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May 10, 2018

VIA ELECTRONIC FILING

Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

**Re: *Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz,*
GN Docket No. 17-183; *Expanding Flexible Use of the 3.7 GHz to 4.2 GHz Band,*
GN Docket No. 18-122**

Dear Ms. Dortch:

On May 8, 2018, Mark Hess, Senior Vice President, Business and Industry Affairs; Margaret Tobey, Senior Vice President, Regulatory Affairs, NBCUniversal; David Don, Vice President, Regulatory Policy, Comcast; and the undersigned met with Erin McGrath, Wireless, Public Safety, and International Advisor to Commissioner Michael O’Rielly. During the meeting, we discussed the critical role C-Band satellite transmissions play in the video distribution ecosystem generally, and for Comcast and NBCUniversal in particular. We also described the innovation that continues to occur in the C-Band, the ongoing need for this spectrum to accommodate new video technologies, and the limits of fiber as a full substitute for the ubiquitous coverage and reliability of C-Band satellites. Finally, we noted that any NPRM seeking comment on efforts to repurpose C-Band spectrum should address the complex questions about potential impacts on the video distribution ecosystem. The attached presentation guided our discussion.

Please direct any questions to the undersigned.

Respectfully Submitted,

/s/ Brian M. Josef
Brian M. Josef
Comcast Corporation

Attachment

cc: Erin McGrath



Critical C-Band Operations

May 2018

The C-Band

- **Critical link in video distribution sourced from national and regional programmers**
 - 3.7-4.2 GHz band for downlink from satellites
 - 6 GHz band for uplink to satellites
- **Satellite service provides ubiquitous coverage, including rural areas that are difficult to serve using other technologies**
- **C-Band satellite transmissions ideally suited to point-to-multipoint video distribution**
 - Efficient, ubiquitous coverage, including difficult-to-serve rural areas
 - Robust resistance to rain fade
- **FCC estimated 4,700 earth stations, but number likely higher**
 - ACA indicates 90% unregistered, SES and SIA estimate over 33,000 total
 - FCC is appropriately seeking more accurate information through earth station registration window

Comcast Depends on Availability and Integrity of C-Band Satellite Links

- Comcast uses hundreds of C-Band receive earth stations at locations throughout the country
- Approximately 80% of video programming is received by Comcast via C-Band satellites
 - 6,600 distinct video services
 - 148 transponders
 - 20 satellites
- Comcast's "head-end in the sky" (HITS) service distributes programming to small and midsize MVPD headends in rural areas via C-Band
 - 270+ services
 - 39 programmer groups
 - 300 cable operators
 - 900 cable systems
 - 900,000 subscribers
- For example, nearly 700 Comcast programming services operate in the 3700-3800 MHz portion of the C-Band downlink
- The current constellation of C-Band satellites is heavily utilized
 - Approx. 86% of transponders on the 20 satellites utilized by Comcast carry full-time feeds

NBCUniversal Depends on Availability and Integrity of C-Band Satellite Links

➤ NBC Network

- 1 full C-Band transponder
- Video sent to approx. 240 C-Band earth stations at affiliate locations in each market
- **Serves 114 million households**

➤ Telemundo

- 1 full C-Band transponder
- Video sent to approx. 80 C-Band earth stations at affiliate locations in each market
- **Serves 14 million Hispanic households**

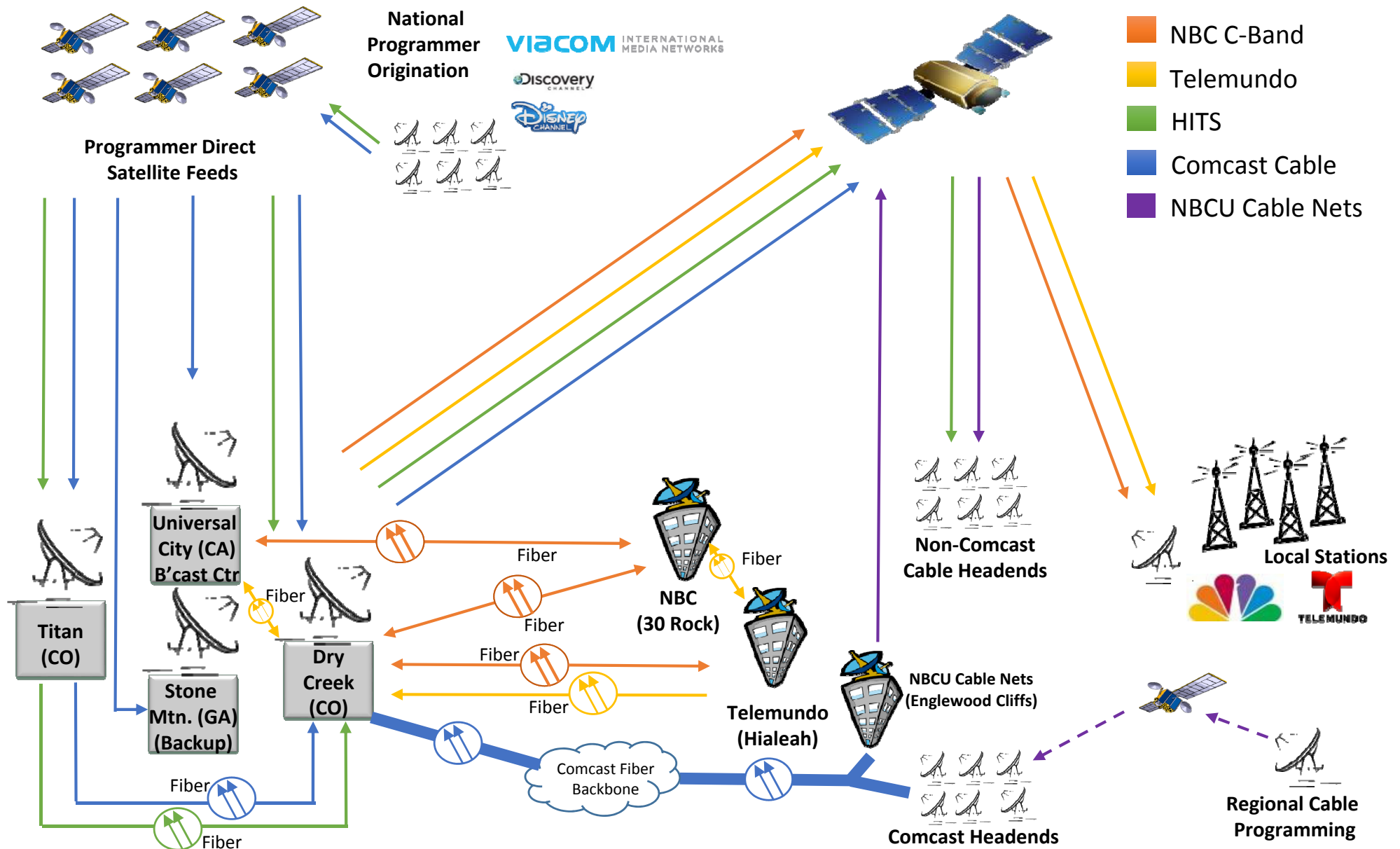
➤ NBCUniversal Cable Networks

- 11 full C-Band transponders
- Video sent to approx. 5,000 MVPD headends around U.S.
- **Serves 100 million households**

➤ Syndicated Programming

- 2 full C-Band transponders used for inbound distribution of syndicated programming to 11 NBC O&O stations **serving more than 32 million households**
- C-Band also used by outside vendors who deliver NBCUniversal's outbound syndicated programming to approximately 200 TV stations in U.S.

Comcast NBCUniversal Video Distribution



Satellite Video Distribution in the C-Band Continues to Evolve

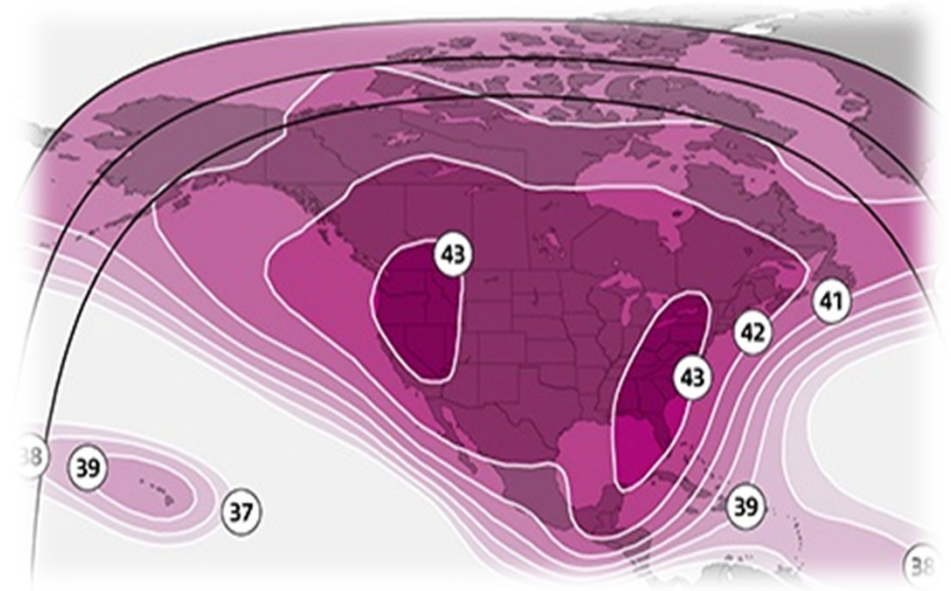
- **Satellite technology has evolved to meet customers' increasing demands**
 - MPEG encoding advances yield compression rates from 3:1 to 9:1 or higher
 - Advanced modulation schemes increase spectral efficiency
 - 8PSK now used to carry HD feeds; implementation of 16ASK and 32ASK for Ultra-HD video coming
 - BUT, advanced modulation and encoding schemes are more sensitive to interference (i.e., require higher E_b/N_0 to meet maximum BER requirements)
- **Innovations are driving the need for more spectrum, not less**
 - Advances in programming / transmission technologies shift capacity demands.
 - Emergence of 4K and other high-bandwidth video technologies are driving demand for more C-Band capacity
 - 1 transponder = 20 SD channels = 8 HD channels = 4 UHD/4K channels
 - Likely need for more transponders to innovate
 - FCC decisions to reallocate C-Band spectrum should not bind deployment decisions that limit technologies consumers demand (e.g., HD, Ultra-HD)

The FCC's NOI Raises Questions About Potential Impacts of Repurposing the C-Band

- **If the FCC moves forward with an NPRM, it should consider the effects on video distribution in the U.S.**
- **If the FCC seeks comment on repacking the nation's video distribution services in less spectrum, it should address impacts on video transmission:**
 - Channel occupancy and power spectral density would increase, increasing risk of adjacent satellite interference at earth stations
 - Multiple carriers sharing a single transponder would increase, increasing risk of intermodulation interference or requiring additional transponder input back-off, and raising operational complexity
 - Signal quality (E_b/N_0) degradation of a few tenths of a dB can increase transmission errors (BER) by orders of magnitude
 - Equivalent portion of the 6 GHz spectrum would become underutilized, as downlink channels are paired with uplink channels

C-Band Satellite Coverage is Ubiquitous and Uniquely Suited for Certain Applications

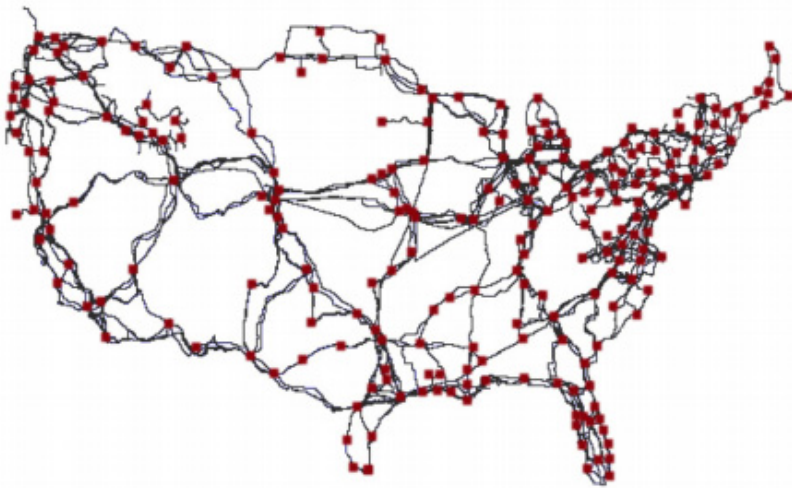
- **C-Band satellites cover 100% of the U.S.**
- **C-Band satellites enable remote programming**
 - Live news
 - Live sports
 - Portable uplink/downlink gear
 - Remote locations
 - Transmit location not known in advance



Source: SES

Fiber Is Not a Full Substitute for the C-Band

- **America's current fiber footprint is inadequate to take over for C-Band**



Source: T-Mobile Comments, GN Docket No. 17-183, at 14 & n.56.

- **To meet current consumer demands for reliability, duplicative and redundant fiber runs would be needed**
 - Comcast's experience shows few content providers using fiber as primary distribution due to fiber's inability to match C-Band's reliability, ubiquitous coverage and costs.
 - Handoffs from multiple fiber network vendors would likely be required, complicating service quality and reliability (e.g., SLAs).
 - Additional transaction costs and difficulty of determining cause of outages serve as further deterrent