LEO Satellites: A Path to Nowhere?

Low-Earth-orbit satellites face various challenges meeting Rural Digital Opportunity Fund requirements.

By Deborah Kish / *Fiber Broadband Association*

The FCC recently awarded more than 180 bidders funding to build broadband access in unserved and underserved rural areas of the U.S. This is great for rural areas as the increase in remote workers and online schooling the pandemic caused means broadband no longer is a nice-to-have but a necessity.

The exciting news is that 85 percent of the Rural Digital Opportunity Fund (RDOF) awards were for gigabit services. Unfortunately, however, 85 percent of the non-gigabit locations were awarded to Starlink, a division of SpaceX. That means nearly $900 million of RDOF money is going to SpaceX to deliver broadband service using its Starlink low-Earth-orbit (LEO) satellite fleet with a commitment to deliver 100 Mbps/20 Mbps rural broadband to 642,000 locations in 35 states.

The Fiber Broadband Association (FBA) and NTCA—The Rural Broadband Association commissioned strategy and analyst firm Cartesian to build a model the FCC can use to better evaluate Starlink's ability to meet RDOF performance criteria. The parameters and variables of this model were set to the most favorable assumptions for Starlink, assuming it can launch 12,000 satellites on schedule and align its constellations in a perfect optimal formation. The model also assumed each satellite could deliver its theorical performance of 20 Gbps. After running the model, the FBA and NTCA determined the LEO satellites will experience challenges meeting the RDOF requirements.

RDOF REQUIREMENTS AND GROWTH EXPECTATIONS

To meet its RDOF obligations, Starlink must design its network to deliver service at the bitrates of 100 Mbps downstream and 20 Mbps upstream for "above baseline" service (50 Mbps downstream and 5 upstream) with a bandwidth allowance of ≥ 250 GB or the U.S. median, whichever is higher. This means that any subscriber should be able to receive 100 Mbps during peak hours. However, the growing bandwidth needs of the average household mean that even under the best circumstances, bandwidth needs likely will not be met.

In addition, winners of RDOF funding must begin to offer at least one voice and one broadband service to the service area in question, which might also prove challenging for satellites. Figure 1 indicates a model with two rates of growth for the required capacity: a high case and a conservative low case.

Factors to consider when thinking about current and future bandwidth needs include:

- An increase in the number of online users. RDOF areas likely will have higher usage of online streaming applications because cable TV is generally not available.
- A continuing rise in the number of networked devices through 2030, particularly with the expected increase in video traffic over 4K/UHD, which requires 30–40 percent more bandwidth than HD. This is a clear indicator of the need for increased broadband speeds.

Figure 2 shows the output of the model measuring the capacity of LEO satellites. It

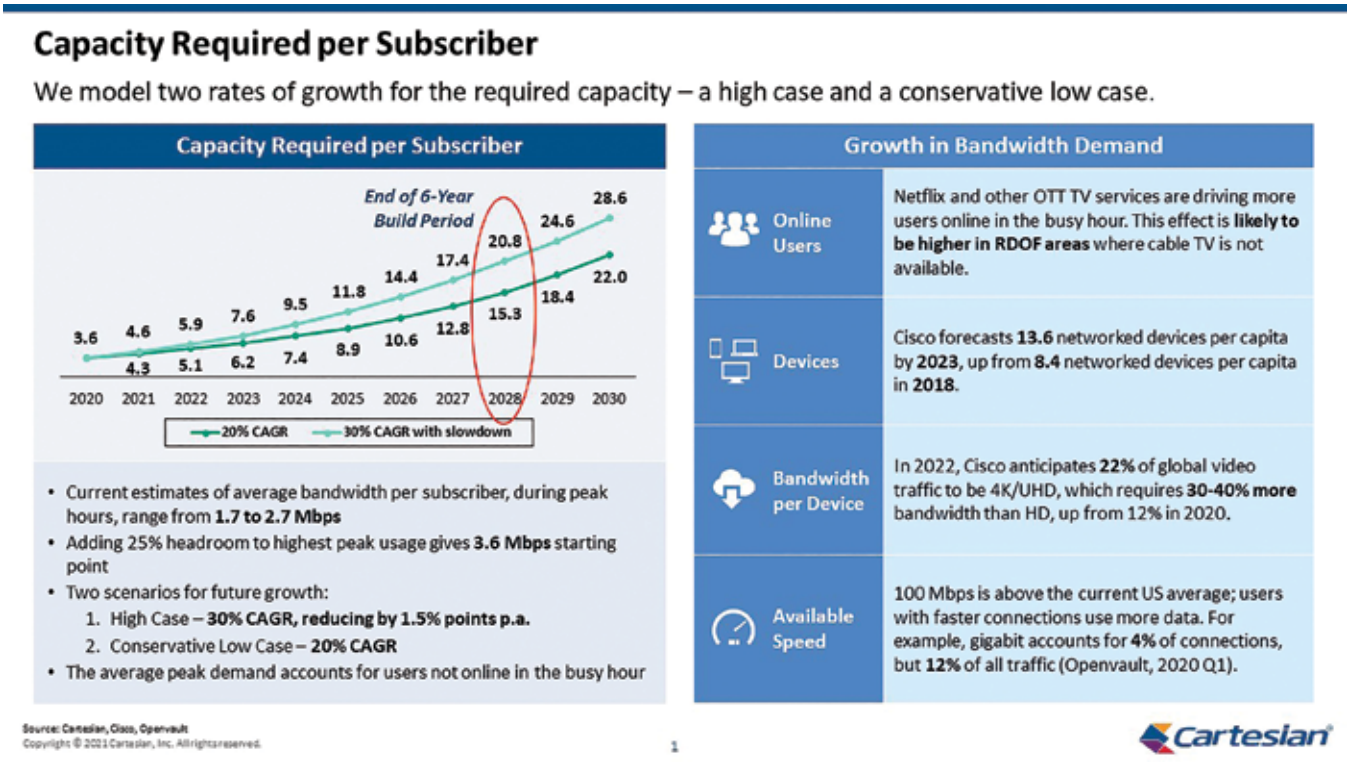

Figure 1. Note: Current estimates of average bandwidth per subscriber, during peak hours, range from 1.7 to 2.7 Mbps.

indicates that more than half of Starlink RDOF subscribers may experience service degradation as early as 2028 in both low-case and high-case capacity requirements of 15.3 and 20.8 Mbps. At least 56 percent of subscribers in the low case and 57 percent of subscribers in the high case will experience service degradation during peak times.

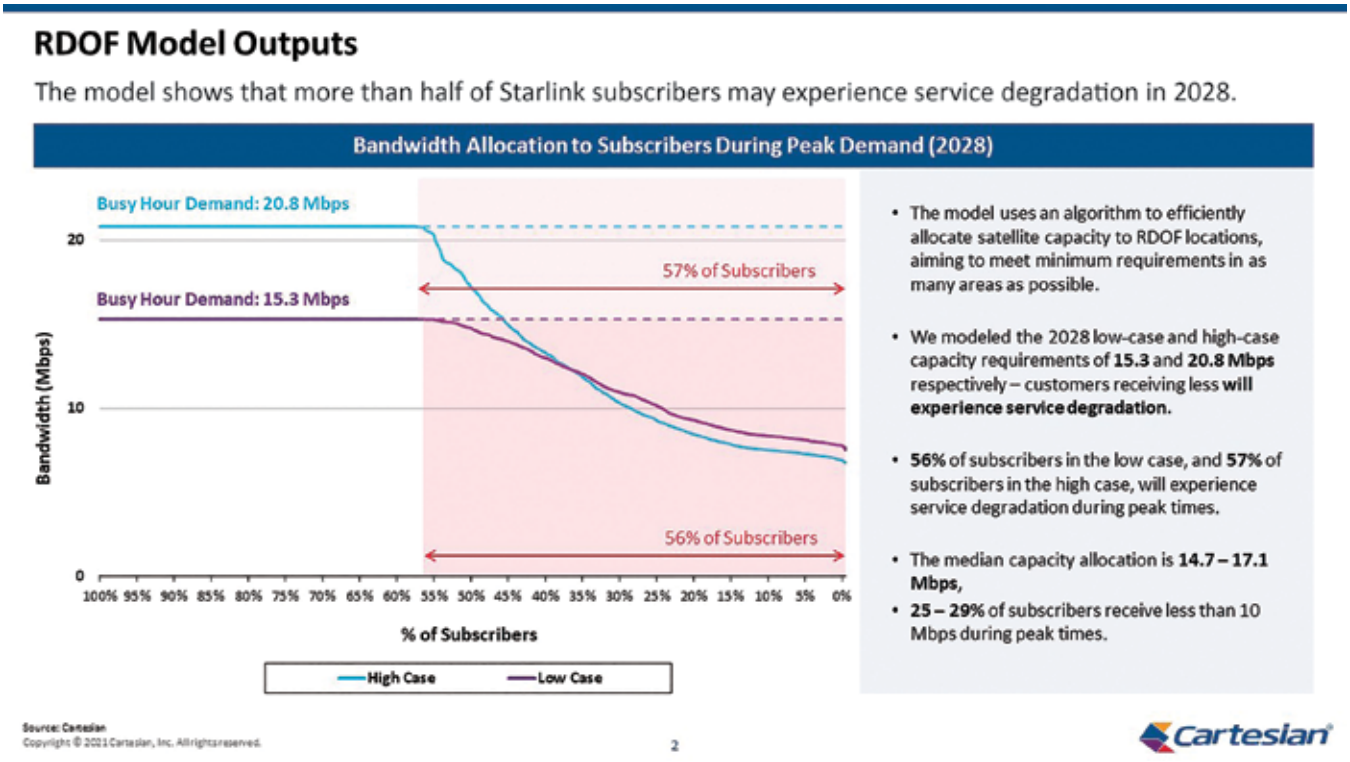

Figure 2.

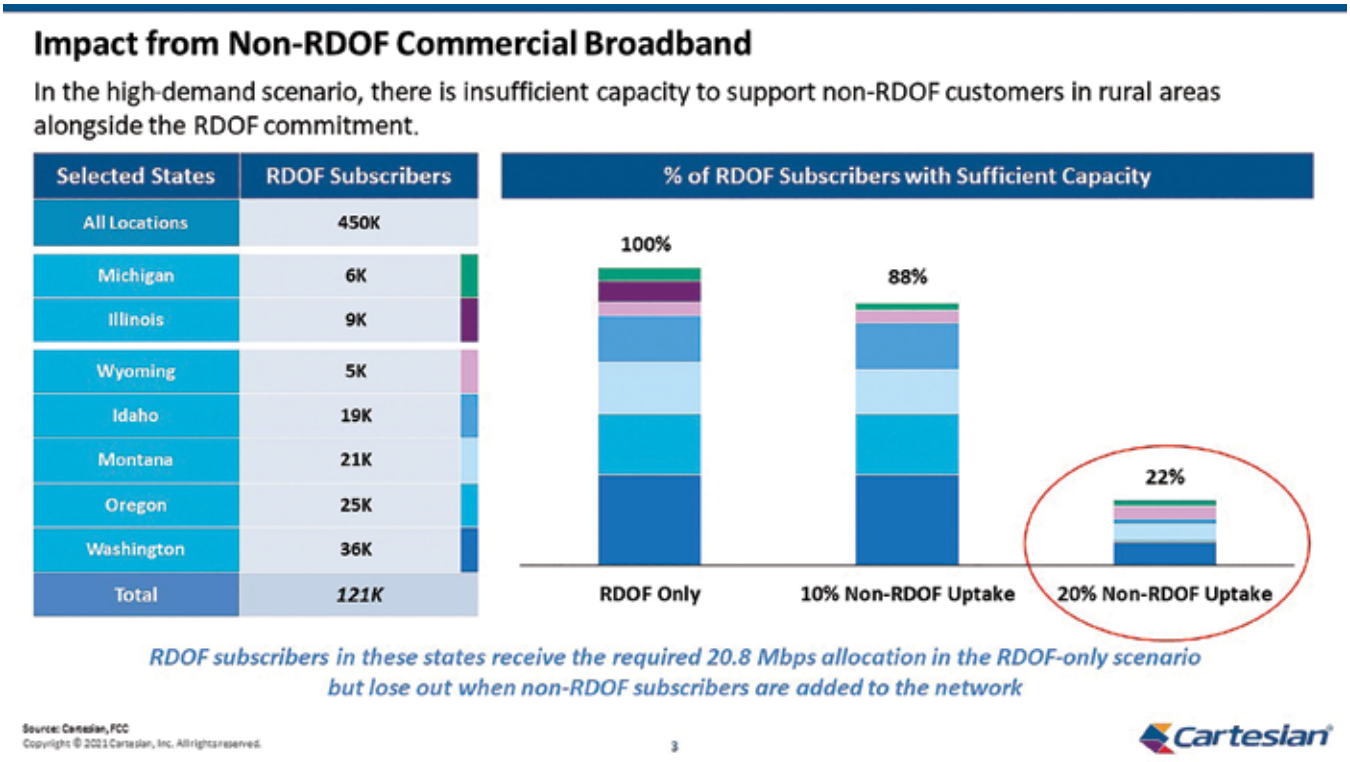

Figure 3.

Furthermore, RDOF service could be significantly worse if Starlink allocates capacity to non-RDOF use cases. Figure 3 shows the outcome from the model using an algorithm to efficiently allocate satellite capacity to RDOF locations, aiming to meet minimum requirements in as many areas as possible. The 2028 model low-case and high-case capacity requirements were set at 15.3 and 20.8 Mbps respectively.

Customers receiving less will experience service degradation. With just 20 percent of its capacity allocated to commercial (non-RDOF) subscribers, only 22 percent of RDOF subscribers will have sufficient broadband capacity (15.3 Mbps to 20.8 Mbps). Given the capacity constraints and the speculation that capacity will be used to serve non-RDOF areas, LEO satellite for broadband services will not be able to meet the future bandwidth needs, nor the RDOF requirements of 100 Mbps downstream and 20 Mbps upstream.

OVERLY OPTIMISTIC ASSUMPTIONS

After the FBA and NTCA filed the LEO satellite assessment and model with the FCC in February, feedback from industry experts suggested that FBA and NTCA assumptions are overly optimistic in favor of Starlink. For example, we modeled a base case of 12,000 Starlink satellites, including 4,408 satellites authorized to operate in the Ku and Ka bands and 7,518 satellites authorized to operate in the V band.

SpaceX found that the V band downlink spectrum was not usable for this application, so only 4,408 satellites should be considered in the Starlink RDOF capacity assessment. This results in our model overestimating Starlink's capacity by 270 percent.

Further, SpaceX indicated to the FCC in a December 2020 ex parte meeting that 250 MHz of its 2 GHz of the Ku band, from the satellite to the user, is unusable. That reduces the effective capacity of each Starlink satellite by 12.5 percent. In addition, Starlink's claim of 20 Gbps per satellite applies only to enterprise class terminals, not residential. The maximum designed data rate for residential terminals is about 13 Gbps.

When considering only these areas of overly optimistic assumptions, the model reduces the assessment of Starlink's broadband capacity by nearly 80 percent. Although we knowingly were generous to Starlink with our assumptions, the intent was to build a model that the FCC can use to scrutinize the Starlink RDOF long-form application. The FCC is then able to input the appropriate assumptions in its efforts to determine whether Starlink can deliver a network that meets the performance criteria promised in the RDOF 904 auction.

Though LEO satellites cannot deliver the required performance for the FCC to approve their long-form applications, the bigger issue is that RDOF locations relegated to LEO satellite service will be on the wrong side of the digital divide, and that gap will widen.

A decade ago, the FCC's national broadband plan was based on 1 Mbps

as the definition of broadband. We are not arguing whether 100 Mbps or 1 Gbps is adequate today, and we expect demand will continue to grow at a 20 to 30 percent CAGR.

FIBER SUPERIOR TECHNOLOGY

It's indisputable that fiber is the goal – nearly every other access technology leverages fiber deployment as deep in its network architecture as is economically feasible. Even the previous CAF-based DSL projects funded middle-mile fiber and fiber to the node, providing a path for subscribers to finally get fiber to the home (FTTH).

Fiber is more than broadband connectivity. It delivers jobs, fuels education and provides billions of dollars in economic development to the communities where it's deployed. For instance, a recent study shows a new fiber network in Chattanooga resulted in 9,516 new jobs and $2.69 billion in economic impact.

In terms of economic value, fiber improves GDP by increasing per-person productivity by up to 300 hours annually, increases home values by 1.8 percent for single-family homes, has the lowest carbon footprint of all technologies because it uses the least power, does not require rocket launches, and is best for telecommuting.

Fiber also delivers critical infrastructure for smart-grid modernization. In the Chattanooga study, fiber deployment resulted in 2.11 million customer interruptions avoided, an average 43 percent reduction in outage minutes, and $421 million in benefits during major weather events. It also reduced 1,865 milliwatts of demand and 10,331 milliwatt hours of electricity consumption over the 10-year study period.

In areas where fiber is deployed, service providers received 80 percent fewer trouble calls. Households with FTTH have a better user experience compared with other technologies because fiber is not affected by weather conditions, natural obstacles such as trees, or other signals as alternative technologies.

Fiber also delivers the 5G future. A 5G network requires a high-capacity, low-latency fiber infrastructure.

Technology continuously evolves, and fiber is no stranger to that. It has come a long way in 50 years, enjoying its fair share of innovation that increased speed and reduced cost and deployment time. Fiber

- Is cheaper than fishing line
- Is a future-ready, build-once technology
- Requires no disruptive upgrades, unlike the competing technologies coax, wireless and copper
- Provides 50,000 times the capacity of wireless or coax and 400,000 times more than copper
- Better supports new applications needing higher upstream bandwidth
- Is more reliable and secure compared with other technologies.

Because customer experience is an essential component in reducing churn, service providers must consider fiber the only technology to provide the best service and meet service-level agreements.

LEO SATELLITES CAN'T COMPETE

LEO satellite technology simply can't compete. It has nothing to build on relative to other technologies, such as fixed wireless access, which serves as a foundation for future fiber buildouts. LEO satellites launched into space can't be built on, have no economic impact, and are subject to interference from weather conditions, which can lead to poor customer experience.

LEO satellite technology is ultimately single-purpose. Without attributes that contribute to the economy, environment and the betterment of users, it is essentially on a path to nowhere. ❖

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