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Spectrum Scanning and Reserve Channel methods for Link Maintenance in Cognitive Radio Networks

Siva Subramani, Simon Armour, Dritan Kaleshi, Zhong Fan*, University of Bristol, UK, *Toshiba Research, UK

MOTIVATION

Spectrum bands are expected to be non-contiguous channels distributed over wide range of spectrum

⇨ Need efficient multi band spectrum scanning that is capable of scanning deeper parts of spectrum and including user's preference

Spectrum access disruption or disconnection due to unexpected events such as primary user arrival and interference

⇨ Need a mechanism to facilitate link maintenance during such unexpected events.

INTRODUCTION

To exploit the Cognitive Radio's ability to switch between channels (spectrum agility/mobility) to improve performance, we present the framework consisting of

Multi-band Scanning

- Spiral-Bidirectional scanning mechanism
- Dual scanning mechanism

Link Maintenance

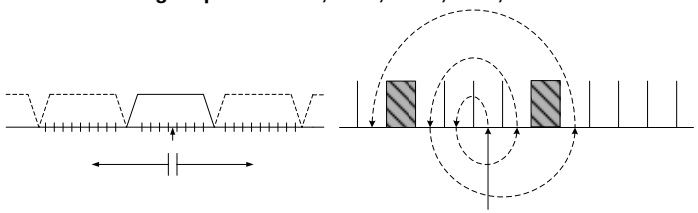
- Adaptive Reserve Channel
- Pointer

SPECTRUM SCANNING

- Scanning mechanism controls the sequence of scanning
- Conventional scanning techniques are sequential

1. Spiral- Bidirectional scanning mechanism

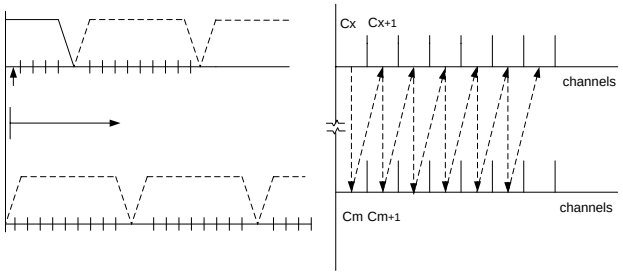
- The cognitive radio pair share the scanning tasks in either direction
- The scanning steps are Cx+1, Cx-1, Cx+2, Cx-2, … so on



Spiral – Bidirectional Spectrum Scanning

2. Dual scanning mechanism

- Two different bands are selected by the pair (combination of random and sequential scanning techniques)
- The channels are checked alternatively



Dual scanning technique

LINK MAINTENACE

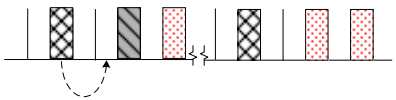
In the scenarios of unexpected events (i.e shorter than the scanning time), the secondary user's link is maintained through

Reserve Channel

- Some channels reserved frequency for smooth transfer of links if necessary
- In shared spectrum regime, no fixed reserve channels; the RCs are adaptive

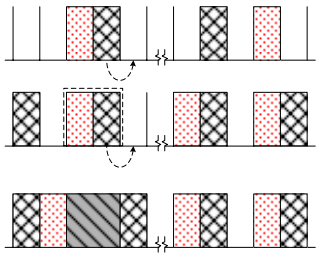
Pointer

- A reference to a valid and regularly checked backup channel
- During unexpected events, pointers serve as first step



Adaptive Channel Mechanism

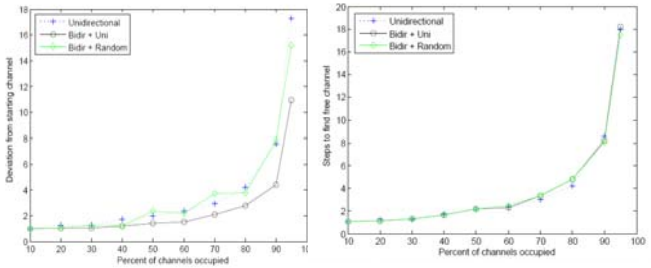
Illustrating simple example:



PERFORMANCE RESULTS

Scanning Mechanism

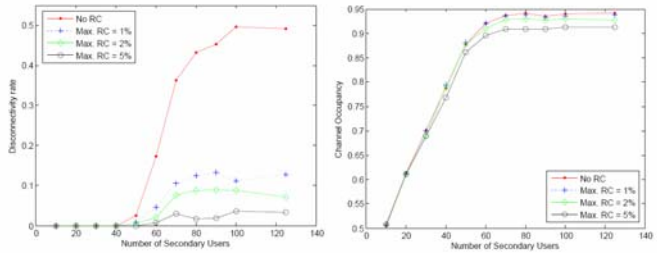
- Bidirectional scanning mechanism ensures the nearest free-channel available
- Number of steps is asymptotical to sequential



Performance of bidirectional scanning mechanism

Link Maintenance: Adaptive Reserve Channel

- Even with 1% of channels as RC, connectivity improved by 77%



Link Maintenance performance with adaptive reserve channel

CONCLUSION

- Analyzed bidirectional and dual scanning mechanism to scan deeper and non-contiguous spectrum
- Proposed adaptive reserve channel and pointer mechanism for link maintenance in the event of primary user arrival
- Performance results demonstrate the ability to produce the nearest channel available without compromising complexity
- Even with 1% of channels as reserve, the connectivity improve by 77%
- Other parameters influencing connectivity such as *lease period* and *PU arrival rate* are illustrated