Outline

• Status of the PAWS protocol document
• Open Issues
  – Review extensibility and IANA registries
Changes from version 00

- Added JSON encoding
  - GeoLocation uses RFC5491
- Added Extensibility section
  - Described how to address new jurisdictions
  - References IANA registries
- Added IANA section
  - Defined registry tables
Protocol Overview

- Database Discovery (TBD)
- Initialization
  - Initial handshake: Exchange capability info
  - Optional for device, DB must support
- Device Registration
  - Regulator-specific (e.g., not all regulators)
- Device Validation
  - Validation of slave devices by master devices asking database
  - Regulator-specific
- Available Spectrum Query
- Spectrum-use Notification
  - Regulator-specific
Encoding: JSON-RPC

• Examples
• GeoLocation
• Extensibility / IANA definitions
Encoding Example: Request

getSpectrum Request:

```json
{
  "method": "getSpectrum",
  "params": {
    "type": "AVAILABLE_SPECTRUM_REQ",
    "version": "1.0",
    "deviceDesc": {
      "serialNumber": "XXX",
      "fccId": "YYY",
      ...
    },
    "location": {
      "point": {
        "center": {"latitude": 37.0, "longitude": -101.3}
      }
    },
    "antenna": {"height": 10.2, "heightType": "AGL"}
  }
  "id": "xxxxxx",
}
```
Encoding Example: Response

Available Spectrum Response

```json
{
    "result": {
        "type": "AVAILABLE_SPECTRUM_RESP",
        "version": "1.0",
        "timestamp": "2013-03-02T14:30:21Z",
        "deviceDesc": {
            "serialNumber": "XXX",
            "fccId": "YYY",
            ...
        },
        "spectrumSchedules": [
            {
                "eventTime": {
                    "startTime": "2013-03-02T14:30:21Z",
                    "stopTime": "2013-03-02T20:00:00Z",
                },
                "spectra": [
                    {
                        "bandwidth": 6e6,
                        "frequencyRanges": [
                            {
                                "startHz": 5.18e8, "stopHz": 5.36e8,
                                "maxPowerDBm": 30.0
                            },
                            {
                                "startHz": 5.36e8, "stopHz": 5.42e8,
                                "maxPowerDBm": 36.0
                            },
                            ...
                        ],
                    }
                ],
                "needsSpectrumReport": false
            },
            {
                "eventTime": {
                    "startTime": "2013-03-02T22:00:00Z",
                    "stopTime": "2013-03-03T14:30:21Z",
                },
                "spectra": [
                    ...
                ],
                "needsSpectrumReport": false
            },
        ],
        "id": "xxxxxx"
    }
}
```
Encoding: GeoLocation

• Location encoding follows RFC5491
  – Point-with-uncertainty encoded using Ellipse
  – Region encoded using Polygon
  – WGS-84 default datum
Example GeoLocation

"location": {
    "point": {
        "center": {
            "latitude": 37.1, "longitude": -120.2,
            "orientation": 45.0,
            "semiMajorAxis": 50.0,
            "semiMinorAxis": 45.0
        }
    }
}

"location": {
    "region": {
        "exterior": [
            {
                "latitude": 37.1, "longitude": -120.2,
                "latitude": 37.1, "longitude": -120.1,
                "latitude": 37.0, "longitude": -120.1,
                ...
            }
        ]
    }
}
Extensibility

• Defines processes for creating:
  – New message parameters
  – Additional error codes
  – Ruleset identifiers

• Proposes new IANA registries
  – PAWS Parameters Registry
  – PAWS Error Code Registry
  – PAWS Ruleset ID Registry
  – Additions made under Designated Expert process with “Specification Required” [RFC5226]
Ruleset Identifier

• Represents a set of rules to be used within a regulatory domain
  – A “harmonized” ruleset may be adopted by multiple domains

• Associated with:
  – Database behavior
  – Device behavior
  – Parameters passed between Device and Database
General Procedure Handles Extensibility

• Device makes a request that includes its location and may include:
  – List of rulesets it supports
  – Parameter values for the request
• If necessary, Database responds with REQUIRED error and list of missing parameters
• Device makes request again that includes its location and:
  – List of rulesets it supports
  – Parameter values that now include the required ones
• Database sends the response, including applicable ruleset for the location
Ruleset Identifier Use Cases

• Simple Cases: Single rulesets
  – Correct DB
    ![Diagram](image1.png)
  – Wrong DB
    ![Diagram](image2.png)
Ruleset Identifier Use Cases

Device supports multiple rulesets

Database supports multiple rulesets (may avoid discovery)
IANA: PAWS Parameters Registry

• Defines new parameters
  – E.g., to support regulatory-specific parameters

• Must include:
  – Parameter name
  – Parameter usage location, e.g., which message(s)
  – Specification document

• Initial contents:
  – “fccId”: FCC certification ID
  – “fccTvdDeviceType”: “FIXED”, “MODE_1”, or “MODE_2”
  – Add other regulatory parameters as rules are finalized
IANA: PAWS Error Code Registry

• Defines error codes
• Specify:
  – Code
  – Name
  – Additional parameters, if any
    • Parameters separately defined in Parameters Registry
  – Description
• Initial contents:
  – Defined in the Section 5.13 of protocol doc
# Error Codes

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-100</td>
<td>(reserved)</td>
<td></td>
</tr>
<tr>
<td>-101</td>
<td>VERSION</td>
<td>The Database does not support the specified version of the message.</td>
</tr>
<tr>
<td>-102</td>
<td>UNSUPPORTED</td>
<td>The Database does not support the Device. For example, it does not support the regulatory domain specified in the request.</td>
</tr>
<tr>
<td>-103</td>
<td>UNIMPLEMENTED</td>
<td>The Database does not implement the optional request or optional feature.</td>
</tr>
<tr>
<td>-104</td>
<td>OUTSIDE_COVERAGE</td>
<td>The specified geo-location is outside the coverage area of the Database.</td>
</tr>
<tr>
<td>-200</td>
<td>(reserved)</td>
<td></td>
</tr>
<tr>
<td>-201</td>
<td>REQUIRED</td>
<td>A required parameter is missing. The Database MUST include a list of the required parameter names. The Database MAY include only names of parameters that are missing, but MAY include a full list. Including the full list of missing parameters may reduce the number of re-queries from the Device.</td>
</tr>
<tr>
<td>-202</td>
<td>INVALID_VALUE</td>
<td>A parameter value is invalid in some way. The Database SHOULD include a message indicating which parameter(s) and why the value is invalid.</td>
</tr>
<tr>
<td>-300</td>
<td>(reserved)</td>
<td></td>
</tr>
<tr>
<td>-301</td>
<td>UNAUTHORIZED</td>
<td>The Device is not authorized to used the Database. Authorization may be determined by regulatory rules or be dependent on prior arrangement between the Device and Database.</td>
</tr>
<tr>
<td>-302</td>
<td>NOT_REGISTERED</td>
<td>Device registration required, but the Device is not registered.</td>
</tr>
</tbody>
</table>
IANA: PAWS Ruleset ID Registry

• Defines ruleset identifiers

• Specify:
  – Name
  – Additional message parameters, if any
    • Parameters separately defined in Parameters Registry
  – Specification Document

• Initial contents
  – “FccTvBandWhiteSpace-2010”
  – Add other regulatory parameters as rules are finalized
Proposed IANA Process

• Review by Designated Experts
  – “Specification Required”
  – Requests sent to: paws-ext-review@ietf.org
  – Two-week review period on the list
  – May approve before specification formally published, but must be assured that it will be published
Implementations

• Reports of successful implementation using schema defined in current document
  – After fixing typos