Shared Spectrum Company Briefing

IEEE 802

802.19.1 Workshop – Panel B

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Cognitive radio that *senses, detects and adapts* to available spectrum through user-defined *policies*

- Efficiently and safely uses encumbered spectrum
- No connection or modification with legacy systems
- Proven interference avoidance technique
- High communication availability and reliability
- Avoid intended/unintended interference
- Selects “best” frequency
- Enables robust spectrum pooling with peer users
Ultra-sensitive detectors identify unused spectrum

Sensing scheduler manages which detectors are used, what frequency the devices use, and when the detectors and tuner/modems operate

Spectrum access components generate and analyze spectrum occupancy measurements to provide estimate of spectrum environment

The Rendezvous discovery and connection management algorithms select which channels to use

The Policy ensures that each DSA radio adheres to the spectrum access control policy rules

The Policy Administrator securely disseminates policy updates

The Policy Analyzer authors and validates policies
Interference/Coexistence Management

- SSC’s DSA solution:
  - Continually senses available channels
  - Clear channels are candidate channels
  - Detects & avoids channels with “non-cooperative” signals and interference
  - Works in accordance with user-defined policies from numerous stakeholders
## DSA Policy Rule Types

### Listen-Before-Talk based types
- LBT – Same up and downlink frequencies
- LBT – Different, but known, up and downlink frequencies
- LBT – Different, but known, up and downlink frequencies, band plan known
- LBT – TV band (TV detector)

### Spatial types
- Geographic border field strength limits

### Temporal types
- Time of Day restrictions
- Authorization for finite time duration (with periodic renewals)

### Device based types
- Device Capability - Ability to measure second and third harmonic
- Device Capability - DSA TX power spectrum density limit
- Adjustable I/N Limit for any policy (-6 dB (insignificant interference impact to Primary users), 20 dB (medium amount of interference impact to peer DSA nodes)

### Connectivity based types
- Beacon reception required to use band
- Connectivity requirement for any policy (can use certain bands only if connected to Spectrum Manager)

### Group Behavior based types
- Type 1 Group Behavior - Abandon channel if any node within certain range detects Non-cooperative signal
- Type 2 Group Behavior - Determine DSA TX power based on estimated interference probability (used Belief, Disbelief, and Ignorance estimates fused with Dempster-Shafer Theory)
- Node Identify restrictions (e.g., use while airborne prohibited, use only in fixed applications, Red Cross use only)

### Distributed Control based types
- Automated policy updates if feedback indicates that existing policy is insufficient for non-interference operations
- Automated policy updates notification of policy revocation or update by policy authority
Policy-Based Controls Draw on Principles Currently Employed Manually by Spectrum Managers

**Policy**
- Is permissive or prohibitive
  - We define a de-confliction rule
- Has metadata
  - Authorization, lease time, priority, etc.
- Specifies spectrum access rules, e.g.
  - Frequency Rules
  - Geographic Rules
  - Time Rules
  - LBT Rules

**Authoring Tool**
- Many policies (Set A)

**Authoring Tool**
- Many policies (Set B)

**Admin Console**
- Secure and authenticated dissemination of selected policies to radios (Sets A, B and C)

**Authoring Tool**
- Many policies encoded in a machine readable form (Set C)

**Radio with policy-controlled DSA**
- DSA-enabled device makes own spectrum decisions

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Sample Spectrum Management Projects

• Policy
  – Numerous projects underway to refine and extend to various platforms

• Distributed Sensing
  – Developed distributed sensing method that creates spectral maps and addresses the hidden node problem

• Radio Spectrum Planning
  – Developed algorithm that merges radio/sensor measurements and automatically improves spectrum management tool database

• RF Encroachment
  – Building software tool to predict man-made signals & RF noise levels