3rd Party Enablement Business Models for Rural Broadband

A White Paper by the
C Spire Rural Broadband Consortium

c spire
Rural Broadband Consortium

1 EXECUTIVE SUMMARY

The C Spire Rural Broadband Consortium is not just interested in technical solutions to provide broadband to rural communities but in economic ones. The typical large-city operator business model with economies of scale and high revenue opportunities with a quick payback period breaks down when used on smaller isolated or loosely scattered communities. While smaller companies such as Wireless Internet Service Providers (WISPs) make the rural business model work, their sometimes-limited capabilities (including access to capital and infrastructure) can hinder their rate of expansion. Sharing costs and expertise between large and small companies through 3rd party enablement business models has the potential to "change the game" and make rural broadband deployment faster and more economically feasible for all parties. This paper introduces a set of 3rd party enablement business models and provides examples of where and how they can be used for favorable outcomes.

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2 INTRODUCTION

The lack of broadband access in rural markets is typically due less to technical reasons than to commercial reasons. In seeking to understand the challenges to rural broadband connectivity, the industry must look closely at current broadband business models and how they apply to rural markets.

Broadband access to rural households can be a unique engineering feat requiring multiple technology solutions. [1] The design challenges to serving rural markets due to environmental variation also manifest in a provider's business model. Low population density, terrain and foliage, lack of backbone backhaul connectivity, lack of accessible infrastructure, and limited service provider resources are all items that a provider's business model must account for. Thus, current broadband business models that depend on scale (especially a consistent, repeatable approach) are inadequate for many businesses to tackle rural connectivity. If this is to change, new business models must address the obstacles of current business models to provide an easier entry into rural markets.

C Spire has some advantages in this space as both a mobility and a fixed provider with cellular towers and thousands of miles of fiber in the ground. C Spire's territory is also quite rural, consisting primarily of Mississippi, Alabama, and Tennessee (ranked 47, 42, and 33 respectively in terms of urban population). [2] The desire to better serve its rural constituents is why the C Spire Rural Broadband Consortium was created and why technology and business model options are being explored.

Deploying a network is usually the focus of an initial cost analysis. However, the ongoing operations and maintenance of running a network can also be challenging logistically and can likewise affect the business case. All parts of deploying and running a network affect scale and sustainability and must be examined.

2.1 TECHNOLOGY REFRESHER

Figure 1 illustrates the key components of how a customer obtains Internet service. Access can be obtained through wireline, fixed wireless, or satellite to Customer Premise Equipment (CPE)[1] placed on the customer's home. The core manages Internet traffic, supported by Operations and Business Support Systems (OSS/BSS) that manage network resources and customer interactions (billing, service assurance, etc.). Backhaul connects the access network to the core network and out to the broader internet.

The most critical items to consider when designing and building a market are market environment (how the market is laid out, including buildings to be connected, population density, terrain, and foliage) as well as access to infrastructure and backhaul.

[1] *The CPE could be a satellite dish, a wireless device, or an ONT*

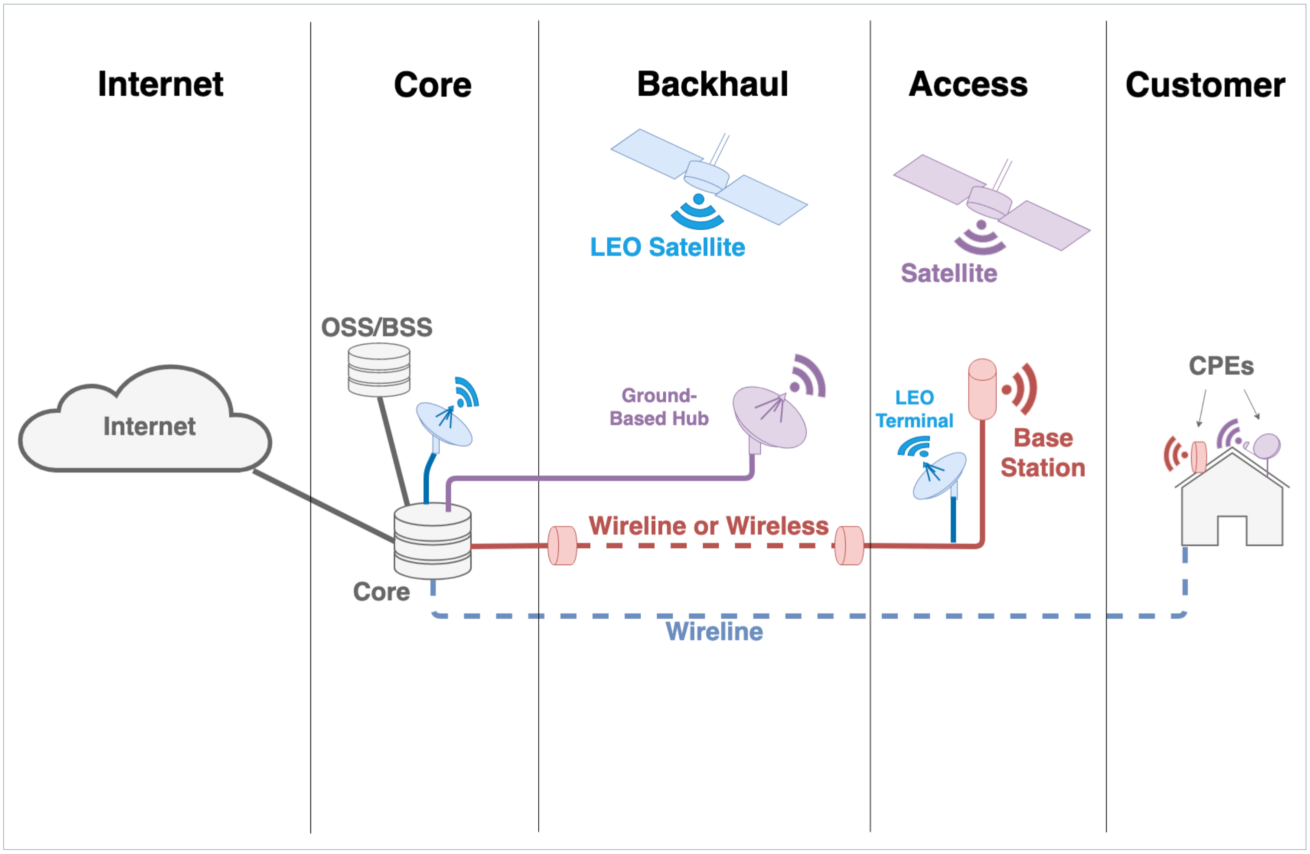

FIGURE 1: ISP architecture

2.2 BEYOND TECHNOLOGY

However, there is more to being an Internet Service Provider (ISP) than building a network. The options selected to run a network and provide services are also essential and critically impact the business case. While technology (building a network) is the highest upfront cost, other resources such as maintenance, sales, and marketing are on-going operational expenses. Each of the following areas must be worked through when entering a market as a service provider:

Network:

- o Market selection
- o Network design (access, core, and backhaul) and purchasing
- o Construction (network)
- o Operations (network monitoring and maintenance)

Customer Interaction:

- o Acquisition (e.g., sales and marketing)
- o Customer installation and provisioning
- o Billing

Section 3 discusses how these items are addressed in the classical operator only model, while Section 4 introduces the new third party enablement models. Section 5 includes potential model improvements through optimization and automation, while Section 6 concludes the paper.

3 CURRENT BUSINESS MODEL - OPERATOR ONLY

The most common business model for providing connectivity to homes is that of an Operator-Only ISP model where a single operator designs, builds, operates, and maintains its network as well as acquires and connects its customers. ISPs who want to have the most control over their network employ this model to provide connectivity to customers. Owning a network requires access to infrastructure assets such as towers and backhaul, including fiber. Any of these can be leased or owned.

There are many different types of operators, including Mobile Network Operators (MNOs) such as C Spire, cable operators, satellite operators, Wireless Internet Service Providers (WISPs), etc. While this paper is written from an MNO perspective, the basic concepts should also apply to other types of operators. Operator capabilities and control of network or end-customer may be slightly different, but the basic requirements to be an ISP should remain the same.

3.1 COSTS

The typical way of providing broadband is for an ISP to select a potential area to serve and perform technical and financial modeling to determine its viability. Each ISP uses its own expertise for technology design and feasibility and analyzes its resources (technical and physical) to determine how they can be reused or expanded to serve the new area. If the area does not meet the ISPs' criteria for business case viability, the ISP moves on to a different area. This is the classical operator-only model, where the operator does all the analysis, planning, building, and operating, taking all the risks, and obtaining all the rewards for that market or service area.

3.1.1 MARKET SELECTION

Market selection includes a unique set of factors for each ISP. These can include the desired customer base (residential, business, government entities), name/brand recognition, competition, rate plans, market demographics or characteristics, expected penetration rates, etc. An in-depth market analysis might require purchasing a database or other research tools and requires time and ability to process large data sets.

3.1.2 MARKET DESIGN

Experienced engineers work through technical options based on the market environment, existing resources, and cost, often using a variety of design tools purchased or home-grown. The critical first component is backhaul availability. Long-haul fiber crisscrosses developed countries such as the United States. If fiber passes close enough to a rural community to be accessed, it is the backhaul of choice. For rural areas that are tens of miles from fiber, single or multi-hop microwave links or Low Earth Orbit (LEO) satellite backhaul can be used. LEO satellites are well-suited to provide city-quality backhaul for rural and remote communities where terrestrial communication infrastructure is not readily available.

The market environment impacts access technology selection. For towns with densely spaced homes, fiber to the home (FTTH) and micro fixed wireless access technologies enable high data speeds and reliability. FTTH is more expensive and time-consuming to deploy but can be less constrained by terrain, morphology, capacity, and building distances than wireless. Macro fixed wireless access (FWA) is more capacity constrained per area and thus more appropriate for scattered users.[2] Macro fixed wireless access costs (and revenues) are often primarily driven by tower costs together with the number of customers that can be served by each tower. One macro FWA benefit is the rapid buildout of coverage, as each tower typically covers a large block of potential customers at turn-up. The difficulty in macro fixed wireless deployments is that most available spectrum is unlicensed and has difficulty reaching non line of site (NLOS) users. This requires more towers (i.e., more cost) to increase the probability of service to end users in that defined area. Micro FWA focuses more on street assets and rooftops, requiring more sites per area than a macro deployment but enabling much higher capacity per area as well. This reduces the cost of infrastructure builds while increasing the amount of overall hardware, backhaul capacity, and expected lease negotiations for micro base station locations.

The relative scaling of wireline and wireless total cost of ownership with household density is different. Wireline cost per connected household increases rapidly as the density decreases, as more cable must be laid. In contrast, the cost of wireless is relatively constant over a wider range of densities. This is because the radio cell size can be expanded or reduced to cover a fixed number of households.[3] As the overall wireless deployment cost is primarily driven by the number of base stations, a fixed number of customers per base station results in a lower cost per customer. Wireless cost per household does start to increase rapidly at very low densities because in this region, the maximum range of the radio link becomes a limiting factor, and there are insufficient households to consume all the capacity of the base station. Fewer households per base station result in a higher cost per household. FWA deployments should aim to maximize the number of customers served per tower while providing a sufficient data rate.

If micro or macro wireless access is selected, a wide range of spectrum and radio technologies are possible, depending on the coverage and capacity needs of the market. The access technology also impacts the core selection and design, including adding capacity or other functionality. Existing infrastructure such as towers or fiber assets or relationships in the market can help down-select some of the options. Other considerations, such as market penetration (scale) and sustainability, are considered when selecting access technology as well. [1] Ultimately, a market design must achieve the desired payback period and return on investment (ROI) in order to move to the construction phase.

Figure 2 illustrates the best network configurations for a community based on population density and distance from the provider's core network.

[2] An MNO may attempt to use existing mobility technology for fixed services but may need to add capacity to support a fixed use case, especially if true broadband service (>25/3 Mbps) is planned.

[3] Note, however, that expanding and reducing cell size changes per user throughput as throughput depends on where in a cell the user is located (as well as total number of users and loading, etc.).

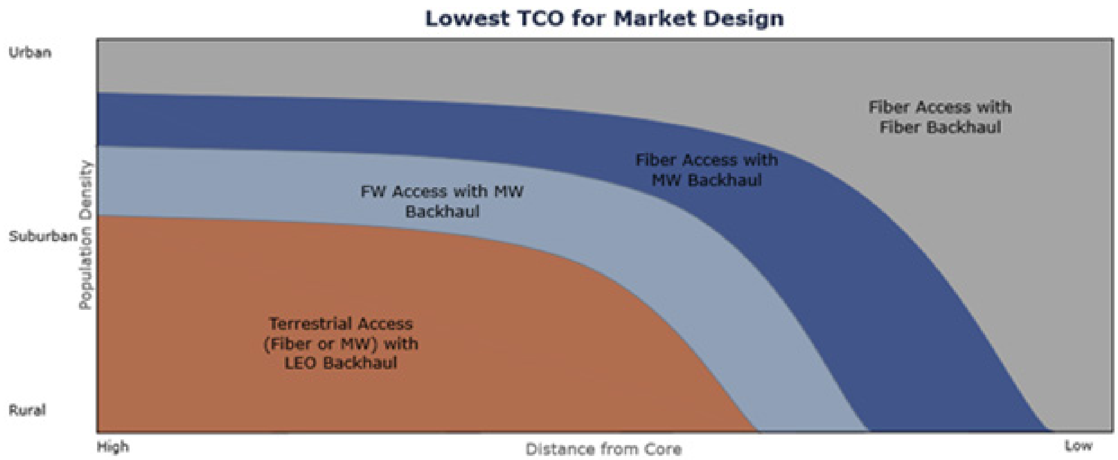

FIGURE 2: Market Characteristics vs. Technology Selection

3.1.3 CONSTRUCTION

Building a market is where market design becomes a reality. Fiber has very high initial costs with low operational costs and a long useful lifespan. The cost of fiber and installation is often measured in feet, and since a physical plant must be built all the way to the customer, cost per household rapidly increases as the distance between households increases. Other considerations include slow time to deploy and high variation in costs depending on the local factors of its environment, such as rights of way, degree of clustering of households, permitted construction methods, municipal regulations, etc.

The major costs for fixed wireless access include spectrum costs (lease/own/unlicensed), tower costs (lease/own, construction), pole placements or rights, land ownership (for poles/towers), backhaul, radio, and other hardware and software as well as installation. Macro towers are expensive to build but can be relatively easy to access and use if an existing tower can support additional equipment. Micro deployments have a smaller footprint per base station, requiring more towers for the same area than a macro deployment. However, micro base stations are less expensive to deploy while enabling a higher throughput per area for the same amount of spectrum. Micro base stations can be deployed on shorter poles or buildings, reducing construction costs compared to a macro. Micro deployments often operate under the tree canopy and can reduce the probability of an NLOS end user.

If the wireless access technology selected is mobility-based, a more elaborate core network is required, usually rack space in a temperature-controlled building. For an MNO, additional capacity in an existing core may be needed to accommodate the new build.

Microwave backhaul costs include hardware, installation, and lease/own towers. A satellite operator can offer their service directly to consumers or as backhaul to an ISP (e.g., satellite backhaul model). Moreover, the satellite backhaul model, when using LEO satellites, offers lower capital costs as the only infrastructure required for backhaul is an efficient user terminal. The cost driver for this model is capacity, which can be sized per need and scaled for demand.

Scale is usually found by repeating the same job over and over in the same (or nearby) area. Scattered small jobs such as work on dozens of towers across thousands of miles are not particularly cost-effective for an MNO to source or perform compared to upgrades to dozens of towers in a single metro area.

3.1.4 OPERATIONS AND MAINTENANCE

Market build dominates market start-up costs and can make or break a business case before ever starting construction. However, on-going operation and maintenance of the newly built market are equally important for a scalable and sustainable business. Operating a network or service means both monitoring the status and health of the end-to-end components of a network and maintaining the network by fixing problems, upgrading software or hardware, etc. A Tier1/2 MNO monitors the network 24/7/365 through a dedicated Network Operations Center (NOC) and on-call technicians that repair problems or do routine upgrades and maintenance as required wherever necessary throughout the network. This level of service is intended to maintain a network with 99.999% reliability (e.g., only ~5 minutes downtime per year) by mobilizing resources to troubleshoot and repair problems within minutes. If the operator already has network monitoring tools, adding a new market should simply mean expanding the existing tools to accommodate the new build. However, having different technologies to fit different market environments often means a different monitoring toolset for each technology. For an MNO used to a standard cellular network operations center (NOC) focused on one or two technologies, adding a whole new set of technologies and monitoring tools and integrating them into existing logistics and troubleshooting processes is expensive and time-consuming to learn, use, and maintain.

As an ISP's territory increases, more technicians are needed to support new markets, from network-related upgrades and fixes to customer technology issues. Large urban markets can support new employees and keep them well-occupied. Rural markets, however, make support challenging. Using existing employees reduces effectiveness and cost efficiencies and decreases customer satisfaction due to the increase in travel time required to reach rural customers. Adding rural markets means that fewer customers or network issues can be addressed for both rural and urban areas. However, the small size of rural markets cannot justify the cost of a new employee for just that market; a large group of rural markets might justify a new employee, but service expectations for rural areas should probably be lower compared to urban areas.

3.1.5 CUSTOMER INTERACTION

There are a number of areas where customer interaction is necessary, including customer acquisition through sales and marketing, customer installation and provisioning, and billing. While there are likely no rural-unique challenges to billing, sales and marketing efforts can be hampered through an absence of face to face opportunities. Sales events are challenging in scattered rural areas with few neighborhoods or central gathering places. Door to door activities are extremely time-consuming in those same scattered areas. Installation and provisioning activities have the same problems as operations and maintenance in terms of workforce and service expectations.

3.2 REVENUE

The other side of the broadband business model is revenue. In the operator-only model, all revenue from the end customers is paid directly to the operator, which is then used to pay back any loans used for the build, for ongoing operations, and for business expansion. In urban markets, large numbers of customers are more easily obtained, making that market self-sustaining relatively quickly. Urban areas also have enough business that construction, operations, and maintenance can be focused in a single area. In rural areas, there are many fewer customers to provide revenue. The result is a much lower revenue stream for that area, even with an unrealistic 100% uptake of the total addressable market (household and businesses alike).

There is a perception that rural customers are economically disadvantaged compared to their urban counterparts and thus cannot afford to pay as much. A 2016 U.S. Census Bureau analysis indicated that nationally rural Americans have about 4% lower median household incomes than urban households. Rural median household income in Mississippi (location of C Spire's primary mobility network footprint) was the lowest in the nation. [3] While a first glance at the national-level data would indicate that rural prices should be slightly lower than those of urban pricing on average, a closer analysis indicates that localized data is much more nuanced.

In all too many rural areas, only high-priced internet options are available, often for internet services that are not even broadband. That pricing can be necessary due to the high cost of deployment and low demand. Sometimes, however, high pricing is a result of a lack of competition; if there is no other internet option, many people will pay the high price just to have some type of internet service. [4-6]

3.2.1 SUBSIDIES

The operator-only model assumes that all costs are borne by the operator, and thus, all customer-provided revenue belongs to the operator as well. However, rural builds are often subsidized through public or private grants or funding given to stimulate new builds or better service. Private funding can result in revenue-sharing partnerships or other cost-reducing mechanisms. [7, 8] Public funding options can include government subsidies, such as the Government of Canada's partnership with Telesat [9] to provide affordable connectivity to rural communities or grants with specific build and reporting requirements. Public-private partnerships also exist.

U.S. public policy efforts to promote rural broadband deployments have existed but face unique challenges. Federal and state support programs, such as the Universal Service Fund, USDA's ReConnect Fund, and various state broadband funds are built on the assumption that reliable data exists for determining where high-capacity broadband services are and are not available to consumers. That assumption, however, is fundamentally flawed. The FCC and the rest of the federal government have long relied on "Form 477 data" to determine broadband service availability. However, Congress, the GAO, and third parties have pointed out in recent years that Form 477 data overstates broadband availability – often grossly. For example, the FCC today still concludes that a census block is 100% "served" if any carrier can provide service to even one customer inside the block.

The Broadband DATA Act passed by Congress and signed into law in 2020 requires the FCC to change the way they collect and report data. While the Commission has yet to start collecting new data, efforts are underway at the Commission to implement the changes from the legislation. Until these underlying issues with data are corrected, it is impossible for policymakers – at the state or federal level - to accurately target public policy, including economic support mechanisms, in a manner that efficiently or effectively promotes the deployment of broadband services to the nation's rural areas.

3.3 RETURN ON INVESTMENT (ROI) OR PAYBACK PERIOD

A full business model canvas includes an analysis of key partners, key activities, key resources, value propositions, customer relationships, sales/delivery channels, customer segments, as well as cost and revenue streams. For the complete business model, the basic formula of costs minus revenue over time results in a payback period. Because rural areas can result in higher costs and lower revenues using standard practices, the payback period is typically much longer for rural areas than urban areas.

Table 1 and **Figures 3-4** demonstrate how an operator might model a new market build. **Table 1** includes a sample list of expenses and their relative costs for the various areas previously discussed, while **Figures 3** and **4** include examples of how revenue vs. cost results in an expected payback period. Obviously, there is variability in costs due to many factors as discussed in Section 3.1 and in revenue as discussed in Section 3.2.

	Description	Cost	One-time vs. on-going	CAPEX vs. OPEX
Market Selection	Market analysis tools	$	One time	CAPEX
Network Design	Access and backhaul design tools and services	$-$$	One time	CAPEX
Backhaul Construction	Equipment (network hardware and construction), software and licenses, labor, permitting, engineering, etc.	$-$$$$$	One time	CAPEX
Access Construction		$$-$$$$	One time	CAPEX
Core Construction		$-$$$$	One time	CAPEX
Customer Acquisition	Marketing + sales, retail operations	$	Both	CAPEX
Customer Installation and Provisioning	CPEs, software and services installation costs	$-$$$	On-going	Both
Billing	Software to manage customer bills, collection, rate plans, etc.	$	On-going	OPEX
Network Monitoring	Operations & customer care (monitoring software and hardware, personnel)	$-$$	On-going	OPEX
Network Maintenance	Equipment upgrades and replacements (network and customer)	$-$$$	On-going	OPEX
General Overhead	New rent/lease (space, tower), employee salaries, utilities, non-network maintenance & upgrades, etc.	$-$$$	On-going	OPEX

TABLE 1: New Market Cost Break-Down

Note that many of the cost estimates in **Table 1** assume the Operator has various components in place already (e.g., billing platforms and network design tools) and the cost to use these for a new rural market are incremental. Under this scenario, it is clear that construction costs including new equipment (and accompanying licenses) can be the biggest influencers to the business model. A larger, established operator likewise has standards of service that are quite high, adding to the overall cost (and timeline) of any project.

For-profit Internet Service Providers must consider the cost of capital and the corporate tax rate in their respective markets. For larger projects where the entity(s) involved do not have enough internal capital to pay for the project outright, or if the opportunity cost of investing a large amount of upfront cash in a project is higher than the cost of capital, a standard rate of 8-12% can be applied to the CAPEX portion of the project. The corporate tax rate will vary from market to market, and by the relative size of the operator, but 25% is a standard rate to apply. In effect, this will increase an ISP's capital expenditures and decrease its yearly revenue, but it will provide a more accurate ROI.

While network build (both equipment and construction) is generally the highest cost, backhaul can have the highest variability and thus the most potential to impact the business case. The next most impactful cost is that of customer equipment and access and core construction. Rural service providers look for the most cost-effective equipment that serves the most people to reduce not just initial build cost, but per-customer costs (e.g., customer premise equipment, installation costs) as these can delay profitability. Some operators charge a one-time installation fee to offset those costs.

Network maintenance costs must consider the life of equipment and frequent software upgrades. Mobility standards experience a generational shift ever 10 years or so and frequent upgrades to software and even hardware are needed to keep up with new features and increased capacity and processing requirements. Fixed deployments, especially in rural markets, should undergo fewer changes and upgrades over time, thus keeping those costs lower.

As discussed previously, there are a variety of options for an operator to build a new rural market. Construction costs could easily be in the mid 6 to 7 figures (i.e., ~$500k or more) for builds that include a new cell tower or ~10 or more miles of fiber (for access and/or fiber). For a market with existing infrastructure, adding typical mobility equipment could be in the upper 5 to lower 6 figures (e.g., ~$100k). Much of the equipment designed for fixed wireless, especially using unlicensed spectrum, is less expensive, in the low to mid 5 figures (~$50k). Figure 3 illustrates how critical keeping network build costs down is in rural areas. The model assumes a rural area of about 1500 people (~600 households) with a 25% take rate for a total of 150 customers. Assuming all 150 customers were acquired in the first month of the first year with a relatively low fee and low per customer installation costs, the difference in payback period for different build costs is clearly demonstrated. Note that yearly OPEX costs are estimated to be 12.5% of the initial build (CAPEX) costs. While the low-cost build achieves payback in less than one year, neither the medium nor high cost builds will achieve payback with this level of on-going expenses combined with low revenue. The high-cost build is particularly problematic, with a swiftly increasing deficit. For an even smaller market or lower uptake (say, 100 total customers), even the low-cost build can cause the business case to go negative, requiring an adjustment in cost or revenue to enable a positive payback.

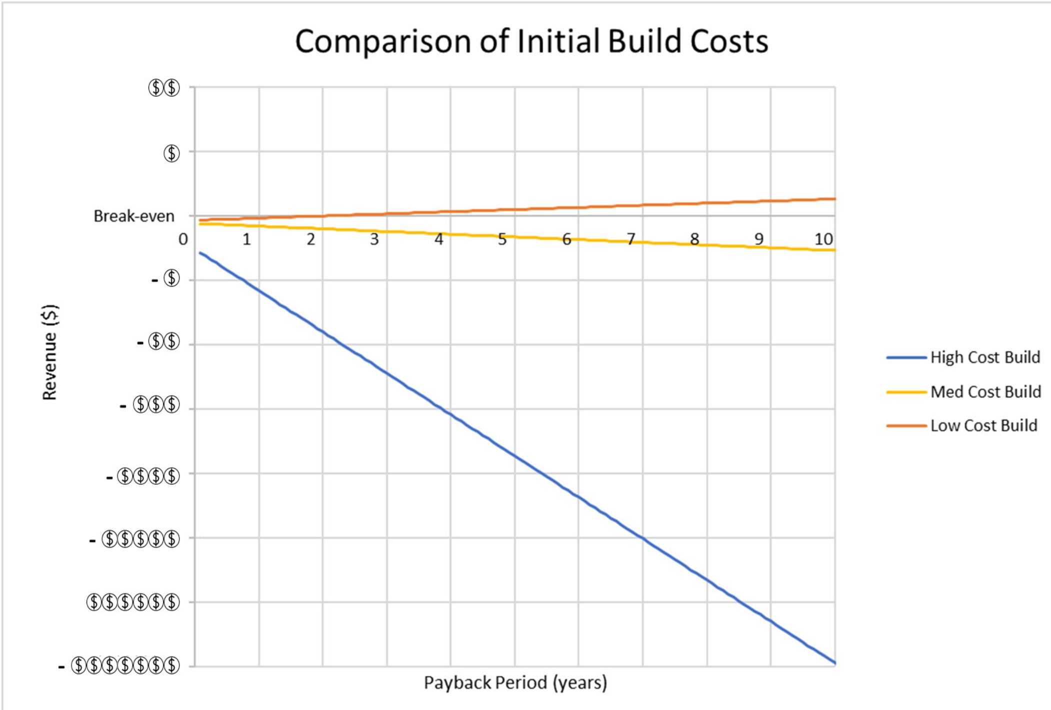

FIGURE 3: Payback Period Comparison for Low, Medium, and High Cost Builds

Figure 4 examines the impact of increasing the number of customers and increasing the revenue per customer on payback period for the medium-cost build. Each item is studied in isolation. Customer count was doubled and then tripled; customer fees (i.e., revenue) were increased by 50% and then doubled (values typically observed in market). As can be seen, any of these changes can move the medium-cost build from a negative business case to a positive payback period, though only doubling (or more) one of those variables can produce a more viable payback period of three years or less.[4]

Larger, more established operators may undergo projects with a much longer payback period (5-10 years) than smaller operators with less access to capital who may need to have a payback period of less than 1 year. Because fiber is considered an asset, it can be easier to obtain capital for a fiber project versus a wireless one, pushing WISPs to a shorter ROI (e.g., 2 years or less). Regardless, all operators expect to have a positive payback period to stay in business, and the shorter the payback period, the better.

Note that both tripling the number of customers and doubling the customer fees together still cannot make the high cost build profitable. 100% of the households in this example market would need to pay the doubled customer fee to achieve a payback period of just over 5 years for the high-cost build.

[4] A study was not performed to estimate whether the medium-cost build would support the increased customer counts at a sustainable broadband data rate; this is a risk for wireless deployments.

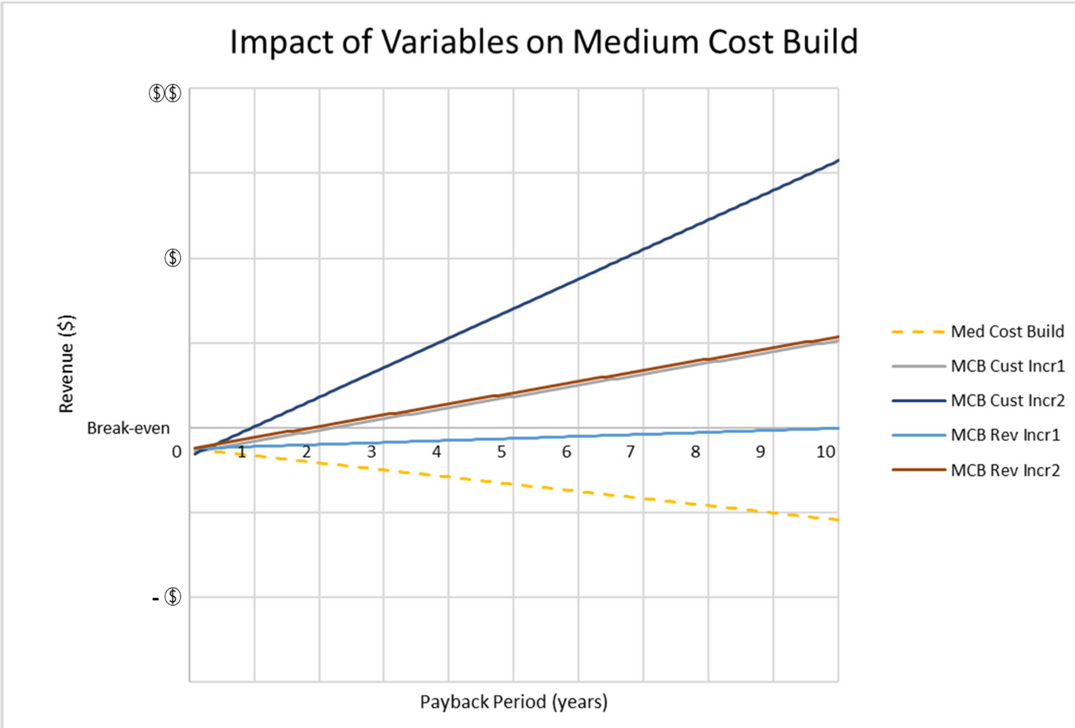

FIGURE 4: Payback Period Impact due to Varying Revenue and Customer Count

4 NEW BUSINESS MODELS FOR RURAL BROADBAND

While the business case for bringing broadband internet service to large, densely populated areas is usually fairly easy to make, especially in underserved markets, the cost to serve small rural markets can quickly soar from backhaul costs alone, as discussed previously. A single company, no matter how large and financially sound, is not likely to take on the challenge of connecting millions of rural users when there are still tens of millions of urban users that are waiting to be served at a much lower cost point.

There are, however, many smaller, localized entities whose focus is on smaller markets. WISPs, for example, are usually localized and often serve smaller markets where the main competition is satellite or DSL.[5] Because their resources are local and small, expanding into a nearby town can be a matter of having the right relationships to make adding a new tower cost-effective. However, there are limitations to how fast and far local entities can expand. Some of those limitations can be overcome by partnerships with other entities.

[5] More recently, WISPs are tackling urban areas as well, challenging fiber and cable companies with high-speed wireless internet offerings enabled by advanced antennas and/or millimeter wave technologies.

The 3rd party enablement model is where two parties collaborate to provide service to an end-user.[6] This partnership allows for shared costs, different levels of expertise, and more efficiencies in areas where owning the whole process is challenging. While an ISP purchasing services or infrastructure access such as backhaul, could be viewed as a type of 3rd party enablement, the intent of this model is a deeper partnership where each party shares in both cost and revenue (risk and reward). The 3rd party is expected to be the customer-facing entity, while the Operator is the enabling entity. Each party has a stake in how well the other performs, and each is invested in the outcome to the end-customer.

There are different types of 3rd parties that an operator can enable, each with varying levels of expertise, as well as different ways the parties can engage. In Table 2, various engagement models are represented by the division of network and customer interaction tasks to either party. The design, deployment, and maintenance of a rural network are divided between the two cooperating serving parties. The 3rd parties identified are Established ISP, Nascent ISP, Local Steward, and Infrastructure Provider, based primarily on levels of experience, capabilities, and assets. More details on these 3rd parties are described in the following sections.

	Engagement Models				
	Operator-Only	Established ISP	Nascent ISP	Local Steward	Infrastructure Provider
Market Selection/Boundary Definition	Operator Provides	Both Provide	Both Provide	Both Provide	Both Provide
Network Design					
Backhaul	Operator Provides	Operator Provides	Operator Provides	Operator Provides	Partner Provides
Core	Operator Provides	Partner Provides	Operator Provides	Operator Provides	Operator Provides
Access	Operator Provides	Partner Provides	Operator Provides	Operator Provides	Operator Provides
Construction					
Backhaul	Operator Provides	Operator Provides	Operator Provides	Operator Provides	Partner Provides
Core	Operator Provides	Operator Provides	Operator Provides	Operator Provides	Operator Provides
Access	Operator Provides	Partner Provides	Partner Provides	Operator Provides	Operator Provides
Customer Acquisition	Operator Provides	Partner Provides	Partner Provides	Partner Provides	Partner Provides
Customer Equipment Installation	Operator Provides	Partner Provides	Partner Provides	Partner Provides	Operator Provides
Provisioning	Operator Provides	Partner Provides	Partner Provides	Operator Provides	Both Provide
Billing (OSS/BSS)	Operator Provides	Partner Provides	Partner Provides	Operator Provides	Operator Provides
Maintenance + Operations					
Network Monitoring	Operator Provides	Partner Provides	Partner Provides	Both Provide	Operator Provides
Equipment Replacement	Operator Provides	Partner Provides	Partner Provides	Both Provide	Operator Provides

Operator Provides	(light blue)
Partner Provides	(grey)
Both Provide	(dark blue)

TABLE 2: 3rd Party Enablement Model Examples

[6] *The three parties in this model are the enabling operator, the customer, and the customer-facing ISP.*

Note that **Table 2** represents a subset of how 3rd party engagements can work, not the only way. There are different types of Operators and non-operator 1st parties and different ways to partner, as each partner may have different areas of expertise, different skills, or tools they can share. There might also be other 3rd Parties not mentioned or subsets of those currently shown.

4.1 ESTABLISHED ISP

An Established ISP has experience providing internet connectivity with an existing footprint and customers. The Established ISP should have the operational capacity to take on most of the responsibilities in the partnership but could move into a new market more quickly or in a new way due to the resources that the Operator has to offer.

The example in Table 1 assumes that the Established ISP uses the Operator's backhaul while building and operating its own access and core network. The C Spire Rural Broadband Consortium is deploying networks with existing WISPs in rural Mississippi to test the Established ISP engagement model, an example of which is found in [10].

4.2 NASCENT ISP

A Nascent ISP is an ISP that is "in the process of being born." The Nascent ISP is a person or persons that do not currently provide internet service but would like to. The parties desiring to start an ISP may have some experience in the service of broadband but are not using it. As a result, they are more likely to require partnerships with others for expertise and support due to limited start-up resources and expertise. While the consortium is not fostering a Nascent ISP, an example of where and how that could work is found in [11].

4.3 LOCAL STEWARD

Local Stewards are local individuals or entities that have a desire to see their community's broadband availability improved and are willing to lend physical resources, time, or finances to the deployment of improved broadband accessibility. Local stewards typically have zero to little ISP experience and require the most assistance establishing their broadband service. However, they can also often be the most creative and flexible in working with a partner as they are highly motivated to find a solution and can have fewer preconceived notions on what is possible and what should be done. Examples can include a local business owner, a homeowner association (HOA), cities (without infrastructure assets to contribute), or an individual consumer. See [12] for an example of this type of partner deployment.

4.4 INFRASTRUCTURE PROVIDER

Infrastructure Providers are organizations with some type of infrastructure assets that can aid in the deployment of a network. These entities may not have the broadband service experience ISPs have but offer other costly assets to make rural networks easier to deploy. Examples can include Utility companies or Cooperatives who have power grid and pole assets and possibly fiber, as well as local governments who own poles, buildings, or other infrastructure assets. These Infrastructure Providers are willing to partner with an Operator (or a WISP), using their backhaul or vertical assets to deploy broadband services.

Infrastructure Providers often have existing customers (for a different service) or some method of reaching potential Internet customers and thus have customer acquisition and billing capabilities. Much of the network side, however, would require support from the Operator. The Infrastructure Provider could become the ISP for the end customer and might create a new entity or subsidiary of the original organization that is dedicated to providing broadband. While this newly created entity or subsidiary could also be considered a Nascent ISP, the ability to contribute infrastructure sets it apart technology and business-wise from a true Nascent ISP.

The example in **Table 2** shows where the Infrastructure Provider has fiber assets for backhaul that are shared with the Operator to deploy an access network (either wireless or fiber). With the Infrastructure Provider as the customer-facing entity, it must perform the customer-facing work, including customer acquisition and billing. While it may use Operator resources or training for customer equipment installation, those resources will likely be "branded" as part of the Infrastructure Provider.

4.5 SUMMARY

Table 2 illustrated one example of how an operator could enable different types of 3rd parties to become ISPs, but there are many ways to split or share responsibilities in each area depending on the capabilities and desires of the Operator and 3rd Party. Another option is an Infrastructure Provider becoming the Operator and enabling an ISP through the use of backhaul or other resources. [11, 13]

While a single ISP typically sources required software toolsets and hardware for themselves, sharing capabilities with a larger partner with a full suite of needed toolsets already should make rural connectivity easier. Even if the overall cost of the deployment is higher than for one party alone, sharing the costs between the Operator and the 3rd Party should reduce the costs and thus improve the payback period for both parties.

Examples found in the C Spire Rural Broadband Consortium Case Studies [10,11,12,14] show the variability in how the models can be implemented in the real world, with specific examples of different types of rural environments using different technologies and different variations of the third party engagement models. All of the markets studied are smaller than what was modeled in Section 3.3, but all demonstrate creative and viable ways to enable rural deployments by sharing costs and reducing payback periods.

5 MODEL IMPROVEMENTS THROUGH AUTOMATION AND OPTIMIZATION

Deploying, operating, and maintaining a broadband internet service, whether in urban or rural areas, requires a wide range of skills and capabilities from market design engineers to sales and marketing personnel. Large Internet Service Providers (ISPs) can afford to hire specialists and purchase purpose-specific tools in each area to optimize performance and maximize profits. Smaller ISPs, such as the ones who often serve rural areas, operate on a more limited scale and need to conserve people and purchases. Whether the ISP is large or small, the pressures on the rural business case require technology advancements, optimization, and automation to reduce the cost and complexity of providing Internet service. Each of the areas in the business model should be studied closely for ways to optimize and automate. This section includes high-level ideas or tools that should be addressed.

For ease of use, all the tools could be available as part of a single platform that provides options for each area from many providers (e.g., platform enablers).[7] The platform user would pick options that best suit his/her needs, including as-a-service options as well as do-it-yourself enablers. The platform would work for the Nascent ISP exploring what is needed to start up an Internet service in a particular market and enable an experienced ISP to expand into new market areas it has identified easily and quickly. It would allow smaller entities and municipalities to get into the market more easily and at a much lower cost. Even large MNOs could use the tools within the platform to explore options outside its normal expertise (e.g., using a new frequency band or technology).

Some options make more sense as do-it-yourself if the ISP has the skills and resources to complete the task. For others, scale, and thus cost reduction is better achieved by using a 3rd party service. This paper does not include an analysis of how the enhancements mentioned in this section can improve the business model and under what conditions; it only puts forward possibilities to be explored. Some of these items already exist; some are under development. Some may have already been tried (and failed); some may require more development (or technological advancements) to become technically feasible or economically viable.

5.1 MARKET SELECTION

While market selection is assumed to be initiated by the platform user, an automated business modeling platform or tool integrated with an automated network design tool could be used to guide an ISP to which markets to target next. The many big data sets that could go into this type of analysis could require sophisticated artificial intelligence algorithms to analyze them and present results in a user-friendly manner.

[7] Platform enablers would include backhaul and infrastructure providers, network design engines, white-label billing platforms, local operations and maintenance providers, as well as databases of available infrastructure, spectrum, and fiber resources etc.

5.2 NETWORK DESIGN

Network design is perhaps the most complicated part of the overall process. There are many different steps, technologies, and techniques to consider before beginning the actual design process. The design itself can take many iterations and re-designs before a final version is completed and approved. Some examples where improvements could streamline this process include the following:

Automated Inputs:

- Completely processed GIS databases
- Imported databases of infrastructure assets, including towers and poles, fiber handholds, power meters, etc.

Features:

- Novice level – do everything automatically
- Expert level – allows the user to provide more input

Automated Output

- Access, core, backhaul design options
    - Allow user down-selection
    - Categorize or recommend options based on ease-of-use or cost
- Purchasing options enabled directly from the provided list

5.2.1 TECHNOLOGY ADVANCEMENTS/ENABLERS

An ISP that is looking to reduce its cost of deployment and operation may look to the following technological advancements for improved performance, efficiency, or lower costs.

- **Core-in-a-box/Cloud core:** Core infrastructure can be a significant upfront capital expense. A core-in-a-box can be used in a physically small location by a single ISP or as a cloud-based option with a 3rd party provider, enabling multiple smaller tenants on a single core. The scalability of core-in-a-box solutions helps to decrease deployment costs for small implementations while futureproofing for prospective growth. Costs will be reduced further as core network elements are moved from dedicated hardware in the network topology to cloud-based environments and lower cost, general-purpose, or off-the-shelf servers. Virtualization and automation will further reduce cost, effort, and time to market.

- **Massive MIMO:** Multi-antenna techniques such as massive MIMO can increase capacity for NLOS, lower band scenarios. These advancements come at a significantly higher cost, however, both in hardware and in deployment (due to size and weight). A balancing act between cost and performance is necessary for an ISP's broadband deployment. [14]

- **Fiber breakout:** The expense of fiber is usually justified by high return through heavy use in urban environments. Using fiber to serve relatively few rural customers requires new ways to splice into long-haul fiber that are cost-effective while maintaining the use of those strands for many towns farther along the way.

- **Gigabit wireless mesh:** High capacity wireless bands such as millimeter-wave or the newly opened 6 GHz band [15] enable gigabit wireless connectivity for small, clustered towns, while autoconfigured, self-healing wireless mesh nodes enable rapid, plug-and-play deployment of a micro network with redundancy. This can be achieved on both licensed and/or unlicensed bands and enabled by various technologies.

- **LEO satellite backhaul:** LEO satellite backhaul offers decreased cost by eliminating heavy infrastructure investments. Along with cost savings, LEO backhaul allows ISPs to connect new markets quickly and accelerate revenue generation via a plug and play model. LEO satellite backhaul is a low risk solution that is scalable to meet demand.

5.3 CONSTRUCTION

Methods to simplify construction can include plug and play models with simple installation and turn-up instructions, virtualized self-service, and digital training sessions to aid in self-installation. Plug and play models are sometimes done at an individual vendor level today, but those types of efforts are not consistent across technologies. Some technologies seem to be more complex and labor-intensive than others. Virtualized, as-a-service, software-defined networks, and cloud options can make a network easier to turn up. For rural broadband, simpler is better!

Training videos for the simpler technologies could be made that show a step-by-step process of installing, activating, and provisioning onto the network. Best practices for cabling and grounding should also be included to ensure reliable site builds. If the training sessions are done well, and the provided kit is made simple enough, even unskilled personnel with some technical aptitude should be able to install much of the necessary equipment successfully.

5.4 CUSTOMER INTERACTIONS

Enabling customer self-installation and zero-touch provisioning can eliminate some of the workforce and time required in customer interactions. Unfortunately, that is not always practical, depending on the limitations of technology being used for access. Efforts should be made to simplify the CPE installation, where a technician is required.

For an experienced ISP, billing is a standard way of doing business. Adding customers, services, and new billing plans should all be optimized for time and for low-scale usage, whether using a classical billing system or an as-a-service platform.

5.5 OPERATIONS AND MAINTENANCE

A smaller, more localized ISP might not have the resources, desire, or need to maintain 99.999% reliability but will have to determine how to monitor and maintain the network and with what level of service guarantees.

The main goal of the operations center is to monitor alarms that are being sent from network equipment, filter out unnecessary events, and escalate any that require immediate attention. Proprietary tools provided by access equipment providers enable ISPs to monitor their networks. Another option is for a 3rd party to provide a NOC-as-a-service, either by providing multi-tenant services (i.e., serving multiple ISPs) or as a part of their existing NOC.

NOC automation using machine learning techniques such as anomaly detection or logistic regression is necessary to increase efficiency and reduce long-term costs. The output from this process would be an automated notification with details to an appropriate party based on pre-defined rules for scheduling technicians or reaching out to customers directly. Skill levels of the ISP should be considered in terms of what alerts are passed on and addressed by which party.

Maintenance should become automated and predictive. One way to reduce the cost of continually growing a large staff of technicians would be to create a platform that offers maintenance as a service (per job, not per contract). In this framework, a pool of local talent would be solicited and paid on a per-job basis. An application for soliciting workers for specific jobs and identifying and creating an appropriate labor pool would require some initial cost and effort to develop, but this would also create work opportunities for local technicians, reduce overall mean-time-to-repair, and help foster the idea of a locally owned network.

5.6 SUMMARY

Making rural broadband simpler requires a lot of upfront work. In an age of artificial intelligence, machine learning, and big data sets, automation and optimization should be used to enable new cost-reduction capabilities as much as possible in all areas of network design, build, and deployment as well as customer interaction. If this could be done as a shared backbone or platform for all rural builds, not just for a single market or operator, the per-market cost should become feasible.

6 CONCLUSION

The 3rd Party Enablement model has been proposed to encourage partnerships between Operators and ISPs to deploy broadband more effectively to rural communities. While this paper is written from an MNO perspective, the enablement model should also apply to other types of operators. Four types of 3rd parties are described (Established ISP, Nascent ISP, Local Steward, and Infrastructure Provider) along with examples of how each type of partnership could work. There are many other ways than those mentioned to partner, depending on the capabilities and desired control of the network by each party. Regardless of the type of parties and how the partners work together, the goal is to reduce cost and time to deploy and serve all parties, resulting in broadband deployment in more rural areas.

Automation and optimization are also key ingredients for reducing the costs of broadband service. While these are not necessarily exclusive to use in rural areas, the rural business case is where reducing cost is most impactful. There are likely some companies already working on tools or ideas similar to those espoused in Section 5, although an exhaustive study of this work has not been made. A platform that integrated all of the needed toolsets to design, deploy, and maintain a network in one place could be simpler for a Nascent ISP, especially, to get started. However, even without a platform to organize all tools in a single location for ease of use, automated network tools that work from the ground up have the potential to shape the future of ISP ownership in general by reducing the time and effort required to design and operate reliable, high-speed networks. Furthermore, new network technologies will allow ISPs to deliver high quality broadband service at a low cost to markets that were previously not feasible.

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