Cognitive Radio Approach for Resource Management in IEEE 802.16

Hazem Shatila, Dr. Mohamed Khedr

Why Cognitive Radio?
- Radio-scene analysis.
- Channel-state estimation and predictive modeling.
- Transmit-power control and dynamic spectrum management.
- Optimizing radio resource usage.
- Accommodating variety of user requirements and services.

Six key Functions of a Cognitive Radio
- Awareness
- Intelligence
- Learning
- Adaptability
- Reliability
- Efficiency

Overview of 802.16
- WiMAX is short for Worldwide Interoperability for Microwave Access, and it also goes by the IEEE name 802.16.

Benefits
- Higher throughput at longer ranges (up to 50 km)
- Scalable system capacity
- Coverage
- Quality of Service
- Help enable last-mile broadband deployment wirelessly while remaining complementary to Wi-Fi technology

NLOS and LOS
- Non-line-of-sight - WiFi sort of service, where a small antenna on your computer connects to the tower.
  - WiMAX uses a lower frequency range -- 2 GHz to 11 GHz
- Line-of-sight - a fixed dish antenna points straight at the WiMAX tower from a rooftop or pole.
  - connection is stronger and more stable
  - able to send a lot of data with fewer errors
  - uses higher frequencies, ranges reaching a possible 66 GHz

Motivation for Cognitive WiMAX
- Rapid Deployment
  - Reduce costs
  - Emergency Infrastructure
  - Easier deployment in emerging nations
- Operation and Maintenance
  - Reduce costs
  - Reduce manpower
  - Mitigate interference
  - Adjust to staged build out
- Convergence
  - Manage connectivity to current and future standards

Some Important “Knobs” in 802.16
- PHYSICAL PARAMETERS
  - Channel selectivity (time, frequency, space)
  - OFDM and OFDMA
  - Power control
  - Coding
  - Bandwidth
- MAC PARAMETERS
  - Scheduler - (priority-based, time constrained-based, resource utilization-based)
  - QOS - UGS (Unsolicited Grant Service), rtPS (Real time Polling Service), ErtPS (Extended real time Polling Service), nrtPS (Non-real time Polling Service)
  - Power Control
  - Admission Control
  - Handover Control

Test Case
- Comparison of adaptive modulation in 802.16 and adaptive modulation using the Cognitive Radio approach

Currently, 802.16 uses only proximity to select adapt the modulation. With CR 802.16h can use proximity and channel conditions to adapt the modulation.