Introduction

- Aim: propose distributed algorithm for channel selection in wireless ad hoc network.
- Assumptions:
  - Limited number of channels (FDM, TDM, SDM)
  - No Active Link protection, aim for more fairness and better performance
System Model

1. Network Model
   - Nodes have omnidirectional antennas
   - Links between nodes are unidirectional

2. Channel model
   - $\Gamma_i = \frac{g_{ii}p_i}{\sum_{j \neq i, j \in T} g_{ji}p_j + \nu_i}$
   - Cross-node interference is major
   - No cross-channel interference
Algorithm Overview

- Basis of our algorithm:
- Foschini-Miljanic algorithm. Uses SINR of previous reception at the receiver end. Requires feedback
- Measured channel characteristics:
  1. Interference ($I$)
  2. Rate of change of interference. ($\Delta I$) Probing process is used to measure reaction to a low powered transmission by node.
- Important to take measurements while channel is stable
- Calculated channel metric: $Q \triangleq I \times \Delta I$
Proposed algorithm

1. Randomly select a channel to join
2. Established Link, Power control using FM algorithm
3. \( p > p_{\text{max}} \)
   - No
   - Yes
     - Take measurements
     - Select channel
Adaptation of the FM algorithm

- Probing process causes temporary spikes in sensed interference.
- Such spikes can potentially kick legitimate, stable links from the channel.
- A buffer/counter is implemented to allow slower reaction of the FM algorithm.
- To efficiently take measurements, we used an aggressive configuration of the FM algorithm (proportionality gain $k = 0.9$).
Selection of a channel

- **Random selection**
  - Uniformly random
  - Weighted random with $I^{-1}$ as weight
  - Weighted random with $Q^{-1}$ as weight

- **Deterministic selection**
  - Minimum($I$)
  - Minimum($\Delta I$)
  - Minimum($Q$)
Performance measures

- Simulation using MATLAB
- Best estimate of algorithm performance is the number of nodes that reached their desired SINR level $\gamma_i$
- In the optimal solution, the nodes in a network would all reach their desired SINR in the optimal number of channels
- Simulations for number of channels: optimal, optimal+1, optimal+2
Example of a communication pair reaching its desired SINR
Example of the previous communication pair’s power in reaction to events
Example of another communication pair reaching its desired SINR

Figure: The transmitter’s power and SINR levels for node 39, for a simulated time period.
Comparison of selection schemes

- Random, NoC=Optimal
- Random, NoC=Optimal+1
- Random, NoC=Optimal+2
- min(\|I\|), NoC=Optimal
- min(\|I\|), NoC=Optimal+1
- min(\|I\|), NoC=Optimal+2

Number of nodes in network (N)

% of nodes active
Conclusions and future work

- Deterministic approaches work, but so do random schemes
- Trade-off between transmitter complexity and negligible performance improvement
- Use of relay nodes could further improve performance
Questions?