Interpath Interference Minimized Multipath Routing in Wireless Sensor Networks for Multiple Source and Destination pairs

K. BhagyaLaxmi1 J. Samatha2
1,2Assistant Professor
1,2Department of Computer Science & Engineering
1,2Matusri Engineering College, Saidabad, Hyderabad, Telangana, India

Abstract— WSN provide high-quality information to be deployed. In which WSN are supported by high-bandwidth backbone networks. Even though bottleneck due to low-rate radios used and the effect of wireless interferences have been eliminated with the help of Interference minimized multipath routing(I2MR) protocol and congestion control scheme still the problem of inter path set interference between the different source and destination pairs is not resolved. In order to implement this, the source and destination pairs to be suitably spaced out. The R12MR protocol resolves this problem by selecting one path (which is currently free) out of three zone-disjoint paths between a pair of source and destinations.

Key words: Wireless sensor networks, wireless interference, multipath routing, Inter path set interference

I. INTRODUCTION

A high-bandwidth backbone network can be deployed to support the WSN, high-rate streaming in a WSN is still very challenging due to three reasons:

1) First, the low-power and low-rate radios used which result in insufficient throughput. Multipath load balancing with link-disjoint paths commonly used in wired networks to increase the throughput.

2) Second, multipath load balancing in wireless networks can be done by using node-disjoint paths to ensure path diversity. However, for effective multipath load balancing in a wireless network, [1] node-disjointedness is not sufficient. This is due to route coupling that is caused by wireless interferences during simultaneous transmissions along multiple paths. Therefore, a set of physically separated i.e., zone-disjoint shortest paths that minimize both inter- and intra path wireless interferences have been discovered and used for load balancing to increase throughput.

3) Third, nodes may interfere beyond communication ranges, thus complicating the discovery of maximally zone-disjoint shortest paths. If nodes interfere beyond communication ranges, simply determining the connectivity between them is not sufficient to determine if they interfere with each other during concurrent transmissions.

The most obvious solution is to use location information of the nodes and directional antennas. Unfortunately, both require special hardware support, making them impractical for resource-constrained WSN. [2] Therefore, it is crucial to consider the effects of both inter- and intra-path wireless interferences when considering the multipath load balancing problem, taking into account that nodes may interfere up to twice the communication range. To resolve these problems, First path set evaluation Technique called conflict graph has been proposed in order to capture the effect of wireless interference. With conflict graphs the total interference correlation factor (TICF) for node-disjoint paths is discovered.

II. PATH-SET EVALUATION FOR MULTIPATH LOAD BALANCING

A. Multipath Load Balancing in Wireless Networks

Consider a general network with N nodes, which can be modeled using a connectivity graph G(V,E) where V is the set of N nodes and E is the set of directed links connecting the nodes in V. [1] Wireless interferences in a wireless network can be modeled using either the protocol model of interference or the physical model of interference. Due to the simplicity of the protocol model and also that it represents the worst case effects of wireless interferences, it will be used. To simplify the analysis, assume that all the nodes in the wireless network have a uniform transmission range of T and a potentially larger interference range of I, where T ≤ I ≤ 2I. Considering the worst-case scenario, let I = 2I. Assume that no physical carrier sensing is used. A static single-channel static wireless network can similarly be modeled using a connectivity graph G.

B. Correlation Factor Metric

The correlation factor metric is used to describe the degree of wireless interferences between two node-disjoint paths. The correlation factor [4] of two node-disjoint paths is defined as the number of links connecting the two paths, which can be easily inferred from the connectivity graph G of the wireless network. [4] The main limitation of using the connectivity graph G of the network to derive the correlation factor metric is that the additional physical constraint that nodes may interfere beyond communication ranges (i.e., T ≤ I ≤ 2I) cannot be captured. Another limitation is that the correlation factor metric only captures the effects of interpath interferences between two node-disjoint paths, but it is not able to capture the effects of intrapath interferences along individual paths.

III. REVISED INTERFERENCE-MINIMIZED MULTIPATH ROUTING PROTOCOL

R12MR protocol is the extended version of I2MR, which overcomes the limitations of existing I2MR, and which takes into the affect of inter path interference for multiple source and destination pairs.

A. Overview of I2MR

The problem is being defined as a multipath and multi hop routing problem, where the sources the sensor node with EO and the final destination is the backbone node connecting directly to the gateway nodes. The source attempts to construct up to three zone-disjoint paths (i.e., primary,
secondary, and backup paths) to the final destination, as shown in Fig.1.

![Diagram](image)

Fig. 1: Zone-disjoint paths from source to final destination

The gateway nodes along these paths will be known as the primary, secondary, and backup destinations,[5] respectively. The source uses both primary and secondary paths concurrently for load balancing and switches to the backup path only when either path fails, thus minimizing path rediscovery overheads. The rationale of using two paths for load balancing [3]is that there is little or no gain in aggregate throughput from using more than two paths.

The source initiates path discovery to the final destination. The three basic steps of path discovery for I2MR are:

1) Primary Path Discovery
   - The objective is to construct shortest paths back to the source. Paths constructed are outside the interference zone construct the shortest path from source to primary destination that minimizes intrapath interference[6]. We modify the path discovery of AODV, where the source searches a route by flooding an RREQ packet. We choose to modify the path discovery of AODV because on-demand protocols are more suitable than table-based protocols and AODV is more scalable than DSR [2]for large-scale WSN. Ensuring minimum spacing between neighboring nodes along a path minimizes intrapath interference and by allowing only the primary destination reply with RREP to the first RREQ it receives ensures the shortest path discovered.

2) Interference-Zone Marking
   - The objective is to mark the interference zone of the primary path [1]with minimum control bytes transmitted (i.e., low overheads), so that nodes marked as within the interference zone of the primary path do not participate in the path discoveries for both secondary and backup paths. Interference-zone marking involves three simple steps:
     - Sector marking: Assigns nodes along primary path as Sector Heads (SHs) and classifies their neighbors into their respective sectors,[5] Overlapped regions of adjacent sectors are also identified. Sector marking is done during the RREP phase of primary path discovery and is shown in Fig.2.
     - Broadcast Zone-marker Potential (BZP) assignment: Assigns different BZPs for different regions of each sector. Nodes that are not in the overlapped regions[5] and furthest away from their respective SHs are assigned higher BZPs, as shown in Fig. 3. Fig. 4 lists the possible BZP assignments in decreasing priorities. BZP assignment is initiated by the source sending an RMARK packet along the primary path to the primary destination.

![Diagram](image)

Fig. 2: Marking sectors and overlapped regions

Fig. 3: Assigning different BZPs for different regions of a sector

Fig. 4: BZP assignments in decreasing priorities.
3) Secondary and Backup Path Discovery
The objective is to construct the shortest secondary and backup paths from the [4]secondary and backup destinations, respectively, back to the source that minimize intrapath interference and are outside the interference zone of the primary path. Using known location information of the source and gateway nodes (i.e., primary, secondary, and backup destinations): First, the final destination [6] determines the source quadrant with respect to the primary destination. Next, the preferred quadrants with respect to the primary destination, [3] from which to select the secondary and backup destinations, are determined.

B. Revised Interference Minimized Multipath Routing Protocol
In order to eliminate the limitation of I2MR protocol, the RI2MR reduces the interpath interference for multiple source and destination pairs. Hence here, the possible solution is that paths between any single source and destinations pairs are supposed to be selected as zone-disjoint. And also path sets (primary, secondary, and backup paths) for different source and destination pairs are also to be zone-disjoint. i.e. the node in one zone-disjoint path set are not included in another source – destination pairs paths. But if this is the case at some moment it may practically become impossible to find paths between source and destinations. Because only few nodes may left over which are supposed to be participated in the path discovery process. This may lead to dropping of sending data as there are no paths.

To overcome this, as explained according to the I2MR at an instance only two paths participate in data transmission from source to destination[2] out of three path (primary, secondary, and backup), and third will be used only when there is failure in any one of two nodes.

According to this we can utilise the third path nodes which is free, in the zone disjoint path discovery of remaining source destination pairs. In order to implement this extra technology is required to keep track of maintaining information about which path of source-destination pair is dropped and which nodes are involved in that particular path. So that the node which are free can be made to participate in path discovery of other source and destination pairs.

IV. CONCLUSION
Interpath interference between the different source and destination pairs can be eliminated by selecting the path set of one source destination pair is to be zone disjoint form other pair. But due to which the nodes participating in the path discovery may reduce. So that we need to consider all the node which are free at the moment of path discovery.

V. LIMITATIONS
In order to maintain the information about which path is free RI2MR may require additional technology and memory.

REFERENCES