

August 2, 2018

Ex Parte

Marlene 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

Dear Ms. Dortch:

On July 31, 2018, representatives from Apple Inc., Broadcom Inc., Cisco Systems, Inc., Facebook, Inc., Google LLC, Hewlett Packard Enterprise, Intel Corporation, Marvell Technology Group, Microsoft Corporation, Qualcomm Incorporated, and Ruckus Networks, an ARRIS Company met with representatives of the Office of Engineering and Technology, Wireless Telecommunications Bureau, and International Bureau. A complete list of participants is attached to this letter.

In the meeting, we discussed the attached presentation addressing protections for fixed-service incumbents in the 6 GHz band.

Pursuant to the FCC's rules, I have filed a copy of this notice electronically in the above referenced docket. If you require any additional information, please contact the undersigned.

Sincerely,



Paul Margie
Counsel to Apple Inc., Broadcom Inc., Facebook, Inc., Hewlett Packard Enterprise, and Microsoft Corporation

Enclosures

cc: meeting participants

MEETING ATTENDEES

Julius Knapp (OET)
Bahman Badipour (OET)
Brian Butler (OET)
Martin Doczkat (OET)
Rashmi Doshi (OET)*
Michael Ha (OET)
Walter Johnston (OET)
Allen Magnusson (OET)
Jordan McWilliams (OET)
Paul Murray (OET)
Nicholas Oros (OET)
Aspasia Paroutsas (OET)
Robert Pavlak (OET)
Barbara Pavon (OET)
Jamison Prime (OET)
Karen Rackley (OET)
Axel Rodriguez (OET)*
Rodney Small (OET)
Hugh Van Tuyl (OET)
Ronald Williams (OET)*

Jose Albuquerque (IB)
Christopher Bair (IB)*
Diane Garfield (IB)

Peter Daronco (WTB)*
Thomas Derenge (WTB)*
Ariel Diamond (WTB)
Paul Powell (WTB)*
Blaise Scinto (WTB)
Jeffrey Tignor (WTB)

Mark Neumann, Apple Inc.
Chris Szymanski, Broadcom Inc.
Mary Brown, Cisco Systems, Inc.
Peter Ecclesine, Cisco Systems, Inc.*
Michael Tseytlin, Facebook, Inc.
Megan Stull, Google LLC
Chuck Lukaszewski, Hewlett Packard Enterprise
Reza Arefi, Intel Corporation
David Horne, Intel Corporation*
Hassan Yaghoobi, Intel Corporation*
Hui-Ling Lou, Marvell Technology Group*
Yi-Ling Chao, Marvell Technology Group*
Paula Boyd, Microsoft Corporation
Scott Blue, Microsoft Corporation*
Dean Brenner, Qualcomm Incorporated
Tevfik Yucek, Qualcomm Incorporated
Stuart Kerry, Ruckus Networks, an ARRIS Company*
Paul Margie, Harris, Wiltshire & Grannis LLP
Paul Caritj, Harris, Wiltshire & Grannis LLP

* Participated telephonically.

6 GHz: Additional FS Protection Discussion

July 31, 2018

Introduction

- Central goal for the NPRM: Establish robust protection of incumbents with flexible rules to support investment and innovation
 - Start with existing U-NII-3 technical rules as a baseline
 - Add requirements necessary to protect 6 GHz incumbent operations from harmful interference

Automated Frequency Coordination

Automated Frequency Coordination (AFC) is a mechanism that determines coordination contours for licensed systems based on applicable databases, identifies available frequencies to avoid harmful interference to these systems, and is part of the remediation process.

- *AFC Registrar* is responsible for administering the AFC systems through interaction with AFC operators
- *AFC Operator* is a certified entity that determines protection contours for licensed systems based on applicable databases and identifies available frequencies for RLAN use
- *AFC Master* is an unlicensed device that is certified under FCC rules that require it to determine its geo-location, operate pursuant to an AFC grant, and specify available channels to connected client devices
- *AFC Client* is an unlicensed device that operates under the control of an AFC Master

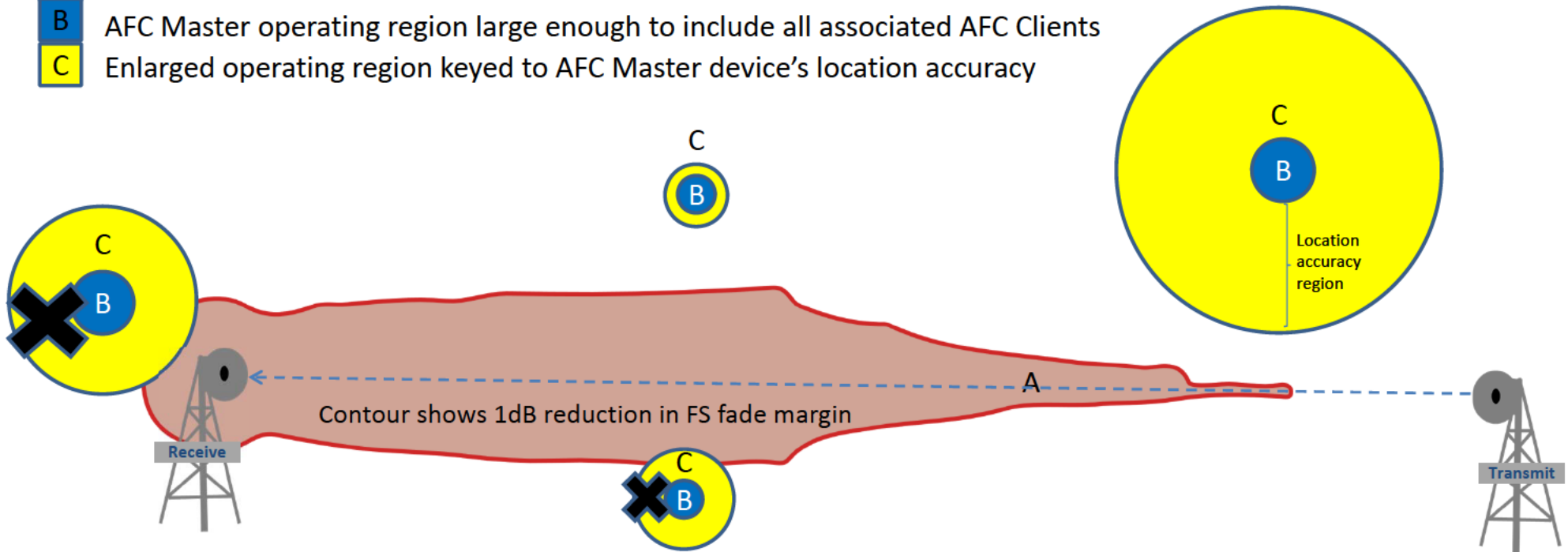
A Robust and Flexible AFC

- **Incumbent Protection**: The AFC prevents RLAN operations if individual RLAN's emissions exceed an interference threshold (i.e., -6 dB I/N) into any individual incumbent link. The AFC allows incumbents to:
 - Grow the size and capacity of their networks
 - Benefit from continuity of protection (e.g., channel permissions expire in a month unless reauthorized by AFC)
- **Targeted rules**: AFC rules should be limited to those necessary to protect incumbents and should not include unnecessary rules that suppress investment and broadband deployment
 - Rules should be based on real-world conditions—virtually every FS receiver has significant signal suppression outside of the main-beam
 - AFC rules should be simple and focused, only requiring coordination directly with applicable databases
- **Flexibility to Innovate**: Allow for a wide range of implementations; repeat the success of 5 GHz innovation in the 6 GHz band
 - While rules should be defined, the government should not prescribe technologies or standards
 - Geolocation accuracy requirements should not be fixed
- **Security**: The AFC system and all of its implementations must have robust security protections

Flexible Geolocation While Ensuring Incumbent Protection (X, Y)

- A** Protection contour necessary to protect FS Receiver's operating frequency
- B** AFC Master operating region large enough to include all associated AFC Clients
- C** Enlarged operating region keyed to AFC Master device's location accuracy

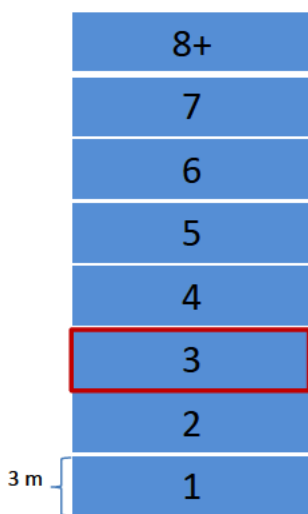
Not to scale



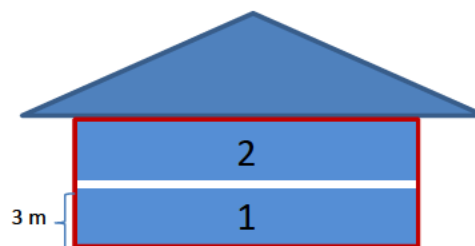
Channel Access: AFC Master Device communicates its location to the AFC Operator, its AFC Clients' operating region, and its location accuracy. AFC Operator ensures that no part of the AFC Master + AFC Clients' operating region + location accuracy region overlaps with an FS protection contour

Flexible Geolocation While Ensuring Incumbent Protection (Z)

- An AFC Operator must ascertain a z-axis value of the AFC Master with a given confidence level
- AFC calculates list of available channels based on the provided z-axis values
- For indoor devices, see examples below



Example Multi-Story Building: ISP provisions internet service and installs AFC Master Device to an office tenant. Location is known based on the height of the floor. In this example the unit is an office constrained to the 3rd floor, so AFC configured to use 9m above terrain as z coordinate.



Example Single Family Home: ISP provisions internet service at residence. AFC Master Device could be used anywhere in the home. In this example, the AFC would therefore be configured with the worst case height of 6m above terrain.

Lower-Power Indoor 6 GHz Devices

- Low Power Indoor (LPI) devices operate at maximum powers sufficiently low that they pose no material risk of harmful interference to incumbent links
 - Incumbent links all operate outdoors and benefit from significant building entry loss
 - Thus, LPI devices should not be subject to AFC
- This device class has great promise for in-home devices and applications that require high throughput and low latency, but that operate in indoor environments where lower power can deliver expected performance—up to and including the full throughput purchased from their ISP
- We expect this class of home devices will include:
 - The quickly growing augmented reality and virtual reality segment
 - In-home video distribution at 4K/8K levels
 - Real time multiplayer gaming through game hubs
 - Ultra high fidelity audio
 - Internet of Things