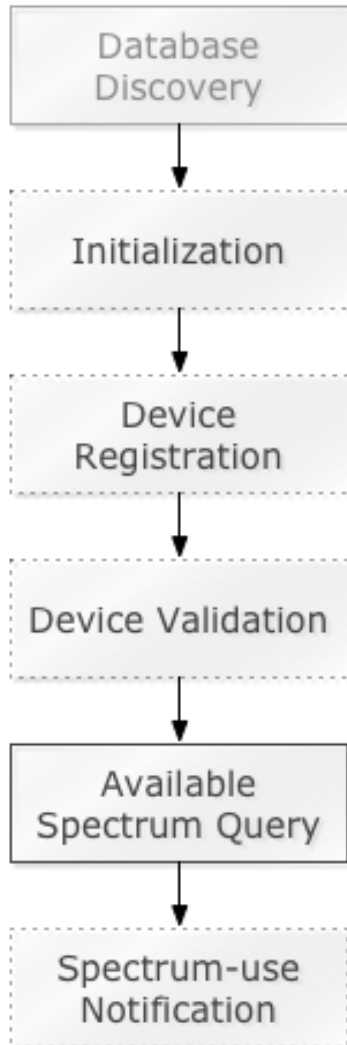


Outline

- Status of the PAWS protocol document: -06
- Review proposed changes for -07
- Open Items
 - Explicit “off”
 - Ability to encode “slopes” for spectral masks
 - Actual encoding of spectrum profile

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

Proposed for Draft 07

- Review: Presented at IETF 87 F2F
 - Terminology
 - Parameter-name changes
 - Update vCard to jCard encoding
 - Support for multiple rulesets in single response
- New items
 - Clarify event-time intervals and spectrum
 - Added parameters for master vs slave
 - Top-level time range and frequency range
 - Typo fixes

Terminology

- Master and Slave: Sync with RFC6953
- Defined “ruleset”
- JSON-RPC
 - Reference generic JSON-RPC error codes
 - E.g., -32700 for “parse error”
 - Added “jsonrpc 2.0” to message examples

Parameter Name Change

- Clarify meaning of maximum power levels:
 - Power spectral density over a specified bandwidth
 - Logical AND when multiple specifications are present
 - Propose name changes:
 - “bandwidth” -> “psdBandwidthHz”
 - “maxPowerDBm” -> “maxPowerDbmPerBw”

vCard: Updated to jCard

- Original draft for JSON vCard withdrawn
- Example of new encoding:

```
{
  "deviceOwner": {
    "owner": [
      "vcard", [
        ["version", {}, "text", "4.0"],
        ["org", {}, "text", "Racafrax, Inc."]
      ]
    ],
    "operator": [
      "vcard", [
        ["version", {}, "text", "4.0"],
        ["fn", {}, "text", "John Frax"],
        ["adr", {}, "text",
          ["", "", "100 Main Street",
            "Summersville", "CA", "90034", "USA"]
        ]
      ],
      ["tel", {}, "uri", "tel:+1-213-555-1212"],
      ["email", {}, "text", "j.frax@rackafrax.com"]
    ]
  }
}
```

Support Multiple Rulesets

- Changed RulesetInfo to have single ruleset ID
- Changed INIT_RESP to return a list of RulesetInfo parameters
- Changed REGISTRATION_RESP to return a list of RulesetInfo parameters to indicate the regulatory domains for which registration was accepted
- Added SpectrumSpec message to represent available-spectrum specification for one regulatory domain
 - Allows AVAIL_SPECTRUM_RESP and AVAIL_SPECTRUM_BATCH_RESP to include answers for multiple regulatory domains

Multiple Rulesets

```
+-----+
|AVAIL_SPECTRUM_RESP          |
+-----+-----+
|timestamp:string            | required |
|deviceDesc:DeviceDescriptor | required |
|spectrumSpecs:list          | required |-----+
|.....|.....|          |
|databaseChange:DbUpdateSpec | optional |
|*other:any                  |          |
+-----+-----+          | 1..*
                          V
```

```
+-----+
|SpectrumSpec                |
+-----+-----+
|rulesetInfo:RulesetInfo     | required |
|spectrumSchedules:list      | required |--+
|needsSpectrumReport:bool    | optional | |
|maxTotalBwHz:float          | optional | |
|maxContiguousBwHz:float     | optional | |
+-----+-----+ |
                          +-----+
                          | 1..*
                          V
```

```
+-----+
|SpectrumSchedule            |
+-----+-----+
|eventTime:EventTime         | required |
|spectra:list                | required |
+-----+-----+
```


Clarification: Event Time Intervals

- Event-time intervals within a single set of schedules **MUST** be disjoint
- Implications:
 - Each time interval specifies available spectrum across the entire frequency ranges of the rule set
 - Does not allow “per-channel” schedule

Added Parameters: Master vs Slave

- “masterDeviceDesc”
 - Also add it to DEVICE_VALID_REQ message
- When request is made by Master on behalf of Slave:
 - “location” is that of Slave
 - Add optional “masterDeviceLocation” param
 - Applies to AVAIL_SPECTRUM_xx and SPECTRUM_NOTIFY messages

Open Items

- Separate issues
 - Ability to distinguish between “explicit off” and “no information”
 - Ability to encode “slopes” in the spectrum profile to define spectral masks
 - Specific encoding for spectrum profile

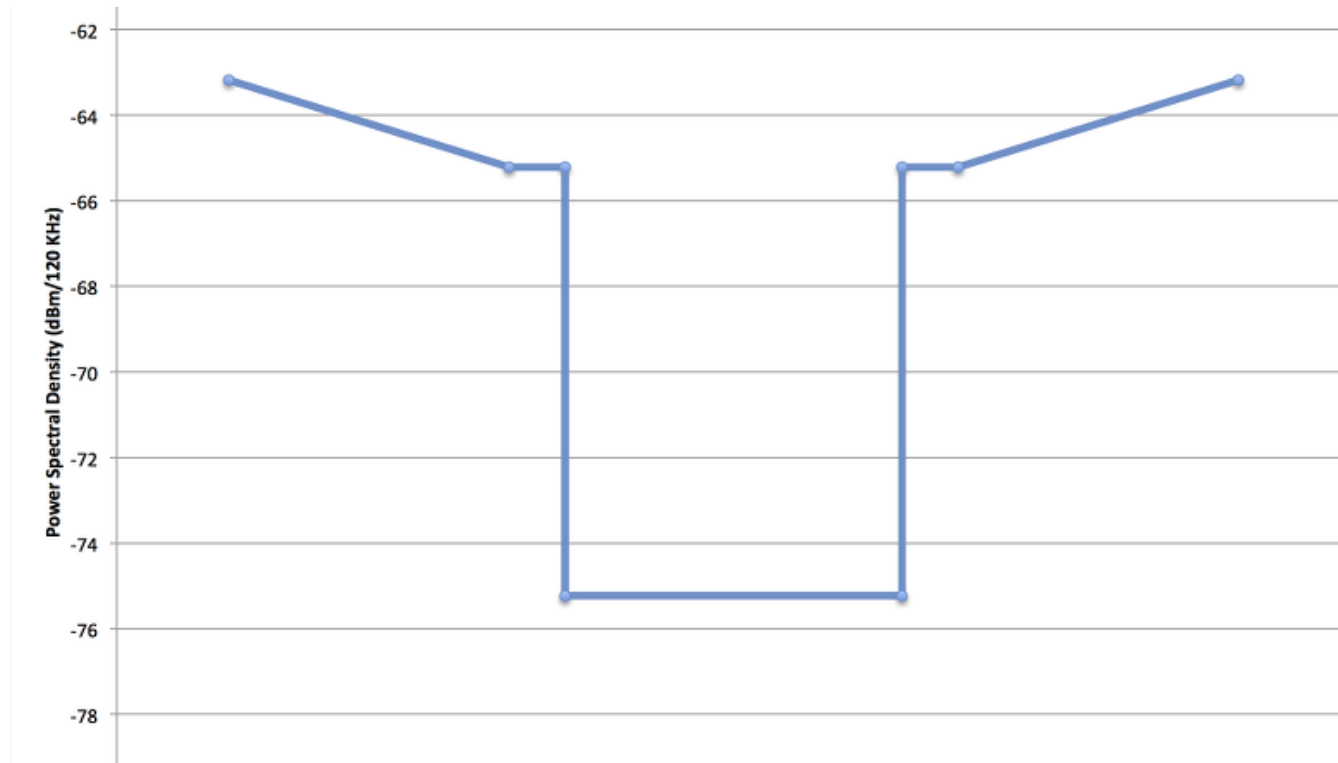
Explicit Off vs No Information

- Top-level time and frequency ranges:

```
+-----+
| SpectrumSpec                               |
+-----+-----+
| rulesetInfo:RulesetInfo                    | required |
| spectrumSchedules:list                     | required |-----+
| timeRange:EventTime                       | optional | |
| frequencyRanges:list                     | optional | |
| needsSpectrumReport:boolean                | optional  | |
| maxTotalBwHz:float                          | optional  | |
| maxContiguousBwHz:float                    | optional  | |
+-----+-----+ |
|                                             | 1..*
|                                             |
|                                             |
|                                             |
|-----+-----+
| SpectrumSchedule                           |
+-----+-----+
| eventTime:EventTime                        | required  |
| spectra:list                               | required  |
+-----+-----+
```

Open Item: Encode Slopes?

- Can reduce amount regulatory-specific logic in firmware
- Example: FCC white space rules uses slopes in their emission limits for channels 36 thru 38 (CFR 47, section 15.709)



Encoding Examples

- Option 1: Draft 06

```
{  
  "psdBandwidthHz": 6e6,  
  "frequencyRanges": [  
    {"startHz":5.18e8, "stopHz":5.26e8, "maxPowerDbmPerBw":30.0},  
    {"startHz":5.36e8, "stopHz":5.42e8, "maxPowerDbmPerBw":36.0},  
    ...  
  ]  
}
```

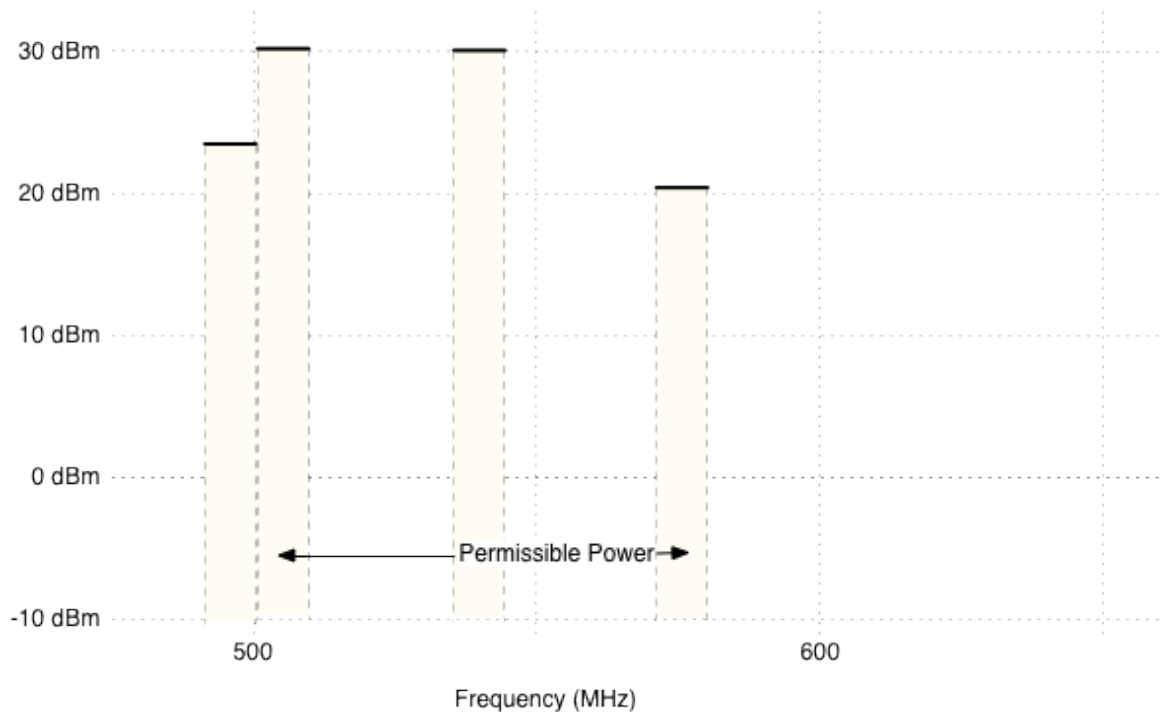
- Option 2

```
{  
  "psdBandwidthHz": 6e6,  
  "profiles": [  
    [  
      {"freqHz":5.18e8, "maxPowerDbmPerBw":30.0},  
      {"freqHz":5.26e8, "maxPowerDbmPerBw":30.0}  
    ],  
    [  
      {"freqHz":5.36e8, "maxPowerDbmPerBw":36.0},  
      {"freqHz":5.42e8, "maxPowerDbmPerBw":36.0}  
    ],  
    ...  
  ]  
}
```

Backup Slides

Open Item: Spectrum profile encoding

- Current encoding has “channelized” view
 - List of (startHz, stopHz, power)



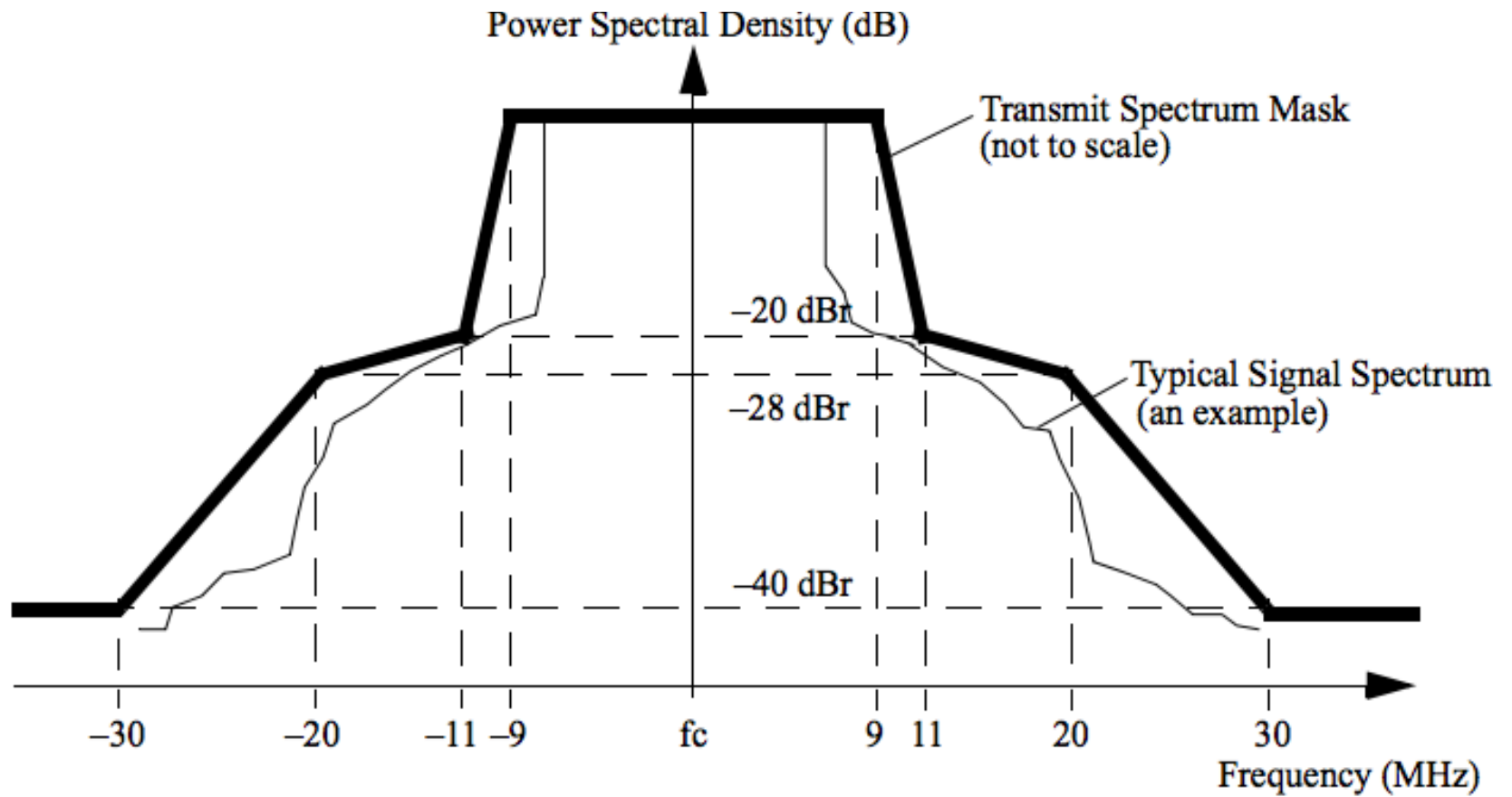


Figure 18-13—Transmit spectrum mask for 20 MHz transmission