
Robust and Scalable Geographic Multicast Protocol for Mobile Ad Hoc Networks

Lee Li-Wei

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Outline

- Introduction
- Related Work
- Robust and Scalable Geographic Multicast Protocol
- Performance Evaluation
- Conclusions

Introduction

- Group communications are important in Mobile Ad Hoc Networks (MANET)
- Overhead
 - Route searching
 - Group membership management
 - Tree/mesh structure maintenance

MANET unicast routing

- Geographic routing protocols
- Mobile nodes are aware of their own positions
- Source can obtain the destination's position
- Forwarding decision
 - Destination's position
 - One-hop neighbor's positions learnt from periodic beacons of the neighbors

Related Work

- Conventional topology-based multicast protocol
 - ODMRP (on-demand multicast routing protocol)
 - Maintenance of a tree-based multicast structure
 - Multicast packet forwarding
- Geographic multicast protocol
 - [6,7,8] is only applicable for small group
 - Packet header

Robust and Scalable Geographic Multicast protocol

- RSGM supports a two-tier membership management and forwarding structure
- RSGM assume every node is aware of its own position

pos: A mobile node's position (x,y)

zone: The network terrain is divided into square zones

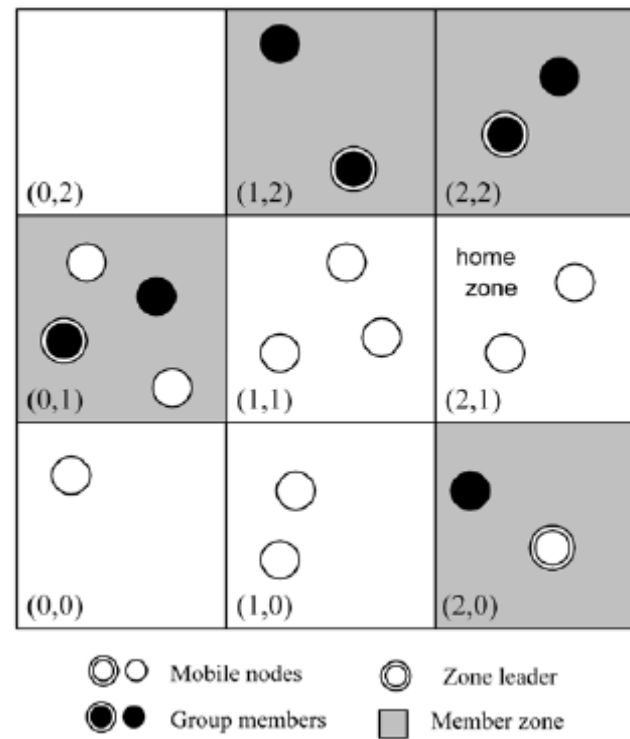
mZone: Member zone

zLdr: Zone leader

hZone: Home zone. To keep track of the addresses and locations of sources

mcastTable: A node records the multicast information in its mcastTable. A mcastTable contains a list of group entries and hZone information . Each group entry saves the information of a group: groupID, source list , member list , and mZone list

Zone Structure



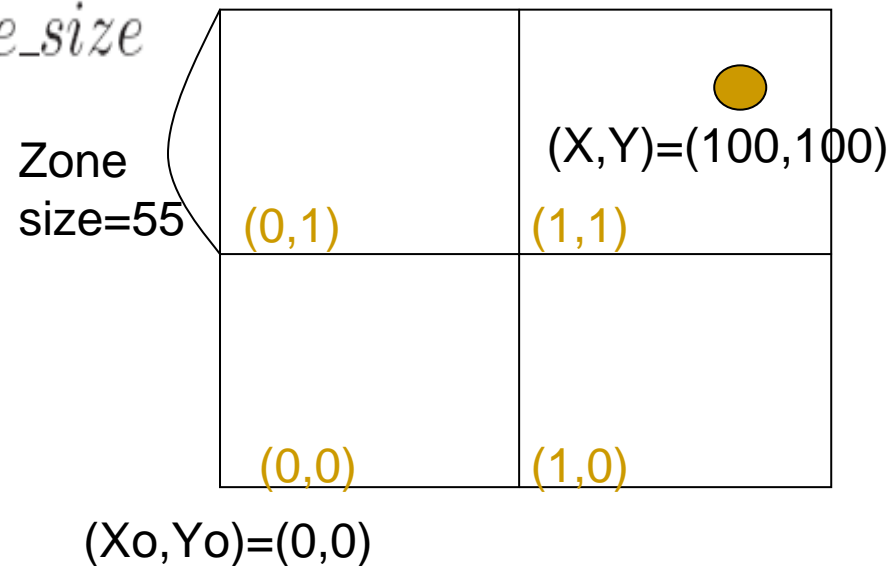
Zone Construction

$$a = \left\lfloor \frac{x-x_0}{zone_size} \right\rfloor = \lfloor (100-0)/55 \rfloor = 1 \quad \text{zID } (a,b) = (1,1)$$

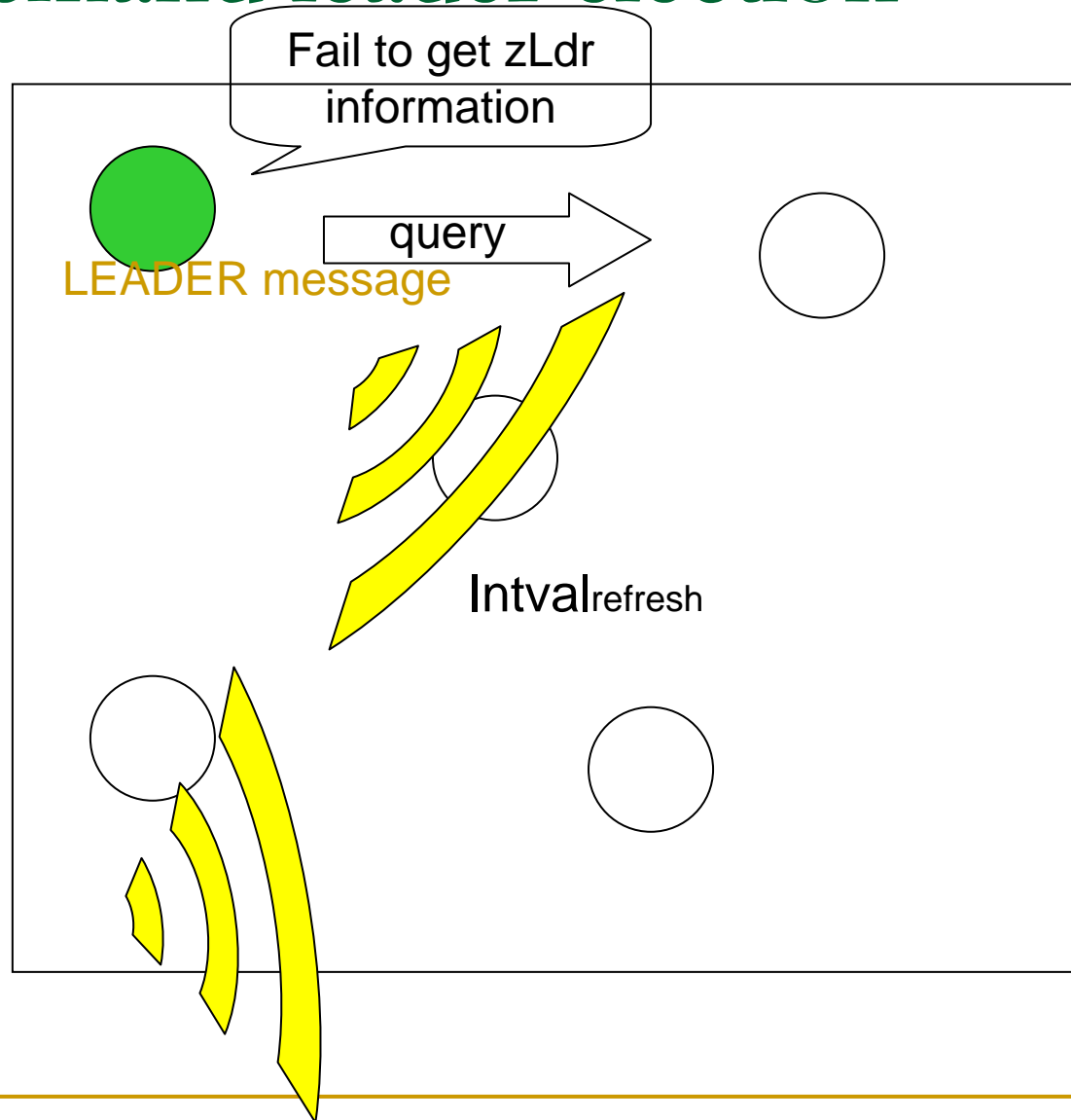
$$b = \left\lfloor \frac{y-y_0}{zone_size} \right\rfloor = \lfloor (100-0)/55 \rfloor = 1$$

$$x_c = x_0 + (a+0.5) \times zone_size$$

$$y_c = y_0 + (b+0.5) \times zone_size$$



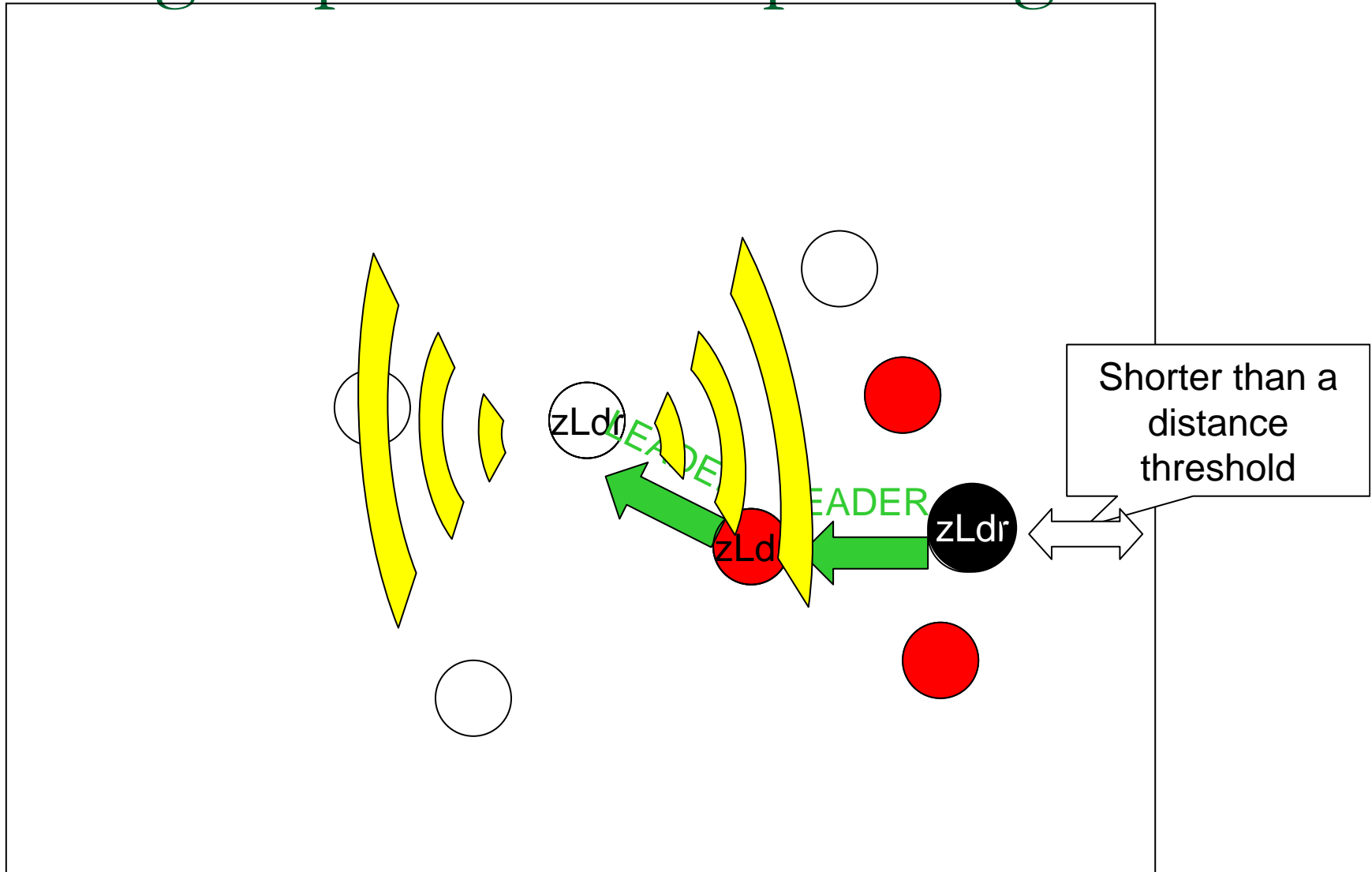
On-demand leader election



Local group membership management

- When joining or leaving a group, a member M sends a message REFRESH (groupIDs , pos_M) immediately to its zLdr to notify its membership change
- A member record will be removed by the zLdr if not refreshed for longer than $2 \times \text{Intval}_{\text{refresh}}$

Local group membership management

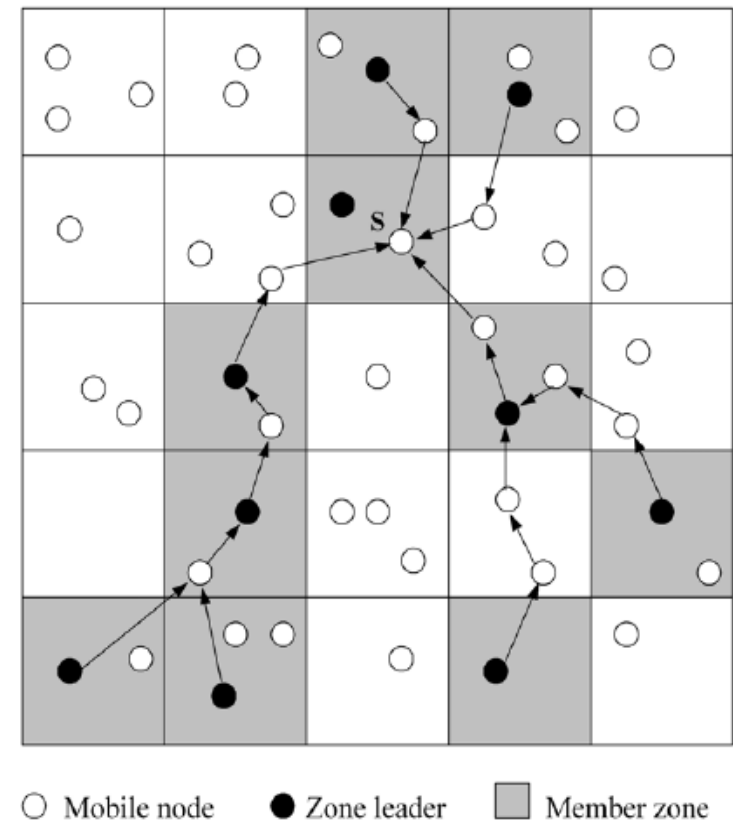


Membership management at network range

- When a zone changes from mZone to non_mZone or vice versa, zLdr sends a REPORT immediately to S to notify the change
- S will remove a mZone record if not refreshed longer than $2 \times \text{Intval}_{\text{zone}}$
- Empty zone handling

Message aggregation

- S schedules the periodic REPORT sending for the mZones. S inserts the next reporting time t into the data packets
- The zLdr of a mZone schedules its next periodic REPORT to S at the time $t + \Delta t$
- The zLdr will form an upstream and downstream relationship according to their distances to S

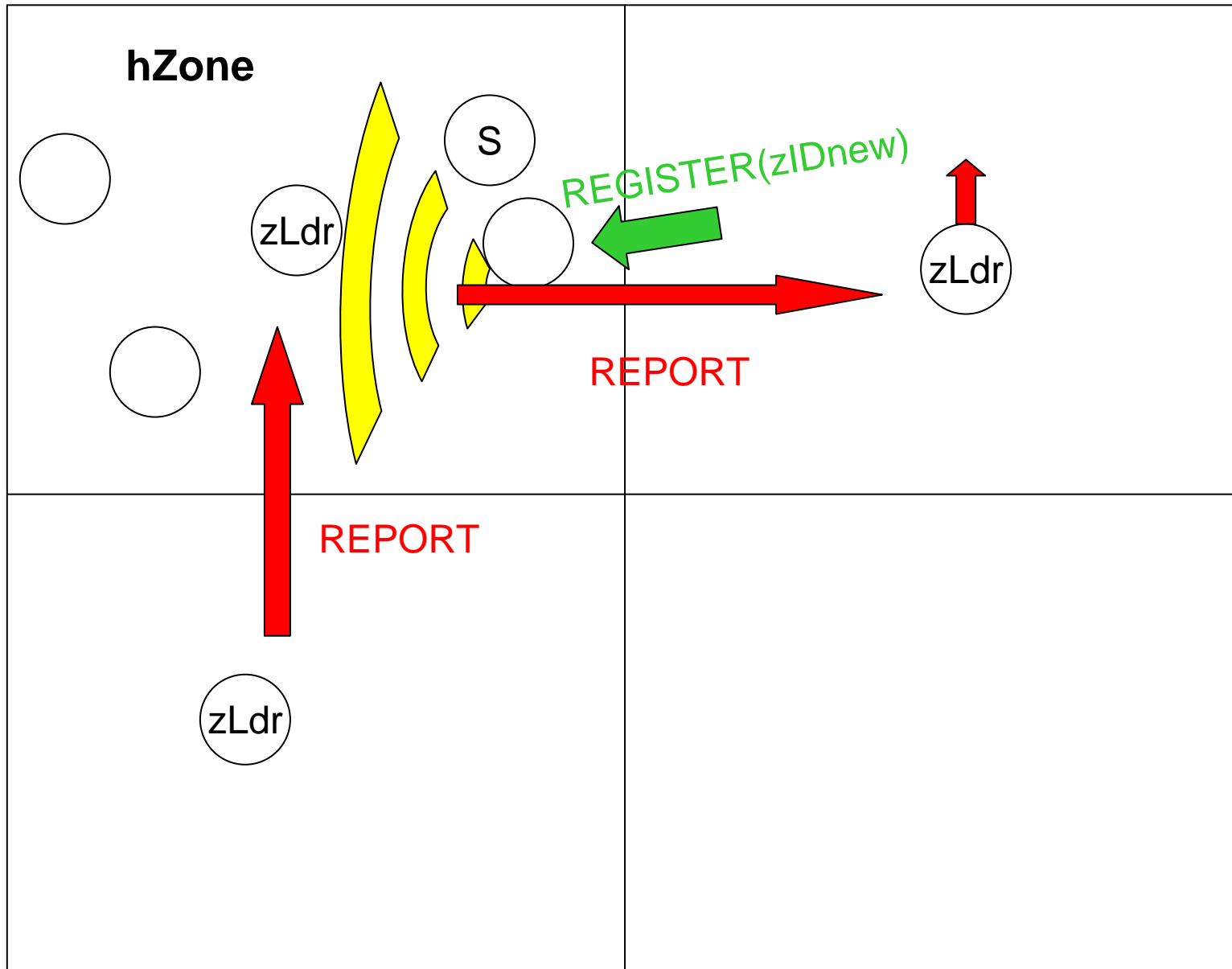


Session initialization

- To start a multicast session, S floods an ANNOUNCE (S, pos_S , groupIDs) into the network by broadcasting
- After session begins, S can piggybacks its position (pos_S) to the multicast packets sent out to refresh its position at the receivers

Source tracking

- S will announce its current zone as hZone by inserting its **zID** and **seqNO** of hZone in the ANNOUNCE to be flooded into the network
- Whenever a source moves to a new zone, it unicasts a REGISTER (zID_{new}) to hZone
- A zLdr will send REPORT to hZone if it doesn't know S's address or the source address maintained is outdated



Multicast Packet Delivery

- S sends each multicast packet to all the mZones , and to the member nodes in its own zone through zLdr
- For robust transmissions, geographic unicast is used in packet forwarding

Performance Evaluation

Beconing interval 4s

Intval_{zone} 6s

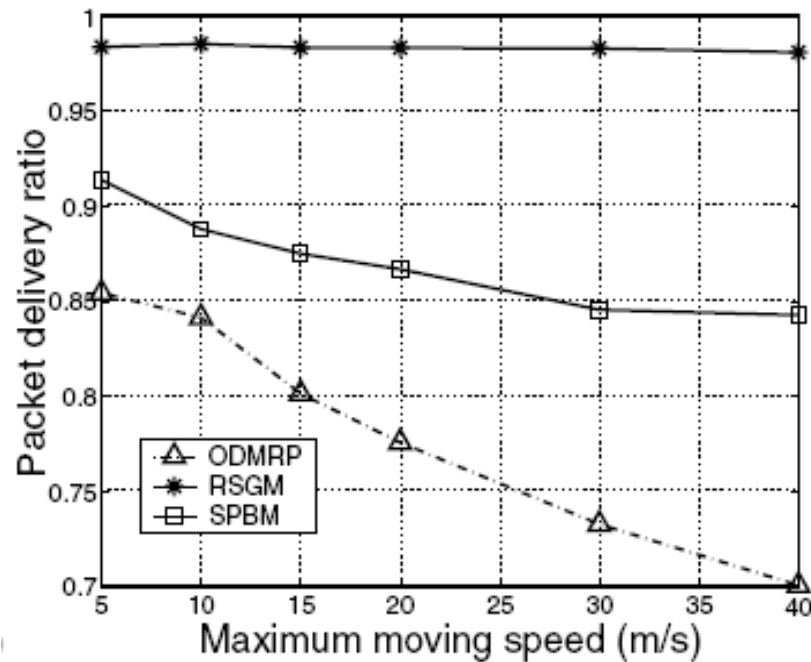
Intval_{refresh} 4s

400 random node

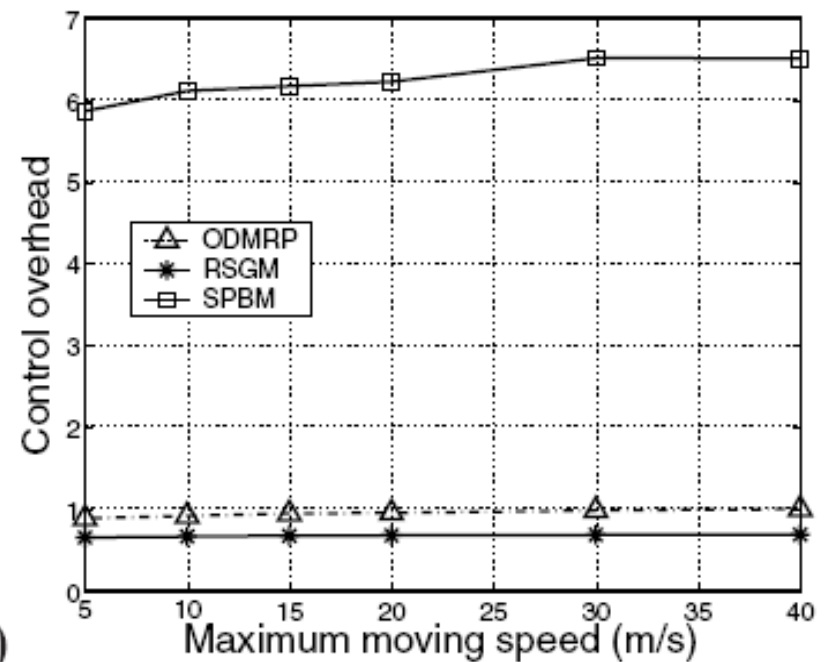
100 member node

Zone size 400 m

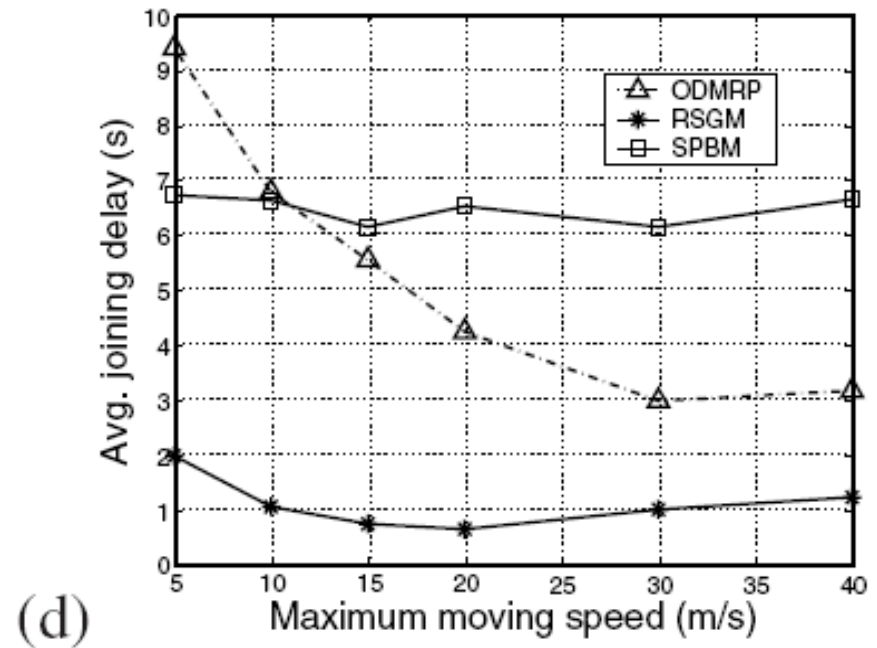
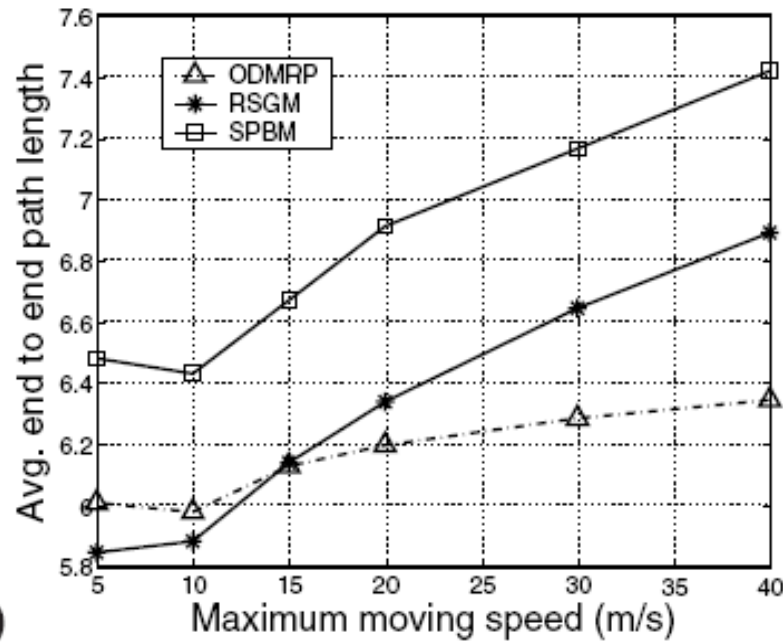
Area 2400m*2400m



(b)



Performance Evaluation



Conclusions

- In RSGM, both the data packets and control messages will be transmitted along efficient tree-shape paths without the need of maintaining a tree structure
- Scalable membership management is achieved through a zone structure
- A home zone can avoid the periodic network-range flooding of source information