July 5, 2021

Re: Comments from CCG Consulting concerning Broadband Speeds

Following are my comments to questions 22, 24, and 25 of the Interim Final rules issued by the Department of the Treasury in 31 CFR Part 35 – Coronavirus State and Local Fiscal Recovery Funds.

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Question 22: What are the advantages and disadvantages of setting minimum symmetrical download and upload speeds of 100 Mbps? What other minimum standards wouldbe appropriate and why?

Summary:

- Treasury is asking the wrong question when asking about current speed requirements. Federal grant money should only be used to build technology that will be capable of meeting broadband demands at least a decade from now. A technology deployment built to meet today's speed requirements starts being obsolete almost immediately after it's constructed.
- I think 100 Mbps download is an adequate definition of broadband in 2021, and I doubt that there will be many arguments against a 100 Mbps requirement since most currently deployed technologies can deliver this speed.
- There will be a huge outcry against 100 Mbps upload speeds since major technologies like cable company HFC networks, fixed wireless, and fixed cellular can't deliver fast upload speeds. Treasury can't be swayed by this argument – grant money should only be used to deploy technology that meets public broadband demand both today and into the future. ISPs are free to use their own money to deploy any technology – but federal money is precious and should be held to a higher standard.
- In looking out only a decade, and using a conservative 21% annual growth rate, the definition of broadband a decade from now is going to conservatively be 600/200 Mbps. That's what I recommend as a reasonable goal for federal grant funding.

Technologies and the 100 Mbps Threshold

I doubt that Treasury will get many responses that take exception to the 100 Mbps download speeds. There are no technologies that are likely being considered for new network construction that can't meet that 100 Mbps download test - be that fiber, cable company hybrid-fiber networks, fixed wireless provided by WISPs, or low-orbit satellites. In many circumstances, some of those technologies will not always deliver 100 Mbps speed, but you're not likely to see any ISP or industry trade association that will be willing to make that honest assessment.

The only industry segment that might take exception to a 100 Mbps download requirement is fixed cellular broadband. All three major cellular carriers – AT&T, T-Mobile, and Verizon – are in the process of rolling out fixed cellular broadband. This technology today can deliver 100 Mbps to customers within a short distance of a cellular tower – assuming a cell site is fully updated and using all available spectrum. But for the most part, this technology will provide download speeds that decrease with distance from a cell tower, and which will mostly be significantly less than 100 Mbps

The primary benefit of raising the minimum download speed to 100 Mbps is that it finally takes DSL out of any discussion. There should never be another federal dollar spent to support DSL. This requirement will also properly exclude grant funding for high-orbit geosynchronous satellites – another technology that should never see another dollar of federal broadband subsidy.

The Upload Speed Controversy

The issue that will be highly controversial is upload speeds. Cable companies and their trade associations will likely argue vehemently against faster upload speeds since current cable networks deliver upload speeds far below the 100 Mbps target. We recently saw Altice announce that it is lowering upload speeds to bring the company into solidarity alignment with other cable companies.

You will also see the same arguments from WISPs that use fixed wireless technology to transmits broadband from a tower to premises. The technology can't currently be configured to reliably deliver 100 Mbps down and upload simultaneously, except perhaps to a premise that is located virtually underneath a tower. I've recently seen WISPA, the trade association for this technology, arguing for low upload speeds between 5 Mbps and 10 Mbps – speeds that are clearly already inadequate today.

In March, John Marsh, an Executive VP for AT&T advocated for a 10 Mbps upload speed. That is surprising for the second biggest fiber provider after Verizon, but the company is perhaps angling to grab federal subsidies for rural fixed cellular service that can't deliver fast upload speeds.

I don't expect that comments from service providers and trade associations for these technologies will mention that their technologies can't deliver fast upload broadband – instead, any filings made in response to your questions will march out a string of arguments about why homes don't need fast upload speeds. As an example, I reference a recent blog published on the WISPA web site[1] that argues that upload speeds don't need to be more than 5 – 10 Mbps.

There are only a few technologies that can meet the 100 Mbps upload threshold:

- Fiber technology including passive and active electronics can easily deliver 100 Mbps upload speeds.
- Fiber-to-the-curb as is being deployed by Verizon can meet the 100 Mbps speed if configured to do so. This product builds fiber close to premises and uses a combination of millimeter-wave and CBRS spectrum to connect to the premise.
- Point-to-point radio connections can meet the 100 Mbps test. The easiest example of the technology are ISPs in urban areas that use high-frequency radios to deliver gigabit speeds to an apartment building which is then shared among tenants of that building. But this technology is too expensive and impractical to be used for mass deployment to individual premises.
- Wireless mesh networks using millimeter-wave spectrum can meet the 100 Mbps test. This technology can bounce a wireless signal from building to building to deliver bandwidth. This technology comes with a long list of caveats and it's possible to configure the product in a way that won't deliver fast broadband. First, there needs to be a fiber connection within the neighborhood to provide the core bandwidth. The millimeter-wave spectrum doesn't travel far, so buildings in the network need to be close to each other – this will work in a typical business district but not in a rural area, and probably not even in the typical suburban neighborhood where businesses have big parking lots. Like any network, speeds

[1] http://wispa.org/news_manager.php?page=23854

will decrease if too many customers are added to a single node. The signal is blocked by almost any obstacle in the environment like foliage. However, in the right setting, this technology can meet the 100/100 Mbps test. As an aside, the idea of using this technology in rural areas is ludicrous, as is being claimed by several winners of the RDOF auction that are claiming the ability to deliver rural gigabit speeds using this technology.

The big downside to setting the target speed to 100 Mbps upload is that it will exclude grant funding from being provided to cable companies, to WISPs using fixed wireless technology, and to cellular companies offering fixed rural cellular. The 100 Mbps upload threshold probably also excludes low-orbit satellites – but we're not going to know this until we see a satellite network deployed to many customers. That creates a huge dilemma for the government because reasonable upload speeds will eliminate major existing broadband technologies. The two largest cable companies, Comcast and Charter, alone serve over 50% of existing broadband customers in the country. WISPA claims that its members serve over 8 million broadband customers today.

Current versus Future Broadband Needs

There is one key question that Treasury did not ask in any of these questions. Should grant funding be awarded to meet today's broadband needs or meet future needs? Should federal funds be used to support any technology that will not be adequate even a decade from now?

This is an important question because most of the parties arguing against the suggested 100/100 Mbps definition of broadband are only going to talk about current broadband needs. They will only talk about the bandwidth that households need today and not what will be needed in the future.

No competent ISP would build a broadband network without considering future demand. The primary reason is that ISPs all understand that the public's use of broadband has steadily been doubling about every three to four years since the 1980s. There is no reason to think that the household demand for broadband is now mature and will suddenly stop growing after forty years of uninterrupted growth.

As an example, 1 Mbps DSL felt blazingly fast in the late 1990s when it was introduced as an upgrade from dial-up Internet. The first 1 Mbps DSL connection was nearly 20 times faster than dial-up, and many people thought that speed would be adequate for many years. However, over time, households needed more speed and the 1 Mbps connections started to feel too slow; ISPs introduced faster generations of DSL and cable modems that delivered speeds like 3 Mbps, 6 Mbps, 10 Mbps, and 15 Mbps. Cable modem speeds continued to grow in capacity and eventually surpassed DSL, and in most cities the cable companies have captured the lion's share of the market by offering internet products starting between 100 Mbps and 200 Mbps.

Bandwidth demand continues to grow. The firm OpenVault measures total broadband usage by households using software deployed by the biggest ISPs around the country and around the world. Consider the following statistics that show the average nationwide U.S. broadband usage per household. These numbers include combined download and upload usage.

1st Quarter 2018	215 Gigabytes

1st Quarter 2019	274 Gigabytes
1st Quarter 2020	403 Gigabytes
1st Quarter 2021	462 Gigabytes

This table shows extraordinary growth in the average use of broadband across the country. The first-quarter 2021 usage is up 69% since 2019 and 115% since 2018. Average household bandwidth usage has more than doubled in three years – an extraordinary growth rate. While some of this growth can be explained by the pandemic, usage was already on a path to double in less than every four years before the onset of the pandemic.

Increased public demand for broadband isn't only manifested by the total amount of data consumed by households. There has been an incessant demand for faster broadband connections. The demand for faster broadband products also leapt upward due to the pandemic. The same report by OpenVault shows that at the end of the first quarter of 2021 the percentage of homes subscribing to gigabit data products jumped to 9.8% of homes. This had grown over tie from 1.9% of home in 2018, 2.8% at the end of 2019 and 8.5% of homes at the end of 2020.

Maybe the most extraordinary statistic from OpenVault is that 80% of all homes at the end of the first quarter of 2021 now subscribe to broadband plans of at least 100 Mbps download. The fact that the vast majority of homes are subscribing to speeds of at least 100 Mbps puts the 25/3 Mbps discussion into perspective – discussing 25/3 Mbps is like having a horse and buggy discussion in a world of fast cars.

There was a lot of debate in 2015 when the FCC established the definition of broadband speed as 25/3 Mbps. Cisco has been publishing annual industry analysis that shows that since 2015 that the demand for broadband speeds has been increasing by roughly 21% annually. If we accept that 25/3 Mbps was an adequate definition of broadband speeds in 2015 – then applying Cisco's 21% growth shows how the definition of broadband probably should have changed over time.

Theoretical Definition of Broadband - Download Speeds in Megabits / Second

2015	2016	2017	2018	2019	2020	2021
25	30	37	44	54	65	79

I believe that once the FCC established the 25/3 Mbps definition of broadband that the agency should have regularly reexamined the definition of broadband. The agency looked at it twice in recent years and decided to not increase the 25/3 definition. But the decision to not increase the definition of broadband is not based upon what households need - upgrading the 25/3 definition would instantly declare many millions of homes to not have broadband. No FCC wants to have the number of households without broadband increase during its tenure.

We have from Cisco that real-life broadband speeds have surpassed the above table pf theoretical broadband speeds. Consider the following numbers from Cisco's 2020 broadband report. This started with actual speeds measured in 2018 and 2019 speeds and predicted the average broadband speeds by year for North America (the U.S. plus Canada).

Average North American Download Speeds in Megabits / Second

2018	2019	2020	2021	2022	2023
56.6	70.1	92.7	106.8	126	141.8

This chart shows that actual average broadband speeds have been exceeding the earlier chart of theoretical values for the definition of broadband. The most interesting thing about this chart is that I'm sure it's quite conservative for 2021 and beyond – it was published by Cisco literally as the pandemic. The real numbers for 2021 and forward are likely to be higher than what Cisco predicted.

Broadband demand and usage have been growing year-over-year and are likely to continue to do so. As can be seen by the Cisco actual numbers, the ISPs in the country have responded to greater demand by increasing broadband performance – which is reflected in the growth of nationwide average broadband speeds. Cisco predicted in 2020 that the average broadband download speeds in the country this year will exceed 100 Mbps. It's outrageous to continue to set rural broadband goals using a 25/3 Mbps definition of broadband when it's clear that most of the country already gets speeds far faster than that paltry goal.

Let me return to the initial question I asked earlier - what is the right speed goal to use for grants to build networks that will be operating into the future? One way to answer that question is from a technical perspective. The electronics for most technologies built with grants will last for perhaps ten years. As can be seen by the discussion about the continuous growth in broadband demand, any network built today will likely see traffic in ten years that is almost 7 times greater than today if the growth rate remains at roughly 21% per year. I would argue that it's common sense that a grant-funded network ought to be robust enough to support broadband a decade from now since the grant-funded electronics should still be operating then.

Carrying the 21% annual growth forward would translate into average household monthly usage a decade from now of 3.1 terabytes (starting with 462 gigabytes today), and the definition of download broadband speed between 600 Mbps to 700 Mbps (starting with Cisco usage for 2020 and 2021 between 93 Mbps and 106 Mbps).

I think the Treasury is dead-on in discussing the right definition of broadband today, and I think 100 Mbps is a reasonable goal for how broadband should be defined in 2021. But that should not be the goal that is used for federal grants. A federal grant awarded this year should be capable of meeting expected broadband demand a decade from now – that means having the capability of delivering a speed of 600 - 700 Mbps download, and the overall capacity to handle average customers using over 3 terabytes of data per month. If federal grants are used to build a network that maxes out at 100 Mbps download, that network will start to be obsolete soon after it is built and will be massively obsolete within a decade.

Question 24: What are the advantages and disadvantages of setting a minimum level of service at 100 Mbps download and 20 Mbps upload in projects where it is impracticable to set minimum symmetrical download and upload speeds of 100 Mbps? What are the advantages anddisadvantages of setting a scalability requirement in these cases? What other minimum standards would be appropriate and why?

Summary

As described earlier, I think federal grant funding ought to be used to support a network that will still be viable a decade from now. My best guess of the upload requirement for a family of four today is between 30 Mbps and 40 Mbps. In looking forward a decade, that means upload speed requirement for a federal grant should be between 200 Mbps and 270 Mbps.

I think there are ISPs using major technologies like cable HFC networks, fixed wireless networks, and fixed cellular networks that are going to suggest that the proper upload speed for a grant should be 20 Mbps or less. Our vast experience of conducting broadband surveys all over the country during the pandemic showed us that a 20 Mbps upload path is not always adequate today for a home with multiple people working or schooling from home at the same time. If Treasury sets the definition as low as major industry players are likely to suggest, then those networks are already inadequate today and will be badly obsolete as time goes by.

Our Experience During the Pandemic

My response to Question 22 above discusses my thoughts on the download speed requirement for grants. It's harder to define the right definition of upload speeds for grant purposes – mainly because there have been almost no studies to define what is adequate upload speeds should be today. As mentioned earlier, my consulting firm helps clients conduct numerous residential broadband surveys. During the pandemic, we routinely heard from households who told us they could not function well from home during the pandemic. Rural DSL and other technologies completely failed during the pandemic. But even in urban areas and on cable networks touted as having gigabit capabilities, households that tried to work online with two or more adults or students ran into problems.

In the markets where we heard complaints about upload speeds, the cable companies were mostly delivered upload speeds between 10 Mbps and 20 Mbps. The numerous responses we got in surveys showed me that the definition of upload broadband has to be something higher than 20 Mbps.

Technology Also Matters

Just like technology matters for download speeds, there are technical issues associated with upload speeds that need to be considered. For example, a cable company HFC network has performance issues that specifically affect upload performance. The larger cable companies have upgraded the download portions of networks in most of their networks to the latest DOCSIS 3.1 standard.

However, most of them kept the upload data path operating with the DOCSIS 3.0 standard. Cable companies likely chose to not make the upgrades since the upgrade means rearranging a lot of channels on a network. The upgrade to DOCSIS 3.1 includes what is technically called a mid-split where bandwidth from several parts of the cable network must be combined to create a faster upload data stream. The bottom line is that cable company uploads could be faster – there is an existing upgrade to DOCSIS 3.1 that would improve upload performance that most cable companies have elected to not implement.

There is a second issue that is relevant because the current upload path on most cable networks uses the noisiest part of the spectrum band. Years ago, when CableLabs designed the specification for providing broadband from a cable network, they chose to place the upload data stream at the lowest bandwidth sector of the network. This was done because very few customers valued upload broadband – it was never much of a problem if it took a little extra time to send a file upstream. The CableLabs specifications put the bulk of the upload data path in what used to be channels 2 – 5 on an analog cable network. Anybody of my age will remember the days when those channels had a lot of interference when an analog signal was delivered either over-the-air with an antenna or from a cable company. That's because the low channels see interference from everyday events like the running motors from kitchen mixers or vacuum cleaners, from operating a microwave oven, or from small engines like a lawnmower.

A coaxial cable network acts like a giant antenna. Any place in a network with a coaxial cable splice is a place where interference can enter the network. In day-to-day use, there is a lot of interference with the portion of the network that delivers upload data. From a practical perspective, this means that a 15 Mbps upload data path on a cable network cannot transmit as much data as would a 15 Mbps data path on other technologies since the upload data path on cable networks contains significant noise and interference.

What is the Right Upload Speed?

As discussed earlier, the residential surveys my firm has been doing throughout the pandemic show that roughly one-third of homes have been dissatisfied with the upload speeds of 10-20 Mbps that are being delivered by most cable companies. That sets the bottom threshold – upload bandwidth in 2021 needs to some amount higher than 20 Mbps.

When the FCC set the definition of broadband in 2015, the agency conducted thought experiments to determine the needed speeds for a family of four. I thought the FCC's conclusion that the definition of download speed should be 25 Mbps felt adequate in 2015.

But in 2015 almost nobody talked about the 3 Mbps definition of upload speed. Interestingly, the broadband industry paid almost no attention to that speed definition. Cable companies have largely supplied upload speeds faster than 3 Mbps since 2015, with average speeds today for most cable companies between 10 and 20 Mbps. Meanwhile, most DSL rarely meets the 3 Mbps broadband test. In 2015 there were already fiber providers delivering symmetrical broadband at speeds between 100 Mbps and 1 Gbps.

It might make sense to mimic the FCC in 2015 and conduct a thought experiment to determine the amount of upload bandwidth that a family of four might need. I don't know about other people in the industry, but I don't know how to undertake that thought experiment for upload speeds. I have to imagine that this is true for most people.

I know that I often take part in video calls on Zoom and other platforms. I know that I routinely send emails with fairly large attachments. But I conduct other upload functions for which I have no feel for the amount of bandwidth used. I work with other employees using Microsoft Teams. Any file I create gets automatically saved in the cloud. I'm not a gamer, but other family members are. I have a number of IoT devices that communicate with the cloud in some manner. When I'm home, everything I do on my cellphone connects with WiFi through my home broadband. Since my business is home-based, I don't have to connect to a work server as many homes must do, and I no longer have any students at home that want to connect to school servers. I haven't the slightest idea of how to turn this list of upload functions into a definition of broadband.

In a recent whitepaper, the Fiber Broadband Association suggested that the right upload speed needed for a family of four in 2021 is 73 Mbps. I know that the FBA folks are biased towards fiber, and I assume that number is probably the top threshold for the definition of upload speed in 2021. My overall conclusion is that I know upload speeds have to be greater than 20 Mbps because I see households all over the country saying they can't work adequate on connections of that speed. I'll take the FBA's word that the upper limit this year is 73 Mbps. My gut feeling is that the broadband need for a family of four likely sits today between 30 and 40 Mbps, so perhaps that's the right definition of adequate upload bandwidth today.

Just like with download speeds, the need for upload bandwidth will continue to grow. As mentioned earlier, I think it is irresponsible to fund any technology with federal grant money that will be obsolete in the foreseeable future.

The FBA says in that same whitepaper that upload speeds are growing at a rate of 28% per year. That number might bake in the effects of the pandemic. If I take a more conservative approach and use the 21% growth rate that we've seen for many years for overall broadband consumption, then looking out just ten years would mean that upload speeds ought to be between 200 and 270 Mbps in ten years (starting with a range today of 30 – 40 Mbps).

Question 25: What are the advantages and disadvantages of focusing these investments on those without access to a wireline connection that reliably delivers 25 Mbps download by 3 Mbps upload? Would another threshold be appropriate and why?

Summary

I think Treasury has identified one of the biggest problems with previous federal broadband grants by now saying that the test for grant eligibility is that an ISP can "reliably" deliver at least 25/3 Mbps. The reality is that much of the technology that is reported to the FCC today as being capable of 25/3 Mbps delivers far slower speeds.

We need to talk about real-life networks using three different speeds – maximum speed, minimum speed, and marketing speed. The maximum speed is the fastest speed that a given technology can achieve in ideal conditions. But network conditions are rarely ideal, except perhaps when a single home is using a node at 3:00 AM – and even then, there could be slowdowns from node congestion outside of the neighborhood.

Minimum speeds are something we've always referred to as actual speeds. These are the speeds we see on speed tests, and they rarely equal the maximum speed.

Marketing speeds are something else altogether, and some ISPs advertise numbers close to actual speeds while others advertise purely fictional speeds that are greater than the maximum speeds. Unfortunately, the FCC allows ISPs to report marketing speeds, and this is one of the big contributors to the lousy FCC mapping data.

Areas should qualify for federal grant funding based upon the minimum speeds actually delivered to customers and should not use the maximum theoretical speed or the advertised marketing speeds.

What Does 25/3 Mbps Mean?

Before answering the question, I think I need to discuss the way that the industry uses and abuses the 25/3 Mbps definition of broadband established by the FCC in 2015.

Let me use an example of a DSL broadband connection that in ideal conditions delivers speeds of 25/3 Mbps. Numerous issues make it nearly impossible for DSL to perform this well such as distance from the DSLAM, the age of the copper, the gauge of the copper wires, the age and capabilities of the electronics, the quality of the drop wire to a premise, and the condition of the copper inside of a premise. But for the sake of discussion, consider a DSL connection that is capable of delivering a top speed of 25/3 Mbps to a customer.

The amount of bandwidth that can be delivered to a given customer varies day-by-day, hour-by-hour, minute-by-minute, and even second-by-second. This is something that anybody can prove by taking repeated speed tests on home broadband. The speed a customer can receive changes according to the capacity of the network at any given point in time.

The simplest explanation of this phenomenon is that the broadband traffic from a customer joins with traffic from other customers throughout the network. Any place in a network where traffic from multiple customers comes together is called a chokepoint. Broadband speeds drop any time the customer traffic hitting a chokepoint is greater than the capacity of the chokepoint. There are numerous chokepoints in every broadband network. To use this DSL customer as an example, the first chokepoint is the DSL electronics card in a neighborhood cabinet that feeds multiple homes. If all of the homes are trying to watch Netflix at the same time, the accumulated bandwidth being requested is likely higher than the bandwidth available to that card. This results in pixelation and poor performance, and even perhaps in customers getting booted from the DSL.

Further up the network are other chokepoints. There is likely a chokepoint in the electronics for the fiber or copper line feeding the neighborhood DSL cabinet. This would be where the traffic from multiple neighborhoods comes together. Even if a customer's local neighborhood isn't overly busy, the DSL performance will be degraded if other neighborhoods are busy and overwhelm the transport electronics. Depending upon the configuration of a network there could be multiple transport choke points. Somewhere in the network, the customer's traffic hits a DSLAM – the primary DSL router. This becomes a chokepoint if the whole system has too much traffic. There are other chokepoints at the network core. For example, things slow down if the DNS routing system gets overwhelmed (the system that decides where to send an Internet connectivity request). Finally, there are likely numerous chokepoints between the customer's ISP and the connection to the Internet.

If any one chokepoint on a network gets over-busy, the speed available to a customer degrades. The slowdown could last for just microseconds or could last for a long time. The performance of a customer's DSL connection is the accumulation of all of the slowdowns caused at the possibly dozens of chokepoints between the customer and the Internet.

The most drastic impacts on speed are normally local. This is why some technologies slow down more noticeably than others. Fiber-to-the-home generally doesn't vary in speed as much as other technologies because the powerful bandwidth being delivered to the local neighborhood is likely greater than the customer demand. As an example, a GPON fiber network provides 2.4 gigabytes of bandwidth to serve up to 32 customers in a neighborhood node. There are not many times when a neighborhood will use the full 2.4 gigabits – many of my clients report that the average usage from neighborhood nodes is only about 40% of the 2.4 gigabits.

By contrast, the speeds on DSL networks tend to vary wildly because there are several local chokepoints that have less capacity than what customers ask for. For example, a DSL neighborhood node might be supplied with a DS3 (45 megabytes of bandwidth) or even with multiple T1s. It's far easier for the DSL neighborhood to hit bandwidth capacity.

But let's get back to the DSL customer who is served with a connection that can deliver 25/3 Mbps performance in ideal conditions. During evenings when lots of households want to watch video, the neighborhood chokepoints get overwhelmed. During the pandemic, the same thing started happening in the daytime when multiple homes tried to connect to work or school servers.

This raises the question if this is a 25/3 Mbps service? Certainly, the telco is going to claim this to the FCC as a 25/3 connection. And for this question, I assume that Treasury also might think of this as a 25/3 Mbps broadband service. But it's not. If this connection with a maximum capacity of 25/3 Mbps more normally delivers 10/1 Mbps during the busy evening times, then *I argue that this is a 10/1 Mbps connection that is capable of bursting to 25/3*.

This might be the most important point that I'm making in these responses. What the telcos or WISPs try to pawn off as 25/3 Mbps is normally something far less. I think using a single speed to describe a broadband service is a fiction that telcos have established over the years to make their broadband sound faster than it really is.

We need to talk about real-life networks using three different speeds – maximum speed, minimum speed, and marketing speed. The maximum speed is the fastest speed that a given technology can achieve in ideal conditions. But network conditions are rarely ideal, except perhaps when a single home is using a node at 3:00 AM – and even then, there could be slowdowns from node congestion outside of the neighborhood.

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I assume that Treasury understands that the ability to "*reliably deliver 25 Mbps download by 3 Mbps upload"* is referring to minimum or actual speed. The speed of a broadband connection is whatever a customer is seeing at a given minute. It's not the maximum speed that is delivered at 3:00 AM or the advertised speed that an ISP invents.

To answer Treasury's question, there is a huge advantage if grants are based upon actual speeds. This will allow funding to be used in places that other grants have excluded. It will allow broadband funding to be used for situations like the following:

- My firm has done speed tests in entire counties where a telco claims 25/3 capability but where we didn't see even a single speed test that achieved a speed even close to 25/3 Mbps. Some past federal grants would have made such counties ineligible for federal broadband grants.
- There are small neighborhoods in urban areas where the cable company delivers far less bandwidth than in other places. This is likely due to local network issues that interfere with the delivery of broadband. Unfortunately, we see these neighborhoods suffer year after year because the cable company doesn't want to spend the capital to replace the coaxial wires and electronics.
- Cable companies generally claim ubiquitous coverage in urban areas. This is likely due to the FCC mapping rules where an entire Census block is declared to have broadband if only one customer in that block is covered. In every city, there are buildings, and streets, and niches that never got coaxial cable and are not served by the cable company. These places

are generally only served by slow DSL, and yet they have never been eligible for federal broadband grant relief.

- I've worked for many communities where broadband from the cable company routinely goes out of service. When broadband goes dead it is devastating to businesses and to people that will more regularly be working from home. Towns and cities that have routine outages month after month and year after year often tell me that is the primary motive to look at alternatives to the cable company. These communities might have decent broadband speeds when the network is operating – but the downside to routinely losing broadband is more than the community can tolerate. I would argue that the phrase 'reliably delivers' applies to this situation every bit as much as it applies to other communities that suffer from slow speeds.
- AT&T walked away from serving new DSL customers in October 2020. Can a neighborhood that only has AT&T DSL as a broadband option be considered as served if a household there without broadband can't order service? AT&T is the first big telco to do this, but it won't be the last.