Device to Database Protocol for White Space

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Outline

- Introduction
- Protocol layer
- Protocol Features/Functionalities
- Encoding Considerations
- Security Consideration
Introduction

- Whitespace protocol must satisfy the requirements that are specified by the regulatory authorities (e.g. FCC/Ofcom and so on). For example, some US specific FCC requirements are:
  - The TVWS devices are required to periodically access the TV Whitespace Database to obtain the list of available TV frequencies (channels) that could be utilized at their location.
  - Along with the list of frequencies/channels, the database should also return maximum permissible power levels that could be used by the TVWS devices.
  - Fixed and Mode II devices are required to access TVWS database every 24 hours to get a list of available TV bands.
  - The Mode II device must additionally do the same upon power-up, and whenever they change their position by 50 meters or more.
  - When a Fixed or Mode II device will serve as an access point for Mode I devices, the serving Fixed or Mode II must check with the TVWS database to ensure that the specified Mode I devices are valid devices at the given location. Initiate the protocol design/framework discussion.
Protocol Layer

+-----------+------------------+
| WS Appl. Protocol | HTTPS             |
+-----------+------------------+
| Reliable Transport | IP               |
+-----------+------------------+
Protocol Features/Functionalities

- Device Bootstrapping
- Device Registration
- Querying the Database
- Device Validation
- ...
Device Bootstrapping

- Device bootstrapping is the process whereby device establishes an initial connection to the database.
INT-REQ Message Format

```
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Ver   |         Authority                      |      Device Type                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|        Device Identity (e.g., Regulatory ID, Serial Number..)              |
.                                                                                                         .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
Ver - Protocol version
Authority - Indicates the regulatory rules that need to be applied to the device
Device Type  - Type of devices , for example, in US FCC rules this is called Fixed or Mode II device
Device Identity  - Information that identifies the class of device (e.g., FCC ID in case of US, Manufacturer Serial number, and so on)
INT-RESP Message Format

Ver - Protocol version
Authority - Indicates the regulatory rules that need to be applied to the device
Result Code - Indicates success or failure
Security Information - Information required to initiate the authentication process or perform the capability negotiation
Device Registration

- Device registration is the process of a device establishing certain operational parameters with the database, as required by the spectrum management authority.
### REG-REQ Message Format

<table>
<thead>
<tr>
<th>Ver</th>
<th>Authority</th>
<th>Device Type</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

Ver - Protocol version; Authority - Indicates the regulatory rules that need to be applied to the device; Device Type - Type of devices, for example, in US FCC rules this is referred to as Fixed or Mode II device; Device Identity - Information that identifies the class of device (e.g., FCC ID in case of US, Manufacturer Serial number, and so on); Device Location - Location information of the device, for example, Geo-location, information about lat, long, antenna height and so on (location encoding of location is TBD); Device Owner - Owner of the device; Message Authentication Code - Code that authenticates the ownership of the message.
REG-RESP Message Format

Ver - Protocol version
Authority - Indicates the regulatory rules that need to be applied to the device Operator
Sequence no - Represents the message sequence
Result Code - Success or failure of device registration
Message Authentication Code - Code that authenticates the ownership of the message
Querying the Database

• To obtain the available channel and other associated parameters, the device needs to query the database.
### AVAIL-CHAN-REQ Message Format

<table>
<thead>
<tr>
<th>Ver</th>
<th>Authority</th>
<th>Device Type</th>
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</thead>
<tbody>
<tr>
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<tr>
<td>Device Identity (e.g., Regulatory ID, Device serial number, etc.)</td>
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<tr>
<td>Device Location (e.g., Geo-location (latitude, longitude, Antenna Height, and so on))</td>
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<tr>
<td>Message Authentication Code</td>
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</tbody>
</table>

- **Ver** - Protocol version
- **Authority** - Indicates the regulatory rules that need to be applied to the device
- **Device Type** - Type of devices, for example, in US FCC rules this is referred to as Fixed or Mode II device
- **Device Identity** - Information that identifies the class of device (e.g., FCC ID in case of US, Manufacturer Serial number, and so on)
- **Device Location** - Location information of the device for example, Geo-location, information about lat, long, antenna height and so on (location encoding of location is TBD)
- **Message Authentication Code** - Code that authenticates the owner of the Message
AVAIL-CHAN-RESP Message Format

<table>
<thead>
<tr>
<th>0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1</th>
</tr>
</thead>
</table>

Ver - Protocol version
Authority - Indicates the regulatory rules that need to be applied to the device
Result Code - Success or failure of device registration
Sequence number - Represents the message sequence
Available Channel(s) - An array or set of channels within the scope of the request and regulatory authority where the returned elements contain for example, the channel frequency range, availability indicator, operating power, event, and so on.
Message Authentication Code - Code that authenticates the ownership of the message
Device Validation

- Device validation is the process by which devices can be validated by the database
# DEV-VALID-REQ Message Format

```
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-----------------------------------------------+
| Ver  | Authority                | Device Type                |
+-----------------------------------------------+
| Device Identity(e.g.,Regulatory ID, Device serial number,..) |
+-----------------------------------------------+
| Device Location (e.g., Geo-location (latitude, longitude, Antenna Height, and so on) |
+-----------------------------------------------+
| Device List (e.g., ID, Serial number..) |
+-----------------------------------------------+
| Message Authentication Code |
+-----------------------------------------------+
```

**Ver** - Protocol version

**Authority** - Indicates the regulatory rules that need to be applied to the device

**Device Type** - Type of devices, for example, in US FCC rules this is referred to as Fixed and Mode II device

**Device Identity** - Information that identifies the class of device (e.g., FCC ID in case of US, Manufacturer Serial number, and so on)

**Device Location** - Location information of the device for example, Geo-location, information about lat, long, antenna height and so on (location encoding of location is TBD)

**Device List** - List of one or more devices that needs the validation with ID, manufacturer serial number and so on.
DEV-VALID-RESP Message Format

<table>
<thead>
<tr>
<th>Ver</th>
<th>Authority</th>
<th>Sequence Number</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td>Device List (List/Array [result code])</td>
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<tr>
<td>Message Authentication Code</td>
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</tbody>
</table>

Ver - Protocol version
Authority - Indicates the regulatory rules that need to be applied to the device
Sequence number  - Represents the message sequence
Device list - List/Array of devices with success or failure
Message Authentication Code - Code that authenticates the ownership of the message
Encoding Considerations

- The examples above suggest the message structure will have bit-oriented fields, similar to the definition of TCP headers.

- Other encodings, for example, XML or JSON to encode the same fields discussed in this document should be discussed and allowed.
Security Considerations

- Following security requirements should be satisfied:
  - Mutual Authentication
  - Message Integrity
  - Confidentiality (optional)
  - Replay protection
  - ....
Questions? Feedback?