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Link Stability in Mobile Ad Hoc Network

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ABSTRACT
Providing an efficient, robust and low overhead path from source node to destination node in MANETs is a critical issue due to frequent change in the network topology and mobility of the node (which cause frequent change in radio link). Hence it is necessary to check the node stability with respect to node mobility during path establishment .path. Many routing algorithms, proposed for ad-hoc network, are based on source routing scheme. When a route is broken in source routing, route recovery and maintenance procedure are executed, these procedure consume many resources. To minimize route breaking, it important to find a route that endures longer time. Shortest path route has short lifetime especially in high dense ad-hoc network. Some routing protocol such as SSA and ABR are considering the link stability and try finding more stable route. The stability is computed by using the parameters such as received power, distance between neighboring nodes and link quality that is assessed using bit error in a packet. The proposed scheme is simulated over a large number of MANETs nodes with wide range of mobility and the performance is evaluated. The performance of the proposed scheme is compared with two well-known mesh based multicast routing protocol, i.e. on demand multicast routing protocols(ODMRP) and enhance on demand multicast routing protocol(EODMRP) It is observed that the proposed scheme produce better packet delivery ratio, reduces packet delay and reduced overheads. This paper also proposes a method to find the stability factor of a node by considering self and neighbor node stability. The stability factor of a node may be used to establish a path from source to destination. The stable nodes in the path will provide higher packet delivery ratio and lower latency. We have tried to show link stability and node stability under the influence of varying node speeds and number of nodes.

Key words: MANETs, Stability factor, Link stability, node stability, SSA and ABR

Introduction

A Mobile Ad Hoc Network (MANET) is a wireless network consisting of mobile nodes, which can communicate with each other without any infrastructure support. In these networks, nodes typically co-operate with each other, by forwarding packets for nodes which are not in the communication range of the source node the routing protocols are classified according to the route discovery philosophy, into either reactive or proactive. Reactive protocols are on demand. Route discovery mechanisms are initiated only when a packet is available for transmission, and no route is available. On other hand proactive protocols are time driven. Route is pre computed and stored in a table, so that route will be available whenever a packet is available for transmission. The number of applications available for wireless communication is growing rapidly, mobile telephony is ubiquitous nowadays, wireless hotspots are spreading everywhere, and also ad hoc networking is growing mature these days. A key charesctrestic of these scenarios is the dynamic behavior of the involved communication partners. Communication protocols will have to deal with a frequently changing network topology. However many application require stable connections to guarantee a certain degree of Q o s. In access network, access point handovers may need to be transferred to the new access point introducing additional overhead and delays to connection. Path stability depends on the availability of all the links constituting the path. The category based on link stability is unique to wireless network. Link stability refers to the ability of a link to survive for certain duration. The higher the link stability, longer the link duration. The stability of a link depends on how long two nodes, which from that link, remains as neighbor when they remains within each other's communication range, or the signal strength is above certain threshold. Mobility causes link breakage and leads to route recovery. A link is available when the radio quality of link satisfied the minimal requirements for successful transmission. Stability based protocols use stability or variations of stability as the routing metric. The implicated goal of most stability based routing protocols is to find and select the long lived routes .The differences lies in how the stability of a link is estimated and how these link estimates can be combined to form an end to end estimates.

A. Associativity Based Routing (ABR)

Associativity Based Routing (ABR) is probability the first protocols in class of stability based protocols for MANETS. In ABR, a new matrix called associavity is defined to determine link stability. In simple terms ABR is based on the idea that nodes which are neighbor for a threshold period are more likely to remain as neighbor 's for longer time, or less likely to move away. ABR assume that after the threshold period, nodes move with similar speeds and directions and tend to stay together. One of the problems with ABR is the choice of the threshold value. This value depends on the mobility patters. In ABR longetisvity of a route IS put at first place, where as in other protocols such as link state and AODV has primary goal to shortest path. However in the latest protocols, data flow transmission and interruption occur more and more route reconstruction are needed. The essence of ABR is that as a mobile device moves its associativity with a neighbor device also change, and this associativity can be qualify by using associativity link .in ABR each mobile device periodically transmitted bacons to signify its existence ..When these bacons are received by the neighbor device, these bacons cause associativity with its neighbor device increases. The greater the associavity is the more of this device will be. A High associativity of device means a low mobility of the device. If a device moves out of the transmission range of another device, the associativity of the former in the latter device is reset. It should be noted that the most fundamental objective of ABR is to device long lived route between source and destination device

B. Signal Stability based Adoptive (SSA)

Signal Stability based Adoptive (SSA) is a routing protocol, which find rout based on signal strength and location stability. In SSA, mobile node measures the signal strength received from other nodes, and this information is used to estimate the link stability between them. The location stability mechanism is considered only as a supplement to signal-strength measurements. Signal stability adoptive routing follows a similar approach as ABR. This distinguished strongly from weakly connected link where a link is considered to be strongly connected. If it has been active for a certain predefined amount of time.

The nodes are mobile, which renders the network topology in MANETs susceptible to change with time. Each node periodically broadcasts a hello packet and it updates its neighbor table on receiving the acknowledgement from the node. Less number of acknowledge is transmitted in maintaining the neighbor table. Less number of collision takes place, less updating is required to maintain the neighbor table. Also based on signal strength measurements in rut e life time assessment based routing (RABR). It tries to predict the time when the received signal strength falls below a critical threshold using a measured value of average change in received signal strength.

C. Protocol overview

A source initiates route discovery request when it has data to send to a destination which is not in the routing table. The route search is a broadcast if it is received over a strong channel and the request has not been prorogated previously. The route search stores the address of each intermediate host the taken. The destination chooses the route recorded in first arriving request. Since this route is probably shorter and/ or less congested than route for slower arriving request. The destination returns the route reply along the selected route.

Host	Signal Strength	Last	Click	Set
Y				
Z				

Table1.1 Signal Stability Table (SST)

Destination	Next Hope
Y	
Z	

Table .2 Routing Table (RT)

Functionally, the signal Stability based Adoptive routing (SSA) protocols consist of two protocols, The static routing protocols (SRP) and dynamic routing protocols (DRP), which utilize the extended device driver interface. This interface is responsible for making available to the routing protocols the signal strength information from the device. DRP maintains the routing table by interfacing with the DRP on other host SRP performs the actual routing table look up to forward a table on to next hope.

Multicast routing protocols are classified into two types according to topology structure that is used to forward multicast packets Current structure is either mesh structure or tree structure. Tree structure creates only one route between any mobile nodes in multicast group. It is band efficient because it decreases the number of packet copies required per network. The essential detriment I single path is link breakdown that is responsible for the reconfiguration of the whole tree topology. Mesh routing mechanism creates a mesh of route to join all mobile nodes in the network Mobile nodes mobility and routes breakdown are more resilient in this mechanism. The major drawback is that mesh mechanism rebroadcast various copies of same control packets, which resulting in increases control pre-head and decreases packet delivery ratio in a high mobility nodes environment. On Demand Multicast Routing protocols (ODMRP) represents one of these mechanisms. Accomplishment of reliable multicast routing mechanism in MANETs is still challenging due to dynamic nature of network topology, high mobility of nodes and flooding mechanism. Most of current multicast routing protocols in MANETs use flooding mechanism to find routing link through in the network, which result in more overhead, waste network resources and increase the cast of routing discovering and maintenance. In this paper we proposed a new multicast routing mechanism for MANETs based on ODMRP. The goal of this proposed mechanism route against the node mobility by modifying the mechanism of route discovery and data forwarding.

Related work

To find a stable path between sources –destination pair for sending and receiving video and data packets is the main purpose of this work. When environment is highly mobile many packets get lost because of collision. Our main target is to implement a stable ODMRP in order to achieve high performance in the highly mobile environment. With this end in view, we tried to measure node movements in periodic manner, so that we can trace out most stable neighbor. If every node can store the information about the stable neighbor, the stable path from source node to destination node can be easily detected. AODC sends periodic “HELLO PACKETS” for detecting the neighbor. We utilize this existing feature of original AODV to find out the stable neighbor of each node. Every node periodically observes its neighborhood for some predefined time $ amount of time and count no of hello message received from its neighbors. Based on the statistics such as mobility of node and link loss, nodes decides about the most stable neighbor, when sources initiates a route request packet it simply broadcast the route request to all its neighbors. As in AODV the route request packets are broadcast but here we are using AODVM, where none of the RREQ packets are discarded. By this, we find multiple node disjoint paths from source to destination. A node receiving this broadcast to its neighborhood after appending the stability measure between itself and source to broadcast. This process continues and stability count gets a measure of stability of paths and can easily determine the most stable path. It just sends out the reply packet through most stable path (in the reverse Order).

3. Stability in MANET

Stability is the quality which asserts the network environment consistency. IN mobile ad hoc network, nodes are continuously moving from one place to another with certain pause time. Stability is an important parameter in such an environment. Here come two types of stabilities, Neighbor stability path Stability. Neighbor Stability gives an idea of the neighbor's consistency in the network while path stability gives an idea of path's consistency from source to node destination. Neighbor stability helps us to find out the stable neighbor being used as a next hope node. Path stability helps us to use always a stable path for sending path.

A. Neighbor Stability

Here we measure the stability of the path using two parameters

A. mobility

B. link loss

Mobility of path is measured using HELLO packets as follow: Suppose if there are two nodes A and B then the mobility of AB is given as follows

$$MOB_{AB} = \frac{\text{Num of hello packets measured from A to B}}{\text{Num of packers measured from B to A}}$$

Link loss of the path is measured by using SNR as follows; link loss can be measured by using bit error rate which is related to SNR as follows:

Let f be the fading in the channel, given by

$$f= P\,t\,x \;/\; d^2 * k$$

Where d is the distance between transmitter and receiver, k is the proportionality constant, P tx is the transmitted power. Assume k= 1, by simplifying we get,

$$f=P\,t\,x \,/\, d^2.$$

Fading can also be represented as difference between transmitter and receiver power

$$f = P\,t\,x - P\,r\,x.$$

SNR or signal to noise ratio is given as ratio of transmitted power v/s the noise power .It is given by

$$SNR = P\,t\,x \,/\, N0$$

as channel is fading based , noise power is fading power. Hence SNR in db can be represented as:

$$SNR= 10 \log_{10} (P\,t\,x \,/\, fading).$$

In non-logarithmic scale $SNR = 10 \log_{10} (P\,t\,x \,/\, P\,t\,x - P\,r\,x)$.

As SNR deceases (when noise power or fading is more), BER also decreases (Mora error per transmitted bits). This relationship is represented by following equation. Hence Bit error rate

$$P\,b \;\alpha\; 1/SNR$$

$$P\,b = k/SNR$$

$$P\,b = 1/SNR \text{ where } k = 1.$$

B. Path stability

Similarly, if there is 'n' number of nodes then Mobility of path AD is measured as follows:

Mob of path AD = Mob of AB* Mob of BC * Mob of CD. And the link loss of path measured as follows

Link loss of Path AD = link loss of AB+ link loss of BC + link loss of CD. Therefore, by using the two parameters the mobility and link loss, the stability of the path is measured as follows

$$\text{STABILITY path} = \frac{\text{MOBILITYpath+LINK LOSS path}}{\text{Number of hope count}}$$

C. Link Stability in multicast routing

The routing protocol ODMRP (On- Demand Multicast routing Protocol) is used to discover the most stable multicast route against the node mobility and data forwarding. Under high mobility environment ODMRP achieve high packet delivery ratio. But, the main drawback of ODMRP grown control overhead that produced from flooding mechanism especially in large size networks. Enhancement ODMRP with motion adoptive Refresh is extension of ODMRP that treat their mobility environment by using the conditioned broadcasting mechanism. Each mobile node in the network computes the number of its neighbor's mobile and their distance and records this information into the table. Link stability based multicast routing scheme in MANET (LSMRM) Proposed mesh mechanism that discover the stable multicast route from source to destinations. Route request and route reply build a mesh multicast mechanism to aid of the routing information that saved in MRIC and some criteria of link stability that saved in LSD on every mobile node in MANET. Forwarding mobile nodes that higher value of link stability through the neighbor mobile nodes selected as stable forwarding node that used to create the most stable nodes, received power and bit error in the packet are the main parameter that used in this mechanism to determine the link stability

Algorithm

We propose a stable multicast routing protocol for MANETs build on ODMRP. This modifies the mechanism of route discovery and data transmitting to enhance the use of route that consist of stable mobile nodes. The target of this algorithm is to improve the stability of route maintenance mechanism. This algorithm finds the most stable route from multiple routes that build by the mesh mechanism to decrease the control overhead and end to end delay between the source and receivers. The main parameters in our proposed algorithm that responsible for like stability are the coverage by each mobile nodes and overall packet delay.

A. *Mobile coverage area and Distance between Neighboring Nodes*

Assume two mobile nodes N1 and N2 within the transmission range R as shown in figure. Let the current coordinate for N1 is (X_1, Y1) and(X2, Y2) be that for N2 is given by equation! As shown below:

$$D(N_1, N2) = \sqrt{(X1 - X2)^2 + (Y_1 - Y_2)^2} \quad (1)$$

Suppose N1 move in

θ1 direction with V1 velosity and N2 moves *in* θ2 with V2 velisity.

$$2\pi \geq \theta 1, \theta \geq 0$$

After t period of time, N1 and N2 move a distance d1 and d2; the new coordinate will be (X_{1new}, Y_{1new}) respectively. The value of distance d1 is given by equation 2 as shown below.

$$d1 = V_I * T = \frac{(V_{II} + V_{IF}) * T}{2} \quad (2)$$

Where Vii and V if represent the initial and final velocity of mobile nodes. The values of the new coordinates Xi new, Yi new is given by equation 3 and 4 respectively.

$$\text{Xi new} = \text{Xi} + \text{d i} * \text{Cos}\,\theta i = \text{Xi} + \text{Y(ViI} * \cos\theta\text{i)} \quad (3)$$

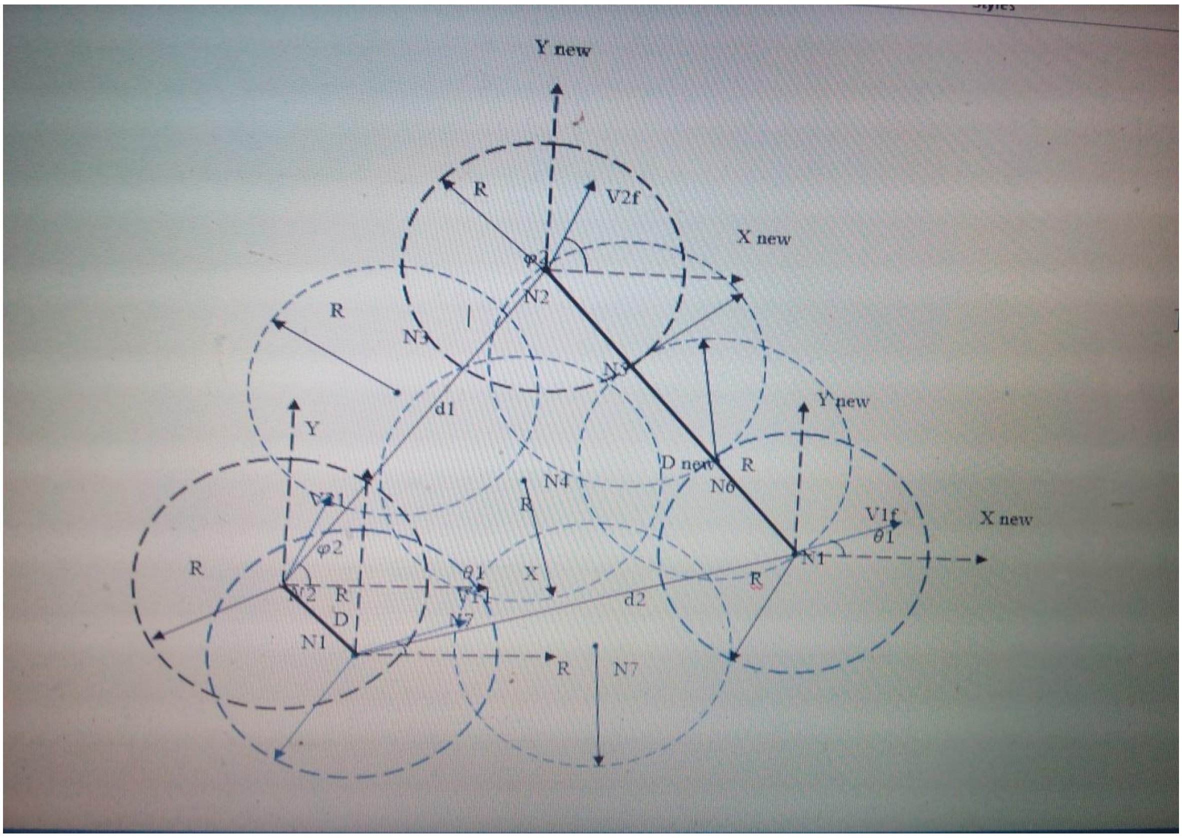
$$\text{Yi new} = \text{Xi} + \text{d1} * \sin\theta i = Yi + Y(ViI * \sin\theta i) \quad (4)$$

The distance between the mobile node N 1 and mobile node N2 in the new coordinate is given by equation 5 as shown below

$$D(N1, N2)\,\text{new} = \sqrt{(X1new - X2new)^2 + (Y1new - Y2new)^2}$$

$$= \sqrt{[(X1 - X2) + T(V1\cos\theta 1 - V2\cos\theta 2]2 + [(Y1 - Y2) + T(V1f\sin\theta 1 - V2\sin\theta 2)]^2} \quad (5)$$

The prerequisite for connection between N1 and N2 is shown in figure 1.



So, depending on coverage area by each mobile node, the link stability between N1 and N2 after time period can calculate by next equation

$$L.S\,(N1,N2) = \frac{R}{D\,(N1,\,N2)} \qquad (6)$$

In the free space prorogation model, the maximum transition range is calculated by equation 7 as shown below

FSPL 32.44 + 10 log (f) +10 log (d)

Where FSPL represents the free space reception at receiver, f is the carrier wavelength in MHz and d is largest linear dimension of antenna in km .In general link stability between any neighboring nodes can be calculated by equation 8.

$$L.S\,(Ni,\,N\,j) = \frac{R}{D\,(Ni,\,N\,j)} \qquad (8)$$

According to coverage area and the distance between neighboring nodes, the route stability from source to receiver will be calculated through the following steps

1. Find the minimum link stability (L.S) between neighboring nodes along the certain route.
2. Replay the step 1 over all available routes from source to receiver
3. Compare between all the selected values (minimum L.S) in each route. And the maximum value will be the most stable (R.S) value.
4. The route from the source to the receiver, which has this value, will be selected as the best stable route.

So, the route stability between source and receiver will calculated depending on previous steps by the following equation

$$R.S1 = \operatorname{Min}_{I=1}^{H.\,C} L.S\,(I) \qquad (9)$$

Where, h .c represents the maximum value of hope counts in the selected route.

B. End to end to delay

Some applications are very sensitive for delay especially video data application, because video data packet must receive by all receivers in creation time with minimum delay. Packet should be transferred by multicast receiver before the maximum threshold of 250 ms to accommodate the delay requirement for high throughput application. The overall delay between two neighboring nodes N1 and N2 can be calculated through transmission delay (d t), queuing delay (dq) AND contention delay (dc) as shown in equation 10

$$D\,(N1, N2) = d\,t + d\,q + d\,c \qquad (10)$$

The transmission delay can calculated from this equation

$$D\,t = \frac{P\,k\,t\ Size}{B\,w} \qquad (11)$$

The Queuing delay and contention delay calculated through equation 12

$$D\,q + D\,d = \frac{k}{\mu} \qquad (12)$$

Note that k is the maximum queue size an µ is an exponential distribution of service times

So, the time delay in any hope between two neighboring node can be calculated trough following equation:

$$T = \frac{P\,k\,t\ Size}{B\,w} + \frac{K}{\mu} \qquad (13)$$

As a result of this, next equation will calculate the overall delay between the source and receivers:

$$Max\ t\,(S, R) = \sum_{I=1}^{H.C} t\,i \qquad (14)$$

Where Max t (S, R) represents the maximum time the source and the receiver in the network.

According to overall time delay between the source and the receiver, the route stability can be calculated from equation 15 as shown below

$$R, S2 = \frac{Max\ t(S, R)}{D\,i\,(S, R)} \qquad (15)$$

Where i(S, R) represents the time delay of certain route between source and receiver. The route that has the maximum R, S2 value (minimum delay between source and receiver will be chosen as a most stable link.

C. Route stability function

To meet the requirements of proposed algorithm target by increasing the route life time and reducing the need for route maintenance mechanism, the overall route stability between source and receiver will be 15 as shown below in equation 16

$$R, S = R\,S_1 + RS_2 \qquad (16)$$

The route that has the maximum R, S value will be chosen as the most stable route to carry the data packets from a source.

Conclusion

We have presented a modification of Ad-hoc on demand Distance vector (AODV) Routing protocol with the assumption that all nodes will corporate and deception is made among neighboring nodes. The modification is solely based on three path stability. We also investigate other mechanism for measuring stability but path stability seems good to us among all the mechanism. We plan to further investigate the proposed model of AODV for multimedia application in MANET field is an attractive issue to the research. In MANET, mobile nodes are moving randomly without any centralized Administration. If these nodes are not having reliable stability of neighbor nodes, links paths from source to destination, it will suffer more loss link. In this paper we have developed a prediction based stability scheme with stability models which attains stability in link, path and neighbor nods. In the first phase of scheme, stability of neighbor nodes is achieved using mobility and stability of paths. In second phase, stability of path is achieved

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