Abstract: The sensor network unreachability problem like the mobile void problem solution to the void problem is taken up as the issue. This situation which exists in the currently existing greedy routing algorithms has been improved for the wireless sensor networks. The GAR protocol is a new protocol proposed here to guarantee the delivery of packets and excessive consumption of control overheads is resolved. This protocol is a combination of the GF algorithm and the RUT scheme. To enhance this protocol’s functionality we go in for three mechanisms that can also be implemented in this thesis. The hop count reduction (HCR) scheme is utilized as a short-cutting technique to reduce the routing hops by listening to the neighbour’s traffic, the intersection navigation (IN) mechanism is proposed to obtain the best rolling direction for boundary traversal with the adoption of shortest path criterion. These three schemes are incorporated within the GAR protocol to further enhance the routing performance with reduced communication overhead.

Keywords- Greedy routing, void problem, unit disk graph, localized algorithm, wireless sensor network.

I. INTRODUCTION

The greedy routing algorithm has been studied for the unreachability problem (i.e. void problem) in the wireless sensor networks. Some of the current research work cannot fully resolve the void problem, while there exist other schemes that can guarantee the delivery of packets with the excessive consumption of control overheads. In this thesis, a greedy anti void routing (GAR) protocol is proposed to solve the void problem with increased routing efficiency by exploiting the boundary finding technique for the unit disk graph (UDG).

The proposed rolling-ball UDG boundary traversal (RUT) is employed to completely guarantee the delivery of packets from the source to the destination node under the UDG network. The boundary map (BM) and the indirect map searching (IMS) scheme are proposed as efficient algorithms for the realization of the RUT technique. Moreover, the hop count reduction (HCR) scheme is utilized as a short-cutting technique to reduce the routing hops by listening to the neighbor’s traffic, while the intersection navigation (IN) mechanism is proposed to obtain the best rolling direction for boundary traversal with the adoption of shortest path criterion. In order to maintain the network requirement of the proposed RUT scheme under the non-UDG networks, the partial UDG construction (PUC) mechanism is proposed to transform the non-UDG into UDG setting for a portion of nodes that facilitate boundary traversal.

These three schemes are incorporated within the GAR protocol to further enhance the routing performance with reduced communication overhead. The proofs of correctness for the GAR scheme are also given in this thesis. Comparing with the existing localized routing algorithms, the simulation results show that the proposed GAR-based protocols can provide better routing efficiency.

II. GAR PROTOCOL

Basically there are some mechanisms which can be implemented or incorporated in this GAR protocol to make this GAR work even better in the network. In the mechanism is explained. Those 3 mechanisms are

- Hop count Reduction
- Intersection Navigation
- Partial UDG construction.

Hop Count Reduction (HCR) Mechanism
Hop Count Reduction (HCR) Mechanism Based on the rolling-ball traversal within the RUT scheme, the selected next-hop nodes may not be optimal by considering the minimal HC criterion. Excessive routing delay associated with power consumption can occur if additional hop nodes are traversed by adopting the RUT scheme. The void node NV starts the RUT scheme by selecting N1 as its next hop node with the LIU AND FENG The HCR and the IN mechanisms.

Counterclockwise rolling direction, while N2 and N3 are continuously chosen as the next hop nodes. Considering the case that N3 is located within the same transmission range of N1, it is apparently to observe that the packets can directly be transmitted from N1 to N3.

Excessive communication waste can be preserved without conducting the rerouting process to N2. Moreover, the boundary set B forms a simple unidirectional ring based on Theorem 1, which indicates that a node’s next-hop SN can be uniquely determined if its previous hop SN is already specified. If NV is the previous node of N1, N1’s next hop node N2 is uniquely determined, i.e., the transmission sequences of every three nodes (e.g., fNV ! N1 ! N2 or fN1 ! N2 ! N3g) can be uniquely defined.

According to the concept as stated above, the HCR mechanism is to acquire the information of the next few hops of neighbors under the RUT scheme by listening to the same forwarded packet. It is also worthwhile to notice that the listening process does not incur additional transmission of control packets.

N1 chooses N2 as its next-hop node for packet forwarding, while N2 selects N3 as the next hop node in the same manner. Under the broadcast nature, N1 will listen to the same packets in the forwarding process from N2 to N3. By adopting the HCR mechanism, N1 will therefore select N3 as its next hop node instead of choosing N2 while adopting the original RUT scheme.

Consequently, N1 will initiate its packet forwarding process to N3 directly by informing the RUT scheme that the rerouting via N2 can be skipped.

III. INTERSECTION NAVIGATION (IN)

The IN mechanism is utilized to determine the rolling direction in the RUT scheme while the void problem occurs. It is noticed that the selection of rolling direction (i.e., either counterclockwise or clockwise) does not influence the correctness of the proposed RUT scheme to solve Boundary Traversal problem. However, the routing efficiency may be severely degraded if a comparably longer routing path is selected at the occurrence of a void node.

The primary benefit of the IN scheme is to choose a feasible rolling direction while a void node is encountered. Consequently, smaller rerouting HCs and packet transmission delay can be achieved. Considerable routing efficiency can be preserved as a shorter routing path is selected by adopting the IN mechanism.

PARTIAL UDG CONSTRUCTION

The PUC mechanism is targeted to recover the UDG linkage of the boundary node Ni within a non-UDG network. The boundary nodes within the proposed GAR protocol are defined as the SNs that are utilized to handle the packet delivery after encountering the void problem. As node Ni is considered a boundary node since the converged SP arc segment Spin (PS, PT) exists after Ni conducts the proposed IMS algorithm by the input of the current one-hop neighbors{N1N2N3N4Nj}.

It is noted that the boundary nodes consist of a portion of the network SNs. Therefore, conducting the PUC mechanism only by the boundary nodes can conserve network resources than most of the existing flooding-based schemes that require information from all the network nodes. The protocol defined with all these enhancements is called as the GAR – E (i.e. The Enhanced GAR) protocol.

This protocol thus stated with all these mechanisms works more appropriate and more effectively than the GAR protocol.

In order to enhance the routing efficiency of the proposed GAR protocol, three mechanisms are proposed in this section, i.e., the HCR, the IN, and the PUC schemes.
1. Networking Module.

Client-server computing or networking is a distributed application architecture that partitions tasks or workloads between service providers (servers) and service requesters, called clients. Often clients and servers operate over a computer network on separate hardware. A server machine is a high-performance host that is running one or more server programs which share its resources with clients.

A client also shares any of its resources. Clients therefore initiate communication sessions with servers which await (listen to) incoming requests.

2. Boundary Evaluation Module

The RUT scheme is adopted to solve the boundary finding problem, and the combination of the GF and the RUT scheme (i.e., the GAR protocol) can resolve the void problem, leading to the guaranteed packet delivery. The definition of boundary and the problem statement are described as follows.

Definition 1 (boundary).

If there exists a set $B$ such that 1) the nodes in $B$ form a simple unidirectional ring and 2) the nodes located on and inside the ring are disconnected with those outside of the ring, $B$ is denoted as the boundary set and the unidirectional ring is called a boundary.


The objective of the GAR protocol is to resolve the void problem such that the packet delivery from NS to ND can be guaranteed. Before diving into the detail formulation of the proposed GAR algorithm, an introductory example is described in order to facilitate the understanding of the GAR protocol.

The data packets initiated from the source node NS to the destination node ND will arrive in NV based on the GF algorithm. The void problem occurs as NV receives the packets, which leads to the adoption of the RUT scheme as the forwarding strategy of the GAR protocol. A circle is formed by centering at SV with its radius being equal to half of the transmission range $R/2$.

Algorithm

Step 1 The algorithm begins by assigning tracks to left

Step 2 The greedy routers are about to examine makes one pass over the channel the left to the right

Step 3 Contact the nearby nodes

Step 4 If path fail means dynamically search for another available node (By PUC Mechanism)

Step 5 The algorithm next locates new link (i.e. choosing another path)

Step 6 Reaching Destination

Packet Arrival Rate

The ratio of the number of received data packets to the number of total data packets sent by the source.

Path Efficiency

The ratio of the number of total hop counts within the entire routing path over the number of hop counts for the shortest path.

Communication Overhead

The average number of transmitted control bytes per second, including both the data packet header and the control packets.

Energy Consumption

The energy consumption for the entire network, including transmission energy consumption for both the data and control packets.

Application

Because of the low energy consumption and less amount of packet loss greedy routing algorithm is used for the transfer of packets. Main advantage of greedy routing algorithm is effective routing when compare to other algorithms.

4. Partial UDG Construction (PUC) Mechanism
The PUC mechanism is targeted to recover the UDG linkage of the boundary node $N_i$ within a non-UDG network. The boundary nodes within the proposed GAR protocol are defined as the SNs that are utilized to handle the packet delivery after encountering the void problem.

Therefore, conducting the PUC mechanism only by the boundary nodes can conserve network resources than most. The PUC mechanism of the existing flooding-based schemes that require information from all the network nodes.

5. Performance evaluation module

The performance of the proposed GAR algorithm is evaluated and compared with other existing localized schemes via simulations, including the reference GF algorithm, the planar graph-based GPSR and GOAFR++, schemes, and the UDG-based BOUNDHOLE algorithm. It is noted that the GPSR and GOAFR++ schemes that adopt the GG planarization technique to planarize the network graph are represented as the GPSR(GG) and GOAFR++(GG) algorithms, while the variants of these two schemes with the CLDP planarization algorithm are denoted as the GPSR(CLDP) and GOAFR++(CLDP) protocols.

Rolling-Ball UDG Boundary Traversal (Rut) Scheme

The RUT scheme is adopted to solve the boundary finding problem, and the combination of the GF and the Rut scheme (i.e., the GAR protocol) can resolve the void problem, leading to the guaranteed packet delivery. The definition of boundary and the problem statement are described as follows.

Definition 1 (boundary)
If there exists a set $B$ such that 1) the nodes in $B$ form a simple unidirectional ring and 2) the nodes located on and inside the ring are disconnected with those outside of the ring, $B$ is denoted as the boundary set and the unidirectional ring is called a boundary.

Definition 2 (Starting Point)
Each node $N_i$ can verify if there exists an SP since the rolling ball $RBN(S_i,R/2)$ bounded by the transmission range of $N_i$. According to Definition 2, the SPs should be located on the circle centered at $P_{N_i}$ with a radius of $R/2$. All the SPs will result in the red solid flower-shaped arcs.

Boundary Traversal Phase

Given $S_i$ as the SP associated with its $RBN(S_i,R/2)$ hinged at $N_i$, either the counter clockwise or clockwise rolling direction can be utilized. As shown in Fig. 2, $RBN(S_i,R/2)$ is rolled counterclockwise until the next SN is reached (i.e., $N_j$ in Fig. 2). The Unidirectional edge $E_{ij}=[P_{N_i}, P_{N_j}]$ can therefore be constructed. A new SP and the corresponding rolling ball hinged at $N_j$ (i.e., $S_j$ and $RBN(S_i,R/2)$) will be assigned, and consequently, the same procedure can be conducted continuously.

Termination Phase

The termination condition for the RUT scheme happens while the first unidirectional edge is revisited. As shown in Fig. 2, the RUT scheme will be terminated if the edge $E_{ij}$ is visited again after the edges $E_{ij}, E_{jk}, E_{kl}, E_{lm}$, and $E_{mi}$ are traversed. The boundary set initiated from $N_i$ can therefore be obtain as $B=\{N_i, N_j, N_k, N_l, N_m\}$

Concept of Boundary Map

In order to resolve the implementation issue of the boundary traversal as mentioned above, a new parameter called BM (denoted as $M_{N_i}$ for each $N_i$) is introduced in this section. Moreover, the BM $M_{N_i}$ is mainly derived from the one-hop neighbor table $T_{N_i}$ via the IMS method, as shown in Algorithm 1.

Instead of diving into the IMS algorithm, the functionality of $M_{N_i}$ is first explained. The purpose of the BM $M_{N_i}$ is to provide a set of direct mappings between the input SNs and their corresponding output SNs with respect to $N_i$. Based on Theorem 1.

The two adjacent communication links formed by the input node, the node $N_i$, and the corresponding output node within the RUT scheme consist part of the network boundary. Therefore, the direct mappings between the input SNs and their corresponding output SNs with respect to $N_i$ lead so called BM.

Enhanced mechanisms For Proposed GAR Protocol

In order to enhance the routing efficiency of the proposed GAR protocol, three mechanisms are proposed in this section, i.e., the HCR, the IN, and the PUC schemes. These three mechanisms are described as follows

Data sent from source to destination

Data sent from source (Node 1) to destination (Node 5)

1. Client has to select the receiving path
2. Router transfers the packets from client to server
3. Select the destination node
4. Packets are sent from Source node to the destination node
5. Packets have been sent without any loss

IV. RESULT AND DISCUSSION

Only packets for which a path exists to the destination are included in the graph delivery failure to a truly disconnected destination does not represent failure of a routing algorithm. However, as mentioned above, disconnection of a node is extremely rare in these simulations, as connectivity is dense. As one would expect, the decrease in precision of neighbour lists caused by the longer beaconing interval of 3 seconds results in a slightly reduced delivery success rate.
Packet Delivery Success Rate

An application packet PD delivers successfully for varying values of $B$, the beaconing interval, as a function of pause time. The same figure for DSR is included for comparison. All data points are bracketed by their 97.7% confidence interval. Note the narrow range of values on the y-axis all algorithms on this graph deliver over 97% of user packets on average. But it appears that there is little added benefit in decreasing $B$ beyond 1.5 for the simulated mobility rates and radio ranges. At all pause times simulated, GPSR delivers a slightly greater fraction of packets successfully.

The simulation results for the packet delivery rate. GLIDER+VF, Hop ID+VF, GLDR+VF, VCap+VF and ABVCapeach successfully set a path for every sourcedestination pair. In GLIDER, Hop ID, GLDR, and VCap, the greater the network density, the higher the packet delivery rate because more dead-end nodes exist in a network with lower density due to the occurrence of more holes.

GLIDER and VCap each have a lower packet delivery rate than Hop ID and GLDR, which results from the introduction of more dead-end nodes because large cells exist in GLIDER and multiple nodes share a virtual coordinate in Cap.

Packet Delivery Rate in Networks with Node Failures Fig. 5(f) illustrates the simulation results for the packet delivery rate in networks with node failure equal to 10%. The packet delivery rate of each routing protocol degrades due to node failures.

In Hop ID and Cap, a node closer to the destination can be a next hop neighbour candidate, and a next hop neighbour candidate can be a next hop neighbour only if it is closest to the destination therefore, Hop ID and VCap each...
have few next hop neighbour’s, but have multiple next hop neighbour candidates. Consequently, node failure has a small impact on the packet delivery rates of Hop ID and Cap. By contrast, GLIDER, GLDR and ABVCap each have few next hop neighbour candidates, and thus have significantly degrade dpacket delivery rates in networks with node failures. In addition, GLIDER+VF, Hop ID+VF, GLDR+VF, and VCap+VF cannot guarantee packet delivery because the boundaries of some virtual face are disconnected due to node failures.

ROUTING PROTOCOL OVERHEAD

The routing protocol overhead, measured in total number of routing protocol packets sent network-wide during the entire simulation, for GFR with varying B and for DSR. Because GPSR’s beacons are sent pro-actively (modulo data traffic with piggybacked position information), each beaconing interval results in a constant level of routing protocol traffic, independent of pause time (and though we didn’t simulate it, number of traffic flows, until application traffic becomes heavy enough to allow nodes never to send beacon packets). Because DSR is a reactive routing protocol, it generates increased routing protocol traffic as mobility increases. At all simulated levels of mobility, GFR generates less routing protocol traffic than DSR.

Note with puzzlement that while we believe we run the exact same DSR simulator code as Broch et al., we observe somewhat greater traffic load from DSR than they did in the 30-flow DSR simulations. To compare with these prior published results, we include a second DSR curve, DSR-Broch, in both for GPSR and DSR, represent means of nine simulation runs. We see little variance in the individual run results at these four shortest pause times, there is less simulation sensitivity to the particular random node placement than there is in longer-pause-time simulations.

STATE PER ROUTER

When measuring state per router, the relevant metric is the number of nodes in a router’s tables not the number of routes. Because DSR uses source routes, each route stored by a DSR router requires storage for each node along the route.

We measure both GFR’s and DSR’s average per-node state for the set of 200-node simulations with pause time 0. Because the state maintained by a node in these networks changes constantly, we take a snapshot at time 300.0 seconds in each of our 900-second simulations, and measure the state in use by each node at that instant. A GFR node stores state for 26 nodes on average in the pause-time-0, 200-node simulations. This figure depends on node density, as the only state a GPSR router keeps is an entry for each of its single-hop radio neighbours.

Note that as number of nodes and network diameter increase in the 50-, 112-and 200-node simulations stores the same quantity of state, as the density of nodes remains fixed. In comparison, the average DSR node in our 200-node, pause-time-0 simulation stores state for 266 nodes—more than the total number of destinations in the network. Implementation this cache is limited to 64 routes. While DSR might profit in robustness from a larger route cache, the state cost per node will increase dramatically as the network.

V. CONCLUSION

A UDG-based GAR protocol is proposed to resolve the void problem incurred by the conventional GF algorithm. The RUT scheme is adopted within the GAR protocol to solve the boundary finding problem, which results in guaranteed delivery of data packets under the UDG networks. The BM and the IMS are also proposed to conquer the computational problem of the rolling mechanism in the RUT scheme. between the input/output nodes.

The proposed GAR algorithms can guarantee the delivery of data packets under the UDG network. The HCR and the IN mechanism are proposed as the delay reducing schemes for the GAR algorithms, while the PUC mechanism is utilized to generate the required topology for the RUT scheme under the non-UDG Networks. Under the UDG network, while the GAR – E scheme further improves the routing performance with reduced communication overhead under different network scenarios.

REFERENCE


