

# Landmark Guided Forwarding

[Extended Abstract for <http://www.cl.cam.ac.uk/~mh128/LGFwd.pdf>]

M H Lim, J Crowcroft  
University of Cambridge  
Computer Laboratory  
William Gates Building  
15 JJ Thomson Avenue  
Cambridge CB3 0FD  
(mh128,jac22)@cl.cam.ac.uk

A Greenhalgh  
University College London  
Computer Science  
Department  
Gower Street  
London WC1E 6BT  
A.Greenhalgh@cs.ucl.ac.uk

A Campbell  
Columbia University  
Department of Electrical  
Engineering  
1312 Seeley W. Mudd Bldg.  
New York, NY 10027-6699  
campbell@comet.columbia.edu

Many wireless Ad Hoc routing protocols have been proposed in recent years. However, none of these is ready for wide area deployment. An early survey paper by Elizabeth Royer categorized these protocols as table driven or source driven. In general, table driven protocols pro-actively gather topological routing information while source driven protocols reactively discover a route or routes to the destination as requested by the source. Pro-active routing protocols such as DSDV, Destination Sequenced Distance Vector, pro-actively exchange routing information between neighboring nodes. The associated routing state and the network traffic overheads is  $O(n)$ , where  $n$  is the number of nodes in the network, which does not scale well in large networks. Reactive routing protocols such as DSR, Dynamic Source Routing, use flooding techniques to discover new routes and repair existing routes. As the amount of traffic in the network increases or the diameter of the network increases, the cost of flooding increases. With reactive routing protocols the routing performance degrading under moderate mobility conditions.

An alternative approach to Ad Hoc routing is to take advantage of the physical location of nodes in the network and to do position based forwarding. An assumption made by protocols that take this approach is that every node knows its own geographical position. By limiting the exchange of positional information to only between adjacent nodes, the state and network overheads are reduced to  $O(u)$ , where  $u$  is number of adjacent nodes. GPSR, Greedy Perimeter Stateless Routing, is a position based routing protocol that in general uses the geographically closest node to the destination as the next hop for the packet to be forwarded. This technique can result in a sub optimal path between source and destination. To address situations where a packet is required to traverse away from the destination to circle around

a void, GPSR uses a perimeter forwarding scheme that uses the well known right hand rule on its planarised graphs. Although GPSR scales well and adapts to random topologies, suboptimal routing is still an issue to be resolved.

These observations lead us to the position that the lack of topological knowledge results in sub-optimal position based forwarding. We agreed with the reasoning of the distance effect from DREAM, which demonstrates that the update frequency from remote nodes can be reduced without compromising the routing accuracy. Moreover, connectivity in wireless Ad Hoc network is unpredictable hence it is therefore realistic to restrict the propagation of route information while considering scalability issue.

Based on these arguments, we propose a protocol that is a hybrid of position and topological based routing. Each device maintains distance vector and position information of other nodes within its local area. The size of the local area is dynamically scoped depending upon the node density and the transmission range of the device. Inside the local area packets are routed based on the distance vector information, outside the local area routing is based upon the position of the destination. A packet destined for outside the local area is routed using the shortest path algorithm to the node in the area that is physically closest to the destination. Upon receiving the packet, the node determines whether it is inside or outside its local area. If it is inside its local area it is routed to the final destination using the shortest path algorithm. If it is outside the area the process is repeated. Preliminary results show of our implementation scale better than DSDV. By extending the scoped topological view into position based routing, we envisage our routing protocol should have better foresight and performance than generic position based routing. Other protocols are yet to be investigated.