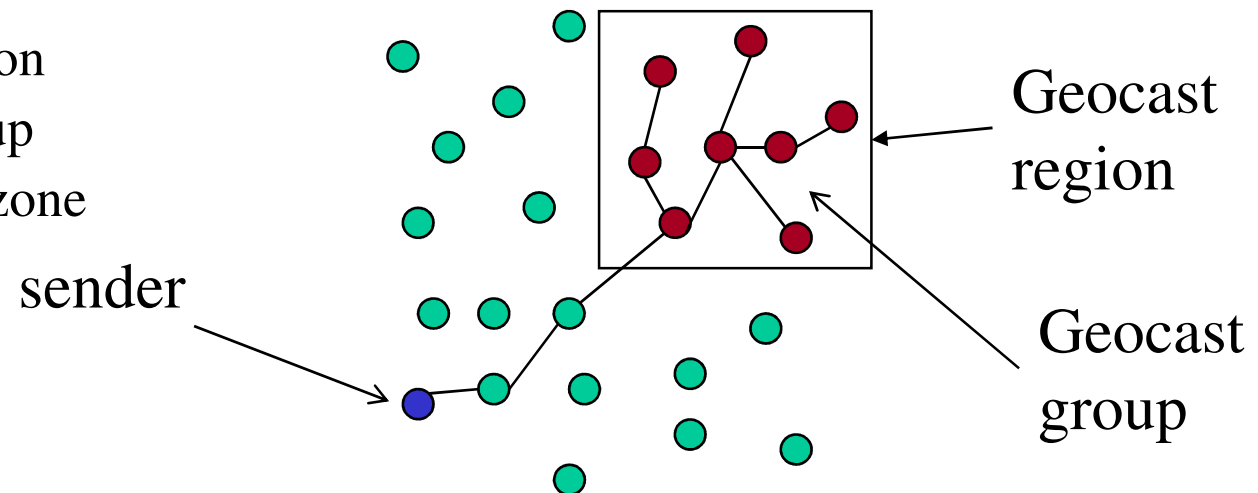# Comparison/survey of different geocasting protocols

Introduction to Geocasting

- Sending a message to everyone in a specified geographical region

- Geocast region
- Geocast group
- Forwarding zone

sender

Geocast region

Geocast group

- Assumptions:
    - Each node has available its own location
    - Whenever a node in the geocast region receives a geocast packet, it will flood the geocast packet to all its neighbors

Categories of the Geocast Routing Protocols

Based on how they transmit information from a source to one or more nodes in the geocast region

- **Data-transmission oriented protocols** (flooding or a variant of flooding to forward geocast packets from the source to the geocast region)
  - Location Based Multicast (LBM) algorithm
  - Voronoi diagram based geocasting
  - GeoGRID
- **Routing-based protocols**(No flooding; create routes from the source to the geocast region via control packets, or other variations)
  - GeoTORA
  - Unicast Routing w/ Area Delivery (URAD)
  - Geographic forwarding Geocast (GFG),
 - Geographic forwarding perimeter Geocast (GFPG)

Location-Based Multicast (LBM)

- It is based upon a flooding with this modification:
  - a node determines whether to forward a geocast packet further via one of two schemes
    - Scheme1: Fixed/adaptive Rectangular forwarding zone (FRFZ, ARFZ)
    - Scheme2: Progressively Closer Nodes (PCN)
- Performance Evaluation:
  - Consistently lower number of packets transmitted than simple flooding and so overhead is lower
- Pros and Cons:
  - Reduced overhead than simple flooding
  - Very simple to implement
  - Not as accurate as simple flooding

Y.Ko & Vaidya. Location Aided Routing (LAR) in mobile Ad hoc networks
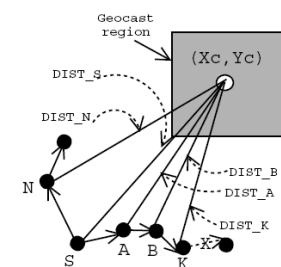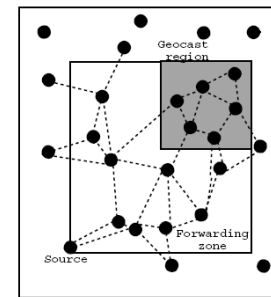
Voronoi Diagram Based Geocasting

- The goal of this protocol is to increase/maintain the success rate and decrease the hop count and flooding rate of LBM

- The definition of the forwarding zone of the LBM is modified:
  - The neighbors of a node that are located within the forwarding zone are those neighbors that are closest in the direction of the destination

- The "best choice" neighbors are determined by intersecting the Voronoi diagram of neighbors with the expected zone for the destination
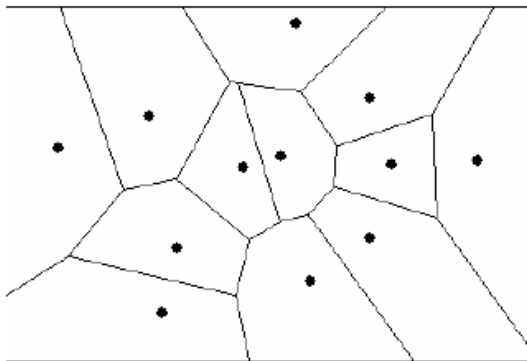
Voronoi diagram
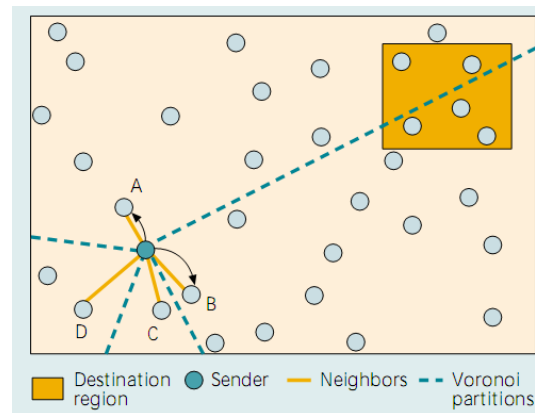
Voronoi diagram based geocasting
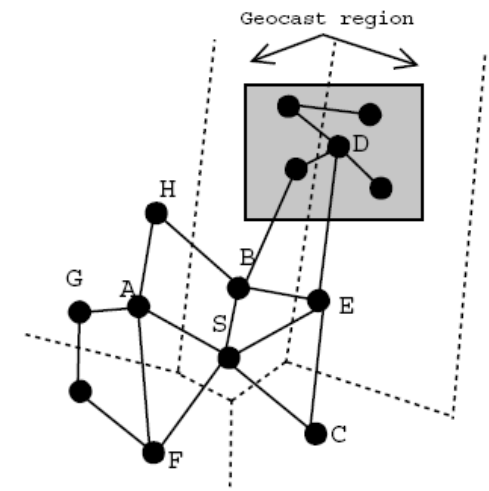
Performance Evaluation, Pros and Cons

- This algorithm reduce the flooding rates of LBM Scheme 1 as fewer packets should be transmitted, but it offers little improvement over LBM Scheme 2

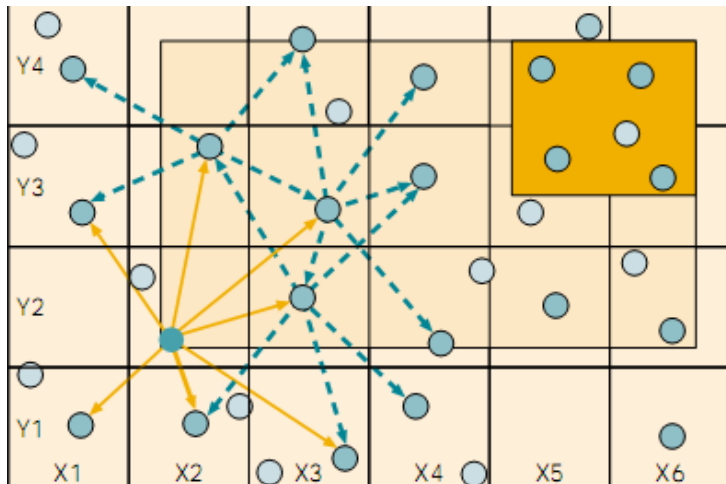- A bit more complicated than the LBM algorithm but provides better performance (lower overhead)than LBM

I. Stojmenovic, 'Voronoi diagram and convex hull based geocasting and routing in wireless networks'

GeoGrid protocol

- Properties:
  - It is based on the unicast protocol GRID
  - It partitions the geographic area of the MANET into 2D logical grids; each grid is a square of size dxd
  - it uses location information, which defines the forwarding zone, and
  - it elects a special host (i.e, *gateway*) in each grid area and <u>only</u> the gateway is responsible for forwarding the geocast packets
  - Two types:
    - Flooding based
    - Ticket based

W.H.Liao, Y.C.Tseng, L.Lo, and P.Sheu. Geogrid: A geocasting protocol for MANETs
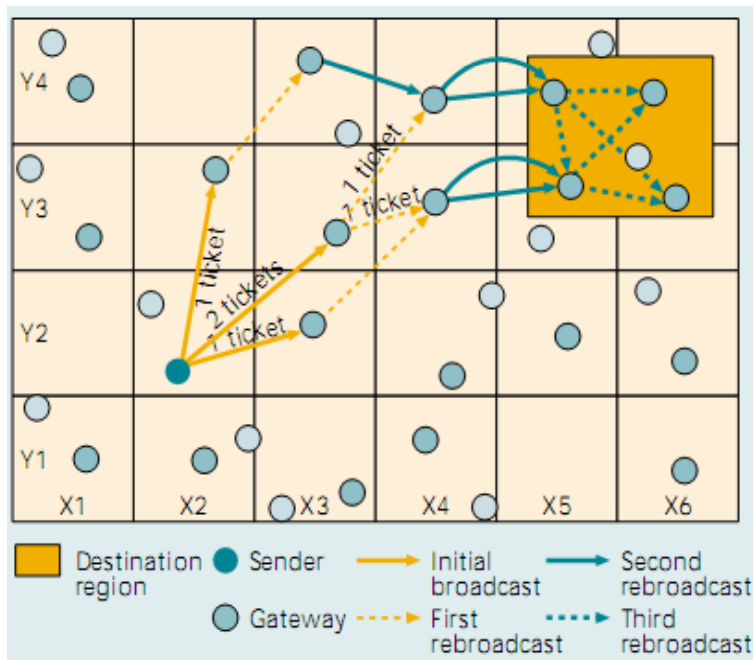
- Flooding-Based GeoGRID
  - Only gateways in every grid within the forwarding zone will rebroadcast the received geocast packets
    - Thus gateway election becomes the key point of this protocol

Ticket-Based GeoGRID
  - The geocast packets are still forwarded by gateway nodes
    - but not all the gateways in the forwarding zone will forward each geocast packet
  - m+n tickets are created by the source
    - if the geocast region is a rectangle of *mxn* grids
  - The source then evenly distributes the m+n tickets to the neighboring gateway nodes in the forwarding zone that are <u>closer</u> to the geocast region than the source

Gateway Election
  - Both the Flooding-Based and the Ticket-Based methods need a gateway election
    - When a gateway needs to be elected, the mobile host nearest to the physical center of a grid is elected
    - Once this node is elected, it remains the gateway until it moves out of the grid

Performance Evaluation, Pros and Cons

- GeoGRID performs better than LBM when MANET is crowded due to collisions from flooding

- The two GeoGRID protocols should offer both higher accuracy and lower delivery cost than LBM or Voronoi due to fewer packets that are transmitted in GeoGRID

- The paper does not address as to why there are m+n tickets are initially created.

Routing-based Geocasting

- Flooding data packets may cause a *storming* effect giving serious redundancy, contention and collision problems
- Its advantage is the reduced overhead in the transmission of data packets
- Its disadvantage is that it requires more latency and control overhead to create routes
- Examples:
  - **GeoTORA**
  - **GFG, GFPG**
  - **URAD (uses GPSR just like GFG and GFPG but does not include face routing)**

GeoTORA

Based on TORA (Temporally Ordered Routing Algorithm) [Park and Corson 97]
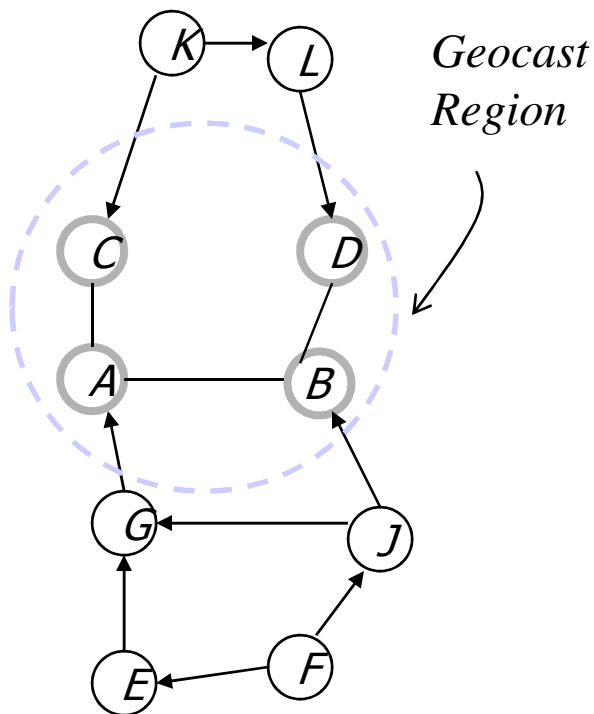
- Unicast routing algorithm for MANETs
- *Destination-oriented* directed acyclic graphs (DAGs)
- Uses "Link-Reversal" techniques to maintain DAGs
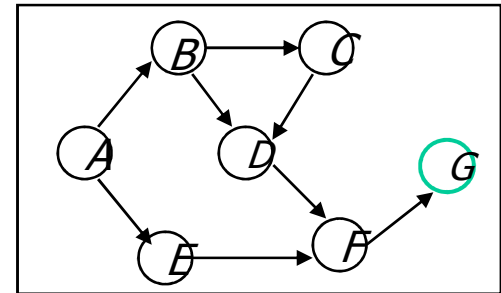
GeoTORA

- Modify TORA to do anycasting
- Modify further to do geocasting

GeoTORA

- All nodes within a specified geocasting
  region are made sinks

- Maintain a single DAG for a given
  geocast group

- Source first performs an *anycast*
  to the geocast group members

- When a group member receives
  a packet, it *floods* it within the
  geocast region

Geocast Region

Y. Ko and N. Vaidya. GeoTora: A protocol for geocasting in MANETs

Performance Evaluation of the GeoTORA

- Its accuracy is high, but not as high as pure flooding or LBM
  - This is because only one node in the geocast region receives the geocast packet from TORA and if that node is partitioned from other nodes in the geocast region, accuracy will reduce
- The overhead is relatively small, compared to data-transmission oriented approaches

GFG and GFPG

- Geographic Forwarding
  - uses greedy forwarding and perimeter routing to route around dead ends until closer nodes to destination are found.
  - Very effective in dense networks and where there are no gaps, partitions.
- Geographic Forwarding Perimeter
  - Able to circumvent the gap problem
  - Very effective in all situations even when there are gaps in the geocast region.
- Both are very low on overhead and almost 100% on delivery ratio.
- **GFPG***
  - For efficiency send perimeter packets only when there is suspicion of a gap – low overhead @ high density; overhead increases only slightly to ensure perfect delivery
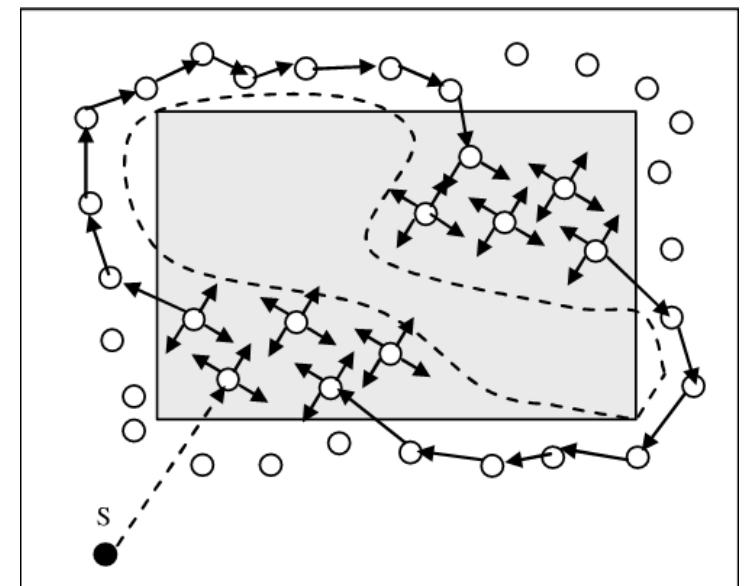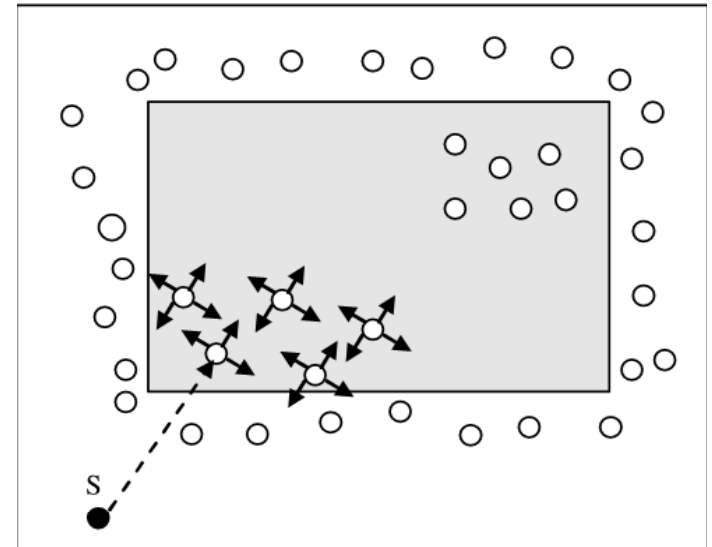
Comparison
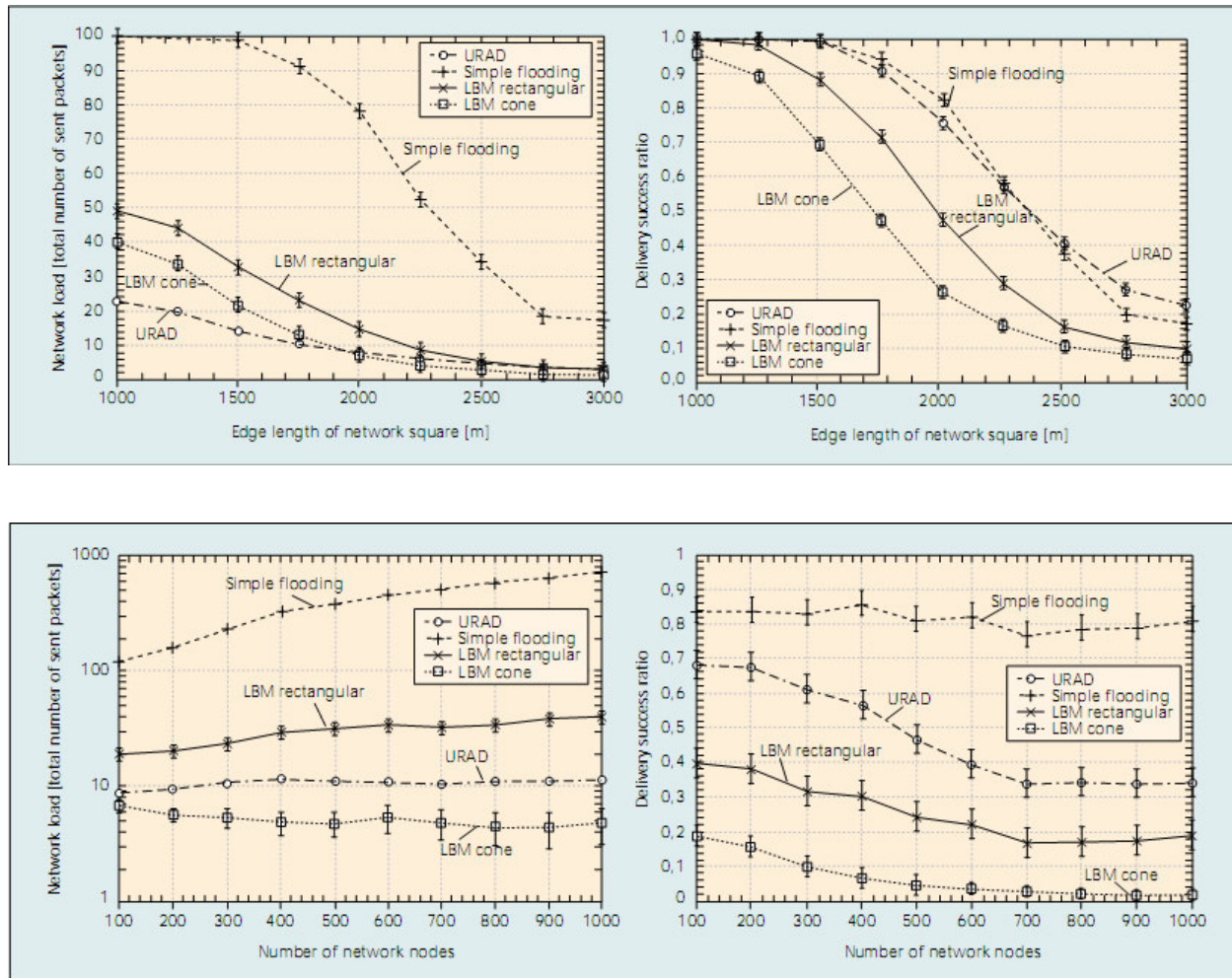
Simulation results from 'Survey of Geocast Routing Protocols', by *Christian Maihofer.*
IEEE Communication surveys, Second Qtr, 2004

Results, analysis & conclusion

- Simplicity:
    - Basic Flooding and LBM are the simplest to implement
- Scalability:
    - GFPG* has high scalability as shown
    - GeoTORA has high scalability when sent several times
    - GeoGRID varies from low to high depending on mobility
    - LBM, Voronoi fare medium while flooding has low scalability
- Memory requirement:
    - GeoTORA has a medium memory requirement where as others have low requirement; flooding has none
- Robustness:
    - Flooding, LBM, Voronoi vary from medium to high based on network congestion
    - GeoTORA has medium robustness
- Guaranteed delivery:
    - Theoretically and assuming ideal wireless conditions and a connected network, simple flooding and GFPG* guarantees delivery