ISSN:2231-0711

**G.V.Sai Aravind et al | IJCSET |September 2013 | Vol 3, Issue 9, 312-317**

# A Study on Scalable Routing Protocol for Ad Hoc Networks

G.V.Sai Aravind , Dr Syed Umar
*Department of ECM,*
*KL University, A.P., INDIA.*

*Abstract*— **The growing interest in Mobile Ad Hoc Network techniques has resulted in many routing protocol proposals. Scalability issues in ad hoc networks are attracting increasing attention these days. In this paper, we will survey the routing protocols that address scalability. The routing protocols we intend to include in the survey fall into three categories: (1) flat routing protocols, (2) hierarchical routing approaches, and (3) GPS augmented geographical routing schemes. The paper will compare the scalability properties and operational features of the protocols and will discuss challenges in future routing protocol designs.**

*Keywords*— **Mobile ad hoc networks, ad hoc routing, scalable routing, scalability, proactive routing, on-demand routing, hierarchical ad hoc routing, geographic position assisted routing.**

## I. INTRODUCTION

With the advance of the wireless communication technologies, small size and high performance computing and communication devices have been increasingly used in daily life and computing industry (e.g., commercial laptops and personal digital assistants equipped with radios). In this paper, we consider a large population of such devices wishing to communicate tetherlessly. While the infrastructure cellular system is a traditional model for mobile wireless network, here we focus on a network that does not rely on a fixed infrastructure and works in a shared wireless media. Such a network, called a *mobile ad hoc network (MANET)* [1], is a self-organizing and self-configuring multi-hop wireless network, where the network structure changes dynamically due to member mobility. Ad hoc networks are very attractive for tactical communication in military and law enforcement. They are also expected to play an important role in civilian forums such as convention centers, conferences, and electronic classrooms. Nodes in this network model share the same random access wireless channel. They cooperate friendly to engage in multiple-hop forwarding. Each node functions not only as a host but also as a router that maintains routes to and forwards data packets for other nodes in the network that may not be within direct wireless transmission range. Routing in ad hoc networks faces extreme challenges from node mobility dynamics, potentially very large number of nodes, and limited communication resources (e.g., bandwidth and energy).The routing protocols for ad hoc wireless networks have to adapt quickly to frequent and unpredictable topology changes and must be parsimonious of communications and processing resources. Due to the fact that bandwidth is scarce in MANET nodes and that the population in a MANET is small, as compared to the wire line Internet, the scalability issue for wireless multi-hop routing protocols is mostly concerned with excessive routing message overhead caused by the increase of network population and mobility. Routing table size is also a concern in MANETs because large routing tables imply large control packet size hence large link overhead. Routing protocols generally use either distance-vector or link-state routing algorithms [2]. Both types find shortest paths to destinations. In distance-vector routing (DV), a vector containing the cost(e.g., hop distance) and path (next hop) to all the destinations is kept and exchanged at each node. DV protocols are generally known to suffer from slow route convergence and tendency of creating loops in mobile environments. The Link-state routing(LS) algorithm overcomes the problem by maintaining global network topology information at each router through periodical flooding of link information about its neighbors. Mobility entails frequent flooding. Unfortunately, this LS advertisement scheme generates larger routing control overhead than DV. Ina network with population N, LS updating generates routing overhead in the order of O(N2). In large networks, the transmission of routing information will ultimately consume most of the bandwidth and consequently block applications, rendering it unfeasible for bandwidth limited wireless ad hoc networks. Thus reducing routing control overhead becomes a key issue in achieving routing scalability. In some application domains(e.g., digitized battlefield) scalability is realized by designing a hierarchical architecture with physically distinct layers (e.g., point-to-point wireless backbone) [3]. However, such physical hierarchy is not cost-effective for many other applications (e.g. sensor networks). Thus, it is important to find solutions to the scalability problem of a homogeneous ad hoc network strictly using scalable routing protocols. The scalability is more challenging in the presence of both large numbers and mobility. If nodes are stationary, the large population can be effectively handled with conventional hierarchical routing. In contrast, when nodes move, the hierarchical partitioning must be continuously updated. Mobile IP solutions work well if there is a fixed infrastructure supporting the concept of the ”home agent”. When all nodes move (including the home agent), such a strategy cannot be directly applied. A considerable body of literature has addressed research onrouting and architecture of ad hoc networks. Relating to the problem describe above, we present a survey with focus on solutions towards scalability in large populations that are able to handle mobility. Classification according to routing strategy ,i.e., proactive (or, table-driven) and reactive (or, on-demand),has been used in other papers [4], [6], [12], [25], [26]. Different from that, we provide here a classification according to the network structure underlying routing protocols. Different structures affect the design and operation of the routing protocols. Different structures also determine the performance with regards to scalability.

## II. ROUTING IN FLAT NETWORK STRUCTURE

The protocols that we review here fall into two categories, namely, proactive routing and on-demand routing. Many proactive protocols stem from conventional link state routing. On-demand routing, on the other hand, is a new emerging routing philosophy in the ad hoc area. It differs from conventional routing protocols in that no routing activities and no permanent routing information is maintained at network nodes if there is no communication, thus providing a scalable routing solution to large populations.

### *A. Proactive Routing Protocols*

Proactive routing protocols share a common feature, i.e., background routing information exchange regardless of communication requests. The protocols have many desirable properties especially for applications including real time communications and QoS guarantees, such as low latency route access and alternate QoS path support and monitoring. Many proactive routing protocols have been proposed for efficiency and scalability.

### *A.1 Optimized Link State Routing Protocol*

Optimized Link State Routing Protocol (OLSR) [13] is a link state routing protocol. It periodically exchanges topology information with other nodes in the network. The protocol uses *Multi-Point Relays (MPRs)* [14] to reduce the number of ”superfluous” broadcast packet retransmissions and also to reduce the size of the LS update packets, leading to efficient flooding of control messages in the network. A node, say node A, periodically broadcasts HELLO messages to all immediate neighbors to exchange neighborhood information (i.e., list of neighbors) and to compute the multipoint relay set. From neighbor lists, node A figures out the nodes that are two hops away and computes the minimum set of one hop relay points required to reach the two-hop neighbors. Such set is the MPR set. Figure 1 illustrates the MPR set of node A. The optimum (minimum size) MPR computation is NP complete. Efficient heuristics are used. Each node informs its neighbors about its MPR set in the HELLO message. Upon receiving such a HELLO, each node records the nodes (called MPR *selectors*) that select it as one of their MPRs. In routing information dissemination, OLSR differs from pure link state protocols in two aspects. First, by construction, only the MPR nodes of A need to forward the link state updates issued by A. Second, the link state update of node A is reduced in sizes as it includes only the neighbors that select node A as one of their MPR nodes. In this way, partial topology information is propagated, i.e., say, node A can be reached only from its MPR Selectors. OLSR computes the shortest path to an arbitrary destination using the topology map consisting of all of its neighbors and of the MPRs of all other nodes. OLSR is particularly suited for dense networks. When the network is sparse, every neighbor of a node becomes a multi-point relay. The OLSR then reduces to a pure link state protocol.

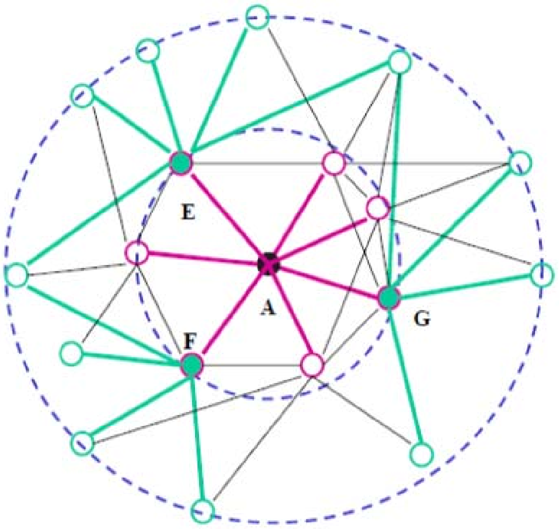
### *A.2 Topology Broadcast based on Reverse Path Forwarding*

Topology Broadcast based on Reverse Path Forwarding(TBRPF) [15], [16] is also a link-state protocol. It consists of two separate modules: the neighbor discovery module (*TND*),and the routing module. TND is performed through periodical” differential” HELLO messages that report only the changes(up or lost) of neighbors. TBRPF routing module operates based on partial topology information obtained through both periodic and differential topology updates. Operation in full topology is provided as an option by including additional topology information in updates. TBRPF works as follows. Assume node S is the source of update messages. Every node i in the network chooses its next hop (say, node p) on the minimum-hop path towards S as its parent with respect to node S. Instead of flooding to the entire net, TBRPF only propagates link-state updates in the reverse direction on the spanning tree formed by the minimum-hop paths from all nodes to the source of the updates. I.e., node i only accepts topology updates originated at node S from parent node p, and then forward them to the children pertaining to S. Further, only the links that will result in changes to i’s source tree are included in the updates. Thus a smaller sub set of the source tree is propagated. The leaves of the broadcast tree do not forward updates. Each node can also include the entire source tree in the updates for full topology operation. The topology updates are broadcast periodically and differentially. The differential updates are issued more frequently to fast propagate link changes (additions and deletions). Thus, TBRPF adapts to topology change faster, generates less routing overhead and uses smaller topology update packet size than pure LS protocols.

### *B. On-Demand Routing Protocols*

On-Demand routing is a popular routing category for wireless ad hoc routing. The design follows the idea that each node tries to reduce routing overhead by only sending routing packets when a communication is awaiting. Examples include Ad hoc On demand Distance Vector Routing (AODV) [17], Associativity-Based Routing (ABR) [18], Dynamic Source Routing (DSR) [19], Lightweight Mobile Routing (LMR) [20] and Temporally-Ordered Routing Algorithms (TORA) [21]. Among the many proposed protocols, AODV and DSR have been extensively evaluated in the MANET literature and are being considered by the MANET IETF Working Group as the leading candidates for standardization. They are described briefly here to demonstrate the on-demand routing mechanism. Interested readers are referred to papers [4], [5], [22] for performance evaluation. On-demand algorithms typically have a route discovery phase. Query packets are flooded into the network by the sources in search of a path. The phase completes when a route is found or all the possible outgoing paths from the source are searched. There are different approaches for discovering routes in on-demand algorithms. In AODV, upon receiving a query, the transit nodes ”learn” the path to the source (called *backward learning*) and enter the route in the forwarding table. The intended destination eventually receives the query and can thus respond using the path traced by the query. This permits establishment of a full duplex path. To reduce new path search overhead, the query packet is dropped during flooding if it encounters a node which already has a route to the destination.

After the path has been established, it is maintained as long as the source uses it. A link failure will be reported to the source recursively through the intermediate nodes. This in turn will trigger another query-response procedure in order to find a new route. An alternate scheme for tracing on demand paths is DSR. DSR uses *source routing*, i.e., a source indicates in a data packet's header the sequence of intermediate nodes on the routing path. In DSR, the query packet copies in its header the IDs of the intermediate nodes it has traversed. The destination then retrieves the entire path from the query packet, and uses it (via source routing) to respond to the source, providing the source with the path at the same time. Data packets carry the source route in the packet headers. A DSR node aggressively caches the routes it has leaned so far to minimize the cost incurred by the route discovery. Source routing enables DSR nodes to keep multiple routes to a destination. When link breakage is detected (through *passive acknowledgements*), route reconstruction can be delayed if the source can use another valid route directly. If no such alternate routes exist, a new search for a route must be re-invoked. The path included in the packet header makes the detection of loops very easy. To reduce the route search overhead, both protocols provide optimizations by taking advantage of existing route information at intermediate nodes. *Promiscuous listening* (overhearing neighbor propagation) used by DSR helps nodes to learn as many route updates as it can without actually participating in routing. *Expanding ring search* (controlled by the *Time-To- Live* field of route request packets) used by AODV limits the search area for a previous discovered destination using the prior hop distance.



O - Neighbors of node A
O- Nodes E,F,G are A's MPR
O - Two-hop neighbors of A that are covered by MPR.
_ - Wireles links
_ -Links connecting MPR nodes and the two-hop nodes they covered
_ -Links connecting A and its neighbors

Fig. 1. OLSR: an illustration of Multi-Point Relays

### *C. Comparisons of Flat Routing Protocols*

N denotes the number of nodes in the network And e denotes the number of communication pairs. The storage complexity measures the order of the table size used by the protocols. The communication complexity gives the number of messages needed to perform an operation when an update occurs. The proactive protocols adopt different ways towards scalability. FSR introduces the notion of multi-level fisheye scope to reduce routing update overhead through reducing the routing packet sizes and update frequency. FSLS/HSLS further drives this limited dissemination approach to an optimal point. OLSR produces less control overhead than FSR because it forces the propagation of link state updates only at MPR nodes, leading to fewer nodes participating in link state update forwarding. Similarly, TBRPF reduces the LS updates forwarding at leaf nodes of each source tree and disseminates differential updates. It also generates smaller HELLO messages than OLSR. Both OLSR and TBRPF achieve more efficiency compared to classic link state algorithms when networks are dense, i.e., OLSR obtains larger compression ratio from number of MPRs over number of neighbors, and TBRPF trims more leaf nodes from propagation. The multi-level scope reduction from FSR and FSLS, however, will not reduce propagation frequency when network grows dense. In contrast, the scope reduction works well when network grows in diameter (in terms of hop distance). Multiple scopes can effectively reduce the update frequency for nodes many hops afar. However, all the four protocols require nodes to maintain routing tables containing entries for all the nodes in the network (storage complexity O(N)). This is acceptable if the user population is small. As the number of mobile hosts increases, so does the overhead. This affects the scalability of the protocols in large networks.

Operations of on-demand routings react only to communication needs. The routing overhead thus relates to the discovery and maintenance of the routes in use. With light traffic (directed to a few destinations) and low mobility, on-demand protocols scale well to large populations (low bandwidth and storage overhead). However, at heavy traffic with large number of destinations, more sources will search for destinations. Also, as mobility increases, the pre-discovered route may break down, requiring repeated route discoveries on the way to the destination. Route caching becomes ineffective in high mobility. Since flooding is used for query dissemination and route maintenance, routing control overhead tends to grow very high [22] in this case. Longer delays are also expected in large mobile networks. In addition, DSR generates larger routing and data packets due to the stored path information. In large networks where longer paths prevail, source routing packets cause larger overhead. In terms of scattered traffic pattern and high mobility, proactive protocols produce higher routing efficiency than on demand protocols. The routes to all the destinations are known in advance. Fresh route information is maintained periodically.

No additional routing overhead needs to be generated for finding a new destination or a new route. The cost of these features is that proactive protocols constantly consume bandwidth and energy due to the periodic updates. This property makes proactive schemes undesirable for some resource critical applications (e.g., sensor networks).

For AODV and DSR, since a route has to be entirely discovered prior to the actual data packet transmission, the initial search latency may degrade the performance of interactive applications (e.g., distributed database queries). In contrast, FSR, OLSR and TBRPF avoid the extra work of ”finding” the destination by retaining a routing entry for each destination all the time, thus providing low single-packet transmission latency. Proactive schemes such as FSR, OLSR and TBRPF can easily extend to QoS monitoring by including bandwidth and channel quality information in link state entries. Thus, the quality of the path (e.g., bandwidth, delay) is known prior to call setup. For AODV and DSR, the quality of the path is not known *a priori*. It can be discovered only while setting up the path and must be monitored by all intermediate nodes during the session, at the cost of additional latency and overhead penalty.

## III. HIERARCHICAL ROUTING PROTOCOLS

Typically, when wireless network size increase (beyond certain thresholds), current “flat” routing schemes become infeasible because of link and processing overhead. One way to solve this problem and to produce scalable and efficient solutions is hierarchical routing. An example of hierarchical routing is the Internet hierarchy, which has been practiced in wired network for a long time. Wireless hierarchical routing is based on the idea of organizing nodes in groups and then assigning nodes different functionalities inside and outside of a group. Both routing table size and update packet size are reduced by including in them only part of the network (instead of the whole), thus control overhead is reduced. The most popular way of building hierarchy is to group nodes geographically close to each other into explicit clusters. Each cluster has a leading node (*clusterhead*) to communicate to other nodes on behalf of the cluster. An alternate way is to have implicit hierarchy. In this way, each node has a local scope. Different routing strategies are used inside and outside the scope. Communications pass across overlapping scopes. More efficient overall routing performance can be achieved through this flexibility. As mobile nodes have only a single Omni directional radio for wireless communications, this type of hierarchical organization will be referred to as ”logical hierarchy” to distinguish from the physically hierarchical network structure.

### *A. Clusterhead-Gateway Switch Routing*

Clusterhead-Gateway Switch Routing (CGSR) [23] is a typical cluster based hierarchical routing. A stable clustering algorithm *Least Clusterhead Change* (LCC) is used to partition the whole network into clusters and a *clusterhead* is elected in each cluster. A mobile node that belongs to two or more clusters is a *gateway* connecting the clusters. Data packets are routed through paths having a format of ”Clusterhead – Gateway- Clusterhead - Gateway ...” between any source and destination pairs. CGSR is a distance vector routing algorithm. Two tables, a cluster member table and a DV routing table, are maintained at each mobile node. The cluster member table records the clusterhead for each node and is broadcast periodically. A node will update its member table upon receiving such a packet. The routing table only maintains one entry for each cluster recording the path to its clusterhead, no matter how many members it has. To route a data packet, current node first looks up the clusterhead of the destination node from the cluster member table. Then, it consults its routing table to find the next hop to that destination cluster and routes the packet towards the destination clusterhead. The destination clusterhead will finally route the packet to the destination node, which is a member of it and can be directly reached. This procedure is demonstrated in Figure 3.The major advantage of CGSR is that it can greatly reduce the routing table size comparing to DV protocols. Only one entry is needed for all nodes in the same cluster. Thus the broadcast packet size of routing table is reduced. These features make a DV routing scale to large network size. Although an additional cluster member table is required at each node, its size only decided by the number of clusters in the network. The drawback of CGSR is the difficulty to maintain the cluster structure in mobile environment. The LCC clustering algorithm introduces additional overhead and complexity in the formation and maintenance of clusters.

### *B. Hierarchical State Routing*

Hierarchical State Routing (HSR) [24] is a multi-level, clustering based link state routing protocol. It maintains a logical hierarchical topology by using the clustering scheme recursively. Nodes at the same logical level are grouped into clusters. The elected cluster heads at the lower level become members of the next higher level. These new members in turn organize themselves in clusters, and so on. The goal of clustering is to reduce routing overhead (i.e., routing table storage, processing and transmission) at each level. An example of a three level hierarchical structure is demonstrated in Figure 4.Generally, there are three kinds of nodes in a cluster, namely, clusterheads (e.g., node 1, 2, 3, and 4), gateways (e.g., node 6,7, 8, and 11), and internal nodes (e.g., node 5, 9, and 10). A clusterhead acts as a local coordinator for transmissions within the cluster.HSR is based on link state routing. At the first level of clustering(also the physical level), each node monitors the state of the link to each neighbor (i.e., link up/down and possibly QoS parameters such as bandwidth) and broadcasts it within the cluster. The clusterhead summarizes link state information within its cluster and propagates it to the neighbor cluster heads(via the gateways). The knowledge of connectivity between neighbor clusterheads leads to the formation of level 2 clusters. For example, as shown in Figure 4, neighbor clusterheads1 and 2 become members of the level 2 cluster C2. Link state entries at level 2 nodes contain the ”virtual” links in C2. A ”virtual” link between neighbor nodes 1 and 2 consists of the level1 path from clusterhead 1 to clusterhead 2 through gateway6. The virtual link can be viewed as a ”tunnel” implemented through lower level nodes. Applying the aforementioned clustering procedure recursively, new cluster heads are elected at each level, and become members of the higher level cluster.

If QoS parameters are required, the clusterheads will summarize the information from the level they belongs to and carry it into the higher level. After obtaining the link state information at one level, each virtual node floods it down to nodes of the lower level clusters. As a result, each physical node has a ”hierarchical” topology information through the hierarchical address of each node (described below), as opposed to a full topology view as in flat LS schemes. The hierarchy so developed requires a new address for each node, the hierarchical address. The node IDs shown in Figure4 (at level = 1) are physical (e.g., MAC layer) addresses. They are hardwired and are unique to each node. In HSR, *Hierarchical ID (HID)* of a node is defined as the sequence of the MAC addresses of the nodes on the path from the top hierarchy to the node itself. For example, in Figure 4 the hierarchical address of node 5, HID(5), is <1,1,5>. The advantage of this hierarchical address scheme is that each node can dynamically and locally update its own HID upon receiving the routing updates from the nodes higher up in the hierarchy. The hierarchical address is sufficient to deliver a packet to its destination from anywhere in the network using HSR tables. Gateway nodes can communicate with multiple cluster heads and thus can be reached from the top hierarchy via multiple paths. Consequently a gateway has multiple hierarchical addresses, similar to a router in the wired Internet, equipped with multiple subnet addresses. Thesebenefits come at the cost of longer (hierarchical) addresses and frequent updates of the cluster hierarchy and of the hierarchical addresses as nodes move. In principle, a continuously changing hierarchical address makes it difficult to locate and keep track of nodes.

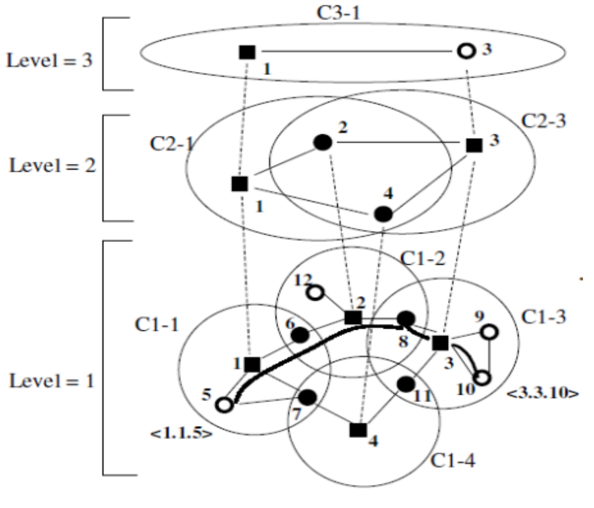


Fig. 4. HSR: An example of Multi Level Clustering

### *C. Zone Routing Protocol*

The Zone Routing Protocol (ZRP) [25] is a hybrid routing protocol that combines both proactive and on-demand routing strategies and benefits from advantages of both types. The basic idea is that each node has a pre-defined *zone* centered at itself in terms of number of hops. For nodes within the zone, it uses proactive routing protocols to maintain routing information. For those nodes outside of its zone, it does not maintain routing information in a permanent base. Instead, on-demand routing strategy is adopted when inter-zone connections are required. The ZRP protocol consists of three components. Within the zone, proactive *IntrAzone Routing Protocol (IARP)* is used to maintain routing information. IARP can be any link state routing or distance vector routing depending on the implementation. For nodes outside the zone, reactive *IntErzone Routing Protocol (IERP)* is performed. IERP uses the *route query (RREQ)* / *route reply (RREP)* packets to discover a route in a way similar to typical on-demand routing protocols. IARP always provides a route to nodes within a node's zone. When the intended destination is not known at a node, i.e., not in its IARP routing table, that node must be outside of its zone. Thus, a RREQ packet is broadcast via the nodes on the border of the zone. Such a RREQ broadcast is called *Bordercast Resolution Protocol (BRP)*. Route queries are only broadcast from one node's border nodes to other border nodes until one node knows the exact path to the destination node, i.e., the destination is within its zone. The hybrid proactive/reactive scheme limits the proactive overhead to only the size of the zone, and the reactive search overhead to only selected border nodes. However, potential inefficiency may occur when flooding of the RREQ packets goes through the entire network.

### *D. Landmark Ad Hoc Routing Protocol*

Landmark Ad Hoc Routing Protocol (LANMAR) [26], [27] is designed for an ad hoc network that exhibits group mobility. Namely, one can identify logical subnets in which the members have a commonality of interests and are likely to move as a "group" (e.g., a brigade or tank battalion in the battlefield). LANMAR uses an IP like address consisting of a group ID (or subnet ID) and a host ID, i.e. <GroupID,HostID>. LANMAR uses the notion of *landmarks* to keep track of such logical groups. Each logical group has one dynamically elected node serving as a "landmark". A global distance vector mechanism (e.g. DSDV [28]) propagates the routing information about all the landmarks in the entire network. Further, LANMAR works in symbiosis with a local scope routing scheme. The local routing scheme can use the flat proactive protocols mentioned previously (e.g., FSR). FSR maintains detailed routing information for nodes within a given scope D (i.e., FSR updates propagate only up to hop distance D). As a result, each node has detailed topology information about nodes within its local scope and has a distance and routing vector to all landmarks. When a node needs to relay a packet to a destination within its scope, it uses the FSR routing tables directly. Otherwise, the packet will be routed towards the landmark corresponding to the destination's logical subnet, which is read from the logical address carried in the packet header. When the packet arrives within the scope of the destination, it is routed using local tables (that contain the destination), possibly, without going through the landmark. LANMAR reduces both routing table size and control overhead effectively through the truncated local routing table and "summarized" routing information for remote groups of nodes. In general, by adopting different local routing schemes [9], LANMAR provides a flexible routing framework for scalable routing while still preserving the benefits introduced by the associated local scope routing scheme.

### *E. Comparisons of Hierarchical Routing Protocols*

Table II summarizes the features of the four hierarchical routing protocols. Some symbols used in the table are: N, the total number of mobile nodes in the network; M, the average number of nodes in a cluster; L, the average number of nodes in a node's local scope, which is used by both ZRP and LANMAR and is given here an identical scope size (r hops). The difference between M and L is that M usually only includes one-hop nodes while L includes nodes up to r hops. The relation between M and L is L = r2 _M. Also in the table, H is the number of hierarchical levels of HSR. G is the number of logical groups in LANMAR. The number of communication pairs is denoted as e. The storage and communication complexity have the same definitions as given in Section II-C. The explicit hierarchical protocols CGSR and HSR force a path to go through some critical nodes like clusterhead and gateways, leading to possibly sub-optimal paths. The two implicitly hierarchical protocols ZRP and LANMAR use a shortest path algorithm at each node. However, LANMAR guarantees shortest paths only when destinations are within the scope. For remote nodes, though data packets are first routed towards remote landmarks through shortest paths, extra hops may be traveled before a destination is hit. Similarly, ZRP does not provide an overall optimized shortest path if the destination has to be found through IERP.

## CONCLUSIONS

Protocols described in this paper reveal the influence of underlying network structure on the routing protocols. And they also show how the routing strategy differs in various design considerations. Flat proactive routing schemes with great advantages of immediate route availability and strong QoS support have been studied using examples FSR, FSLS, OLSR and TBRPF. In these protocols, routing overhead has been efficiently limited. FSR and FSLS achieve routing traffic reduction by selectively adjusting routing update frequencies. OLSR reduces both the size of routing packets and the number of nodes forwarding such packets. TBRPF limits the propagation of routing updates at leaf nodes and reports only differential information on source trees. Both OLSR and TBRPF work more efficiently in dense networks while FSR and FSLS are more suitable for large diameter networks. The drawbacks of proactive schemes are the constant bandwidth consumption due to periodic routing updates. On-demand routing schemes overcome this problem by searching for available routes to destinations only when needed, thus keeping bandwidth usage and routing table storage low. Two popular on-demand schemes, AODV and DSR, scale well for large networks when communication pattern is sparse and mobility is low. However, flat routing schemes only scale up to a certain degree: on one hand, routing table sizes in proactive schemes grow more than linear when network size increases, resulting in overly congested channel and blocked data traffic; and on the other hand, on-demand schemes incur huge amount of flooding packets in large networks in search for destinations.

## REFERENCES

[1] S. Corson and J. Macker, ”Mobile Ad hoc Networking (MANET): Routing Protocol Performance Issues and Evaluation Considerations,” *RFC 2501*, Jan. 1999.

[2] S. Keshav, *An Engineering Approach to Computer Networking: ATM networks, the Internet, and the telephone network*, Chapter 11, Addison Wesley Inc., 1997.

[3] K. Xu, X. Hong and M. Gerla, ”An Ad Hoc Network with Mobile Backbones,” in*Proceedings of IEEE ICC 2002*, New York City, April, 2002.

[4] S. R. Das, R. Castaneda and J. Yan, “Simulation Based Performance Evaluation of Mobile, Ad Hoc Network Routing Protocols,” *ACM/Baltzer Mobile Networks and Applications (MONET) Journal*, July 2000, pages 179-189.

[5] J. Broch, D.A. Maltz, D.B. Johnson, Y.-C. Hu, and J. Jetcheva, “A Performance Comparison of Multi-Hop Wireless Ad Hoc Network Routing Protocols,” in *Proceedings of ACM/IEEE MOBICOM’98*, Dallas, TX, Oct. 1998, pp. 85-97.

[6] E. M. Royer and C.-K. Toh, ”A Review of Current Routing Protocols for Ad-Hoc Mobile Wireless Networks”, *IEEE Personal Communications Magazine*, April 1999, pp. 46-55.

[7] S.-J. Lee, C.-K.Toh, and M. Gerla, ”Performance Evaluation of Table-Driven and On-Demand Ad Hoc Routing Protocols,” in *Proceedings of IEEE PIMRC’99*, Osaka, Japan, Sep. 1999, pp. 297-301.

[8] *Ad Hoc Networking*, edited by C. E. Perkins, Addison Wesley, 2001.

[9] X. Hong, M. Gera, Y. Yi, K. Xu, and T. Kwon, ”Scalable Ad Hoc Routing in Large, DenseWireless Networks Using Clustering and Landmarks,” in *Proceedings of ICC 2002*, New York City, New York, April 2002.

[10] A. Iwata, C.-C.Chiang, G. Pei, M. Gerla, and T.-W. Chen, ”Scalable Routing Strategies for Ad-hoc Wireless Networks,” *IEEE Journal on Selected Areas in Communications*, Aug. 1999, pp. 1369-1379.

[11] G. Pei, M. Gerla, and T.-W. Chen, ”Fisheye State Routing: A Routing Scheme for Ad Hoc Wireless Networks,” in *Proceedings of ICC 2000*, New Orleans, LA, Jun. 2000.

[12] C. Santivanez, R. Ramanathan, I. Stavrakakis, ”Making Link-State Routing Scale for Ad Hoc Networks,” in *Proceedings of The 2001 ACM International Symposium on Mobile Ad Hoc Networking and Computing (Mobihoc2001)*, Long Beach, California, Oct. 2001.

[13] P. Jacquet, P. Muhlethaler, A. Qayyum, A. Laouiti, L. Viennot and T. Clausen, ”Optimized Link State Routing Protocol,” *draft-ietf-manet-olsr- 05.txt*, Internet Draft, IETF MANET Working Group, Nov. 2000.

[14] A. Qayyum, L. Viennot, A. Laouiti. “Multipoint relaying: An efficient technique for flooding in mobile wireless networks”. *INRIA research report RR-3898*, 2000

[15] B. Bellur and R. G. Ogier, “A Reliable, Efficient Topology Broadcast Protocol for Dynamic Networks,” in *Proc. IEEE INFOCOM ’99*, New York, March 1999.

AUTHOR DETAILS:

.G.V.Sai Aravind is studying B.Tech (Electronics and Computer Engineering) in KL UNIVERSITY, VIJAYAWADA. His area of interest includes computer Networks, wireless sensor networks, embedded systems. He is doing a research project in the area of sensor networks titled as 'ETHERNET INTERFACE FOR AUTOMATION SYSTEMS’. He attended various workshops on PSOC (Programmable-System on chip), ROBOTICS. He is participating in various National and International conferences and Seminars related to his Subjects of interest. His area of research is Wireless sensor networks.

Dr Syed Umar is working as an Associate Professor in KL UNIVERSITY, Vaddeswaram, Vijayawada. Obtained B.Tech (Electronics and Communication Engineering) degree from Jawaharlal Nehru Technological University Hyderabad in 2003. He obtained M.Tech (Computer Science Engineering) degree from Jawaharlal Nehru Technological University Hyderabad in 2008. He got PhD from Monad University in 2012. His area of interest includes Computer Networks Wireless adhoc networks, Wireless sensor networks and network security.