March 14, 2019

VIA ECFS

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

Re: Notice of Ex Parte Presentation

GN Docket No. 18-122, Expanding Flexible Use of the 3.7 to 4.2 GHz Band
GN Docket No. 17-258, Promoting Investment in the 3550-3700 MHz Band
RM-11791, Petition for Rulemaking to Amend and Modernize Parts 25 and 101 of the Commission’s Rule to Authorize and Facilitate the Deployment of Licensed Point-to-Multipoint Fixed Wireless Broadband Service in the 3.7-4.2 GHz Band
RM-11778, Fixed Wireless Communications Coalition, Inc., Request for Modified Coordination Procedures in Band Shared Between the Fixed Service and the Fixed Satellite Service
WT Docket No. 18-197, Applications of T-Mobile US, Inc., and Sprint Corporation for Consent to Transfer Control of Licenses and Authorizations

Dear Ms. Dortch:

On March 12, 2019, Craig Cowden, head of wireless technologies for Charter Communications, Inc. (“Charter”), Colleen King, also of Charter, and the undersigned met with Nicholas Degani and Rachael Bender, advisors to Chairman Pai; Commissioner Michael O’Rielly and his advisor Erin McGrath; Commissioner Brendan Carr and his advisor Will Adams; Umair Javed, advisor to Commissioner Rosenworcel; William Davenport, advisor to Commissioner Starks; and Donald Stockdale, Dana Shaffer, Joel Taubenblatt, and Matthew Pearl of the Wireless Telecommunications Bureau regarding the above-captioned matters.

At the meetings, we discussed the company’s Spectrum Mobile product and our potential plans for next steps. These potential plans are illustrated in the attached deck, which we walked through with the FCC meeting participants. We explained that Charter is working to combine its advanced wireline network with innovative wireless technologies to deliver the next generation of broadband to customers across the country—regardless of whether they are inside their homes and offices, or outside on the go. We also discussed the importance of mid-band spectrum,
including the 3.7-4.2 GHz band (or C-Band), for 5G mobility and fixed wireless, especially for rural broadband deployments. For these reasons, we explained that Charter supports maximizing the amount of spectrum available for 5G through open and transparent processes.

In addition, we were asked about limitations to our existing MVNO agreement. We explained that we are under an NDA and directed them to our response to the FCC’s request for information in the pending Sprint/T-Mobile transaction proceeding.

Please direct any questions regarding the foregoing to the undersigned.

Respectfully submitted,

/is/ Elizabeth Andrion
Elizabeth Andrion
Senior Vice President
Regulatory Affairs

Attachment

cc: Commissioner Michael O’Rielly
Commissioner Brendan Carr
Nicholas Degani
Rachael Bender
Erin McGrath
Will Adams
Umair Javed
William Davenport
Donald Stockdale
Dana Shaffer
Joel Taubenblatt
Matthew Pearl

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1 See, e.g., Reply Comments of Charter Communications, Inc., GN Docket No. 18-122 (Dec. 11, 2018); Comments of Charter Communications, Inc., GN Docket No. 18-122 (Oct. 29, 2018); see also Letter from Elizabeth Andrion, Senior Vice President, Regulatory Affairs, Charter Communications, Inc., to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-122 (Feb. 22, 2019).
Fixed Mobile Convergence

**Transition from nomadic Wi-Fi network to a full mobility network**

**From “Wireless” to “Mobility”**
Umbrella MVNO for coverage, Wi-Fi/4G small cells for capacity

**Inside-Out Strategy**
80% wireless traffic inside, Opportunistic outdoor

**From Macro to Small Cell**
Densify with 4G Small Cells 3.5GHz/CBRS

**5G Solutions**
1000x capacity increase
Ultra low latency
1. Extreme Broadband
2. Massive IoT
3. Mission Critical Services

**MVNO – 3G/4G Access**

**MNO Network**

**Charter Mobile Core – EPC**

**Charter Network**

**Wi-Fi Access**

**Small Cell Access**

**Wi-Fi Technology** – Drives much higher bandwidth at much lower cost providing for efficient offload

**Small Cell Access**

3.5 GHz
5G
3.5 GHz
5G

**3.5 GHz** - Provides for licensed micro layer coverage and mobility.

**5G Technology** – Drives much higher bandwidth at much lower latency for next generation services (e.g. Autonomous Vehicles, Mobile, VR)

**Business Value:** Positioned to deploy existing assets – power, backhaul, ROW - to enable seamless connectivity

**Offloading MVNO traffic to Wi-Fi/small cell infrastructure is critical to customer experience and economic success**
MVNO Continuum

<table>
<thead>
<tr>
<th>Macro RAN Coverage</th>
<th>Product Roadmap Control</th>
<th>SIM Card Migration Control</th>
<th>Roaming Control</th>
<th>Small Cell Integration</th>
<th>WiFi Offload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light MVNO</td>
<td>MNO Managed</td>
<td>MNO Managed</td>
<td>MNO Managed</td>
<td>N/A</td>
<td>MVNO Managed</td>
</tr>
<tr>
<td>Service MVNO</td>
<td>MNO Managed</td>
<td>MVNO Managed</td>
<td>MVNO Managed</td>
<td>N/A</td>
<td>MVNO Managed</td>
</tr>
</tbody>
</table>

**MVNO Models with Small cell integration**

- **Light MVNO**
  - MNO Managed
  - MNO/MVN Managed
  - MNO/MVN Managed
  - MNO/MVN Managed
  - MNO/MVN Managed

- **Service MVNO (Dual SIM)**
  - MNO Managed
  - MVNO Managed
  - MVNO Managed
  - MVNO Managed
  - MVNO Managed

- **Full MVNO**
  - MNO Managed
  - MVNO Managed
  - MVNO Managed
  - MVNO Managed
  - MVNO Managed

**Ability to deploy and integrate small cells**
Charter CBRS Trial – Phase 2 + Dual SIM Development

Validate efficacy of dual-SIM phone to seamlessly switch between small cell & macro
When proven, drives better connectivity and product control of mobility service

- A total of 262 (142 in NY & 120 in LA) sites planned across New York and Los Angeles markets
- Multiple clusters designed in different morphologies such as Urban, Suburban, Industrial & Residential
Smart Farm Field Test: C-Band, LoRA, and IoT

Business Value: Combine licensed and unlicensed spectrum to maximize efficient cost structure for industrial IoT

42 field sensors

C-band 5G NR

LoRa

5 GHz

100 Mbps @ 610m

5 GHz

C-band 5G NR

[429 Mbps @ 4.5km]

Farmhouse

Hog House 1
8 sensors

Hog House 2
5 sensors

Hog House 3
14 sensors

Hog House 4
14 sensors

5 GHz

60 GHz

1 Gbps @ 60m

360° Camera

LTE based drone

60 GHz

1 Gbps @ 75m

Grain silos

Business Value: Combine licensed and unlicensed spectrum to maximize efficient cost structure for industrial IoT
Mid-Band Spectrum – CBRS & C-Band

CBRS is unique spectrum sharing band, but only identifies 70MHz of licensed spectrum, and with narrow channel sizes not ideal for 5G mobility.

C-Band identifies as much as 500MHz, with wide channel sizes suitable for true 5G mobility

Significance of tiers in CBRS:
- Tier 1 incumbents have protection from PAL and GAA
- Tier 2 (PAL) has priority over GAA, 10 MHz licensed blocks at the county level
- Tier 3 (GAA) can use any spectrum unused by upper tiers

CBRS Spectrum Sharing model

<table>
<thead>
<tr>
<th>Tier</th>
<th>Description</th>
<th>Spectrum Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier 1</td>
<td>Incumbents</td>
<td>3550 MHz - 3700 MHz</td>
</tr>
<tr>
<td>Tier 2</td>
<td>Priority Access License (PAL)</td>
<td>3600 MHz - 3650 MHz</td>
</tr>
<tr>
<td>Tier 3</td>
<td>General Authorized Access (GAA)</td>
<td>3700 MHz - 3800 MHz</td>
</tr>
</tbody>
</table>

Today, C-Band currently used by satellite operators in downlink exclusively for broadcasters/programmer video transport

Potential to create much wider channels per operator for terrestrial 5G (as compared to 10 MHz channels in CBRS)

Ability to deliver Gigabit speeds wirelessly for both fixed and mobile traffic if freed from satellite usage

Gives fair access at offering a competitive 5G wireless solution