6712-01

FEDERAL COMMUNICATIONS COMMISSION

47 CFR Part 15

[ET Docket No. 18-295 and GN Docket No. 17-183; FCC 23-86; FR ID 192755]

Unlicensed Use of the 6 GHz Band; and Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz.

AGENCY: Federal Communications Commission.

ACTION: Proposed rule.

SUMMARY: In this document, the Federal Communications Commission (Commission) explores additional steps it could take and rules it could modify to provide more utility for very low power (VLP) unlicensed devices. Specifically, the Commission seeks comment on permitting higher power VLP devices under a two-tiered system where those higher powered devices would be permitted to operate only in locations where the potential for causing harmful interference to incumbent operations remains insignificant. The Commission's decision provides a balance between accommodating these new and novel devices to deliver innovative applications to the American public now and taking a judicious approach toward modifying the rules to provide even more robust use at most locations. The Commission also seeks comment on VLP device requirements and limits for operation in the U-NII-6 (6.425-6.525 GHz) and U-NII-8 (6.875-7.125 GHz) bands.

DATES: Comments are due on or before **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]** and reply comments are due on or before **[INSERT DATE 60 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**.

ADDRESSES: You may submit comments, identified by ET Docket No. 13-115 and RM-11341, by any of the following methods:

Federal Communications Commission's Web Site: https://www.fcc.gov/ecfs/. Follow the instructions for submitting comments.

- *Mail*: Filings can be sent by hand or messenger delivery, by commercial overnight

courier, or by first-class or overnight U.S. Postal Service mail (although the Commission continues to experience delays in receiving U.S. Postal Service mail). All filings must be addressed to the Commission's Secretary, Office of the Secretary, Federal Communications Commission.

- *People with Disabilities*: Contact the Commission to request reasonable accommodations (accessible format documents, sign language interpreters, CART, etc.) by e-mail: FCC504@fcc.gov or phone: 202-418-0530 or TTY: 202-418-0432.

For detailed instructions for submitting comments and additional information on the rulemaking process, see the **SUPPLEMENTARY INFORMATION** section of this document.

FOR FURTHER INFORMATION CONTACT: Nicholas Oros of the Office of Engineering and Technology, at Nicholas.Oros@fcc.gov or 202-418-0636.

SUPPLEMENTARY INFORMATION: This is a summary of the Commission's *Second Further Notice of Proposed Rulemaking*, ET Docket No. 18-295 and GN Docket No. 17-183; FCC 23-86, adopted on October19, 2023 and released on November 1, 2023. The full text of this document is available for public inspection and can be downloaded at: https://docs.fcc.gov/public/attachments/FCC-23-86A1.pdf. Alternative formats are available for people with disabilities (Braille, large print, electronic files, audio format) by sending an email to *fcc504@fcc.gov* or calling the Commission's Consumer and Governmental Affairs Bureau at (202) 418–0530 (voice), (202) 418–0432 (TTY).

Comment Period and Filing Procedures. Pursuant to sections 1.415 and 1.419 of the Commission's rules, 47 CFR 1.415, 1.419, interested parties may file comments and reply comments on or before the dates indicated on the first page of this document. For comments regarding the *Second Further Notice*, comments must be filed in ET Docket No. 13-115. Comments may be filed using the Commission's Electronic Comment Filing System (ECFS). *See Electronic Filing of Documents in Rulemaking Proceedings*, 63 FR 24121 (1998).

- All filings must be addressed to the Commission's Secretary, Office of the Secretary,

Federal Communications Commission.

- Electronic Filers: Comments may be filed electronically using the Internet by accessing the ECFS: https://www.fcc.gov/ecfs/.
- Paper Filers: Parties who choose to file by paper must file an original and one copy of each filing. If more than one docket or rulemaking number appears in the caption of this proceeding, filers must submit two additional copies for each additional docket or rulemaking number.
    - Commercial overnight mail (other than U.S. Postal Service Express Mail and Priority Mail) must be sent to 9050 Junction Drive, Annapolis Junction, MD 20701.
    - U.S. Postal Service first-class, Express, and Priority mail must be addressed to 45 L Street, NE, Washington, DC 20554.

Ex Parte Presentations. These proceedings shall be treated as "permit-but-disclose" proceedings in accordance with the Commission's *ex parte* rules. Persons making *ex parte* presentations must file a copy of any written presentation or a memorandum summarizing any oral presentation within two business days after the presentation (unless a different deadline applicable to the Sunshine period applies). Persons making oral *ex parte* presentations are reminded that memoranda summarizing the presentation must (1) list all persons attending or otherwise participating in the meeting at which the *ex parte* presentation was made, and (2) summarize all data presented and arguments made during the presentation. If the presentation consisted in whole or in part of the presentation of data or arguments already reflected in the presenter's written comments, memoranda or other filings in the proceeding, the presenter may provide citations to such data or arguments in his or her prior comments, memoranda, or other filings (specifying the relevant page and/or paragraph numbers where such data or arguments can be found) in lieu of summarizing them in the memorandum. Documents shown or given to

Commission staff during *ex parte* meetings are deemed to be written *ex parte* presentations and must be filed consistent with rule 1.1206(b). In proceedings governed by rule 1.49(f) or for which the Commission has made available a method of electronic filing, written *ex parte* presentations and memoranda summarizing oral *ex parte* presentations, and all attachments thereto, must be filed through the electronic comment filing system available for that proceeding, and must be filed in their native format (*e.g.*, .doc, .xml, .ppt, searchable .pdf). Participants in this proceeding should familiarize themselves with the Commission's *ex parte* rules.

Paperwork Reduction Act. This document may contain proposed modified information collection requirements. The Commission, as part of its continuing effort to reduce paperwork burdens, invites the general public and the Office of Management and Budget to comment on the information collection requirements contained in this document, as required by the Paperwork Reduction Act of 1995, Public Law 104-13. In addition, pursuant to the Small Business Paperwork Relief Act of 2002, Public Law 107-198, *see* 44 U.S.C. 3506(c)(4)), the Commission seeks specific comment on how it might further reduce the information collection burden for small business concerns with fewer than 25 employees.

Procedural Matters

Initial Regulatory Flexibility Analysis. The Commission has also prepared an Initial Regulatory Flexibility Analysis (IRFA) concerning the potential impact of the rule and policy changes contained in the Second Further Notice of Proposed Rulemaking. The IRFA is set forth in Appendix D of the FCC document, https://docs.fcc.gov/public/attachments/FCC-23-86A1.pdf . Written public comments are requested on the IRFA. Comments must be filed by the deadlines for comments on the Second Further Notice of Proposed Rulemaking indicated on the first page of this document and must have a separate and distinct heading designating them as responses to the IRFA.

Accessing Materials.

Providing Accountability Through Transparency Act: The Providing Accountability Through Transparency Act requires each agency, in providing notice of a rulemaking, to post online a brief plain-language summary of the proposed rule. Accordingly, the Commission will publish the required

summary of the Second Further Notice of Proposed Rulemaking at https://www.fcc.gov/proposed-rulemakings.

Synopsis

1. As discussed in greater detail below, the Commission seeks comment on how it can refine the very low power (VLP) device rules to provide VLP devices greater use of the 6 GHz band while continuing to protect licensed incumbents. The Commission's intent is to seek comment on specific rules aimed at providing additional power and flexibility for VLP devices. With the limited exception of seeking comments on some aspects of the VLP out-of-band emission limits, the Commission is not seeking comment on any of the rules adopted in the *Second Report and Order* (89 FR 874, January 8, 2024). Below, the Commission proposes to allow VLP devices to operate in the U-NII-5 (5.925-6.425 GHz) through U-NII-8 (6.875-7.125 GHz) bands (i.e., a total of 1200 MHz of spectrum) at a PSD level greater than -5 dBm/MHz—up to 1 dBm/MHz EIRP PSD and 14 dBm EIRP—provided they operate under the control of a geofencing system that prevents devices from operating in close proximity to co-channel licensed incumbent services in these bands. VLP access points would obtain information from a geofencing system on locations where operation is prohibited on specific frequencies, and VLP client devices would operate only under the control of VLP access points. These geofenced VLP devices would be a new class of higher-power VLP devices in addition to those the Commission is permitting in the Second Report and Order. The Commission also seeks comment on whether it should relax the restrictions on mobile use of VLP devices (e.g., on aircraft and oil platforms). In addition, the Commission seeks comment on whether it could allow VLP devices that operate without a geofencing system in the U-NII-6 (6.425-6.525 GHz) and U-NII-8 (6.875-7.125 GHz) bands in addition to the U-NII-5 and U-NII-7 bands where the Second Report and Order permits them to operate. As the Commission stated in the *Policy Statement* (FCC 23-27), "[r]elevant information about services' transmitter and receiver standards, guidelines, and operating characteristics is needed to promote effective spectrum management and efficient co-existence." Thus, going forward, the Commission encourages representatives from the unlicensed device community and those representing the incumbent services to work collaboratively and provide relevant information on their systems to the Commission to allow us to continue to refine its rules for the 6 GHz band and to ensure that equipment designed for and used in the 6

GHz band can fully function within the spectral environment.

A. Power Limits for Geofenced VLP Devices in the U-NII-5 through U-NII-8 Bands

2. As discussed in the Second Report and Order, the Commission is permitting VLP devices to operate at power levels up to -5 dBm/MHz EIRP PSD and up to 14 dBm EIRP. Apple, Broadcom, et al. request that the Commission permits a higher maximum level of 1 dBm/MHz EIRP PSD with the same maximum total power of 14 dBm EIRP, which they contend would enable important new VLP devices while protecting incumbent operations. This PSD level would permit VLP devices to operate at the maximum 14 dBm EIRP levels for any channel bandwidth greater than 20 megahertz, whereas under the rules the Commission is adopting in the Second Report and Order that maximum EIRP level can only be achieved for 80 megahertz and wider channel bandwidths. Based on the record and the Commission's analysis of that record, it declined to adopt rules permitting VLP devices to operate at this requested level of 1 dBm/MHz EIRP PSD in the Second Report and Order. However, the Commission believes that it can leverage the automated frequency coordination (AFC) systems used for 6 GHz band standard-power devices for use within a framework that combines higher power operation with geofencing to keep these higher powered VLP devices in locations where there have an insignificant potential to cause harmful interference to other users in the band. The Commission notes that these proposals are not intended to curtail the VLP use the Commission is adopting in the Second Report and Order. The Commission is fully satisfied that VLP devices operating at -5 dBm/MHz EIRP PSD in the U-NII-5 (5.925-6.425 GHz) and U-NII-7 (6.525-6.875 GHz) bands will protect incumbent operations and the Commission does not seek comment on these existing rules. Rather, these proposals are designed to explore the possibility for providing more flexibility for higher power use at the expense of additional complexity to implement and use a geofencing capability so that additional use cases and applications can be brought to the American public.

1. In-band Power Limits

3. The Commission believes that it could allow geofenced VLP devices to operate at the higher PSD level suggested by Apple, Broadcom, et al. if the Commission requires certain frequency and geographic area restrictions, specifically, that VLP devices with higher PSD be prohibited from operating

co-channel and in close proximity to licensed incumbent services receive sites. Accordingly, the Commission proposes to allow VLP devices to operate in the U-NII-5 through U-NII-8 bands at a level greater than -5 dBm EIRP PSD and 14 dBm EIRP, specifically up to 1 dBm EIRP PSD and 14 dBm EIRP, provided they operate under the control of a geofencing system to minimize the likelihood of harmful interference to licensed incumbent services. Under this system, geofenced VLP devices would be required to incorporate a capability to ensure that they avoid transmitting on certain channels within certain geographic areas, i.e., this is analogous to erecting a fence to prevent VLP devices from operating on certain channels within certain geographic areas, hence the descriptive term "geofencing system." While a geofencing system is not identical to an AFC system that several parties requested be required for VLP device operation, it will provide similar protection to licensed incumbent operations.

4. The Commission seeks comment on these proposals. Should the Commission allow VLP devices to operate with up to 1 dBm EIRP PSD and 14 dBm EIRP, provided they are prevented from operating in areas where there is an elevated risk of harmful interference? What are the advantages and disadvantages of allowing a higher PSD limit? What additional VLP applications could be enabled by this proposed increase? Could the Commission allow a power limit higher than 14 dBm EIRP, e.g., up to 21 dBm EIRP, as suggested by some commenters? What are the advantages and disadvantages of a higher power limit? Would higher power limits result in higher data usage and if so by how much? Would a higher power limit create new use cases for VLP? Would even higher PSD and EIRP limits increase the risk of harmful interference to licensed incumbent services, and would the proposed geofencing system described below be sufficient to reduce this risk? What are the costs and benefits of requiring higher power VLP devices to operate under a geofencing system? How would the additional benefits of geofenced U-NII-6 and U-NII-8 operations compare to the benefits the Commission estimates for non-geofenced U-NII-5 and U-NII-7 operations in the Second Report and Order? Would the power level increase that the Commission proposes provide a sufficient incentive for equipment manufacturers to develop geofencing systems?

2. Transmit Power Control

5. Consistent with the rules the Commission adopts for VLP devices in the Second Report and Order, it proposes to require geofenced VLP devices operating within the U-NII-5 through U-NII-8

bands to employ a transmit power control mechanism that has the capability to operate at least 6 dB below the maximum EIRP the Commission permits for the bands (e.g., 14 dBm or 21 dBm). Because geofenced VLP devices do not yet exist and the Commission does not know what specific transmit power control algorithm these devices may employ, the Commission does not propose any specific requirements in its rules as to how the transmit power control algorithm of the VLP devices will function. The Commission does not expect that adopting this transmit power control requirement will present an undue burden on geofenced VLP device manufacturers since these are expected to be battery-powered devices that are likely to employ transmit power control to conserve battery power. In the Second Report and Order, the Commission requires VLP devices to employ a transmit power control mechanism with the capability to operate at least 6 dB below the permitted power level. Because many VLP devices will be capable of both geofenced and non-geofenced operation, these devices will by necessity incorporate the ability to implement at least a 6 dB power reduction. Nevertheless, the Commission seeks comment on whether a different transmit power control requirement may be appropriate for geofenced VLP devices. Is there a need to specify any additional transmit power control requirements for geofenced VLP devices that the Commission proposes could operate at a higher power than VLP devices? For example, should the Commission adopt a different requirement along the lines of the European requirement in the 5250-5350 MHz and 5470-5725 MHz bands? That requirement specifies that transmit power control shall provide, on average, a mitigation factor of at least 3 dB on the maximum permitted output power of the systems; or, if transmit power control is not in use, then the maximum permitted mean EIRP and the corresponding mean EIRP density limit shall be reduced by 3 dB. What information should manufacturers be required to include in their application for certification to show compliance with a transmit power control requirement, e.g., an attestation of compliance, a detailed operational description, actual equipment test data? What are the advantages and disadvantages of requiring a transmit power control mechanism in terms of spectrum efficiency, costs, and complexity? Commenters who favor the European requirement should provide specific information regarding how such an requirement could be implemented, verified during the equipment certification process, and enforced. What ramifications, if any, would arise if there were differing transmit power control requirements for VLP devices and geofenced VLP devices?

3. Emission Mask

6. The Commission proposes to require emissions from geofenced VLP devices within the U-NII-5 through U-NII-8 bands to comply with the transmission emission mask adopted for standard power and LPI devices in the *6 GHz Order* (FCC 20-51, 33 FCC Rcd 10496) and for VLP devices in the Second Report and Order. That is, the power spectral density would have to be suppressed by 20 dB at one megahertz outside of an unlicensed device's channel edge, suppressed by 28 dB at one channel bandwidth from an unlicensed device's channel center, and suppressed by 40 dB at one and one-half times the channel bandwidth away from an unlicensed device's channel center. At frequencies between one megahertz outside an unlicensed device's channel edge and one channel bandwidth from the center of the channel, the limits would be linearly interpolated between the 20 dB and 28 dB suppression levels. At frequencies between one and one and one-half times an unlicensed device's channel bandwidth from the center of the channel, the limits would be linearly interpolated between the 28 dB and 40 dB suppression levels. Emissions removed from the channel center by more than one and one-half times the channel bandwidth, but within the U-NII-5 and U-NII-8 bands, would have to be suppressed by at least 40 dB. Because geofenced VLP devices would operate in the same bands and on the same channels as VLP devices, LPI, and standard power 6 GHz devices and need to protect the same incumbent operations, the Commission believes that using the same emission mask for geofenced VLP devices as the Commission adopted for VLP devices, LPI, and standard power devices is appropriate. Using the same mask would ensure that licensed incumbent operations are fully protected from unlicensed adjacent channel operations. Moreover, by specifying the same emission requirements, the Commission anticipates that these requirements would act to reduce costs by permitting all devices throughout the VLP ecosystem to use the same filters and benefit from economies of scale for their acquisition.

4. Emission Limits Outside the U-NII-5 and U-NII-8 Bands.

7. The Commission proposes emissions limits at the edge of the U-NII-5 and U-NII-8 bands for geofenced VLP devices that are identical to the emissions limits that the Commission adopted in the *6 GHz Order* and the Second Report and Order. Specifically, the Commission proposes a -27 dBm/MHz EIRP limit for 6 GHz VLP devices at frequencies below the bottom of the U-NII-5 band (5.925 GHz) and above the upper edge of the U-NII-8 band (7.125 GHz), but proposes to not require it between the sub-

bands, i.e., between the U-NII-5 and U-NII-6, the U-NII-6 and U-NII-7, and the U-NII-7 and U-NII-8 bands; those emissions would be subject to the emission mask and OOBE limits proposed above. These limits are intended to protect cellular vehicle-to-everything (C-V2X) operations below the 6 GHz band and federal operations above the 6 GHz band. The Commission previously determined that the -27 dBm/MHz limit will sufficiently protect C-V2X operations from harmful interference from U-NII devices operating in other bands. Because geofenced VLP devices could be mobile and potentially used near C-V2X operations, to help protect these services below the U-NII-5 band from harmful interference, the Commission proposes to require that geofenced VLP devices prioritize spectrum above 6105 MHz, as the Commission required in the Second Report and Order for VLP devices.

8. The Commission seeks comment on the proposed emission mask and the proposed emission limits outside the U-NII-5 and U-NII-8 bands. Are these limits appropriate for geofenced VLP devices? Would they adequately protect licensed incumbent services, both within and outside of the U-NII bands? Would different emission limits be more appropriate? If so, what limits should the Commission requires and why? Is a requirement for geofenced VLP devices to prioritize spectrum use above 6105 MHz necessary? What are the costs and benefits of the proposed emission mask and limits? Would requiring the same emission limits for geofenced devices that the Commission requires for non-geofenced VLP devices reduce the cost of compliance with the emission mask?

B. Geofencing System for Geofenced VLP Devices in the U-NII-5 through U-NII-8 Bands

9. The Commission proposes to allow VLP devices to operate at a PSD greater than -5 dBm/MHz EIRP PSD, up to a maximum of 1 dBm/MHz EIRP PSD, when they operate under the control of a geofencing system to minimize the likelihood of causing harmful interference to licensed incumbent services. The proposed geofencing system would ensure that geofenced VLP devices with greater than -5 dBm/MHz EIRP do not operate on the same channels as licensed incumbents inside of defined exclusion zones designed to minimize the potential for geofenced VLP devices to cause harmful interference. The Commission proposes requirements for geofencing systems and the criteria that would be used to calculate the exclusion zones as well as technical requirements for geofenced VLP devices. The Commission also proposes procedures for testing and approving geofencing systems to ensure that they

would operate as intended and correctly restrict co-channel operation with licensed incumbents in the 6 GHz band at certain locations.

1. Requirement to use Geofencing

10. *Background*. Standard power access points and fixed client devices must register with and be authorized by an AFC system prior to their initial service transmission by providing their geographic coordinates, antenna height above ground level, FCC identification number, and manufacturer's serial number. They may transmit only on frequencies and at power levels as indicated by an AFC system. After registration, they must contact an AFC system at least once per day to obtain the latest list of available frequencies and the maximum permissible power the device may use on each frequency at their location. As discussed in the Second Report and Order, the Commission is permitting VLP device operation at levels up to -5 dBm/MHz PSD EIRP and 14 dBm EIRP maximum without the use of an AFC or other database system because the Commission determined that the risk of harmful interference to licensed incumbent services is insignificant at that power level.

11. *Discussion*. For VLP device operation at PSD levels higher than -5 dBm/MHz EIRP where the risk of harmful interference to incumbent services is elevated, the Commission proposes to require VLP access points to use a geofencing system to protect fixed microwave service, BAS, CARS, radio astronomy, and FSS receive sites in the 6 GHz band. The Commission believes that this would be an effective approach to protecting licensed incumbent services since it could be implemented using the same methodology that the Commission previously developed for standard power access points and fixed client devices to protect these services. A geofencing approach, as opposed to requiring VLP devices to access an AFC system, could help preserve VLP device battery life by not requiring each device to re-check a database every time it moves, as is the case for standard power access points. Similarly, a geofencing approach could help protect user privacy since devices would not be required to report their location to a centralized system. A geofencing system would enable VLP devices to operate at PSD levels greater than -5 dBm/MHz EIRP to enable a variety of uses while protecting licensed incumbent services in the 6 GHz band. The Commission previously required certain types of devices to operate pursuant to a geofencing system. It adopted similar requirements to ensure protection to fixed service receivers in the 5925-6425 MHz portion of this band when it granted Higher Ground a blanket earth

station license to operate SatPaqs on a non-interference basis through an automated frequency coordination system basis to enable cellphones to communicate with FSS space stations. Additionally, the Commission permits unlicensed white space devices to operate in certain bands subject to their use of a geofencing system to protect licensed incumbent services.

12. The Commission proposes to protect licensed services in the 6 GHz band by prohibiting geofenced VLP access points with power levels greater than -5 dBm/MHz EIRP PSD from operating on certain channels within defined exclusion zones around the sites where licensed incumbent services operate. The geofencing system would prevent a VLP access point from operating on the frequencies within these exclusion zones where there may be a higher risk of causing harmful interference. The Commission proposes that the exclusion zones be determined based on the operational frequency being used by the incumbent service licensee as well as the power of the geofenced VLP access point. A geofenced VLP access point located within an exclusion zone would be prohibited from operating only on the specific frequencies excluded within that zone and would be permitted to operate on any other frequencies that are available at its location at the maximum power level permitted. Depending on the number of incumbent licensees in an area and the size of the exclusion zones, a geofenced VLP access point could fall within multiple overlapping exclusion zones at a particular location. In such cases, the device would have to avoid all excluded frequencies for all the overlapping zones in which it is located. To provide manufacturers flexibility in developing geofencing systems, the Commission proposes that geofencing systems may also determine areas where particular frequencies are available throughout the entire area based on the same protection criteria used to calculate exclusion zones. Each approach may have advantages in terms of spectrum availability or device complexity, so permitting either approach would provide manufacturers with the ability to determine the most suitable implementation for a specific use case. The proposed methodology for calculating exclusion zones is described below.

13. The Commission seeks comment on these proposals. Is a geofencing system necessary to minimize the likelihood of harmful interference from VLP devices with a PSD greater than -5 dBm/MHz EIRP to licensed incumbent services in the 6 GHz band? Is the proposed method of using exclusion zones around licensed incumbent receive sites an appropriate way to protect these sites? Would the proposed alternative method allowing geofencing operators to calculate zones in which a channel is

available over an entire zone provide the same protection to incumbent services as determining exclusion zones in which one or more channels are unavailable? Should the Commission permit use of either method, or is one method preferable to the other, and if so, why? How would the benefits of higher power VLP operations in the 6 GHz band vary with differences in exclusion zone design?

14. The Commission also seeks comment on whether an approach other than geofencing, such as requiring the use of an AFC system for higher power VLP devices, would be more appropriate. What are the advantages and disadvantages of requiring a geofencing approach for protecting licensed services as opposed to other approaches? What are the benefits and costs of the various approaches for the public, unlicensed device manufacturers, and incumbent users of the 6 GHz band? Are there any other factors that the Commission should consider in determining whether to require use of a geofencing system for VLP devices with a PSD greater than -5 dBm EIRP? Commenters advocating for the proposed approach or any alternatives should provide details explaining why their desired approach is most beneficial for enabling these higher powered geofenced VLP devices.

2. Geofencing Architecture

15. *Definition of geofenced VLP devices.* The Commission proposes to define a geofenced VLP access point as an access point that operates in the 5.925–7.125 GHz band, has an integrated antenna, and uses a geofencing system to determine channel availability at its location. The Commission proposes that these devices could simultaneously operate as clients to other access points or telecommunications systems (e.g., low-power indoor access points, standard power access points, other U-NII band access points, commercial telecommunication carriers' networks, etc.) and very low power access points. The Commission believes that this definition adequately describes the types of VLP devices that could operate under a geofencing system, and the proposed requirement for an integrated antenna, which is consistent with the current rules for indoor access points and subordinate devices, will help ensure that geofenced VLP devices cannot be easily modified to increase their EIRP.

16. The Commission proposes to require that geofenced VLP access points obtain or calculate the exclusion zones—where some operational restrictions are required—that will protect licensed services, have the capability to determine their location, and intelligently choose their operating channel to avoid operating on a prohibited frequency within an exclusion zone. The Commission further

proposes to require that client devices operating under the control of a geofenced VLP access point operate only on channels as determined by its connected geofenced VLP access point. Under these proposals, client devices would not be required to directly obtain or calculate exclusion zone information as they would only be operating on channels already cleared through the geofenced VLP access point. The same client devices may also be capable of operating under the control of LPI access points and standard power access points, in which case the client devices must adjust their power levels depending on which type of access point they are connected to. That is, when connected to an LPI access point or standard power access point, the client device would have to follow the client device rules for those operations, which require those client devices to reduce their power at least 6 dB below the access point power level. Because geofenced VLP access points and client devices would operate at lower power levels than standard power and LPI devices, thus reducing the distance at which harmful interference may possibly occur, the Commission does not propose to require client devices to reduce their power below that of the access point and propose to limit both geofenced VLP access points and client devices operating under the control of a geofenced VLP access point to the same power levels.

17. The Commission seeks comment on these proposals. Is the proposed geofenced VLP two-tier model based on access points and client devices in which a geofenced VLP access point is required to obtain geofencing information, but the client device is not, appropriate? Is the proposed definition of VLP access point appropriate, or are different or additional definitions that better describe the types of permissible geofenced VLP devices necessary? Should all geofenced VLP devices be required to incorporate an integrated antenna? Should client devices be permitted to operate at a different power level than geofenced access points? Is there any need for a 6 dB power reduction for a client to a geofenced VLP device?

18. *System architecture.* The Commission proposes to allow geofencing systems for VLP devices operating at greater than -5 dBm/MHz flexibility in their design by permitting the use of either a distributed architecture or a centralized model. One possible architecture would have a centralized geofencing system calculate exclusion zones based on information obtained from Commission databases, e.g., the Universal Licensing System (ULS) and Cable Operations and Licensing System (COALS) databases, as well the Commission's rules. A VLP access point would contact this centralized geofencing

system to download the exclusion zones and then manage its use of spectrum based on these areas. Another possible architecture would be for a VLP access point to regularly send its location to a centralized geofencing system, which would then inform the access point as to the channels it may use. Yet another possible architecture would be for the geofencing system to be integrated within a VLP access point. A VLP access point would download information about the licensed services to be protected from an external source. It would contain the data and software necessary to independently determine exclusion zones and manage its use of spectrum. The Commission is not proposing specific details for the geofencing system architecture for VLP devices because the Commission wants to provide manufacturers with the flexibility to design appropriate geofencing systems for different equipment use cases, many of which may not be known at this time.

19. The Commission seeks comment on these proposals. How much flexibility should the Commission provide in geofencing system architecture? Should the Commission provide flexibility for different geofencing system implementations or should a single approach be specified? What are the benefits and drawbacks of each approach? How would costs for users of a geofencing system vary between different approaches? Is there a need to specify the overall framework of geofencing systems in more detail, e.g., whether they are centralized or decentralized? Does the Commission need to provide more specific requirements for a geofencing system architecture and if so, what requirements should be specified? Does the Commission need to provide further details on the process that the Commission will use to approve geofencing systems, and if so, what additional details are necessary?

3. Protection of Incumbent Services

20. The Commission proposes requirements for geofenced VLP devices operating at greater than -5 dBm/MHz EIRP to protect licensed incumbent services in the 6 GHz band, specifically, fixed microwave services, BAS and CARS receive sites, as well as radio astronomy and FSS receive sites. Consistent with the requirements for standard power access points and fixed client devices, the Commission proposes that geofencing systems use data from Commission databases to protect fixed microwave services. The Commission proposes that BAS and CARS receive sites be protected using data provided by licensees, as described below. The Commission further proposes that geofenced VLP devices protect certain radio astronomy sites and FSS receive sites as provided in the Commission's rules.

Geofenced VLP operations, like all other unlicensed 6 GHz band operations, would have to comply with international agreements with Canada and Mexico.

21. *Fixed microwave services protection*. The Commission proposes to require geofencing systems to follow the same criteria for protecting fixed and temporary fixed microwave receive sites used for standard power access points and fixed client devices. Specifically, the Commission proposes that geofenced VLP device exclusion zones be calculated based on the -6 dB I/N interference protection criterion used in the *6 GHz Order*, where N (noise) represents the background noise level at the fixed microwave receiver, and I (interference) represents the co-channel signal from the VLP device at the fixed microwave service receiver. The Commission noted in the *6 GHz Order* that use of this metric is a conservative approach that will ensure that the potential for harmful interference to the fixed microwave services is minimized and that the important fixed microwave services in the 6 GHz band are protected.

22. The Commission also proposes to allow an assumption of 4 dB for body loss in the exclusion zone calculations because of its finding, discussed in the Second Report and Order, that due to the nature of VLP devices and how they will be used, an additional 4 dB attenuation for body loss is appropriate when analyzing the potential effect of their emissions. The Commission does not propose to consider aggregate interference from geofenced VLP devices since they will operate at a significantly lower power level than standard power access points and fixed client devices for which the Commission previously determined that an aggregate interference limit is not necessary.

23. The Commission seeks comment on these proposals. Are the proposed interference metric and body loss assumption appropriate? Would other values be more appropriate? Are there other parameters in addition to body loss that should be accounted for when determining exclusion zones (e.g., transmit power control)? Commenters who advocate for additional parameters should specify the parameters, appropriate values, and a detailed justification for why that parameter and value are appropriate. The Commission seeks estimates of the benefits and costs of different parameter proposals. The Commission also seeks comment on whether there is a need for an aggregate interference limit. If so, what is the appropriate limit and why? How could the Commission enforce an aggregate interference limit using a geofencing system? Would a centralized system be required and if so, who would build and run such a system?

24. The Commission proposes to require geofencing systems to use the same propagation models that are used for standard power access points and fixed client devices to determine the VLP device exclusion zones. Specifically, the Commission proposes to require geofencing systems to use the free space path-loss model at separation distances of up to 30 meters, the Wireless World Initiative New Radio phase II (WINNER II) model at separation distances greater than 30 meters and up to and including 1 kilometer, and the Irregular Terrain Model (ITM) combined with the appropriate clutter model at separation distances greater than 1 kilometer. Where such data are available, the Commission proposes that the exclusion zone calculation use site-specific information, including buildings and terrain data, for determining the line-of-sight/non-line-of-sight path component in the WINNER II model. For evaluating paths where such data are not available, the Commission proposes that the calculation use a probabilistic model combining the line-of-sight path and non-line-of-sight path into a single path-loss as set forth in the requirements for AFC systems. The Commission believes that these propagation models are appropriate for determining exclusion zones for geofenced VLP access points for the same reasons that they are appropriate for determining channel availability for standard power devices described in the *6 GHz Order*. The Commission proposes that these propagation models be implemented to determine the exclusion zones consistent with the way that they are being used to determine standard power device exclusion zones and consistent with the consensus methodology WinnForum published for AFC systems, which permits certain allowances for feeder loss and antenna mismatch. Each of these models could be used at the antenna height above ground (1.5 meters) that the Commission assumed for VLP operation in the Second Report and Order.

25. The Commission seeks comment on these proposals. Are the proposed propagation models appropriate for calculating geofenced VLP device exclusion zones? Could the Commission allow the use of different propagation models for calculating geofenced VLP device exclusion zones or simplify the methodology in some way? For example, could the Commission require use of a single propagation model, such as ITM, for all distances? If so, what is the appropriate propagation model? If the Commission specifies a different propagation model for determining exclusion zones, should the Commission make its use mandatory or should it be an optional alternative to the proposed propagation models? Parties should address how a different propagation model would ensure that incumbent services

in the 6 GHz band are adequately protected. The Commission also seeks comment on the benefits and costs of requiring or allowing the use of different propagation models. Could this approach reduce the size of the exclusion zones where geofenced VLP devices are prohibited from operating on certain frequencies?

26. The Commission also seeks comment on whether there are land-use databases that could account, for example, for actual buildings and other structures, especially in cities and suburbs, that could allow a more accurate determination of where VLP devices can operate without causing harmful interference? If so, what databases are available for this purpose? If this information is not available, would it be possible for parties to develop it, either nationwide or for specific areas? Could the Commission allow modifications to any parameters used in the specified propagation models, and if so, which ones? If the Commission allows modifications to the method of determining spectrum availability for VLP devices, what criteria would the Commission have to specify in the rules? Would the Commission needs to develop a process for modifying the locations where VLP devices can and cannot operate? Should a geofencing system operator be required to obtain prior permission from the Commission to use a modified methodology, or could the Commission adopt rules that do not require operators to obtain prior permission?

27. *Electronic news gathering central receive site protection*. The Commission proposes to require that geofencing systems protect BAS and CARS operations in the U-NII-6 and U-NII-8 bands, including low power auxiliary devices. Both the U-NII-6 and U-NII-8 bands are used by mobile broadcast auxiliary services, including outdoor electronic news gathering (ENG) trucks and low power short range devices, such as portable cameras and microphones. Low Power Auxiliary Stations, which are licensed in portions of the U-NII-8 band, operate on an itinerant basis and transmit over distances of approximately 100 meters for uses such as wireless microphones, cue and control communications, and TV camera synchronization signals. ENG trucks transmit video programming, generally using telescoping directional antennas that are oriented toward a central receive site from remote sites, such as the location of news or sporting events, to a central receive site. According to the ITU, ENG collection sites are generally operated by TV networks in major city areas where the typical central collection site is located within the city center, on the roof of a high building (e.g., 150 m above the surrounding terrain)

and that many TV networks also have alternative dedicated ENG collection sites mounted on their broadcast transmission towers. The ITU also states that these receive sites include both steerable antennas and fixed arrays that may have up to 360° of azimuthal coverage. The central receive sites, align with the locations of the ENG trucks. Hence, the communication link between the ENG truck and central receive site shares many of the characteristics of a fixed microwave link—i.e., they use directional antennas to send signals between two fixed locations that are located mostly above the local clutter—and can be protected by the geofencing system by creating exclusion zones to protect the receiver at the central receive site. Due to the steerable nature of the central receive antennas, would exclusion zones surrounding central receive sites need to be circular to ensure protection in all directions, or could they be only part of a circle, i.e., less than 360 degrees, if they only receive from specific directions and the directional pattern and range of orientations of the receive antenna are known?

28. Because links from ENG trucks to BAS and CARS receive sites are essentially temporary fixed point-to-point links, the Commission proposes the use of the same -6 dB I/N interference protection criterion and propagation models along with an additional 4 dB body loss consistent with the Commission's proposal for calculating geofenced VLP device exclusion zones for fixed microwave links. Since BAS and CARS operations are typically licensed for the entire band(s) in which they operate (i.e., U-NII-6, U-NII-8, or both), should geofenced VLP devices avoid operation across the entire band that a BAS/CARS site receives within the area where the interference protection criterion is calculated to be greater than -6 dB I/N unless more information about actual operations are known? Should the exclusion zones be circular when the directivity of the BAS/CARS receive antenna is not known?

29. A full record of BAS and CARS central receive sites would be needed in the Commission's licensing databases to calculate the geofencing exclusion zones. The Wireless Telecommunications Bureau, the Media Bureau, and the Office of Engineering and Technology could collect information from BAS and CARS licensees regarding locations and associated information for existing central receive sites to ensure that the Commission's databases are complete and up-to-date. The Commission would not permit geofenced VLP unlicensed devices to operate in the U-NII-6 and U-NII-8 bands until after the Commission's databases are updated.

30. The Commission seeks comment on these proposals. Although the Commission is

proposing to protect BAS/CARS using the -6 dB I/N ratio and 4 dB body loss assumption, the Commission seeks comment on whether a different metric or assumption is more appropriate? Are the propagation models the Commission proposes above to protect fixed microwave links also appropriate for BAS/CARS? Commenters should provide detailed technical justification and analysis. The Commission seeks comment on whether there are ways that it could reduce the size of the exclusion zones to protect BAS and CARS receive sites, limit the number of frequencies excluded within those zones, or limit receive site protection to only the specific times when they are in use. For example, should the Commission requires BAS and CARS users to notify a geofencing system of their ENG operations, and for the geofencing systems to incorporate a push notification feature or similar functionality to provide information (e.g., actual operating locations and frequency usage, on a near real-time basis) to VLP devices so that the exclusion zones in the U-NII-6 and U-NII-8 bands can be tailored to actual usage rather than all possible usage areas? What specific requirements would the Commission need to specify for a push notification system? Would it be better for the Commission to simply require the geofencing system to provide updated exclusion zone information to devices within a defined time interval from the time it receives updated usage information, similar to the approach in the Citizens Broadband Radio Service, which requires devices to respond to instructions within a specific time limit, and allow device manufacturers to determine the most appropriate way to comply with this requirement?

31. The Commission seeks comment on the benefits of obtaining more detailed information from BAS/CARS licensees and limiting protection to only the associated exclusion zones and times that these services actually operate. The Commission also seeks comment on how much spectrum ENG operations typically use. The *Policy Statement* (FCC 23-27) emphasized data-driven regulatory approaches to promote co-existence. In this regard, the Commission specifically noted that "[r]elevant information about services' transmitter and receiver standards, guidelines, and operating characteristics is needed to promote effective spectrum management and efficient coexistence." The Commission therefore proposes that BAS/CARS licensees be required to register their receive site information in Commission databases so that geofencing systems can use site-specific data to create appropriate exclusion zones for these sites. The Commission seeks comment on what information should be collected. Should it be limited to information currently collected by Commission databases, such as

location, antenna height, antenna model, and azimuth, or are there other information fields that the Commission should collect?. Is the current information in ULS and COALS appropriate for estimating the number of affected incumbents and their equipment? Could the Commission use past activity on ULS and COALs systems to extrapolate the future number of necessary updates? The Commission seeks comment on this proposal and whether the Commission should conduct an information collection for these sites. Assuming that the Commission does initiate an information collection, what is an appropriate time frame over which to require licensees to provide their information?

32. The Commission also seeks comment on whether multiple ENG operations at a location use the same or different receive sites. What is the number of ENG operations that typically occur at a news event, sporting event, or other event where such operations may be used? And what is the maximum that might be used at larger national events such as political conventions or large scale sporting events? How much time do ENG operations typically need to transmit for these events? Is continuous operation required before, during, and after an event or only within discrete timeframes? Are there ways to predict when operation may be heaviest? Looking across these dimensions of time, location, and spectrum occupancy, how much additional spectrum, operating area, and time could this approach make available for VLP devices, as compared to assuming that ENG might always be operating within a circular or part of a circular area around an ENG receive site? How would this differ from a system where ENG operations simply preregistered their entire service areas and operating channels, but with no time limit to account for use at unscheduled breaking news events? If the specific location, antenna pattern, and look angle of an ENG receive antenna are known, is it necessary for the exclusion zone to be circular, or could the Commission considers non-circular exclusion zones, such as keyhole shaped zones or arcs, to protect ENG receive sites? If the Commission were to implement a registration requirement, should the ENG use be updated during in-use times or for non-real-time registration, or should the ENG use be updated on a regular basis? What is a reasonable time period for such updates? Can ENG operations be automated to inform a geofencing system when it is operating and on which channels and to which receive site it is broadcasting, or would registration have to be a manual process? What up-front and ongoing costs would be involved with setting up and using such a system and who would incur them?

33. Although the Commission proposes to allow either a distributed or centralized

architecture model for VLP device geofencing systems, if the Commission were to adopt a push notification or similar approach to protect BAS/CARS based on actual usage, it appears that there would be a need for one or more centralized systems to register BAS/CARS usage and provide the information to geofencing systems. The Commission seeks comment on whether this would be necessary. If so, who would develop and operate these systems? How should any information be shared amongst geofencing systems? For example, in the white space rules, white space device operators are required to share registration information with all other database administrators. Would such a requirement be necessary here? If so, how would data sharing work to ensure that all geofencing systems, both centralized and decentralized, have up-to-date information to protect ENG operations at scheduled and unscheduled events? What information should licensees be required to file and what procedure would they use to get their information to the system? Should licensees be required to file or update information within a specific timeframe? What would be the burden on licensees for filing this information? Could the filing process be automated? The Commission seeks comment on any other options for transmitting channel utilization information to geofencing operators. Are there any other factors that should be considered in this process? Finally, the Commission seeks comment on whether there should be any channels (e.g, one or two channels) set aside as a safe harbor for ENG operations in these bands where ENG could operate without risk of harmful interference from VLP devices at times when the operator could not register its parameters? If so, how much spectrum would need to be set aside for such operation? Would spectrum be needed in both U-NII-6 and U-NII-8? Are there particular places in the band that would be most useful; e.g., the top of the band, bottom of the band, middle of the band, or on the same spectrum permitted for satellite downlink operations? Would such safe harbor be needed nationwide or only in certain areas (e.g., around large cities)? Commenters advocating such an approach should provide detailed information regarding ENG requirements and fully support their position with technical information.

34. The Commission seeks comment, especially quantitative, on the benefits and costs of requiring a push notification system. Should any particular protocol or security measures be required? To what extent would a push notification system permit service continuity for geofenced VLP devices, as compared to how often such users would need to modify their channel usage to avoid exclusion zones

when those areas are tailored to the specific situation rather than assuming that ENG might always be operating within a circular or part of a circular area around an ENG receive site? How would data rates be affected? What would be the potential costs associated with establishing, maintaining, and operating the push notification system? In particular, the Commission seeks comment on the costs for BAS and CARS licensees to report their location information to enable push notifications.

35. *Low-power short range mobile device protection.* The Commission proposes that low power short range BAS and CARS devices, such as portable cameras and microphones, and Low Power Auxiliary stations be protected from harmful interference by a combination of a required contention-based protocol and low probability of a VLP device operating on the same channel in a nearby location. This proposal is consistent with the *6 GHz Order* in which the Commission required that all 6 GHz unlicensed LPI access points, subordinate devices, and client devices employ a contention-based protocol. Further, the *6 GHz Order* showed that the probability of channel overlap between 6 GHz unlicensed devices and incumbent station operations is low due to unlicensed devices having a full 1200 megahertz over which to operate.

36. The Commission believes that a similar approach for geofenced VLP devices will adequately reduce the risk that mobile service incumbents in the U-NII-6 and U-NII-8 bands will be subjected to harmful interference and keep that risk to an insignificant level. The Commission's reasoning is consistent with the *6 GHz Order*, i.e., the sensing function associated with the contention-based protocol, along with the low probability for co-channel operation, is sufficient to ensure that geofenced VLP devices detect nearby mobile BAS operations and avoid transmitting co-channel to protect those operations from harmful interference. While the Commission is not proposing a specific technology protocol or contention method, the Commission proposes to require geofenced VLP devices to use a contention-based protocol as the Commission requires for LPI devices. The Commission believes that this proposal has additional benefits as it provides multiple geofenced VLP devices as well as LPI devices equal access to the spectrum, while protecting mobile incumbents' services. The Commission also believes that the use of a contention-based protocol will limit the duty cycle of geofenced VLP devices as they will need to share the spectrum with other devices. Additionally, geofenced VLP devices would transmit at lower power levels than LPI devices, further reducing the risk

of harmful interference to mobile services. Given all these reasons, the Commission believes that requiring use of a contention-based protocol by geofenced VLP devices would protect mobile service incumbents.

37. The Commission seeks comment on this proposal. Would requiring geofenced VLP devices to incorporate a contention-based protocol adequately protect mobile service incumbents? If not, what other protection measures could be used by geofenced VLP devices to protect mobile services? For example, could a registration system with a push notification provide near real-time information to geofenced VLP devices to avoid transmitting near mobile BAS operations? Is there a need to provide greater specificity in the requirements for a contention-based protocol used by geofenced VLP devices? If so, what particular requirements should be specified and why? What are the costs and benefits of requiring the use of a contention-based protocol?

38. *Radio astronomy and fixed satellite protection*. The Commission proposes to require that geofencing systems implement the same exclusion zone rules for protecting radio astronomy sites in the 6650-6675.2 MHz band as standard power access points and fixed client devices, which are based on the distance to the radio horizon. The locations of the protected radio astronomy sites and the protection criteria for these sites are specified in the rules for standard power access points and fixed client devices. Additionally, the entire 6 GHz band is home to an FSS allocation (Earth-to-space), while the U-NII-8 band has a few space-to-Earth MSS feeder downlink earth stations operated by Globalstar. The only requirement the Commission adopted to protect the Fixed Satellite Service in the *6 GHz Order* was restricting standard power access point EIRP to 21 dBm above a 30 degree elevation angle. Because the Commission proposes to limit geofenced VLP devices to 14 dBm EIRP and seeks comment on a maximum EIRP of no greater than 21 dBm, the Commission proposes no additional restrictions to protect FSS Earth-to-space operations. The Commission seeks comment on these proposals.

39. Globalstar operates receiving earth stations for non-geostationary Mobile-Satellite Service feeder links at five locations. The Commission proposes to require that geofenced VLP access points protect Globalstar's earth stations using the same exclusion zone calculation methodology used to protect radio astronomy sites. The Commission proposes to require the geofencing system to implement these exclusion zones over 6875-7055 MHz at each of Globalstar's five feeder link earth station locations.

As these exclusion zones are designed to protect extremely sensitive radio astronomy facilities, the Commission believes that they will provide more than adequate protection for Globalstar's earth stations.

40. The Commission seeks comment on this proposal. If different criteria are appropriate, what are the key parameters that must be considered to protect these earth stations? Are parameters such as minimum elevation angle from the earth station to the satellite, gain of earth station antenna, and earth station receiver characteristics readily available? Are Commission databases, such as the International Communications Filing System (ICFS), able to collect the necessary parameters for calculating exclusion zones? If not, and given the limited number of these Earth stations in the U-NII-8 band, could exclusion zones around these Earth stations be determined based on generalized parameters? What should those parameter values be? Would earth station receivers require a different level of protection than the -6 dB I/N ratio used to protect other incumbents in the band? If so, what is the protection criterion? What would be the cost of implementing and maintaining necessary protections for space-to-Earth stations from geofenced VLP devices? The Commission also seeks information on the economic harm from interference that these protections would prevent. Commenters should provide technical analysis to support their positions.

41. *Adjacent channel protection*. The Commission proposes that exclusion zones for geofenced VLP access points account for only co-channel operations and not consider adjacent channel operations. The Commission believes that this proposal is appropriate due to the significantly lower power the Commission proposes for geofenced VLP devices as compared to standard power and fixed client devices. The out-of-band emission rules for 6 GHz unlicensed devices require such emissions to be suppressed by 20 dB at 1 megahertz outside of channel edge, by 28 dB at one channel bandwidth from the channel center, and by 40 dB at one- and one-half times the channel bandwidth away from channel. center. When compared to standard power devices that may operate at EIRP levels up to 23 dBm/MHz and must meet the same OOBE mask, VLP adjacent channel emissions begin at least 22 dBm below those standard power device OOBE levels. Thus, VLP OOBE levels must begin at -19 dBm/MHz at 1 megahertz outside the channel edge and reduce from that level with spectral distance. Moreover, the Commission notes that adding 20 dB or more additional emission reduction represents at least a tenfold reduction (assuming free space propagation) in distance along any radial for determining adjacent channel

protection as compared to standard power device adjacent channel geofenced distances. In the *6 GHz Order*, the Commission concluded that the risk of adjacent channel interference to microwave receivers was low and stated that it expects these adjacent channel zones will be small and not significantly impact the amount of spectrum available to unlicensed devices at any given location, but included adjacent channel protection in the adopted rules for standard power devices as part of a conservative approach to protecting the incumbent receivers. Given the additional 22 dB in adjacent channel protection provided by geofenced VLP devices as compared to standard power devices, and the further reduction in protection areas size, the Commission concludes that the risk of adjacent channel interference is so low as to not require geofencing systems to account for them. The Commission seeks comment on this proposal.

42. *Geofencing update interval*. The Commission proposes to require a geofencing system to obtain the most recent public access file data from Commission databases (e.g., ULS and COALS) for registered fixed microwave links and BAS/CARS central receive sites at least once per day and to recalculate the exclusion zones, as necessary, to account for any new or updated information. The Commission believes that once per day would be an appropriate re-check interval because the ULS and COALS, which contain the data that will be used to determine the exclusion zones to protect fixed microwave services and BAS/CARS central receive sites, are generally updated on a daily basis, and a daily re-check requirement would also ensure that newly registered microwave receive sites and BAS/CARS central receive sites are promptly protected. The Commission seeks comment on this proposal. Is a daily update necessary, or recognizing that not many new stations get licensed on a daily basis and that there is often a lag between licensing and operation, could a longer interval be specified? If so, what update interval should be required? Conversely, as discussed above, could the Commission or should it establish a process to update BAS/CARS information in a much shorter timeframe to enable more efficient use of spectrum in areas near BAS and CARS receive sites? How would the benefits and costs change with differing interval lengths?

4. Other Geofencing Requirements

43. The Commission proposes additional requirements for geofencing systems and operators that are similar to certain requirements for 6 GHz AFC systems. Specifically, the Commission proposes that each geofencing system and operator thereof for centralized systems and the equipment certification

responsible party for systems internal to the very low power device must: (1) ensure that a regularly updated geofencing system database that contains the information required for geofencing systems by paragraphs (o) through (r) of proposed § 15.407, including incumbent's information and very low power access points authorization parameters, is maintained; (2) respond in a timely manner to verify, correct, or remove, as appropriate, data in the event that the Commission or a party presents a claim of inaccuracies in the geofencing system; (3) establish and follow protocols to comply with enforcement instructions from the Commission, including discontinuance of very low power access point operations on specified frequencies in designated geographic areas and predetermined exclusion zones; and (4) comply with instructions from the Commission to adjust exclusion zones to more accurately reflect the potential for harmful interference.

44. The Commission further proposes that for centralized geofencing systems, geofencing system operators must provide continuous service to all VLP devices for which it has been designated to provide service, and that if a geofencing system ceases operation, the operator must provide at least 30-days' notice to the Commission and a description of any arrangements made for those devices to continue to receive exclusion zone update information. In addition, the Commission proposes that a geofencing system operator may charge fees for providing service and that the Commission may, upon request, review the fees and can require changes to those fees if the Commission finds them to be unreasonable. The Commission also proposes that at the time that a VLP device receives equipment certification, the device must either have its geofencing system approved or specify an already approved geofencing system that it is using. The Commission further proposes that it may specify criteria for such approval, which could require test results to be submitted.

45. The Commission seeks comment on these proposals. Are all the proposed requirements appropriate and necessary? Should the Commission modify any of these proposed requirements or establish additional requirements for geofencing systems and operators? If so, what requirements are necessary? The Commission seeks quantitative analysis of the likely fee structure that would result under its proposal allowing fees. What would be the initial cost of developing a geofencing system and the ongoing cost of providing daily information to it? The Commission also seeks comment on how any fees would relate to usage or other costs of operating the geofencing system.

46. Finally, in light of the proposals to base higher power VLP operation on using a geofencing system, the Commission seeks comment on whether there are alternative methods to achieve the same result. Are there other technical or operational approaches that would similarly permit more flexible VLP operation while protecting incumbent operations? Commenters advocating for alternative approaches should provide specific detail regarding any alternative approach along with descriptions and analysis of how such an approach would protect incumbent operations.

C. Client-to-Client Device Communications

47. In the *6 GHz Order*, the Commission prohibited unlicensed client devices from operating as "mobile hotspots" because "[p]ermitting a client device operating under the control of an access point to authorize the operation of additional client devices could potentially increase the distance between these additional client devices and the access point and increase the potential for harmful interference to fixed service receivers or electronic news gathering operations." To avoid this situation, the Commission's rules prohibit 6 GHz unlicensed client devices from directly communicating with one another. The Commission proposes two limited exceptions to this rule for VLP devices that operate above the -5 dBm/MHz EIRP PSD level. First, the Commission proposes to permit higher powered VLP devices that are all operating under the control of the same LPI access point to directly communicate with each other. The Commission further proposes that these communications be limited to the LPI client device power spectral density level (i.e., 6 dB below the LPI access point power level) and the VLP device 14 dBm EIRP limit. Because both VLP devices under this approach would also meet the LPI requirements, the Commission would have assurance that their operations are indoors and thus that their emissions are subject to the same building entry loss as LPI devices. With their lower power limit, these client devices will have even lower potential to cause harmful interference to incumbent operations than the insignificant level the Commission already determined exists for LPI devices. This proposed exception could provide increased flexibility to a limited class of devices, such as laptop computers, that generally do not incorporate GPS or other geolocation technologies while protecting incumbent operations beyond levels that similar devices (i.e., LPI devices) already provide.

48. Second, the Commission proposes to permit direct client-to-client communications between VLP client devices when they are both under the control of the same VLP access point and the

geofencing system determines that they are operating outside of any geofencing restrictions; i.e., there are channels available for VLP use that are not subject to geofencing requirements in the location where these devices are being used. The rules the Commission proposes for geofenced VLP devices would permit up to 1 dBm/MHz EIRP PSD and up to 14 dBm EIRP when operating on channels that are not within an exclusion zone. Thus, because each client device in this scenario would be permitted to operate at the maximum power permitted for VLP devices, there would be no increase in the potential for causing harmful interference to incumbent operations if the client devices being used are also able to communicate directly with each other. However, all VLP access points would still be subject to the applicable geofencing requirements including location and geofencing recheck intervals and switching channels or ceasing communications should they enter an exclusion zone and are currently using a channel that is prohibited within that area. In that case, client devices operating under the control of a VLP access point that switches channels would also be required to switch channels as directed by the VLP access point. This proposed limited exception, as with the first, could provide additional flexibility to implement novel VLP use cases without increasing the risk of harmful interference to incumbent operations.

49. The Commission seeks comment on these proposals. Are these proposed limited exceptions to the prohibition on client-to-client device communications appropriate? Would any other exceptions with respect to VLP devices be appropriate? Does the Commission need to specify any additional requirements or limitations on client-to-client device communications? How much and what kinds of additional usage would these proposals create in client-to-client operations? Would these proposals impose any additional costs to users of the associated spectrum?

D. Very Low Power Device Requirements

50. In the *6 GHz Order*, the Commission established that an AFC system require a device's geographic coordinates—along with the accuracy of those coordinates—and the device's antenna height above ground to determine which channels are available for use at the device's location. Standard power access points (APs) are required to contact an AFC system at least once per day, consistent with the frequency of the update to the ULS public access file, to obtain the latest lists of available channels at their locations. The daily update ensures that stationary unlicensed devices do not operate on a channel in

proximity of a newly licensed fixed service receiver. Although VLP devices may be mobile or stationary, mobile VLP devices may move to different locations, potentially resulting in a changing available channel list. In lieu of an AFC system, the Commission proposes to require that geofenced VLP devices access a simpler geofencing system to prevent them from operating where there may be an elevated risk of causing harmful interference to licensed incumbent services in the 6 GHz band. Under this proposed geofencing system, geofenced VLP devices would have to incorporate provisions to ensure that they avoid transmitting on certain channels within certain geographic areas.

51. A mobile geofenced VLP device operating at a power level greater than -5 dBm/MHz EIRP PSD would have to consider exclusion zone(s) not only at its present location, but also at all areas that may be traversed by a mobile VLP device between the present time and a future location update. Naturally, the area traversed by the mobile VLP device is a function of the VLP device's speed and direction. For example, a mobile VLP device located in a vehicle traveling 35 miles per hour could cover approximately one kilometer within one minute. However, there are other mobile use cases in which a pedestrian using a VLP device will cover well under a hundred meters in the same one-minute time period. Accordingly, rather than proposing a set time period within which a mobile VLP device must update its location to check if it is in an area with different geofencing requirements than the previous area in which it checked, the Commission proposes a flexible approach with varying recheck times based on speed to better meet device usage requirements. Thus, the recheck interval can be tailored to require fewer rechecks when moving at slow speeds and thus ease processing requirements and save battery power.

52. *Incorporated geo-location.* Consistent with the requirements for standard power access points, the Commission proposes to require that geofenced VLP access points generally include a geo-location capability to determine their geographic coordinates. The Commission proposes to require a geofenced VLP device's geo-location capability to determine its location uncertainty in meters, with a 95% confidence level, and that the applicant for certification of a VLP access point demonstrate the accuracy of the geo-location method used and the location uncertainty. The Commission further proposes to require that a geofenced VLP access point, using its geographic coordinates, take this location uncertainty into account when it determines whether the VLP access point is within an exclusion zone.

The Commission seeks comment on this proposal. The Commission also seeks quantitative information on the benefits and costs of this proposal to VLP device users, manufacturers and the wider public.

53. *Location Update.* The Commission proposes to require that geofenced VLP access points have the capability to timely adjust their operating frequencies when moving into, out of, or between exclusion zones. The Commission proposes flexible requirements to enable device designers to optimize efficiency while still meeting the requirement to avoid operating on channels where -6 dB I/N interference protection criterion is not met. Specifically, the Commission proposes that the time interval for a geofenced device to re-check its location and adjust its frequency usage must decrease proportionally based on an increase in the mobile device's speed. Under this proposal, a geofenced VLP access point that is in a powered state must regularly re-check its location and speed and identify its position with respect to any exclusion zones that may exist within the vicinity of its current location. The Commission further proposes that this geolocation update be done frequently enough that, based on the geofenced VLP access point's position and speed, the device will not transmit on a channel that is unavailable within an exclusion zone. The Commission believes that this proposal provides flexibility to device designers to adjust how often the VLP access point must obtain geolocation information based on how fast the VLP access point is moving and how far it is from an exclusion zone where it would have to change its operating channel. As an additional safeguard, the Commission proposes to require the VLP access point to determine its location and speed at least once a minute. This one-minute update proposal is designed to provide additional assurance that the VLP access point avoids transmitting on frequencies that are not permitted by the geofencing system. The Commission further proposes to require applicants for geofenced VLP access point certification to submit an attestation describing their algorithm for updating the device's location with an explanation describing how these requirements are met.

54. The Commission seeks comment on these proposals. Do they provide sufficient flexibility for mobile geofenced VLP devices? Is it necessary for us to specify more detailed requirements on how often a geofenced device must re-check its speed and its position with respect to exclusion zones? If so, what additional requirements should be specified and why? Is a requirement for devices to re-check their location and speed at least once per minute necessary? Is the proposed information that applicants for certification of geofenced VLP access points must submit appropriate, or

should any additional information be required? If so, what information? The Commission seeks quantitative information on the benefits and costs to VLP device users, manufacturers and the wider public of its proposal and any proposed alternatives.

55. *Antenna Height.* The Commission proposes to require geofencing systems to use an assumed antenna height above ground level of 1.5 meters for geofenced VLP access points similar to the approach used in the Second Report and Order for interference modeling of VLP devices. The Commission seeks comment on this proposal. Is an assumed 1.5 meter antenna height appropriate, or should the Commission specifies a different value? If so, what height should the Commission require for the exclusion zone calculations? The Commission also seeks quantitative information on the benefits and costs to VLP device users, manufacturers and the wider public of the Commission's proposed antennas height. Commenters proposing alternative values should quantify the benefits and costs of alternatives.

56. *Fixed Infrastructure.* Consistent with the Commission's actions in the Second Report and Order, the Commission proposes to prohibit geofenced VLP devices from operating as part of a fixed outdoor infrastructure as an additional measure to reduce the likelihood of interference to licensed incumbent services. The Commission seeks comment on this proposal. Is a prohibition on fixed outdoor infrastructure necessary when a geofencing system is used? The Commission seeks quantitative information on the benefits and costs to VLP device users, manufacturers and the wider public of the Commission's proposal versus allowing operations as part of fixed outdoor infrastructure.

57. *Updates to exclusion zones.* The *6 GHz Order* established a requirement that standard power access points must recheck the frequency availability with an AFC system once per day. Similarly, the Commission proposes to require geofencing systems to update the exclusion zones at least once per day using the data from Commission databases on the licensed microwave links and BAS/CARS central receive sites. The Commission also proposes to require geofenced VLP access points to obtain or calculate the updated exclusion zones from the geofencing system at least once per day. This proposal is designed to ensure that newly registered microwave receive sites and BAS/CARS central receive sites are promptly protected. Consistent with the rules for standard power access points and fixed client devices, the Commission also proposes that if a VLP device is unable to obtain the latest ULS or COALS data on a given day, it may continue operating until 11:59 p.m. of the following day at which time it must cease

operation until it is able to obtain the latest geofencing data. The Commission seeks comment on these proposals. The Commission also seeks quantitative information on the benefits and costs to VLP device users, manufacturers and the wider public of the Commission's proposal and alternative update schedules and requirements.

58. *Security Issues.* Consistent with the Commission's requirements for standard power devices and AFC systems in the 6 GHz Order, the Commission proposes to require that geofenced VLP access points incorporate adequate security measures to: 1) prevent them from accessing geofencing systems and geofencing methods not approved by the Commission, 2) ensure that unauthorized parties cannot modify devices to operate in a manner inconsistent with the rules and licensed incumbent protection criteria, and 3) ensure that communications between VLP access points and geofencing systems are secure to prevent corruption or unauthorized interception of data. The Commission also proposes to require that geofencing systems, whether centralized or internal to a VLP device, must ensure that all communications and interactions between the geofencing system and VLP access points and/or all communications between the geofencing system and Commission databases are accurate and secure and that unauthorized parties cannot access or alter the database, the exclusion zones, or the list of excluded or available frequencies. The Commission further proposes to require that a geofencing system incorporate security measures to protect against unauthorized data input or alteration of stored data, including establishing communications authentication procedures between client devices and VLP access points. These proposed requirements are intended to prevent a VLP device from using geofencing methods not approved by the Commission and to ensure that unauthorized parties cannot modify a device to operate in a manner inconsistent with the rules. The Commission seeks comment on these proposals. What would be the cost of implementing the Commission's security proposals versus alternatives? The Commission seeks quantitative information on the costs of geofenced VLP device security requirements.

59. *Device testing and approval.* As indicated above, the Commission proposes to require that VLP devices operating with greater than -5 dBm/MHz PSD EIRP incorporate a geofencing capability that prevents them from operating where there may be an elevated risk of causing harmful interference to licensed incumbents in the 6 GHz band. Under this proposal, geofenced systems in the 6 GHz band would determine exclusion zones within which specific channels are prohibited from use by geofenced

VLP access points when a -6 dB I/N interference protection criterion is not met (e.g., areas around fixed microwave and BAS/CARS central receive sites), and each geofenced VLP access point would have to be able to connect to a geofencing system or have an integrated geofencing system capability.

60. Applicants seeking VLP device certifications would have to show in their applications how their device will comply with any geofencing requirements adopted in this proceeding. For example, applicants for geofenced VLP access point certification would have to demonstrate that the device operates only pursuant to a geofencing system and that the geofencing system prevents operation in areas where the -6 dB I/N metric is not met when calculated in accordance with the proposed methodology. They would also have to demonstrate that their devices could not operate on any channel that the geofencing system determines is prohibited at its location at a power level greater than -5 dBm/MHz EIRP PSD. Applicants would also be required to demonstrate that their VLP access points comply with the proposed requirements to periodically check their location and comply with the database recheck intervals proposed above as well as adjust their operating channel if they move into an exclusion zone where that channel is not available. They would further have to demonstrate how geofenced VLP access points obtain exclusion zone data either from a geofencing system or through calculations based on data downloaded from Commission databases.

61. The Commission seeks comment on testing and certification issues for geofenced VLP access points and client devices. Are there any specific testing or certification issues that the Commission will need to address, either in a subsequent item in this proceeding or subsequent to adopting rules, e.g., through the KDB process? If so, what issues would need to be addressed? Would industry groups such as the Wi-Fi Alliance or WinnForum be likely to develop procedures for testing geofencing systems? The Commission seeks quantitative information on the benefits and costs to VLP device users, manufacturers and the wider public of geofenced VLP testing and certification requirements.

E. Spectrum Availability for Very Low Power Devices

62. The Commission seeks comment on any changes that it could make that would allow for increased spectrum availability for geofenced VLP devices without increasing the likelihood of harmful interference to incumbent services, i.e., more efficient spectrum use. Consistent with the Commission's recent *Policy Statement*, the Commission seeks additional data that can be used to assess geofenced VLP

device operation and the potential impact on incumbent services. Are there any particular characteristics of geofenced VLP devices, e.g., size, operating location, specific applications, operating bandwidth, modulation types, data rates, duty cycle/activity factor, or mobility or lack thereof, that could be considered in enabling increased spectrum availability for these devices? Is there currently any operational or other data that would be helpful in this regard? How much additional spectrum could be made available for geofenced VLP devices? Would there be any significant increase in the areas where they could operate as compared to the rules proposed above? The Commission recognizes that actual operational data that may help us reach a decision on these issues may not yet be available. In this regard, the Commission encourages parties with additional data to approach the Commission in the future when such data becomes available. The Commission also seeks information from incumbents regarding their systems, particularly with respect to the amount of fade margin incorporated into system design, statistics on when fades occur, their severity, and how long they last, and how systems are designed to cope with fading events using techniques such as adaptive modulation or adjusting their data streams to focus on more time-sensitive critical data over less critical data.

F. Restrictions on Very Low Power Device Mobile Operations

63. The Commission also seeks comment on whether to relax the restrictions on VLP device mobile operations (e.g., on aircraft, boats on the ocean, oil platforms, and terrestrial vehicles). In the *6 GHz Order*, the Commission prohibited standard power and LPI access points from operating on board aircraft, with the exception of LPI use in the U-NII-5 band on large passenger aircraft while flying above 10,000 feet. In the Second Report and Order, the Commission is largely adopting the same operational restriction for VLP devices, except the Commission is permitting them to operate on boats. Similar to the rules for standard power and LPI access points, the Commission is prohibiting VLP devices from operating on oil platforms. The restrictions on oil platforms is being put in place to protect incumbent EESS remote sensing operations, which, in this band are used *inter alia* for monitoring ocean temperature.

64. As noted, these decisions were made largely to provide consistency with the Commission's prior decision regarding standard power and LPI devices. However, given the inherent differences between those devices and VLP devices, the Commission seeks comment on whether these

restrictions on mobile operations on aircraft and oil platforms can be relaxed for non-geofenced VLP devices, geofenced VLP devices, or both. First, emissions from both types of VLP devices will be lower than standard power and LPI devices; geofenced VLP access points and associated client devices are permitted to operate with no more than 1 dBm/MHz EIRP PSD and 14 dBm EIRP while standard power and LPI devices may operate at 23 dBm/MHz EIRP PSD and 36 dBm EIRP and 5 dBm/MHz EIRP PSD and 30 dBm EIRP, respectively. VLP devices operate at an even lower -5 dBm/MHz EIRP PSD. Second, both types of VLP devices are mobile, generally operate close to the ground and in proximity to the body or other objects, are likely to be battery powered, and either operate pursuant to a geo-location system or at or below -5dBm/MHz EIRP PSD.

65. Considering expected use cases and the minimal potential for VLP and geofenced VLP devices to cause harmful interference, the Commission proposes to permit mobile operation on commercial and general aviation aircraft more generally, but not on UAS. The Commission can speculate that several prominent use cases will occur on aircraft. The Commission seeks comment on permitting more general use of VLP and geofenced VLP devices onboard commercial and general aviation aircraft. For example, because FAA guidance specifies that aircraft operators, when operating aircraft that have been certified to meet portable electronic device tolerance standards, may permit certain portable electronic devices to operate in all phases of flight (i.e., from gate-to-gate), body-worn VLP and geofenced VLP devices could be used to monitor a person's health metrics or to stream a movie (e.g., from a smartphone to smart glasses). In such cases, operation is not likely to be near a fixed microwave, BAS, or CARS receive site and is likely to be low power, given the short transmission distance and the fact that emissions will be shielded by the aircraft fuselage and will be subject to clutter loses from nearby seats and passengers. In addition, the Commission notes that the worst case for harmful interference potential is likely to be on take-off or landing when the aircraft is lower to the ground and thus, potentially closer to an incumbent receiver. However, good engineering practice should prevent microwave links in locations where aircraft are likely to fly as their mere presence could cause link degradation. And even if an aircraft were to fly in an area where it may be seen by a microwave receive antenna main beam, the aircraft will be moving at significant speed and the time a VLP or geofenced VLP device's emission could be within an incumbent's receiver main beam will be fleeting and handled by

forward error correction or other techniques. In addition, when operated on the ground, geofenced VLP access points and associated clients would operate under the control of a geofencing system, while non-geofenced VLP devices would operate at even lower power. As an initial matter, considering operation on aircraft, should the Commission considers permitting all VLP devices to operate across all phases of flight or just VLP devices that are not geofenced? Or should geofenced VLP devices be limited to only operating when above 10,000 feet or not permitted to operate on aircraft at all? The Commission is already permitting non-geofenced VLP devices to operate on large aircraft above 10,000 feet and ask if there is a different metric that could be used for the specific case of aircraft. For example, noting the very fast take-off and landing speeds, could the Commission implement a rule stating that if a geofenced VLP access point is moving at an average speed over 100 mph, it would no longer need to check the geofencing system? Moving at or above this speed would imply operation on a very fast moving vehicle, such as an aircraft. If the Commission allows a minimum average speed metric for this purpose, should it apply only to devices operated on aircraft, or could it apply to other modes of transportation such as rail? Is there a different speed or metric that would work better in providing a demarcation between when the geofencing system must be used and when it is not necessary when considering use on aircraft? What other considerations need to be taken into account? For example, could there be issues that affect radio astronomy sites? If so, should certain channels be prohibited from use until an aircraft exceeds 10,000 feet? We seek comment on the Commission's proposal to permit any or all VLP devices to operate gate-to-gate while on aircraft.

66. The Commission continues to believe that any VLP operation when such devices are mounted on a UAS could pose more than an insignificant harmful interference risk, given the potential of UAS to fly almost anywhere and to have clear line of sight to an incumbent's receiver. In addition, because the geofencing system determines exclusion zones based on an assumed 1.5 meter antenna height, any exclusion zone associated with a UAS would be much larger than for general VLP device usage. Nevertheless, the Commission seeks comment on whether there are operational limitations or guidelines the Commission could adopt that could permit VLP devices to operate when mounted on a UAS. Are there applications that are specifically well-suited for use on a UAS? Are there methods using the geofencing system or otherwise that could be implemented to ensure that incumbent receivers are

protected from harmful interference? If so, how complex and feasible would these methods be to implement? Would the costs associated with additional complexity outweigh any benefits that might be gained from permitting such operation?

67. In the Second Report and Order, the Commission maintained its prohibition on all types of 6 GHz device usage on oil platforms to protect EESS operations but did not prohibit the use of VLP devices on boats. The Commission now seeks comment on whether the prohibition on all types of 6 GHz device usage on oil platforms can be scaled back or lifted. For example, given the differences between VLP devices (both geofenced and non-geofenced) and standard power and LPI devices, does the use of VLP devices on oil platforms pose the same risk of harmful interference to EESS operations? Could standard power, LPI or either type of VLP devices be used on oil platforms without causing a risk to EESS ocean temperature monitoring operations? The Commission can foresee applications where a 6 GHz device could provide utility through augmented reality to a worker on an oil platform to provide relevant information, such as for safety, maintenance tasks, or general operating instructions. Is any restriction of VLP device use on boats appropriate to protect EESS operations? If such a restriction were adopted, could it be limited to boats located in the ocean, given that EESS is used for sensing over the ocean? How could the prohibition on use of VLP devices on oil platforms or a prohibition on use on boats, if adopted, be implemented for non-geofenced VLP devices?

68. Finally, the Commission seeks comment on whether there is additional flexibility that can be provided for terrestrial in-vehicle use (e.g., cars, buses, and trucks). For example, are there devices that are designed to be used solely in vehicles, such as an in-car hotspot, that can only be used in a vehicle where due to the nature of use - within a vehicle cabin, generally in motion at high speeds – different requirements regarding power or exclusion zones could apply? If so, are there requirements that could provide assurance that a VLP device (geofenced or non-geofenced) is, in fact, in a vehicle, such as having a connection to Carplay or Android Auto?

69. The Commission invites commenters to address these issues and provide detailed information regarding whether the Commission can provide more flexibility to VLP devices, both geofenced and non-geofenced, for expanded use in aircraft, on boats, in vehicles, and in more places while still ensuring that incumbent operators' facilities are protected from harmful interference. The

Commission seeks quantitative estimates of benefits or costs of its proposals for relaxing the VLP prohibition in these locations and potential alternatives. How much and what kinds of additional VLP operations might occur? How much and what kind of costs would be incurred to accommodate these increased operations?

G. Expanding Very Low Power Operations to U-NII-6 and U-NII-8

70. In the Second Report and Order, the Commission adopted rules to permit VLP devices to operate in the U-NII-5 and U-NII-7 bands at power levels up to -5 dBm/MHz EIRP PSD and 14 dBm EIRP. The Commission determined that the risk of harmful interference to incumbent services in those bands, e.g., fixed microwave links and radio astronomy, was insignificant for VLP devices operating at that power level. In this Second Notice of Proposed Rulemaking, the Commission proposes to permit VLP devices to also operate in the U-NII-6 and U-NII-8 bands without geofencing. Given that fixed microwave links in the U-NII-8 band have the same characteristics as those in U-NII-5 and U-NII-7, the Commission concludes that any risk of harmful interference from VLP devices to these microwave links is insignificant. The Commission seeks comment on whether allowing VLP devices on U-NII-6 and U-NII-8 band devices will yield comparable benefits to those that stem from allowing VLP devices in the U-NII-5 and U-NII-7 bands in the Second Report and Order. The Commission tentatively concludes that at a minimum the benefits would be in proportion to the amount of spectrum in U-NII-6 and U-NII-8 bands relative to the amount of spectrum in the U-NII-5 and U-NII-7 bands. The Commission anticipates that these benefit estimates are conservative, as making available the full 1200 MHz in the 6 GHz band could lead to larger channel sizes that could increase speed and decrease latency. The Commission seeks comment on this and alternate methods of estimating these benefits.

1. Protection of Mobile Services

71. As discussed above, both the U-NII-6 and U-NII-8 bands are used by mobile BAS and CARS, including outdoor electronic news gathering (ENG) trucks and low power short range devices, such as portable cameras and microphones. Low Power Auxiliary Stations, which are licensed in portions of the U-NII-8 band, operate on an itinerant basis and transmit over distances of approximately 100 meters for uses such as wireless microphones, cue and control communications, and TV camera synchronization signals. There are also BAS and CARS fixed microwave links in these bands, which are

used for such purposes as video links between studios and transmitters and to relay video signals between cities.

72. *Outdoor electronic news gathering central receive sites*. As described above, the communications link between ENG trucks and a central receive site shares many of the characteristics of a fixed microwave link—i.e., they use directional antennas to send signals between two fixed locations that are mostly above the local clutter. The Commission proposes to permit VLP devices to also operate in the U-NII-6 and U-NII-8 bands and seek comment on whether VLP devices could operate at up to -5 dBm/MHz EIRP PSD and 14 dBm EIRP while keeping the risk of harmful interference to ENG central receive sites to an insignificant level. Would the same type of analysis discussed in the Second Report and Order showing an insignificant risk of harmful interference to fixed microwave receive sites be appropriate with respect to ENG receive sites? Are there inherent differences between BAS/CARS operations as compared to fixed point-to-point operations that must be considered when analyzing the harmful interference risk? For example, are there differences in antenna types, e.g., beamwidth and gain, or in typical antenna heights or the locations of receive antennas? Commenters noting differences should provide detailed descriptions and information regarding how any difference could affect the potential for VLP devices to cause harmful interference? Are there specific VLP device characteristics that need to be considered in analyzing their interference potential to ENG operations and if so, what are they? The Commission seeks to provide uniform rules for operations across the full 6 GHz band, but recognizing that there could be differences in how VLP emissions may interact with different incumbent systems, the Commission also seeks comment on what effect a lower power limit for VLP devices might have regarding protecting ENG operations in the U-NII-6 and U-NII-8 bands. Commenters advocating for a lower power level should provide detailed analysis regarding their preferred power level and the incremental effect such a power level would have on the ability for VLP devices to access spectrum as well as to what extent ENG operations would have additional protection from harmful interference. Are there any other requirements that the Commission could adopt for VLP devices to protect ENG operations?

73. Apple, Broadcom, and Meta submitted a Monte Carlo simulation addressing the potential for VLP devices operating at -5 dBm/MHz to exceed -6 dB I/N for two specific ENG receive sites. For

the ENG receivers, the simulation used the same two ENG receive sites and technical parameters that were used in a Monte Carlo simulation previously submitted by NAB that examined the potential for 6 GHz band unlicensed access points to interfere with ENG receivers. As the ENG receive antennas are directional but generally are able to provide 360° azimuthal coverage, it is not practical to simulate every azimuth. Thus, Apple, Broadcom, and Meta limited their simulation to the same three antenna orientations that NAB simulated for the two ENG receive sites. For the VLP devices, the simulation used similar assumptions for body loss, transmit power control, and propagation models as the Apple, Broadcom et al. and Apple simulations discussed in the Second Report and Order that assessed the potential for VLP devices to exceed -6 dB I/N for microwave links in San Franscisco and Houston. The Apple, Broadcom, and Meta Monte Carlo analysis found no instances where the VLP devices caused the signal received at the ENG receive sites to exceed -6 dB I/N. The Commission notes that NAB previously expressed skepticism about the accuracy of a similar Monte Carlo simulation provided by Apple, Broadcom, et al. that likewise found that the -6 dB I/N threshold was never exceeded for one of these ENG receive sites. The Commission seeks comment on the Apple, Broadcom, and Meta simulation. The Commission seeks comment on its conclusions that -6 dB I/N will not be exceeded or will only be exceeded in so few instances at ENG central receive sites that the Commission can conclude that the risk of harmful interference from VLP devices operating at -5 dB/MHz EIRP PSD is insignificant. Given that this simulation used two ENG receive sites that were chosen by NAB, can the Commission assume that they are representative of BAS and CARS receive sites in general? Are there particular scenarios that need further study?

74. *Outdoor electronic news gathering ENG trucks*. ENG trucks are generally situated near news or sporting events and receive signals from hand-held cameras or other portable news gathering devices. Based on a study previously submitted by NAB, the ENG truck receive antenna may be omni-directional or sectoral with adjustable height and location. Additionally, the ENG truck signals may use various bandwidths between 3 to 20 megahertz. For its study, NAB evaluated harmful interference based on free space path loss and on whether an unlicensed device would cause the I/N to exceed -10 dB.

75. Broadcom submitted a simulation showing a low probability (< 0.001%) that a VLP device operating at -5 dBm/MHz will cause the signal-to-interference-plus-noise ratio (SINR) at the ENG

truck receiver to fall below 1 dB. Broadcom's 1 dB SINR threshold is based on a previously submitted Broadcom study showing that a 10 megahertz ENG channel with a 7/8 coding rate can maintain a signal with a bit-error-rate (BER) less than 1e-8 in the presence of an RLAN signal operating with a 2% duty cycle. Charter, Comcast, Cox and CableLabs also previously submitted studies of the ENG truck signal SINR requirements in the presence of RLANs operating at various duty cycles. While these studies examined the impact of LPI transmissions, which operate at a higher power than is proposed for VLP, their findings with respect to SINR are also applicable to assessing VLP impact to BAS operations. CableLabs finds that a 10 dB SINR "provides an accurate view of system requirements for high-quality BAS video delivery".

76. The Commission proposes to permit non-geofenced VLP devices operate in the U-NII-6 and U-NII-8 bands and seeks comment on whether those devices could operate at up to -5 dBm/MHz EIRP PSD and 14 dBm EIRP while minimizing the risk of harmful interference to ENG truck receive sites. What is the appropriate metric for evaluating the harmful interference risk to a ENG truck receiver, which is fixed during operation but otherwise transportable, from a mobile or transient VLP transmission? Regarding potentially using SINR, because actual signal levels are not known prior to any transmission, what value or range of values should be used for the ENG signal level for any analysis? Commenters should provide insight and data regarding how any assumed signal level is consistent with the signal levels used for ENG operations. Previously submitted studies show that the required SINR will vary according to channel bandwidth and coding rate. What are the typical bandwidths and coding rates used by ENG truck receivers? If the Commission were to rely on evaluating SINR, what SINR threshold should be assumed to be necessary at the ENG truck receive site to maintain a high quality signal? Broadcom's study predicted an impact when the VLP device was within 5 meters of the receiver. Under normal operating conditions, how close could a random user's VLP device actually come to an ENG truck receiver? Is assuming at least a 5 meter separation distance realistic? Or is that distance too short or too long? Will the itinerant nature of VLP devices help reduce the likelihood of a VLP device causing harmful interference? Are there any particular connections the Commission should make between its reliance on an I/N metric when evaluating ENG trucks connecting to a central receive site and potentially evaluating the harmful interference risk from portable devices to an ENG truck based on SINR? In

evaluating analysis methodology and protection metrics, commenters should detail how such an approach supports permitting non-geofenced VLP operations at power levels up to -5 dBm/MHz EIRP PSD or indicates that a different power level may be appropriate.

77. *Low-power short range mobile devices*. The Commission proposes that low power short range BAS and CARS devices, such as portable cameras and microphones, and Low Power Auxiliary stations be protected from harmful interference by a combination of a required contention-based protocol and the low probability of a VLP device operating on the same channel in a nearby location. This proposal is consistent with the *6 GHz Order* in which the Commission required that all 6 GHz unlicensed LPI access points, subordinate devices, and client devices employ a contention-based protocol as well as the Commission's proposal above with respect to geofenced VLP devices. Further, the *6 GHz Order* showed that the probability of channel overlap between 6 GHz unlicensed devices and incumbent station operations is low due to unlicensed devices having a full 1200 megahertz over which to operate.

78. The Commission believes that a similar approach for VLP devices will adequately reduce the risk that mobile service incumbents in the U-NII-6 and U-NII-8 bands would be subjected to harmful interference and keep that risk to an insignificant level. The Commission's reasoning is consistent with the *6 GHz Order*, i.e., the sensing function associated with the contention-based protocol, along with the low probability for co-channel operation, is sufficient to ensure that VLP devices detect nearby mobile BAS operations and avoid transmitting co-channel to protect those operations from harmful interference. While the Commission is not proposing a specific technology protocol or contention method, the Commission proposes to require VLP devices to use a contention-based protocol as the Commission requires for LPI devices. The Commission believes that this proposal has additional benefits as it provides multiple VLP devices as well as LPI devices equal access to the spectrum, while protecting mobile incumbents' services. The Commission also believes that the use of a contention-based protocol will limit the duty cycle of VLP devices as they will need to share the spectrum with other devices. Additionally, VLP devices would transmit at lower power levels than LPI devices, further reducing the risk of harmful interference to mobile services. Given all these reasons, the Commission believes that requiring use of a contention-based protocol by VLP devices would protect mobile service incumbents.

79. The Commission seeks comment on this proposal. Would requiring VLP devices to

incorporate a contention-based protocol adequately protect mobile service incumbents in the U-NII-6 and U-NII-8 bands? If not, are there any other protection measures that could be used by VLP devices to protect mobile services? Is there a need to provide greater specificity in the requirements for a contention-based protocol used by VLP devices? If so, what particular requirements should be specified and why? What are the costs and benefits of requiring the use of a contention-based protocol?

2. Fixed Satellite Services

80. The U-NII-7 and U-NII-8 bands contain Fixed Satellite Service (FSS) space-to-Earth allocations and are restricted to feeder links for Mobile-Satellite Service non-geostationary satellite systems. No such earth stations are currently licensed in the U-NII-7 band. The U-NII-8 space-to-Earth allocation is limited to use by Globalstar's non-geostationary Mobile-Satellite Service feeder links and earth stations receiving at locations within 300 m of coordinates in Brewster, WA, Clifton, TX, and Finca Pascual, PR. Globalstar also operates earth station receive sites at Naalehu, HI, Wasilla, AK, and Sebring, FL. These last two locations are authorized to operate on a co-primary basis for FSS feeder downlinks, except for the 7.025-7.055 GHz band, where they are authorized only on an unprotected basis. In the *6 GHz Order*, the Commission determined that the probability of harmful interference to FSS space-to-Earth stations from LPI device operations in U-NII-8 is low, primarily due to the restriction that LPI devices operate indoors and at EIRP power levels no greater than 30 dBm.

81. The Commission seeks comment on whether any restrictions on VLP device operation is necessary to protect space-to-Earth stations. Because VLP devices would operate at significantly lower PSD levels than geofenced VLP access points and associated client devices, how does this impact the analysis of the potential for harmful interference occurring? As VLP devices operate without the supervision of a geofencing system, how could such restrictions, if needed, be implemented? Would there be differences in the cost of protection for VLP devices compared to geofenced VLP access point and associated client devices? The Commission also seeks comment on how the earth station antenna sites themselves provide interference protection by creating a physical barrier (e.g., fencing) or using geographic features to keep members of the public that could be using a VLP device beyond some minimum distance from those earth stations. Commenters should provide technical analysis to support their positions.

H. Emission Limits Below the U-NII-5 Band

82. The 5.895-5.925 GHz band immediately below the U-NII-5 band is used by the Intelligent Transportation Service (ITS) which the Commission is requiring to transition to C-V2X-based technology. In the Second Report and Order, the Commission adopted the same -27 dBm/MHz out-of-band emission (OOBE) limit for VLP devices for emissions below the U-NII-5 band and above the U-NII-8 band as it had already required for standard power and low-power indoor 6 GHz devices. NTIA filed a technical exhibit into the record that includes a Department of Transportation study (*DoT Exhibit*) addressing C-V2X protection requirements in the 5.895-5.925 GHz band from 6 GHz VLP devices' and mobile access points' out-of-band emissions. Deployers plan to transmit basic safety messages for crash-avoidance applications that require low-latency, free-from-harmful-interference in the 5.895-5.925 band. According to the *DoT Exhibit*, testing shows that VLP devices operating within a motor vehicle and that comply with the 27 dBm/MHz OOBE limit will decrease the operational range of C-V2X receivers in the same vehicle by more than 50%. While these tests are based on U-NII-4 (5.850-5.895 GHz) devices in the band immediately below the 5.895-5.925 GHz ITS band, the *DoT Exhibit* contends that the results can be translated to assess the impact of VLP devices in the U-NII-5 band. The *DoT Exhibit* claims that implementing both parts of a two-part compromise submitted by several VLP proponents is necessary to protect C-V2X receivers. This compromise proposal would require VLP devices to prioritize their operations to frequencies above 6.105 GHz and limit VLP OOBE below 5.925 GHz to -37 dBm/MHz. The Alliance for Automotive Innovation, 5GAA, and ITS America similarly point to the compromise proposal and advocate that the Commission modifies the VLP OOBE limits. While the rules the Commission adopted for VLP devices implement the former requirement, the Commission adopted the same -27 dBm/MHz OOBE limit.

83. The Commission seeks additional information on the potential impact that VLP devices operating in motor vehicles could have on C-V2X performance when a VLP device is operating within the same motor vehicle as the C-V2X receiver. In seeking comment on this issue, the Commission notes that the *DoT Exhibit* is narrowly limited to VLP operation as an access point or as a client connected to a 6 GHz enabled mobile access point within motor vehicles and does not address any other 6 GHz device or VLP device operation outside of motor vehicles. In particular, the Commission seeks technical

information, including studies, analyses, and measurements detailing the interaction between VLP devices operating under the Commission's rules and C-V2X receivers in the 5.895-5.925 GHz band when these devices are in close proximity such as in the same motor vehicle. What affect, if any, do VLP devices' OOBE have on C-V2X devices' ability to communicate at distances and with timing necessary to ensure a vehicle has sufficient reaction time to keep passengers safe in various situations? In undertaking studies to submit to the record, commenters should assess realistic scenarios for VLP device deployment, whether VLP devices are installed inside the vehicle or carried by a passenger from outside of the vehicle, as well as realistic scenarios for C-V2X devices as they pertain to device location within the vehicle, power level, OOBE level, antenna directivity, and activity factor. For example, are VLP devices expected to be mounted on dashboards, in headrests, etc. and are C-V2X antennas expected to be mounted inside or outside the vehicle, on the roof, in the grille, etc.? How do the various relative placements between VLP and C-V2X devices affect performance? The Commission seeks comment on whether any adjustments are needed to its VLP device rules to adequately protect C-V2X operation in vehicles. Commenters advocating for adjustments should address whether they believe prioritization and a more stringent emission limit, such as -37 dBm/MHz below 5.925 GHz for VLP devices, is necessary as the *DoT Exhibit* advocates. Or whether either acting on its own provides the protection level being claimed as needed. Similarly, commenters advocating for prioritizing spectrum should address whether a single limit is needed, such as above 6.105 GHz, or whether a variable limit based on channel bandwidth can be implemented to provide more flexibility for VLP devices. For example, would one bandwidth buffer suffice such that 20-megahertz channels would not transmit on the lowest 20 megahertz of the band, 40-megahertz channels would not transmit on the lowest 40 megahertz of the band, etc.? Are there other alternative measures that VLP devices could use to safeguard C-V2X operations? Although, the Commission seeks comment on the narrow issue of in-vehicle VLP device use, the Commission asks how any change to the OOBE limit might affect the entire VLP device market. Commenters should address whether permanently installed in-vehicle VLP devices should be treated differently than other VLP devices, such as those used as mobile access points or "hotspots," or would all VLP devices need to comply with a more stringent OOBE limit should the record indicate some adjustments to the Commission's rules are necessary for in-vehicle VLP operation? Finally, the Commission seeks

comment on whether or how any changes to its rules would affect device harmonization regarding the global VLP device market. The Alliance for Automotive Innovation, 5GAA, and ITS America state that dozens of countries have adopted a -37 dBm/MHz OOBE level to protect ITS services. They claim that the European Union (EU) as well as many non-EU member countries in the CEPT region, adopted a more stringent OOBE level of -45 dBm/MHz below 5935 MHz, which may be adjusted to -37 dBm/MHz in 2025 following additional protection studies. The Commission notes, however, that the EU OOBE limit is designed to protect urban rail intelligent transport systems, including communication based train control systems, not C-V2X operations. Thus, the Commission seeks comment on the applicability of the EU adopted rule to C-V2X operations. Do equipment manufacturers seeking to supply a global market plan to do so with a single device that meets the most stringent OOBE level or would they provide variants for different regions based on local rules? What are the costs and benefits of various approaches?

I. LPI Client-to-client Communications

84. In this section, the Commission seeks comment on whether the Commission should permit direct communications between clients to LPI devices. The Commission also seeks comment on the requirements that it would have to specify to enable client-to-client communications without causing harmful interference to licensed incumbent operations in the 6 GHz band.

85. *Background.* Standard-power access points can operate in the U-NII-5 and U-NII-7 bands and require use of an AFC system for providing access to spectrum in the band. LPI access points can operate across the entire 6 GHz band but at lower power levels than standard power devices. Client devices operate under the control of either a standard-power or LPI access point and communicate using power levels that depend on the type of access point to which they are connected. To ensure that client devices not associated with standard power access points transmit indoors, the Commission required that these devices operate under the control of an indoor access point and prohibited 6 GHz U-NII client devices from directly communicating with one another. The Commission prohibited unlicensed client devices from acting as "mobile hotspots" because "[p]ermitting a client device operating under the control of an access point to authorize the operation of additional client devices could potentially increase the distance between these additional client devices and the access point and increase the potential for harmful interference to fixed service receivers or electronic news gathering operations." To avoid this

situation, the Commission's rules prohibit 6 GHz U-NII client devices from directly communicating with one another. The Commission did not, however, consider whether a more limited approach to indoor client-to-client communications should be permissible, such as when a client is not acting as a mobile hotspot.

86. In response to suggestions by Apple, Broadcom et al. that client devices could be permitted to directly communicate with each under certain conditions, OET released a public notice on January 11, 2021 seeking information regarding client-to-client device communications in the 6 GHz band. The conditions that Apple, Broadcom et al. suggest for permitting client-to-client communications include requiring client devices to decode an enabling signal transmitted by an LPI device within the last four seconds, and requiring that an enabling signal be received at a signal strength of at least -99 dBm/MHz. These parties assert that these requirements would ensure each individual client participating in client-to-client communications is safely inside the area where a client device is authorized to communicate with an access point.

87. Fourteen parties filed comments and 12 parties filed reply comments in response to the OET public notice. Advocates of unlicensed operation support permitting client-to-client communications by LPI devices, arguing that they will enable new applications that benefit the public, such as AR/VR and digital education and training. Incumbent operators in the 6 GHz band (e.g., fixed microwave and broadcast) and in adjacent bands express concern about permitting client-to-client operations; specifically the potential for harmful interference and a lack of interference testing with devices operating under the current rules.

88. *Discussion.* The Commission invites comment on whether and under what circumstances LPI client devices could be permitted to directly communicate with each other in a limited manner while protecting incumbent licensed services. The Commission recognizes that OET previously sought comment on these issues. However, more than two years have passed since the Commission received responses to OET's public notice. During that time, many LPI devices have been certified and put into operation. In addition, the approval process for AFC systems for standard power devices has advanced, and as discussed in the Second Report and Order, several parties have provided detailed analyses on the potential for interference from 6 GHz devices to incumbent services such as fixed microwave and

broadcast services. Given that there is now more information available or that could become available in the near future concerning the interference potential of 6 GHz devices, the Commission believes it is now appropriate to refresh and further build the record on whether the Commission could permit LPI client-to-client operations.

89. Specifically, the Commission seeks comment on whether the Commission should permit 6 GHz client devices to directly communicate when they are under the control of or have received an enabling signal from a LPI access point. Commenters should explain how to define an enabling signal (e.g., power level, modulation type, how often it should be broadcast if it is discrete from the regular data stream, etc.), what characteristics it should have, how it would be similar or different from signals, such as beacons, that access points already use to connect with client devices, and the degree to which an enabling signal would tether a client device not under the direct control of an access point to that access point. Commenters should also provide information on the types of applications that direct client-to-client communications would enable that cannot be accomplished by communications through an access point. In addition, commenters advocating for rule changes should address whether direct client-to-client communications should be under the current power limits or restricted to lower power limits to reduce the potential for harmful interference to incumbent operations.

90. The requirement that 6 GHz client devices operate under the control of either a standard-power or low-power indoor access point is intended to prevent client devices from causing harmful interference by limiting their operation either to outdoors in areas where an AFC system has determined that interference is unlikely to occur, or in the case of LPI devices to indoor locations where other factors such as building entry loss prevent harmful interference. It may be possible for a client device to receive an enabling signal from an access point even when the enabling signal is too weak to enable the client device to conduct communications with the access point. In such situations, the weak received signal level makes it more likely that the client device could be outdoors. By requiring that the enabling signal have a specific signal strength, this problem could be potentially avoided. If the Commission were to adopt rules permitting client-to-client communications, should it require the enabling signal from the low-power indoor access point to be received by the client device with a particular signal level, such as -99 dBm/MHz as suggested by Apple, Broadcom et al.? If not, what signal level would be appropriate? How

can a specific signal level be correlated with the requirement that the client device be under the control of an access point? Should the enabling signal level be of sufficient strength to effectively require that the signal levels between the access point and client device be sufficiently strong to permit bi-directional communications between the client devices and the access point, thereby ensuring that both client devices are close to the access point? How frequently should a client device be required to receive an enabling signal to continue transmitting to another client device?

The Commission also seeks comment on whether client devices should be limited to receiving an enabling signal from the same access point or whether client-to-client communications could be permitted so long as each client device receives an enabling signal from any authorized access point. Apple, Broadcom et al.'s suggestion would potentially permit two client devices to communicate even if they receive enabling signals from two different access points. For example, client devices in two different buildings receiving enabling signals from different low-power indoor access points could attempt to communicate with each other. Would permitting this situation to occur increase the potential for the client devices to cause harmful interference to licensed services? Should other configurations be permitted? For example, could a client device controlled by a standard power access point be permitted to communicate with a client device controlled by a low-power indoor access point? In such a case, should the client device power level be restricted to the standard power client device power level? Could client-to-client communications be permitted between devices when both clients are controlled by a standard power access point? If so, are any changes needed to the AFC systems? Must an enabling signal be received on the same channel for each device under any of the scenarios contemplated? Under any envisioned client-to-client communication scenario, commenters should provide detailed descriptions of how such communications can be enabled including how such communications fit under the current rules that limit client devices to operating only under the control of a standard power access point or a low-power indoor access point or whether, and which, rules would need to be modified. Commenters should provide detailed analysis of how any client-to-client communication configurations they prefer would protect incumbent

operations from harmful interference. Finally, commenters should provide any other information relevant to evaluating whether direct client-to-client communications should be permitted, including any alternative methods or necessary rule changes not directly discussed above.

E. ORDERING CLAUSES

1. Accordingly, IT IS ORDERED, pursuant to sections 2, 4(i), 302, and 303 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 152, 154(i), 302a, and 303, this *Second Further Notice of Proposed Rulemaking* is hereby ADOPTED.

2. IT IS FURTHER ORDERED that the Office of the Secretary, Reference Information Center, SHALL SEND a copy of the *Second Further Notice of Propose Rulemaking* including the Initial Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the Small Business Administration.

List of Subjects in 47 CFR Part 15

Communications equipment, Radio, and Reporting and recordkeeping requirements.

Federal Communications Commission.

Marlene Dortch,
Secretary.

Proposed Rules

For the reasons discussed in the document, the Federal Communications Commission proposes to amend 47 CFR part 15 as follows:

PART 15 – RADIO FREQUENCY DEVICES

1. The authority citation for part 15 continues to read as follows:

Authority: 47 U.S.C. 154, 302a, 303, 304, 307, 336, 544a, and 549.

2. Section 15.403 is amended by adding the definitions of "Geofenced very low power access point" and "Geofencing" in alphabetical order, to read as follows:

§ 15.403 Definitions.

* * * * *

Geofenced Very Low Power Access Point. For the purpose of this subpart, an access point that operates in the 5.925–7.125 GHz band, has an integrated antenna, and uses a geofencing system to determine channel availability at its location.

Geofencing. For the purposes of this subpart, a method of establishing exclusion zones within which very low power devices are not permitted to operate on frequencies specified by the geofencing system.

* * * * *

3. Amend §15.407 by:

A. Redesignating paragraphs (a)(7) and (8) as paragraphs (a)(8)(i) and (ii);

B. Adding new paragraphs (a)(7) and (a)(8)(iii);

C. Redesignating paragraphs (a)(9) through (a)(12) as paragraphs (a)(10) through (a)(13);

D. Revising newly redesignated paragraph (a)(10);

E. Revising paragraphs (d)(3) and (d)(5);

F. Removing and reserving paragraph (d)(7);

G. Adding paragraphs (d)(8) through (10); and

H. Adding paragraphs (o) through (r).

The revisions and additions read as follows:

§ 15.407 General technical requirements.

(a) * * *

(7) For a geofenced very low power access point operating in the 5.925–7.125 GHz band, the maximum power spectral density must not exceed 1 dBm e.i.r.p in any 1-megahertz band. In addition, the maximum e.i.r.p over the frequency band of operation must not exceed 14 dBm.

(8) ***

(iii) For client devices operating under the control of a geofenced very low power access point in the 5.925–7.125 GHz bands, the maximum power spectral density must not exceed 1 dBm e.i.r.p in any 1-megahertz band, and the maximum e.i.r.p over the frequency band of operation must not exceed 14 dBm.

* * * * *

(10) Access points operating under the provisions of paragraphs (a)(5), (6), and (7) of this section must employ a permanently attached integrated antenna.

* * * * *

(d) * * *

(3) Transmitters operating under the provisions of paragraphs (a)(5), (6), and (8)(ii) of this section are limited to indoor locations.

* * * * *

(5)(i) In the 5.925–7.125 GHz band, client devices must operate under the control of a standard power access point, low-power indoor access point, subordinate device, or geofenced very low power access point; Subordinate devices must operate under the control of a low-power indoor access point.

(ii) Fixed client devices may only connect to a standard power access point.

(iii) In all cases, an exception exists such that a client device may transmit brief messages to an access point when attempting to join its network after detecting a signal that confirms that an access point is operating on a particular channel.

(iv) Client-to-client communications: Client devices are prohibited from connecting directly to another client device, except that client devices under the control of the same indoor access point or geofenced very low power access point may communicate directly with each other.

(v) Client devices under the control of indoor access point, that directly connect to another client, transmit power must not exceed -1 dBm e.i.r.p. in any 1-meghertz band, and the maximum e.i.r.p. over the frequency band of operation must not exceed 14 dBm.

* * * * *

(7) [Reserved]

(8) Geofenced very low power and very low power devices may not employ a fixed outdoor infrastructure. Such devices may not be mounted on outdoor structures, such as buildings or poles.

(9) Geofenced very low power and very low power devices must prioritize operations on frequencies above 6.105 GHz prior to operating on frequencies between 5.925 GHz and 6.105 GHz.

(10) Transmit power control (TPC). Geofenced very low power devices operating in the 5.925-7.125 GHz bands shall employ a TPC mechanism. A very low power device is required to have the capability to operate at least 6 dB below the maximum EIRP PSD value of -5 dBm/ MHz.

* * * * *

(o) *Geofencing system.* (1) A geofencing system must obtain information on protected services within the 5.925–7.125 GHz band from Commission databases and use that

information to determine frequency-specific exclusion zones where very low power access points and associated client devices may not operate on specified frequencies based on the propagation models and protection criteria specified in paragraph (p) of this section. The geofencing system must access the Commission's licensing databases and update the frequency-specific exclusion zones at least once per day to ensure that they are based on the most recent information in the Commission's databases.

(2) Geofencing systems may be implemented using a centralized database or may be integrated into geofenced very low power access point devices.

(3) A geofenced very low power access point operating under paragraph (a)(7) of this section must access a geofencing system to obtain frequency-specific exclusion zones for the area in which it is operating or intends to operate (e.g., within a specific point radius or within specific geopolitical boundaries) prior to transmitting. If the geofenced very low power access point moves outside this area, it must obtain additional frequency-specific exclusion zones for the area and adjust its operating frequency, if necessary, prior to operating in this new area. The geofenced very low power access point must obtain updated frequency-specific exclusion zones from the geofencing system at least once per day. If the geofenced very low power access point fails to obtain the updated frequency specific exclusion zones on any given day, the geofenced very low power access point may continue to operate until 11:59 p.m. of the following day at which time it must cease operations until it can obtain updated frequency-specific exclusion zones.

(4) A geofenced very low power access point must determine its location and avoid transmitting on frequencies that are not available in accordance with the frequency specific exclusion zones. The geofenced very low power access point may not permit a client device operating under its control to transmit on frequencies that are not available in accordance with the frequency specific exclusion zones. The geofenced very low

power access point must determine its location frequently enough that, based on its position and speed, it will not transmit on an unavailable frequency. The geofenced very low power access point must determine its location and speed at least once a minute.

(5) A geofenced very low power access point must incorporate adequate security measures to prevent it from accessing geofencing systems and geofencing methods not approved by the FCC and to ensure that unauthorized parties cannot modify the device to operate in a manner inconsistent with the rules and protection criteria set forth in this section and to ensure that communications between geofenced very low power access points and geofencing systems are secure to prevent corruption or unauthorized interception of data.

(6) A geofenced very low power access point must include an internal geo-location capability to automatically determine the geofenced very low power access point's geographic coordinates and location uncertainty (in meters), with a confidence level of 95%.

(i) The geofenced very low power access point must use such coordinates and location uncertainty when comparing the devices specific location to the exclusion zone boundaries.

(ii) The applicant for certification of a geofenced very low power access point must demonstrate the accuracy of the geo-location method used and the location uncertainty.

(7)(i) For centralized geofencing systems, geofencing system operators must provide continuous service to all very low power devices for which it has been designated to provide service. If a geofencing system ceases operation, the operator must provide at least 30-days' notice to the Commission and a description of any arrangements made for those devices to continue to receive exclusion zone update information.

(ii) For geofencing systems internal to the geofenced very low power device, the equipment certification responsible party must ensure that the device continues to be capable of receiving Commission database updates as required by this section.

(iii) As required by paragraph (o)(3) of this section, devices that do not receive timely geofencing update information or timely Commission database updates necessary to calculate up-to-date exclusion zones must cease operating.

(8) The geofencing system whether centralized or internal to the geofenced very low power device must ensure that all communications and interactions between the geofencing system and the geofenced very low power access point and/or all communications between the geofencing system and Commission databases are accurate and secure and that unauthorized parties cannot access or alter the database, the exclusion zones, or the list of excluded or available frequencies. Additionally, the geofencing system must incorporate security measures to protect against unauthorized data input or alteration of stored data, including establishing communications authentication procedures between client devices and geofenced very low power access points.

(9) A geofencing system must implement the terms of international agreements with Mexico and Canada.

(10) At the time that the geofenced very low power device receives equipment certification, the device must either have its geofencing system approved or specify an already approved geofencing system that it is using. The Commission may specify criteria for such approval, which could require test results to be submitted.

(11) Each geofencing system and operator thereof for centralized systems and the equipment certification responsible party for systems internal to the geofenced very low power device must:

(i) Ensure that a regularly updated geofencing system database that contains the information described in this section, including incumbent's information and geofenced very low power access points authorization parameters, is maintained.

(ii) Respond in a timely manner to verify, correct, or remove, as appropriate, data in the event that the Commission or a party presents a claim of inaccuracies in the geofencing system.

(iii) Establish and follow protocols to comply with enforcement instructions from the Commission, including discontinuance of geofenced very low power access point operations on specified frequencies in designated geographic areas and predetermined exclusion zones.

(iv) Comply with instructions from the Commission to adjust exclusion zones to more accurately reflect the potential for harmful interference.

(12) A geofencing system operator may charge fees for providing service. The Commission may, upon request, review the fees and can require changes to those fees if the Commission finds them to be unreasonable.

(p) *Incumbent protection by geofencing system.* A very low power access point or very low power client device must not cause harmful interference to fixed microwave services and Broadcast Auxiliary Service and Cable Television Relay Service receive sites authorized to operate in the 5.925–7.125 GHz bands. Based on the criteria set forth below, a geofencing system must establish location and frequency-based exclusion zones around fixed microwave receivers, fixed Broadcast Auxiliary Service receive sites, and fixed Cable Television Relay Service receive sites operating in the 5.925–7.125 GHz bands. Individual very low power access points and their associated client devices must not operate co-channel to the frequencies licensed for fixed microwave systems, fixed Broadcast Auxiliary Service receive sites, and fixed Cable Television Relay Service sites within an exclusion zone.

(1) Geofencing systems must use the following propagation models to determine exclusion zones for very low power access points. For a separation distance between geofenced very low power devices and fixed microwave receive sites , fixed Broadcast Auxiliary Service receive sites, or fixed Cable Television Relay Service receive sites

(i) Up to 30 meters, the geofencing system must use the free space path-loss model.

(ii) More than 30 meters and up to and including one kilometer, the geofencing system must use the Wireless World Initiative New Radio phase II (WINNER II) model. The geofencing system must use site-specific information, including buildings and terrain data, for determining the line-of-sight/non-line-of-sight path component in the WINNER II model, where such data are available. For evaluating paths where such data are not available, the geofencing system must use a probabilistic model combining the line-of-sight path and non-line-of-sight path into a single path-loss as follows:

Equation 3 to paragraph (p)(2)(ii)

Path-loss (L) = $\sum_i P(i) * L_i = P_{LOS} * L_{LOS} + P_{NLOS} * L_{NLOS;}$

Where:

P_{LOS} is the probability of line-of-sight;

L_{LOS} is the line-of-sight path loss;

P_{NLOS} is the probability of non-line-of sight;

L_{NLOS} is the non-line-of-sight path loss; and

L is the combined path loss.

(iii) The WINNER II path loss models include a formula to determine P_{LOS} as a function of antenna heights and distance. P_{NLOS} is equal to $(1-P_{LOS})$.

(iv) In all cases, the geofencing system will use the correct WINNER II parameters to match the morphology of the path between a very low power access point and a fixed microwave receiver, fixed Broadcast Auxiliary Service receiver, or fixed Cable Television Relay Service receiver (i.e., Urban, Suburban, or Rural).

(v) More than one kilometer, the geofencing system must use Irregular Terrain Model (ITM) combined with the appropriate clutter model. To account for the effects of clutter, such as buildings and foliage, the geofencing system must combine the ITM with the ITU–R P.2108–0 (06/2017) clutter model for urban and suburban environments and the ITU–R P.452–16

(07/2015) clutter model for rural environments. The geofencing system should use the most appropriate clutter category for the local morphology when using ITU–R P.452–16. However, if detailed local information is not available, the "Village Centre" clutter category should be used. The geofencing system must use 1 arc-second digital elevation terrain data and, for locations where such data are not available, the most granular available digital elevation terrain data.

(vi) Geofencing systems may include up to 4 dB additional loss to account for losses due to scattering and absorption from a nearby body or object.

(vii) Geofencing systems may calculate exclusion zones based on a 1.5 meter very low power access point antenna height above ground level, regardless of the actual antenna height above ground level.

(2) The geofencing system must use −6 dB I/N as the interference protection criteria when calculating the exclusion zones where I (interference) is the co-channel signal from the very low power access point at the fixed microwave service receiver, fixed Broadcast Auxiliary Service receiver, or fixed Cable Television Relay Service receiver and N (noise) is background noise level at the fixed microwave service receiver, fixed Broadcast Auxiliary Service receiver, or fixed Cable Television Relay Service receiver.

(q) *Incumbent Protection by Geofencing System: Radio Astronomy Services.* (1) The geofencing system must enforce exclusion zones to the following radio observatories that observe between 6650-6675.2 MHz: Arecibo Observatory, the Green Bank Observatory, the Very Large Array (VLA), the 10 Stations of the Very Long Baseline Array (VLBA), the Owens Valley Radio Observatory, and the Allen Telescope Array.

(2) The exclusion zone sizes are based on the radio line-of-sight and determined using 4/3 earth curvature and the following formula:

Equation 4 to paragraph (q)(2)

dkm_los = 4.12*(sqrt(Htx) + sqrt(Hrx))

Where:

Htx is the height of the very low power access point and is set at 1.5 meters above ground level; and

Hrx is the height of the radio astronomy antenna in meters above ground level.

(3) Coordinate locations of the radio observatories are listed in § 2.106(c)(131), (c)(385) of this part.

(r) *Incumbent Protection by Geofencing System: FSS (space-to-Earth) Earth Stations.* (1) The geofencing system must enforce exclusion zones to protect FSS earth stations that receive in the 6875-7055 MHz band at Clifton, TX, Cabo Rojo, PR, Wasilla, AK, Sebring, FL, and Naalehu, HI.

(2) The exclusion zone sizes are based on the radio line-of-sight and determined using 4/3 earth curvature and the following formula:

Equation 5 to Paragrarph (r)(2)

dkm_los = 4.12*(sqrt(Htx) + sqrt(Hrx))

Where:

Htx is the height of the very low power access point and is set at 1.5 meters above ground level; and

Hrx is the height of the FSS antenna in meters above ground level. Coordinate locations of the FSS sites are listed in the following table:

Table 1 to Paragraph (r)(2)

Location	Coordinates
Clifton, Texas	**31° 47' 59.22" N, 97° 36' 46.71" W**
Clifton, Texas	**31° 48' 2.149" N, 97° 36' 44.37" W**
Clifton, Texas	**31° 47' 57.4" N, 97° 36' 47.9" W**
Clifton, Texas	**31° 48' 0.1" N, 97° 36' 48.9" W**
Clifton, Texas	**31° 48' 3" N, 97° 36' 49.2" W**

Clifton, Texas	**31° 47' 57.5" N, 97° 36' 44.7" W**
Clifton, Texas	**31° 48' 0.2" N, 97° 36' 44.3" W**
Sebring, Florida	**27° 27' 34.3" N, 81° 21' 26.6" W**
Sebring, Florida	**27° 27' 35.6" N, 81° 21' 26.8" W**
Sebring, Florida	**27° 27' 35.6" N, 81° 21' 28.4" W**
Sebring, Florida	**27° 27' 34.3" N, 81° 21' 28.3" W**
Wasilla, Alaska	**61° 35' 24.9" N, 149° 29' 9.6" W**
Wasilla, Alaska	**61° 35' 24.1" N, 149° 29' 6" W**
Wasilla, Alaska	**61° 35' 24.6" N, 149° 29' 2.4" W**
Cabo Rojo, Puerto Rico	**17° 58' 48" N, 67° 8' 15" W**
Cabo Rojo, Puerto Rico	**17° 58' 50" N, 67° 8' 13" W**
Cabo Rojo, Puerto Rico	**17° 58' 49" N, 67° 8' 14" W**
Cabo Rojo, Puerto Rico	**17° 58' 48" N, 67° 8' 12" W**
Naalehu, Hawaii	**19° 0' 51.99" N, 155° 39' 47" W**
Naalehu, Hawaii	**19° 0' 52.99" N, 155° 39' 48.99" W**
Naalehu, Hawaii	**19° 0' 51" N, 155° 39' 48.9" W**

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