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January 19, 2016

Ms. Marlene Dortch
Secretary
Federal Communications Commission
445 12th St. S.W.
Washington, D.C. 20554

Re: ***Ex Parte Communication:*** **Docket No. 10-90**

Ms. Dortch:

I am filing this ex parte on behalf of Consolidated Companies ("Consolidated") and Great Plains Communications ("Great Plains"), along with other Nebraska companies that serve rural customers in the state ("Nebraska Companies"). The Nebraska Companies have advocated that the Federal Communications Commission ("Commission") implement an optional model to spur broadband deployment by rate-of-return ("RoR") companies. The Nebraska Companies have recommended that in order to reach a significant number of customers with robust broadband service, the Commission should provide model-opting RoR companies at least $200 million annually in additional support plus their legacy support, or provide up to $200 monthly per eligible location.[1] Additional support at the $200 million level will allow significantly more locations to be reached with broadband speeds of 25/3, 10/1 and 4/1 Mbps. If the Commission commits the resources to allow RoR carriers to deploy fiber optic technology deeper into their networks, customers will be better served in the long run. Fiber investments can be leveraged over time to bring service to currently unserved customers and higher speeds to currently served customers. Further, fiber technology can be scaled to serve customers for the long term as broadband speeds continue to grow.

In recent discussions with Commission staff, the important issue has arisen of how locations that are not fully funded under the model will receive broadband service. In those discussions, staff asked whether utilizing alternative technologies, such as fixed wireless and satellite, would make sense to reach some partially-funded locations. Great Plains and Consolidated's experience with alternative technologies leads them to conclude these

[1] *See* Letter and Attachment from Cheryl L. Parrino to Marlene H. Dortch, Secretary, Federal Communications Commission, WC Docket No. 10-90 (filed January 14, 2016).

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technologies are severely deficient. The Commission has also recognized the deficiencies of fixed wireless and satellite, describing them as not scalable and lacking the capabilities of fiber-based networks.[2] A recent filing by ITTA addressed how to deploy broadband to partially funded locations, proposing that model recipients provide broadband service of at least 4/1 Mbps to significant numbers of locations.[3] The Nebraska Companies encourage the Commission to adopt the ITTA proposal because in the long run customers will be better served if the Commission commits resources for the deployment of fiber now rather than forcing the use of alternative technologies and having to invest again when these alternative technologies no longer meet customer needs.

To aid the Commission in its deliberations on how and whether to rely on alternative technologies to reach unserved RoR customers, Consolidated and Great Plains prepared the following description of their experiences and analyses regarding the capabilities of fixed wireless and satellite technologies. Customers that have used these alternative technologies have stated in no uncertain terms that they prefer landline-based broadband. In fact, because of the significant deficiencies connected with wireless or satellite technologies, customers will frequently choose a slower speed landline service over a higher speed alternative technology, as will be reported in this filing. In the business judgment of Consolidated and Great Plains, fixed wireless is a niche service suitable in limited circumstances for some areas, but is not now and never will be a technology that should be used to service large areas of rural America. When speeds were much lower and customers only used the Internet for web browsing and email, fixed wireless perhaps performed adequately — however, that situation no longer exists. Satellite broadband service is "better than nothing," but is not a service that customers want if alternatives are available.

Fixed Wireless Technical Analysis

Some limitations of fixed wireless networks are technical and cannot be overcome.[4] Other limitations are economic and can be resolved by making additional investments. When scarce universal service dollars are used to make these investments, one must consider whether the investments are readily scalable to meet future broadband needs. Unlike fiber networks, fixed wireless networks are not efficiently scalable to higher broadband speeds. Rapidly evolving customer usage patterns make network scalability more important than ever. The bandwidth-hogging Bit Torrent user of the early 2000s has been replaced by a more typical millennial household streaming multiple HD programs during the busy hour. This trend toward widespread video streaming is expected to continue. In 2014, consumer

[2] *See* Report and Order, WC Docket No. 10-90 (rel. Oct. 31, 2013), and Report and Order, WC Docket No. 10-90, WC Docket No. 14-58, and WC Docket No. 14-192 (rel. Dec. 18, 2014).

[3] *See* Letter from Genevieve Morelli, ITTA, to Marlene H. Dortch, Secretary, Federal Communications Commission, WC Docket No. 10-90 (filed January 19, 2016).

[4] Much of this technical analysis was derived from the March 2015 paper "Wireless Broadband is Not a Viable Substitute for Wireline Broadband" by Vantage Point Solutions. https://www.ntca.org/images/stories/Documents/fixedwirelesswhitepaper.pdf

Internet video traffic comprised 64 percent of all consumer traffic, and will rise to 80 percent in 2019.[5]

As there are more users on the network and their usage increases over time, wireless carriers can attempt to meet the demand in a variety of ways. First, carriers can manage network resources by imposing stricter capacity limitations on users. Second, carriers can attempt to obtain more spectrum. Unfortunately, spectrum is a limited resource that is becoming more difficult to obtain and increasingly expensive. Third, carriers can upgrade equipment to use the spectrum more efficiently, but wireless equipment is approaching the theoretical maximum of spectral efficiency so additional gains are not promising. Spatial diversity techniques can be used to improve throughput capacity; however, these techniques are not economically viable in sparsely populated rural areas and usually only benefit those customers in close proximity to the tower. As a last resort to increase capacity and speed, a carrier can build more towers, an uneconomic solution for vast rural areas.

A wireless customer's speed depends where the user is located relative to the wireless tower. The closer a customer is to the wireless tower, the higher the customer's speed. A customer located at the edge of a tower's range may have on average a 60% lower data rate than a customer close to the tower. The addition of customers at the edge of a tower's range reduces spectral efficiency, resulting in a disproportionate degradation of service for all other customers on the tower. In rural areas, where towers are spaced widely apart, broadband service may be extremely slow or non-existent for customers far from a tower.

In addition to the proximity of the wireless customer to the tower, the customer's speed also depends on how many others are using the shared network at the same time. Each user's speed and capacity declines as more users are on the network. To build networks economically, wireless carriers design their networks to be over subscribed. Oversubscription worked well when Internet usage was mainly in short bursts, but has become more problematic as customers' usage has changed to include more IP video and other streaming applications. Unless network congestion problems can be remedied, wireless customers' Internet experiences will become increasingly disappointing as needs and expectations grow.

For optimal performance, wireless signals need a "line of sight" between the tower and the customer's location. Terrain and obstacles, such as mountains, hills, buildings and trees, attenuate wireless signals. Signals that may be acceptable at one point in time can be degraded simply by a neighbor erecting a new structure or by trees leafing out in the spring. While some wireless technologies can serve "non-line-of-sight" locations, the throughput is greatly diminished. Some customers cannot be served by fixed wireless without the construction of additional towers. Weather conditions such as rain, fog or snow also attenuate wireless signals, reducing speeds and causing outages.

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[5] "Cisco Visual Networking Index: Forecast and Methodology, 2014–2019," May 27, 2015. http://www.cisco.com/c/en/us/solutions/collateral/service-provider/ip-ngn-ip-next-generation-network/white_paper_c11-481360.pdf

Consolidated's Experience Deploying Fixed Wireless

For a Nebraska Broadband Grant Project,[6] Consolidated tried to implement a hybrid technology solution incorporating both fiber cable and fixed wireless. The fiber portion of the project involved extending fiber from the central office or existing fiber-fed nodes to five wireless tower sites. The wireless portion of the project used TV white space spectrum in a Point to Multi-Point configuration. According to the vendor, the equipment could deliver voice and broadband speeds of up to 12 Mbps. The technology did not require line-of-sight design; thus it should have been suitable for hilly areas such as the Nebraska Sandhills.

The grant specification required that dial tone and broadband at a minimum speed of 4/1 Mbps be provided. This project was to serve 26 customers in a 369 square mile area of Arthur County. After many months of working with its vendor, Consolidated abandoned the wireless project because the equipment did not perform up to specifications and did not meet the grant requirements. The following problems made the project unworkable unless additional towers were constructed, and even then future performance was uncertain:

(a) The equipment didn't transmit adequate data rates to meet the grant requirements. The maximum data rate recorded was 5/1 M when only one customer was connected at a distance of 1 mile and in line of sight of the tower.
(b) The equipment would lose its connection to the wireless hub on a regular basis.
(c) Many locations could not be connected to the tower, even though the product purportedly didn't require line-of-sight connections. The wireless signal could not penetrate foliage or reach customer locations in the valleys of the Sandhills where the customers live.
(d) Dial tone quality was not reliable. Callers would experience delay, jitter and echo.

To make the technology function as required, Consolidated would have needed to construct many more towers at a cost comparable to that of fiber-to-the-home ("FTTH"). Consolidated chose instead to spend the money on FTTH facilities because the network would be "future proof" and its performance would be significantly better.

Great Plains' Experience Deploying Fixed Wireless

Great Plains also built a fixed wireless network in its Arnold exchange in central Nebraska for a state Broadband Grant Project using two 6 MHz blocks of 700 MHz spectrum it already owned. At the time the network was designed in 2012, the 25 Mbps of shared bandwidth per up or down channel seemed adequate, but as customers were connected, the bandwidth was depleted quickly. Only a few customers using the service for video streaming exhausted the entire bandwidth of the tower and had to be disconnected. New customers are being asked to only use the service for email and web browsing, not video streaming. Great Plains also encountered several other problems that made the project less economical:

[6] The Nebraska Public Service Commission has devoted a portion of the Nebraska Universal Service Fund ("NUSF") support to broadband deployment of specific projects submitted by companies. This program is supplemental to the primary NUSF mission of providing high-cost support for companies to build and maintain networks for voice and broadband services in rural areas of the state.

- Great Plains engineers expected that approximately 200 customers could be served on a three-sector tower. In reality, only about 45 customers could be served per tower. The difference in the counts of customers that could actually be served vis-à-vis the expected number of customers from engineering design was a result of changes in customers' usage patterns to include more video.
- To maximize bandwidth utilization, Great Plains had to change from an indoor modem to an outdoor, pole-mounted model. This change increased the cost by about $200 per modem.

Great Plains has investigated ways to salvage its fixed wireless investment by either severely limiting customers' Internet experience or making additional investments. The options available to Great Plains include the following: (a) add more sectors to each tower, (b) purchase a deep packet inspection device and monitor customers' Internet usage in order to dynamically reduce the bandwidth being consumed by video streaming, (c) reduce customers' service offerings to 1/1 Mbps in violation of the grant program's requirements, or (d) purchase additional spectrum at unknown cost and availability.

While the equipment generally performed as expected, the lack of scalability is problematic. Given that the Busy Hour Offered Load ("BHOL") is about five times higher than it was three years ago, the 12 MHz of spectrum used for this project does not begin to handle the traffic loads generated by customers today. In retrospect, Great Plains could have deployed a fiber-fed remote digital terminal for every rural location in the Arnold exchange for less than the cost of the wireless system.

Satellite Technical Analysis

The goal of the Commission is to stimulate deployment of more broadband-capable infrastructure while retaining voice service. If universal service money is diverted to fund satellite technology, it will not be available to deploy additional terrestrial infrastructure. Without adequate funding in place to upgrade existing wireline infrastructure, eventually it will not remain functional, which means that many customers will have neither voice nor broadband service. In the most remote areas, wireless service is not universally available or dependable. Where wireless service is available, the towers are generally connected using high-capacity, wireline fiber facilities. In rural areas, most investments in these fiber facilities are only possible because of the support of universal service.

Satellite is not a panacea for remote areas. Satellite is not a good choice for voice service because the transmission delay is noticeable to users, especially for calls between two satellite users as might happen in rural areas only served by satellite. Packet loss and packet corruption also degrade the quality of satellite voice service. The technical limitations of satellite mean that customers generally only choose satellite broadband when there is no other option available. Satellite broadband service suffers from high latency, capacity

limitations and degradation due to environmental factors.[7] Technical advances may ease some of satellite's limitations, but latency problems and environmental interference cannot be solved. Capacity constraints may be mitigated by technical advancements or the launch of additional satellites, but the capacity available on a satellite is much smaller than that on a single strand of fiber. Specific concerns include:

(a) *Latency*[8]—Geostationary satellites, located more than 22,000 miles above the equator, are commonly used to deliver fixed broadband service. Even though signals travel at the speed of light, given the distance that a signal must travel from a customer's location to the satellite and back, latency will always be a problem for satellite communications. The latency experienced by satellite users is more than 20 times the latency of typical landline communications and limits the service to applications that are not real time. Technical improvements, such as protocol acceleration and information caching, can minimize latency by reducing how often the base station must communicate with the satellite. Nevertheless, latency for broadband applications remains high.

(b) *Capacity*—A limited amount of shared spectrum is used to provide broadband to all customers on the satellite. As customers' usage increases or more customers are added, the spectrum is depleted. Satellite providers respond by placing strict capacity constraints on their customers. Additional satellites can ease the capacity limitations, but since there must be orbital separation of between two and three degrees, there is a limit on the number of geostationary satellites that can be put into orbit. In the future, normal Internet use will be highly video intensive,[9] tailored to the customer needs, and satellite providers will be unable to provide that experience to their customers. With data caps ranging from 5 to 25 GB per month, a consumer will be able to watch, at most, just over eight hours of HD video before being cut off by the satellite data caps.[10]

(c) *Environmental Interference*—Rain, ice and snow interfere with the signals from a satellite, making the service unreliable. The newer, higher-capacity satellites utilize higher frequency bands, which are even more susceptible to weather interference. The problem is exacerbated in the northern United States because satellite dishes must be aligned at low elevations, causing signals to travel longer distances through the atmosphere to reach the satellite. In addition, for several weeks twice a year sun

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[7] Much of this technical analysis was derived from the November 2013 paper, "Analysis of Satellite-Based Telecommunications and Broadband Services," by Vantage Point Solutions. http://apps.fcc.gov/ecfs/document/view?id=7520956711

[8] Latency is a measurement of the delay that occurs from the time a signal is sent to the time it is received. Round-trip latency is used to evaluate two-way communications systems.

[9] According to Cisco, "video traffic will be 80 percent of all consumer Internet traffic in 2019," and 70 percent of the video traffic will be HD. "Cisco Visual Networking Index: Forecast and Methodology, 2014–2019," May 27, 2015. http://www.cisco.com/c/en/us/solutions/collateral/service-provider/ip-ngn-ip-next-generation-network/white_paper_c11-481360.pdf

[10] Watching video uses about 1 GB of data per hour for standard definition and up to 3 GB of data per hour for high definition. https://help.netflix.com/en/node/87

spots also create outages lasting in excess of 15 minutes per day. These reliability issues associated with satellite make it unsuitable for emergency services.

Great Plains' Experience as a Satellite Reseller

Great Plains has resold two distinct satellite service products and has more than 500 satellite customers, generally in areas that do not have terrestrial broadband available. One service is available for new customers, while the other only remains available to existing customers. At times when the newer service's satellite beam is full, new customers cannot subscribe to the service. Such prohibitions on new customers have lasted up to 18 months. In Midwestern states, customers are limited to a package with speeds of 5/1 Mbps and capacity limits between 5 and 25 GB.[11] Once these customers exceed their capacity limits, they must buy extra capacity at a $10 per GB. When customers of the grandfathered service exceed their capacity limits, they are restricted to dial-up speeds.

Great Plains views these satellite services as stop-gap offerings for customers who don't have access to terrestrial broadband. Great Plains personnel report that most customers prefer a lower-speed 512/512 Kbps wireline product to satellite service, given satellite's high installation costs and low-capacity limits. Customers who want to use low-latency applications, such as video conferencing and gaming, are not satisfied with satellite service. Great Plains also finds that businesses generally don't want satellite service because the latency and lack of a static IP address make the service unsuitable for VPN use. Customers who have high data needs find the capacity limits too stringent. In 2015, satellite providers sent 580 emails to Great Plains customers notifying them that they exceeded or were about to exceed their capacity limits. Thus, on average every customer exceeded or nearly exceeded his or her capacity limit during the year, assuming the emails were evenly spread among customers. Even minimal television or movie viewing over satellite can cause a customer to exceed capacity limits. Customers also have to schedule computer software updates at night during a period when capacity limits don't apply or risk not being able to complete the update.

The quantity of trouble reports for satellite broadband service is also much higher than for wireline broadband service, the company has found. During the past year, Great Plains received 935 trouble calls from the approximately 500 satellite customers, almost two calls per customer per year. In contrast, Great Plains wireline broadband customers reported significantly less than one trouble report per year. The following are a sampling of customers' comments regarding their satellite broadband service:

- "When will high speed broadband be available to rural customers south of Wisner? Getting tired of … high prices and data limits and lack of speed, i.e. no streaming, usages of normal sites seems to gobble data at an extreme rate."
- "Satellite service is too slow to bid in on-line cattle auctions."

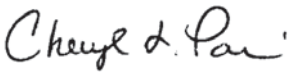
[11] Customers in other parts of the United States can subscribe to 12/1 M service.

Summary

Consolidated and Great Plains provide the above documentation to demonstrate that rural RoR customers would greatly benefit from RoR model support being used to deploy fiber further into rural networks. Fiber investments can be leveraged over time to bring service to currently unserved customers and higher speeds to currently served customers. As customers have experienced, alternative technologies such as fixed wireless and satellite offer service that is inferior to landline broadband. The Nebraska Companies respectfully request that in order to reach a much larger number of customers with robust broadband service, the Commission should provide at least $200 million in additional annual support,[12] or provide up to $200 monthly per location for companies that elect the model. The Nebraska Companies also request that the Commission adopt the ITTA proposal on commitments to serve partially funded locations with broadband service of at least 4/1 Mbps.

Consolidated and Great Plains welcome inquiries from the Commission about the above "real-world" experiences. Contact Ken Pfister of Great Plains at 402-427-3942 (kpfister@gpcom.com) or Wendy Thompson Fast of Consolidated Companies at 402-489-2728 (wfast@nebnet.net).

Respectfully submitted,



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[12] Companies opting for the model should receive their existing legacy support plus additional support.