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Comparison of DSR and Weight Based Reliable Routing in MANET

[1]M. Prakash Kumar and [2]R. Karthik

[1]M.E. (Computer Science) Final Year, Computer Science Engineering
Karpagam University, Coimbatore, India
E-mail: powerfullmail@gmail.com
[2]Assistant Professor of CSE, Computer Science Engineering,
Karpagam University, Coimbatore, India
E-mail: karthikrme@gmail.com

Abstract

Mobile ad hoc networks (MANET) consist of a set of mobile hosts that can communicate with each other without the assistance of base stations. MANETs are heterogeneous mix of different wireless and mobile devices, ranging from little hand-held devices to laptops. In MANETs, the high mobility of mobile nodes is a major reason for link failures. In this paper, we propose a Stable Weight-Based on-demand Reliable Routing Method (WBRR) for MANETs. This method incorporates features that enhance routing reliability, defined as the ability to increase packet delivery rate and uses the weight-based route strategy to select a stable route in order to enhance system performance. We assume some parameter that affected the quality of service like residue power, link stability between two node, error count and hop count.

Index Terms: MANET, Reliable routing, DSR, Routing Protocols, Linkage break..

Introduction

With the advance of very large-scale integrated circuits (VLSI) and the commercial popularity of global positioning services (GPS), the geographic location information of mobile devices in a mobile ad hoc network (MANET) is becoming available for various applications. Mobile ad hoc networks are among the fastest growing areas in networking research. They are best suited for applications in environments where fixed infrastructures are unavailable or unfeasible. Mobile ad hoc networks are a heterogeneous mix of different wireless and mobile devices, ranging from little hand-held devices to laptops. The effect of battery depletion is similar to a crash fault, from which the mobile may or may not recover depending on the availability of battery replacement /recharge. Ad hoc networks implement a distributed cooperation environment, based on a P2P paradigm. The range of wireless communication, the network is generally multi hop, since direct communication between mobiles is generally not available. For this reason, a distributed routing protocol is required in order to provide communication between arbitrary pairs of nodes. A major problem arises from the mobility of nodes causing the network topology to be variable and to some extent unpredictable. In fact, linkage break probability of nodes will be high, when stability of routing path is not considered. Best criteria's that are used for reliability in routing are Route expiration time, Residue energy, Error count and Hop count.

These criteria give us weight of the path. Procedures of path discovery usually find several path from source node to destination node then select path with maximum weight path as optimal path. There have been many efforts given to designing reliable routing protocols. The key routing protocols in MANETs can be of Proactive routing protocols, Reactive routing protocols, Location based protocols. A reliable path has more reliability than a command path. Because a reliable path can reduce control packets and eliminate delay time, it can increase the utilization of bandwidth in MANETs. The routing algorithm with high stability this method selects a stable routing path by maximizing the weight among the feasible paths. The route selection is based on the weight value of each feasible path. In a feasible path, the less weight value represents less reliability. It also represents higher mobility of each node in the path. Experimental results show that the proposed WBRR method outperforms.

Routing Protocol

A routing protocol is a protocol that specifies how routers communicate with each other, disseminating information that enables them to select routes between any two nodes on a computer network, the choice of the route being done by routing algorithms. Each router has a prior knowledge only of networks attached to it directly. A routing protocol shares this information first among immediate neighbors, and then throughout the network. The routing protocols can be classified into proactive routing protocol, reactive routing protocol and location based protocol. In Proactive routing protocols, each node maintains path information from each node to destination node and update its routing table entries periodically. In Reactive routing protocols, mobile nodes maintain path information for destinations only when they need to contact the source node. In Location based protocols, mobile node knows it current physical location and such location information can be exploited to facilitate routing.

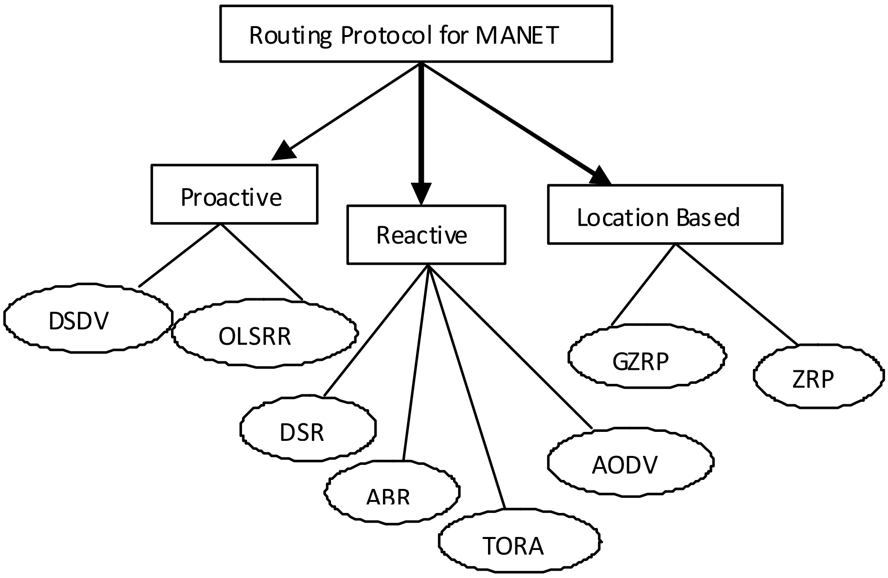


Figure 1: Protocols in MANET

Proactive Routing Protocol

The nodes maintain a table of routes to every destination in the network, for this reason they periodically exchange messages. At all times the routes to all destinations are ready to use and as a consequence initial delays before sending data are small. Keeping routes to all destinations up-to-date, even if they are not used, is a disadvantage with regard to the usage of bandwidth and of network resources.

Destination Distance Sequence Vector

Destination-Sequence Distance Vector (DSDV) has one routing table, each entry in the table contains the destination address, number of hops toward destination, next hop address. Routing table contains all the destinations that one node can communicate. When a source A communicates with a destination B, it looks up routing table for the entry which contains *destination* address as B. Next hop address C was taken from that entry. A then sends its packets to C and asks C to forward to B. C and other intermediate nodes will work in a similar way until the packets reach B. DSDV marks each entry by sequence number to distinguish between old and new route for preventing loop.

Reactive Routing Protocol

These protocols were designed to overcome the wasted effort in maintaining unused routes. Routing information is acquired only when there is a need for it. The needed routes are calculated on demand. This saves the overhead of maintaining unused routes at each node, but on the other hand the latency for sending data packets will considerably increase. The mobile nodes maintain path information for destinations only when they need to contact the source node.

Location Based Routing Protocol

The mobile node knows its current physical location to facilitate routing. These are based on geographic model. There have been many efforts given to designing reliable routing protocols. A reliable path has more reliability than a command path. Because a reliable path can reduce control packets and eliminate delay time, it can increase the utilization of bandwidth in MANETs.

Dynamic Source Routing Protocol

DSR (Dynamic Source Routing) is an on-demand routing protocol based on source routing. In DSR, mobile nodes are required to maintain route caches that contain the source routes of which the mobile is aware. Entries in the route cache are continually updated as new routes are learned. In is the shortest path between source and destination. In the other side minimum number of Hop between Source and Destination is important although shortest path may be having minimum durability.

DSR is a reactive routing protocol which is able to manage a MANET without using periodic table-update messages like table-driven routing protocols. DSR was specifically designed for use in multi-hop wireless ad hoc networks. Ad-hoc protocol allows the network to be completely self-organizing and self-configuring which means that there is no need for an existing network infrastructure or administration. For restricting the bandwidth, the process to find a path is only executed when a path is required by a node. In DSR the sender (source, initiator) determines the whole path from the source to the destination node (Source-Routing) and deposits the addresses of the intermediate nodes of the route in the packets.

Compared to other reactive routing protocols like ABR or SSA, DSR is beacon-less which means that there are no messages used between the nodes to notify their neighbors. The DSR contains two phases A. Route discovery and B. Route maintenance.

Route Discovery

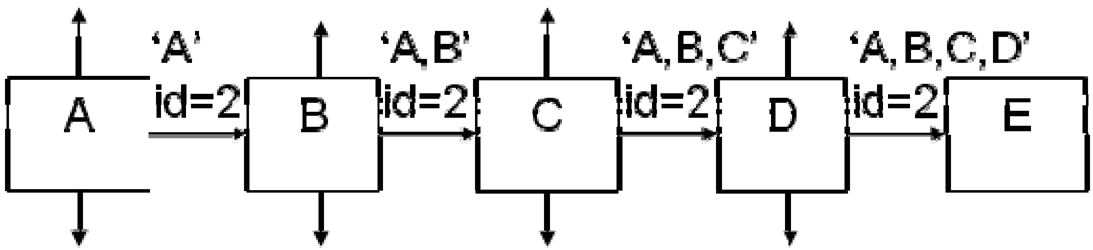


Figure 2: Flow of Route Discovery

If node A has transfer a route to the destination E, this route is immediately used. If not, the Route Discovery protocol is as

- Node A (initiator) sends a Route Request packet by flooding the network.
- If node B has recently seen another Route Request from the same target or if the address of node B is already listed in the Route Record, then node B discards the request.
- If node B is the target of the Route Discovery, it returns a Route Reply to the initiator. The Route Reply contains a list of the best path from the initiator to the target. When the initiator receives this Route Reply, it caches this route in its Route Cache for use in sending subsequent packets to this destination.

Route Maintenance

In DSR every node is responsible for confirming that the next hop in the Source Route receives the packet. If a packet can't be received by a node, it is retransmitted up to some maximum number of times until a confirmation is received from the next hop.

Only if retransmission results then in a failure, a Route Error message is sent to the initiator that can remove that Source Route from its Route Cache. So the initiator can check his Route Cache for another route to the target. If there is no route in the cache, a Route Request packet is broadcasted.

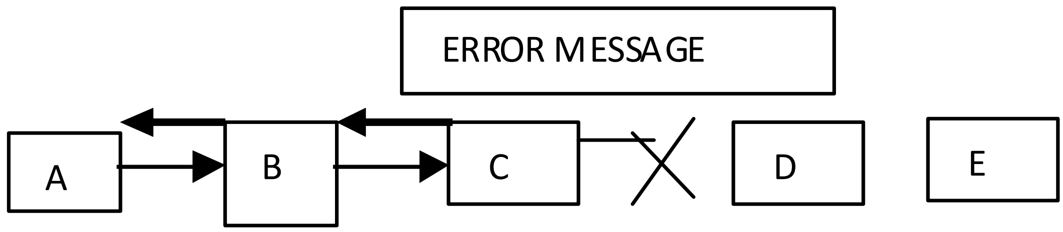


Figure 3: Flow of Route Maintenance.

Ad hoc on demand distance vector routing (AODV) is the combination of DSDV and DSR. In AODV, each node maintains one routing table. When a node wants to communicate with a destination, it looks up in the routing table. If the destination is found, node transmits data in the same way as in DSDV. The Route Request packet (RREP) to its neighbor nodes, which in turns rebroadcast this request to their neighbor nodes until finding possible way to the destination. When RREP is routed back, node in the reverse path updates their routing table with the added next hop information. If source node receives more than one RREP, the one with greater sequence number will be chosen. For two RREPs with the same sequence number, the one will less number of hops to destination will be chosen. The node which does not receive Hello message will invalidate all of its related routes to the failed node and inform other neighbor using this node by Route Error packet. The source if still want to transmit data to the destination should restart Route Discovery to get a new path.

Route Expiration Time

he Route Expiration Time (RET) is the minimum of the set of link expiration times (LETs) for the feasible path. The LET represents the duration of time between two nodes. First we obtain minimum value of LET in each path and then select the maximum number of RET which represents the more reliable routing path. It can be calculated by

$$RET = Min\ (LETs)$$

Thus, the RET is the maximum value among LETs of the feasible path. The LET can be obtained by the principle that two neighbors in motion will be able to predict future disconnection time. The motion parameters of two neighboring nodes can be obtained by using global positioning system (GPS). We assume a free space propagation model in which the signal strength solely depends on the distance to the transmitter. We also assume that all nodes have their clocks synchronized by using the GPS clock. If we know the motion parameters of two nodes, we can calculate the duration of time for two nodes remained connected. These parameters include speed, direction, and radio range and can be obtained from GPS. We assume that nodes n1 and n2 have equal transmission radius *r* and that they are initially within hearing range. Let (x1, y1*)* and (x2, y2*)* denote the (x, y*)* position for node n1 and n2 respectively. Let vi and vj denote their speeds along the directions q1 and q2 respectively. Then the duration of time between n1 and n2 is given by the following equation

$$Dt = \frac{-(ab+cd)+\sqrt{(a^2+c^2)r^2-(ad-cd)^2}}{(a^2+c^2)}$$

$$a = v_1\cos\theta_1 - v_2\cos\theta_2 \quad b = x_1 - x_2$$

$$c = v_1\sin\theta_1 - v_2\sin\theta_2 \quad d = y_1 - y_2$$

Residue Energy

In this parameter requested energy for complete sending of file or data before transfer, according to its size is calculated. All data packets are moved from optimal path that has enough energy for sending all of packets. In reliable path selecting, must consider the estimation of total energy for sending all of packet. It is assumed that all nodes are equipped with a residual power detection device and know their physical node position. The packet transmitting energy for a packet can be calculated by

$$E_{tk} = packet_{size} \times P_{tk} / BW$$

Where Packet is the data packet size, P_{tk} is the packet transmitting power, and BW is the wireless link bandwidth.

Error Count and Hop Count

The Error Count (EC) is the maximum value between set of node error counts (linkage break and node failure) for the feasible path. The smaller EC represents the more reliable routing path. The error count is used to indicate the number of link failures caused by a mobile node. When an intermediate node receives a RREQ packet, it compares the error count in the route record of the packet with the error count in its route cache, and assigns the larger one as the new error count in the packet. The process continues until the RREQ packet reaches the destination node. The destination node eventually takes record of the error count values along all feasible routes.

The Hop Count (HC) is the number of hops for the feasible path. The smaller HC presents the more reliable and less cost of routing path. If each intermediate host has a larger roaming area, and the MANET has many nodes (hops), then a feasible path with fewer hop is the preferred choice.

Route Weight Function

The reliability for a feasible path is based upon four items: Route expiration time, Residue energy, Error count and hop count. Based on the preceding discussions, the weight function is defined as an empirical mean value

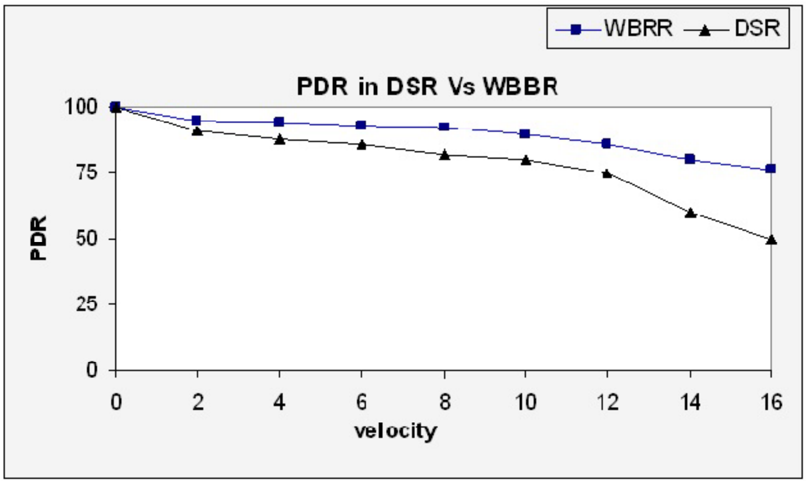
$$W_i - C_1 \times (\frac{RET_i}{MaxRET}) + C_2 \times (\frac{ECD_i}{MaxECD}) + C_3 \times (\frac{EC_i}{MaxEC}) + C_4 \times (\frac{HC_i}{MaxHC})$$

C1, C2, C3 and C4 are the values which can be chosen according to the system needs. Route expiration time is very important in MANETs, thus the weight of C1 factor can be made larger. C3 factor related to path error and reduce the weight of path so it is one of the important negative factor in our equation.The flexibility of changing the factors helps to select routing path. Larger both route expiration time (RET) and Residue energy and so on both lower error count (EC) and hop count (HC) represent higher reliability.

Simulation Results

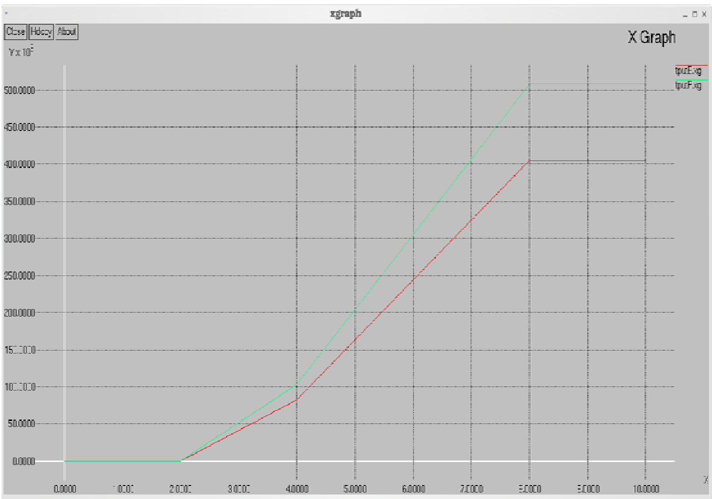
Simulation shows the packet delivery ratio of proposed method and DSR with different mobility speeds.

The packet delivery ratio is the ratio of the number of data packets received by the destination to the number of data packets transmitted by the corresponding source. We can observe that proposed method transmits and receives more data packets than DSR.



Output of Packet Delivery Rate

DSR algorithm does not control the path so it will select shortest path and could not select path with high reliability. When speed of nodes is increased, links are broken and therefore packet delivery rate is decreased. However, in WBRR according to high reliability of path packet delivery rate 10-15% increased.



Output of the feasible path

Conclusion

The Comparison of DSR and weight based demand reliable routing in MANET propose a routing algorithm with high stability this method selects a stable routing path by maximizing the weight among the feasible paths. The route selection is based on the weight value of each feasible path. In a feasible path, the less weight value represents less reliability. It also represents higher mobility of each node in the path. Experimental results show that the proposed WBRR method outperforms DSR especially in the high mobility environment.

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