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Broadband Myth Series: Is It a National Imperative to Achieve Ultra-Fast Download Speeds?

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Some advocates are willing to take extreme steps to transform the U.S. broadband system, because they claim we require universal broadband networks capable of gigabit-per-second speeds. This is not true.

KEY TAKEAWAYS

- All else being equal, more bandwidth is better than less, and investment that drives fiber deeper into access networks is welcome. But there is no need to radically change the competitive system that continues to expand network capacity.
- Even the most data-hungry of today's high-bandwidth applications require vastly less than a gigabit per second. While faster networks can save time for massive file transfers, there is only negligible benefit from dramatically higher speeds.
- Because there are not applications that require gigabit-per-second rates, demand for additional speed drops off quickly after a certain point, even in countries with widespread fiber infrastructure.
- Nevertheless, the U.S. market-based system continues to invest to improve capacity. Both cable and telco providers lay fiber where it is economical. But in rural areas fiber may not be cost effective compared to fixed wireless.
- Applications like holograms someday may require extreme speeds. But that future is a long way off, network capacity expansion is on pace to accommodate these uses, and extreme speeds are only needed for large, high-resolution versions.

INTRODUCTION

For years, policymakers have asked a series of questions related to broadband speed: How fast is fast enough? What is an appropriate target for rural networks built with government subsidies? Is current competition sufficient to see the speeds we need? Questions around broadband speeds are often legitimate inquiries for public policy, but unfortunately, many of these discussions are mired in myth around the imperative to transition to all-fiber networks in order to achieve universal speeds of a gigabit per second.

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The Electronic Frontier Foundation (EFF) is particularly fanatical on the need to transition to fiber networks. EFF asserted that "fiber is so vastly superior to all of its alternatives… that only universal fiber to the home will ensure a network viable for decades of growth."[1] And apparently the stakes are high—EFF claimed that if we do not take on this "national challenge" of universal fiber, then "there is very little reason to expect the future Silicon Valley to be in the United States," and the next-generation Internet "will not be accessible to us."[2] Others, such as Susan Crawford, echoed this sentiment, calling for "massive government mobilization," in order to ensure our network remains competitive with fiber-only countries.[3]

This is mythmaking of the highest order. Wanting gigabit fiber networks everywhere is like saying we should invest hundreds of billions of dollars to design our freeways so that cars can drive 600 miles per hour. The only problem is cars can't go that fast. The same is true with broadband. Past a certain speed, the perceived performance for virtually all applications is the same.

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Yes, fiber is a fantastic technology, and we should ensure the gradual deployment of fiber deeper into U.S. networks continues. Even if it is simply to serve human impatience for large file transfers, more bandwidth is generally better than less—just not at any cost. Advocates spreading myths on the imperative for a gigabit per second and beyond are willing to make trade-offs that should give policymakers pause. What are the realistic needs of next-generation applications? How much would it costs to transition to ultra-fast networks? Answers to questions such as these should be grounded in fact and analysis, not feel-good myth.

An honest investigation of major "high-bandwidth" applications and technologies shows no imperative for anything close to gigabit speeds anytime soon. Even in a COVID-19 world with multiple family members engaged in simultaneous Zoom calls, today's average speeds are more than enough.[4] In fact, empirical research shows the benefits of additional broadband speed are close to zero after a certain point. Even acknowledging more bandwidth is better than less, private investment continues to drive fiber deeper into the network, developing ever-faster broadband speeds both through improvement to existing infrastructure—including super-fast coax cables—and deploying new, all-fiber networks. The United States faces no risk of losing Silicon Valley due to slow broadband (U.S. speeds are actually quite competitive internationally),

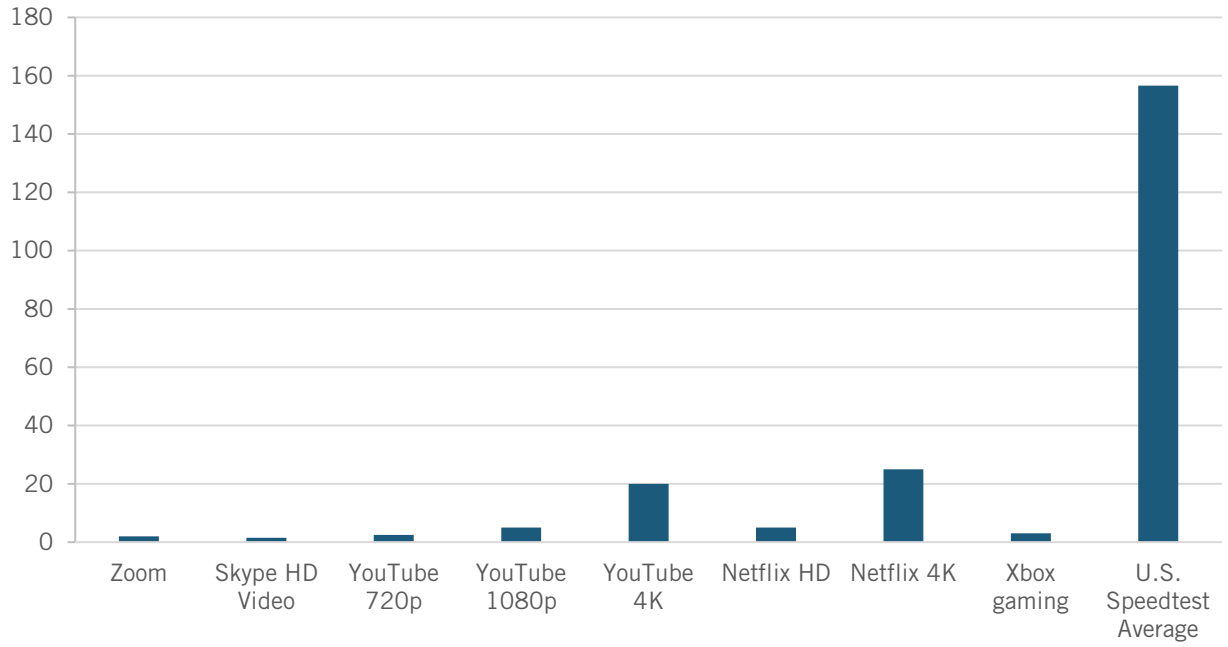
but we do risk undermining the strengths of our competitive, dynamic broadband system by heeding the advice of gig-fiber fanatics.

WHAT IS THE SPEED WE NEED?

There seems to be a pervasive conventional wisdom that we will never have enough bandwidth. Perhaps in the back of folks' heads is the apocryphal quotation from Bill Gates that "640K [of PC memory] ought to be enough for anyone."[5] No one wants to be on the wrong side of history—it feels safer to assume the need for network capacity will continue to increase forever, despite indications to the contrary. Like many trends that once appeared exponential, there are good indications that the bandwidth needs for home access are starting to plateau, with demand tapering off as speeds achieve effective real-time streaming of high-quality video. With widely available broadband speeds that are sufficient for streaming at resolutions (and refresh rates) quickly approaching the maximum humans can perceive, it is becoming increasingly clear that when it comes to mass-market broadband service, super-fast speeds enabled by fiber are at best about unlocking new levels quality at the bleeding edge of the entertainment market (e.g., 8K resolution) rather than any breakthroughs in new applications or improvements in existing functionality.[6]

An evaluation of some bandwidth-intensive applications that are currently used suggests that we are far from requiring gigabit speeds in the foreseeable future to ensure the functionality of applications (see figure 1). Average existing connections are able to comfortably handle far more than what typical applications require today, even for multiple streams per household.

Figure 1: Bandwidth requirements for common technology, in Mbps[7]



For example, if we assume a household with five individuals all simultaneously watching YouTube in 4K resolution, the household would only need two-thirds of the current average tested speed—a tenth of the gigabit per second advocates call for. A household that can afford five 4K screens can probably afford a decent broadband connection—policymakers may be more

concerned about the bandwidth needs of a more modest scenario closer to reality for most Americans: If the same family were willing to watch their video in 1080p high definition, rather than ultra HD 4K, the five streamers would only require 25 Mbps.

A related myth in broadband policy is U.S. speeds are falling behind other countries—this isn't the case. Recent speed test averages from August, gathered by Ookla, show the United States had an average download speed of 156.61 Mbps for fixed broadband, ranking 11th in the world.[8] This is pretty darn good considering half the countries in the top 10 were smaller than the size of West Virginia, and much more densely populated, which significantly lowers the cost of providing broadband to each household.[9] This same speed test data listed South Korea (which EFF vaunts as a "global broadband leader") with an average of 159.98 Mbps, a whopping 2.2 percent faster than the United States.[10] South Korea is indeed often held up as a broadband leader: South Korea's urban super-city, Seoul, houses roughly half of its population, helping give the country a much lower cost-per-home-served compared with suburbanized countries such as the United States, Canada, and Australia.[11]

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So then why, when it comes to the actual speeds tested by users, does South Korea come out only 2 percent faster than the United States? It does not appear to be a fluke of the methodology: Ookla maintains a global platform and utilizes the same methodology everywhere. Any flaws or sampling bias should be roughly the same in the United States and South Korea. One likely explanation is demand—even if South Korea has the infrastructure to provide super-fast speeds, consumers likely do not see the value in subscribing to and paying for higher speeds. Organization for Economic Cooperation and Development (OECD) data indicates that only 3 of every 100 inhabitants in South Korea subscribes to gigabit speeds.[12] The majority subscribe to broadband plans that range from 100 megabit per second to under 1 gigabit per second.[13] Why pay for what you don't need?

Other countries that similarly have had almost universal fiber-to-the-home for years, such as Singapore, do not show much faster speeds in actual use.[14] Demand for gigabit speeds appears to be lacking across all countries, including those with gigabit-capable infrastructure. This lack of demand makes sense as we simply have not seen the applications that require investing in super-fast broadband infrastructure or paying to access those networks where they exist.

ECONOMIC BENEFIT AND DEMAND FOR FASTER BROADBAND

Demand limitations do seem to be holding back adoption of high-speed broadband in the United States, even where it is available. A 2017 study shows a dramatic reduction in the perceived return on investment by consumers once they reached 100 Mbps for downloads.[15] To increase bandwidth from roughly 100 Mbps to 1 Gbps, users were only willing to pay an additional $20 (roughly 2 cents per Mbps).[16] But to move from 50 Mbps to 100 Mbps, users were willing to pay an additional $12 (24 cents per Mbps).[17] The largest jump in willingness to pay occurred when consumers shifted from 10 Mbps to 25 Mbps, where consumers valued, on average, each additional Mbps at roughly $2.50.[18] This demonstrates that consumer willingness to pay would likely not justify immediate investment of fiber to the home for every household. This is not an

issue for the gig-fiber proponents, because in their view the government pays for the super-fast networks and therefore consumers get it for free.[19]

Beyond consumer demand, the important question of what broadband speeds are required to see economic benefits throughout society has interested empirical researchers for years. Research consistently shows that, as one might expect, broadband does have a positive impact on productivity and economic growth.[20] However, the important factor needed to achieve economic growth from broadband is in reaching a critical threshold of penetration of basic broadband that's able to perform common functions. Regression analysis of U.S. broadband data indicates that "compared to normal-speed broadband, faster broadband did not generate greater positive effects on employment."[21] Even community leaders from Chattanooga, Tennessee, known as the "Gig City" by fiber fanatics, have publicly indicated that gigabit speeds are unnecessary today. A local school community there, in partnership with municipal broadband provider EPB, is deploying free Internet to students from low-income families through its HCS EdConnect Program.[22] The program will provide 100 Mbps Internet service, which it states is "more than enough broadband capacity and data to participate in video-based learning and other high bandwidth educational applications."[23]

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A recent paper by European researchers similarly finds that a full fiber network is not worth the costs, concluding that, based on data from 27 EU countries, "partial but not full end-to-end fibre-based broadband coverage entails the largest net benefits."[24] Since neither a nation's GDP nor consumers see a major benefit, there seems little reason to force an early transition to full fiber networks, or dramatically disrupt the broadband market as it continues to improve speeds and coverage. The empirical data is clear: To see the largest benefits, get basic broadband to as many people as you can. Significantly higher speeds are much less important.

THE MARKET IS WORKING TO MEET FUTURE DEMAND

Facilities-based broadband competition continues to drive remarkable investment year after year. Industry reports investment in U.S. broadband networks of over $668.8 billion since 2010.[25] U.S. broadband investment is roughly twice the European average on a per-subscription basis.[26] EFF is correct that fiber is a fantastic technology, but there is no need for a full-scale government intervention to our competition-based system in order to achieve ultra-fast networks today.[27] In fact, the existing market continues to provide more ultra-fast networks in more areas. In two years alone, between 2017 and 2019, fiber connectivity options to the home increased 17 percent, 71 percent of which was offered by one of the major providers.[28]

Investment in the fiber-to-the-home market by the national players indicates that there are strong incentives for large broadband players to continually upgrade existing infrastructure. While this does not predict the speed at which adoption will necessarily occur, it does indicate that fiber is coming—if not already available. Based on the Federal Communications Commission's (FCC) most recent data from June 2019, 22.1 percent of the population has access to gigabit download speeds from at least one (if not more) providers.[29] Recent projections from the Fiber Broadband Association and Cartesian indicate that fiber to the home will be accessible to half of

U.S. homes within the next five years.[30] Wall Street analysts (who are generally better incented than policy advocates to get these questions right) have estimated that over the coming years homes with fiber access available will increase from 40 million to 60 million.[31] Competition continues to drive investment in fiber.

Private companies are vocal about their plans to expand into the market of ultra-fast speeds. AT&T's CEO John Stankey said fiber and the expansion of fiber networks is not only a priority, but that it even makes good business sense based on the expected returns.[32] This has been reiterated by comments from AT&T Communications CEO Jeff McElfresh, who noted that a fiber expansion "is in the making for AT&T over the next several years."[33] While fiber deployment may have higher initial costs, it has lower operational expenses once deployed, making it a natural progression of the existing facilities-based competition.

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The private sector is not just leaning into fiber in preparation for near-term demands such as 5G backhaul, but they are also modifying existing infrastructure in order to accommodate a future market wherein competition forces gigabit speeds to be the norm. We see this through continual advancement of improved cable delivery services that enable existing infrastructure to realize fiber-comparable speeds. This includes DOCSIS 4.0 and the 10G platform, which will allow for speeds up to 10 Gbps, as well as the testing of Full Duplex models that will allow for symmetric up- and download speeds.[34]

Expanded fiber deployments are not happening in a vacuum. Both Google Fiber and the Gig.U initiative to expand fiber access in college towns deserve a lot of credit for identifying barriers to entry and changing the conversation around partnering with cities to lower the costs of deployment.[35] But there is a big difference between efforts to lower costs and enable entry through things such as pole access reform, easy access to rights of way, and uniform permitting processes, for example, and the direct government entry into providing the infrastructure, as advocates call for.

WHAT ABOUT FUTURE APPS AND TECHNOLOGIES?

Many argue that policies to force a transition to gigabit-capable networks are needed to enable high-bandwidth applications of the future. Without the chicken of a gig, there is no egg of next-gen applications—or so goes the thinking. The U.S. Ignite program, established by the Obama administration and well-funded through National Science Foundation (NSF) grants and a partnership with Mozilla attempted to develop gigabit applications to kick demand for ultra-fast networks into gear.[36] U.S. Ignite did a lot of great work, and continues to help drive innovation, but no "killer app" has yet emerged from that research. As NYU researchers summarized of the project: "[T]he majority of the proposed [U.S. Ignite] applications can be deployed in the current network, as their bandwidth requirement is mostly under 100 Mbps," and "there is no project that requires bandwidth higher than 1 Gbps" used by ordinary end-users.[37]

To push a gigabit and beyond, you have to look to rather exotic future applications. Very high resolution 360-degree video is quite bandwidth intensive—16K VR (virtual reality) can approach

a gigabit in throughput.[38] Of course, lower resolution requires far less bandwidth (for 8K AR, only 55.3 Mbps are required), and for most VR, it makes more sense to render the video on-site rather than in the cloud.[39] Also, non-real-time streaming video can always be buffered. But for real-time, high-resolution, 360-degree VR, researchers are working to lower the needed bandwidth by sending only the video around a cone of vision for the user (rather than the full 360-degrees.[40]

While technologies that will require gigabit speeds (and beyond) are being developed, they are still a long ways away. Holograms are the go-to example of super bandwidth-intensive application.[41] But again, the speeds needed really only impact the quality and size of the hologram, not whether it is possible at all. Given that our competitive broadband system continues to expand capacity, and there are already enough broadband connections capable of running superfast applications, any new applications will be able to find the bandwidth they need to get off the ground. As such, there is no need to undermine the facilities-based competitive system to achieve higher-speed infrastructure just to overcome a theoretical chicken-and-egg problem.

SO WHY DO THE GIG-FIBER ADVOCATES MAKE THEIR CLAIMS?

If it turns out that it's a myth that the United States needs universal fiber-based gigabit networks, why do so many progressive and muni-broadband advocates keep calling for it? The answer is simple: Their goal is not gigabit networks; their goal is municipally government-owned networks. They oppose corporate broadband providers on an ideological basis. For example, Susan Crawford claimed that "the fiction of fervent private-market competition" isn't working, while calling for government intervention.[42] And because they know that private-sector providers may not invest in a fully fiber-optic network anytime soon—because their customers have no need for it—they know they can use the "gig network is the only good network" argument to make it look like the current model is structurally flawed. Then it becomes clear—so they hope—that the only solution to the ginned-up speed crisis is government ownership.

CONCLUSION

EFF's overreaching claim, that "the rest of the world marches ahead while our current Federal approach repeatedly fails," is clearly not true.[43] Sure, fiber is a better technology than coaxial or copper, but by no stretch of the imagination is universal fiber a national imperative. We do not need to shift to government-owned infrastructure across the country to ensure broadband continues to advance and exceed current and upcoming needs. Nor should rural subsidies stipulate fiber as a necessity. Fiber can be the most cost-effective way to build a new network, but considering the great diversity of challenges facing rural connectivity, all different access technologies—fiber, fixed-wireless, upgrading copper, and satellite—should be on the table.

We do not need to shift to government-owned infrastructure across the country to ensure broadband continues to advance and exceed current and upcoming needs.

It is likely bandwidth demands will gradually continue to grow in the future. Maybe someday we will see widespread use of Princess Leah-like holograms or other applications that actually require gigabit speeds. But for now, it appears bandwidth needs are reaching a plateau, roughly following the speeds required to stream high-definition video. The demand for additional speed

quickly drops off after 100 Mbps, likely because there is no current need for anything more. This is consistent with the economic evidence, which indicates the societal benefits to faster broadband are marginal. The "national imperative" of universal gigabit broadband is a myth.

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