Location Based Anonymous Routing Protocol for Power Heterogeneous MANETs

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***Abstract*—Power heterogeneity is common in mobile ad hoc networks (MANETs).With high-power nodes, MANETs can improve network scalability, connectivity, and broadcasting robustness. However, the throughput of power heterogeneous MANETs can be severely impacted by high-power nodes. Heterogeneous wireless network may consist of a network of computers or devices with different capabilities in terms of operating systems, hardware, protocols, etc., In mobile ad hoc networks communication can be performed through number of nodes. In such networks two type of nodes are available: high power node (H) and low power node (L). Low power nodes transmission range is smaller compared to the H node .H node has several advantages, but it suffers from reduced throughput. To address this issue, we present a protocol called Type Based Clustering (TBC) that improves the throughput by avoiding transmission through high power nodes.**

***Index Terms*— Clustering, mobile ad hoc networks (MANETs), power heterogeneous, routing*.**

I. INTRODUCTION

IN RECENT years, there has been growing research interest in heterogeneous mobile ad hoc networks (MANETs). Such mobile network consists of devices with heterogeneous characteristics in terms of transmission power [1], [2], energy [3], capacity [4], radio [5], etc. [6]. A typical example of power heterogeneous MANETs is the vehicular ad hoc networks (VANETs), which are composed of heterogeneous wireless equipment carried by human and vehicles. In such a heterogeneous network, different devices are likely to have different capacities and are thus likely to transmit data with different power levels.

Wireless network are designed to work independently. Current 4G network is referred to as Heterogeneous wireless access network .the structure of heterogeneous network is classified as "Integrated networks" and "interworking network". A typical example of power heterogeneous MANETs is the vehicles ad hoc networks (VANETs). Vehicular Ad hoc Networks (VANET) is part of Mobile Ad Hoc Networks (MANET), this means that every node can move freely within the network coverage and stay connected. Interesting types of data exchanged are

- Traffic/road conditions.
- Accidents/events.
- Commodity/entertainment.

Mobile nodes have different transmission power, and power heterogeneity becomes a double-edged sword. On one hand, the benefits of high-power nodes are the expansion of network coverage area and the reduction in the transmission delay. High power nodes also generally have advantages in power, storage, computation capability, and data transmission rate. As a result, research efforts have been carried out to explore these advantages, such as backbone construction and topology control. On the other hand, the large transmission range of high power nodes leads to large interference, which further reduces the spatial utilization of network channel resources. Because of different transmission power and other factors (e.g., interference, barrier, and noise), asymmetric or unidirectional links will exist in MANETs. Existing research results show that routing protocols over unidirectional links perform poorly in multihop wireless networks[5]. However, the existing routing protocols in power heterogeneous MANETs are only designed to detect the unidirectional links and to avoid the transmissions based on asymmetric links without considering the benefits from high-power nodes. Hence, the problem is how to improve the routing performance of power heterogeneous MANETs by efficiently exploiting the advantages and avoiding the disadvantages of high-power nodes, which is the focus of this paper.

II. RELATED WORK

Numerous routing protocols have been developed in the wireless networking community to target various scenarios, and much research effort has been paid to study the taxonomy of ad hoc routing protocols and to survey the representative protocols in different categories [1]–[2]. For example, Boukerche *et al.* [4], [3] provided the comprehensive summary of the routing protocols for MANETs. Unfortunately, most of the existing protocols are limited to homogenous networks and perform ineffectively in power heterogeneous networks. To improve the network performance and to address the issues of high-power nodes, this paper proposes a TRPH MANETs. As shown in Fig. 1, TRPH consists of two core components. The first component (Component A) is the LVC algorithm that is used to tackle the unidirectional link and to construct the hierarchical structure. The second component (Component B) is the routing, including the route discovery and route maintenance. In the following, we first list the network model and definitions. We then present the two components in detail.

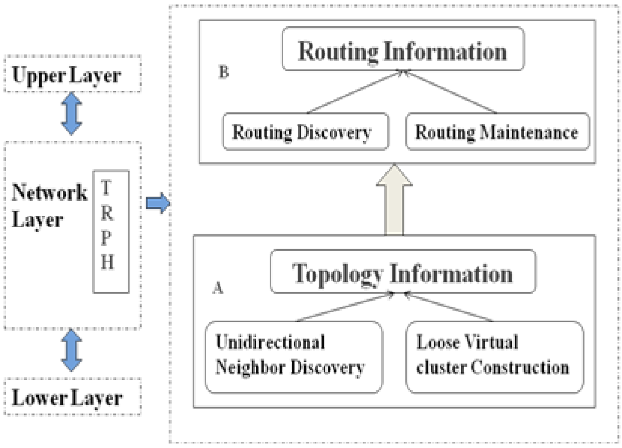

Fig.1 Overview of the TRPH

III. PROPOSED SYSTEM

A. Network Model

There are two types of nodes in the networks: H-nodes and general nodes (L-nodes). H-nodes refer to the nodes with high power and a large transmission range. L-nodes refer to the nodes with low power and a small transmission range. The numbers of H-nodes and L-nodes are denoted as N_H and N_L, respectively. Because of the complexity and high-cost of H-nodes, we assume that $NH << NL$.

Let as assume that each node is equipped with one IEEE 802.11b radio using a single channel. The theoretical transmission ranges of H-nodes and L-nodes are R_H and R_L, respectively. To reflect the dynamic nature of MANETs in practice, assume that transmission ranges may be 10% deviated from theoretical values. Hence, unidirectional links may exist not only in the link between H-nodes and L-nodes but in the link between two homogeneous nodes as well. To facilitate the discussion, the list of key notations described in Table I.

TABLE I. NOTATION DEFINITION

Notation	Definition
T(n)	T (n) Ɛ {H-node, L-node}.
D(ni , nj)	The Euclidean distance between two node ni and nj.
CH(gi)	The Cluster Head of L-node gi.
S(gi)	The state of L-node gi.
ρL ,ρH	density of L-node and H-node.
degL	The average degree of L-node.
degH	The average degree of H-node.

B) *TBC Algorithm*

In TBC algorithm, bidirectional link in the network can be discovered using the bidirectional table (BT). It can identify the nodes which is in its bidirectional links.

1) *Neighbor Table (NT):*

At first, it can identify the neighbors of each node in a two hop distance by broadcasting the control packet periodically. Each node broadcasts control packet containing the information of its type, ID, Distance, etc. The neighbors that are found represent the nodes learned by the received control packet. Each node constructs a NT and BT tables based on the received control packet.

Procedures for discovering BTs:

Step 1: Each node broadcast control packet within two hops and notifies its neighbors.

Step 2: The received control packet will be used to build the NT, which contains the information about its neighbor's position and type. As a result,

$$NT= N^{H}_{RH}(n_i) \cap N^{L}_{RL}(n_i). \quad (1)$$

Step 3: Then all nodes are waiting for some time to gather the information about its neighbors and broadcast control packet again. In this step, the information about obtained neighbors also updated.

Step 4: On receiving that packet each node check whether its own information is present in the control packet. If it is present, a bidirectional link will be established between the corresponding node and the sender of the control packet. Then the sender node will be added into the BT .As a result,

$$BT= N^{H}_{RL}(n_i) \cap N^{L}_{RL}(n_i). \quad (2)$$

2) *Local Topology(LT):*

To obtain the benefit of H-node, the cluster head is chosen as an H-node. It establishes a relationship between the H-node and L-node. Number of L-node within the coverage region of the cluster head (H-node) only participate in the clustering. All nodes build a LT table, that store local topology information based on exposed bidirectional links.

Three stage of L-node:

- L isolated: L-nodes which are not covered by any H-node.
- L member: L-nodes which are covered by its cluster head and form a bidirectional link.

- L gateway: L-nodes which are not covered by its cluster head.

Procedures for constructing TBC:

Step 1: Each L-node broadcasts L-node TBC initialization (LTI) packets to all H-nodes in the NT table. In that LTI packet the information about the BT is added.LTI packets will be broadcasted within the limited region due to its time-to-live (TTL) value.

Step 2: Each node waits for some time to gather the BT information and LTI packet. Based on the information in the received packet each node builds the LT table. The same process is performed by H-node. Each H-node broadcasts H-node TBC initialization (HTI) packets to all L-nodes within its coverage region.

Step 3: After sending the LTI packet as mentioned in step 1, L-nodes wait some time to receive the HTI packet from the H-node. Based on the information received, L-node builds a LT table.

Step 4: Each L-node selects a cluster head by using the LT table. The L-node sends a cluster registration (CR) packet to the selected cluster head. If an L-node is in the G-isolated state, No HTI packet received by the L-node and it does not have a cluster head. Hence it does nothing.

Step 5: To collect the CR packet, each cluster head wait for some time and rebuild the LT table for its cluster members. Cluster head broadcasts cluster head declare (CHD) packets to the L-nodes, which is in its coverage region.

Step 6: On receiving the CHD packet from cluster head, each L-node update information in its LT table.

3) TBC Maintenance:

In TBC, there are two reasons to maintain the link between the nodes. So TBC make a procedure for maintaining the links. Following reasons are make the TBC to enter into the procedure.

- If the node A goes out of coverage region of B, then the node A does not receive the control packet from node B.
- To form a new link between nodes.

Procedures for L-nodes to maintain TBC:

Step 1: The information in the NT and BT is updated in the L-node.

Step 2: if node A is the cluster head of node c, the maintenance happen to obtain the route to new cluster head.

4) Cluster Head Selection:

The rule for L–node (L_i) to select the cluster head is, if N=0, L_i is not covered by any H-node. If N=1, L_i is covered by H-node. Otherwise, L_i is in the region of number of H node (N > 1). In this situation, it selects the cluster head based on the shortest path.

Procedure for forwarding packet:

Route request packet (RREQ) and route reply packet (RREP) is used for forwarding the packet. If source want to send the data to destination then it will check whether the route to destination is available in it cache if it present then it will send a data directly to the destination. Otherwise, to find a route it will send a RREQ packet to it neighbors. That RREQ packet is received by number of nodes.

If any node contains the route the destination then it will send a RREP to the source. If the route of RREQ is through the H-node then in the RREP packet from the node is not passed by using the same route, it will avoid the H-node in the path to the source. So in the point of path to H-node it will create a new route to the source by only using the L-nodes. In fig.2 it will show the path from source to destination, H is the high power node so it at as a cluster head. The source S is in one cluster group and destination D is in other cluster group. To find the route to destination, source can send the RREQ to neighbor node. The node which receives RREQ check whether it contains the route to destination, if it contain then send the route to the source by RREP. So source can send the RREQ to A that pass it to the cluster head to find the route quickly and reduce the transmission. But in the RREP from D it avoid the high power node so at the point C, it will create a new route to node A through the node M and N. That means it will take advantage of high power node B1 in RREQ and avoid high power node B1 in RREP. So it reduces the transmission delay and improves the routing performance.

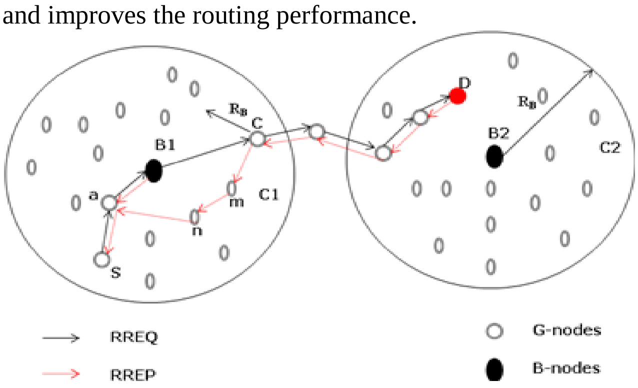

Fig.2 Routing Process

5) Route Maintenance Procedure:

When a middle node on the route detects the link failure through the BN table, the route maintenance is activated. First, a route error (RERR) packet is created and sent to the source node along the reverse route. When any middle node (including the source node) along the route receives the RERR packet, the route with the broken link will be removed from the routing cache. When the source node receives the RERR packet, a new round of route discovery procedure will be activated.

IV. ANALYSIS

***Communication between Two H-nodes**:* When two H-nodes communicate with each other; each node will create the interference area of $\pi R2H$. Hence, the total created space SH can be derived by $\pi R2H \leq SH \leq (4\pi/3 + \sqrt{3}/2)\ R2L$. If the transmission between two H-nodes is replaced by multihop L-nodes, the required channel space S space can be depicted as the shadowed region. For a route that consists of n + 1 L-nodes, it is obvious that the maximum value can be created for the linear topology. In this case, each node is located at the edge of its neighbors' coverage area, and all nodes on the route are in a line. Then,

$$SG \leq n\ (\pi/3 + \sqrt{3}/2)\ R2G + \pi R2G. \tag{3}$$

V. CONCLUSION

In this paper, developed a TBC-based routing protocol named TRPH for power heterogeneous MANETs. TRPH is considered to be a double-edged sword because of its high-power nodes. In this paper designed a TBC algorithm to eliminate unidirectional links and to benefit from high-power nodes in transmission range, processing capability, reliability, and bandwidth. It developed routing schemes to optimize packet forwarding by avoiding data packet forwarding through high power nodes. Hence, the channel space utilization and network throughput can be largely improved. Through a combination of analytical modeling and an extensive set of simulations, demonstrated the effectiveness of TRPH over power heterogeneous MANETs. A proof-of-concept system on *Microsoft WinCE* has been also implemented, and real-world experiments have been conducted and validated our theoretical and simulation findings well.

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