A Loose Clustering based QoS Aware 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. To address this issue, we present a loose-virtual-clustering-based (LVC) routing protocol for power heterogeneous (LRPH) MANETs. To explore the advantages of high-power nodes, we develop an LVC algorithm to construct a hierarchical network and to eliminate unidirectional links to reduce the interference raised by high-power nodes; we develop routing algorithms to avoid packet forwarding via high-power nodes. Also introduce Quality based service and admission control technique for routing. Quality based service decrease the delay and energy failure. Admission control used to avoid packet loss. Providing quality of service (QoS) assurances in a mobile ad hoc network (MANET) is difficult due to node mobility, contention for channel access, a lack of centralized co-ordination, and the unreliable nature of the wireless channel. A QoS-aware routing (QAR) protocol and an admission control (AC) protocol are two of the most important components of a system attempting to provide QoS guarantees in the face of the above mentioned difficulties faced.

Keywords: QoS-aware routing protocol, MANET, LRPH, and Admission control protocol.

I. INTRODUCTION

Mobile network consists of devices with heterogeneous characteristics in terms of transmission power, energy, capacity, radio, etc. 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. IEEE 802.11 is the most popular and practical technology deployed by a communication device in a vehicular network. In 802.11-based power heterogeneous MANETs, 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. 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 network .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, and avoid energy lost of nodes. Energy lost occurs when a particular path is used for packet forwarding without using alternative path. In this paper, we develop a loose clustering based Qos aware routing protocol for power heterogeneous manets and (LVC) routing protocol for power heterogeneous MANETs, and Rate Switching mechanism(RSM). Our protocol is compatible with the IEEE 802.11 distributed coordination function (DCF) protocol. LRPH takes the double-edged nature of high-power nodes into account. To exploit the benefit of high-power nodes, a novel hierarchical structure is maintained in LVC, where the unidirectional links are effectively detected. Clustering is a known scheme to improve the performance of the networks. However, in the existing clustering schemes, each node in the network should play a certain role (e.g., cluster head, member, or gateway). We define this as a strong coupling cluster. In a strong coupling cluster, the cost of constructing and maintaining a cluster may significantly increase and affect the network performance. In our clustering, a loose coupling relationship is established between nodes. Based on the LVC, LRPH is adaptive to the density 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.

II. RELATED WORK

Quality of service and admission control used for packet transmission by avoiding energy lost of nodes and decrease delay, avoid packet lost between nodes. Here we use LVC algorithm and LRPH algorithm for high power nodes that was used in the existing paper. Because we add admission control and QoS for nodes without changing the other procedure of clustering based routing protocol. There are some routing protocols for heterogeneous MANETs. Multiclass (MC) is a position-aided routing protocol for power heterogeneous MANETs. The idea of MC is to divide the entire routing area into cells and to select a high-power node in each cell as the backbone node (B-node). Then, a new medium access control (MAC) protocol called hybrid

MAC (HMAC) is designed to cooperate with the routing layer.

A cross-layer-designed device–energy–load aware relaying (DELAR) framework that achieves energy conservation from multiple facets, including power-aware routing, transmission scheduling, and power control, is proposed. DELAR mainly focuses on addressing the issue of energy conservation in heterogeneous MANETs. A cross-layer approach to address several challenging problems raised by link asymmetry in power heterogeneous MANETs is developed. In particular, an algorithm at the network layer was proposed to establish reverse paths for unidirectional links and to share the topological information with the MAC layer. In the link layer, a new MAC protocol was presented based on IEEE 802.11 to address the heterogeneous hidden/exposed terminal problems in power heterogeneous MANETs. Our proposal considers both the advantages and disadvantages of high-power nodes. In addition, we introduce quality based service and admission control for routing the nodes.

A. QoS

The protocols discussed so far, as well as most AC protocols for MANETs described in the open literature focus on ensuring adequate capacity and upholding applications throughput requirements. This is because no multimedia or real-time application can operate without a steady stream of packets arriving at, or near, the data generation rate. Moreover, ensuring adequate capacity is a prerequisite to ensuring bounded end-to-end packet delay, since if there are insufficient transmission opportunities to transmit packets as quickly as they arrive, packet queues will form, and delays will increase. Similarly, this can lead to packet losses due to buffer overflow, and thus, ensuring adequate available capacity along a route is also one prerequisite of bounding the packet loss ratio. Consequently, while the discussed protocols, as well as those to be proposed in this paper, do not explicitly consider QoS constraints other than throughput, they form the basis of slightly extended versions of themselves, which can consider other QoS constraints. As an example, consider that AC decisions based on end-to-end delay requirements may be made by checking for adequate capacity with any of the discussed protocols, and then, sending delay-probe packets along the route.

B. Admission control

Here admission control technique is used to control packet loss. By using this technique we can control the packet lost between nodes. Admission control can be achieved by Rate Switching Mechanism. For an example at the time of route discovery the path can be selected by avoiding high power nodes, unidirectional links. After selecting the path the packets can be send threw the path for a long time. So the energy of the nodes gets decreased. At that time packet lost may occur. Consider that we set the packet lost limit up to 30 packets. If the limit is reached select alternative path. So we maintain the packet transmission away from maximum packet lost.

Consider the following path

A→B→D→G→N→Z

In this path packet lost reached over the maximum level so, we select the alternative path

A→E→I→L→F→H→Z

Source Node: A
Destination Node: Z

III. SYSTEM MODEL

A. Rate Switching Mechanism

We implemented a rate-switching mechanism inspired by the hybrid auto-rate fallback (HARF) scheme proposed in to adapt the transmission rate based on the channel's condition. Our scheme inherits HARF's main mechanisms. These include first that the transmission rate is increased if a given number of ACK frames acknowledging data frames are successfully received in a row. By contrast, the rate is decreased if a given number of ACK timeouts occur in a row (ACK misses). Furthermore, the rate is not only increased or decreased by one level, but the received signal strength indicator (RSSI) corresponding to the last received packet is used to determine whether to keep increasing or decreasing the rate. In our scheme, as opposed to HARF, the last received packet's power is compared to the receive thresholds stipulated for the various rates. In the case of rate increase, the rate continues to be increased while the received power is higher than the threshold to be exceeded for switching to the next highest rate. A similar scheme is used for decreasing the rate, until it has been reduced to a value that has a lower receive threshold than the last received packet's signal strength. This enables fast adaptation to the varying received signal strength resulting from shadowing.

As an extension to HARF's above mentioned behavior, we also use missed RTS frames (lacking a CTS response) to increase the so-called ACKs_missed count. This ensures that the rate can still be adapted even if no data frames are transmitted due to a failed RTS-CTS handshake. In our implementation, each node stores the rate that was last used for transmission to each of its neighbors with which it has communicated, as well as the numbers of contiguous missed or received ACKs. Since the transmission rate is likely to change multiple times per second, following the fluctuations due to shadowing, it is impractical to report every change to the network layer protocols. Instead, the rate in use by each packet is recorded, and the average rate is calculated in a 1 s sliding window. This average rate is rounded off to the nearest supported rate, which is reported to the routing protocol when it queries that particular link rate. Note that despite the different transmission ranges achieved by the different modulation schemes, the optimal CS range does not vary. Therefore, a fixed CS range is maintained for simulations in this work.

B. H Mobile Ad Hoc Networks

To improve the network performance and to address the issues of high power nodes, we propose an LRPH MANETs. LRPH 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.

1) Network Model

There are two types of nodes in the networks: B-nodes and general nodes (G-nodes). B-nodes refer to the nodes with high power and a large transmission range. G-nodes refer to the nodes with low power and a small transmission range. The numbers of B-nodes and G-nodes are denoted as *NB* and *NG*, respectively. Because of the complexity and high-cost of B-nodes, we assume that *NB* _ *NG*. We assume that each node is equipped with one IEEE 802.11b radio using a single channel. The theoretical transmission ranges of B-nodes and G-nodes are *RB* and *RG*, respectively. To reflect the dynamic nature of MANETs in practice, we assume that transmission ranges may be 10% deviated from theoretical values. Hence, unidirectional links may exist not only in the link between B-nodes and G-nodes but in the link between two homogeneous nodes as well. state of G-nodes in the networks can be defined as follows.

Definition 1–G isolated*: G*isolated is defined as a G-node that is not covered by any B-node.

Definition 2–G member*: G*member is defined as a G-node whose bidirectional neighbors (BNs) is covered by its cluster head.

*Definition 3–G*gateway*: G*gateway is defined as a G-node whose BNs are not covered by its cluster head.

2) LVC Algorithm

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.

- *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 *T*LVC 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 notifies *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 *T*LVC 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 *T*LVC 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 LAT based on the received CMR packets, and all G-nodes build LAT based on the received CHD packets.

- *Routing Components in LRPH*

Here, we focus on the routing components in LRPH, including the route discovery and route maintenance. In the route discovery, the route to the destination can be obtained effectively based on LVC. In the route maintenance procedure, we deal with cases such as route failure.

Route Discovery Procedure:

When source node *S* wants to send a data packet to destination node *D*, *S* first searches whether the route to *D* exists in its route cache. If the route exists, *S* directly sends the data packet. Otherwise, *S* activates the route discovery procedure to find a route to *D*. The route discovery process consists of the local routing (LR) and global routing (GR) components described in the following.

LR:

If *D* is in the LAT table, the route to *D* will be directly obtained. To reduce the interference from data transmission from a B-node, the route calculation intends to avoid B-nodes in the path.

GR:

If *D* is not in the LAT table, *S* broadcasts a route request (RREQ) packet to discover the source route to *D*. When a node receives the complete route to *D*, it replies with a route reply (RREP) packet to *S*. After *S* receives the RREP packet, it inserts the new route into its route cache and sends data packets.

If the route discovery fails for several times, data transmission will ultimately be canceled. To summarize, we highlight some unique features of our route discovery procedures. First, our technique takes the large coverage space for B-nodes to the broadcast RREQ packet. Hence, the delay from the route discovery can be improved. Second, forwarding rules for the RREQ packet is based on the state of a node and local topology information; therefore, redundant transmissions of RREQ packets can be avoided, and the overhead of the route discovery procedure can be significantly reduced. Third, our scheme intends to avoid forwarding data packets through B-nodes; therefore, the impact of B-nodes on network throughput can be largely reduced. Finally, LRPH is adaptive to the density of B-nodes for LVC. In an extreme case where no B-node exists in the network, i.e., the state of all nodes belongs to *G*isolated; LRPH becomes a routing protocol similar to classical source routing. The difference is that LRPH forwards data packets through bidirectional links and improves transmission efficiency.

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 communication between a *B-node and a G-node*. Communication between two *B-nodes* receives the RERR packet; a new round of route discovery procedure will be activated.

3) *Discussion*

The G-nodes in LRPH take more responsibility for forwarding data packets to the destination. Nevertheless, the energy consumption of G-nodes might not necessarily be faster than that of high-power nodes. In particular, for a network with light traffic load, the energy consumption of the network mainly comes from the control packets for maintaining the network, and B-nodes may consume energy faster than G-nodes. First, B-nodes in LRPH play the role of cluster head; more control information should be transmitted for the purpose of local network management and maintenance (e.g., CHD packets). Second, the energy consumption of B-nodes for transmitting per bit data is much higher than G-nodes. For the energy model, when *RG* and *RB* are 250 and 550 m, respectively. By using Quality of service and admission control for the nodes the performance of the node will be better by compare with previous paper. Also packet lost can be totally reduced.

IV. CONCLUSION

In this paper, we attached Quality of service and admission control techniques for developing an LVC-based routing protocol named LRPH for power heterogeneous MANETs. Qos develop the node performance and admission control decrease packet lost LRPH is considered to be a double-edged sword because of its high-power nodes. We designed an LVC 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.

REFERENCES

[1] V. Bhandari and N. Vaidya, “Heterogeneous multi-channel wireless networks: Routing and link layer protocols,” *ACM SIGMOBILE Mobile Comput. Commun. Rev.*, vol. 12, no. 1, pp. 43 45, Jan. 2008.

[2] Y. Huang, X. Yang, S. Yang, W. Yu, and X. Fu, “A cross-layer approach handling link asymmetry for wireless mesh access networks,” *IEEE Trans. Veh. Technol.*, vol. 60, no. 3, pp. 1045–1058, Mar. 2011.

[3] 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 monitoring architecture in wireless heterogeneous networks,” *IEEE J. Sel. Areas Commun.*, vol. 27, no. 4, pp. 400–411, May 2009.

[4] A. A. Jeng and R.-H. Jan, “Adaptive topology control for mobile ad hoc networks,” *IEEE Trans. Parallel Distrib. Syst.*, vol. 22, no. 12, pp. 1953– 1960, Dec. 2011.

[5] P. Leonardi, E. Garetto, and M. Giaccone, “Capacity scaling in ad hoc networks with heterogeneous mobile nodes: The super-critical regime,” *IEEE/ACM Trans. Netw.*, vol. 17, no. 5, pp. 1522–1535, Oct. 2009.

[6] W. Liu, C. Zhang, G. Yao, and Y. Fang, “Delar: A device–energy–load aware relaying framework for heterogeneous mobile ad hoc networks eous networks,” *IEEE J. Sel. Areas Commun.*, vol. 29, no. 8, pp. 1572–1584, Sep. 2011.

[7] J. Liu, X. Jiang, H. Nishiyama, and N. Kato, “Exact throughput capacity under power control in mobile ad hoc networks,” in *Proc. 31th IEEE*

[8] V. Shah, E. Gelal, and P. Krishnamurthy, “Handling asymmetry in power heterogeneous ad hoc networks,” *J. Comput. Network.—Int. J. Comput. Telecommunication. Network*, vol. 51, no. 10, pp. 2594–2615, Jul. 2007.