TCB Workshop

Software Defined Radio (SDR)/Cognitive Radio (CR) Technologies

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Software Defined Radio (SDR)

➤ Report and Order FCC 01-264 (Docket No. 00-47)
  http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-01-264A1.pdf

➤ Definition - a radio that includes a transmitter where operating parameters of **frequency** range, **modulation type** or **maximum output power** can be altered by making a change in software without making any changes to hardware components that affect radio frequency emissions.

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Software Defined Radio (SDR)

 Does not include Receivers

 Does not include devices that use software to control functions such as frequency, power or modulation type within a range approved by the Commission. (e.g., cell phones, WLANs)

 Does not include installation of memory modules and reconfiguration of existing hardware or firmware logic

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Software Defined Radio (SDR)

 Class III Permissive Change
  ► Only available for devices identified as SDR in original filing
    ► Previously approved devices not reclassified as SDR
  ► No Class III changes made to SDR after Class II approved
  ► Class II change stops ALL Class III changes
  ► No limit on number of Class III changes
  ► Upload a copy of Software Code
    ► Policy under reconsideration; alternatives approved on a case-by-case basis

Software Defined Radio (SDR)

➤ **Radio Software - programming that modifies a SDR in frequency, modulation type or maximum output power**

- ➤ Manufacturer to take steps to prevent unauthorized software changes
    - ➤ Precise methods left up to the manufacturer
    - ➤ Electronic filing system programmed to withhold radio software exhibit from public view

➤ **Multiple Testing Required**

- ➤ Each software application must be tested for compliance
- ➤ Simultaneous transmissions in multiple frequency bands must be evaluated for potential intermodulation products and RF safety

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Software Defined Radio (SDR)

➤ **Electronic Labeling of FCC ID Number**

- ➤ Only for SDRs at this time
- ➤ Label must be readily accessible via menu option or hotkey
    - ➤ User manual must explain how to access the FCC ID
- ➤ Limited to SDRs equipped with an LED, LCD or similar display
- ➤ Only FCC ID number is required to be displayed on an electronic label
    - ➤ Not required when battery is removed from SDR

Proposal in ET Docket No. 03-108

- Adopted: December 17, 2003
- Released: December 30, 2003
- http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-03-108A1.pdf

Definition – a radio that can change its transmitter parameters based on the environment in which it operates

- Active negotiations with other spectrum users
- Passive sensing and decision making (Smart radio)
- Majority of cognitive radio will probably be SDR

Advantages of Cognitive Radio

- Senses RF Environment and modifies frequency, power or modulation
- Allow for Real Time Spectrum Management
- Significantly Increases Spectrum Efficiency

Cognitive Radios currently in use

- LAN devices
- CDMA networks
- Cordless Phones
- U-NII/DFS (Europe)

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Possible CR Techniques

- Dynamic Frequency Selection (DFS)
- Adaptive modulation
- Transmit Power Control (TPC)
- Adjust transmit parameters based on location
- Spectrum sharing between a licensee and a third party (Security features for authorized use)
- Other techniques to be developed as technology progresses

- **Proposed changes to the SDR Rules**
  - To date no SDR applications filed although some devices may have qualified
  - High level description of the software and flow diagram to replace software code
- **Comments requested concerning:**
  - Requirement for manufacturer to declare SDRs
    - What constitutes a requirement for filing as a SDR
    - Minimizing the possibility of unauthorized operation through software modification
  - Should SDR requirements apply to transmitter modules
  - Amateur SDR requirements – preventing unauthorized use outside the amateur band
  - High speed Digital/Analog Converters (DAC)
  - Security and authentication requirements

Proposed Part 15 Rule Changes

- Section 15.247 CR devices – up to 6 times the maximum permitted power
- Section 15.249 CR devices – up to 2.5 times the maximum permitted field strength
- Requirements for intentional radiators operating at higher power limits:
  - Device must incorporate a mechanism to monitor the entire permitted transmission band
  - Signals exceeding the monitoring threshold are detected in less than TBD% of the operational band
  - Device incorporates TPC to limit power to current limits upon detection of signals exceeding the monitor threshold

Proposed Part 90 Rule Changes

- Secondary leasing of Public Safety License
  - Employ mechanism for lawful compliance of leasing agreement
  - Beacon Signal Detection mechanism – public safety
    - Transmits a beacon no less than once per second specifying frequency(s) available for use
    - Transmits time of day
    - Transmits licensee secure ID
  - CR device must cease operation within 2 seconds upon Public Safety signal detection