Resilient and Efficient Data Access in Cognitive Radio Networks

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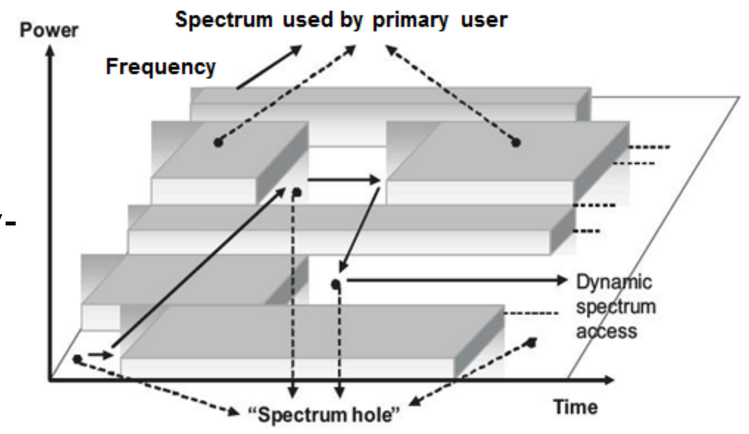
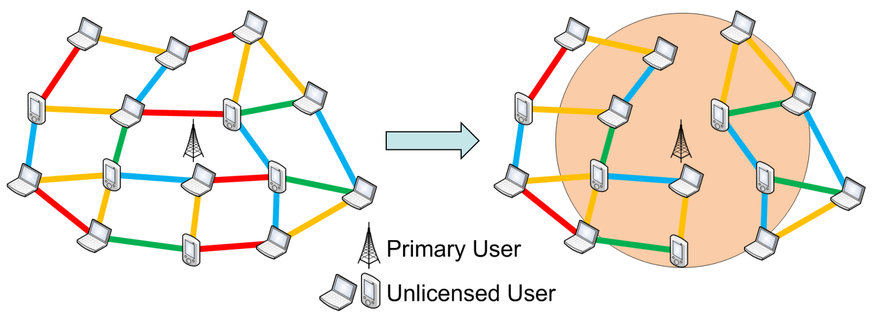
Introduction & Motivation

- Cognitive Radio Networks
  - Uneven spectrum usage
  - Cognitive radio techniques
    - Dynamically configure the operating spectrum based on the environment
  - Applications: white space networks
    - IEEE 802.22: rural broadband access
    - Microsoft KNOWS prototype
    - "Smart city" wireless network in Willington, NC
- Data access: mitigate the effects of primary user appearance
  - Data accessibility: robust topology control
  - Delay: delay-constrained caching
  - Node mobility: spectrum-aware data replication

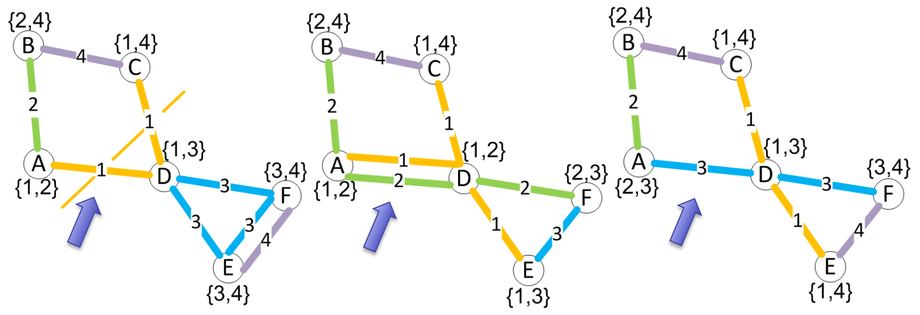


Robust Topology Control [INFOCOM'12]

- Goal: assign the operating channel
  - Avoid network partitions
  - Minimize channel interference

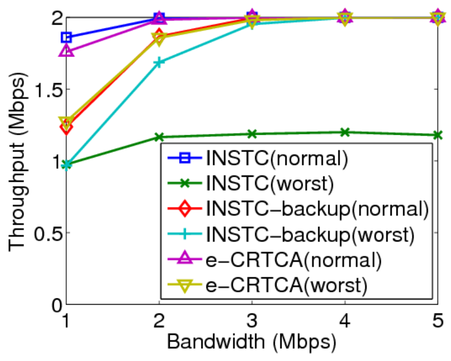


- Solution
  - Assign the least used channel that does not partition the network



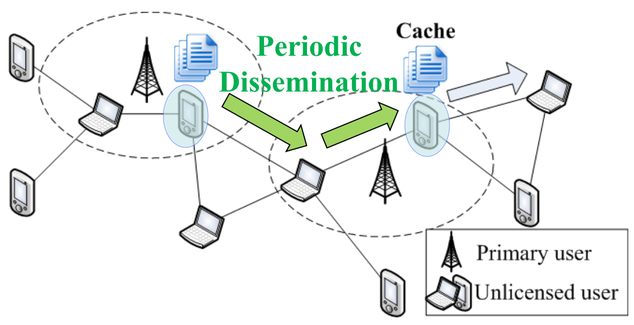
(a) interference-aware (b) CRTCA (d) Enhanced-CRTCA

- Results
  - No network partitions when any single channel is reclaimed

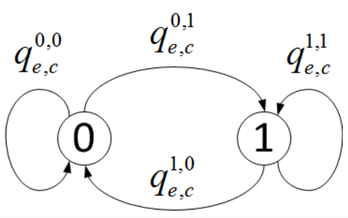


Delay-Constrained Caching [INFOCOM' 14]

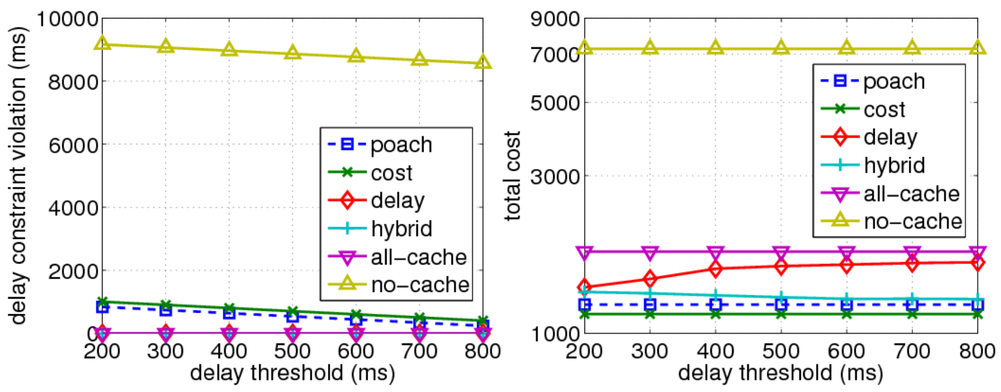
- Goal : cache data at proper nodes
  - Meet delay constraint
  - Minimize the total cost
    - Access/Dissemination



- Model
  - Primary user appearance: Markov chain
  - Link transmission delay: exponential distribution
  - Data access delay: stochastic shortest path length

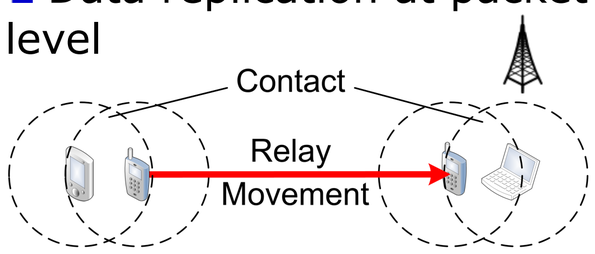


- Solution
  - Cost-based/Delay-based
  - Hybrid



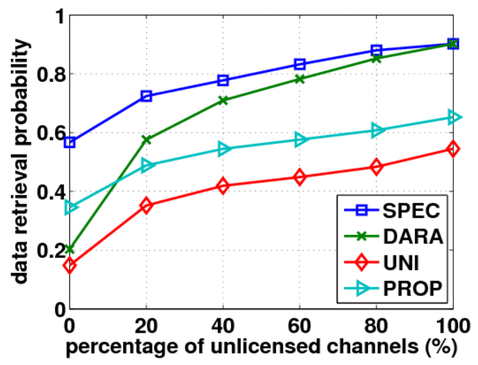
Spectrum-Aware Data Replication [INFOCOM' 14]

- Goal
  - Improve data access in intermittently connected cognitive radio networks
- Problem of carry-and-forward paradigm
  - Short contact duration
  - Primary user appearance
- Technique
  - Erasure coding: encode data into packets and
  - Data replication at packet level



- Solution
  - Replication benefit
  - Data transmission capacity

$$D_l^t = \beta\left(\sum\nolimits_{c\epsilon\mathcal{C}} Y_{l,c}^t\right)$$



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