International journal on applications of graph theory in wireless ad hoc networks and sensor networks
(GRAPH-HOC) Vol.2, No.4, December 2010

A Review: Optimal Path Selection in Ad hoc Networks using Fuzzy Logic

[1]A.Gowri, [2]R.Valli, [3]K.Muthuramalingam
[1&2] Assistant Professor, Dept of Computer Science, Shrimati Indra Gandhi College, Trichy
[3]Assistant Professor, Dept of Computer Science, Jamal Mohamed College, Trichy
Gowri71@yahoo.co.in, valli_vinayak@yahoo.com, jmcmuthu@yahoo.co.in,

Abstract

Ad hoc networks are collections of mobile nodes communicating with each other using wireless media without any fixed infrastructure. Designing routing protocols for this kind of restricted resources is very difficult due to dynamic characteristics of their network topology. A fundamental issue arising in mobile ad hoc networks is the selection of the optimal path between any two nodes. A route discovery attempt can possibly result in several paths being uncovered for a single destination. As nodes often have a finite capacity path cache, it may not be possible to store all paths. To improve routing efficiency the caching decisions of fuzzy logic system is to be appropriate. This action causes a cessation in the generation of low quality route, as only paths with good routing metrics are selected for the rebroadcast of route discovery packets.

Keywords : Ad hoc, Cache, Fuzzy logic, Membership function, Multicast.

Introduction

Ad hoc networks are multi-hop wireless networks consisting of radio-equipped nodes that may be stationary or mobile. Routing in ad hoc network faces extreme challenge due to node mobility or dynamics, potentially very large number of nodes and limited communication resources. The topology of network is ever changing with time. There are several challenges incorporating the issues of efficient routing. There exist numerous routing paths from source to destination node to data transfer. One of the routing paths is to be selected by any routing algorithm. If the route fails, again a new route is evaluated from source to destination, costing the time and resource. Hence, it is more desirable to distribute data packets along the distributed paths and transmit these data at the same time. Our work mainly involves in selecting the effective routing paths to transfer data. Traffic over the Ad hoc networking is growing with increasing number of demands [4]. Many of these networks require certain rate guarantees.

As the nodes correspond over wireless links, all the nodes must combat against the extremely erratic character of wireless channels and intrusion from the additional transmitting nodes. These factors make a challenging problem to exploit on data throughput, even if the user-required a quality of service in wireless ad hoc networks. Repeated route changes cause huge complications in implementing ad hoc networks owing to the mobility of the nodes and intrusion between nodes [1]. The high packet loss rates and recurrent topological changes lead to unbalanced transport layer and constrained amount of traffic being carried out by the network.

Traffic mapping is one particular method, which deals with the problem of assigning the traffic load into pre-established paths to meet certain requirements. Eventhough the problem is more general, practicality of these solutions is limited due to the unrealistic assumption that the network is lossless as long as the average link rates do not exceed the link capacities.

Moreover, a packet loss is much costly when network is compared with coding. So it potentially affects the decoding of a large number of other packets. In addition, the changes in flow between a source and a receiver require update at every node simultaneously, which brings high level of complexity and coordination. A proposal for fuzzy based optimal routing algorithm is needed to balance the load along multiple paths.

Finding Route Availability

One class of protocols is based on preparation of information tables and the other class is without them. It augments the classical, distributed algorithm by tagging each distance entry by sequence number that originated in the destination node. Each node maintains this sequence number, incrementing it each time the node sends an update to the neighbours. The above table's driven approaches are simple, but cost too much memory to maintain information tables and also consume too much bandwidth in order to refresh the information periodically, since every mobile need to maintain its own information table. Dynamic Source Routing (DSR) proposed the routing, path is established only where the Routing Request (RREQ) reaches the mobile device. The Ad-hoc On-Demand Distance Vector (AODV), proposed is to find more stable routing path with a lower block probability.

In the literature, very few routing algorithm will exists for MANET using fuzzy logic these are Fuzzy Logic Wireless Multipath Routing (FLWMR) and Fuzzy Logic Load Aware Multipath Routing (FLWLAR). The routing algorithm FLWMR is considered only when the metric is hop count and in FLWLAR metric is traffic load along the link are input to the fuzzy controller, based on these metrics fuzzy controller evaluates the fuzzy cost, but our proposed algorithm considers five characteristics of network to find the fuzzy cost. In FLWMR and FLWLAR fuzzy controller was designed, based on nonlinear property where as our method introduced linearity when evaluating the fuzzy cost.

In unipath approaches like DSDV, AODV, and DSR the same node repeatedly utilized. Hence it is subjected to higher resource exhaustion and over load. Even if the intermediate node changes its position, the routing protocol again initiates the RREQ packet which is in turn lead to redundancy of broadcasting [1]. To over come this problem, multi path routing protocols have been proposed. In this approach, the traffic only on one route is examined because traffic load is not diverted into multiple routes. In ImRMR (Improved Rank-based Multipath Routing) protocol the traffic is distributed amongst the best selected paths from the existing multipath routing. The selection is based on consideration of five resource constraints bandwidth, computing efficiency, power consumption, traffic load, and the number of hops. In ImRMR based on the available resources, the algorithm evaluates the rank for each path in the existing paths. Instead, our method determines the cost of each vector which is more helpful in the situation when more number of vectors have the same rank.

The first criterion in wireless medium is to discover the available routes and establish them before transmitting. The selection of path for data transmission is done based on the availability of the nodes in the region using the ad-hoc on demand distance vector routing algorithm. By using the Ad hoc on Demand Distance Vector routing protocol, the routes are created on demand that is only when a route is needed for which there is no "fresh" record in the routing table. In order to facilitate determination of the freshness of routing information, AODV maintains the time since an entry has been last utilized [2]. A routing table entry is "expired" after a certain predetermined threshold of time. Considering all the nodes are in the position. Now the shortest path is to be determined by implementing the Ad hoc on Demand Distance Vector routing protocol in the wireless simulation environment for periodically sending the messages to the neighbors and the shortest path.

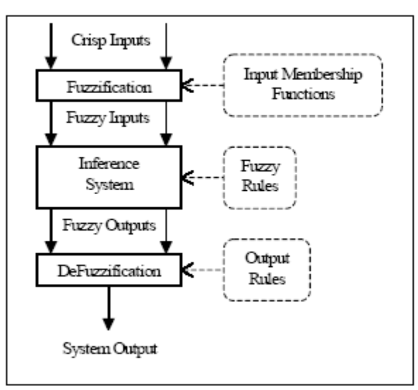
Route and Data Maintenance

In the MANET, the nodes are prone to undergo change in their positions. Hence the source should be continuously tracking their positions. By implementing the AODV protocol in the simulation scenario it transmits the first part of the data through the below allowed path. After few seconds the nodes move to new positions. The next step is the maintenance of these routes which is equally important. The source has to continuously monitor the position of the nodes to make sure that the data is being carried through the path to the destination without loss. In any case, if the position of the nodes change and the source doesn't make a note of it then the packets will be lost and eventually have to be resent [2]. The path selection, maintenance and data transmission are consecutive processes. Hence the paths allocated priory are used for data transmission. The first path allocated previously is now used for data transmission. The data is transferred through this highlighted path. The second path selected is now used for data transmission. The data is transferred through this highlighted path. The third path selected is used for data transmission. The data is transferred through this highlighted path.

Fuzzy Optimization on Routing Ad hoc Networks

A fuzzy system, which includes the system rule where the input membership functions to fuzzify the input variables and the output variable de-fuzzification process. Fuzzification is a procedure where crisp inputs values are represented in terms of the membership function. The fuzzy logic controls the membership's functions, which defines over the range of the fuzzy input values. In Dynamic Source Routing the route request is flooded through the network nodes append their own addresses to the route record and if needed rebroadcast the request. It is proposed here that nodes that appear in this route record should determine whether to continue with the route discovery process or not. Route metrics that are used to make this decision are linked to strength, energy available at a link vertex, and number of hops currently in a path. Current routing protocols are typically optimized with regard to one of these metrics. DSR selects the paths that consist of the shortest number of hops [2] and the Associativity-Based Long-Lived Routing protocol [3] selects the paths that exhibit long-lived connectivity between nodes, with nodes periodically transmitting beacons as a means of identifying themselves.

Figure 1



It is proposed here that the metrics link strength, energy available at a link vertex, and number of hops in a path will be combined into a single decision thereby optimizing a routing protocol over a number of metrics and making it more robust. The decision to continue with a network broadcast will be determined via a fuzzy logic system with the caching parameters being applied to a fuzzifier that translates them into fuzzy sets.

The fuzzy sets are used to appraise each constraint as being Low, Medium or High, assigning each a value between {0,1}. These evaluations are passed to a fuzzy inference engine that applies a set of fuzzy rules that determines if a route is apt for caching or not. If a route is deemed suitable then the route request is rebroadcast and the node extracts and caches the route record. When a route request arrives at the necessary destination, a route reply is generated and sent to the initiator of the route request by reversing the path stored in the route record. The decision to cache or not (and continue with a route request rebroadcast) is made by using the min-max rule [4], with the minimum value of the To Cache rule set being taken as the outcome and likewise for the Not To Cache set.

The maximum value of these two outcomes is then selected as the conclusion for the decision. Due to the broadcast nature of route discovery techniques, network resources can be unnecessarily used in this network with wide propagation that often leads to the selection of unstable paths. Unstable paths are classified as paths that have a large associated signal loss and consists of low-energy nodes with high number of hops or paths spread over a large distance between source and destination. So as to eliminate unsuitable paths from the route discovery/reply process and to optimize caching decisions. Broadcast floods are only continued if a node's fuzzy system indicates that it is valid to do so. Likewise, node caches route information extracted from packet headers that are received over good links.

However, while under network topology model the algorithm is able to minimize the cost to a certain level, it cannot eliminate the packet losses and has a much higher overall cost compared to traditional ones. The reason behind this result, is the lack of multicast functionality. Since we cannot create multicast trees, the only savings due to multicasting occurs between the sources and overlay nodes. Once multicast packets reach the overlays, overlay nodes need to create independent unicast sessions for each destination ignoring the multicast nature of the traffic, and this creates a high level of link stress as multiple copies of the same packets are generated [7]. This is due to the fact that, it is only need to optimize the overlay rates instead of individual receiver rates.

In Mobile ad hoc networks, the unstable transport layer and inhibited amount of traffic being carried out by the network is owing to the high packet loss rates and frequent topological changes. It is essential that least available bandwidth and end-to-end latency along with congestion around a link are integrated in a Quality based service routing for MANETs. Multipath Routing protocol for mobile ad hoc networks is to allot weights to the individual links, depending on the metrics link quality, channel quality and end-to-end delay. The individual link weights are combined into a routing metric to validate the load balancing and interference between links using the same channel [3]. Consequently, the traffic is balanced and the network capacity is improved as the weight value assists the routing protocol to evade routing traffic through congested area. Subsequently, the selection of the proportion of traffic to be routed to each neighbor is made to perform routing such that the weight of the node is a possible minimum.

Here, it's to be addressed that the maximum lifetime routing problem in wireless sensor networks, and present an online multipath routing algorithm. The proposed algorithm strives to maximize the network lifetime metric by distributing the source-to-sink traffic for a given routing request along a set of paths. Fuzzy membership function is used for designing the edge weight function. The multipath scheme is able to achieve better lifetime results than those obtained by its predecessor single-path fuzzy routing scheme as well as by another well-known online routing scheme, namely the Online Maximum Lifetime heuristic. The routing algorithm Fuzzy Logic Wireless Multipath Routing is considered only when the metric is hop count and in Fuzzy Logic Wireless Load Aware Multipath Routing metric is traffic load along the link are input to the fuzzy controller, based on these metrics fuzzy controller evaluates the fuzzy optimality.

Conclusion

The fuzzy optimal routes suggest that the complexity of having smart routers that are able to forward packets onto each branch at a different rate. However, it is hard to draw due dynamic topology of source-destination pair selections. In Mobile ad hoc networks, the unstable transport layer and inhibited amount of traffic being carried out by the network, which owes high packet loss rates and frequent topological changes. It is essential that least available bandwidth and end-to-end latency along with congestion around a link are integrated in a Quality based service routing for MANETs. Once multicast packets reach the overlays, overlay nodes need to create independent unicast sessions for each destination ignoring the multicast nature of the traffic. An idea of selecting best paths from multi path routing from source to destination node in Mobile Ad-hoc Networks, is based on fuzzy measure. The changes in rank is based on Multipath Routing in Mobile Ad-hoc Networks are categorized using rank fitness. But the paths will be categorized using a fuzzy optimization, which tends to minimize the disadvantages of both unipath and multipath routing.

Reference

[1] S.Gunasekaran and Dr.K.Duraiswamy, Multicast Multi-path Power Efficient Routing in Mobile ADHOC networks, IJCSNS International Journal of Computer Science and Network Security, VOL.10 No.4, April 2010.

[2] S.Venkatasubramanian and Dr.N.P.Gopalan," A QoS-Based Robust Multipath Routing Protocol for Mobile Adhoc Networks" IACSIT International Journal of Engineering and Technology ol.1,No.5,December,2009.

[3] A Naga Raju, Dr S Rmachandram," FUZZY COST BASED MULTIPATH ROUTING FOR MOBILE AD-HOC NETWORKS" Journal of Theoretical and Applied Information Technology, @ 2005-2008 page, Vol4 No4 ,319-326.

[4]. Stephen Mueller, Rose P. Tsang, and Dipak Ghosal "Multi path Routing Ad Hoc Networks: Issues and challenges" .This research was founded in part by a grant from Sandia National Laboratories, CA, USA

[5]. Charles Perkins E ,Pravin Bhagwat Highly Dynamic Destination-Sequenced Distance- Vector Routing (DSDV) for Mobile Computers. In the proceedings of the Conference on Communication architecture, protocols and applications page 234-244 ACM Press 1994.

[6]. Perkins C E and Royer E M . "Ad-hoc ondemand distance-vector routing", In the Proceedings of the Second IEEE Workshop on Mobile Computer System and Applications, Page 90. IEEE Computer Society, 1999.

[7]. Broach J, David B Jhonson and David A Maltz "Dynamic Source routing Algorithm for Mobile Ad Hoc Networks " IETF (Internet Engineering Task Force) Internet Draft-ietf-manet-dsr-01.txt,December 1998.

[8]. Nagraju A , Dr Ramachandram S, Dr Rao C R "Highly Dynamic Distance Sequence Vector routing with multi value unified vector routing for mobile ad-hoc networks. In the proceedings of Second international conference on "Embedded System and Mobile Communication" .Organized by PESIT Banglore.

[9]. Ming-Shen Jain and Chienting Lin "Improved Rank-based Multi-Path Routing in Mobile Ad-hoc Networks". In the Advanced Communication Technology, 2005, ICACT 2005. Volume 2, Issue, 21-23 Feb. 2005 Page(s): 1249 – 1254

[10]. Narasipuri A and Das S R ," On- Demand Multi-Path Routing for Mobile Adhoc Networks." Proc 8th Int.Conf on Computer Communications and Networks, Oct, 1999.

[11]. Gasim Alandjani and Eric E. Johnson "Fuzzy Routing in Ad Hoc Networks", Performance, Computing, and Communications Conference, 2003. Conference of the 2003 IEEE International Volume, Issue, and 9-11 April 2003 pages 525-530.

[12]. Xu ZHANG, Sheng CHENG,Mei-yu FENG and Wei Ding, " Fuzzy Logic QoS Dynamic Source Routing for Mobile Ad Hoc Networks ", In the conference of Computer and Information Technology ,2004 .CIT ' 04.The Fourth International Conference.