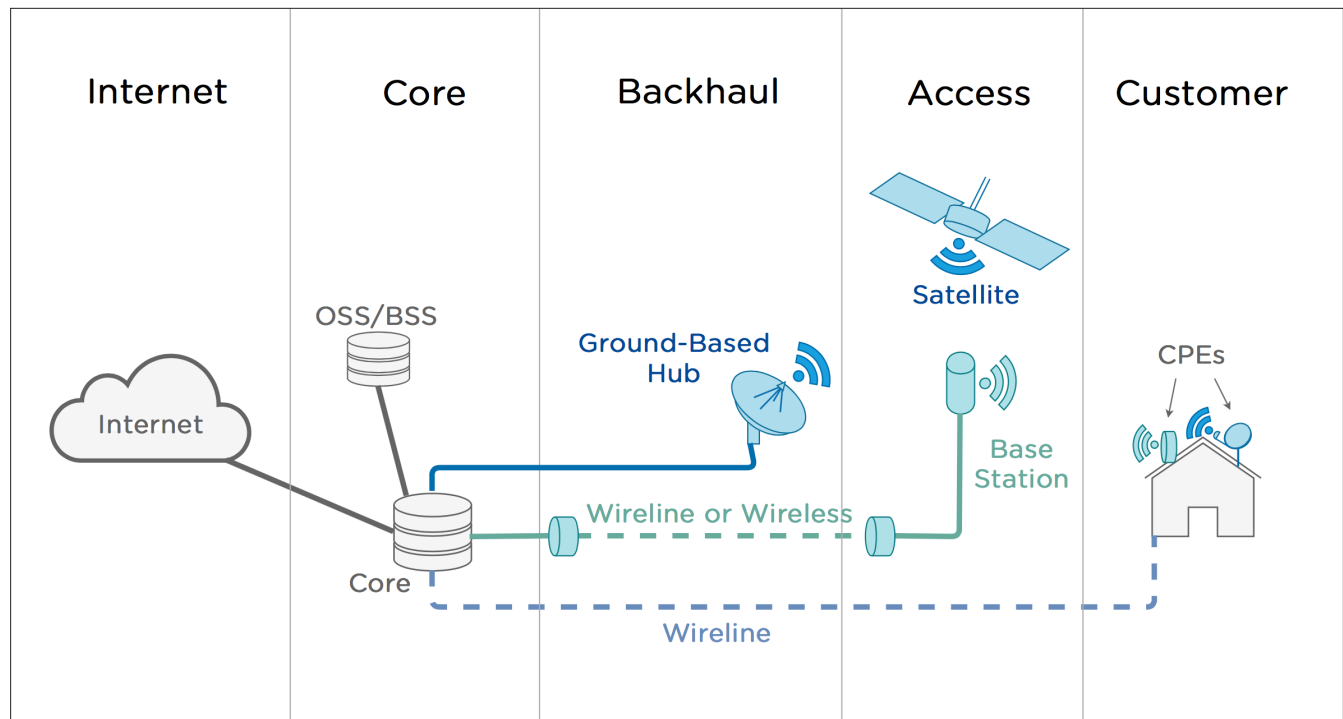
- **MICRO FIXED WIRELESS ACCESS (FWA)**

- o Existing Operator fiber fed macro tower is 1 mile from the property and can be used to provide wireless backhaul to a smaller, more localized and centralized tower
- o **Pros** - Reasonably high speed and reliability, and low cost. LOS only required to one structure from the macro tower
- o **Cons** - Has multiple points of failure, and if the micro host loses service all the customers will experience an outage

- **LEO SATELLITES**

- o LEO satellites will be appropriate for access or backhaul to community sites without direct LOS to existing Operator towers or located far from an Operator's core assets
- o **Pros** - Economical for medium to low density areas, easy to deploy, eliminates challenges related to LOS, foliage, and terrain
- o **Cons** - Not currently available, more expensive than fiber and microwave backhaul in this scenario due to consumer proximity to existing Operator assets

FIGURE 2:
Broadband Connectivity Options Considered



4 MARKET DESIGN AND COST

4.1 DESIGN

The first solution explored for this project was fiber because of the fast and reliable connection. The proposed fiber path required to connect the four customers would be cost prohibitive, but this method of connectivity was feasible.

A macro fixed wireless solution was explored next based on a line of site (LOS) analysis and an on-site visit. It was determined that no LOS could be achieved to the Operator tower from the ground or the roof of any structure. However, there was clear site visibility at about 30 feet above ground level.

A micro fixed wireless solution was considered and found to be plausible if a permanent structure could be installed on the consumer's property that supported LOS conditions to the Operator macro tower for a wireless backhaul connection. The consumer researched and sourced different tower solutions and was responsible for all tower construction and electric work. Once the tower construction was completed, a wireless backhaul antenna was installed as well as a micro base station to provide point-to-multipoint access on the property. The access technology used for the micro base station was a 5 GHz unlicensed solution. Then, a wireless CPE (Customer Premise



FIGURE 3:
Consumer Signal Distribution

4.2 DEPLOYMENT COSTS

The known and approximated variables for both viable solutions (fiber and micro fixed wireless) were collected in order to determine the total time and cost associated with each type of deployment for this installation. The totals were then used to compare the two solutions in order to better understand the scope of work. Each cost was also broken into a category so it could later be used to explore different engagement models.

Table 1 and **Table 2** compare the amount of time and costs associated with each step in the deployment and on-going operations process for both fiber and micro FWA over the course of one year. Each category, Fiber and Micro FWA, is divided by their respective totals. Both are measured over one year to show how much time and cost is associated with operational expenses as they are difficult to compare with capital expenses. Table 1 indicates that billing, network monitoring, and provisioning are the most time-consuming processes. This is because they are operational in nature. In comparison, Table 2 indicates that Equipment) was installed on each structure that needed service and a link from each CPE to the micro base station was established as shown in Figure 3. construction carries the highest cost for both fiber and micro FWA, but fiber is much more expensive. Other high cost items for micro FWA are customer installation and design.

TABLE 1: Time Comparison

	FIBER	MICRO FWA
Access Construction	0.0%	0.3%
Backhaul Construction	0.4%	0.2%
Billing	33.1%	33.1%
Customer Installation	0.0%	0.0%
Design	0.2%	0.2%
Equipment Replacement	0.0%	0.0%
Marketing + Sales	0.1%	0.1%
Network Monitoring	33.1%	33.1%
Provisioning	33.1%	33.1%

TABLE 2: Cost Comparison

	FIBER	MICRO FWA
Access Construction	0.0%	40.8%
Backhaul Construction	78.2%	0.0%
Billing	0.1%	0.5%
Customer Installation	11.4%	23.3%
Design	6.0%	23.6%
Equipment Replacement	2.6%	5.1%
Marketing + Sales	1.5%	5.9%
Network Monitoring	0.1%	0.5%
Provisioning	0.1%	0.5%

5 BUSINESS MODEL COMPARISON

5.1 3RD PARTY ENGAGEMENT

Two engagement models were explored for this deployment: 1) the Operator bears the full cost for the deployment and 2) a hyper local steward, in this case the direct consumer, takes on some of the deployment and operational costs. **Table 3** indicates that specific elements, such as network design and billing, remain with the Operator even for the Hyper Local Steward Engagement Model. While billing could be a shared cost in some cases, network design cannot be accomplished effectively outside of the Operator's organization due to internal knowledge and assets. Some of the other costs can and should be shared to help make projects more feasible.

For the Hyper Local Steward Engagement Model, the Local Steward was willing to be responsible for all construction and installation costs for elements the Local Steward provided. For instance, the Local Steward was willing to trench from the Operator handhole to the respective locations that needed coverage and to lay their own fiber. The Local Steward was also willing to monitor any outages having to do with the equipment the Local Steward purchased and installed. Finally, the steward agreed to pay for any equipment replacements that might be required.

TABLE 3: Engagement Model Comparison

Operator Provides	
Partner Provides	
Both Provide	

ENGAGEMENT MODELS				
	100% Operator		Hyper Local Steward	
	FTTH	Micro FWA	FTTH	Micro FWA
Network Design				
Backhaul				
Access				
Construction				
Backhaul				
Access				
Customer Acquisition				
Customer Equipment Installation				
Provisioning				
Billing (OSS/BSS)				
Maintenance + Operations				
Network Monitoring				



5.2 PAYBACK PERIOD

Typically, a payback period for an ISP or Steward is a straightforward calculation: 1) how much capital investment is required to connect each consumer and 2) how quickly will the investment be returned based upon the monthly subscription cost. In this case, the Hyper Local Steward is the end user, so there is no revenue shared. Therefore, the consumer’s “profit” is the amount of money saved each month on each consumer’s internet bill. As mentioned earlier, the customers previously paid a high price for poor service and used several wireless cellular hotspots with data plans.

Table 4 shows the payback period for each party using the same conditions for each engagement model and each type of considered installation. By charging the consumer a reasonable rate each month for service, the payback period for a 100% Operator Engagement Model is far too high for a fiber solution, reasonable for a micro fixed wireless solution, and unfavorable to the Operator. The Hyper Local Steward Engagement Model is favorable to the consumer in both scenarios, high investment for the Operator with fiber, and favorable for the Operator with a micro fixed wireless solution.

TABLE 4: Payback Period Comparisons

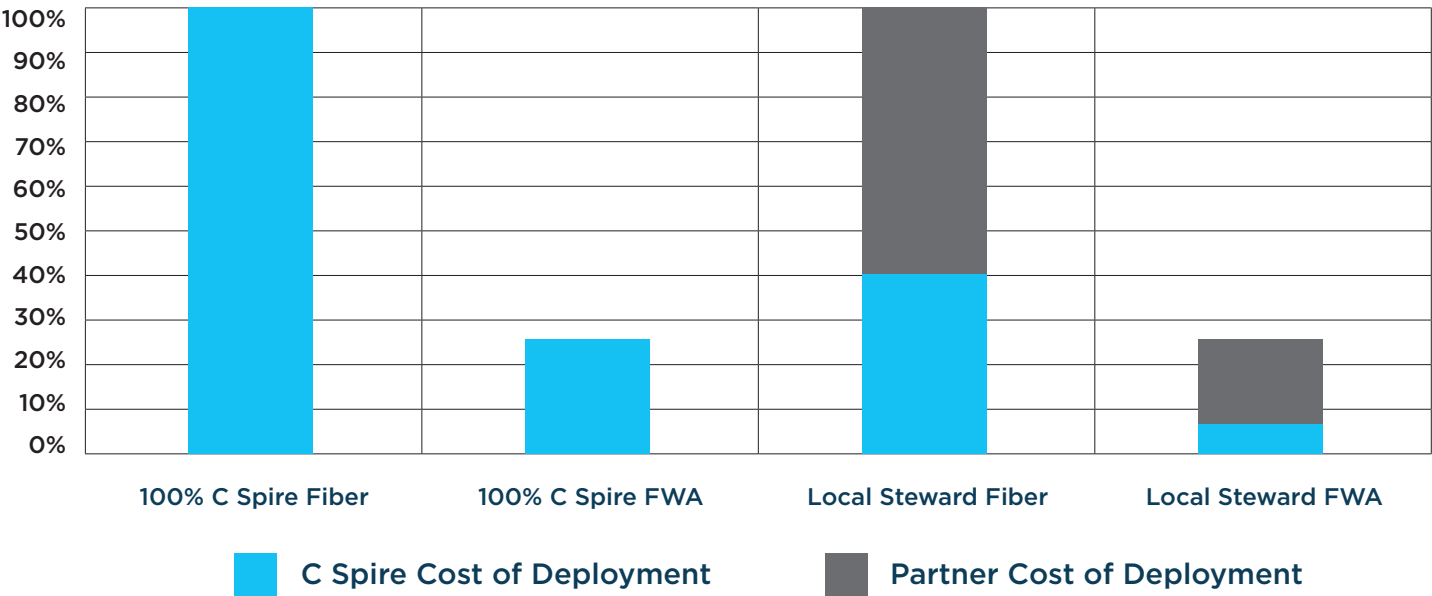
Operator	Payback Period
Partner	Payback Period

	Customers	Service Area (Square Miles)	Consumer Density	FTTH Distance (Miles)	100% Operator Engagement Model		Hyper Local Steward Engagement Model	
Fiber	4	10	0.4	0.64	11.75	0.00	4.64	1.83
FWA Hyrid					2.63	0.00	0.64	0.55

Once all the estimated costs and payback periods were collected, the information was compiled into Figure 4 for comparison. While the different engagement models did not reduce the amount of capital needed for each install, it is clear that the lowest cost solution with the most favorable payback periods for each party is the micro fixed wireless solution paired with the Hyper Local Steward Engagement Model.

TABLE 4: Financial Comparison Summary Chart

PARTNER COST BREAKDOWN



6 CONCLUSION

The final technical solution for the scattered farmhouse scenario is shown in Figure 5. A micro fixed wireless solution was selected for this consumer because of existing tower and fiber resources in the area and the consumer/Local Steward was willing to build a small tower on their property to provide the necessary infrastructure for wireless backhaul with micro fixed wireless access solution. The Local Steward built a small tower on their property to achieve LOS for wireless backhaul to the Operator tower. A point-to-multipoint access point (AP) was deployed on the Local Steward’s tower to allow multiple customers to connect from various houses on the property. Both the Operator and the Consumer/Local Steward had favorable payback periods because of the shared deployment costs and the use of a fixed wireless solution instead of fiber.

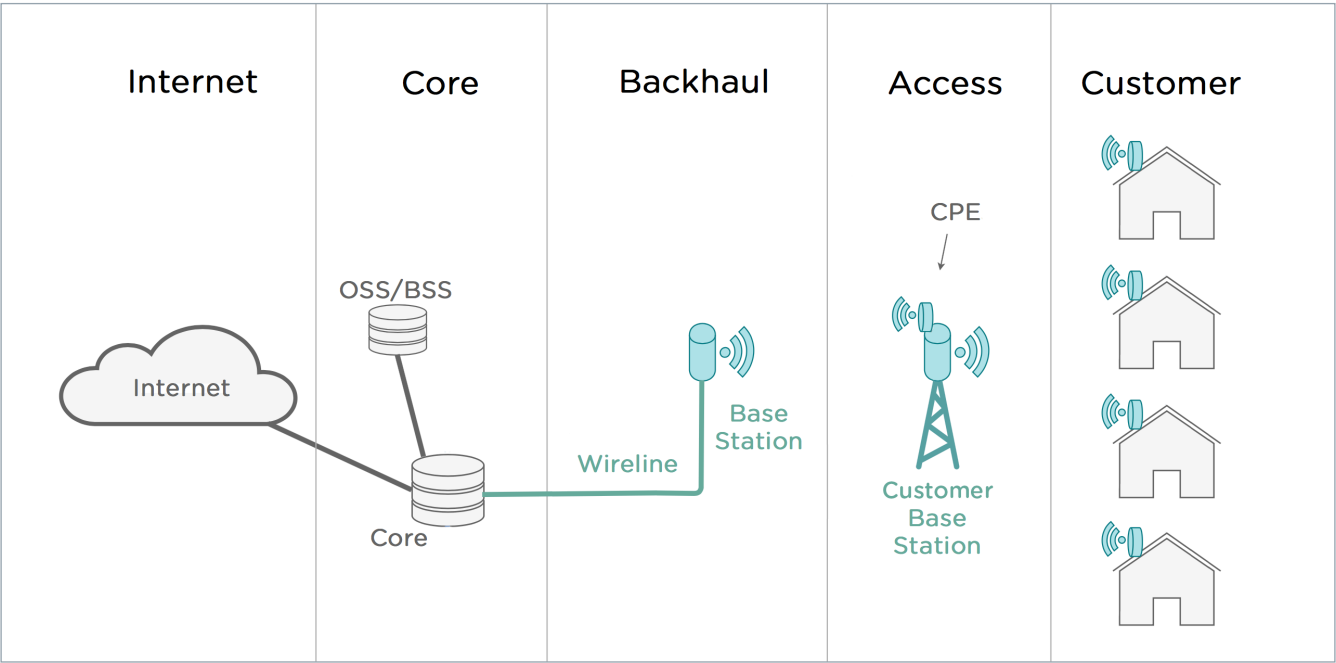


FIGURE 5: Broadband Connectivity Solution Diagram

Connecting a consumer is technologically feasible in most situations, but it is not always economically feasible. In this scenario, the economic challenges were reduced by ignoring rural household income. The consumer/Local Steward was able to purchase and install a micro tower, which allowed the Operator to treat the installation in the same way as other fixed wireless installations. Not all customers will be able to install and pay for a tower, however, a simple payback period calculation showed that there was consumer savings each month when compared to what would typically be spent on a wireless bill. If payment plans were implemented with some company or creditor, any consumer could pay a portion of installation costs and receive the economic benefits associated with a high-speed internet connection in addition to tangible financial savings. While a lower cost solution (fixed wireless) and a hyper local steward engagement model lowered the cost to the Operator, it did not reduce the overall cost of the solution. Looking at Tables 1 and 2, areas which would benefit most from cost reduction efforts are construction, design, and consumer installation. Tables 1 and 2 also indicate that billing, network monitoring, and provisioning are the most time-consuming components of any method and making these components more efficient would reduce manpower.

With the current infrastructure in place, Micro Fixed Wireless for access and wireless backhaul to a nearby fiber fed tower is a suitable option both technologically and economically. In many cases, however, communities may not have this existing infrastructure readily available. In these situations, LEO backhaul might become a viable and cost-effective option. The main advantage of a LEO system is the potential for a low risk solution that allows the ISP to serve the consumer reliably, without the large upfront capital expense investment of a microwave or fiber system. Rural markets should be studied more thoroughly and discussed in future white papers.

7 REFERENCES

- [1] “What is Rural?,” USDA, October 2019,
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- [2] “Broadband Technology Options,” C Spire Rural Broadband Consortium white paper,
August 2019, https://www.cspire.com/resources/docs/rural/CS_RuralBroadband_BroadbandTechnologyOptions_TechPaper_201908_v2.pdf.

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