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Route Driven Gossip

Probabilistic Reliable Multicast in Ad Hoc Networks

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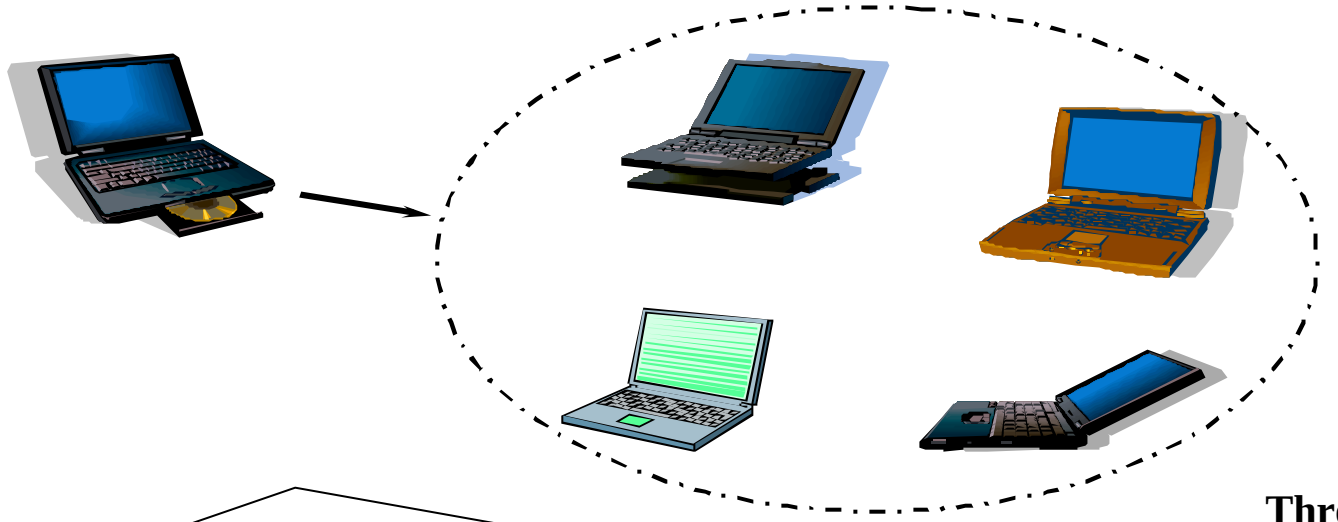
Outline

- **Background**
- **Problem definition and network model**
- **Protocol description**
- **Results**
- **Conclusions**

Multicast Reliability in Wired Networks



Throughput

Question: Will all destinations receive the packet ?

Answer:

Who cares!	**– (Pure) unreliable**
Try my best	**– Best-effort**
With high, known, probability	**– Probabilistic reliable**
Sure!	**– Reliable**

Reliability

Existing Solutions in Ad Hoc Networks

- **Unreliable multicast protocols**
  - ***Multicast Ad hoc On Demand Distance Vector*** *(*MAODV) [RoyerP99]
  - ***On-Demand Multicast Routing Protocol*** (ODMRP) [LeeGC99]
  - ***Adaptive Demand-driven Multicast Routing*** (ADMR) [JetchevaJ01]
- **Best-effort multicast protocols**
  - ***Adaptive Reliable Multicast Protocol*** (ARMP) [GuptaS99]
  - ***Reliable Broadcast Protocol*** (RBP) [PaganiR99]
- **Probabilistic reliable multicast protocols**
  - ***Anonymous Gossip*** (AG) [ChandraRB01]
- **Reliable multicast protocols**
  - ???

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Problem Definition

- **Probabilistic reliability: If some group member sends out a flow of *M* packets, a certain group member receives a fraction *?* of all packets with probability $p_M(?)$. *?* and *p* are termed *reliability degree* and *reliability probability distribution* respectively**

- **Predictability: The reliability $p_M(?)$ of the protocol is predictable given simple information about the network, like packet loss ratio**

- **Scalability: Reliability only degrades modestly with the increase of network size and mobility**

Assumptions

- **A unicast routing protocol is available. We use DSR as an example**
- **CSMA/CA MAC (e.g., IEEE 802.11) provides reliable, sequenced single-hop unicast by RTS/CTS–Data/Ack handshake sequence**
- **Assumptions on mobile nodes:**
  - **Unique node identifier *id***
  - **Identical and fixed transmission ranges**
  - **No Byzantine failures**
  - **Packets sent are uniquely identified by *pid* [*gid*, *sid*, *seq*]**

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Basic Data Structures and Operations

Data Structures

Identifier

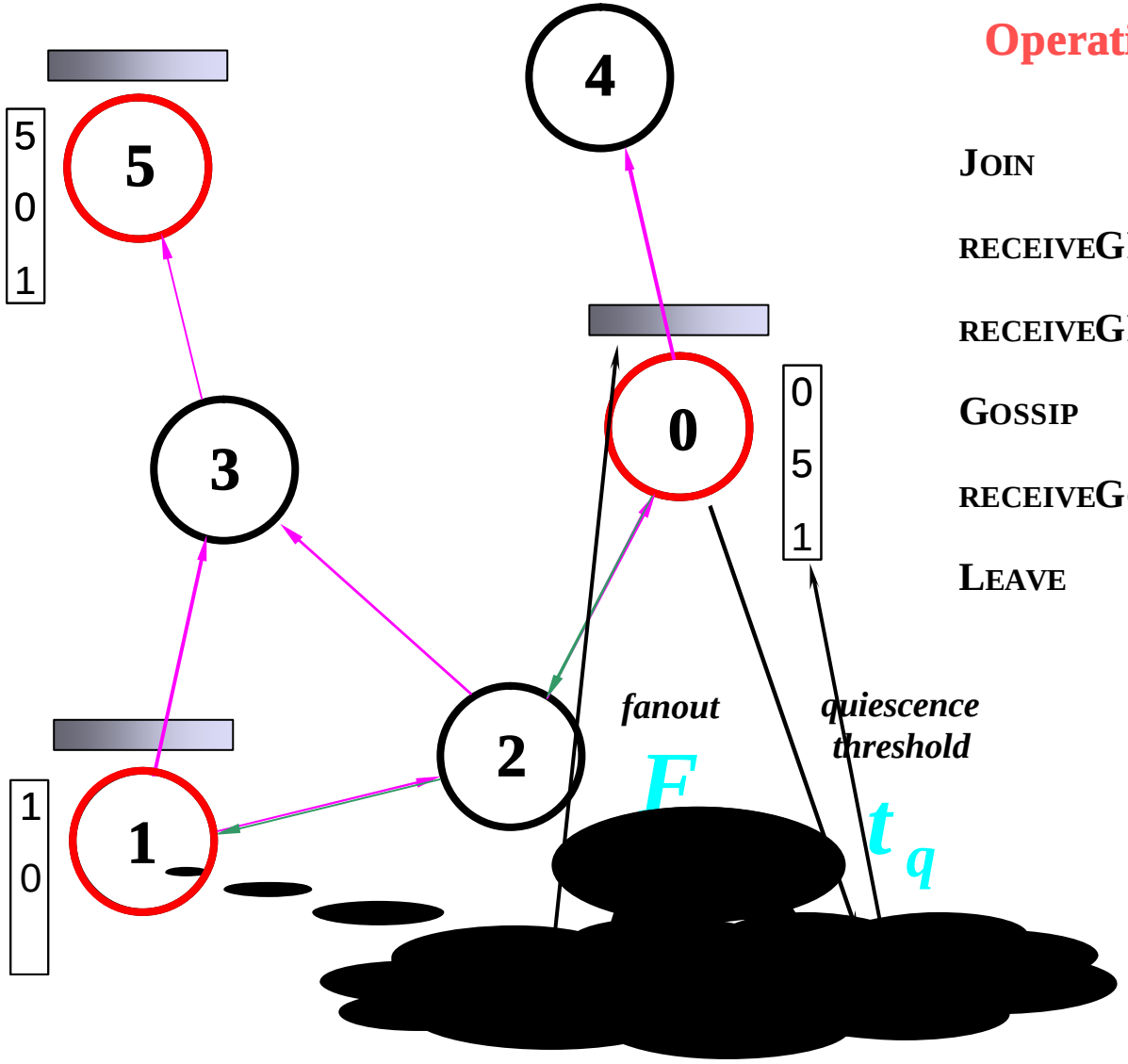
Group identifier

Data buffer

- **new**
- **old**

View

- **active**
- **passive**
- **remove**



Operations

JOIN

RECEIVEGREQUEST

RECEIVEGREPLY

GOSSIP

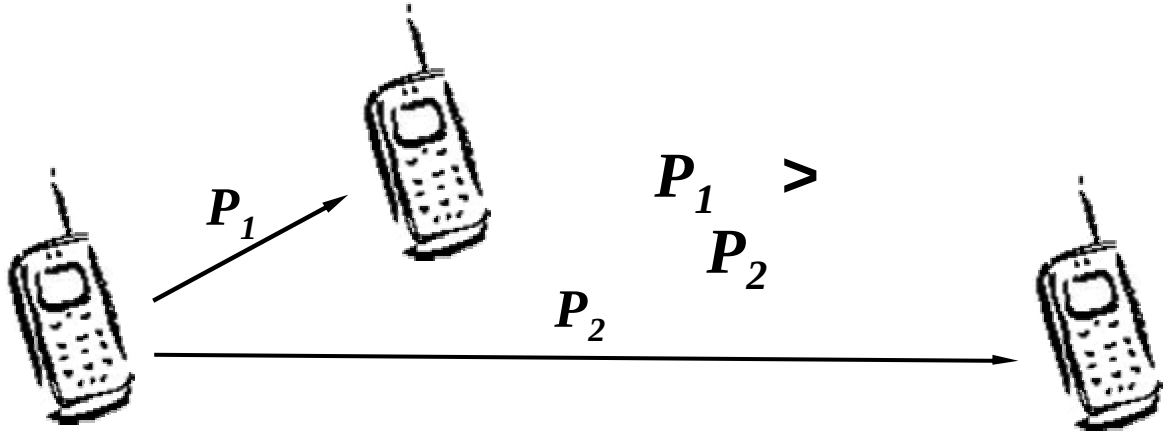
RECEIVEGOSSIP

LEAVE

Optimization: Topology-aware RDG

- **Locality of the traffic can reduce network load**
- **Routing protocol can provide partial topology information**
- **Always gossiping locally may create logical partition**

- **Approach:**



P_1, P_2 ? the reciprocal of the routing path length

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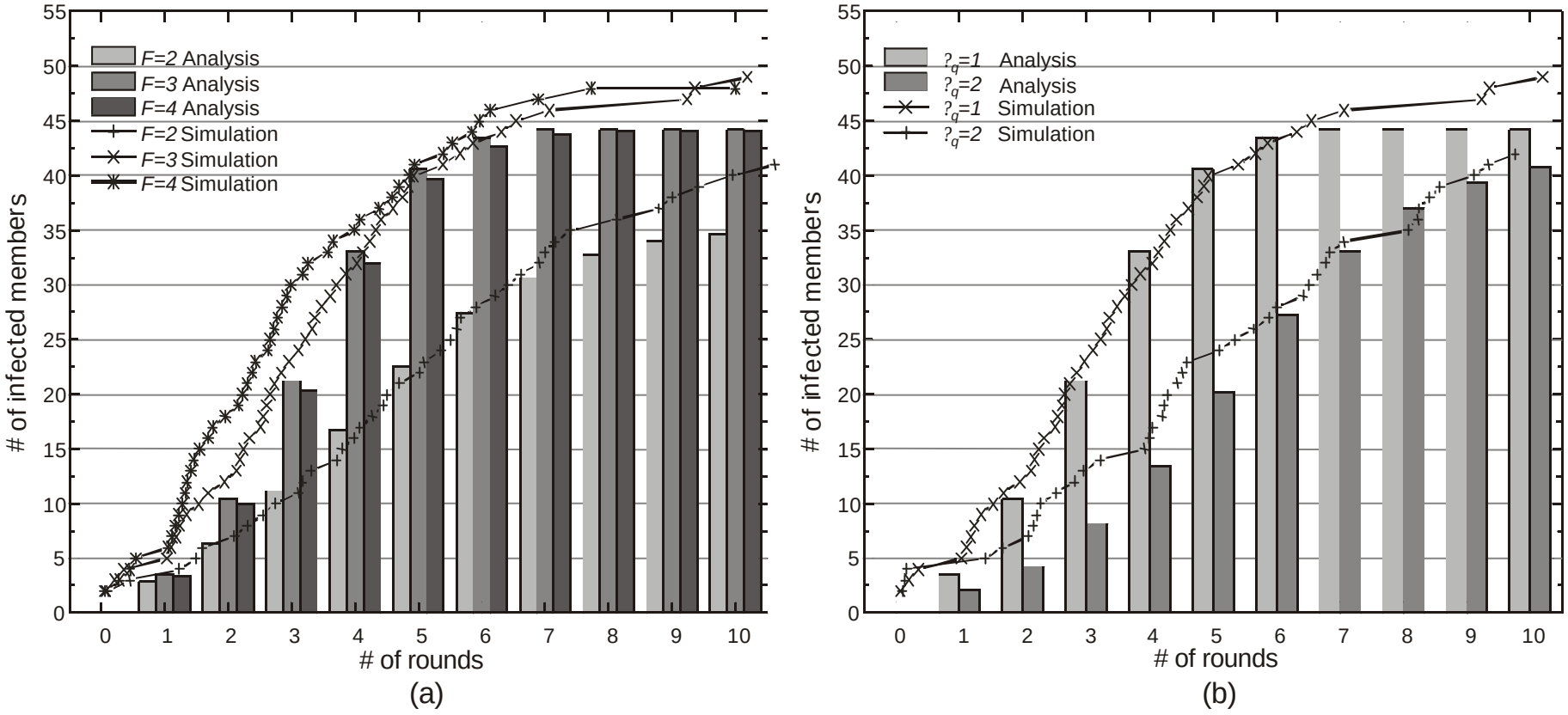
Simulation Model

- **Simulator: *ns-2***
- **Network nodes are randomly distributed in a 1000m?1000m square**
- **MAC: IEEE 802.11, 2Mbps, 250m nominal transmission range**
- **Mobility pattern: Random Way-point Model**
- **Traffic pattern: CBR with 64 bytes packet at a interval of 200ms. The gossip period is also set to 200ms**
- **Simulation period is 280s, 1400 packets are multicast**
- **The group size is half of the network size**

Reliability of the Gossip

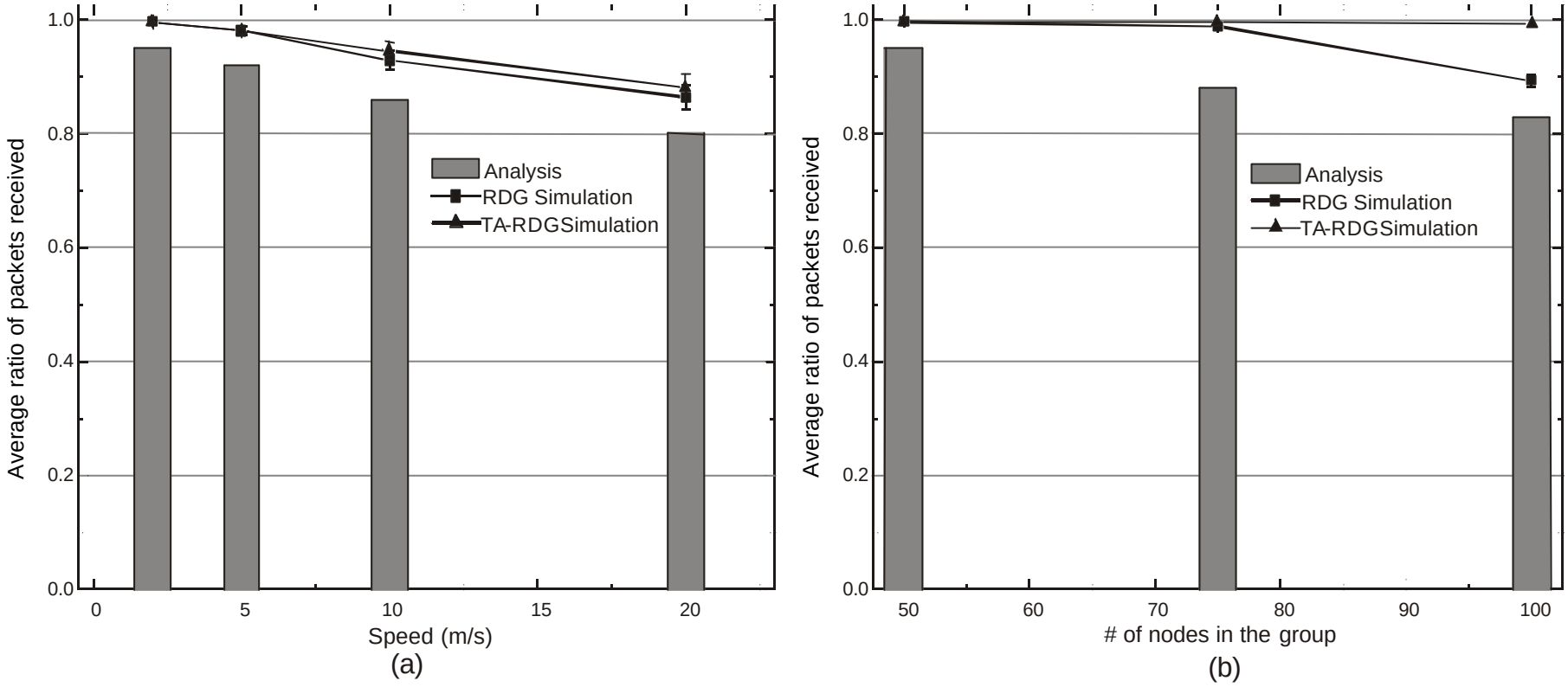
— Single Packet Dissemination Reliability



Average number of infected members (simulation results) at a certain time against expected number of infected members (analytical results), for a given round with *n=50*. The maximum node speed is 2m/s. (a) $?_q=1$ with different values of *F*. (b) *F=3* with different $?_q$.

Reliability of the Gossip

— Reliability Probability Distribution $p_M(?)$



(a) The performance of the protocol in a group of *n=50* with maximum node speed varying from 2m/s to 20m/s. (b) The performance of the protocol with group size varying from 50 to 100 while the maximum node speed is 2m/s. The design parameters are *F=3* and $?_q=1$ for both cases.

Conclusions and Future Work

- **RDG is a gossip-based multicast protocol for ad hoc networks, with the following features:**
  - **Probabilistic reliability**
  - **Predictable reliability thanks to analysis**
  - **Scalability**
  - **No support from underlying multicast primitive**
- **Possible future work:**
  - **Further optimizations, e.g., using existing unreliable multicast primitives**
  - **Building block for further group communication protocols**

Thanks for your attention !

Any Questions ?