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A MOVABLE EFFECTIVE CLUSTERING BASED ROUTING WITH LINK QUALITY FOR POWER VARIED MANETS

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***Abstract*: The fast paced progress in the Mobile Ad Hoc Networks (MANETs) has enabled the use of a number of wireless applications on the move. These MANETs exhibit heterogeneity in the power levels. In such a heterogeneous network, different devices are likely to have different capacities and are thus likely to transmit data with different power levels. With high-power nodes, MANETs can progress network scalability, connectivity, and spreading robustness. However, the throughput of power heterogeneous MANETs can be rigorously impacted by high-power nodes. In this paper, we develop a loose-virtual-clustering-based (LVC) routing protocol for power heterogeneous MANETs, i.e., LRPH. To discover the advantages of high-power nodes, we build up an LVC algorithm to construct a hierarchical network and to eliminate unidirectional links. To decrease the interference raised by high-power nodes, we build up routing algorithms to avoid packet forward via high-power nodes. We demonstrate the system implementation and experimental results through simulations in Network Simulator [ns2].**

***Keywords:* LVC, Heterogeneous Networks, MANET, Power nodes, Routing, Virtual Clustering.**

I. INTRODUCTION

Mobile Ad Hoc Networks, or MANETs, are a type of wireless network with no fixed infrastructure. The clustering of wireless nodes for various network management purposes has been proposed by several researchers for various purposes in network management.

Most of the previous work in the literature focuses on clustering nodes for routing purposes. Srivastava and Ghosh put forth a unique approach to clustered routing with the creation of two levels of trees with the upper level forming a backbone between the lower layer clusters which also follow a tree structure. These tree structures are formed with procedure based on the goal of minimizing the number of hops between communicating nodes. Sivavakeesar and Pavlou propose a location-based routing strategy for MANETs, in which a region is broken in a matrix of overlapping, adjacent circles or zones where virtual. Clusters are based on the location of nodes within each zone. This approach looks more strictly at transmission ranges and the nature of links among nodes.

In 802.11-based power heterogeneous MANETs, mobile nodes have dissimilar 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 [7] and topology control [8]. On the other hand, the large transmission range of high- power nodes leads to large interference, which auxiliary reduce the spatial utilization of network channel resources [9], [10]. Because of different transmission power and other factors (e.g., interference, barrier, and noise), asymmetric or unidirectional links will survive in MANETs. Existing research outcome show that routing protocols over unidirectional links perform poorly in multihop wireless networks [11]. 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.

They present a loose-virtual-clustering-based (LVC) routing protocol for power heterogeneous (LRPH) MANETs. To discover the advantages of high-power nodes, we build up an LVC algorithm to construct a hierarchical network and to eliminate unidirectional links. To decrease the interference raised by high-power nodes, we develop routing algorithms to evade packet forwarding via high-power nodes. All nodes build a local aware topology (LAT) table by exchanging control packets during building LVC. Notice that the LAT table stores local topology information based on discovered bidirectional links. They present an effective scheme to discover bidirectional links. In particular, each node periodically sends a bidirectional neighbor discovery (BND) packet, containing its own information (e.g., ID, type, state, etc.) and the information on its discovered neighbors. The discovered neighbors refer to the nodes learned by the received BND packet. All nodes build aware neighbor (AN) and BN tables based on the received BND packets.

In our clustering, a loose coupling relationship is established between nodes. Based on the LVC, LRPH is adaptive to the compactness of high-power nodes. Recall that high-power nodes with a larger transmission range will create large interference areas and low channel spatial utilization. In such case, we developed routing algorithms to avoid packet forwarding via high-power nodes. We conducted general analysis, simulations, and real-world experiments to validate the effectiveness of LRPH. Simulation results show that LRPH achieves much better performance than other existing protocols. We have implemented LRPH in Microsoft WinCE environment and conducted real-world experiments. Our data matches the theoretical and simulation findings well.

II. PROPOSED SYSTEM

Clustering

In clustering procedure, a representative of each sub domain (cluster) is 'elected' as a cluster head (CH) and a node which serves as intermediate for inter-cluster communication is called gateway. Remaining members are called ordinary nodes. The boundaries of a cluster are defined by the transmission area of its CH.

Cluster architectures do not necessarily include a CH in every cluster. CHs hold routing and topology information, relaxing ordinary MHs (mobile host) from such requirement; however, they represent network bottleneck points. In clusters without CHs, every MH has to store and exchange more topology information, yet, that eliminates the bottleneck of CHs.

In active clustering, MHs cooperate to elect CHs by periodically exchanging information, regardless of data transmission. On the other hand, passive clustering suspends clustering procedure until data traffic commences [11]. It exploits on-going traffic to propagate "cluster-related information" (e.g., the state of a node in a cluster, the IP address of the node) and collects neighbor information through promiscuous packet receptions. Passive clustering eliminates major control overhead of active clustering, still, it implies larger setup latency which might be important for time critical applications; this latency is experienced whenever data traffic exchange commences. On the other hand, in active clustering scheme, the MANET is flooded by control messages, even while data traffic is not exchanged thereby consuming valuable bandwidth and battery power resources.

Proposed work

Here, we introduce the LVC algorithm. In LVC, unidirectional links in the network can be discovered using a BN discovery scheme. To exploit the benefits of high-power nodes, LVC establishes a hierarchical structure for the network. 1) BND: To eliminate unidirectional links, we present an effective scheme to discover bidirectional links. In particular, each node periodically sends a bidirectional neighbor discovery (BND) packet, containing its own information (e.g., ID, type, state, etc.) and the information on its discovered neighbors. The discovered neighbors refer to the nodes learned by the received BND packet. All nodes build aware neighbor (AN) and BN tables based on the received BND packets. Using the BN table, the BNs can be identified.

Procedures for discovering BNs

Step 1: Each node broadcasts BND packets within one hop and notices all neighbors about its type or state.

Step 2: After sending BND packets, each node waits for TBND to collect BND packets sent from its neighbors. The received BND packets will be used to construct the AN table, which stores the information (e.g., ID, type, state, etc.) of all discovered nodes. As a result,

$AN = NB\ RB(g_i) \cap NG\ RG(g_i)$.

Step 3: After waiting for TBND, each node broadcasts BND packets again. In this step, the information on the node itself and all nodes in the AN table will be added to the BND packets.

Step 4: When receiving BND packets, each node will check whether its own node information is in the BND packets. If so, a bidirectional link between the current node and the sender of that BND packet will be determined. Then, the sender of the BND packet will be added into the BN table.

As a result, $BN = NB\ RG(gi) \cap NG\ RG(gi)$.

LVC

To exploit the benefits of B-nodes, we design a novel LVC algorithm. In LVC, a B-node is chosen as the cluster head and establishes a loose coupling relationship with G-nodes. Different from the strong coupling clustering, only G-nodes under the coverage of B-nodes will participate in the clustering. Consequently, only G-nodes in the G_{member} or $G_{gateway}$ state will be involved in the clustering, whereas those nodes uncovered by the B-nodes (e.g., $G_{isolated}$) will not be involved in the clustering. Two features appear in LVC. First, the loose clustering avoids heavy overhead caused by reconstructing and maintaining the cluster when the density of B-nodes is small.

Second, LRPH protocol can be adaptive to the density of B-nodes, even when all G-nodes are in the $G_{isolated}$ state. All nodes build a local aware topology (LAT) table by exchanging control packets during building LVC. Notice that the LAT table stores local topology information based on discovered bidirectional links. The detailed procedures for constructing LVC are presented in the following.

Procedures for Building LVC

Step 1: Each G-node broadcasts G-node LVC initialization (GLI) packets to all B-nodes in the AN table. The BN information in the BN is added to GLI. Notice that GLI will only be delivered within the limited area controlled by time-to-live (TTL). Because TTL is very small, broadcasting GLI packets will not incur much overhead to the network.

Step 2: Each B-node waits for TLVC to collect GLI and build the LAT table for the local topology information local_topo_info based on the BN information in GLI. Then, the B-nodes broadcast B-node LVC initialization (BLI) packets within one hop and notices local_topo_info to all the G-nodes within its covered range.

Step 3: After sending GLI packets in Step 1, the G-nodes wait TLVC for receiving BLI packets from the B-nodes. Then, the G-nodes build LAT based on the local_topo_info received in BLI packets.

Step 4: Each G-node determines its own state based on the definitions about G-nodes and selects the cluster head using the scheme proposed in Section III-B4. Then, each node takes the following operation according to its state.

• If a G-node is in either the G_{member} or $G_{gateway}$ state, it multicasts clusters member register (CMR) packets to both the new and old cluster heads. Notice that CMR packets will only be sent to the new cluster during the initialization. Similar to the GLI packet, the information in CMR contains the BNs. The routes to the new and old cluster heads can be obtained based on the topology in LAT table.

• If a G-node is in the $G_{isolated}$ state, it cannot receive any BLI packets and does not have a cluster head.
Hence, the G-node will do nothing.

Step 5: Each cluster head waits for TLVC to collect CMR packets from its cluster members and rebuild the LAT for its cluster members. The topology information on cluster members will be managed by the cluster head. Then, the cluster head broadcasts cluster head declare (CHD) packets to the G-nodes covered by the cluster head in one hop.

Step 6: When a G-node receives CHD packets, it knows the topology information and updates the information into LAT. However, the B-node does not process received CHD packets.

After the given six steps of initialization, a hierarchical structure is established. In particular, all B-nodes build the based on the received CMR packets, and all G-nodes build LAT based on the received CHD packets.

LVC Maintenance
When links between nodes fail, the maintenance of LVC will be activated. In particular, when node n_i detects any of the following conditions based on the periodical BND packets, it enters the procedure of LVC maintenance.

• If node n_i does not receive the BND packet from node n_j in the AN table within a time window, n_j should be out of its coverage range.

• If node n_i receives the BND packet from node n_j and node n_j is not in the AN table, a new link between n_i and nj should be added.
In the following, we present the detailed procedures for G-nodes and B-nodes to maintain LVC, respectively.

Procedures for G-nodes to maintain LVC:

Step1: G-node n_i updates its node state and AN and BN tables.

Step 2:•If n_j is the cluster head of ni, the maintaining procedure need to obtain a new cluster head. First, n_i calculates the route to the old cluster head in accordance to LAT and then updates the topology information related to n_j in LAT. Second, n_i selects a new cluster head (except in the case when the state of n_i becomes $G_{isolated}$). Finally, ni multicasts CMR packets to both the new and old cluster heads n_j . Hence, at this moment, node ni registers to the new cluster head and notices the old cluster that ni is out of the transmission range of n_j .

•If n_j is a B-node but not the cluster head of n_i then n_i leaves the coverage range of B-node n_j and n_i updates the topology information on n_j in LAT.

•If n_j is G-node and in the BN table, the bidirectional link fails. G_{member} or $G_{gateway}$ nodes send the BN update (BNU) packet to the cluster head for updating the BNs.

Step 3: When a B-node receives CMR packets, it broadcast CHD packets. If the cluster head receives BNU packets, it broadcasts BNU packets again in one hop. The G-node updates the cluster and LAT information in accordance with received packets.

III. SIMULATION RESULTS

The Network Simulator ns-2.28 is used to analyse the system. The NS2 is a discrete event time driven simulator which is used to analyse the performance of a network. The following parameters give the efficiency of the proposed system.

Packet Receive Ratio
The packet receive ratio is one of the Quality of Service (QoS) metric to evaluate the performance of network.

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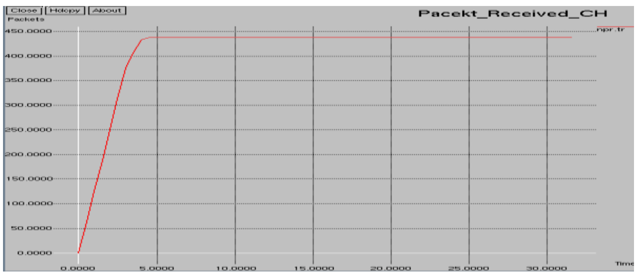

Figure 2. Packet Receive Ratio

Low packet receive ratio depletes the network performance. Figure.2 shows that the proposed system has a good packet receive ratio.

Packet Loss Ratio

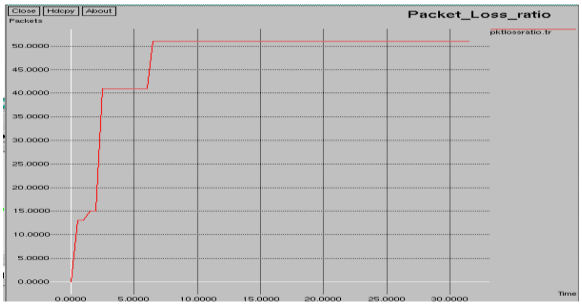

Figure 3. Packet Loss Ratio

The Packet Loss ratio is the maximum number of packets possible to be dropped by a node. Figure 3 shows that the packet loss is optimal during the data transmission.

Packet Delay

Packet Delay is the delay occurred during data transmission and it is given in figure 4.

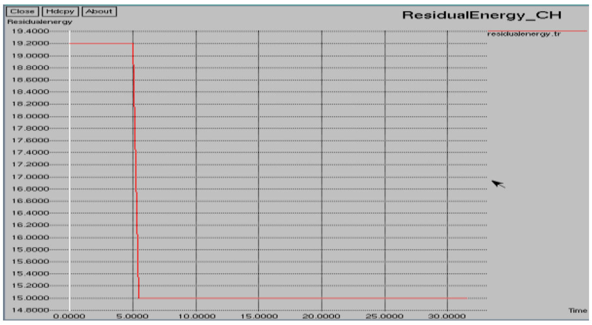

Figure 4. Packet Delay

V. CONCLUSION

An MEC based routing protocol named LRPH for power heterogeneous MANETs was developed. LRPH is considered to be a double-edged sword because of its high-power nodes. We designed an MEC algorithm to eliminate unidirectional links and to benefit from high-power nodes in transmission range, processing capability, reliability, and bandwidth. We 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, we demonstrated the effectiveness of LRPH over power heterogeneous MANETs using ns2 simulations.

REFERENCES

[1] T. Clausen, P. Jacquet, "Optimized Link State Routing Protocol", Internet Draft, draft-ietf-manet-olsr-11.txt, July 2003.

[2] Y. M. Huang, M. Y. Hsieh, H. C. Chao, S. H. Hung, and J. H. Park, "Pervasive, secure access to a hierarchical sensor-based healthcare mon- itoring architecture in wireless heterogeneous networks," IEEE J. Sel. Areas Commun., vol. 27, no. 4, pp. 400 411, May 2009.

[3] X. Zhang, Q. Gao, J. Zhang, and G. Wang, "Impact of transmit power on throughput performance in wireless ad hoc networks with variable rate control," Comput. Commun., vol. 31, no. 15, pp. 3638–3642, Sep. 2008.

[4] J. Liu, X. Jiang, H. Nishiyama, and N. Kato, "Exact throughput capacity under power control in mobile ad hoc networks," in Proc. 31th IEEE INFOCOM, Mar. 2012, pp. 1–9.

[5] D. Johnson, Y. Hu, and D. Maltz, The Dynamic Source Routing Protocol (DSR) for Mobile Ad Hoc Networks for IPv4, Feb. 2007. [Online]. Available: http://www.ietf.org/rfc/rfc4728.txt

[6] F. Ren, J. Zhang, T. He, C. Lin, and S. K. D. Ren, "EBRP: Energy- balanced routing protocol for data gathering in wireless sensor networks," IEEE Trans. Parallel Distrib. Syst., vol. 22, no. 12, pp. 2108–2125, Dec. 2011

[7] F. Li and Y. Wang, "Routing in vehicular ad hoc networks: A survey," IEEE Veh. Technol. Mag., vol. 2, no. 2, pp. 12–22, Jun. 2007.

[8] A. Boukerche, "Performance Evaluation of Routing Protocols for Ad Hoc Wireless Networks," Mobile Networks and Applications, vol. 3, pp. 333-342, 2004.

[9] B. Peltsverger, A. Shah, and S. Peltsverger, "Inter-Personnel Communications and Security Procedures," Proceedings of the Winter International Symposium on Information and Communication Technologies. Cancun, Mexico, pp. 2-7, 2004.

[10] J. Y. Yu and P. H. J. Chong, "3hBAC (3-hop between Adjacent Clusterheads): a Novel Non-overlapping Clustering Algorithm for Mobile Ad Hoc Networks,".

