FCC and to ensure that unauthorized parties cannot modify the device or configure its control features to operate in a manner inconsistent with the rules and protection criteria set forth in this subpart.

(g) *Antenna requirements*—(1) *Fixed white space devices*— (i) *Above ground level.* The transmit antenna height shall not exceed 10 meters above ground level in any area for fixed white space devices operating in the TV bands at 40 mW EIRP or less or operating across multiple contiguous TV channels at 100 mW EIRP or less.

(ii) *Height above average terrain (HAAT).* For devices operating in the TV bands below 602 MHz, the transmit antenna shall not be located where its height above average terrain exceeds 250 meters generally, or 500 meters in less congested areas. For devices operating in all other bands the transmit antenna shall not be located where its height above average terrain exceeds 250 meters. The HAAT is to be calculated by the white space database using the methodology in §73.684(d) of this chapter. For HAAT greater than 250 meters the following procedures are required:

(A) The installing party must contact a white space database and identify all TV broadcast station contours that would be potentially affected by operation at the planned HAAT and EIRP. A potentially affected TV station is one where the protected service contour is within the applicable separation distance for the white space device operating at an assumed HAAT of 50 meters above the planned height at the proposed power level.

(B) The installing party must notify each of these licensees and provide the geographic coordinates of the white space device, relevant technical parameters of the proposed deployment, and contact information.

(C) No earlier than four calendar days after the notification in paragraph (g)(1)(ii)(B) of this section, the installing party may commence operations.

(D) Upon request, the installing party must provide each potentially affected licensee with information on the time periods of operations.

(E) If the installing party seeks to modify its operations by increasing its power level, by moving more than 100 meters horizontally from its location, or by making an increase in the HAAT or EIRP of the white space device that results in an increase in the minimum required separation distances from co-channel or adjacent channel TV station contours, it must conduct a new notification.

(F) All notifications required by this section must be in written form (including email). In all cases, the names of persons contacted, and dates of contact should be kept by the white space device operator for its records and supplied to the Commission upon request.

(2) *Personal/portable white space devices.* Personal/portable devices shall have permanently attached transmit and receive antenna(s).

(3) *Sensing-only white space devices operating under the provisions of §15.717 of this subpart.* (i) The provisions of §15.204(c)(4) do not apply to an antenna used for transmission and reception/spectrum sensing.

(ii) Compliance testing for white space devices that incorporate a separate sensing antenna shall be performed using the lowest gain antenna for each type of antenna to be certified.

(h) *Compliance with radio frequency exposure requirements.* White space devices shall ensure compliance with the Commission's radio frequency exposure requirements in §§1.1307(b), 2.1091 and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of RF sources under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

[80 FR 73070, Nov. 23, 2015, as amended at 84 FR 34797, July 19, 2019; 85 FR 18149, Apr. 1, 2020; 86 FR 2291, Jan. 12, 2021; 87 FR 54901, Sept. 8, 2022]

§15.711 Interference avoidance methods.

Except as provided in §15.717 of this part, channel availability for a white space device is determined based on the

geo-location and database access method described in paragraphs (a) through (e) of this section.

(a) *Geolocation required.* White space devices shall rely on a geolocation capability and database access mechanism to protect the following authorized service in accordance with the interference protection requirements of §15.712: Digital television stations, digital and analog Class A, low power, translator and booster stations; translator receive operations; fixed broadcast auxiliary service links; private land mobile service/commercial radio service (PLMRS/CMRS) operations; offshore radiotelephone service; low power auxiliary services authorized pursuant to §§74.801 through 74.882 of this chapter, including licensed wireless microphones; MVPD receive sites; wireless medical telemetry service (WMTS); radio astronomy service (RAS); and 600 MHz service band licensees where they have commenced operations, as defined in §27.4 of this chapter. In addition, protection shall be provided in border areas near Canada and Mexico in accordance with §15.712(g).

(b) *Geo-location requirement*—(1) *Accuracy.* Fixed white space devices that incorporate a geo-location capability and Mode II devices shall determine their location and their geo-location uncertainty (in meters), with a confidence level of 95%.

(2) *Reference datum.* All geographic coordinates shall be referenced to the North American Datum of 1983 (NAD 83).

(c) *Requirements for fixed white space devices.* (1) The geographic coordinates of a fixed white space device shall be determined at the time of installation and first activation from a power off condition by an incorporated geo-location capability. The antenna height above ground shall be determined by the installer or operator of the device, or by an automatic means. This information shall be stored internally in the white space device and transmitted automatically by the device to the white space database. The operator of a fixed white space device shall be responsible for assuring the accuracy of the information registered in the white space database. If a fixed white space device is moved to another location or if its stored coordinates become altered, the operator shall reestablish the device's:

(i) Geographic location through the incorporated geo-location capability and the antenna height above ground level and store this information in the white space device; and

(ii) Registration with the database based on the device's new coordinates and antenna height above ground level.

(iii) A fixed white space device may obtain its geographic coordinates through an external geo-location source when it is used at a location where its internal geo-location capability does not function. An external geo-location source may be connected to a fixed device through either a wired or a wireless connection, and a single geo-location source may provide location information to multiple fixed devices. An external geo-location source must be connected to a fixed device using a secure connection that ensures that only an external geo-location source that has been approved with a particular fixed device can provide geographic coordinates to that device. The geographic coordinates must be provided automatically by the external geo-location source to the fixed device; users may not manually enter them. Alternatively, an extender cable may be used to connect a remote receive antenna to a geo-location receiver within a fixed device.

(iv) The applicant for certification of a fixed device must demonstrate the accuracy of the geo-location method used and the location uncertainty as defined in paragraph (b) of this section. For fixed devices that are not using an internal geo-location capability, this uncertainty must account for the accuracy of the geo-location source and the separation distance between such source and the white space device.

(2)(i) Each fixed white space device must access a white space database over the Internet to determine the available channels and the corresponding maximum permitted power for each available channel that is available at its geographic coordinates, taking into consideration the fixed device's antenna height above ground level and geo-location uncertainty,

prior to its initial service transmission at a given location.

(ii) Operation is permitted only on channels and at power levels that are indicated in the database as being available for each white space device. Operation on a channel must cease immediately or power must be reduced to a permissible level if the database indicates that the channel is no longer available at the current operating level.

(iii) A fixed white space device shall access the database at least as frequently as specified in paragraph (h) of this section to verify that the operating channel(s) and corresponding power levels continue to remain available. The fixed device's registration information shall be updated if the geographic coordinates reported to the database differ by more than ±50 meters from the previously registered coordinates.

(iv) Fixed devices without a direct connection to the Internet: A fixed white space device may not operate on channels provided by a white space database for another fixed device. A fixed white space device that has not yet been initialized and registered with a white space database consistent with §15.713 of this part, but can receive the transmissions of another fixed white space device, may transmit to that other fixed white space device on either a channel that the other white space device has transmitted on or on a channel which the other white space device indicates is available for use to access the database to register its location and receive a list of channels that are available for it to use. Subsequently, the newly registered fixed white space device must only use the channels that the database indicates are available for it to use.

(d) *Requirements for Mode II personal/portable white space devices.* (1) The geographic coordinates of a Mode II personal/portable white space device shall be determined by an incorporated geolocation capability prior to its initial service transmission at a given location and each time the device is activated from a power-off condition to determine the available channels and the corresponding maximum permitted power for each available channel at its geographic coordinates, taking into consideration the device's geo-location uncertainty. The location must be checked at least once every 60 seconds while in operation, except while in sleep mode, *i.e.*, in a mode in which the device is inactive but is not powered-down.

(2) Each Mode II personal/portable white space device must access a white space database over the Internet to obtain a list of available channels for its location. The device must access the database for an updated available channel list if its location changes by more than 100 meters from the location at which it last established its available channel list.

(3) Operation is permitted only on channels and at power levels that are indicated in the database as being available for the Mode II personal/portable white space device. Operation on a channel must cease immediately or power must be reduced to a permissible level if the database indicates that the channel is no longer available at the current operating level.

(4) A Mode II personal/portable white space device that has been in a powered state shall re-check its location and access the database at least as frequently as specified in paragraph (h) of this section to verify that the operating channel(s) and corresponding power levels continue to be available.

(5) A Mode II personal/portable device may load channel availability information for multiple locations, (*i.e.*, in the vicinity of its current location) and use that information to define a geographic area within which it can operate on the same available channels at all locations. For example a Mode II personal/portable white space device could calculate a bounded area in which a channel or channels are available at all locations within the area and operate on a mobile basis within that area. A Mode II white space device using such channel availability information for multiple locations must contact the database again if/when it moves beyond the boundary of the area where the channel availability data is valid.

(e) *Requirements for Mode I personal/portable white space devices.* (1) A Mode I personal/portable white space device may only transmit upon receiving a

list of available channels from a fixed or Mode II white space device. A fixed or Mode II white space device may provide a Mode I device with a list of available channels only after it contacts its database, provides the database the FCC Identifier (FCC ID) of the Mode I device requesting available channels, and receives verification that the FCC ID is valid for operation.

(2) A Mode II device must provide a list of channels to the Mode I device that is the same as the list of channels available to the Mode II device.

(3) A fixed device may provide a list of available channels to a Mode I device only if the fixed device HAAT as verified by the white space database does not exceed 106 meters. The fixed device must provide a list of available channels to the Mode I device that is the same as the list of channels available to the fixed device, except that a Mode I device may operate only on those channels that are permissible for its use under §15.707 of this part. A fixed device may also obtain from a white space database and provide to a Mode I personal/portable white space device, a separate list of available channels that includes adjacent channels available to a Mode I personal/portable white space device, but not a fixed white space device.

(4) To initiate contact with a fixed or Mode II device, a Mode I device may transmit on an available channel used by the fixed or Mode II white space device or on a channel the fixed or Mode II white space device indicates is available for use by a Mode I device. At least once every 60 seconds, except when in sleep mode (*i.e.*, a mode in which the device is inactive but is not powered-down), a Mode I device must either receive a contact verification signal from the Mode II or fixed white space device that provided its current list of available channels or contact a Mode II or fixed white space device to re-verify/re-establish channel availability. A Mode I device must cease operation immediately if it does not receive a contact verification signal or is not able to re-establish a list of available channels through contact with a fixed or Mode II device on this schedule. If a fixed or Mode II white space device loses power and obtains a new channel list, it must signal all Mode I devices it is serving to acquire and use a new channel list.

(f) *Display of available channels.* A white space device must incorporate the capability to display a list of identified available channels and its operating channels.

(g) *Identifying information.* Fixed white space devices shall transmit identifying information. The identification signal must conform to a standard established by a recognized industry standards setting organization. The identification signal shall carry sufficient information to identify the device and its geographic coordinates.

(h) *Database re-check requirement.* (1) Mobile devices and fixed and Mode II personal/portable devices, excluding narrowband devices, operating in the television bands.

(i) A device that has been in a powered-on state shall access the white space database at least once every 60 minutes to verify that the operating channel(s) and associated maximum power levels continue to be available at its location. Devices shall adjust their channel usage in accordance with the most recent channel availability schedule information provided by the white space database for the two-hour period beginning at the time of the device last accessed the database for a list of available channels.

(ii) If a device fails to successfully contact the white space database, it may continue to operate until no longer than 120 minutes after the last successful contact, at which time it must cease operations until it reestablishes contact with the white space database and re-verifies its list of available channels and associated maximum power levels.

(2) Fixed and Mode II personal/portable devices operating outside of the television bands.

(i) A device that has been in a powered-on state shall access the database at least once a day to verify that the operating channel(s) and associated maximum power levels continue to be available at its location.

(ii) If a device fails to successfully contact the white space database during any given day, it may continue to

operate until 11:59 p.m. of the following day at which time it must cease operations until it re-establishes contact with the white space database and re-verifies its list of available channels and corresponding power levels.

(3) Narrowband devices operating in the television bands.

(i) A device that has been in a powered-on state shall access the database at least once each 24-hour period to verify that the operating channel(s) and associated maximum power levels continue to be available at its location.

(ii) A device must cease operating if it fails to successfully access the database once 24 hours from its last successful contact elapses until it re-establishes contact with the white space database and re-verifies its list of available channels and corresponding power levels.

(i) *Push notifications.* Device manufacturers and database administrators may implement a system that pushes updated channel availability information from the database to white space devices. However, the use of such systems is not mandatory, and the requirements for white space devices to validate the operating channel and to cease operation in accordance with paragraph (h) of this section continue to apply if such a system is used.

(j) *Security.* (1) White space devices shall incorporate adequate security measures to ensure that they are capable of communicating for purposes of obtaining lists of available channels only with databases operated by administrators authorized by the Commission, and to ensure that communications between white space devices and databases are secure to prevent corruption or unauthorized interception of data. This requirement includes implementing security for communications between Mode I personal portable devices and fixed or Mode II devices for purposes of providing lists of available channels. This requirement applies to communications of channel availability and other spectrum access information between the databases and fixed and Mode II devices (it is not necessary for white space devices to apply security coding to channel availability and channel access information where they are not the originating or terminating device and that they simply pass through).

(2) Communications between a Mode I device and a fixed or Mode II device for purposes of obtaining a list of available channels shall employ secure methods that ensure against corruption or unauthorized modification of the data. When a Mode I device makes a request to a fixed or Mode II device for a list of available channels, the receiving device shall check with the white space database that the Mode I device has a valid FCC Identifier before providing a list of available channels. Contact verification signals transmitted for Mode I devices are to be encoded with encryption to secure the identity of the transmitting device. Mode I devices using contact verification signals shall accept as valid for authorization only the signals of the device from which they obtained their list of available channels.

(3) A white space database shall be protected from unauthorized data input or alteration of stored data. To provide this protection, the white space database administrator shall establish communications authentication procedures that allow fixed, mobile, and Mode II white space devices to be assured that the data they receive is from an authorized source.

(4) Applications for certification of white space devices shall include a high level operational description of the technologies and measures that are incorporated in the device to comply with the security requirements of this section. In addition, applications for certification of fixed, mobile, and Mode II white space devices shall identify at least one of the white space databases operated by a designated white space database administrator that the device will access for channel availability and affirm that the device will conform to the communications security methods used by that database.

(k) *Requirements for mobile white space devices.* (1) Mobile white space devices shall operate within geo-fenced areas over which the white space database has determined channel availability. A mobile white space device shall have the capability to internally store the boundaries of a geo-fenced area and determine its location with respect to

those boundaries. The area boundaries stored within a mobile white space device must be the same as those used by the white space database to determine channel availability.

(2) A mobile white space device shall incorporate a geo-location capability to determine its geographic coordinates. A mobile white space device may obtain its geographic coordinates through an external geo-location source, provided that source is on the same vehicle or other mobile platform as the mobile device. An external geo-location source may be connected to a mobile device through either a wired or a wireless connection, and a single geo-location source may provide location information to multiple mobile devices on the same mobile platform. An external geo-location source must be connected to a mobile device using a secure connection that ensures that only an external geo-location source that has been approved with a particular mobile device can provide geographic coordinates to that device. The geographic coordinates must be provided automatically by the external geo-location source to the mobile device; users may not manually enter them. Alternatively, an extender cable may be used to connect a remote receive antenna to a geo-location receiver within a mobile device.

(3) The applicant for certification of a mobile device must demonstrate the accuracy of the geo-location method used and the location uncertainty as defined in paragraph (b) of this section. For mobile devices that are not using an internal geo-location capability, this uncertainty must account for the accuracy of the geo-location source and the separation distance between such source and the white space device.

(4) The antenna height above ground shall be determined by the operator of the device, or by an automatic means. The mobile device shall provide this information to the white space database when it requests a list of available channels for the geo-fenced area in which it will operate.

(5) Each mobile device must access a white space database over the internet to determine the available channels and the maximum permitted power for each available channel within the geo-fenced area in which it will operate. The white space database must take into consideration the mobile device's antenna height above ground level and geo-location uncertainty in determining the list of available channels. It must also take into consideration any variation in mobile device HAAT throughout the geo-fenced area and must use the highest HAAT within the geo-fenced area in determining channel availability. Operation is permitted only on channels that are indicated by the database as being available at the same power level throughout the entire geo-fenced area in which the mobile device will operate.

(6) Mobile devices must comply with the same separation distances from protected services in §15.712 as fixed devices.

(7) Mobile devices may use electrically steerable directional antennas, but a device's maximum EIRP in any direction must be used by the white space database in determining channel availability.

(8) A mobile device must re-check its coordinates at least once every 60 seconds while in operation except while in sleep mode, *i.e.*, in a mode in which the device is inactive but is not powered down. It must cease operation if its location is within 1.9 kilometers of the boundary, or outside the boundary, of the geo-fenced area over which the white space database has determined the available channels.

(9) A mobile white space device shall access the database at least as frequently as specified in paragraph (h) of this section to verify that the operating channel(s) and corresponding power levels continue to remain available.

(10) Operation of mobile white space devices on satellites and aircraft, including unmanned aerial vehicles, is prohibited.

[80 FR 73070, Nov. 23, 2015, as amended at 81 FR 4974, Jan. 29, 2016; 82 FR 41559, Sept. 1, 2017; 84 FR 34797, July 19, 2019; 86 FR 2292, Jan. 12, 2021; 87 FR 18992, Apr. 1, 2022; 88 FR 32692, May 22, 2023]