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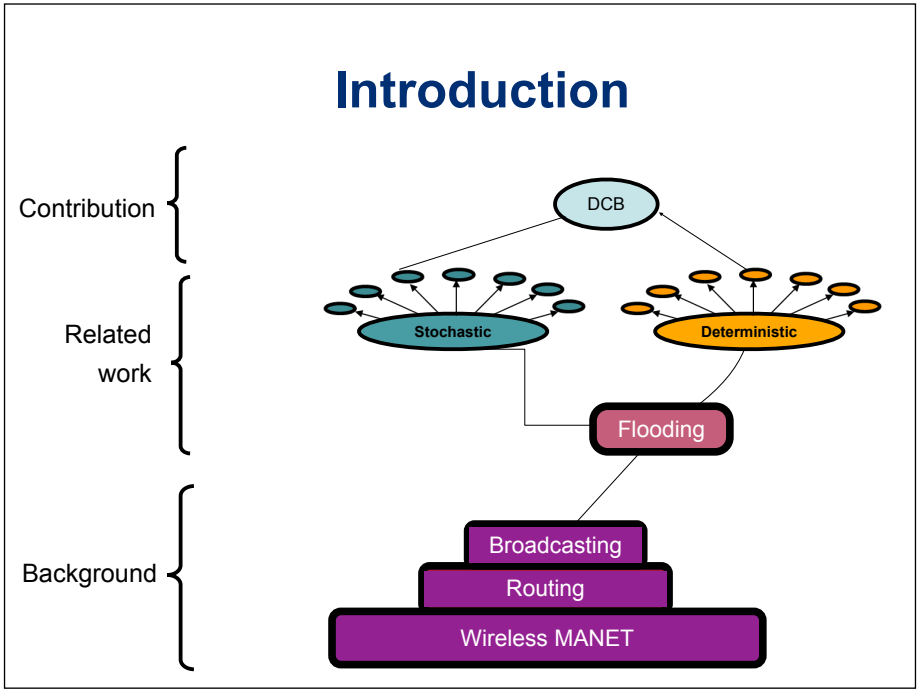
Dynamic Counter-Based Broadcast in MANETs

Sara Omar al-Humoud

Introduction



Outline

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- **MANETs**
- Broadcasting
- Fixed Counter-Based Broadcast
- Dynamic Counter-Based Broadcast
- Simulation and Results
- Questions

MANETs

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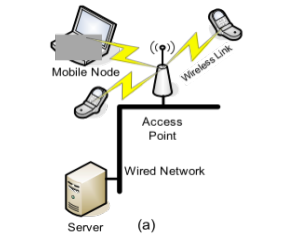
MANETs?

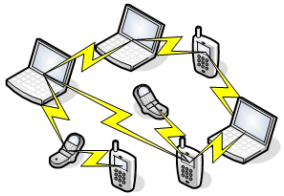
Decentralised

Dynamic topology

Radio communication

Energy constrained





Wireless Local Area Networks.
(a) Infrastructure-based wireless network (b) ad hoc wireless network.

MANET Applications

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Military applications

Collaborative and distributed computing

Inter-Vehicle Communications

Emergency operations

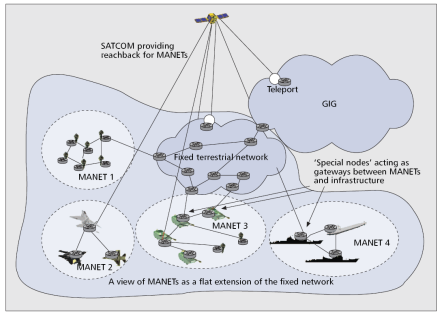

Figure 2. *A view of MANETs as a flat extension of the network infrastructure.*

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Broadcasting

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Broadcasting is the process by which a given node sends a packet to all other nodes in the network:

- Discovering neighbours
- Collecting global information
- Addressing
- Helping in multicasting and Unicast
- Route discovery, route reply, in on-demand routing protocols like DSR, AODV to broadcast control messages

Conventionally broadcast is done through **flooding**

Broadcast by Flooding

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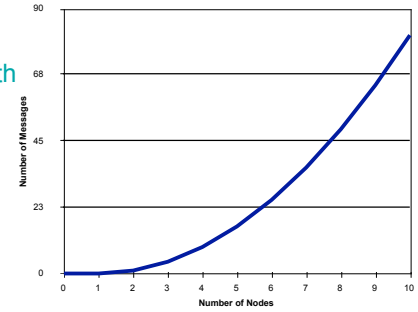
Flooding may lead to

- Redundancy
  - x Consume limited bandwidth
- Contention
  - x Increase in delay
- Collision
  - x High packet loss rate
- Broadcast storm problem!



$$f(n) = n^2 - 2n + 1$$

Stochastic Broadcasting Methods

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Probability-based

Rebroadcast with probability P

Counter-based

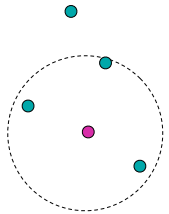
Rebroadcast if the node received less than C_{th} copies of the msg

Location-based

Rebroadcast if the area within the node's range that is yet to be covered by the broadcast > A_{th}

Distance-based

Rebroadcast if the node did not receive the msg from another node at a distance less than D_{th}



Simple Implementation
RD based on instantaneous information from broadcast msgs

Deterministic Broadcasting Methods

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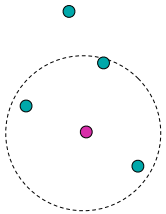
Self-pruning

Scalable broadcasting

Dominant Pruning

Cluster-based



Elaborate Implementation
Rebroadcast decision based on neighbourhood study

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Counter-Based Broadcast

When receiving a message:

- counter ***c*** is set to keep track of number of duplicate messages received.
- Random Assessment Delay (RAD) timer is set.
- When the RAD timer expires the counter is tested against a fixed threshold value ***C***, broadcast is inhibited if **c > C**.

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Dynamic Counter-Based Broadcast

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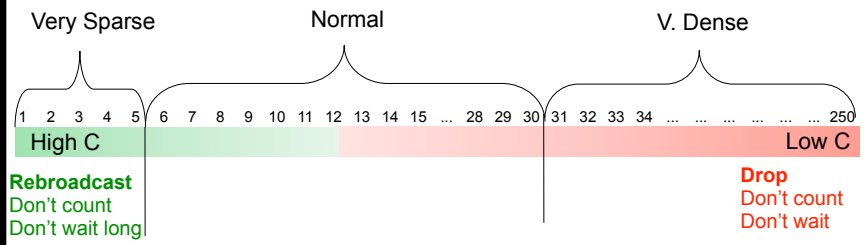
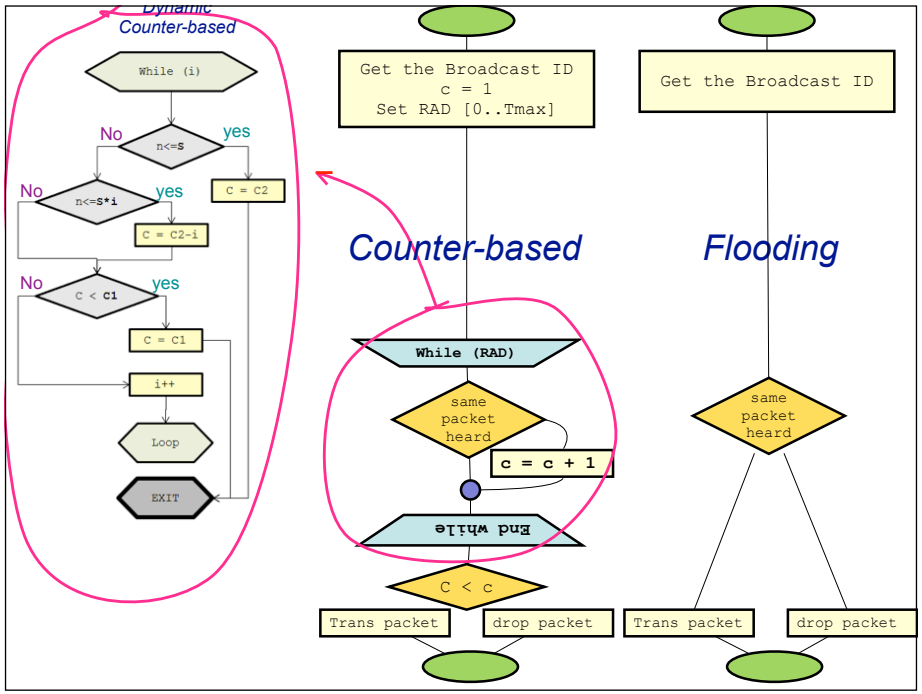
combines both techniques

Stochastic: counter threshold

Deterministic: neighbour-knowledge




Dynamic
Counter-based
While (i)
No
n<=S
yes
C = C2
No
n<=S*i
yes
C = C2-i
No
C < C1
yes
C = C1
i++
Loop
EXIT
Get the Broadcast ID
c = 1
Set RAD [0..Tmax]
Counter-based
While (RAD)
same packet heard
c = c + 1
End while
C < c
Trans packet
drop packet
Get the Broadcast ID
Flooding
same packet heard
Trans packet
drop packet

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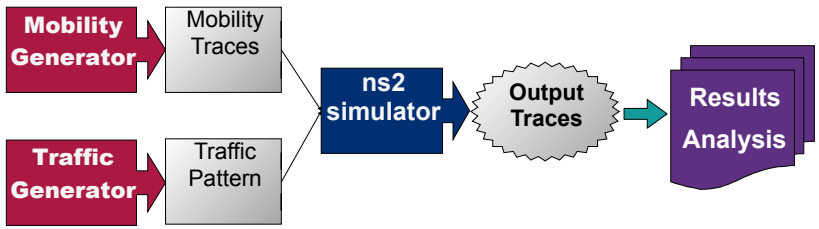
Simulation Environment



Simulation Parameters

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Simulation parameter	Value
Simulator	ns-2 (version 2.33)
Network Area	1000x1000 meters^2
Transmission range	100 meters
Simulation Time	900 sec
Number of Trials	30
MAC layer protocol	IEEE 802.11b
Maximum Nodal Speed	8 (m / sec) = 28.8 km / hour
Confidence interval	95%
Mobility Models	Random Way Point Manhattan Mobility Model Reference Point Group Mobility Model

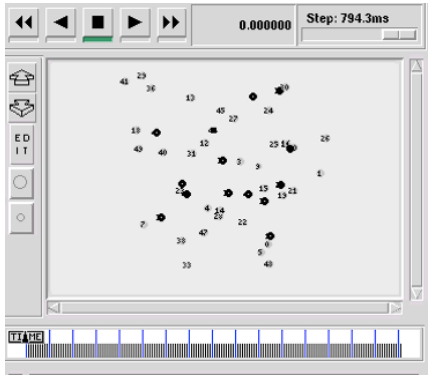
Mobility Models

Random Way Point

How it works?

at every instant, a node randomly chooses a destination

and moves towards it with a velocity chosen uniformly randomly from $[0,V_{max}]$



50 nodes

Mobility Models

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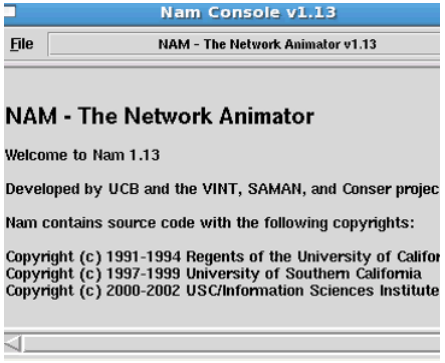
Manhattan Mobility Model

Geographic restrictions on node mobility

Depend on maps

Map: horizontal and vertical streets

At an intersection of a horizontal and a vertical street, the mobile node can turn left, right or go straight

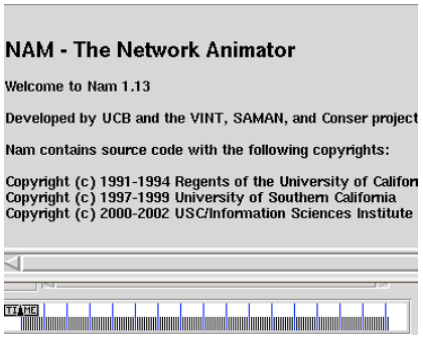


50 nodes

Mobility Models

Reference Point Group Mobility Model

- **Military, touring groups**
- Group: has a logical centre (group leader) that determines the group's motion behaviour
- Each node **deviates** its velocity (both speed and direction) randomly from that of the leader.
  - Number of groups
  - Speed Deviation
  - Angle Deviation
  - Leader mobility trace



10

$$V_{member}(t) = V_{leader}(t) + random() * SDR * max\_speed$$
$$theta_{member}(t) = theta_{leader}(t) + random() * ADR * max\_angle$$

SDR: Speed Deviation Ratio ADR: is the Angle Deviation Ratio.

Mobility Models

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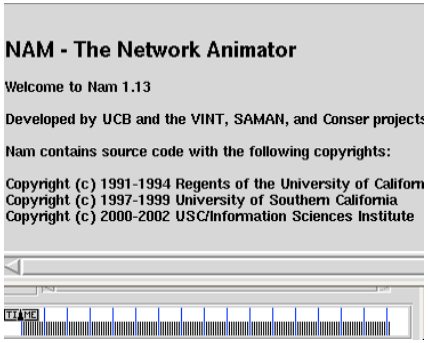

30

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Performance metrics

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Saved Rebroadcast

(r − t)/r : how much a node saves packets (not rebroadcast)?

- *r* = number of hosts receiving the broadcast message
- *t* = number of hosts that actually transmitted the message.

Reachability

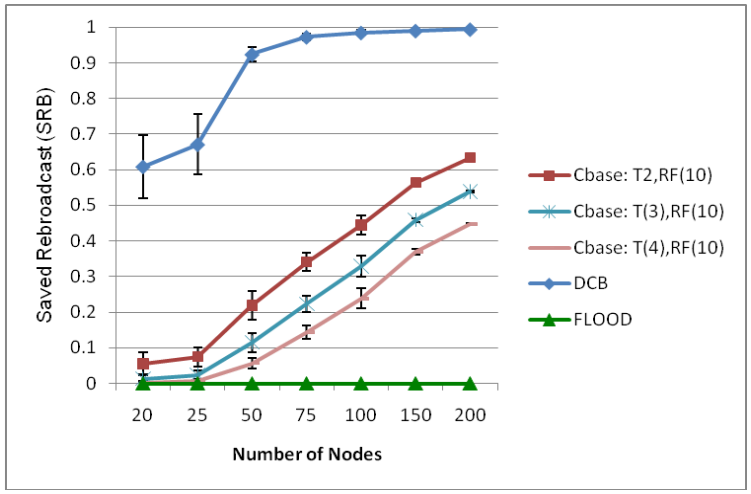
r/e: what is the percentage of nodes delivering packets successfully?

- *r* = number of hosts receiving the broadcast packet
- *e* = number of reachable mobile hosts, directly or indirectly, from the source host .

Average latency ***how long it takes a packet to be delivered?***

the interval from the time the broadcast was initiated to the time the last host finished its rebroadcasting.

Simulation results



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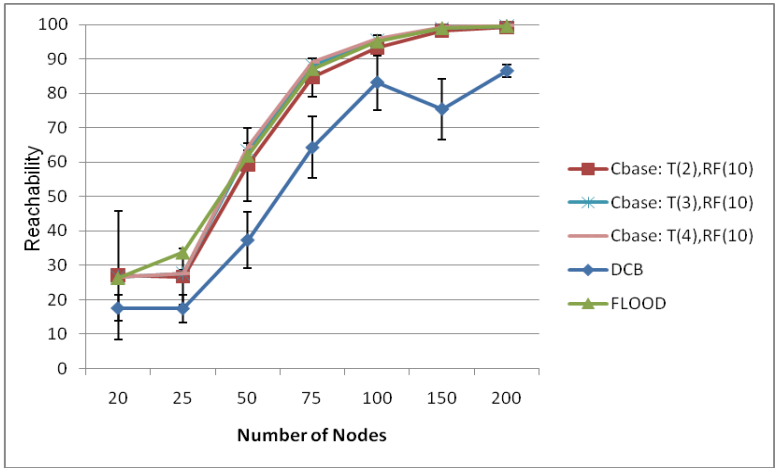

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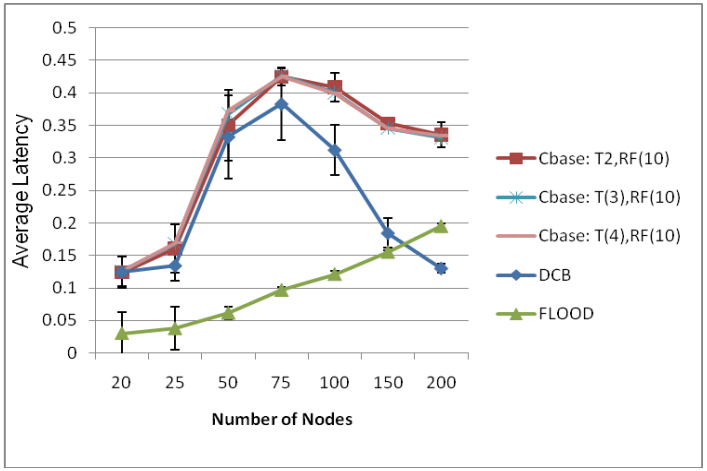

Conclusions and Future Directions

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DCB broadcasting scheme
gain in SRB (+62%)
slight loss in reachability (-14%)
some gain (+8%) in average latency

Questions

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Thank you!

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