IEEE P802.22 Wireless RANs

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| Updates and Additions to Annex A Reflecting New or Revised Regulatory Rules |
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NOTE: DRAFT; SOME TIDYING AND ADDITIONS TO BE MADE

Abstract

The regulatory rules under which TV white space devices operate are of course essential to their deployment. This contribution provides updates and additions capturing new or revised regulatory rules for TV white space.

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# Modifications to Section A.1

*Modify Table A.1 as follows*

***-----------Start of text modification----------***

Table A.1—Regulatory domains

|  |  |  |  |
| --- | --- | --- | --- |
| **Geographic****Area** | **Regulatory domain ISO 3166 (3 Bytes)** | **Licensing regime** | **Approval****authority** |
| United States | USA | License-Exempt | FCC |
| Canada | CAN | Lightly Licensed | IC |
| United Kingdom | GBR | License-Exempt; Lightly-Licensed if manually configurable | ~~OFCOM~~Ofcom |
| European Union | N/A | License-Exempt | CEPT |
| Singapore | SGP | License-Exempt | IMDA |
| Columbia | COL | License-Exempt | ANE |
| South Africa | ZAF | License-Exempt | ICASA |
| — | — | —— | — |

***-----------End of text modification----------***

*Modify Table A.2 as follows*

***-----------Start of text modification----------***

Table A.2—Regulatory classes

|  |  |
| --- | --- |
| **Regulatory domain** | **Regulatory class and profile** |
| **Fixed** | **Personal portable** |
| USA | Fixed | Mode I & IIa |
| CAN | Fixed | N/A |
| GBR | Fixed, Type A | Non-fixed, Type B |
| European Union | Fixed, Type A | Non-fixed, Type B |
| SGP | Fixed | Mode I & IIb |
| COL | Fixed | Mode I & IIa |
| ZAF | Fixed | Nomadic |
| — | — | — |

a The behavioral limits sets for Modes I and II are defined in the FCC Report and Order. However, IEEE Std 802.22 will only operate in portable nomadic Mode II.

b The behavioral limits sets for Modes I and II in the case of Singapore are defined in: IMDA, “Telecommunications Standards Advisory Committee (TSAC)— Technical Specification—Television White Space Devices”, October 2016

***-----------End of text modification----------***

*Modify Table A.3 as follows*

***-----------Start of text modification----------***

Table A.3—Professional installation requirement

|  |  |  |
| --- | --- | --- |
| **Regulatory domain** | **Type of device** | **Definition of professional installer** |
| **Fixed** | **Portable/nomadic** |
| USA | Must be professionally installed if geolocation not possible | Does not need to be professionally installed | A professional installer is a competent individual or team of individuals with experience in installing radio communications equipment and who normally provides service on a fee basis—such an individual or team can generally be expected to be capable of ascertaining the geographic coordinates of a site and entering them into the device for communication to a database.  |
| CAN | Professionally installed | N/A | Same as for USA. |
| GBR | If manually configurable must be professionally installedIf not manually configurable does is not required to be professionally installed | If manually configurable must be professionally installedIf not manually configurable does is not required to be professionally installed | The licensee is responsible for the actions of the professional installer, under the provision that the licensee operates the equipment in according with their license. There are a range of requirements associated with this. Two are as follows; the rest are indicated in [X Ofcom MCWSD License Template].* The Licensee shall comply with the requirement that the Radio Equipment is established, installed and operated in accordance with the provisions of this Licence including the schedules to the Licence. Any proposal to amend any detail specified in the schedules to this Licence must be agreed with Ofcom in advance and implemented only after this Licence has been varied or reissued accordingly.
* The Licensee shall comply with the requirement that the Radio Equipment is operated in compliance with the terms of this Licence and is used only by persons who have been authorised in writing by the Licensee to do so on behalf of the Licensee and that such persons are made aware of, and of the requirement to comply with, the terms of this Licence.
 |
| European Union | N/A | N/A | N/A |
| SGP | Does not need to be professionally installed | Does not need to be professionally installed | Despite manual input of parameters being allowed, there is no explicit statement that professional installation is required. |
| COL | Professionally installed | Professionally installed | A professional installer is a competent individual or team of individuals with experience in installing radio communications equipment and who normally provides service on a fee basis—such an individual or team can generally be expected to be capable of ascertaining the geographic coordinates of a site and entering them into the device for communication to a database.  |
| ZAF | Professionally installed | Professionally installed | An installer of wireless equipment in possession of a radio dealer certificate (see Radio-Frequency-Spectrum-Regulations-2015, Government Gazette 38754 (Notice 386 of2015) as amended); or, professional radio technician, registered with the Institute of Electrical Engineers. |
| — | — | — | — |

***-----------End of text modification----------***

# Modifications to Section A.2

*Modify Table A.4 as follows*

***-----------Start of text modification----------***

Table A.4—Transmit power level by regulatory domain and classes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Regulatory domain** | **Regulatory class** | **Maximum BS EIRP /Maximum antenna height** | **Maximum CPE EIRP/Maximum antenna height** | **Polarization** |
| USA | Stationary fixed | 4 W / 30 m AGL,a76 m GHAATb | 4 W / 30 m AGL, 76 m GHAAT | Any |
| USA | Personal Portable (Modes I & II) | 100 mW / N/A | 100 mW / N/A | Any |
| CAN | Stationary fixed | 500 W / ≤ 60 m AHAATc250 W / ≤ 90 m AHAAT125 W / ≤ 120 m AHAAT66 W / ≤ 180 m AHAAT33 W / ≤ 240 m AHAAT4 W / ≤ 500 m AHAAT | 4 W / 10 m AGL | Vertical |
| GBR | All | 4 W / N/A | 4 W / N/A | Any |
| European Union | All | 4 W / N/A | 4 W / N/A | Any |
| SGP | Fixed | 36 dBm / N/A | 20 dBm / N/A | Any |
| COL | Stationary fixed | 4 W / 30 m AGL,76 m GHAAT | 4 W / 30 m AGL, 76 m GHAAT | Any |
| COL | Personal Portable (Modes I & II) | 100 mW / N/A | 100 mW / N/A | Any |
| ZAF | Rural fixed | 41.2 dBm per 8 MHz channel or 22.2 dBm per 100 kHz / 80 m AGL | 41.2 dBm per 8 MHz channel or 22.2 dBm per 100 kHz / 80 m AGL | Any |
| ZAF | Urban fixed | 36 dBm per 8 MHz channel or 17 dBm per 100 kHz / 30 m AGL | 36 dBm per 8 MHz channel or 17 dBm per 100 kHz / 30 m AGL | Any |
| ZAF | Rural nomadic | 20 dBm per 8 MHz channel or 1 dBm per 100 kHz / 80 m AGL | 20 dBm per 8 MHz channel or 1 dBm per 100 kHz / 80 m AGL | Any |
| ZAF | Urban nomadic | 20 dBm per 8 MHz channel or 1 dBm per 100 kHz / 30 m AGL | 20 dBm per 8 MHz channel or 1 dBm per 100 kHz / 30 m AGL | Any |
| — | — | — | — | — |

a AGL: Above ground level

b GHAAT: Ground height above average terrain

c AHAAT: Antenna height above average terrain

***-----------End of text modification----------***

*Modify Table A.5 as follows*

***-----------Start of text modification----------***

Table A.5—Transmit spectrum mask requirements

| **Regulatory domain** | **Regulatory class** | **Transmit spectrum mask** | Description |
| --- | --- | --- | --- |
| USA | Stationary fixed | First adjacent channelBeyond the outer edge of the first adjacent channel(See 1928HFigure A.1) | 55 dB below the highest power in a 6 MHz operating channel in 100 kHz bandwidthComply with FCC section 15.209(a) |
| USA | Portable Mode II | First adjacent channelBeyond the outer edge of the first adjacent channel(See Figure A.1) | 55 dB below the highest power in a 6 MHz operating channel in 100 kHz bandwidthComply with FCC section 15.209(a) |
| CAN | Stationary fixed(Δ*f* is referenced to the edge of the operating channel, Measurement bandwidth is 100 kHz, levels are expressed in dBc, relative to the total power in the operating channel) | 0.05 ≤ Δ*f* ≤ 66 ≤ Δ*f* ≤ 1212 ≤ Δ*f* ≤ 18Δ*f* > 18 AND within *54–72 MHz, 76–88 MHz, 174–216 MHz, 470–608 MHz and 614–698 MHz**Outside the above cases* (See Figure A.2)  | 44.9 + 1.1 × ( Δ*f*)1.637.8 + 4.4 × Δ*f*70.2 + 1.7 × Δ*f*100.8BS: 43+10×log(P in Watts)CPE: Comply with Table 2 of RSS-210 [B44] |
| GBR/European Union | All | 5 classes, numbered 1 to 5, each with different requirements expressed in terms of the maximum ACLR per any 100 kHz sub-channel compared with the emission EIRP per 8 MHz intended channel(s), expressed up to 3 or more channels from the intended channel(s). | See Clause 4.2.4.2 in [X ETSI EN 301 598] and Table A.5a for the full detail. Note that as this is comparing 100 kHz with 8 MHz, it is automatically 19 dB more than an equal-bandwidth comparison. 74 dB is therefore equivalent to the 55 dB case for the USA regulatory domain. |
| SGP | All | Where n is a transmission channel EIRP per 100 kW in channels n+1, n+2, n-1, n-2; spurious emissions in 470-862 MHz; spurious emissions in the range of 30 MHz to 4 GHz, measured at 3m | -56.8 dBm; -54 dBm; 200 µV/m |
| COL | Stationary fixed | First adjacent channelBeyond the outer edge of the first adjacent channel(See 1928HFigure A.1) | 55 dB below the highest power in a 6 MHz operating channel in 100 kHz bandwidthComply with FCC section 15.209(a) |
| COL | Portable Mode II | First adjacent channelBeyond the outer edge of the first adjacent channel(See Figure A.1) | 55 dB below the highest power in a 6 MHz operating channel in 100 kHz bandwidthComply with FCC section 15.209(a) |
| ZAF | Fixed, Nomadic | 5 classes, numbered 1 to 5, each with different requirements expressed in terms of the maximum ACLR per any 100 kHz sub-channel compared with the emission EIRP per 8 MHz intended channel(s), expressed up to 3 or more channels from the intended channel(s). | See Clause 4.2.4.2 in [X ETSI EN 301 598] and Table A.5a for the full detail. Note that as this is comparing 100 kHz with 8 MHz, it is automatically 19 dB more than an equal-bandwidth comparison. 74 dB is therefore equivalent to the 55 dB case for the USA regulatory domain.The WSD out-of-band power (EIRP) spectral density shall be measured in the first 100kHz beyondthe channel edge.The WSD out-of-band power (EIRP) spectral density shall be less than or equal to the measuredin-band transmit power spectral density over 8 MHz minus the ACLR (-84 dBm).If a WSD use channel bonding technique to transmit on multiple contiguous TVWS channels asguided by the secondary GLSD; the ACLR limits:(a) do not apply within the bonded adjacent contiguous channels; but(b) do apply within the 8 MHz TV channel immediately adjacent below and above theedges of the bonded channels. |
| — | — | — | — |

***-----------End of text modification----------***

*Insert after Figure A.2*

***-----------Start of text modification----------***

Table A.5a— IEEE 802.22 WRAN transmission RF mask for the United Kingdom/European Union and South Africa: Adjacent Channel Leakage Ratios (ACLR) for different Device Emission Classes

a

a POOB (dBm / (100 kHz)) ≤ max{ PIB (dBm / (8 MHz)) - ACLR (dB), - 84 (dBm / (100 kHz)) }

***-----------End of text modification----------***

# Modifications to Section A.3

*Modify Table A.6 as follows*

***-----------Start of text modification----------***

Table A.6—Channel availability requirements

|  |  |  |
| --- | --- | --- |
| **Regulatory domain** | **Regulatory class** | **Unavailable channels** |
| USA | Stationary fixed | N±0.5 |
| USA | Portable (Modes I & II) (above 40 mW) | NN±0.5 |
| USA | Portable (Modes I & II) (below 40 mW) | N |
| CAN | Stationary fixed | NN±1N±2 |
| GBR | All | No channels are unavailable; maximum EIRP is calculated and conveyed to the white space device for all channels (even the channel in which the television station is operating) up to the permitted interference limit to the television receivers.Channel 38 is reserved for location-inspecific PMSE hence an unusable (-999 dBm) power is returned for that channel.For Channel 60 an unusable (-999 dBm) power is returned in order to protect mobile broadband services above. This situation will change when the 694- 700 MHz spectrum is made available to mobile broadband likely in 2020. |
| European Union | All | No channels are unavailable; maximum EIRP is calculated and conveyed to the white space device for all channels (even the channel in which the television station is operating) up to the permitted interference limit to the television receivers. |
| SGP | All  | 25, 26, 47 |
| COL | Stationary fixed | N±0.5 |
| COL | Portable (Modes I & II) (above 40 mW) | NN±0.5 |
| COL | Portable (Modes I & II) (below 40 mW) | N |
| ZAF | All | No channels are unavailable; maximum EIRP is calculated and conveyed to the white space device for all channels (even the channel in which the television station is operating) up to the permitted interference limit to the television receivers. |
| — | — | — |

***-----------End of text modification----------***

*Modify Table A.7 as follows*

***-----------Start of text modification----------***

Table A.7— Channel move timing specifications

|  |  |  |
| --- | --- | --- |
| **Regulatory domain** | **Regulatory class** | **Channel Move Time (T44) once incumbent signal is detected (seconds)** |
| USA | Stationary fixed | 2 |
| USA | Portable (Mode I & II) | 2 |
| CAN | Stationary fixed | N/A |
| GBR | All | N/A, at least as applies to sensing. Sensing for incumbent protection is not allowed under the GBR regulatory framework. |
| European Union | All | N/A |
| SGP | All | N/A, at least as applies to sensing. Sensing for incumbent protection is not allowed under the SGP regulatory framework, although may be used as a *complementary* method. |
| COL | Stationary fixed | 2 |
| COL | Portable (Mode I & II) | 2 |
| — | — | — |

***-----------End of text modification----------***

*Modify Table A.8 as follows*

***-----------Start of text modification----------***

Table A.8—Microphone protection radius

|  |  |  |
| --- | --- | --- |
| **Regulatory domain** | **Regulatory class** | **Microphone protection radius (MPR)** |
| USA | Stationary fixed | 1 km  |
| USA | Portable (Mode I & II) | 1 km |
| CAN | Stationary fixed | — |
| GBR | All | N/A—sensing is not permitted for incumbent protection. Calculation done by database and returned in terms of max. EIRPs per channel; result is never zero. |
| European Union | All | N/A |
| SGP | All | N/A—sensing is not permitted for incumbent protection. Further, channels 25 and 47 are reserved as “safe harbor” channels for wireless microphones. |
| COL | Stationary fixed | 1 km  |
| COL | Portable (Mode I & II) | 1 km |
| ZAF | All | N/A—sensing is not permitted for incumbent protection. Calculation done by database and returned in terms of max. EIRPs per channel; result is never zero. |
| — | — | — |

***-----------End of text modification----------***

*Modify Table A.9 as follows*

***-----------Start of text modification----------***

Table A.9— WRAN device location accuracy and distance threshold

|  |  |  |  |
| --- | --- | --- | --- |
| **Regulatory domain** | **Location accuracy** | **Confidence level** | **Distance threshold for portable devices** |
| USA | 100 m300 m | 67%95% | 50 m |
| CAN | — | — | — |
| GBR | N/A; location uncertainty is reported in meters by the white space device to the database. Database takes uncertainty into account in calculating allowed EIRPs | 95% (for reported uncertainty) | 50m |
| European Union | N/A; location uncertainty is reported in meters by the white space device to the database. Database takes uncertainty into account in calculating allowed EIRPs | 95% (for reported uncertainty) | 50m |
| SGP | +/- 50 m maximum. location uncertainty is reported in meters by the white space device to the database. Database takes uncertainty into account in calculating allowed EIRPs | 95% |  |
| COL | 100 m300 m | 67%95% | 50 m |
| ZAF | N/A; location uncertainty is reported in meters by the white space device to the database. Database takes uncertainty into account in calculating allowed EIRPs | 95% | 100m |
| — | — | — | — |

***-----------End of text modification----------***

*Modify Table A.10 as follows*

***-----------Start of text modification----------***

Table A.10— Microphone protection radius

|  |  |  |
| --- | --- | --- |
| **Regulatory domain** | **Regulatory class** | **Microphone protection radius (MPR)** |
| USA | Stationary fixed | ±25 m  |
| USA | Portable (Mode I & II) | ±25 m |
| CAN | Stationary fixed | — |
| GBR | All | N/A, at least in the context of sensing as sensing is not required within the framework. Database calculates and returns allowed EIRPs in any location |
| European Union | All | N/A |
| SGP | All | N/A, at least in the context of sensing as sensing is not required within the framework |
| COL | Stationary fixed | ±25 m  |
| COL | Portable (Mode I & II) | ±25 m |
| ZAF | All | N/A |
| — | — | — |

***-----------End of text modification----------***

*Modify Table A.11 as follows*

***-----------Start of text modification----------***

Table A.11—Channel sensing requirements

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| STA Index | **Signal type** |  |  |  |  | **Regulatory domains** |
| **USA** | **CAN** | **GBR** | **European Union** | **SGP** | **COL** | **ZAF** | **—** |
| 0 | Undetermined | Optional | Not required | Not required | Not required | Not required | Optional | Not required | — |
| 1 | IEEE 802.22 WRAN | Not required | Not required | Not required | Not required | Not required | Not required | Not required | — |
| 2 | ATSC | Optional | Not required | N/A | N/A | N/A | Optional | N/A | — |
| 3 | DVB-T | N/A | N/A | Not required | Not required | Not required | N/A | Not required | — |
| 4 | ISDB-T | N/A | N/A | N/A | N/A | N/A | N/A | N/A | — |
| 5 | NTSC | Optional | Not required | N/A | N/A | N/A | Optional | N/A | — |
| 6 | PAL | N/A | N/A | Not required | Not required | Not required | N/A | Not required | — |
| 7 | SECAM | N/A | N/A | Not required | Not required | Not required | N/A | Not required | — |
| 8 | Wireless Microphone | Optional | Not required | Not required | Not required | Not required | Optional | Not required | — |
| 9 | IEEE 802.22.1 Sync Burst | Not required | Not required | Not required | Not required | Not required | Not required | Not required | — |
| 10 | IEEE 802.22.1 PPDU MFS1 | Not required | Not required | Not required | Not required | Not required | Not required | Not required | — |
| 11 | IEEE 802.22.1 PPDU MSF2 | Not required | Not required | Not required | Not required | Not required | Not required | Not required | — |
| 12 | IEEE 802.22.1 PPDU MSF3 | Not required | Not required | Not required | Not required | Not required | Not required | Not required | — |
| 13–32 | *Reserved* | — | — | — | — | — | — | — | — |

***-----------End of text modification----------***

*Modify Table A.14 as follows*

***-----------Start of text modification----------***

Table A.14—Applicable Spectrum Manager policies

|  |  |
| --- | --- |
| **Regulatory domain** | **Spectrum Manager policies** |
| USA | 1a, 1b, 1c, 1d, 1e, 1f, 2, 3a, 3b, 4, 5, 6, 7, 8 |
| CAN | N/A |
| GBR | 1a, 1b, 1c, 1d, 1e, 1f, 4, 7a, 8 |
| European Union | 1a, 1b, 1c, 1d, 1e, 1f, 4, 7a, 8 (note, will vary in national regulations) |
| SGP | 1a, 1b, 1c, 1d, 1e, 1f, 4, 7a, 8 |
| COL | 1a, 1b, 1c, 1d, 1e, 1f, 2, 3a, 3b, 4, 5, 6, 7, 8 |
| ZAF | 1a, 1b, 1c, 1d, 1e, 1f, 4, 7a, 8 |
|  |  |

***-----------End of text modification----------***

# Modifications to Section A.4

*Modify Table A.15 as follows*

***-----------Start of text modification----------***

Table A.15—Device identification requirements

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Regulatory domain** | **Minimum period** | **Maximum period** | **Signaling process** | **Timer** | **Note** |
| USA | 8 seconds | 15 minutes | CBP burst | TCBP | The minimum time between transmission of a CBP packet carrying a Device ID and Serial Number for identification by spectrum monitoring systems to document potential interference situations.  |
| CAN | N/A | N/A |  |  |  |
| GBR | N/A | N/A | N/A | N/A | N/A |
| European Union | N/A | N/A | N/A | N/A | N/A |
| SGP | N/A | N/A | N/A | N/A | N/A |
| COL | 8 seconds | 15 minutes | CBP burst | TCBP | The minimum time between transmission of a CBP packet carrying a Device ID and Serial Number for identification by spectrum monitoring systems to document potential interference situations.  |
| ZAF | N/A | N/A | N/A | N/A | N/A |
| — | — | — | — | — | — |

***-----------End of text modification----------***

*Modify Table A.16 as follows*

***-----------Start of text modification----------***

Table A.16—Database service access requirements

|  |  |  |
| --- | --- | --- |
| **Regulatory domain** | **Regulatory class** | **Maximum time without database service refresh** |
| USA | Stationary fixed and nomadic | 30 minutes |
| USA | Portable (Mode II) | 24 hours |
| CAN | N/A | N/A |
| GBR | All | 15 minutes |
| SGP | Fixed and personal/portable mode II | 6 hours |
| COL | Stationary fixed and nomadic | 30 minutes |
| COL | Portable (Mode II) | 24 hours |
| ZAF | Fixed | 24 hours |
| ZAF | Nomadic | 12 hours |
| — | — | — |

***-----------End of text modification----------***

# Modifications to Section A.5

*Modify Table A.20 as follows*

***-----------Start of text modification----------***

Table A.20—Frequency of TV channels in Western Europe and many other countries
in Africa, Asia, and the Pacific (BW= 8 MHz) (System H)

|  |  |
| --- | --- |
| **Regulatory domain** | TV channels prohibited from broadcast operation |
| USA | 37 |
| CA | 37 |
| GBR | 38 |
| SGP | 25, 47 |
| COL | 37 |
| ZAF | 38 |
| — | — |

***-----------End of text modification----------***

# General Modification to Annex A

[NOTE: Left in anyway for completeness, but to be removed if decided that it is inappropriate to have this level of detail for the UK specifically]

*Insert the following Clause that the end of Annex A*

***-----------Start of text modification----------***

## A.6 Example of the Regulatory Framework in the UK

**Background**

TV transmissions in the UK operate in the frequency range 470-790 MHz, reduced to 470-694 MHz after the 700 MHz spectrum is reallocated to mobile broadband to implement an ITU WRC 2015 decision. Further, Channel 38 (606-614 MHz) is reserved exclusively for shared (location-unspecific) PMSE usage. Taking these aspects into account, this gives 312 MHz total bandwidth that might be used by white space devices depending on local availability, or 216 MHz after the ITU WRC 2015 decision implementation. There is an 8 MHz channel raster in the UK, and the channel numbers in the UK are 21 (474 MHz center frequency) to 60 (786 MHz center frequency) in accordance with this, making 39 channels in total excluding Channel 38. However, UK deployments are currently limited to channels 22 to 59 (of course excluding channel 38) to help protect services that are next to the TV frequencies.

The UK TV white space framework is captured, in terms of conformance requirements for white space devices, in the ETSI EN 301 598 standard [X]. This is because such a technology must be standardized and accepted at the European level given the UK’s part of a customs union within the EU, e.g., to allow white space devices to be imported and operate in the UK.

**Key Innovations in the UK TV White Space Framework**

Building on the foundations of TV white space in the USA, there are several innovations in the UK framework. A first key one is that a continuum of allowed EIRP levels (at least to a resolution of 1dB) is allowed in responses from database, thereby allowing devices to transmit (at reduced EIRP) in many locations that they wouldn’t be able to transmit given a like-for-like implementation of the US rules in the UK.

A second key innovation is that 5 classes of devices’ ACLR performance are defined. Better ACLR performance means less interference in adjacent channels, hence typically the ability to transmit at higher EIRP without violating adjacent channel interference limits. This gives a lot of flexibility, with devices of even relatively poor ACLR performance being able to use white space with appropriate EIRPs.

**Types of White Space Devices**

There are four key labels put on white space devices in the UK. They are:

* “Master” devices, which are geolocated, and able to communicate directly with a geolocation database.
* “Slave” devices, which are only able to communicate with other white space devices, and are under the control of a master device and not necessarily geolocated.
* “Type A” devices, which are for fixed use only, and might have an integral, dedicated or external antenna.
* “Type B” devices, which are not intended for fixed use, and might have an integral or dedicated antenna.

**Procedure**

Figure A.3—The TV white space device database interaction procedure for the UK

Referring to Figure A.3, the UK TV white space framework defines a two-stage process. First, illustrated as phased (1) in this figure, a master white space device must communicate with a listing of databases provided by the regulator, and select a database to use based on the response from that. The message the white space device sends to the listing of databases is the following: <https://TVWS-Databases.ofcom.org.uk/weblist.xml?UniqueID=myDeviceSerialNumber>. An example response from the listing is as in Figure A.4.

Figure A.4—UK database listing response

The master white space device has to retrieve the listing again every refresh\_rate minutes—currently set at 1,440 mins, or 24 hours. If the listing can’t be accessed then it must check again every 1-2 hours, but can nevertheless continue operating using the last received information.

Next is the communication with the actual database itself, a process that can start only after the master has checked and selected a database from the Ofcom list of geolocation databases. This is illustrated as phase (2) in Figure A.3.

*Master Specific Messages*

First, a master obtains specific parameters from the chosen database. To do this, it sends its information to the database, including its description (manufacturer, model, serial number, type (A or B), master or slave, spectrum mask class of performance, technology identifier), location (including height AGL—optionally with other information), among other information.

The database calculates the EIRPs that can be used in which channels at which times based on this information, and responds with information on allowed maximum EIRPs in which channels. Database implementations vary: for some both the per 8 MHz and power spectral density (per 100 kHz) are reported, for others only the power spectral density is reported. This response is combined with other information such as a time stamp and echoed device information. Channels’ allowed EIRPs are in the form of a schedule, stating the start and finish times for which the information is valid.

*Master Usage Messages*

Next, before it can actually transmit, the master device responds to the database confirming again its description, location, and its chosen channels and EIRPs. It is noted that various combinations of channels and EIRPs can be used. Further, aggregation of channels is possible through the information structures supported.

The database then responds with a confirmation, or otherwise an error message. If it receives a confirmation then the master can start to transmit.

*Slave Generic Messages*

Slave generic operational parameters reflect the worst case slave EIRPs allowed in any location that is in the master’s coverage, thereby applying to any slave for which its position (among other characteristics) is not known without violating EIRP limits at any specific location. The purpose is generally only to allow initial slave transmissions in link formation, i.e., to send their information (such as location, type, etc.) back to the master, although transmissions based on generic slave information can be used on a longer-term basis if desired.

In this stage of the procedure, the master requests information for a generic slave device from the database. The database then uses its knowledge of the master obtained in previous phases (e.g., its chosen channels/EIRPs), among other characteristics, and also other knowledge, e.g., on location characteristics, to calculate the master’s coverage. In each channel, it will take the most conservative (lowest) value of allowed slave EIRP for any possible slave location in the master’s coverage area.

The resulting list of channels and allowed maximum EIRPs is returned back to the master. The master then broadcasts these parameters, and the slave will scan channels to listen for a broadcast of them. The slave can then start transmitting with these parameters in order to report its precise information to the master.

*Slave Specific Messages (Includes Master Association)*

Using the generic parameters, the slave can now transmit to the master its detail, e.g., location, characteristics. It is a requirement that the slave must anyway associate with the master, and that association must be informed to the database, whether or not the slave chooses to use the generic or specific operational parameters. Master sends description for itself and the slave in a message (thereby informing of the association) to the database, including now the slave’s location and other characteristics if specific operational parameters are required by the slave. The database then calculates and returns the specific allowed channels/EIRPs for the slave’s characteristics and location. The master then transmits those specific parameters to the slave on its chosen channel.

*Slave Usage Messages*

Next, the Slave confirm with the database which specific channels/EIRPs it has chosen to use, before it uses them. Slave device responds (transmitting via the master with its generic parameters, noting that the master is the only gateway to the Internet it has) to the database confirming again its description, location, and its chosen channels and EIRPs. It is noted that various combinations of channels and EIRPs can be used through the structure of the associated JSON messages. Further, aggregation of channels is possible through the information structures supported.

The database then responds with a confirmation, or otherwise error message. These messages are again relayed by the master to the slave. After it receives a successful confirmation, the slave can then transmit with its chosen specific parameters.

***-----------End of text modification----------***

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