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A PATH FOR HORIZING YOUR INNOVATIVE WORK

ROUTES STABILITY IN AD HOC NETWORKS USING HOP COUNT OF NODE-DISJOINT AND LINK-DISJOINT MULTI-PATH ROUTING PROTOCOL

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Abstract: The high-level contribution of this paper is a simulation-based analysis to provide benchmarks for the stability and hop count of node-disjoint and link-disjoint multi-path routes in mobile ad hoc networks. For a given source s and destination d, the stability of a link-disjoint and node-disjoint multi-path routing approach is the number of multi-path sets of s-d routes determined over the duration of a network simulation session. We persist with the determined multi-path set of s-d routes as long as at least one path in the set exists. The average hop count of a multi-path set of s-d routes is the time averaged hop count of the constituent s-d routes according to the duration of their utility. We observe that for different conditions of network density and node mobility, node-disjoint paths are as stable as link-disjoint paths and also there is not much difference in the hop count of these paths.

Keywords: Routes Stability, Link-Disjoint, Multi-Path

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INTRODUCTION

A Mobile ad hoc network is a collection of mobile nodes that can communicate with each other using multi-hop wireless links without utilizing any based station infrastructure and centralized management. Each node in the network acts as both a host and a router. The design of an efficient and reliable routing protocol in such a network is a challenging issue.

On-demand routing protocols in particular, are more preferred because they consume much less bandwidth than table-driven protocols. Ad hoc On-Demand Distance Vector (AODV) and Dynamic Source Routing (DSR) are the two most widely studied on-demand ad hoc routing protocols. Previous works have shown limitations of the two protocols. The main reason is that both of them build and exhaustively use single path route for each data session. Whenever communication link breaks on the active route, each protocol has to invoke a route discovery process. Route discovery flood is associated with significant latency and overhead. Besides, exhaustively using a single path causes for nodes faster consume energy and high traffic load on the path. Therefore preventing concentration on a single path and distribution of energy and traffic load on whole network is a new challenge.

On-demand multi-path routing protocols can alleviate these problems by establishing multiple paths between a source and a destination in a single route discovery. A new route discovery is invoked only when all of its routing paths fail or when there only remains a single path available. The main focus is not choosing multi-path or single path, but how to discover maximum possible complete node-disjoint paths. Discovery of complete node-disjoint multipath has been proposed . Although these protocols build multiple paths on demand, most of them could not guarantee to find all available complete disjoint paths even though they use much complex methods.

2.PROPOSED SYSTEM

2.1 Algorithms to Determine Set of Lin-Disjoint and Node-Disjoint Paths

We now explain the algorithms we used to determine the sequence of link-disjoint and node-disjoint paths for our simulation studies. Let *G* (*V*, *E*) be the graph representing a snapshot of the network topology collected at the time instant in which we require a set of link-disjoint or node-disjoint routes from a source node *s* to a destination node *d*. Note that *V* is the set of vertices (nodes) and *E* is the set of edges (links) in the network. We say there is a link between two nodes if the distance between the two nodes is less than or equal to the transmission range of the nodes. We assume all nodes are homogeneous and have identical transmission range. Figures 1 and 2 respectively illustrate the algorithms to determine the set of link-disjoint and node-disjoint *s-d*routes on a graph *G* collected at a particular time instant. Let *PL* and *PN* be the set of link-disjoint and node-disjoint *s-d* routes respectively. We use the DijkstraO(*n*2) algorithm to determine the minimum hop *s-d* path in a graph of *n* nodes. If there exist at least one *s-d* path in *G*, include the minimum hop *s-d* path *p* in both the sets *PL* and *PN*. Determine the minimum hop *s-d* path in the modified graph *G*', add it to the set *PL* and remove the links that were part of this path to get a new updated *G*' (*V*, *E*'). Repeat this procedure until there exists no more *s-d* paths in the network. The set *PL* is now said to have the link-disjoint*s-d* paths in the original network graph *G* at the given time instant. Similarly, to add more paths to *PN*, remove all the intermediate nodes (nodes other than the source *s* and destination *d*) that were part of the minimum hop *s-d* path *p* in the original graph *G* and obtain the modified graph *G*" (*V*'', *E*''). Determine the minimum hop *s-d* path in the modified graph *G*'' (*V*'', *E*''), add it to the set *PN* and remove the intermediate nodes that were part of this *s-d* path to get a new updated *G*" (*V*'', *E*''). Repeat this procedure until there exists no more *s-d* paths in the network. The set *PN* is now said to contain the node-disjoint *s-d* paths in the original network graph *G*. Note that when we remove a node *v* from a network graph, we also remove all the links associated with the node (i.e., links belonging to the adjacency list *Adj-list*(*v*)) where as when we remove a link from a graph, no change occurs in the vertex set of the graph .The two algorithms could be implemented in a distributed fashion in ad hoc networks by flooding the route request (RREQ) message, letting the destination node to select and inform about the link-disjoint and node-disjoint routes to the source by using the route reply (RREP) packets. The source could then use these routes in the increasing order of hop count (i.e., use the least hop count route until it exists and then use the next highest hop count path as long as it exists and so on) or distribute the packets through several paths simultaneously such that the paths with minimum hopcount being used more.

Input: Graph *G* (*V*, *E*), source *s* and destination *d*

Output: Set of link-disjoint paths *PL*

Auxiliary Variables: Graph G' (*V*, *E*')

Initialization: *G*' (*V*, *E*') _ *G* (*V*, *E*), *PL*

Begin

1 **While** ($ at least one *s-d* path in *G*')

2 *p* _ Minimum hop *s-d* path in *G*'.

3 *PL* _ *PL*U {*p*}

4 *edge*,*e*Î*pG*' (*V*, *E*') _ *G*' (*V*, *E*'-{e})

5 **end While**

6 **return** *PL*

End

Fig. Algorithm to Determine the Set of Link-Disjoint Paths

Input: Graph *G* (*V*, *E*), source *s* and destination *d*

Output: Set of node-disjoint paths *PN*

Auxiliary Variables: Graph G'' (*V*'', *E*'')

Initialization: *G*'' (*V*'', *E*'') _ *G* (*V*, *E*), *PN*

Begin

1 **While** ($ at least one *s*-*d* path in *G*'')

2 *p* _ Minimum hop *s*-*d* path in *G*''.

3 *PN* _ *PN*U {*p*}

4 "*vertex v p v s d*

edge e Adj list v

G''(*V*'',*E*'')_*G*''(*V*''-{*v*},*E*''-{e})

5 **end While**

6 **return** *PN*

End

Fig. Algorithm to Determine the Set of Node-Disjoint Paths

2.2ALGORITHM TO FIND ENERGY EFFICIENCY IN MANETS BYMULTI-PATH ROUTING

The proposed algorithm counts the number of active neighbors for each path,and finally it chooses some paths for sending information in which each node has lower number of active neighbors all together. Here, active neighbors of a node are defined as nodes that have previously received the RREQ. There is this possibility that source and destination choose another path with nodes to exchange information; thus, information exchanging depends on this path. In fact, these two nodes are on two disjoint but adjacent paths.

SOURCE NODE PSEUDO CODE IN THE SUGGESTED ALGORITHM

1.Send the corresponding path PPEP for all the nodes that you have received the RREQ packets.

DESTINATION NODE PSEUDO CODE IN THE PROPOSED ALGORITHM

1. If you received the RREQ packet and this packet is acceptable, do the following steps. Otherwise, dismiss the packet.

a. Put this packet's specification into the RREQ_Seen table.

b. Prepare the RREQ_QUERY packet and assign it a value.

c. There is a question on this packet that asks: Have you seen such a request packet before?

d. Send the RREQ_Query packet to your neighbors

e. Wait a specific period of time for your neighbors to reply

f. Increase the Active Neighbor Count with regard to the number of accepted replies.

g. Rebroadcast the RREQ packet

2. When you received the RREQ_Query packet, perform the following actions:

a. With regard to the RREQ_Seen table, if you have not seen this RREQ before, dismiss the packet and don't consider it.

b. According to the REQ_Seen table, if you have seen this RREQ before, inform the query node by sending aRREQ_Query_Reply packet then add one uniteto the After_A_N_C field of the corresponding RREQ in its RREQ_Seen table.

3. If you have received the RREQ_Qeury_Reply packet, add one unite to this RREQ's Active Neighbor Count field.

4. When you receive the RREP packet, add the corresponding after_a_n_c to active neighbor count field of RREP packet and send it.

MIDDLE NODE PSEUDO CODE IN THE PROPOSED ALGORITHM

3. SIMULATION

The results of simulations and a comparison between the proposed algorithm and other existing algorithms are presented in this section. For this purpose, the following algorithms have been compared with each other in various scenarios:

• The proposed multi-path routing algorithm, which is presented as ZD-AOMDV in

graphs and results.

• AOMDV

• AODVM

• IZM-DSR

3.1. Simulation Environments

In this study, GLOMOSIM is used for the simulation. For this purpose, we have compared the proposed algorithm with AOMDV algorithm in various scenarios. Conditions, simulation environment and simulation results are presented in this section. In these simulations, both algorithms use three paths for sending data simultaneously.

50 nodes with radio range of 250m in an environment with the dimension of 750x750m are used for simulation. In such status, nodes have random movement with using the Random Waypoint mobility model. In this model, each node randomly selects a point as a destination. After the node reaches to destination, it stays at the same point for the duration of Pause Time and again it repeats the same action.

3.2. Simulation Metrics

Five important performance metrics were evaluated in our simulation: (i) End-to-End Delay Average –this includes all possible delays caused by buffering during route discovery phase, queuing at the interface queue, retransmission at the MAC layer, propagation and transfer delays. (ii) Packet Delivery Ratio, (iii) Routing Overhead Ratio – the number of routing packets per each data packet. (iv) Energy Consumption. (v) Number of Dead Nodes

4.CONCLUSION

In this paper we analyze the stability and hop count of link-disjoint and node-disjoint routes through extensive simulations under different network scenarios and compare theperformance with minimum hop single path routing. A significant observation is that the link-disjoint multi-paths are only 15-30% more stable compared to node-disjointmulti-paths with often negligible difference in the average hop count. Simulation results indicate that with an average neighborhood size of 10, the number of minimum-hop single path route discoveries is around 1.6 times the number of node-disjoint/ link-disjoint multi-path route discoveries, whereas with an average neighborhood size of 30, the number of minimum-hop single path route discoveries is around 4 times the number of the link-disjoint/ node-disjoint multi-path route discover. Using the link-disjoint and node-disjoint algorithms discussed in this paper, it is possible to determine a sequence of link-disjoint and node-disjoint routes that are highly stable compared to the minimum hop single path routing approach and at the same time there is no need to use paths with significantly higher hop count. Future work would involve analyzing the energy consumption aspect of multi-path routing and studying the effect on node lifetime.

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