



Laboratory for
computer Communications
and Applications



Route Driven Gossip

Probabilistic Reliable Multicast in Ad Hoc Networks

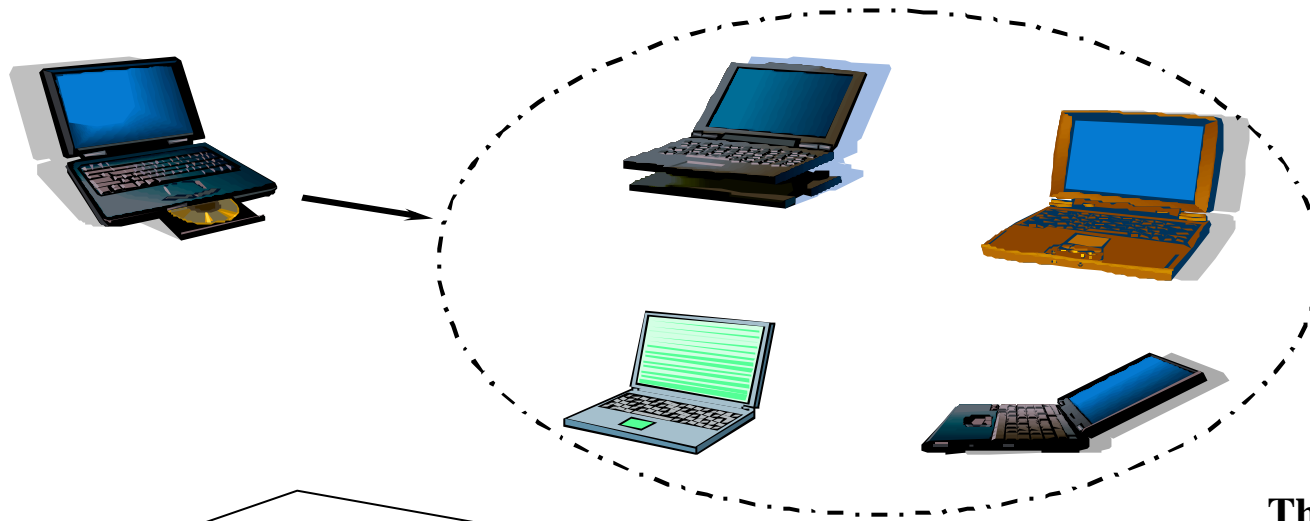
J. Luo, P. Th. Eugster, and J.-P. Hubaux

Swiss Federal Institute of Technology in Lausanne

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 ρ of all packets with probability $p_M(\rho)$. ρ and p are termed *reliability degree* and *reliability probability distribution* respectively
- ✍ **Predictability:** The reliability $p_M(\rho)$ 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

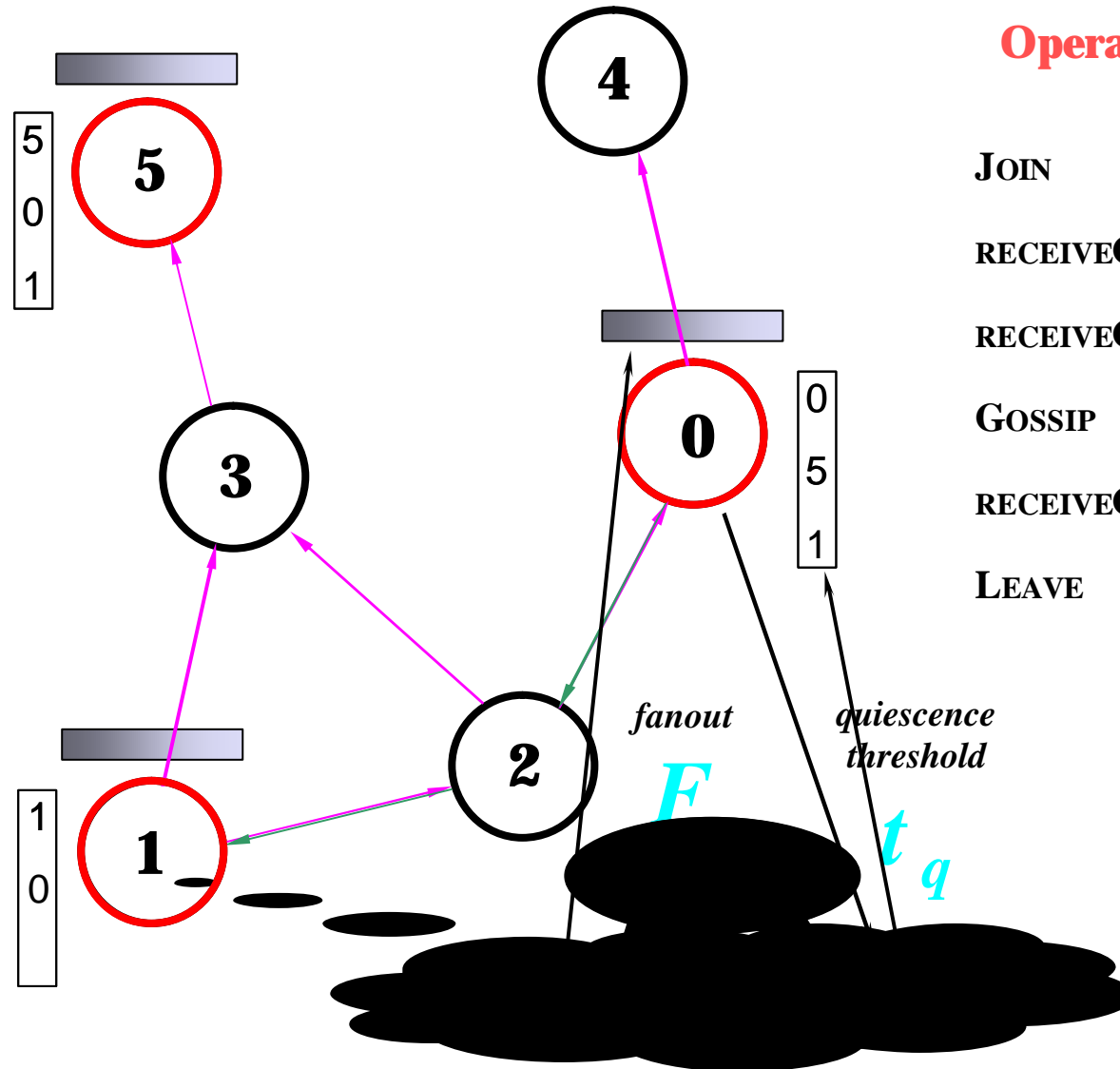
- old

View

- active

- passive

- remove



Operations

JOIN

RECEIVEGREQUEST

RECEIVEGREPLY

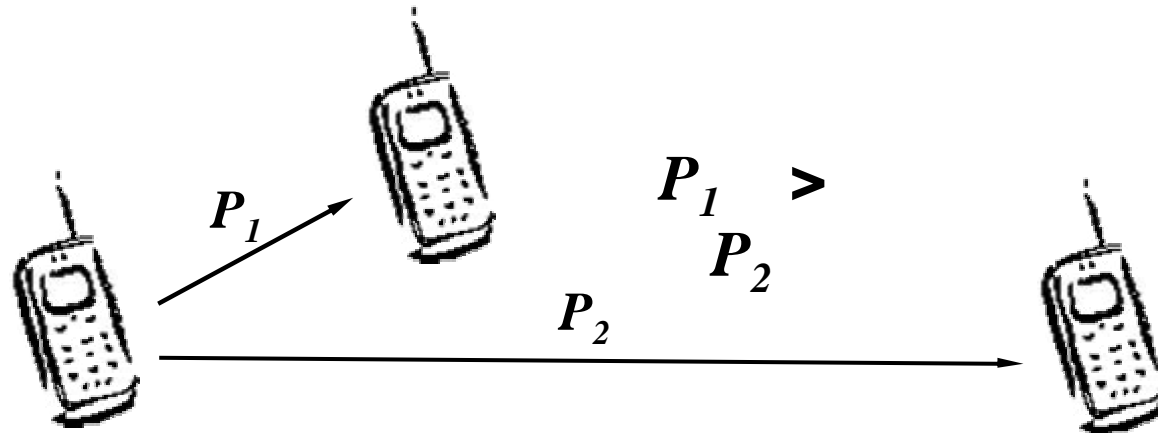
GOSSIP

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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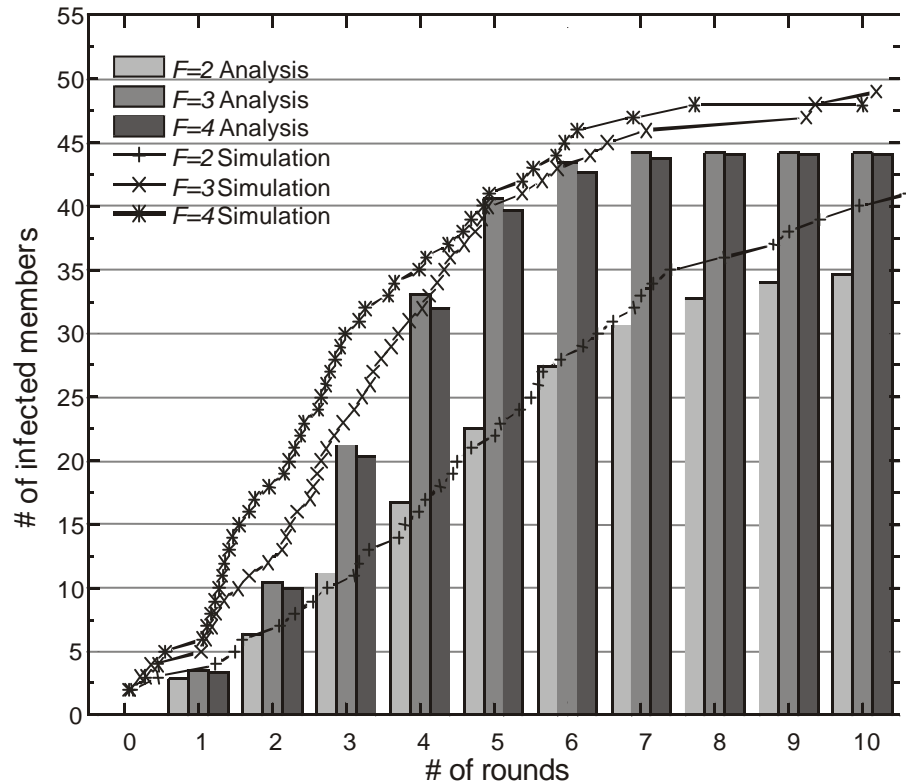
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Simulation Model

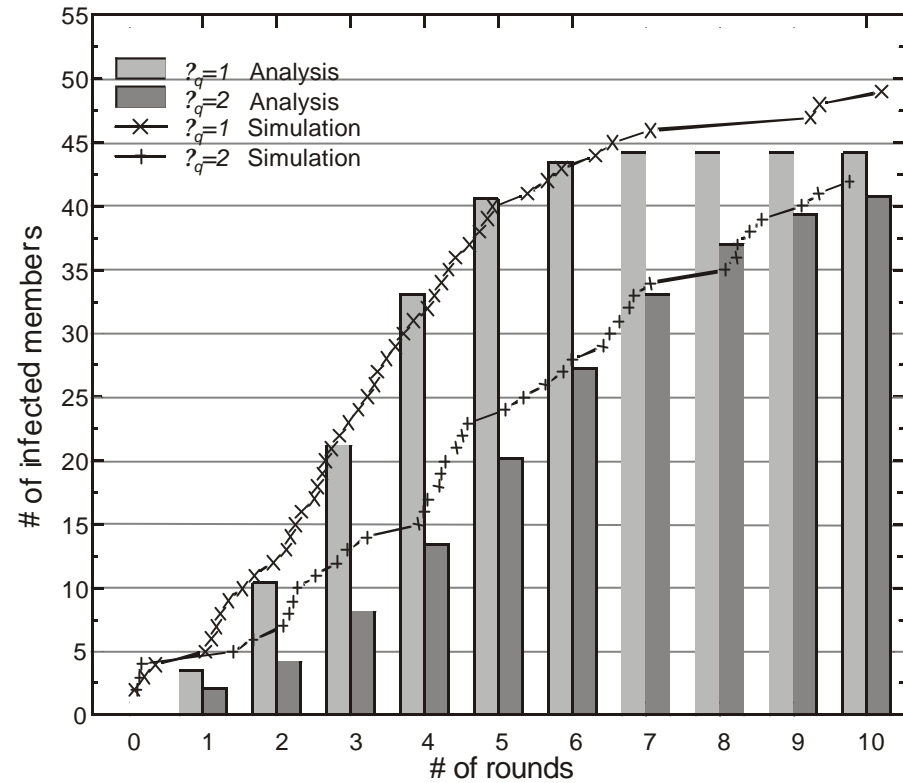
- ✍ **Simulator: *ns-2***
- ✍ **Network nodes are randomly distributed in a 1000m? 1000m square**
- ✍ **MAC: IEEE 802.11, 2Mbps, 250m nominal transmission range**
- ✍ **Mobility pattern: Random Way-point Model**
- ✍ **Traffic pattern: CBR with 64 bytes packet at a interval of 200ms. The gossip period 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



(a)

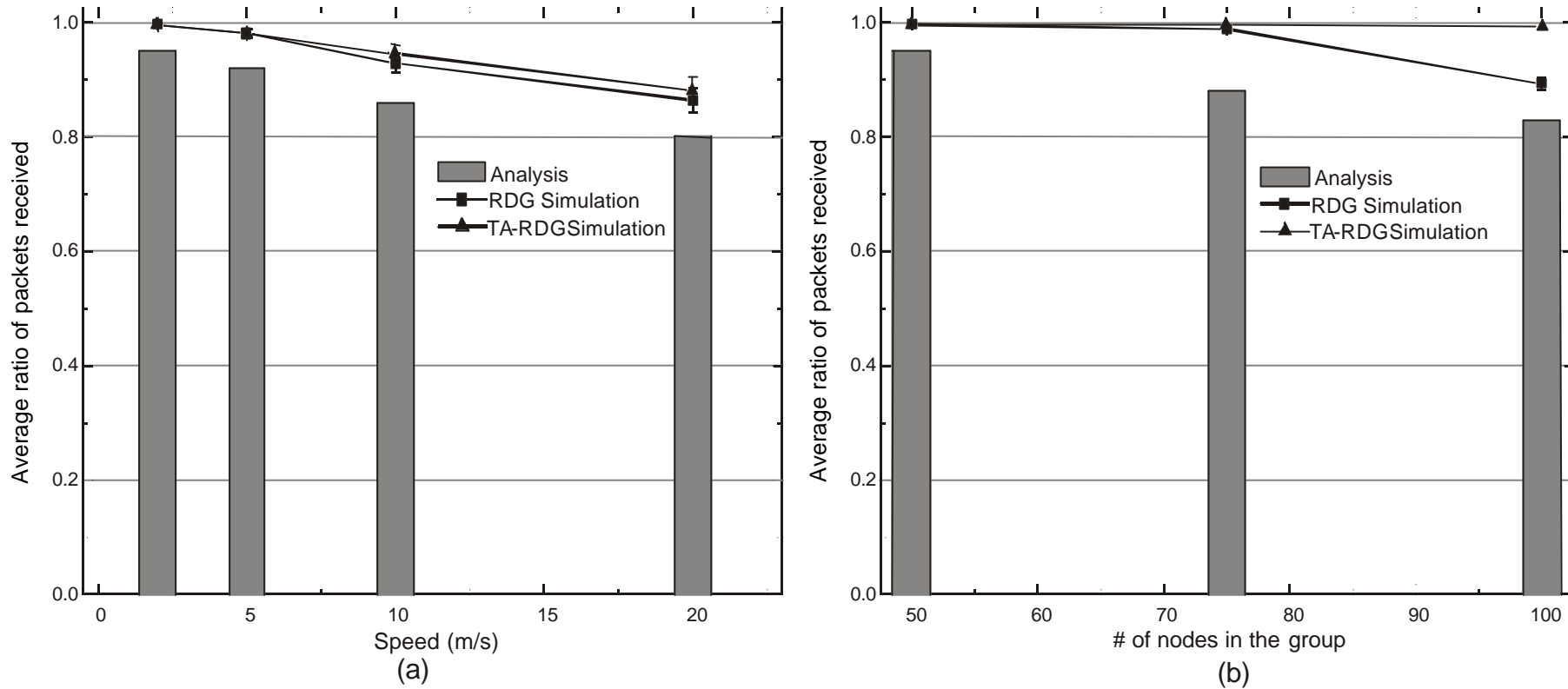


(b)

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 ?