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COMMERCE AUTHORITY

Introduction to Broadband Infrastructure

August 2023

FOR DISCUSSION PURPOSE ONLY

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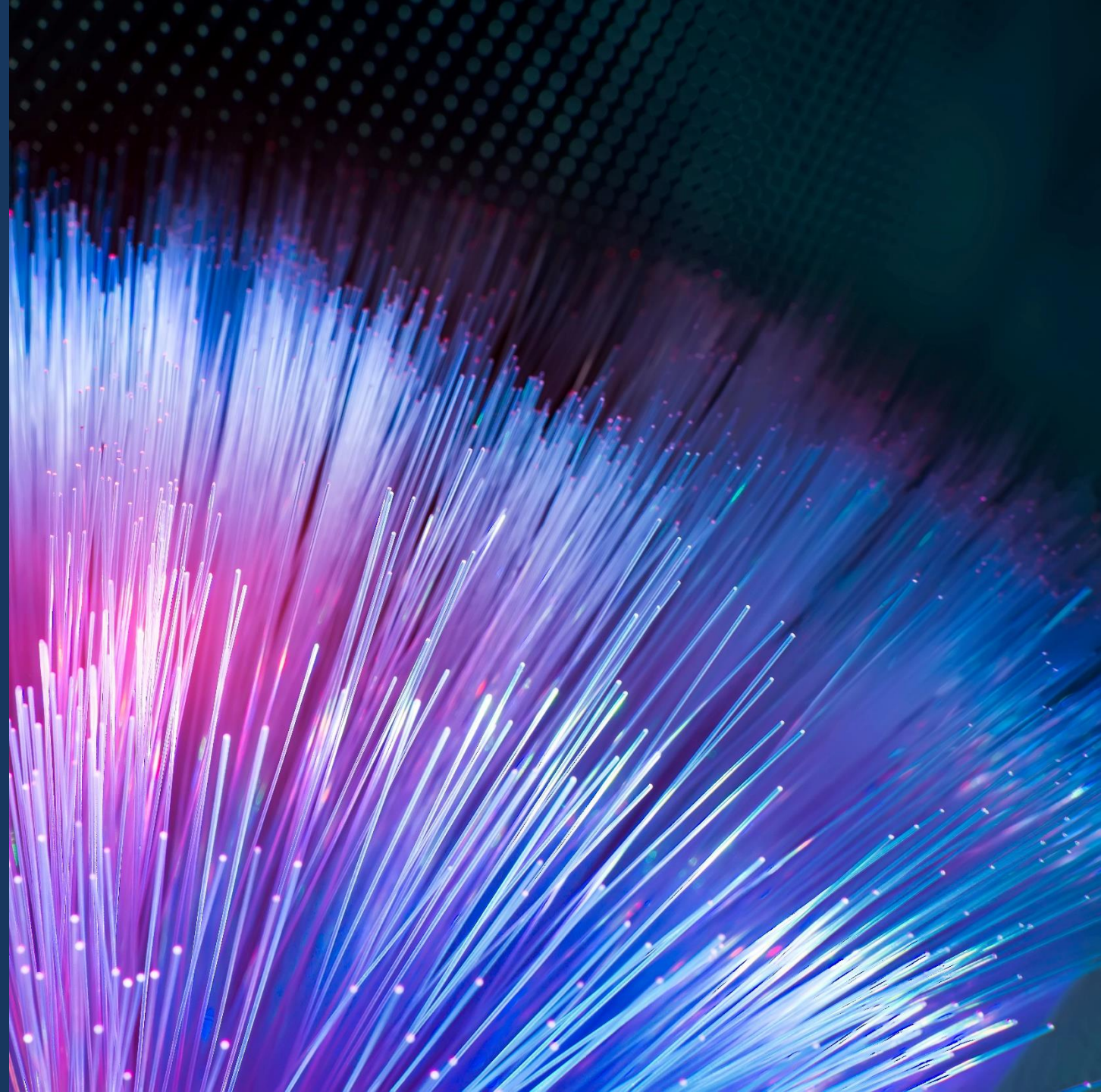
Broadband Overview



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Broadband Overview

What is Broadband?	• "Broadband" refers to always on, high-speed Internet that is faster than traditional dial-up • It may use a variety of technologies: fiber-optic, Cable Modem/Hybrid fiber-coaxial, digital subscriber line (DSL), or terrestrial fixed wireless • ACA defines broadband Internet as having download speeds of 100 megabits per second (Mbps) and upload speeds of 100 Mbps or higher
Why do we need it to be fast?	• Internet speeds are measured by how much data a connection can transfer per second • Data goes in two directions, so every Internet connection will have download and upload speeds • Downloading or uploading large files with low network speed may take significant time • Quality of connection may impact speed of delivery for telemedicine or remote learning
Why do we need Internet?	• Too many Arizonians have been left out or left behind because they do not have access to affordable, reliable high-speed Internet • Access to Internet plays a critical and growing role in the ways in which Arizonians work, play, learn, receive healthcare, participate in democracy, and more

Source: ACA and NTIA Internet for All presentation

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Broadband Network Elements (1/2)

- Backbone / Trunkline / Long Haul Network: Refers to long-distance principal data routes between large, strategically interconnected networks and core routers – i.e., ADOT Interstate Broadband Network
- Middle-Mile Network: Refers to the segment of a network, typically fiber optic, linking a network operator's core network to the local network plant – i.e., linking the backbone / long-haul network to the last-mile service providers
- Last-Mile Network: Refers to the final leg of a broadband connection between a service provider (ISP, Electric Co-operatives, Telcos, etc.) and the customer

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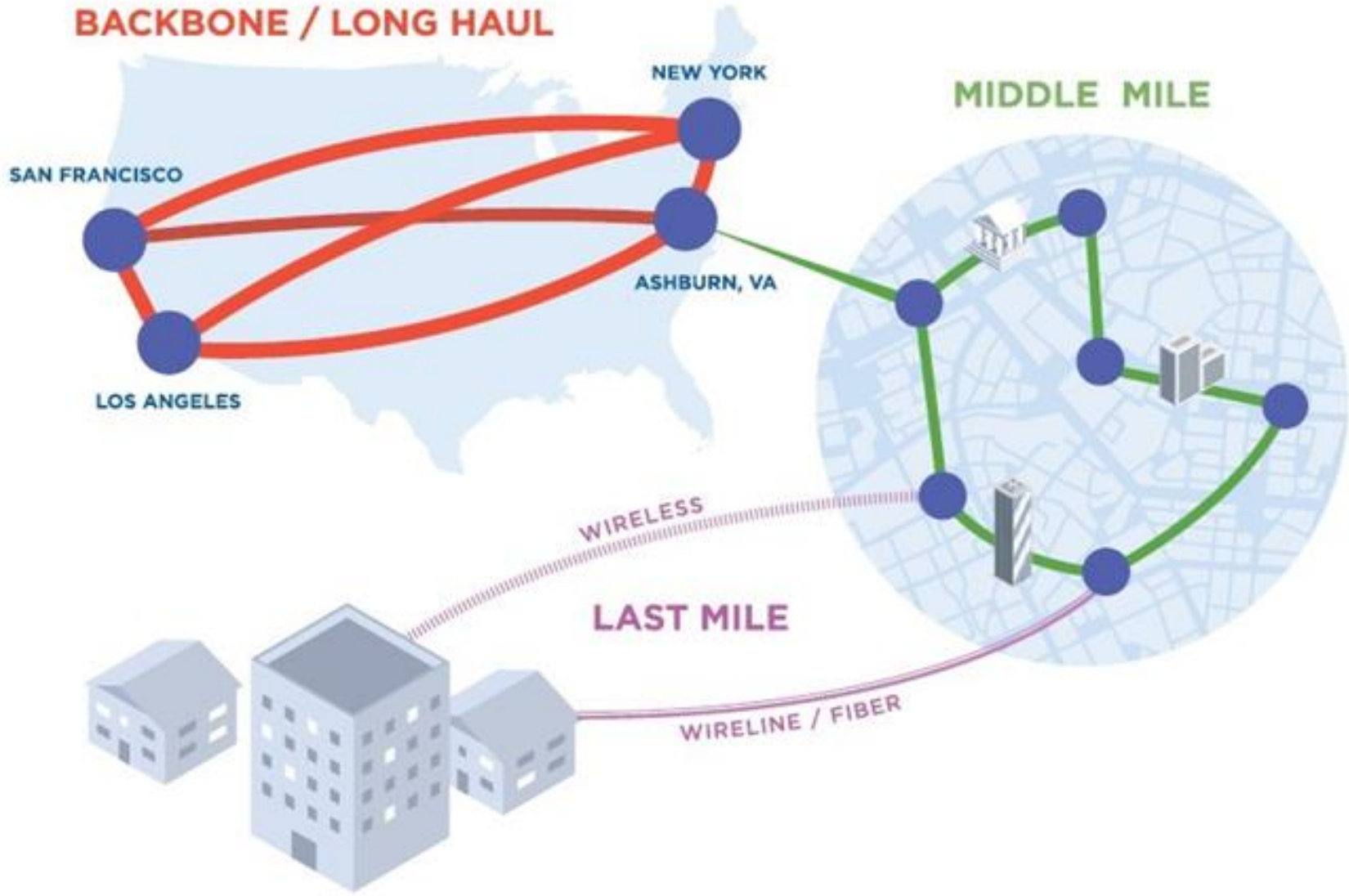
Broadband Network Elements (2/2)



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Broadband Speed Thresholds

Broadband Speeds Thresholds

25/3 Mbps
The FCC's definition is 25 Mbps down and 3 Mbps up (25/3 Mbps)

100/20 Mbps
Congress set a new 100/20 Mbps standard in the American Rescue Plan Act and Infrastructure Investment & Jobs Act

100/100 Mbps
Arizona's threshold for adequate broadband is 100/100 Mbps

Types of Broadband Infrastructure

01 **Fiber-to-the-premises**

02 **Hybrid fiber-coaxial (cable)**

03 **Digital Subscriber Line (DSL)**
frequently not at broadband speeds

04 **Fixed wireless**
sometimes not at broadband speeds

05 **Mobile wireless**
(4G and 5G)

06 **Satellite**

Source: ACA Research

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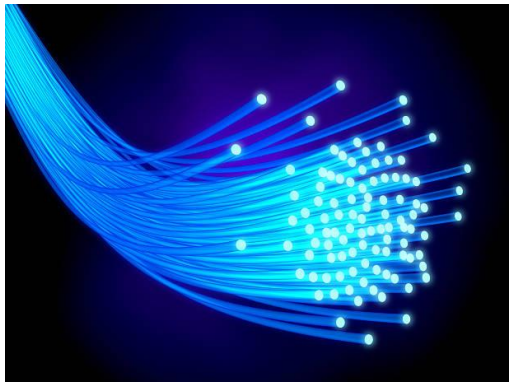
Broadband Basics and Definitions

BROADBAND DELIVERY TECHNOLOGIES:



FIBER OPTIC

Data transmission using light pulses traveling along a long **fiber strand/s** which is usually made of plastic or glass. ... A single mode **fiber** is used for long-distance transmission while multimode **fiber** is used for shorter distances.

PROs:

- *Reliable, scalable and secure*
- *Data transfers over light pulses, long distance communications*
- *FAST! Gig speeds*
- *Low maintenance costs*
- *Future technology friendly*

CONs:

- *Higher cost for initial installation*
- *Damage more expensive to repair*
- *Geographically prohibitive*

Source: ACA Research

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Broadband Basics and Definitions

BROADBAND DELIVERY TECHNOLOGIES:

WIRED (Coaxial)

Type of transmission line, used to carry high-frequency electrical signals with low losses. Used in applications such as telephone trunk lines, broadband internet networking cables, high-speed computer data busses, cable television signals, and connecting radio transmitters and receivers to their antennas.

PROs:

- *High broadband speeds in Mb*
- *Lower cost of installation and maintenance.*

CONs:

- *Limited to Mb speeds*
- *Higher maintenance cost than fiber*
- *Subject to corrosion and degradation and Electromagnetic interference.*
- *Being replaced by fiber optics in many areas*

Source: ACA Research

Broadband Basics and Definitions

BROADBAND DELIVERY TECHNOLOGIES:

WIRELESS

Technology that allows communication without using cables or wires. Wireless technology includes RF and IR waves. RF and IR stand for radio frequency and infrared respectively.

PROs:

- *Low cost **installation** and quick setup times*
- *Requires little infrastructure. Easily deployed in large or small areas*

CONs:

- *Limited speeds*
- *Ongoing **maintenance** and **replacement** costs*
- *Requires complete infrastructure change to increase future speeds*
- *Interference from multiple sources*

Source: ACA Research

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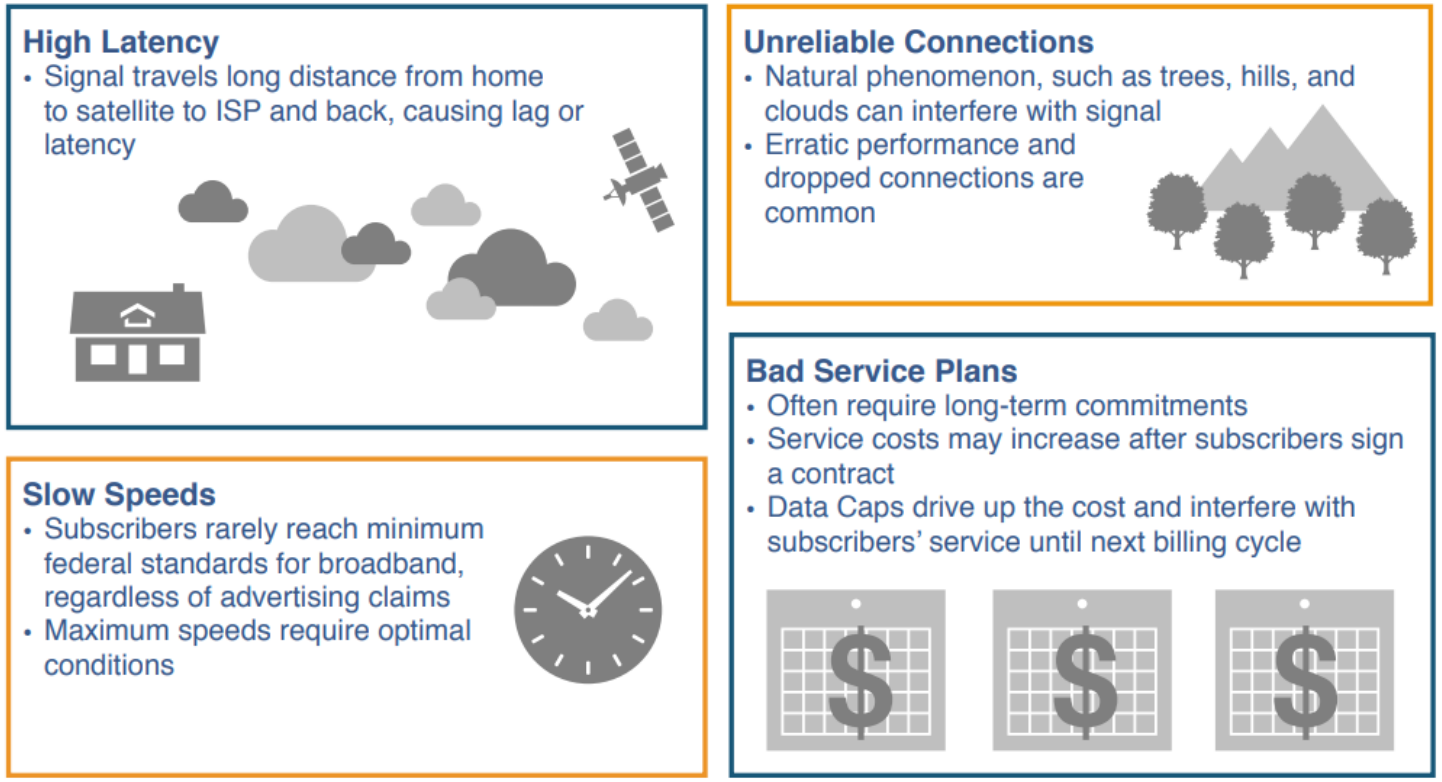
Broadband Basics and Definitions

BROADBAND DELIVERY TECHNOLOGIES:

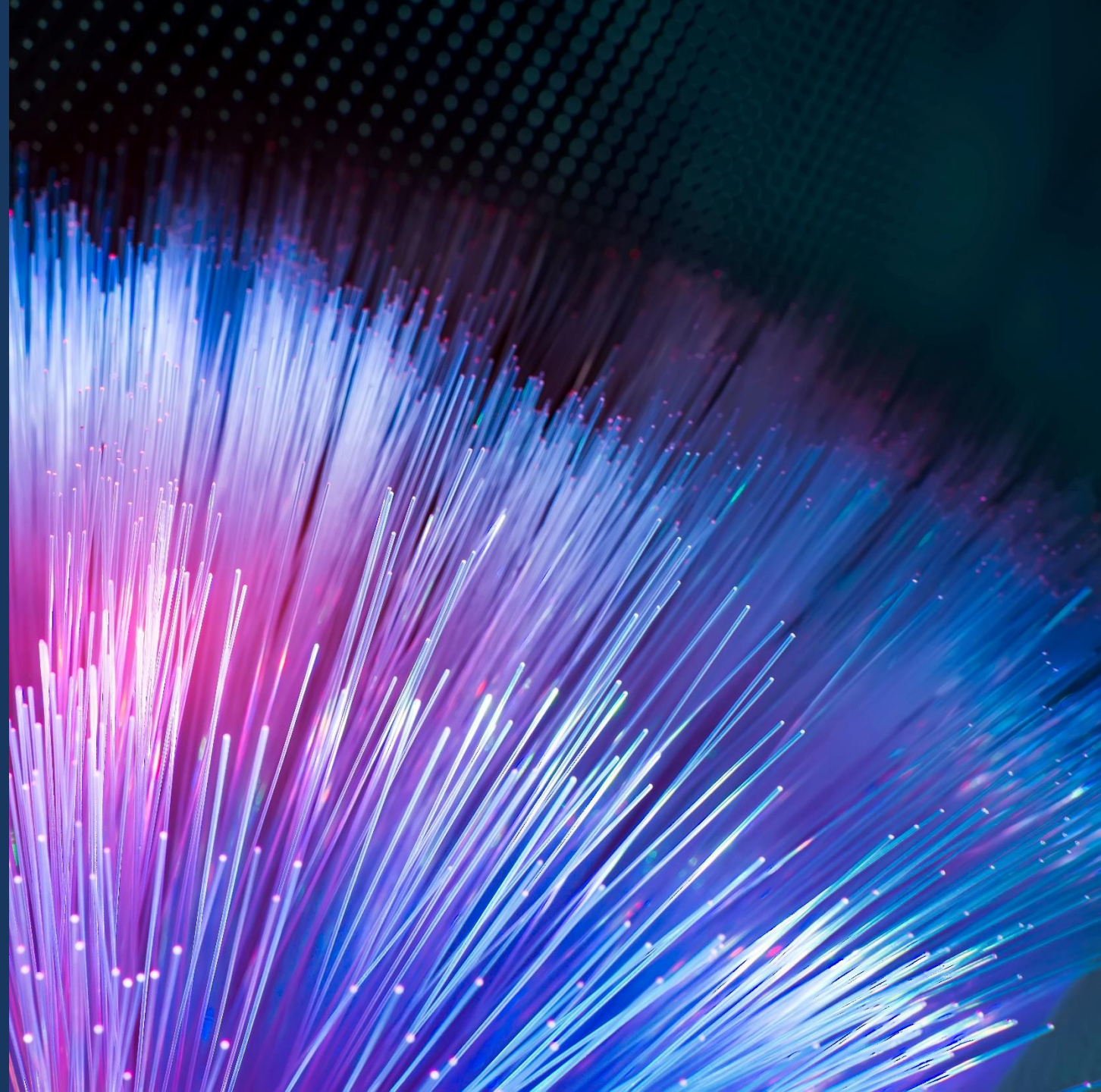
High-quality connectivity needs to be fast, affordable, and reliable. Satellite is none of the three.



- **High Orbit Satellites:**
  - Stationary satellites
  - Limited capacity
  - High latency
  - Expensive
  - Weather affects performance
- **Low Earth Orbit Satellites:**
  - Still experimental
  - Latency should be reduced
  - Greater capacity and bandwidth

Source: ACA Research

Broadband Economics



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Broadband Economics Overview

- 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

Source: NTIA

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Addressing 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
- 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

Source: NTIA

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Broadband Infrastructure Costs

For the broadband infrastructure, the network costs are segmented into two key categories:

Capital Expenditures (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 Expenditures (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.

Source: NTIA

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Broadband Infrastructure Revenues

Customers of last-mile networks are typically individuals and organizations who pay 'recurring' subscription. 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.

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.

Source: NTIA

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Broadband Infrastructure Sustainability

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.

Source: NTIA

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Enhancing Broadband Access in Arizona

Broadband Access	• Increases access for unserved and underserved households to ensure that all Arizonians have access to high-speed Internet • Ensures Arizonians have access to high-quality, high-speed Internet services to support full participation in the 21st century economy and beyond
Broadband Affordability	• Supports affordability of broadband services, esp. in low-income households • Fosters a system that promotes long-term, sustainable, affordable solutions
Broadband Adoption and Equity	• Enables investment in digital skills training to increase the number of households adopting high-speed Internet and narrow adoption disparities • Makes investments to ensure Arizonians can participate in economy & society, reducing inequities across sectors, including healthcare, workforce & education

Source: ACA and NTIA Internet for All presentation

Contact Information

Arizona Broadband Office

- Local Government Survey – promote and participate
- Feedback / Questions / Additional program information:

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