

RURAL INFRASTRUCTURE BRIEFINGS

Telecom Network Evolution and its Impact on the Rural Telecom Industry

These Briefings showcase different facets of the rural infrastructure industries: power, energy, and utilities; water utilities; and communications.

Inside this Issue...

Introduction..... 1
Out with the Old, In with the New..... 1
Network Convergence..... 2
Rural Telecom’s Evolution 3
Global Telecom Networks..... 4
CoBank’s Role in Financing the Telecom Value Chain 5

Introduction

Modern telecommunications networks are globally interconnected. Over the past two decades, the rise of the Internet and the development of wireless smartphone technology have upended the conventional regulatory distinctions between the rural and urban telecom networks. Today, telecom users in rural communities access the valuable content and applications they need to remain well-informed and competitive in the knowledge economy via a complex telecom network that spans both rural and urban areas. Rural telecom providers are no longer able to deliver on their mission to provide affordable access to communications services without partnering with other service providers, many of which are located in urban areas. These partners provide the infrastructure and services that ultimately enable rural telecom providers to link rural homes and businesses to the global network.

Local broadband providers located in rural communities often provide the “pipes” and wireless spectrum used to transmit information and data from web-based sources worldwide to the users. But these providers are increasingly dependent on urban-based companies to provide the final links to telecom services that represent modern, advanced communications. As fiber density increases and broadband speeds improve in rural areas, the local broadband providers – urban as well as rural – will become primarily fast and reliable “on-ramps” to the worldwide internet, while the important content and applications will be largely accessed “over-the-top” of that infrastructure.

Out with the Old, In with the New

Prior to enactment of the Telecommunications Act of 1996, rural telecom systems or networks were separate, self-contained, and easily distinguished from their urban counterparts. America’s communications infrastructure was then bifurcated between narrowband voice transmission (telephone) and one-way video entertainment products (cable TV), with mobile wireless voice (still essentially a narrowband product) added in the 1980s and ‘90s.

In those pre-Internet days, each of the two segments of the communications industry had its own physical infrastructure (e.g., twisted pair, coaxial cable, or electromagnetic spectrum), its own regulatory framework, and its own separate

and distinct customer bases. The telecom and cable companies within each of the segments were mostly vertically integrated monopolies; and as such, they controlled a specific, well-defined region, and owned all of the equipment and infrastructure needed to provide its services to the businesses, consumers, and other customers located within its region. Additionally, there was little competition between companies within each of the two segments and no competition at all between the two segments.

The telecommunications industry has undergone a complete transformation during the past two decades. One way of illustrating how much the industry has changed is to highlight the products and services that are now being marketed to consumers and businesses, which bear little resemblance to the voice and cable TV services offered twenty years ago.

- Broadband
- Video
- Voice
- Wireless

Today's telecom users access these services through a wide variety of electronic devices, including computers, smartphones, and other wireless, handheld devices.

Another major structural change within the telecommunications industry is the intense competition among telecom providers for customers. Voice transmission serves as a prime example, even though it has devolved into the least demanded of all the major telecom services. Nonetheless, the competitive landscape for voice transmission is now more crowded than ever with fixed-line local exchange carriers, cable operators, over-the-top players, and mobile service providers all battling for market share. Technology and regulatory shifts are quickly eroding providers' voice margins resulting in increased customer churn. As voice becomes more of a commodity service, many providers are migrating or launching next-generation voice delivery in the cloud to gain a competitive advantage and reduce capital and operating expenses.

“None of the industry today, including the rural segment, looks or functions the same as it did formerly.”

Voice over Internet Protocol (VoIP) gained marked acceptance in the early-2000s and has been widely adopted by businesses of all types since then. VoIP is a group of technologies that enable the delivery of voice, messaging, and video across the Internet Protocol (IP) network – i.e., the internet. Prior to the internet, the primary means of voice transmission was through networks of switches that connected voice transmissions locally for a flat fee or long distance for an additional fee based on minutes used. This legacy network, commonly referred to as the Public Switched Telephone Network (PSTN), is still in use today, but traffic has been declining as subscribers migrate to wireless and VoIP as their primary means of voice communication.

Network Convergence

With the rise of the Internet in the 1990s and the introduction of smartphone technology in 2007, the entire telecom industry has been reinvented. Communications networks have been converging since then towards Internet-based protocol (IP) dependent upon an increasingly optical, fiber-based physical infrastructure. These networks have become increasingly interconnected and dense, with fiber “backbone” routes connecting cities and “middle mile” connections linking Internet access points to neighborhoods. “Last mile” connectivity to individual homes and businesses still depends largely on legacy copper infrastructure, but these copper wires are gradually being replaced by fiber “drops” from neighborhood nodes to individual homes and businesses.

Ownership of the various network elements, meanwhile, has become highly fragmented. Gone forever are the days of the monopoly telephone company that totally controls one specific regional territory and owns its own switching equipment and other network elements. Today,

coaxial cable networks, fiber routes, data centers, cell towers and the physical last mile connections may all be owned by different companies, yet all of these network elements are essential to create the seamlessly operating telecom network that underpins America's vibrant economy – including small towns and rural communities as well as major metropolitan areas. Increasingly, the telecom companies that own these assets are horizontally integrated, with business strategies focused on expanding their scale and competency within a particular segment of the telecom value-chain. Examples of these horizontally integrated network operators include fiber transport companies, wireless tower companies, and data center real estate investment trusts.

Spurred by regulatory reform, advances in computer technology, the proliferation of modern telecom infrastructure, and the fragmentation in the ownership of those assets, the telecom industry's growth momentum has shifted away from the traditional vertically integrated telecom providers and toward a new breed of telecom companies with a more service-oriented business model. These new telecom service providers offer a complete suite of telecom services entirely over the internet, including voice. They generally own few if any physical network assets, preferring to acquire access to these assets through leasing or partnership arrangements with other network operators that own the physical infrastructure.

These companies are developing the next generation of telecom services, which will be increasingly software-defined and focused on delivering content and applications, instead of merely transmitting communications data. Examples of this next generation of service providers include cloud-oriented data centers, unified communications providers, and operational support system providers.

Rural Telecom's Evolution

Because of rural America's much lower population densities, lower service usage, and lower disposable incomes, rural communications providers have historically found it difficult to generate sufficient

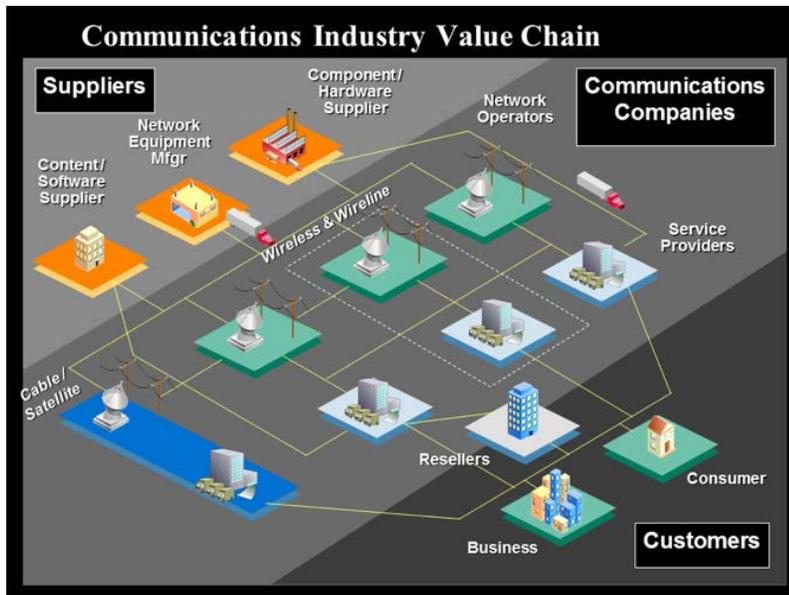
income to support and upgrade the far-flung and costly infrastructure needed to connect rural communities, households, and businesses with each other and the rest of the world.

Today's rural telecom providers continue to face the fundamental challenge that it is uneconomical to provide the costly telecom services to customers located in low-density rural areas. The costs remain too great to be recovered solely from rural subscribers. Since the Telecommunications Act of 1996, the U.S. government has used a system of inter-carrier compensation and Universal Service Fund (USF) payments to provide subsidies to support the high cost of serving low-density rural areas. The smaller rural local exchange carriers (RLECs) – i.e., those with fewer than 10,000 access lines – were the ones most heavily dependent on these subsidies. For decades, the USF along with other government programs and local cooperative efforts succeeded in providing basic telephone service for virtually every U.S. household and business in rural America.

But within the past 15 to 20 years, the nation's telecommunications industry has undergone profound technological, structural, and regulatory change. None of the industry today, including the rural segment, looks or functions the same as it did formerly. Moreover, in response to these sea changes, the FCC has sought to curtail the Universal Service Fund (USF) and other subsidies for legacy voice networks and re-direct the financial support toward broadband investments designed specifically to benefit rural America.

As a result, the rural telecom industry is moving away from the former monopolistic business model employed so successfully by the RLECs – but it was also heavily reliant on regulatory support subsidies and legacy voice telephony. That too is changing. To gain efficiencies and provide the most up-to-date services to rural consumers, today's rural telecom providers have had to become increasingly dependent upon infrastructure and network connections that are often hundreds or thousands of miles away. Establishing and maintaining those connections is costly. And as rural demand for bandwidth increases, rural broadband providers must partner with a number of firms

Figure 1: Communications Industry Value Chain



Source: Business Analytics 3.0.

throughout the value chain to make rural service possible. These partnering firms operate in rural as well as urban areas, but each of them provides a vital link that connects rural communities to the global network.

Telecommunications networks everywhere benefit from global interconnectivity. Advances in IP-based services mean that telecommunications companies in rural areas can now also serve businesses located in major metropolitan areas or even other countries. This evolving interconnectivity, we believe, is creating a transformative business model for telecom providers whereby serving each of the supporting segments of the communications network is increasingly necessary and indispensable to serving rural areas.

For some rural telecom providers, however, this new business model is not a workable solution. Some rural-based telecom companies operating in particularly low-density areas have been unable to adapt and reorient by expanding their network reach. These companies have two choices. They may elect to merge with other similarly-positioned systems, or they may be acquired by larger companies wishing to consolidate these types of assets. In both cases, the aim is the same – to gain scale and cost efficiencies that allow the assets to be operated profitably with less reliance on direct subsidies.

Global Telecom Networks

Rural telecommunications networks today must, by their very nature, be globally connected. Much of the same physical infrastructure that serves rural subscribers also serves urban subscribers, and all U.S. domestic telecom networks are interconnected with global networks. The voice, video, and data content that flows across those networks are stored in hundreds of locations, some that are rural and some urban. In many cases, this content is stored on file servers predominately in urban-based data centers and is replicated and transported to rural subscribers over these globally interconnected networks. When delivered to end-users in rural America, this Internet-based content is reformatted into data packets

which then bounce back-and-forth between routers located alternately in both rural and urban areas before terminating on the end users' televisions, computers, cell phones, or other hand-held electronic devices.

Today's communications industry encompasses three layers of companies linked together to provide seamless transmissions of converged voice, video, and computer data from one end-user's access device to another. (See Figure 1.) These three layers consist of network operators, telecom service providers, and resellers:

- **Network operators** provide the essential infrastructure necessary to physically capture, aggregate, and transmit the electrical signals that represent communications information. This consists of cabling, electronics, wireless spectrum, software, and human resources necessary to maintain the network.
- **Service providers** primarily deliver the software-defined functions that make meaning out of the electrical signals transmitted by the network operators. They provide the essential applications or network control layers with which the user and higher network functions interact. A service provider, for instance, might provide a business with an integrated platform of voice, email, and video

conferencing. These communications services ride over the top of the network operator's infrastructure.

- **Resellers** are essentially marketing companies that resell the services provided by others. An example is a Mobile Virtual Network Operator like Virgin Mobile or Cricket Wireless. They own the customer relationship, but fulfill the delivery of the wireless service through resale agreements with the major national wireless carriers.

In the not-too-distant past, rural telecommunications networks were totally separate and distinguishable from urban networks. Today, rural networks are inextricably linked and dependent upon urban segments of the value chain to connect rural communities with the global network. Increasingly, rural telecommunications companies are operating their own data centers and providing broadband services not just to their rural customers, but also to some urban customers. This strategy has emerged as a way to offset regulatory reforms that continue to diminish subsidies for rural networks. Many more rural telecom providers expect that they will soon have to develop strategies to tap into urban-based revenue streams in order to continue

servicing their rural customer base. In effect, many rural telecom providers will struggle to survive without vital connections to urban segments of the network and the patronage of some urban consumers.

CoBank's Role in Financing the Telecom Value Chain

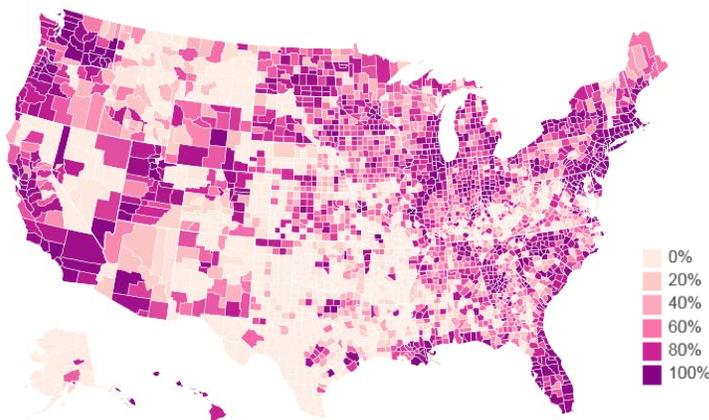
Despite the continual transformation of rural telecom providers and the necessary intermingling of rural and urban networks, large swaths of rural America still lack access to broadband service. (See Figure 2.) This is largely due to the prohibitive cost of the infrastructure needed to serve these areas. These low population density regions often cannot generate enough revenue to justify such investments. To close this rural-urban divide in broadband access, rural networks must integrate more closely with urban networks, and achieve greater efficiencies. In turn, for CoBank to support these rural communities and achieve its mission, it is vitally important that it continues to finance telecom service providers across the full value chain. Without such an ability, CoBank would fail to serve the changing needs of its rural customers and further limit financing and capex

options for rural telecom providers. As the Rural Broadband Association recently stated to Congress, "With rare exception, RUS, CoBank and RTFC are the primary lenders that small rural providers can turn to for outside financing."¹

With the traditional vertically integrated telecom delivery model being deconstructed, CoBank must continue to finance the new horizontally integrated network and the interdependent firms that have emerged. Jointly, these firms make the delivery of all telecom services (i.e., broadband, video, voice, and wireless) possible, and without their connectivity, the rural-urban divide would widen and rural communities would fall further behind.

Figure 2: Internet access in America

In many counties, only a fraction of the population has access to high-speed broadband.



High-speed is defined as 25 Mbps/3 Mbps
The Conversation, CC-BY-ND
Source: Federal Communications Commission (2015) Get the Data

¹From NTCA-The Rural Broadband Association testimony to the U.S. House of Representatives Committee on Agriculture, March 9, 2017.

All of these players, new and old, are an integral part of the modern telecom industry and the end-to-end value chain that links both rural and urban customers to each other and to the important content and applications they need to manage their businesses, educate their children, and enrich their personal lives. By financing companies at every point in the telecom value chain, CoBank can continue to serve its mission to promote the well-being of Rural America, while maintaining essential diversification, industry knowledge, and provide a return to its customer-owners. ■

Disclaimer: *The information provided in this report is not intended to be investment, tax, or legal advice and should not be relied upon by recipients for such purposes. The information contained in this report has been compiled from what CoBank regards as reliable sources. However, CoBank does not make any representation or warranty regarding the content, and disclaims any responsibility for the information, materials, third-party opinions, and data included in this report. In no event will CoBank be liable for any decision made or actions taken by any person or persons relying on the information contained in this report.*