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Opportunistic Wireless Energy Harvesting in Cognitive Radio Networks

S. Lee, R. Zhang; *National Univ. of Singapore*, K. Huang; *Hong Kong Poly. Univ.*

- Goal
  - Optimally design RF energy powered CR networks
  - Analyse transmission probability and spatial throughput of the secondary network
  - Optimizing transmission power and density of the STs
- System Model
  - PTs and STs are distributed as independent HPPPs, slotted ALOHA
  - **Guard Zone**: To prevent interference to PTs
  - **Harvesting Zone**: Depends on sensitivity of the power conversion circuit

- Contributions
  1. Exact ST transmission probability for single and double slot charging based on Markov chain model
  2. Upper and lower bounds on ST transmission probability for multi slot charging
  3. Outage probabilities for PRs and SRs
  4. Maximize spatial throughput to optimize ST power and density

- Results and Conclusion
  1. Proposed a novel architecture enabling STs to harvest energy as well as reuse spectrum of PTs in CR network model
  2. The results can also be applied to other models WSN powered by WPC network

Optimal Combination of Base Station Densities for Energy-Efficient Two-Tier Heterogeneous Cellular Networks

D. Cao, S. Zhou, Z. Niu; *Tsinghua University*

- Goal
  1. Homogeneous Network: Optimal BS density
  2. Heterogeneous Network: Capacity extension and Energy Saving
- System Model
  1. BS and User Locations: Homogeneous PPP's
  2. QOS requirement is the **outage probability**
- Contribution
  1. Homogeneous network: Upper and lower bounds on optimal BS density
  2. Two-tier Heterogeneous Network:
     - Use Gamma distribution for cell size distribution
     - Capacity Extension: Optimal BS density
     - Energy Saving: Switching off BSs

- Results and Conclusion
  - Homogeneous Network: Numerical simulations demonstrate bounds to be tight
  - Heterogeneous Network: If ratio b/w micro and macro BS cost is below a threshold
    - Deploy micro BSs for capacity extension
    - Switch off macro BSs for energy saving
  - Deploying micro BSs can reduce costs upto 40%
  - With BS sleeping capability costs can be further reduced to 75%

Mobile Network Resource Sharing Options: Performance Comparisions

J. S. Panchal; *Verizon*, R. D. Yates ; *WINLAB, Rutgers University; M. M. Buddhikot; Alcatel-Lucent Bell Labs*

- Problem Statement
  - To evaluate sharing options among mobile network operators
    1. Simple approaches- Traditional infrastructure
    2. Complex methods - Specialized/virtualized infrastructure
- System Model
  - Two geographically overlapping 4G LTE cellular networks
  - UEs, Traditional and Virtual sectors
  - Multi-operator Virtual evolved Node-B(MoV-eNB)
  - Only downlink is simulated

- Contribution
  1. Simulation testbed
  2. Simple Approaches: Capacity sharing and Spectrum sharing
  3. Complex Approaches: Virtual spectrum sharing (VSS) and Virtual PRB sharing (VPS)
  4. Collocated and Non collocated antenna topologies
- Results and Conclusion
  1. Capacity sharing is performs best and is the simplest option
  2. Spectrum sharing is least effective
  3. VSS and VPS perform better then spectrum sharing

Some Useful Publications

- Spectrum Sensing Using a Hidden Bivariate Markov Model
  T. Nguyen ; B. L. Mark. ; Y. Ephraim
- Performance Analysis and Design of Maximum Ratio Combining in Channel-Aware MIMO Decision Fusion
  D. Ciuonzo ; G. Romano ; P. S. Rossi
- Energy Efficiency of Power-Adaptive Spatial Diversity Methods
  O. Apilo ; M. Lasanen; S. Boumard ; A. Mammela
- Reconfiguring Networked Infrastructures by Adding Wireless Communication Capabilities to Selected Nodes
  H. Wang ; Q. Zhao ; X. Guan ; Q. Jia ; L. Li