ALPEN-ADRIA UNIVERSITÄT KLAGENFURT

Lakeside Labs

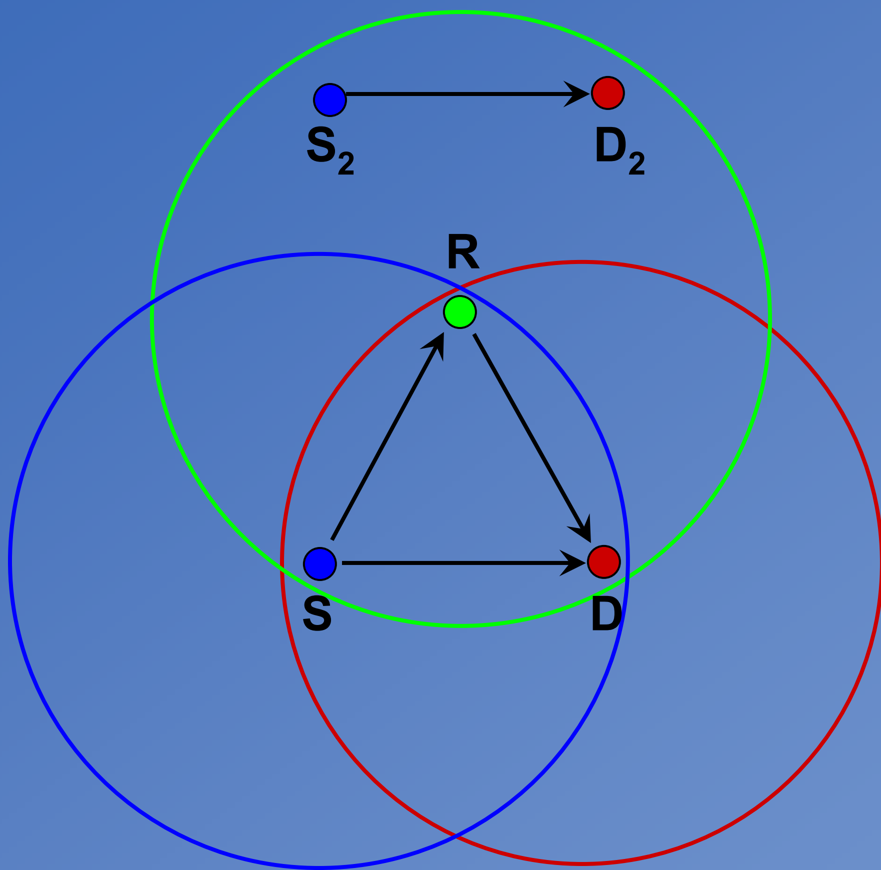
Selecting Spatially Efficient Relays

<u>Nikolaj Marchenko</u>, Evşen Yanmaz,
Helmut Adam, and Christian Bettstetter

Mobile Systems Group, NES
University of Klagenfurt, Austria

Intro

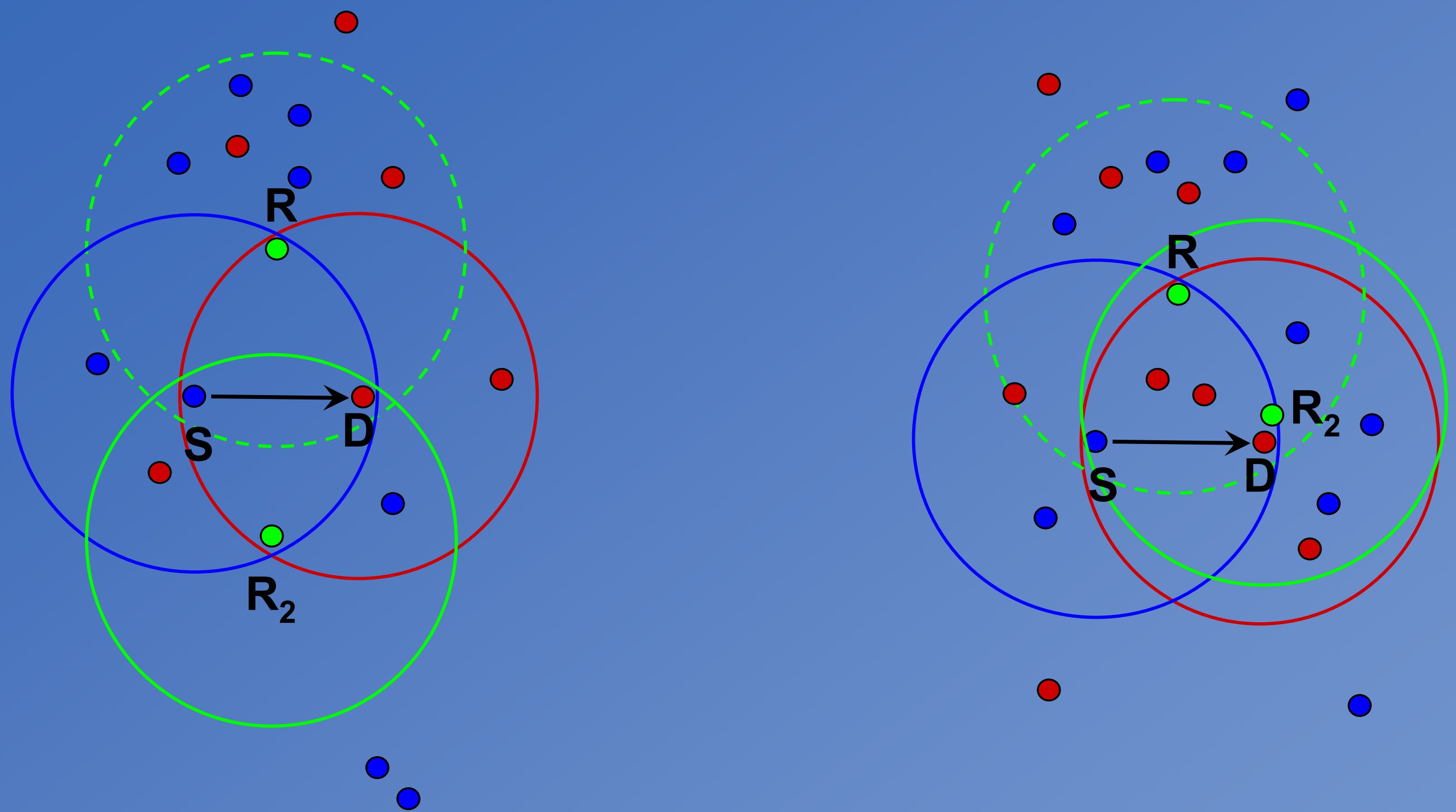
Introduction



- IEEE 802.11 DCF-like resource allocation
- Additional spatial radio resources for the coop. relay

Relay selection procedure

Relay Selection



Spatial Efficiency of a Relay

- Minimal number of blocked neighbors
- Close to S or D (Scenario B – just to D)

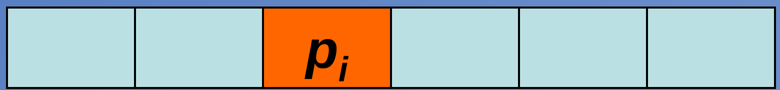
Relay Selection Procedure

1. **Source-Destination handshake:** other nodes overhear the medium

2. **Qualification phase:** nodes qualify themselves as potential relays

   $SNR>SNR_{min}$, battery life, etc.

3. **Nomination phase:** probabilistic contention-based nomination
   - ► Randomly select a slot in the window of ***w*** slots
   - ► Transmit a nomination message with certain probability $\boldsymbol{p_i}$



4. **Election phase:** select a relay from successfully received nominations

Nomination Functions

1. Contention-optimal

$$p = \begin{cases} 1, & \text{if } N_R \le w \\ \dfrac{w}{N_R}, & \text{if } N_R > w \end{cases}$$

2. Degree-based

$$p_i = \begin{cases} 1, & \text{if } n_i - 2 \le w \\ \dfrac{w}{n_i - 2}, & \text{if } n_i - 2 > w \end{cases}$$

3. Distance-and-Degree-based

$$p_i = \begin{cases} 1, & \text{if } n_i - 2 \le w \\ \min\left(\dfrac{1-d_i}{d_i} \cdot \dfrac{w}{n_i - 2}; 1\right), & \text{if } n_i - 2 > w \end{cases}$$

Scenario A

$$d_i = \frac{\min(d_{iS}; d_{iD})}{r}$$

Scenario B

$$d_i = \frac{d_{iD}}{r}$$

w : contention window size

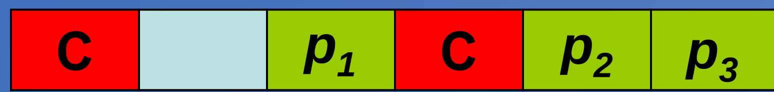
N_R : number of potent. relays

n_i : degree of node ***i***

$d_{iS(D)}$: distance from ***i*** to S (D)

r : transmission range

Election functions



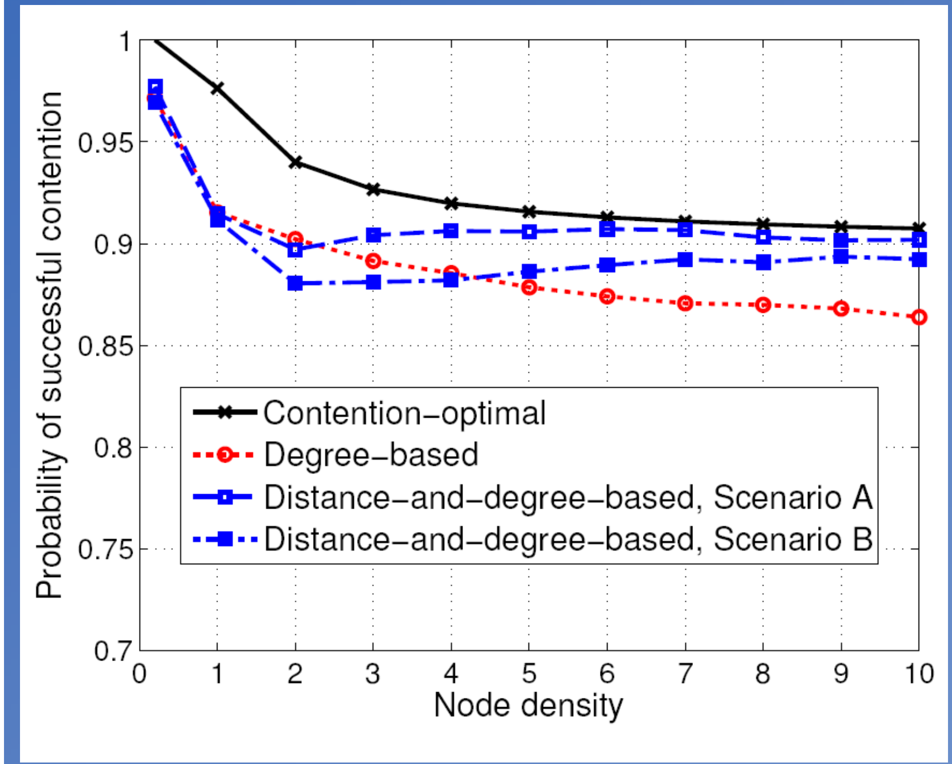
- Random selection
- <u>Maximal nomination probability</u> p_i
- Minimum number of neighbors
- Minimal distance to source/destination

Results

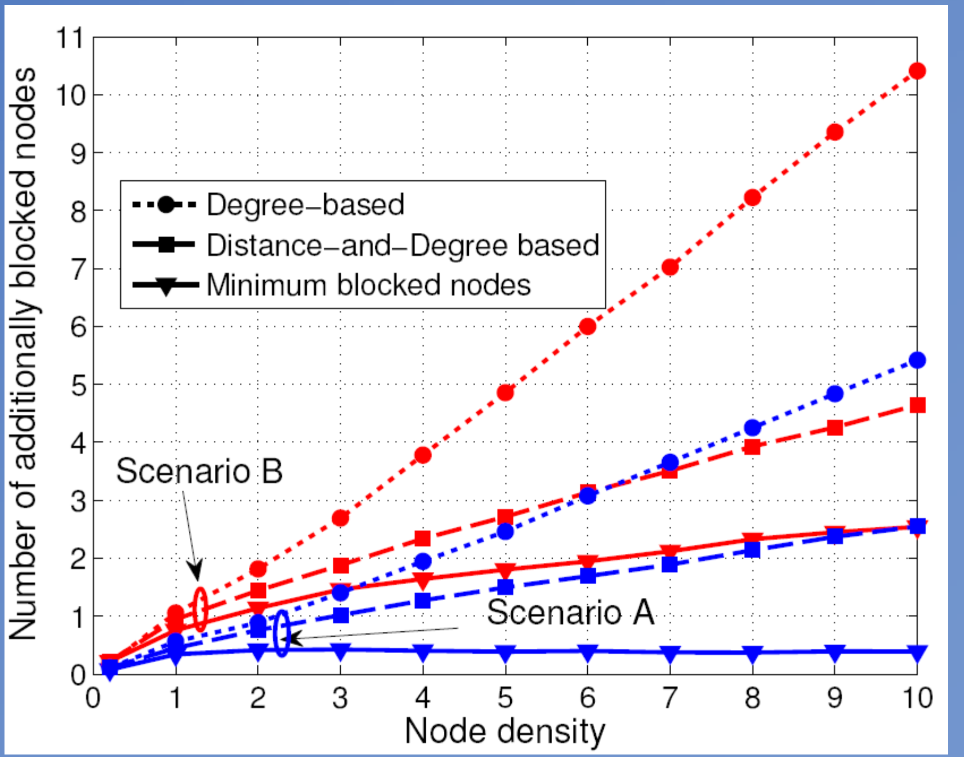
Results. Random uniform topology

- Transmission range r =1
- Source-destination distance d_{SD}=0.7
- Random uniform node distibution
- Contention window size w =5

Selection probability



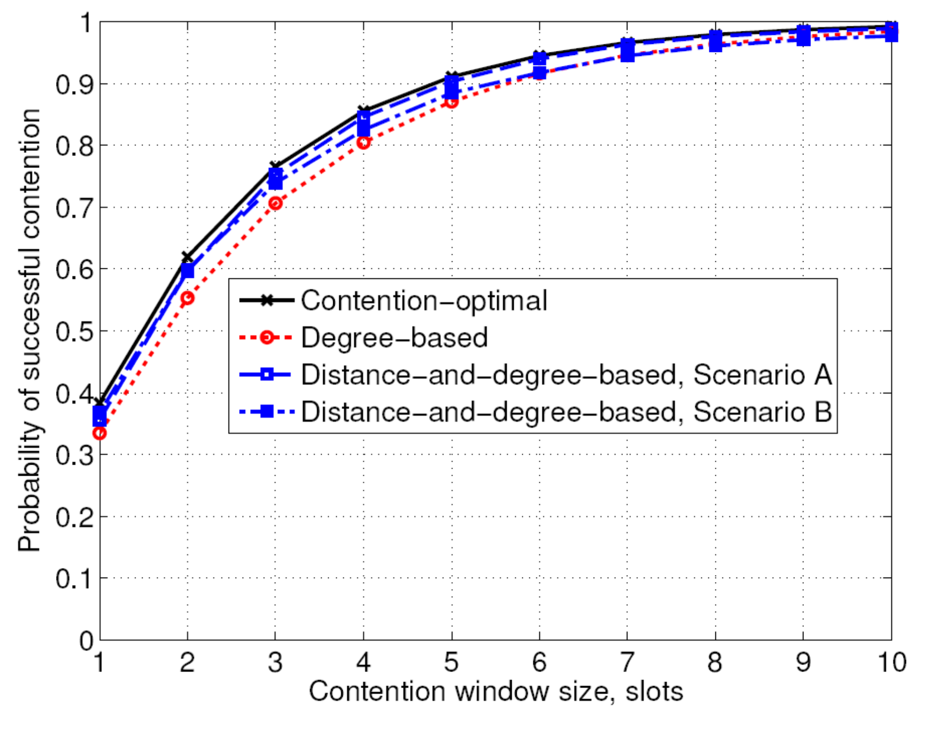
Spatial efficiency



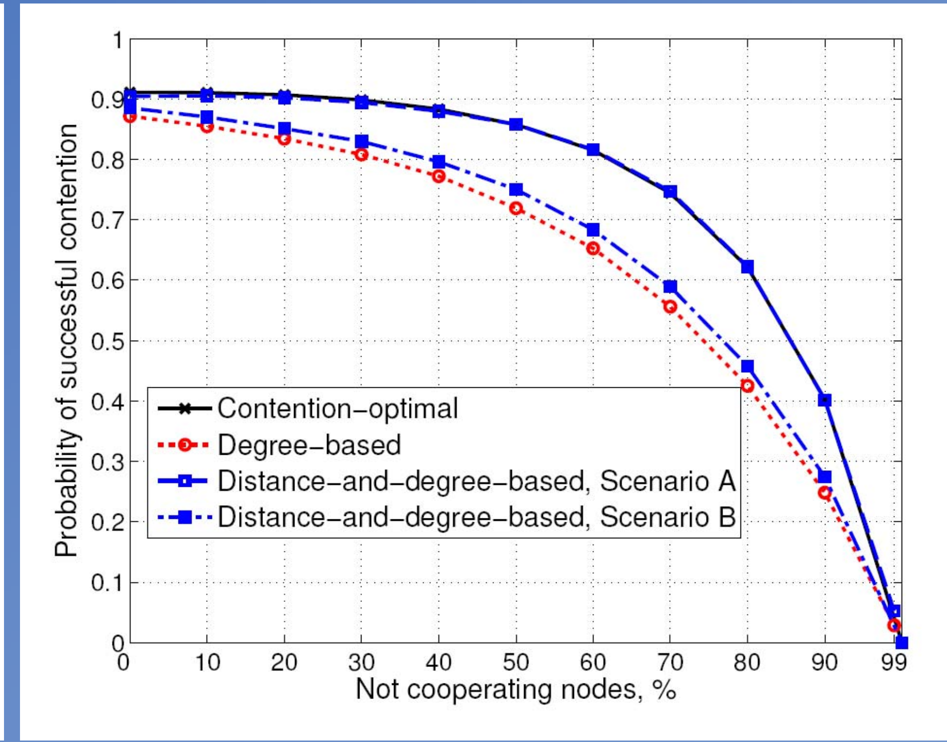
Results. Random uniform topology

- Node density =7 nodes per square unit

Impact of contention window



Impact of non-cooperating nodes



- Number of additionally blocked nodes changes very slowly

Summing-up

Summary

- We propose a distributed relay selection scheme
- Defined by two functions: *nomination* and *election*
- Uses local node information: *degree* and *distance*
- Achieves high selection probability (90% for ***w***=5)
- Increases spatial reuse by 50%

► N. Marchenko, E. Yanmaz, H. Adam, and C. Bettstetter
Selecting a Spatially Efficient Cooperative Relay. GLOBECOM'09.

Finally the Final Slide

Thanks!