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Minimal Routing Cooperation using Route Weight for MANET

Neha Tripathi[1], Vivek Kumar[2], K.S. Raghuwanshi[3]

Abstract

Now days people moves to flexible and wireless network facilities hence Mobile ad-hoc network and sensor networks are growing very fast. Ad-hoc network can performed great task using multi-hop communication in such environment where dedicated infrastructure is hard to established, where node are movable and topology changes rapidly. Such type of network have to suffer with several constraints for example limited energy of nodes, information of the coordinate location of the mobile nodes at any geographical location, and need of real-time or multi-cast communication. Lots of research has been done in this field as importance and challenges in this field for covering various situations. This paper gives detail classification of the ad hoc routing protocols and to survey and proposed a new method for effective route discovery. Proposed scheme is based on total delay of path and remain power of path for selection route between source and destination. Proposed method is expected to be more effective and efficient route discovery from existing.

Keywords

Ad hoc networks, sensor networks, routing protocols, delay, remaining power, route discovery.

1. Introduction

Wireless local area networks grow to be one of the most everywhere of networking with portable nodes. The user wants the mobile phone or laptop is to access to a website positioned around the world, the best policy is to get away as quickly as possible from the problems of wireless area and come in the consistency of fibre optic networks and time-tested networking practice. During such system, all the nodes join to an access point which generally has a wired link to the Internet.

NehaTripathi, Department of Computer Science and Engineering, Oriental College of Technology, Bhopal, India.
Vivek Kumar, Department of Computer Science and Engineering, Oriental College of Technology, Bhopal, India.
Dr. K. S. Raghuwanshi, Department of Computer Science and Engineering, Oriental College of Technology, Bhopal, India.

In this state the nodes connected to the identical wireless LAN exchange data with each other only indirectly.There are a lot of essential purposes where this form is not valid. Primary, still if the objective is Internet access, the access point might not be capable to face all the significant nodes due to restrictions in transmission range, cost or access rights concern. An additional situation is when Internet access is not preferred, the central application being to communicate close by among a collection of nodes.
These situations can be examines only if allow some routing hops to be achieved in the wireless area. Such networks can be group in any position in an ad hoc mode, without the required of an full setup wired infrastructure.These networks are known as ad hoc wireless networks [1], other proposed names being infrastructure less wireless networks, instant infrastructure and mobile-mesh networking [2]. One of the major technological challenges of such networks is that they require new types of routing protocols. As opposed to the wired infrastructure, there are no dedicated router nodes: the task of routing needs to be performed by the user nodes, which can be mobile, unreliable and have limited energy and other resources.

2. Different Routing Protocols and Comparisons

Many of routing algorithms proposed till now for MANET routing protocol from various researchers.
All work have done in field of routing protocol aim to minimize delay and packet loss and try to maximize throughput with control overhead and energy minimization. But the priority of every work is different as their applicable area. Among these solutions some applications combined with other technology where some are proposed a unique solution for problem removing.
Thus, the performance expectations of the ad hoc networks differ from application to application and the architecture of the ad hoc network, thus each application area and ad hoc network type must be evaluated against a different set of metrics.
Table 1 shows a summary of all protocol have been proposed till now with its characteristics, advantage and disadvantages.

Table 1: Various routing algorithm comparison

Traffic Allocation Method	Based on Protocol	Route Selection Criteria	Single Path / Multi Path	Category	Advantage	Disadvantage
Packet Scheduling method	AODV	Data Packets and Control Packets are buffered in Queue for route selection	Single Path	Traffic Based	End-to-end delay is reduced with respect to pause time. Packet delivery ratio as compared to other scheduling method is increased.	Performance is reduced when mobility of nodes in MANET is high.
Weighted Hop Scheduling	AODV	Higher weights are assigned to those data packets has less remaining hops to traverse from source to destination	Single Path	Traffic Based	It avoids the starvation problem and high traffic on only some nodes in network.	In low mobility average delay is dominated by network congestion and in high mobility it is dominated by route changes.
RTLB		ETX link to estimate transmission count	Multi path	Traffic Based	In this method, each intermediate node consumes minimum energy to forward data packets in network. When traffic increases in network, the relaying node at center becomes congested. RTLB finds better route by balancing traffic and avoids congestion in centre of network.	It consumes time to route to discover routes, propagation of RREQ packets and transmission of RREP packets.
Efficient Path Routing	AODV	By considering distance and delays along with data rates	Multi path	Traffic Based	Calculates high throughput path in high traffic network. it also maintains quality of service.	Determination of correct cut-off conditions to decide high throughput path is difficult in dynamic environment.
VAP		Differentiate between Reliable and Un-Reliable nodes by classifying their velocity	Multi path	Traffic Based	It identifies the link failures in network and retransmission is suppressed through unreliable nodes. Decrease overhead of routing packets.	Stability of route depends on stability of network.
SWAP	VAP	With reliable and unreliable nodes	Multi path	Traffic Based	The total net effect is reduces the number of generated RREQ packets.	Not stable in congested area.
AVAP	SWAP	By proper Probabilistic function and timer	Multi path	Traffic Based	By using velocity vector information it avoids the route rediscovery phase. As the number of nodes increases in network, link failure reduces. It is stable in congested network.	More complicated and difficult Probabilistic function is used in algorithm.
TAODV	AODV	Query localization technique	Multi path	Traffic Based	It brings the route request packet physically closer to its destination node to avoid unnecessary traversing in whole network. packet delivery ratio is	Qualitative performance analysis is limited.

Traffic Allocation Method	Based on Protocol	Route Selection Criteria	Single Path / Multi Path	Category	Advantage	Disadvantage
					increased.	

In the reminder of this paper, we organize the discussed routing protocols into nine categories based on their underlying architectural framework as follows-

- Source-initiated (Reactive or on-demand)
- Table-driven (Pro-active)
- Hybrid
- Location-aware (Geographical)
- Multipath
- Hierarchical
- Multicast
- Geographical Multicast
- Power-aware

3. Literature Review

Reliability and power management is critical for the sensors/actuators network in wireless monitoring systems based on WSANs [3] with a limited amount of energy to spend. To overcome this problem paper [3] gives the cooperative-based routing algorithm to assurance a good performance trade-off among reliability and power efficiency techniques of wireless monitoring scheme. Authors have been quantify the impact of the proposed algorithm on the in general monitoring system reliability and energy efficiency and a compare with presented with the traditional Ad-hoc On-Distance Vector (AODV), the cooperation along the shortest non-cooperative path (CASNCP) and minimum-power cooperative routing (MPCR) algorithms.

Another method proposed in paper [4] by energy-efficient GR algorithms: ORF and OFEB to extend the network lifetime and to get better other network performance metrics. The results for this scheme with existing GR algorithms including MFR and NFP shows effectiveness of this method. New ORF algorithm picks as the next hop node the node nearest to the optimal transmission range and therefore minimizes the energy consumption. Second new OFEB algorithm chooses the next hop node as the node that minimizes the energy consumption. This is a node that has the best combination of energy reserves and needs the minimum energy to be reached. The weight factor a determines the relative significance placed on these two requirements.

Paper [5] has illustrated Reliability Map Routing (RMR) protocol for tactical mobile ad hoc networks that need high consistency. Authors have introduced a reliability function by the degrees of reliability of spatial position, unidentified land can be described. Results specify that the spatial maps of network reliability that are in use by RMR prove low sensitivity to node mobility. The RMR protocol successfully discover routes throughout reliable and trustworthy area, keep away from potentially untrustworthy or compromised regions based on trust management signals transmitted by the nodes. The results specify that a great packet delivery ratio (PDR) and a less average delay can be accomplishing end-to-end. The RMR protocol performs well in fast mobility, more density set-up due to its proscribed routing overhead and spatial approach, and is suitable for tactical mobile ad hoc networks.

In this paper [6], authors have deal with the optimal constraint tuning of the OLSR routing protocol to be used in VANETs by using a regular optimization tool. For this task, author distinct an optimization policy based on coupling optimization algorithms (PSO, DE, GA, and SA) and the ns − 2 network simulator. Also evaluate the optimized OLSR configurations with the standard one in RFC 3626 as well as with human expert configurations set up in the current state of the art. In turn, validated the optimized configurations found by comparing them with each other and with the standard tuning in RFC 3626 and studying their performance in terms of QoS over 54 VANET scenarios.

The paper [7] inspects the longevity of wireless sensor networks. Wireless sensor network routing algorithms are broadly categorize into two class, flat multi-hop routing algorithms, which are superb in their capacity in minimizing the whole power utilization of the network by proficient transmission space, and hierarchical multi-hop routing algorithms, which reduce the amount of data flow in the network by capitalizing on the extremely associated nature of the collected data by apply data aggregation. In both class, sink node isolation bound the longevity of the wireless sensor network. Authors have proposed HYMN and exposed through mathematical analysis the energy consumption and the conditions for optimality of HYMN. In conclusion, HYMN is hopeful in terms of its capability to get better the longevity of wireless sensor networks.

Several modification of the ad-hoc on-demand distance vector (AODV) [8] has been projected in the literature to develop the QoS in WSANs and eventually in WBANs. In [9] a QoS routing protocol is offered that set up routes with a set to the side bandwidth. In [10], a protocol is launch in order to achieve path finding simultaneously with time slot scheduling time division multiple access (TDMA).

In [11] author used bandwidth by PDR. This method provides high PDR with lower overheads. But also make longer end to end delay have to pay. Most of protocol performance gets lower when congestion occurs. Although recent AODV modifications include load-balancing operations during the route set-up, once the path is fixed they cannot efficiently deal with a dynamic environment because of for instance flash crowds, burst traffic, transient congestion and mobile nodes [12,13,14,15,16, 17].

Newly, the chance of initiate cooperation communication to advance monitoring system performance has been suggested in [18, 19,20]. Also literature scheduling and topology control algorithms have been proposed to improve the network energy efficiency [21, 22, 23, 24,25, 26]. Moreover in [27] distributed routing algorithms are describes, such as minimum-power cooperative routing algorithm (MPCR) and the cooperation along the shortest non-cooperative path (CASNCP) algorithm. The first algorithm takes into consideration the cooperative communications while constructing the minimum-power route. The resulting power formulas for direct transmission and cooperative transmission are utilized to construct the minimum-power route. It can be distributive implemented by the Bellman Ford shortest path algorithm. The CASNCP algorithm is a heuristic algorithm that applies cooperative communications upon the shortest-path routes [27].

4. Cooperation-Based Ad-Hoc Routing Algorithm (C-AODV)

The AODV routing protocol [17] is one common routing algorithm in ad hoc networks and is based on the principle of discovering routes as needed. Every node keep record of each it adjacent node by sending hello or beacon message after every fixed time interval. Whenever any node wants to communicate with other node that is not in its direct transmission range it start route discovery process, for route discovery to destination node route request packet (RREQ) is to be broadcast to all its neighbours. This RREQ packet mainly contains source address, destination address, sequence number as unique ID and message life time in network.

When neighbour nodes receive any RREQ packet, they update their routing tables for a reverse route to the source. When this RREQ packet reached to destination node it sends request reply packet (RREP) in the reverse paths from which path RREQ received. If source node gets multiple RREPs the route with the shortest path is selected. Route maintenance is necessary to keep track of all nodes current update that how many nodes are in transmission rang for better route discovery performance, this method keeps track of its neighbours by listening for a hello or beacon message that each node broadcasts at regular intervals. If any route is unused for some time that means a node is not sure for the route validity and hence the node need to eliminate this route from its routing table. Sequence numbers serve as time stamps allowing nodes to determine the timeliness of each packet and to prevent the creation of loops.

A higher sequence number refers to a fresher route. AODV is also able to handle changes in routes and can create new routes if there is an error.

If any node is not in network more or not taking part in route discovery process due to power off or other problem reported as bad node. This type of node is reported as route error (RERR) to destination node. If any node gets an RERR, it checks its routing table and deletes all the routes that contain this bad node. If data is flowing and a link break is detected, an RERR packet is sent to the source of the data in a hop-by-hop fashion. As the RERR forward towards the source, each intermediate node invalidates routes to any unreachable destinations.

AODV routing based on two steps first one is route discovery and second one is route maintain [18]. A source node initiates a route discovery procedure by sending out a flood of RREQ messages, and each node receiving an RREQ will rebroadcast it. As discussed when RREQ reached to destination it resend RREP packet to source node in reverse path by its entire neighbour node. Hence an intermediate node can received multiple RREP messages. Routing table of every node is updated as according to fresher

RREP route having shorter route or the smaller path regarding its quality. With the C-AODV algorithm [3] do not eliminate the previous information of the RREP relating to the alternative paths to a destination but store it in a routing table as alternative path. By doing so, at the end of the route discovery phase, each node has in its routing table both the current next hop and the alternative ones to use to send data to a specific destination node. C-AODV algorithm during the route maintenance phase, each node uses the HELLO packet to inform periodically the neighbour nodes about its queue length.

In this way, each node can check if the queue length becomes congested if its length is above a specified congestion threshold (e.g. 60% of the buffer size). Another reserve path is used for communication.
In what follows describe the aforesaid phases for the scenario depicted in Fig. 1a. During the route discovery phase (Figs. 1a and 1b), node Si1 wishes to communicate with the sink node, and so it sends a flood of RREQs to the intermediate nodes. Let us suppose that the intermediate node Si1 receives first RREP1 from the sink node through the path Si2 2 Si5 (Fig. 1b). When node Si1 receives RREP2 through the path Si3 2 Si6, it uploads its routing table by selecting Si3 as an alternative next hop to the sink node.

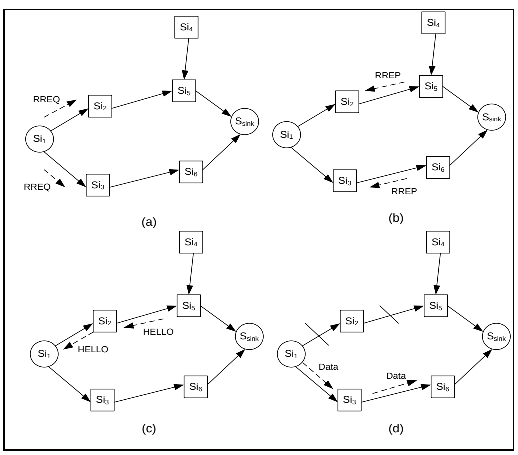

Figure 1: Protocol phases

(a) Discovery phase – RReq packets
(b) Discovery phase – RRep packets
(c) Maintenance phase – HELLO packets
(d) Cooperative algorithm–switch to alternative path.
Notice that, in contrast to the standard AODV protocol, the information about the alternative route to the sink destination from the intermediate node Si3 is stored in the routing table of node Si1 as 'alternative' next hop information. During the maintenance phase, node Si1 uses the path Si2 2 Si5 and periodically receives information about the queue length of its neighbour nodes Si2 and Si3 by the HELLO packets (Fig. 1c). In the same way, Si2 has information aboutSi5's queue length. If the queue lengths of nodes Si5 and Si2 are increasing (Fig. 1d), then node Si1 checks its routing table observing that Si3 is an 'alternative' next hop. Therefore node Si1 will send packets to the sink node by the route Si3 2 Si6. Here point out that the proposed C-AODV is a hop by hop strategy that can dynamically balance the load avoiding congestion and to improve the QoS. Moreover, the modifications of our proposed algorithm can be implemented on the top of the AODV protocol and do not require much overhead in terms of memory and computation.

5. Proposed Method

When any node ready to send data source node seeking route to send a data packet to a destination

1) Source node checks its route table for existing valid route to the destination node.
2) If a route exists, it simply forwards the packets to the next hop along the way to the destination.
3) Else if there is no route in the table,
4) The source node begins a route discovery process.
5) It broadcasts a route request (RREQ) packet to its immediate neighbours until the request either reaches an intermediate node with a route to the destination or the destination node itself.
6) The route request packet contains
   a. the IP address of the source node,
   b. current sequence number,
   c. IP address of the destination node,
   d. the last known sequence number,
   e. Remaining battery power of path and
   f. Average Delay of path.

Initially Remaining battery power of path and Average Delay of path is set to zero by source node.

7) An intermediate node can reply to the route request packet only if it has a destination sequence number that is greater than or equal to the number contained in the route request packet header.
8) When the intermediate nodes forward route request packets to their neighbours put its remaining battery power and Average delay

of reaching packet from its neighbour to this node with RREQ packet, they record in their route tables the address of the neighbour.

9) This recorded information is later used to construct the reverse path for the route reply (RREP) packet.
10) If the same RREQ packets arrive later on, they are discarded.
11) When the RREP packet arrives from the destination or the intermediate node, the nodes forward it along the established reverse path and store the forward route entry in their route table by the use of symmetric links.
12) When source node received RREP packet it select first RREP packet for route establishment for communication on basis of weight calculate by delay and remaining battery power as

*Wp = A*Delay + B*RP*

Where Delay is average delay calculated by all intermediate nodes till destination

RP is remaining battery power of route it is minimum power if any node in whole path because if any node off due to power all route will fail for communication.

A and B are constants values for these constants between 0 and 1 such that A + B = 1.

13) On receiving another RREP from different route source will not discard this route it select second best route according above weight calculation and keep record this route. This route is select if current route have more traffic or overload according base method.
14) Route maintenance is performed by sending a link failure notification message to each of its upstream neighbours to ensure the deletion of that particular part of the route.
15) Once the message reaches to source node, it then re-initiates the route discovery process.

6. Conclusion

This paper gives classification of ad hoc routing protocols. Reviewed and evaluate several representative protocols. This paper also enhance of the wireless monitoring system performance accomplish by bring in a minimal routing cooperation using route weight. we have addressed the new method which is an enhancement of cooperative AODV protocol (C-AODV) for wireless monitoring system applications, expected to be good performance in terms of scalability, packet losses, reliability, latency and energy efficiency in real simulation conditions. The proposed routing algorithm expected to performed well for trade off between reliability and energy effective use for whole wireless monitoring system. The main issue for wireless communication is power management of nodes in network to increase life time of network. Finally hope that proposed method also give better power utilisation for device to save battery power and help to improve life span of network. This method could give benefits to healthcare system management for enhance the QoS and future emerging healthcare systems and other important applications.

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Neha Tripathi, born on 14 Nov 1987 at Bhopal. Having qualification of B. E., M. Tech Scholar from OCT, Bhopal. Her interested research area of is Ad-hoc Network.