Volume 2, Issue 7, July 2012 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Energy Efficient Clustered Georouting in Ad-hoc Networks

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***Abstract*— In wireless ad-hoc networks, there are several characteristics different with wired networks. The differences are frequently changing of network topology, limited resources like bandwidth and energy and so on. In this network, the mobile nodes become important composer in the ad-hoc networks and get a role of host or router. Thus the energy depletion of mobile nodes cause decreasing the number of router nodes and shortening the life time of entire network. In mobile ad-hoc networks, there is a problem in path search model. It is about the flooding mechanism which broadcast packets to entire networks that causes unnecessary congestion overhead and consumption of resources. If we use the location based protocol, then routing path search is easier than the other methods. In addition, the scalability of networks will be better and overheads will be minimized, because it does not need to use flooding. Traditional Location aided Routing Protocol doesn't consider the energy consumption. Devices are deployed for long periods of time with limited potential for recharging batteries. This demands the conservation of energy in all components of the mobile device to support improvements in device lifetime. So there is a need for an energy-efficient flooding mechanism for information dissemination in distributed wireless ad hoc networks. The method proposed is an improvement to the traditional Location aided routing that use clustered energy conservation that helps to eliminate the unreachable corner problem and control overhead of grid header in grid architecture.**

***Keywords*— LAR, Wireless Networks, Flooding, CEC, GAF**

I. INTRODUCTION

Mobile ad hoc networks consist of wireless mobile hosts that communicate with each other, in the absence of a fixed infrastructure. Routes between two hosts in a Mobile Ad hoc Network (MANET) may consist of hops through other hosts in the network. Host mobility can cause frequent unpredictable topology changes. Therefore, the task of finding and maintaining routes in MANET is nontrivial. Many protocols have been proposed for mobile ad hoc networks, with the goal of achieving efficient routing. These algorithms differ in the approach used for searching a new route or modifying a known route, when hosts move. In this network, the mobile nodes become important composer in the ad-hoc networks and get a role of host or router. Thus the energy depletion of mobile nodes cause decreasing the number of router nodes and shortening the life time of entire network. Consequently the efficient management of energy resource is an important issue in the life time of system. Generally for the algorithms in Ad-hoc networks, it is important to know the location of node. They also have important issues to find the method of effective communication. Location based routing mechanism assumes that each mobile node already knows the location of oneself: and the information is used to find routing path. The location based routing [1] cannot obtain accurate location of node due to technical limitation of GPS. However, recent location measuring technique will be able to confirm the location of node within a little error scope.

In mobile ad-hoc networks, there is a problem in path search model. It is about the flooding mechanism which broadcast packets to entire networks that causes unnecessary congestion overhead and consumption of resources. If we use the location based protocol, then routing path search is easier than the other methods. In addition, the scalability of networks will be better and overheads will be minimized, because it does not need to use flooding. In traditional LAR more nodes need to be active than necessary. There is no switch off between the redundant nodes and thus no energy conservation. Devices are deployed for long periods of time with limited potential for recharging batteries. This demands the conservation of energy in all components of the mobile device to support improvements in device lifetime. So there is a need for an energy-efficient flooding mechanism for information dissemination in distributed wireless ad hoc networks. LAR [1] with GAF as power saving technique proposed in [2] has got the disadvantage of unreachable corner problem and grid header has to store the location information of all nodes in the entire network.

In the paper, we propose a routing mechanism which takes idea of expected zone. And our mechanism considers cluster based energy conservation (CEC) [3] as the energy conservation technique. Proposed protocol has better energy efficiency than the location based routing algorithm and the previous improved location based routing algorithm [1]. As increasing of energy efficiency, reliability and life time of the entire network is improved.

The paper includes a brief description about the basic location aided routing and the improved location aided routing that uses GAF for power consumption. Finally the proposed solution will give better energy conservation and improved operational lifetime.

II. LOCATION AIDED ROUTING

One of geographical-based routing protocols is location-aided routing (LAR). The central point of LAR is the limited flooding of routing request packets in a small group of nodes which belong to a so-called request zone.

Compared with other routing protocols such as AODV or DSR, in which routing packets are flooded throughout the network, LAR saves considerable bandwidth and leaves those mobile nodes that are not between the source and destination untouched. To construct the request zone, the expected zone of the destination needs to be obtained first. Suppose both the average speed (say v) and the location of the destination at time $t0$ (say L) are known to the source, the expected zone of the destination at time $t1$ is the circle with centre at L and radius of $v(t1 - t0)$.

Two different schemes are brought to construct the request zone a rectangular request zone which contains the location of source and the expected zone of the destination, or the group of the nodes closer to the destination than the source.

The procedure of route discovery in LAR is:
a. The source puts the location information of itself and the destination in the routing request packet
b. The routing request packet is broadcast within the request zone. In other words, the nodes within the request zone forward the message, others discard the message.
c. On receipt of the route request packet, the destination sends back a route reply packet which contains its current location.
d. If LAR fails to find the route to the destination due to estimation error or other reasons, the routing protocol resorts to flooding of routing message throughout the MANET.

Despite many of its uses, flooding suffers from disadvantages such as the broadcast storm problem. There are situations when duplicated messages are sent to the same node and also if two nodes share the same observing region, neighbour nodes receive duplicated messages. The flooding protocol does not take into account of the available energy resources. Wireless nodes are typically characterized by small form-factor, limited battery power, and a small amount of memory. So there is a need for an energy-efficient flooding mechanism for information dissemination in distributed wireless ad hoc networks.

III. IMPROVED LOCATION AIDED ROUTING

A. Routing framework in Improved LAR

The traditional location aided routing protocol does not take into account of the available energy resources. Wireless nodes are typically characterized by small form-factor, limited battery power, and a small amount of memory. So there is a need for an energy-efficient flooding mechanism for information dissemination in distributed wireless ad hoc networks.

Improved Location aided Routing Protocol [4] uses GAF as power saving technique which uses location information of each node in a wireless ad-hoc network for grouping of nodes. This achieves power saving by making some nodes sleep autonomously. GAF groups nodes according to their locations. One active node that works as a grid header of the group for routing is elected in each group according the remaining battery power of each node in a distributed manner. The grid layout of GAF guarantees the connectivity between all nodes in two adjacent grids. However, if the relative locations of all active nodes to the grid are synchronized and the distance between them is constant, the maximum communication range can be smaller than the distance between two possible farthest nodes in any adjacent grids. The data sent by each grid header includes information of all nodes in its grid. So grid header can get the information of entire nodes. Source node requires the information of destination node from the header node in his virtual grid .Header node transmits data to source node that is about the information of destination node, specifically location, speed and time. Source node calculates expected zone which indicate area where destination node will be located by considering movement. And the intermediate node is selected by considering the neighbour locations energy remains and transmitting power. For this considering, all the packets include information about the location of destination and energy remains of node. When the packet arrives at expected zone that is considered as possible area where destination node exists, restricted flooding is processed. In this time, expected zone is presented by coordinate value (x, y) and speed of destination node. This process reflects the movement of destination node and makes finding destination more stable. When RREQ packet is reached at destination node, RREP packet is sent to source node by AODV process. And finally the routing path configuration is completed.

IV. MOTIVATION TO CLUSTER BASED LAR

The main issue in improved LAR is the issue found in GAF. GAF make very conservative connectivity assumptions because it guesses are based on a radio model. Being conservative requires more nodes to stay active than necessary, leading to less energy conservation**.** Also GAF algorithm can communicate directly to its adjacent horizontal and vertical grid cells. But the diagonal cell cannot be covered directly by virtual grid method due to range limitations. For the diagonal cell, packets to be transferred through vertical and horizontal cell which cause the longer path else if node transmits directly the packet drop rate increases. And one grid header contains the location information of the entire nodes in the network.

V.PROPOSED MODIFICATION

Improving LAR protocol by incorporating the cluster based energy conservation or (CEC) and there by directly and adaptively measuring the network connectivity which helps to find network redundancy more accurately to conserve more energy. The energy conservation is done by making some nodes to sleep autonomously or by switching off the redundant node radio signal to reduce redundant transmissions.

Instead of dividing the network to grid, divide it into clusters. Clustering can be used to reduce the flooding in expected zone since only gateways and cluster heads participate in the propagation of routing control/update messages. Ordinary nodes send the packets to their cluster head that either distributes the packets inside the cluster, or (if the destination is outside the cluster) forwards them to a gateway node to be delivered to the other clusters. Since a cluster head need to maintain only the information of its cluster nodes and not the entire nodes and therefore the overhead on cluster head is minimized that grid. By replacing the nodes with clusters, LAR can be directly

applied to the network. The steps in Cluster based LAR are discussed below.

A. Determining Network Redundancy

Cluster based LAR organizes nodes into overlapping clusters that are interconnected to each other as shown in Fig 1 A cluster is defined as a subset of nodes that are mutually "reachable" in at most 2 hops. As shown in Fig 1, a cluster can be viewed as a circle around the cluster-head with the radius equal to the radio transmission range of the cluster-head. Each cluster is identified by one cluster-head, a node that can reach all nodes in the cluster in 1 hop. A *gateway* is a node that is a member of more than one cluster. The gateway nodes connect all clusters together to ensure overall network connectivity. A node is *ordinary* if it is neither a cluster-head nor a gateway node and is thus redundant.

B. Distributed Cluster Formation

In order to elect cluster-heads and gateway nodes, each node periodically broadcasts a *discovery* message that contains its node ID, its cluster ID, and its estimated lifetime. A node's estimated lifetime can be conservatively set by assuming the node will constantly consume energy at a maximum rate until it runs out of energy. While forming clusters, it first elects cluster-heads, then elects gateways to connect clusters.

A node selects itself as a cluster-head if it has the longest lifetime of all its neighbour nodes, breaking ties by node ID. Each node can independently make this decision based on exchanged discovery messages. Each node sets its cluster ID to be the node ID of its cluster-head. Among the gateway nodes, those nodes that can hear multiple cluster-heads are *primary gateway* nodes and those that can hear a combination of cluster heads and primary gateway nodes are *secondary gateway* nodes.

When multiple gateway nodes exist between two adjacent clusters, CEC suppresses some of them in order to conserve energy since these gateway nodes are redundant. Figure 1 shows an example of cluster formation in which all nodes have the same estimated network operational lifetime.

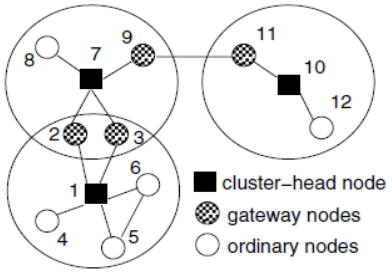

Fig.1 Cluster Formation in Cluster based LAR

Fig 1 shows an example of cluster formation in which all nodes have the same estimated network operational lifetime. Here the clustering algorithm used is Lowest Cluster ID algorithm. Nodes 1 and 10 can directly decide they are the cluster-heads because they have the lowest ID of all of their neighbours. Node 7 becomes a cluster-head after nodes 2 and 3 choose node 1 as their cluster-head. Nodes 2 and 3 are primary gateway nodes because they are neighbours of two cluster-heads: nodes 1 and 7. Note that one of nodes 2 and 3 is redundant. Nodes 9 and 11 are secondary gateway nodes between clusters 7 and 10.

C. Controlling Duty cycle of Nodes

After the selection of cluster-heads and gateway nodes, the remaining redundant nodes are powered off to conserve energy. Whenever a cluster is formed, each redundant node sets a wake-up timer that will wake it up in time T*s*. T*s* is set to some fraction of the estimated node lifetime (*enlt*) of the cluster-head. Here, we normally set to be T*s* to *enlt*/2. In order to avoid thrashing, we set T*s* to be *enlt* when it becomes less than a threshold (say 30s). All nodes in the same cluster will thus be powered on to re-form the cluster before the cluster-head runs out of energy. While re-forming clusters, it is more likely that the last cluster-head has less remaining energy than the other nodes in the cluster since most have been in a sleeping state and conserving energy. CEC therefore achieves the goal of balanced energy use.

D. Adapting to Network Mobility

With only a subset of the nodes active, it is possible that network mobility could cause a loss of connectivity. If a cluster-head moves then it might no longer be able to serve as a cluster-head.

CEC uses *mobility prediction* in order to maintain network connectivity. By estimating how soon a cluster-head will leave its current cluster and informing all nodes in the cluster of that time, the clustered nodes can power themselves on before the cluster-head leaves its cluster.

E. Algorithm for Proposed Solution

1) Source node requires the information of destination node from the cluster head of its cluster.
2) If the source and destination is in same cluster source can directly send message. If it is in another cluster the cluster head and gateway node participate in routing
3) Cluster head transmits data to source node that is about the information of destination node, specifically location, speed and time.
4) Source node calculates expected zone which indicate area where destination node will be located by considering movement. The path from source to destination node is established by multi-hop.
5) The intermediate node is selected by considering the neighbour locations energy remains and transmitting power.
6) When the packet arrives at expected zone the gateway node and cluster head in that zone will participate in routing thus reducing flooding in the expected zone.
7) When RREQ packet is reached at destination node, RREP packet is sent to source node.

V. CONCLUSIONS

The proposed modification to location aided routing protocol increase the operational lifetime more better than improved location aided routing that use GAF as power saving technique because it vanishes the unreachable corner problem and grid header overhead in GAF by using the clustering technique. It also reduces the routing message overhead since in clustering only gateways and cluster head participates in routing.

ACKNOWLEDGMENT

I thank everyone for the kindful cooperation in doing my work especially my guide Mr.Robin Cyriac Asst. Professor of RSET Cochin.

REFERENCES

[1] Young-Bae Ko and Nitin H. Vaidya, "Location-Aided Routing (LAR) in mobile ad hoc networks", Journal of Wireless, 2000.

[2] Y. Xu, J. Heidemann, D. Estrin ,"Geography-informed Energy Conservation for Ad-hoc Routing" In Proceedings of the Seventh Annual ACM/IEEE International Conference on Mobile Computing and Networking, 2000.

[3] Xa Yu, Solomon Bien ,".Topology Control Protocols to Conserve Energy in Wireless Ad Hoc Networks", IADIS International Conference Wireless Applications and Computing, 2000 .

[4] Jangsu Lee, Seunghwan Y0, and Sungchun Kim , "Energy aware Routing in Location based Ad-hoc Networks", Proceedings of the 4th International Symposium on Communications, Control and Signal Processing. ISCCSP . Limassol, Cyprus, 2011.

[5] Ahmed A. Radwan, Tarek M. Mahmoud, Essam H. Houssein, " Performance Measurement of Some Mobile Ad Hoc Network Routing Protocols**",** IJCSI International Journal of Computer Science Issues.Vol. 8, Issue 1, 2011.

[6] Ratish Agarwal, Dr. Mahesh Motwani, " Survey of clustering algorithms for MANET", International Journal on Computer Science and Engineering Vol.1(2), 2008.

