

Cognitive Radio: Key Performance Indicators

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Presentation Outline

- **Are today's cellular network cognitive?**
- **Cognitive radio vs. cognitive network?**
- **How to implement cognitive networks?**
- **What are the key performance indicators?**
- **What are the take-away points?**

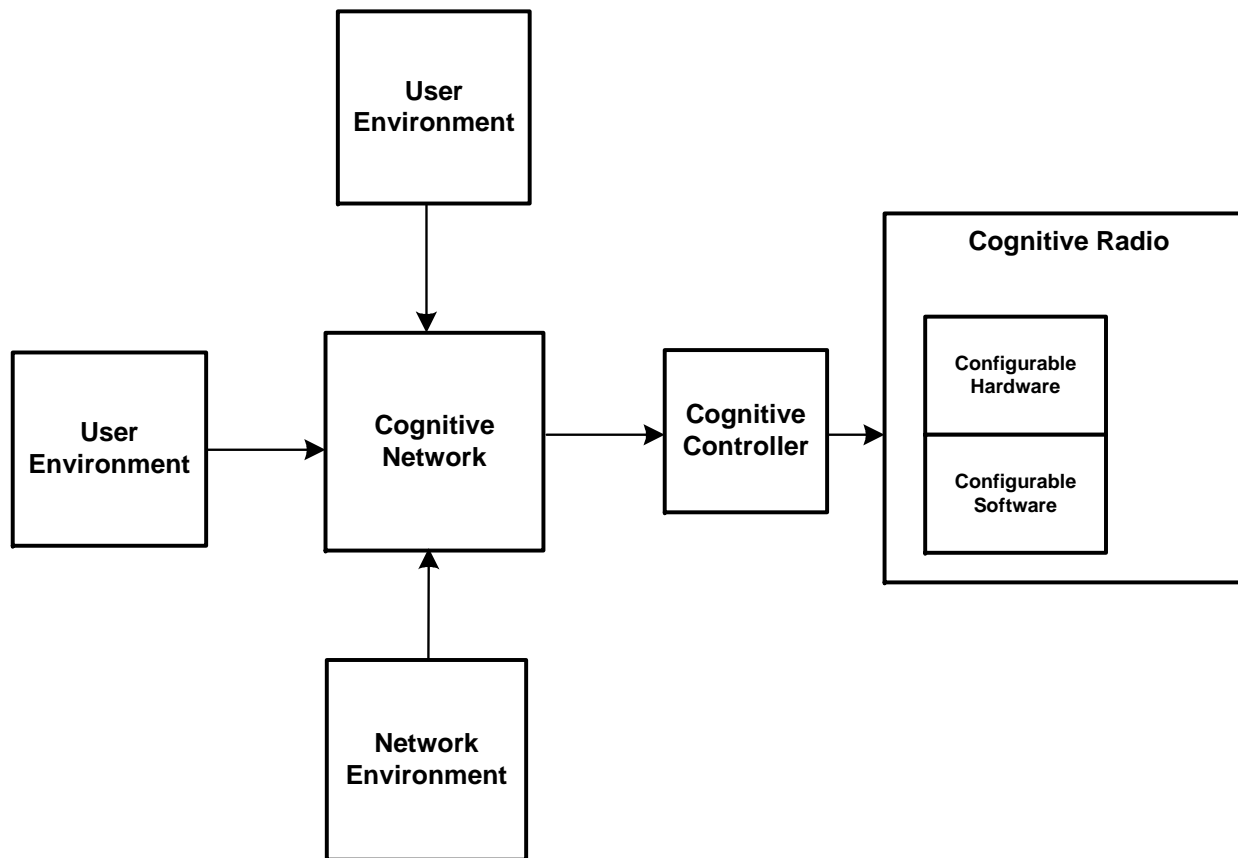
Are Cellular Networks Cognitive?

- **Much of what we think of as cognitive radio is implemented today in cellular networks**
 - » Reconfigurable (system determination)
 - » TPC (uplink and downlink fast power controls)
 - » Networks coordination (intra and inter system handover)
 - » System based on a real-time database (registration and paging)
- **These systems guarantee its ability to share spectrum without creating interference**

Cognitive Networks

- **It is not as simple as base stations network can command each handset to maximize available spectrum**
- **It is necessary for the terminal and network to be aware of the:**
 - » End user Environment
 - » Radio Environment,
 - » Network Environment

Cognitive Network (cont.)



Two Known Approaches

- **Underlay**
 - » Sharing channels
 - » Unless a CR can measure the effect of its transmission on all possible receivers, taking a useful interference temperature measurement may not be feasible.

- **Overlay**
 - » Opportunistically find empty channels
 - » How do you get a CR transmitter to relinquish the channel when transmitting at high power levels while existing users of the channel are far away and transmitting at low power levels.

Key Performance Indicators

- **Spectral efficiency should be mutually applied to both incumbent and cognitive networks**
- **Should not abuse spectrum or sacrifice QoS**
- **Quality of Service (QoS) components**
 - » Data throughput
 - FTP
 - HTTP
 - » Voice Quality
 - » Video Quality
 - » Latency

Key Performance Indicators (cont.)

- **Sensitivity**
 - » Must be able to see weak signals
 - » Noise figure?
 - » Cost impact?

- **Dynamic Range**
 - » Minimum requirements?

Key Performance Indicators (cont.)

- **Accurate identification of incumbent**
 - » Signal classifier functionality
 - » Autonomous detection: scan all channels, identify any incumbent users based on signal characteristics, and create a database automatically
 - » Prob. Of detection
 - » False alarm?

Key Performance Indicators (cont.)

- **Location awareness**
 - » Use GPS or some other location technology along with a pre-programmed database
 - » Coverage predication capabilities
 - » Ability to update location database

Key Performance Indicators (cont.)

- **Power control**
 - » Step size
 - » Tolerance in measuring RSSI
 - » Tolerance in transmit power
 - » Speed of power control commands
 - » Quality of feedback channel

Key Performance Indicators (cont.)

- **Over the air programming**
 - » Reconfigurable hardware
 - » Reconfigurable software
 - » Software download

Key Performance Indicators (cont.)

- **Impact on incumbent services**
 - » Rise above thermal
 - » QOS degradation
 - » Increase in call drop rate
 - » Increase in origination failure
 - » Increase in termination failure
 - » Increase in handover failure
 - » Etc...