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Improving the Performance of Path Discoveries in Dense Mobile Ad Hoc Networks

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Agenda

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- Introduction
- Proposal
- Performance evaluation
- Conclusion

Ad-hoc Network Introduction (1)

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"**An ad hoc network** is a collection of wireless mobile hosts forming a **temporary** network **without the aid of any established infrastructure or centralized administration**."

- Does not use network infrastructure:
  autonomous, P2P
- Dynamic (Changing) network topology
  wireless and mobile environments
- Multi-hop network

Ad-Hoc network is one of key techniques to provide small devices with **ubiquitous networking/computing**

Applications of Ad-hoc Network

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- **Military**

  Communication:Soldier, Tank, Battleship, Fighter

- **Disaster**

  Emergency call, Shelter inducement during Earthquake, Tidal wave, Flood, Typhoon

- **New services over PAN (Personal Area Network)**

  Management of commodity warehouse, Construction work site, Shopping Mall
  Navigation at Event Place

- **ITS (Intelligent Transport System)**

  Congestion information flooding among cars
  Information retrieval from road side to car

Ad-hoc Network Structure

Introduction (3)

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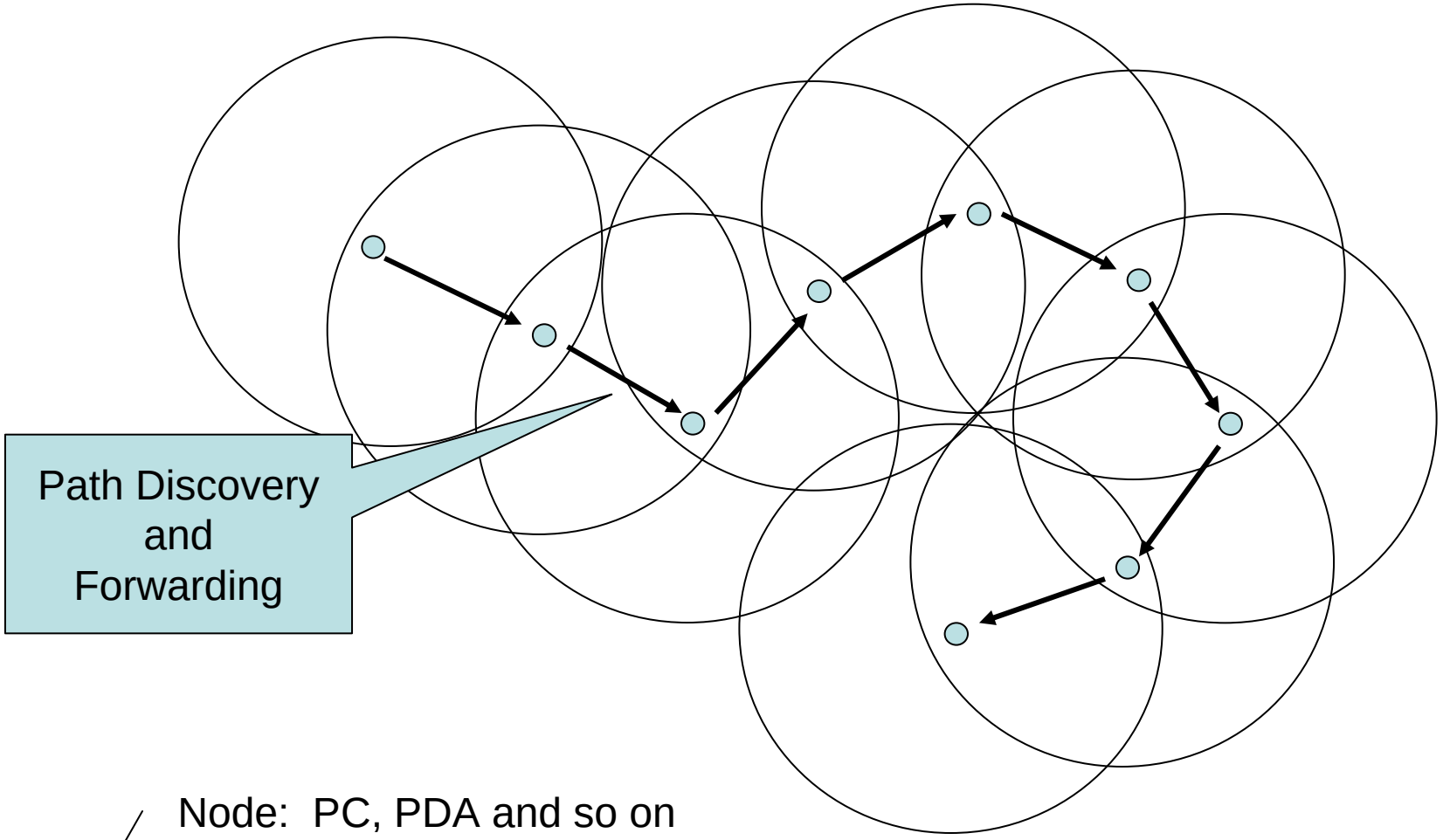

Node: PC, PDA and so on

Communication Area: IEEE 802.1b, Bluetooth and so on

AODV:Routing Protocol RFC3261 Proposal (1)

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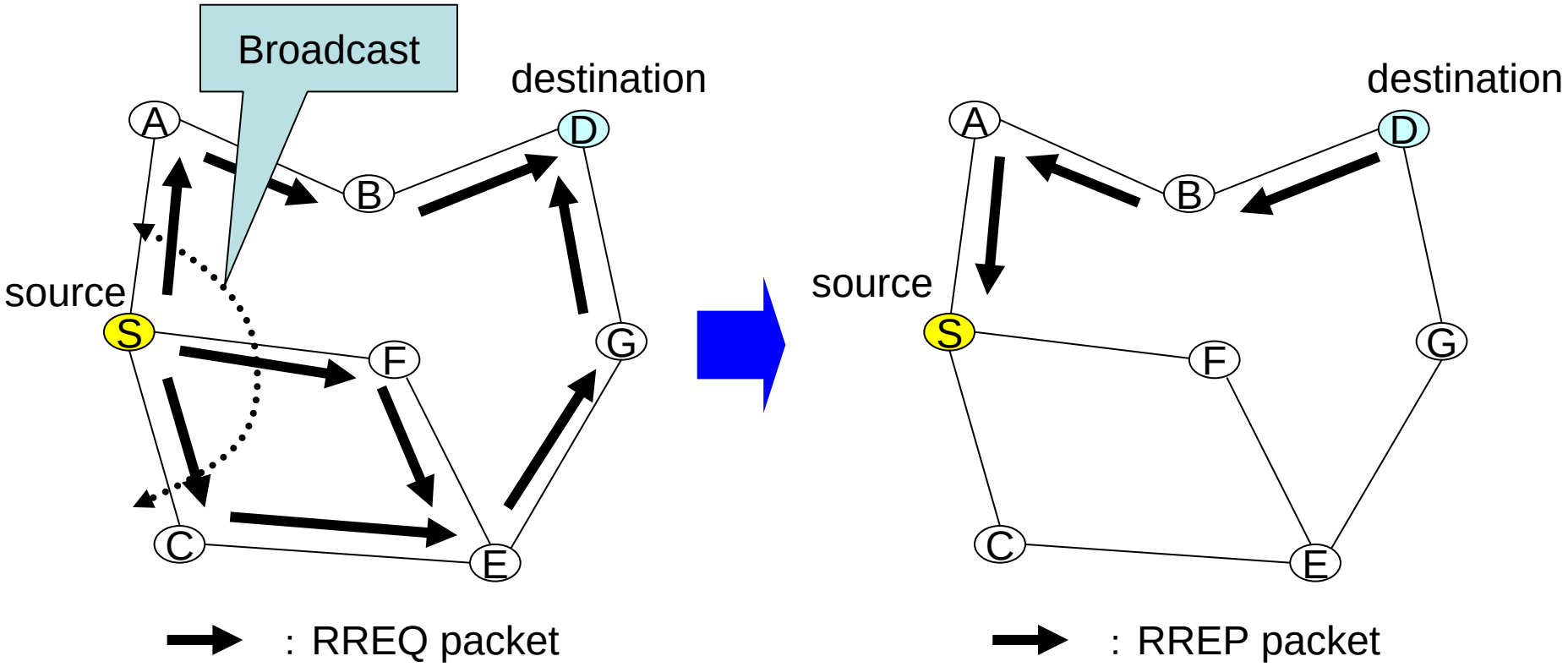
AODV (Ad hoc On-demand Distance Vector algorithm)

- Reactive (On-demand)
  Route is established at communication request time
  RREQ(Route request) packets are broadcast to all areas repeatedly until they reached to the destination



Overhead of re-broadcasting Proposal (2)

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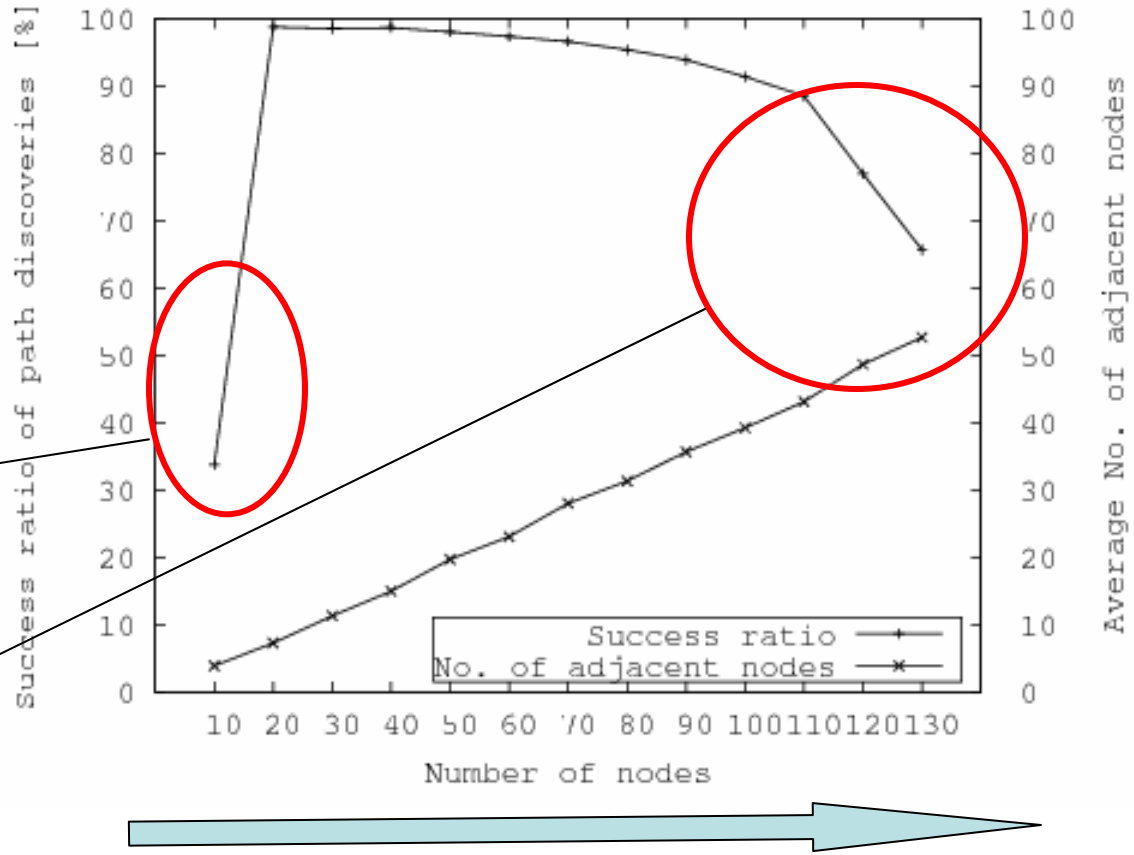
- Results in AODV
  - NS2 simulation
- **Low path discovery success ratio** because of …
  - Isolated nodes

Not our focus

  - **Overhead of re-broadcasting**

Our focus



Dense

Goal Proposal (3)

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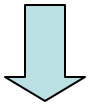
Requirements

- To decrease the number of broadcast packets
- To keep success ratio of path discoveries
- Not to use new control packets



Approach

- Re-broadcast control packets stochastically
  Not all RREQ packets are not broadcast

Metrics for re-broadcasting Proposal (4)

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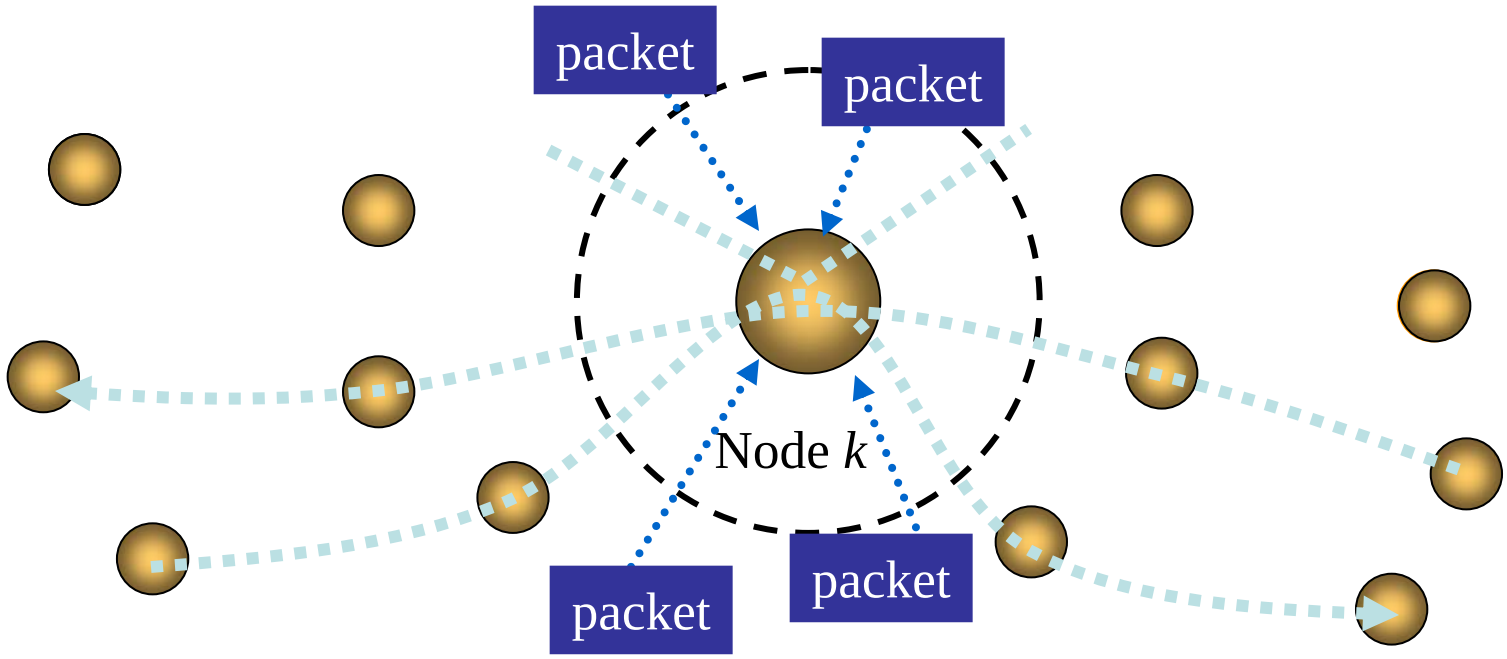
- **Need to determine the appropriate probability**
  - Decrease re-broadcasting
    - Not too relaxed
    - Not too rigid
- **Determine the probability according to these two metrics**
  - Node density: No. of received control packets
  - Path concentration: No. of active routes
- **Policy**

Metric		Probability
Node density	High	Low
	Low	High
Path concentration	High	Low
	Low	High

Metrics for re-broadcasting Proposal (5)



Node k counts:

- No. of packets adjacent nodes broadcast → $\overline{N}_k$
- No. of active routes the node accommodates → L_k

Path Discovery in Proposed Method Proposal (6)

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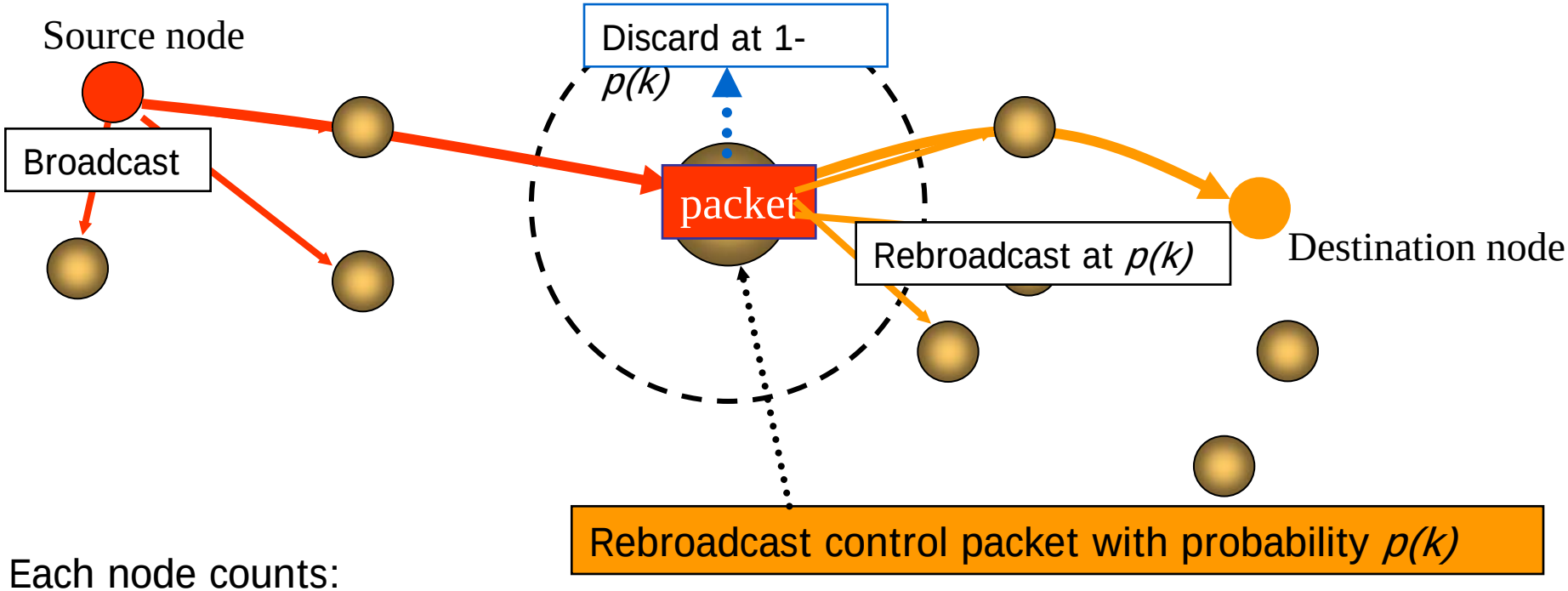

Each node counts:

- No. of packets → $\overline{N}_k$ Metric of node density
- No. of routes → L_k Metric of path concentration

$$p(k) = \min\left[\max\left(0, 1 - \alpha L_k + A_k\right), 1\right]$$

$$A_k = \begin{cases} -\beta & \text{if} \quad \overline{N}_k > \theta_h \\ +\beta & \text{if} \quad \overline{N}_k \le \theta_l \\ 0 & \text{otherwise} \end{cases}$$

Simulation 1 Performance Evaluation (1)

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- Compare our proposed method with AODV
- NS-2 simulation
  - Wireless I/F: IEEE 802.11
  - Simulation field: 250mx1000m
  - 64kbps CBR traffic
  - No. of nodes: 120, 60
- Focus on the effects of the two metrics
  - Node density
  - Path concentration

120 Static nodes

Performance Evaluation (2)

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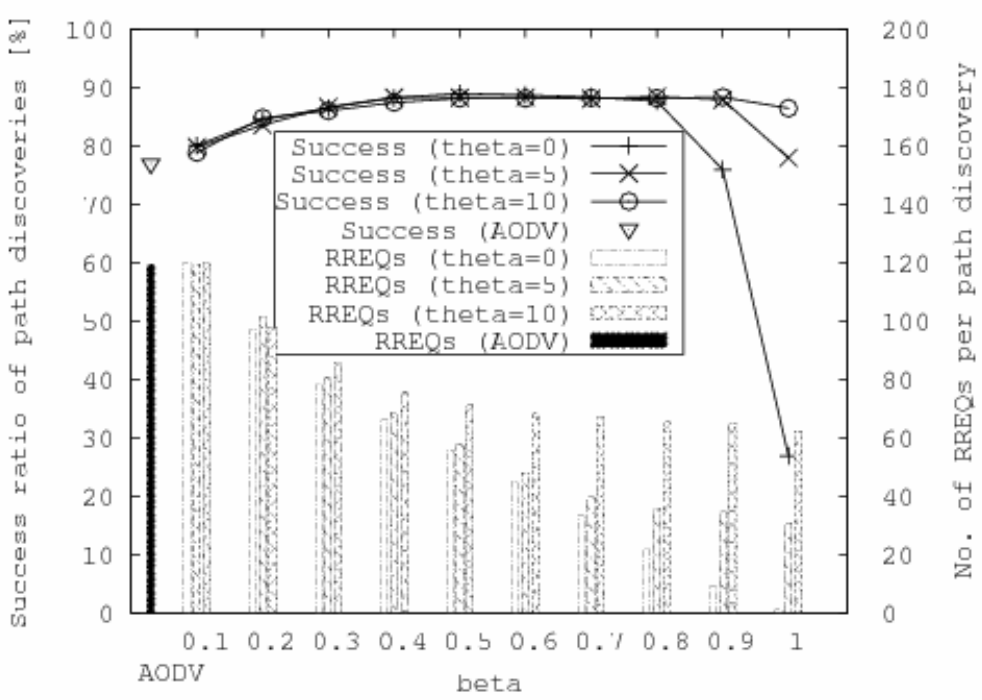
- θ_h decides "re-broadcast stochastically or not"
- If the metric > θ_h, the probability=1-β
- AODV succeeds in path discoveries with about 77%
- As β increases
  - No. of RREQs decreases
  - θ_h =0 ,5 ⇒ The success ratio decreases = too rigid
  - θ_h =10: Improve the success ratio



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$$A_k = \begin{cases} -\beta & \text{if} \quad \overline{N}_k > \theta_h \\ +\beta & \text{if} \quad \overline{N}_k \le \theta_l \\ 0 & \text{otherwise} \end{cases}$$

α =0, θ_l=0

⇒ $p(k)$ depends on β and θ_h

Mobile nodes

Performance Evaluation (3)

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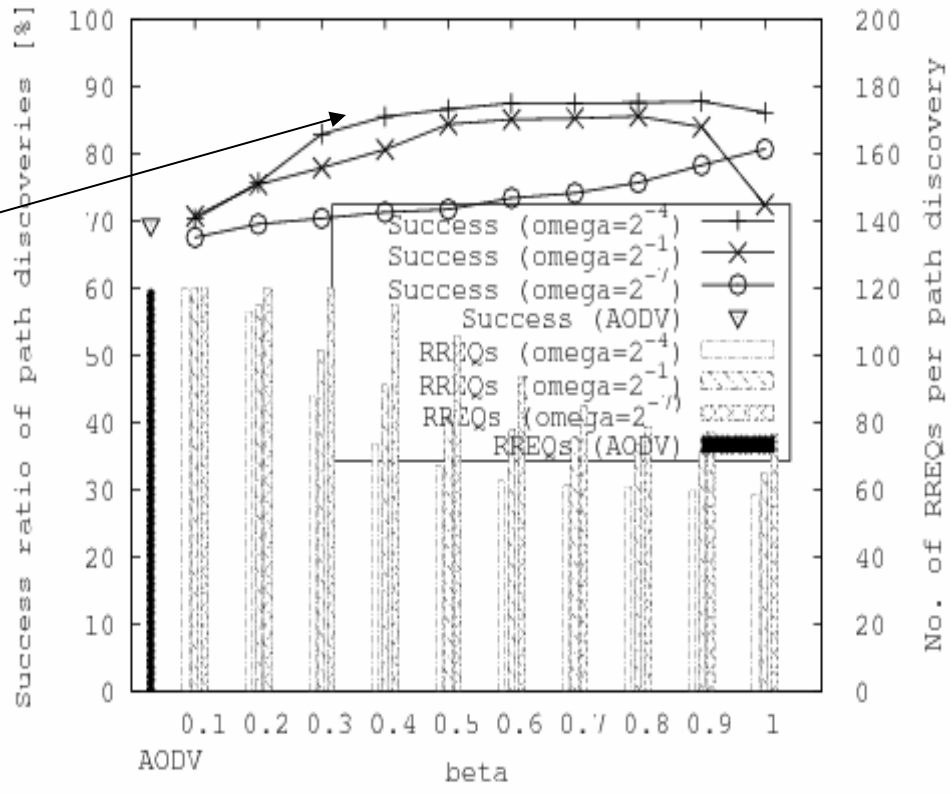
- Our proposed method
  - Decrease No. of RREQs
  - Keep success ratio
- Impact of ω
  - Middle ω obtains the best performance



To consider convergence of the metric

- ω is the key parameter of the node density metric
  - $\overline{N}_k = \omega N_k + (1-\omega) N_{k-1}$

Conclusion

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- Proposed efficient on-demand routing method for dense ad-hoc networks
  - Re-broadcast control packets
- Showed simulation results
  - Improve the performance of path discoveries by our proposed method