

# Closing the American Digital Divide This Decade

Getting the job done in time



ERICSSON

# Making digital equality a reality this decade

The pandemic accentuated digital divide priorities

## Making digital equality a reality

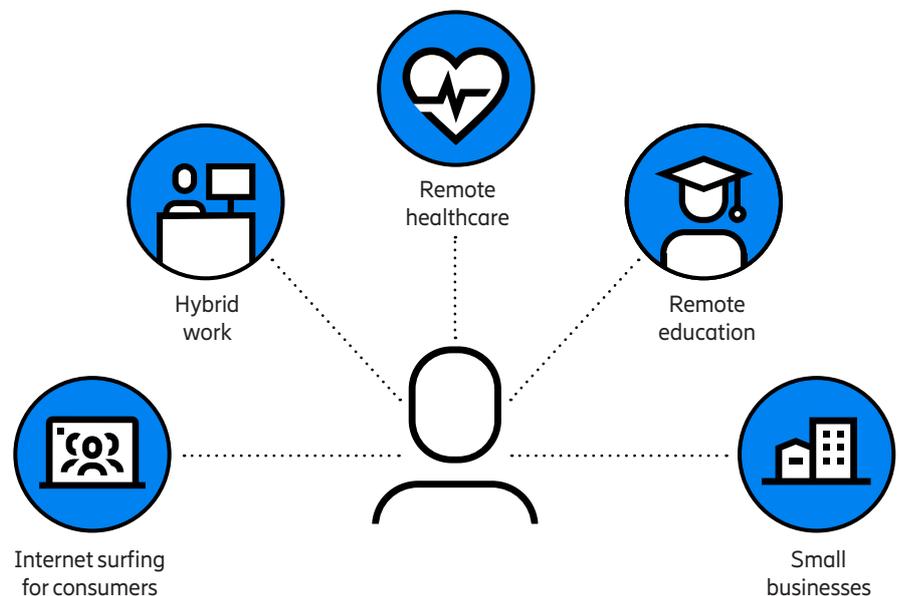
The digital divide has never been so apparent as during the COVID-19 pandemic. Workers transitioned to work from home (WFH), students were forced to learn from home (LFH), and patients and caregivers turned to telemedicine. Digital access to information and services often determined success or failure. Large, unsatisfied demands in underserved rural and urban areas were exposed, particularly among minorities.

If access to broadband technology was once nice-to-have, it's now clear that broadband technology is essential if all members of our society are to have equal access to opportunity.

Government, business and community stakeholders agree that we must act to close the broadband gaps soon. This paper explores the challenges of bringing broadband to various areas, the technologies available, and suggests the best routes for achieving the goal of broadband for everyone by 2030.

## A holistic approach to the problem

To close the broadband gaps in this decade, not the next, we must take a holistic approach that includes 5G fixed wireless along with fiber and satellite. Smart and selective use of 5G can help deliver needed connectivity more quickly than fiber and more reliably than satellite.



## How fast do we need to move?

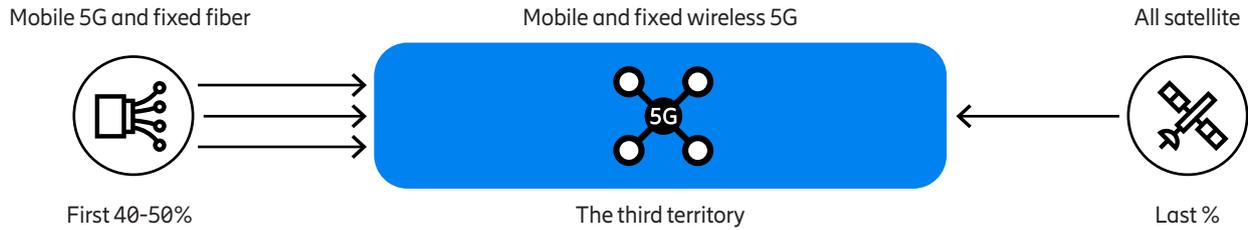
The pandemic accentuated the need to more quickly enable remote work in employees' homes; support remote education in students' homes; and connect small and medium businesses that are outside the fiber footprint.

The North American digital divide is multi-faceted and varies by geography, race and income. And it encompasses mobile as well as fixed broadband.

## Choosing the right technology to close the divide

There's clear consensus between society, business and policy makers about closing the digital divide. But what's the best approach to get it done? Broadband in the U.S. is a mixture of legacy and more recent technologies, ranging from DSL over phone wires and cable over wired TV networks to 4G mobile broadband and fixed wireless access in rural areas. In addition, dedicated fiber connections bring broadband to businesses via Gigabit Ethernet and shared fibers (Passive Optical Networks) deliver service to consumers.

## Three new technologies for three different purposes



### Three technology choices

In rural areas, higher capex investments are required to reach fewer customers. That's been a barrier to closing the digital divide. Fortunately, we have some good options for expanding coverage to underserved areas: Fiber, 5G and Low Earth Orbit Satellites. Fiber is a thriving technology in urban and suburban areas as well as in rural towns, when complemented by 4G or 5G for mobile services. The new space race and the associated Low Earth Orbit Satellites are attracting investment capital for communication service and space trips. Currently, four providers—SpaceX-StarLink, Amazon-Kuiper, OneWeb and TeleSat—offer system-specific solutions for service delivery in the U.S. 5G has the advantage of offering a single broadband infrastructure for both fixed and mobile broadband services. 5G is also a quantum leap forward in comparison to previous generations of wireless such as 4G and Wi-Fi.

All three technologies offer attractive paths to closing the digital divide. Each has its own advantages and disadvantages in terms of performance, deployment times and coverage in remote areas. Let's consider each one in-depth.

#### Fiber: Great performance, slow to the finish line

There's no doubt that fiber delivers both speed and bandwidth. But building out fiber networks is a slow and expensive process. Fiber deployments in the U.S. have so far yielded modest results. Only 16.4 percent of all fixed broadband lines in the U.S. are

fiber-based today. For comparison, consider that South Korea achieved 83.9 percent by 2020. Business fares better: In 2020, almost 70 percent of larger U.S. business buildings were served by fiber, though only 14.1 percent of small U.S. business buildings were. At the current growth of 1.5 to 2 percent, U.S. households and small business buildings are multiple decades away from closing the digital divide with fiber. Exclude South Korea and 1.5 to 2 percent of U.S. households and small business buildings are multiple decades away from closing the digital divide with fiber.

#### The outlook for fiber

Fiber benefits from significant investment, both private and subsidized, in densely populated areas. This is because the business logic of fiber leads to a single fiber provider dominating each residential neighborhood to compete with cable, DSL or fixed wireless. Business districts attract multiple providers, who grow micro-monopolies in single buildings. Fiber is already penetrating a larger portion of large commercial buildings and continued growth at 5 percent per year would close this divide this decade. But to reach just half of U.S. residential households and small business building by the end of the decade, we'd have to double the build rates from pre-pandemic times over the coming eight years. That's quite a tall order especially considering that we've begun with the easier fiber deployments. The challenge of connecting the harder—and the hardest—to reach households still lies ahead of us.

#### Satellite services: Universal coverage, but limited capacity

Low Earth Orbit (LEO) Satellite systems are attracting a large increase in investments for different regions such as the U.S., China and Europe. Four providers serving the U.S. have obtained FCC licenses for broadband services: SpaceX-StarLink, with 12,000 satellites; Amazon-Kuiper, with 3,236 satellites; One Web, with 2,000; and TeleSat with 117.

As the numbers show, SpaceX-StarLink is far ahead of other entrants in the LEO market. Each of its satellites supports 14Gbps throughput, or 28 thousand users at 5Mbps average throughput. Having populated 68 out of its 72 orbital planes, SpaceX-StarLink's initial build-out is close to complete. What does this portend for using satellites to close the digital divide?

#### The outlook for satellite broadband

Whereas fiber dominates in the urban/suburban environment, and 5G excels in a broad span of small business and rural consumer needs, satellite services are best suited to provide mobile and fixed broadband in remote areas where fixed and mobile broadband infrastructure is too costly even to subsidize. That's a real advantage: a 2017 study on closing the digital divide concluded that bridging the last two percent of the coverage gap is as costly as going from 86 to 98 percent. One disadvantage to satellite broadband, though, is the competition between multiple satellite providers using incompatible technologies. The lack of terminal interoperability across service providers limits the potential to reach economies of scale.

## American fiber realities for consumers and businesses

Even more significantly is the cost of satellite broadband. About four-in-ten adults with lower incomes do not have home broadband services. Satellite services, typically costing USD 99 a month, plus a USD 499 installation fee, could be beyond the financial means of many low-income families in both urban and rural regions.

### 5G: Best of both worlds?

5G deployments in the U.S. have progressed rapidly. Nationwide, 5G now covers more than 90 percent of mobile services in the low-band spectrum. 5G mid-band coverage reaches 165 million people on existing mid-band spectrum. In addition, 280MHz of new spectrum is now allocated through the C-band auction.

The long reach version of 5G mmWave has also been proven for fixed wireless access, delivering 1Gbps of sustained downlink speed over 7km. The combination of mid-band and long-reach mmWave makes 5G a strong candidate for closing the digital divide.

### The outlook for 5G

Fiber is optimal in denser urban and suburban areas where the investment in funds and time for build-out time makes the most sense. On the other hand, fiber fails to address rural needs and the mobile divide. 5G, however, is the only technology that can be used to close both the mobile and fixed digital divides with the same infrastructure. Here's how:

**The mobile divide:** For mobile and personal connectivity, 5G will continue to enable a penetration advantage of 5 to 10 percent over fixed and shared broadband.

**Competitive divide:** 5G will also allow multiple service providers to compete in a geographical area for mobile services, and for fixed wireless access to compete with DSL, cable fiber alternatives and 4G/5G in shared Citizens Broadband Radio Service (CBRS) spectrum.

**Residential and small business gap:** Fixed 5G wireless access will make closing the gap for residential access as well as for small business buildings possible within ten years.

**Rural coverage divide:** It's estimated that it will take only 10,000 new macro towers erected in rural areas to bring mobile 5G penetration to 99 percent of the U.S. population. In a significant commitment to making this a reality, the FCC's 2020 5G Fund for Rural America includes USD 1 billion to enable precision agriculture by connecting 95 percent of U.S. farmland by 2025.

To reconnect rural areas, residences and small-to-medium businesses on similar scale to what cities enjoy, we'll need a rapid build-out within the next decade. 5G is the technology with the most potential for accomplishing that.

### What's currently being done

Closing the digital divide is a priority of the current U.S. administration. The bipartisan infrastructure framework includes such major initiatives as USD 65 billion for broadband infrastructure, USD 20 billion for the Regional Development Opportunity Fund (RDOF) and USD 9 billion for the 5G Fund (with USD 8 billion for mobile services and USD 1 billion dedicated to precision agriculture). These initiatives are on top of existing ones such as the Emergency Broadband Benefit (EBB), the Emergency Connectivity Fund (ECF), NTIA Connectivity Grants, CARES Act and Coronavirus Response and Relief Supplemental Appropriations (CRRSA) Act programs for infrastructure for telehealth and general broadband.

Total U.S. households	128 million
Total small businesses	32.5 million
Residential fiber penetration	16.4%
Fiber lit small business buildings	14.2%
Fiber lit large business buildings	69.2%
Growth in fiber penetration	~1.5% YOY
Growth in small fiber lit buildings	~2% YOY
Growth in large fiber lit buildings	4.8% YOY

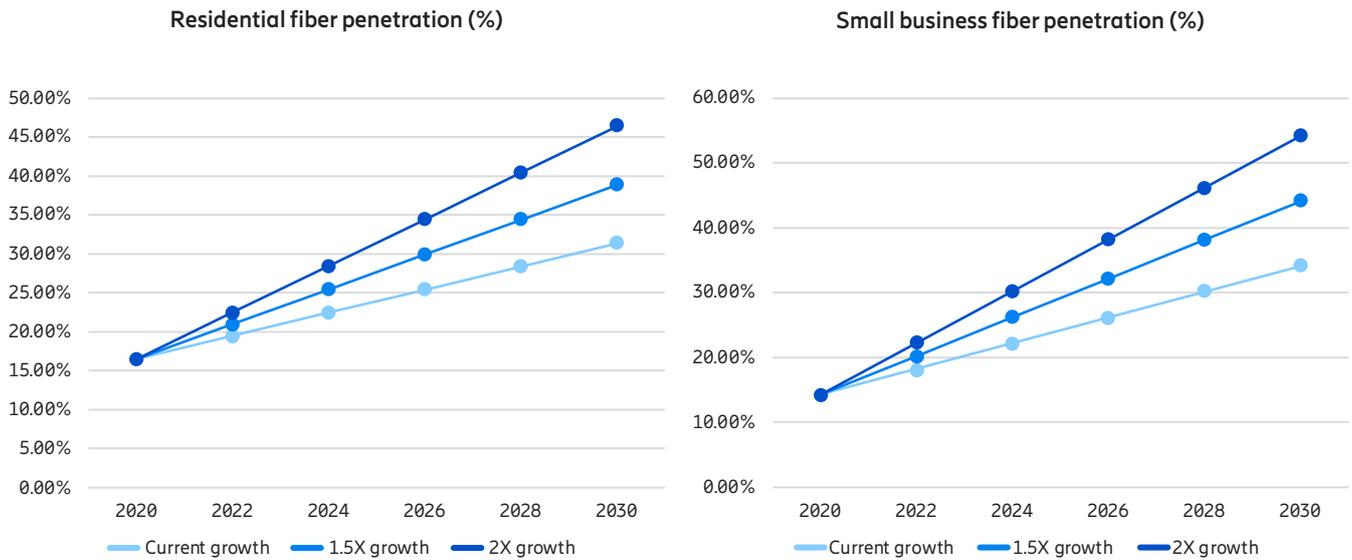
### How do we accelerate closing the divide?

As the pandemic made obvious, we must take a more aggressive approach if we are to achieve social, economic and technological equality. It's obvious that at the current pace, a fiber-dependent policy will take far too long to solve the digital divide challenge. In this paper, we propose, instead, a holistic, multi-tiered approach to closing the digital divide. This proposal comprises five significant steps:

- View the divide as really two divides, the mobile and the fixed broadband.
- Recognize the proven role of mobile broadband for fast rollouts and high adoption.<sup>1</sup>
- Identify 5G as the one infrastructure that can close both mobile and fixed divides where neither fiber nor satellite is ideal.
- Address the distinct hurdles to overcome related to performance, coverage, affordability and digital literacy.
- Set a goal of closing the American digital divide by 2030, at a pace of two percent a year.

1. Mobile broadband has enabled a 5–12 percent higher penetration across all segments.

## Growth scenarios for fiber to the premises



## Lessons from the pandemic

In most people's minds, closing the digital divide simply means providing broadband internet access to consumers. COVID-19 revealed the true societal and economic cost of a digital divide. The pandemic has been a crucible that exposed weaknesses across many facets of society including the demand-driven gaps in broadband connectivity. By looking at these gaps, we can derive insights for shaping a practical strategy for closing the digital divide.

### Connected schools and unconnected students

The pandemic unveiled fundamental shortcomings in connecting students for remote education and homework at home. Instituted pre-COVID-19, the FCC E-rate program offers 20 to 90 percent subsidies for broadband and telecommunication services for schools and libraries, often in combination with free Wi-Fi in schools. Then the pandemic shifted the need from schools to personal computers and broadband at home. Students and teachers were often left without resources. Fifteen million K–12

students lack access to devices or broadband. Nine million lack both device and broadband access—equivalent to 30 percent of all K–12 students nationwide.<sup>2</sup> The deficit wasn't limited to students. Eight percent of teachers—300 to 400 thousand educators—also suffered from inadequate access to the broadband they needed to teach.

When government stepped up, however, the results could be dramatic. In Oakland, California, for instance, the city provided Chromebooks and mobile hotspots to low-income students. Secure access to education by low-income students rose from 12 percent pre-pandemic to 98 percent in the fall of 2021. Now that students are returning to the classroom, Oakland plans to continue growing the program. "You have to continue to work collectively to solve deep, systemic inequity," said Oakland United School District Superintendent Kyla Johnson-Trammell. "This is a great first step, but we have a lot more to do."<sup>3</sup>

Higher education faces a similar transformation. An interest in getting a college degree often forces young citizens

to move to a city or a campus to participate in in-classroom learning. This could soon be history. New digital education methods can enable a larger portion of students to gain a college education while remaining in their home town or village.

### Remote/hybrid work is the new normal

The pandemic is also driving fundamental shifts in where we will work in the future. Nine months into the pandemic, 41.8 percent of the American workforce was fully remote.<sup>4</sup> By 2025, estimates Boston Consulting Group (BCG), 36.2 million people will be working fully remotely. In comparison, only 19.5 million workers were remote in February 2020.<sup>5</sup> During COVID, employees have grown to prefer the flexibility offered by working from home. More than a third of the companies surveyed by BCG expected a quarter or more of their employees to work in hybrid models. Supporting remote and hybrid workers with consistent broadband capabilities is vital to attract workers, whether in urban, suburban or rural areas.

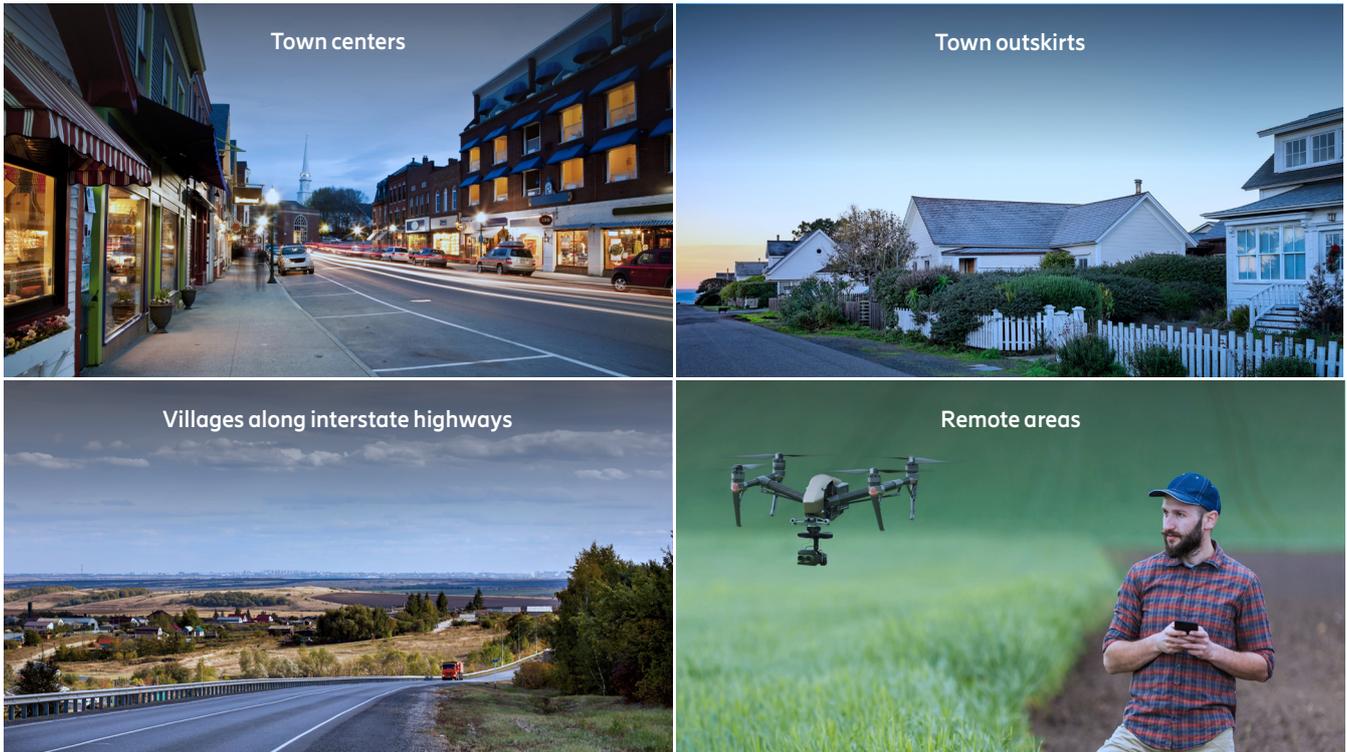
2. [Closing the K-12 digital divide in the age of distant learning](#), BCG and Common-Sense Media, June 29, 2020

3. [Oakland made gains in closing the digital divide during COVID](#), The classroom tech could be here to stay, The Oaklandside, July 20, 2021

4. [Economist report: Future workforce](#), Upwork, December 15, 2020

5. [Remote work works, where do we go from here?](#), BCG, June 30, 2020

## Four different rural broadband realities for fiber



### Zoom towns are the new boom towns

We associate the pandemic with the word “lockdown,” but the pandemic released a new sense of freedom when it comes to the location of work. The pandemic and associated remote working trends are engendering a larger shift in the workforce from living close to work to living where one wants and working remotely.

“Zoom towns”—locations suitable for remote work with the occasional commute to the office—are becoming rural America’s new boom towns. 20.8 percent of workforce migration will entail urban-to-rural relocation, often in search of a more affordable home. More than half of those surveyed are open to travel two hours or longer, if it’s not a daily or weekly commute.

### A prescription for remote healthcare

Healthcare comprises a fourth area driving expansion of broadband access. While 20 percent of the U.S. population resides in rural areas, only 11 percent of physicians practice there. Not surprisingly, 60 percent of revenues of most rural hospitals comes from outpatient care. The era of telemedicine is no longer the future; it’s today. During the pandemic, 30.1 percent of all medical visits were done via telemedicine. And telemedicine requires reliable and consistent broadband.

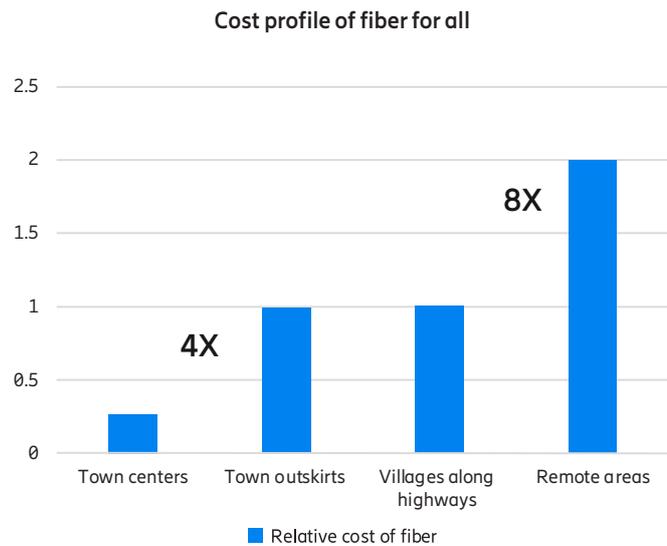
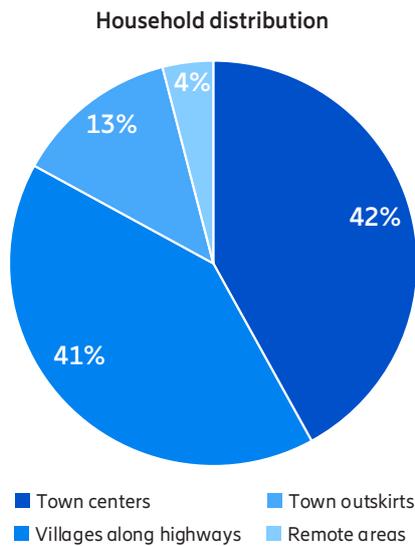
A strategy for closing the digital divide should focus first on rapid network build-out for these four most opportune segments: K–12 and college education, remote working, local businesses and government and healthcare.

### SMBs and digital transformation

The third demand-driven area arises from the needs of small and medium-sized businesses (SMBs) and government functions. Only 12.8 percent of small business buildings are connected with fiber and at the slow pace it takes to install fiber, it’s unlikely many of them will be reached by fiber this decade. To accelerate the digital transformation of these small and medium-sized businesses, we must accelerate their access to new broadband technologies in rural areas.

In the 4G-enabled digital economy, much of the growth centered on metropolitan areas. Rural areas missed out on the fast-growing digital part of the economy over the last decade. 5G has the potential to have an even larger impact than 4G on both business and government functions. If deprived of timely 5G, rural areas won’t just miss out on potential growth; they’ll lose critical opportunities for education, healthcare, work and small businesses as a whole.

## Insights from 12 counties in rural America



### The challenging realities of rural broadband

To better clarify the potential and the challenges of bringing broadband to rural areas with fiber, Ericsson conducted a study to assess what it would take. The study looked at 12 rural counties, with 140,000 households, in one U.S. state. The number of households per mile of feeder fiber ranged from five to 16, and the drop feet required per household ranged from 165 to 500 feet.

### The four categories of need

We found four distinct categories of areas or communities, each with its own challenges and costs for building out broadband infrastructure.

#### Town centers and micropolitan areas:

Represents 42 percent of the households and 16 percent of the capex required.

- Geography—Flat, developed, managed terrain
- Location—Fiber end points in towns and cities
- Existing broadband infrastructure—Metro rings, local exchanges and ISPs
- Leverageable assets—Poles, easements and right of ways

This segment is easiest and least costly to build out, with business logic similar to urban and suburban broadband challenges where fiber can and will be built.

#### Town outskirts near towns and micropolitan areas:

- Includes sizeable towns and urban areas with a population between 10,000 and 50,000.
- Represents 13 percent of the households and 18 percent of the capex required.
- Geography—Partly managed or restricted terrain
- Location—In proximity to the first two types
- Existing broadband infrastructure—None
- Leverageable asset—Poles easement and right of way

For this second category, we expect fixed wireless access to be the primary choice.

#### Villages and houses along major highways:

- Represents 41 percent of the households and 58 percent of the capex required.
- Geography—Managed terrain
- Location—Long haul fiber routes along state and federal highways
- Existing broadband infrastructure—Long haul fiber
- Leverageable assets—Right of way and potential dark fiber conduits

This type is second easiest and second least costly to address. Both fiber and fixed wireless are possible here, presenting a choice between different price points and deployment times.



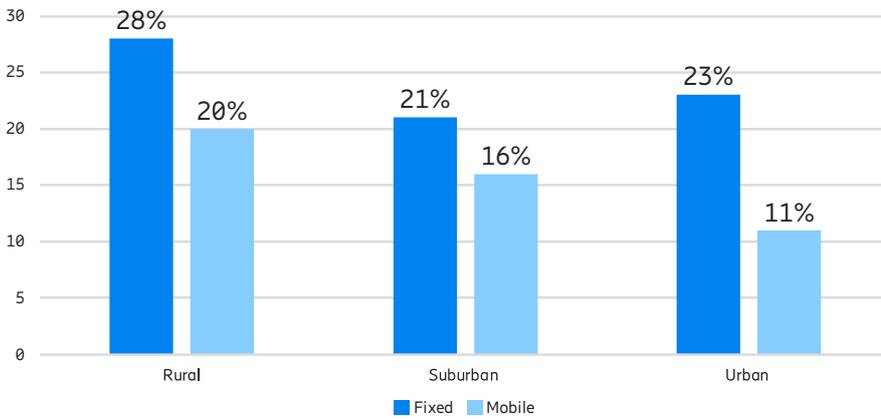
#### Houses in remote areas:

- Represents 4 percent of the households and 8 percent of the capex required.
- Geography—Partly managed or restricted terrain
- Location—Remote
- Existing broadband infrastructure—None
- Leverageable assets—Poles easements and right of way

This fourth category would be the most likely candidate for satellite service.

# Remaining American digital divides to close

Unconnected share of the U.S. adult population (%)



Remaining fixed digital divide to close	<b>21-28%</b>
Remaining mobile digital divide to close	<b>11-20%</b>
Difference between fixed and mobile divides	<b>5-12%</b>

### Strategies for rural deployment

Understanding the four categories of broadband deployment challenges can facilitate detailed planning of network rollouts. Based on the study, we conclude that closing the digital divide in rural areas entails focusing first on town/micropolitan areas and towns/villages along highways. We should leverage aerial fiber when possible, rather than digging.

To accelerate the build of both fixed and mobile broadband across one infrastructure, we should consider 5G Fixed Wireless as a fixed broadband option. At the same time, we must also take the longer view. In areas with very high uptake and/or broadband usage, we should prepare to further extend the fiber grid to smaller radio cells or fiber over the next decade.

### Where do we go from here?

Closing the digital divide is a complex, multi-faceted challenge but this study helps clarify the path we should take. First, we must acknowledge the importance of closing both the fixed shared broadband and mobile personal broadband divides. As we pointed out, only 5G can address both with one infrastructure.

Second, we must affirm a goal of closing the U.S. and Canadian digital divides by the end of this decade. The gap can be quantified: For mobile broadband, it's 11 to 20 percent. For fixed broadband, it's 21 to 27 percent. That means we must reduce the gap by two percent per year during this decade relying on a mix of performance, coverage, affordability and education-focused initiatives.

Begin with the most apparent needs. The pandemic exposed a set of distinct segments with high demand:

- remote working
- remote education
- remote healthcare
- small and medium businesses (SMBs)

These demand-driven divides should be the low-hanging fruit we target first.

### Adopt a technology-neutral strategy

All three technologies meet the criteria for delivering the FCC baseline (and above baseline) tiers of broadband services. The recently passed Senate infrastructure legislation requires funding recipients to deploy service at speeds of at least 100/20Mbps. That sets a new high bar for broadband. By choosing a judicious

mix of multiple technologies, we can close the digital divide effectively, cost-effectively and expeditiously.

### Small steps toward a big goal

The digital divide will be closed through many small infrastructure efforts rather than in one big battle. We won't be able to get fiber to all Americans this decade, but all Americans can get great fixed and mobile broadband through a combination of fiber, 5G, and satellite services. Community organizers could play a significant role in mobilizing demand in each community—more among the leaders in the business community and local governments than among consumers.

If society pushes to get 5G and get it early, there is potential for work, education, and healthcare to end up on the right side of the digital divide. When we combine fixed and mobile broadband options to close the American digital divide, we can get the job done this decade at a pace of two percent per year. By working undivided, in small steps, we can close the digital divide and make broadband commonplace in every business and community. And that's huge.

## About Ericsson

Ericsson enables communications service providers to capture the full value of connectivity. The company's portfolio spans Networks, Digital Services, Managed Services, and Emerging Business and is designed to help our customers go digital, increase efficiency and find new revenue streams. Ericsson's investments in innovation have delivered the benefits of telephony and mobile broadband to billions of people around the world. The Ericsson stock is listed on Nasdaq Stockholm and on Nasdaq New York.

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