# ECONOMICS OF BROADBAND NETWORKS

AN OVERVIEW

## Overview

The Bipartisan Infrastructure Law is historic in its size – the largest ever investment in broadband, rail and transit, clean energy, and water, including $65B to help close the digital divide through broadband deployment, improved affordability, and digital equity.

Deploying affordable broadband to unserved and underserved locations is often challenging for providers due to the economics. To optimally deploy incoming broadband funding, it is critical to understand the unique challenges of deploying broadband in these areas, the economics of broadband networks, and what considerations are important when designing networks to ensure broadband access for all.

## The Difficult Economics of Unserved & Underserved Locations

Under the IIJA's Broadband, Access, Equity & Deployment program (BEAD), funding must prioritize unserved and underserved locations. The IIJA defines **unserved locations** as locations without access to Internet service with at least 25 megabits per second (Mbps) download speed and 3 Mbps upload speed.[1] **Underserved locations** are locations that have access to broadband above 25 Mbps/3 Mbps but do not have access to Internet service with at least 100 Mbps download speed and 20 Mbps upload speed.[1]

Based on current data, unserved and underserved locations may one or more of the following characteristics:

### LOW POPULATION DENSITY

- Fewer people per geographic area is an economic challenge for broadband deployment, as per capita costs rise.[2]
- In these areas, service providers must cover or "pass" a longer distance per end user, measured in passings per mile (PPM). This, in turn, increases their cost per homes passed (CPHP), a common industry metric that informs return on investment (ROI).

### RURAL & REMOTE LOCATIONS

- Can be more difficult for providers to deploy service to, increasing capital expenditure costs (e.g., construction equipment, labor) and the likelihood of needing to build a longer middle mile to reach the Internet core.
- For similar reasons, it is also more expensive to operate and maintain networks in these locations, particularly as these locations are likely to also have low population density.[2]

### DIFFICULT GEOGRAPHY

- Rocky soil and mountainous terrain, for example, increase costs by making buried or aerial deployments harder and slower.
- Mountainous areas can also negatively impact the reliability of wireless technologies due to reduced line-of-sight.
- These geographical factors also likely reduce providers' ability to meet consumer demand and expectations, reducing revenues.

1. Infrastructure Investment and Jobs Act (IIJA), Division F, Pub. L. 117-58 (Nov. 15, 2021), Title I. Unserved and Underserved definitions also include "lacks access to…a latency sufficient to support real-time, interactive applications."
2. USDA, "Broadband Internet's Value for rural America" (2009).

Due to these characteristics and the resulting challenging economics of deployment, unserved and underserved locations remain in the US. Unserved areas can lack a strong or sufficient business case for broadband deployment entirely, while underserved areas may earn insufficient returns to incentivize further investment in existing infrastructure to increase the speed, capacity, and/or reliability of the network.

## Basics of Broadband Network Economics

### COSTS

In broadband, the industry typically segments network costs into two key categories:

#### Capital expenditure (CapEx)

CapEx is the dollar cost to build the network asset (typically a large, upfront cost) which is depreciated over the useful life of the asset for accounting purposes. CapEx can include material, land, labor for construction and connection, engineering, permitting, upgrades and replacements, and construction equipment.

#### Operational Expenditure (OpEx)

OpEx is the day-to-day (ongoing) cost to run and maintain a network to provide services. OpEx can include power, network maintenance, middle mile and/or core Internet transit fees (if any), sales and marketing, customer support, rent, and other business operation expenses.

### REVENUES

Customers of last mile networks are typically individuals and organizations who pay 'recurring' subscription fees to receive Internet services, usually on a monthly or yearly contract basis. This is typically called the “retail” business. In addition to these recurring fees, customers may also pay an initial upfront (non-recurring) connection fee. Backbone and middle mile networks customers (typically other broadband providers) pay monthly wholesale or transit fees for the lease of an amount of network capacity. They may also pay some non-recurring fees as well. This is often called the “wholesale” business.

In addition to these revenue streams, adjacent business activities which utilize the network infrastructure or services can generate additional revenues for the owner/provider (e.g., voice, video/content services, home monitoring services or home security services, smart grid for utility companies).

Several factors influence Internet service providers’ revenue:

#### AVERAGE REVENUE PER USER (ARPU)

Average revenue per household activated. Providers can increase ARPU in many ways, such as by raising prices, creating new tiers of plans with higher speeds, or by adding value added services (e.g., voice or security services).

#### CHURN RATE

Percentage of subscribers who unsubscribe over time, often measured monthly. New market entrants, technologies, or competitive practices can lead to customer switching, increasing a provider’s churn rate.

#### TAKE RATE

Percentage of customers with access to the network who choose to subscribe. Take rate can be hard to predict and is a driver of uncertainty for providers due to various barriers to consumer adoption and competitive offerings.

# Implications for Providers

## SUSTAINABLE NETWORK

An economically sustainable network is the goal. Every network should be an economically sustainable network defined by its post-deployment success, whereby it remains financially viable once the network is operational and the provider is offering services.

### FINANCIAL CONSIDERATIONS

Financially, long-term viability depends on annual revenues being greater than OpEx (including the depreciation and servicing cost of CapEx). In particular, OpEx needs to be controlled over a project's useful lifetime. For many rural areas, the cost of middle mile access and maintenance can be key factors in network viability.

### KEY REVENUE METRICS

Project success also relies on key metrics, such as the take rate and corresponding ARPU. A network may become unsustainable if aggregate demand is low and/or if the customers and revenue in an area are split across multiple providers.

### DEPLOYMENT COSTS

The time it takes to deploy infrastructure is also an important metric, as longer build times increase costs and delay revenue generation. Furthermore, investments in increasing network resiliency may increase CapEx costs.

## LEVERAGING EXISTING INFRASTRUCTURE

Providers can leverage existing infrastructure (e.g., poles, towers, ducts, building space) to help reduce CapEx costs when deploying broadband infrastructure.

### BROWNFIELDS

"Brownfields" are networks built by extending or upgrading an existing network, thus leveraging existing infrastructure to reduce deployment costs.

### GREENFIELDS

"Greenfields" are networks built entirely from scratch and thus deployment costs are typically higher.

### REDUCING CAPEX COSTS

The majority of CapEx tends to be in civil works (e.g., digging, plowing, construction, permitting), and the rest in network materials (e.g., fiber) and electronics. To manage costs, providers can work with state and local entities, as well as private entities, to leverage existing infrastructure or planned construction work in relevant areas (e.g., transportation) to lower mobilization and permitting costs. For example, laying fiber along roads where construction is already taking place can reduce CapEx costs.

### BEAD FUNDING

In the context of IIJA, the Broadband Equity, Access and Deployment (BEAD) program in effect provides a significant CapEx subsidy. Therefore, the key cost considerations for providers are their remaining CapEx costs (match amount) and ongoing OpEx once the network is operational.

**Network expansion,** such as speed increases, can typically be completed with minimal impact on OpEx, so long as the underlying infrastructure has the capacity.

# Considerations When Deploying in Unserved & Underserved Areas

For a network to be successful, several aspects must be factored into planning by a provider and should be carefully considered when reviewing any application.

A **starting list** of considerations is provided below

## DEMONSTRATED UNDERSTANDING OF THE AREA FOR DEPLOYMENT

- Why the area is unserved/underserved
- The population density in the area
- Complexity of the build (e.g., difficult terrain)
- Existing competition in the area, and associated pricing and take-rates
- Accessibility to an affordable middle mile
- Understanding of area's existing infrastructure

## ESTIMATED COSTS

- Capital expenditure
- Operating expenditure (*all relevant OpEx for proposed business model*)
- Middle mile access and associated cost (if last-mile project). If no middle mile is accessible, include cost to build the necessary middle mile.
- Supply chain or labor constraints that would increase costs or delay project development

## ESTIMATED REVENUES

- Are planned revenues sufficient to ensure economic viability? (*Pricing schedules can show how applicants anticipate prices to change with various take rates and/or demand)*
- Is the end-price sufficient for estimated costs (incl. inflation) and reasonable in local market?

## KEY ASSUMPTIONS & HOW THEY WERE CALCULATED

- Take rate over time
- Average Revenue per User (ARPU)
- Cost Per Home Passed (based on building density and technology type)

## COST MINIMIZATION STRATEGIES & EXPECTED IMPACT

- Coordination with state/local entities or third parties to speed up permitting and utilize existing infrastructure (e.g., ducts, towers)
- OpEx economies of scale from adjacent businesses (e.g., labor and vehicles from electric business)

*Consider how applicants are funding their match requirement and thus the cost of capital.*

## REVENUE OPTIMIZATION STRATEGIES & EXPECTED IMPACT

- Development and consideration of alternative revenue streams (e.g., back-haul for mobile, transit fees/wholesale offering, government contracts/uses)
- Utilization of the infrastructure for other business purposes (e.g., utilizing fiber for smart grid for utility companies)

*Consider what other information may be needed to evaluate applications.*

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ntia.gov
broadbandusa.ntia.gov

BroadbandForAll@ntia.gov