AMSE JOURNALS –2014-Series: Advances D; Vol. 19; N° 2; pp 19-29
Submitted Sept. 2014; Revised Nov. 1, 2014; Accepted Nov. 20, 2014

Lifetime Maximization Technique using Light Weight Memory Sharing Scheme of Nano Machines for Data Transmission in MANET

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Abstract

The dynamically changing topological nature of mobile adhoc network needs frequent route computation between source and destination. The Problem of memory constraints in MANET has been studied extensively earlier but suffers with memory shortage where the nodes have to keep track of information about the topology and neighbour details to perform route computation. We propose a new memory sharing scheme between nano machines, where the route computed between source and destination is shared between nodes to reduce the overall latency and to increase the throughput of the network. In the proposed approach the source node broadcasts the route request called NRREQ, upon receiving this request the neighbour node verifies the neighbour list and pre-computed available route table for an entry to the particular node. The node will be replied with the NRREP otherwise the node re broadcasts the route request to other neighbours and so on. Whenever an intermediate node receives the reply, then it updates the route table and shares the same with the neighbours and sent the reply towards the destination. This proposed approach reduces the frequency of route computation and increases the throughput of the overall network.

Key words

Nano Machines , Memory Sharing. Route Discovery, Qos, Network Overhead.

1. Introduction

In ad hoc network the mobile nodes are moving between base stations and will be switching between base stations dynamically. The mobile adhoc network has base station nodes and mobile station nodes. The base station node will be a fixed one and mobile station node will be moving. The mobile node can communicate with the base station only if it present within the range of base station. Each node whether it is BS or MS has their own range of communication. Each node has fixed power and each communication made by the base station or mobile node costs some power. The power consumption caused by the communication is hugely affecting the life of the BS and MS. Another constraint is routing, a process of transferring data packets between a source and destination through set of mobile nodes. There are various techniques exists for the routing of data packets in mobile adhoc networks.

Mobile adhoc network which has no persistent or fixed topology and routing data's in Manet makes the researchers to invent new protocols and methodologies. As routing in Manet becomes difficult task, people started thinking possible solutions for a better service of the real world. Among them the standard AODV routing becomes popular due to the accuracy and performance of the algorithm. We focus on routing protocol here and propose a new method to increase the efficiency of aodv.

Nano machines are tiny nodes which have limited memory capacity and can store information in limited concern. The nano nodes are mobile nodes which can move between stations and has little memory storage. In our case the nano machines share memory between them by storing the route details in all the nodes and share the complete and recent route details between the neighbors. The most energy consuming process in the nano machine is route discovery, and the nano machines discover the routes between source and destinations by sending request and reply methods. It needs number of broadcasts and number of replies to be received. This makes the node to lose most of the energy in this phase. To avoid this, the memory sharing schemes can be used to reduce the energy depletion occurring in the neighboring nodes.

The quality of service in mobile adhoc network has a great deal where the service has to be provided for a prolong period of time. The quality of service not only based on energy as well as the memory constraints. We consider both here to improve the quality of service of the overall network. The energy loss has to be reduced by reducing the frequency of route discovery process in order to increase the quality of service and life time of the network.

2. Related Works

There are many approaches discussed earlier in this area for the lifetime maximization of mobile adhoc networks and we discuss few of them here.

In ad hoc networks, however, topology information maintenance for routing is much more costly because nodes are mobile, and wireless links are fragile compared to wired links, even with static nodes (Shanthi.T, Ganesan. L and Ramar. K.).DYMO (Dynamic On-demand MANET routing protocol) is the current engineering focus for reactive routing in the MANET . It operates very similarly to AODV, but requires only the most basic route discovery and maintenance procedures. DYMO has also been built with enhancements in mind that most of the optimizations available in AODV should be applicable to DYMO as well (K.L. Espensen, M.K. Kjeldsen, and L.M.Kristensen, 2008 Bagwari, A. 2012). Proximity based groupcast in Manet (A.G.Kriyanov, Gim 2012) is presented, for the routing of multimedia streams where the packet delivery time and loss ratio have restrictions. They have designed a new mode which supports groupcast based on proximity.

Generalized two hop relay for flexible delay control (JiaJia Liu, 2012) extends the conventional two hop relay and proposes a general group-based two-hop relay algorithm with packet redundancy. In such an algorithm with packet redundancy limit and group size , each packet is delivered to at most f distinct relay nodes and can be accepted by its destination if it is a fresh packet to the destination and also it is among g packets of the group the destination is currently requesting. Two-hop relay protocols cover as special cases, like the in-order reception ones, the out-of-order reception ones with redundancy or without redundancy. A Markov chain-based theoretical framework is further developed to analyze how the mean value and variance of packet delivery delay vary with the parameters, where the important medium contention, interference and traffic contention issues are carefully incorporated into the analysis (Alexandre Massayuki Okazaki 2011).

The upcoming generations of wireless communication shall observe a form of faultless integration made up of a variety of platform. Incidentally, wireless mobile ad hoc network (MANET) could be an additional component within the LTE (Long Term Evolution) implementation. It would be transporting various multimedia applications such as voice, video and data with an additional protection feature (M. P. Sebastian, 2007). It is a well-known fact that pure proactive or reactive protocols are recognized to perform well only in a restricted range of wide operational conditions and network configurations. Since diverse protocols are suited for different regions of the ad hoc network design space, combining them into a solo framework constitutes a useful approach to take advantage of on each protocol's strengths (Jiwa Abdullah 2012).

In the Optimized Routing Protocol for Mobile Ad-hoc Networks a node selects next hop node among its one hop neighbors with "symmetrical", i.e. bidirectional, linkages. Therefore, selecting the direction through neighbor node automatically avoids the troubles linked with data packet transfer over uni-directional links (Lei Chen, Adel Ben Mnaouer and Chuan Heng Foh ,2007, C. Adjih, A. Laouiti, P. Minet, P. Muhlethaler, A. Qayyum, L. Viennot ,2010). Being a proactive protocol, path to all destinations within the network are identified and maintained before use. Having the routes available within the regular routing table can be valuable for some systems and network applications as there is no route discovery delay associated with finding a new route (T.Ganesan, Dr.N.Rajkumar ,2013, B. A. Mohan, H. Sarojadevi 2012, Fabio Pozzo, Lucio Marcenaro, Carlo Regazzoni ,2012, Iazi Yi, Asmaa Adnane, Sylvain David, Benoît Parrein, 2011 udusok.edu and eecs.yorku ,2009)

All the above discussed approaches have the problem of route discovering and maintaining routing strategies which occupies more memory constraints. We propose a lightweight memory sharing scheme between nodes to maximize the life time of the network.

3. Proposed Approach

The proposed method which is shown in fig 1 has four stages of data transmission namely: Neighbor discovery- where the nano machine discovers geographic neighbor nodes within its range of data transmission. Route Discovery-Performs discovery of available routes to reach a destination on demand. Memory sharing- shares the discovered routes to all its neighbors and finally forwarding phase of the protocol.

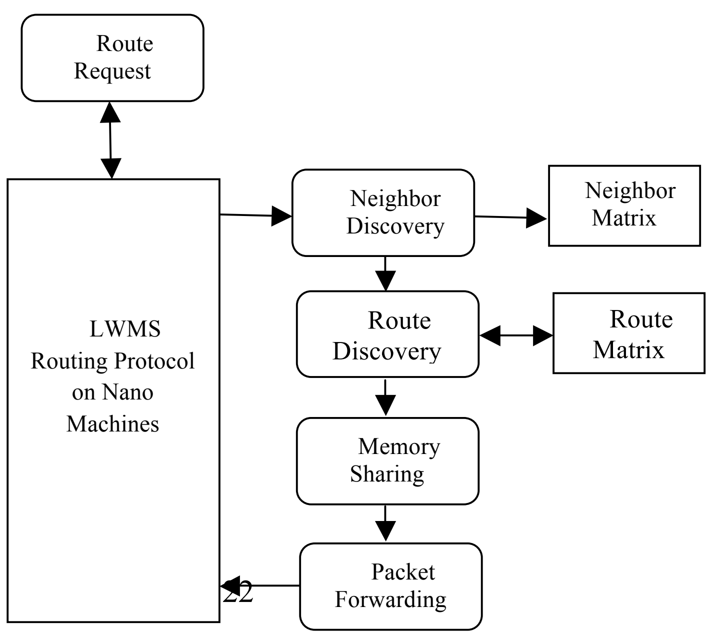

Fig.1. Proposed system architecture

Neighbor Discovery

The source node which has a packet to be transmitted constructs a Hello Message and broadcasts the packet. The neighbor nodes which are all near to the source node and which are within the coverage of the source will reply for that. Upon receiving the reply, the source node updates its neighbor table with the node id of the node replied. The process of receiving the reply will be performed for certain time limit to cut off. The Hello message will be broadcasted to only one hop and the protocol collects one hop neighbor only.

Algorithm

Input: Neighbor table Nt.

Output: Neighbor table Nt.

Step1: Initialize Nt to Null. and LWMSB Timer

Step2: Construct Hello Message HM= {Node Id, Packet ID, Packet Type}

Step3: Broadcast Packet Hm.

Step4: Start LWMSBTimer

    While Timer=On

        Receive Hello Reply HRP.

        NodeIdi = HRP(Node.Id).

        NT = ΣNodeId + NodeIdi

    end.

Step5: Stop.

Route Discovery

At the route discovery phase, the source node intended to forward a packet towards a destination which does not have a direct route or some other route in its route table constructs a LWMSRREQ packet, and broadcast into the network which will be further rebroadcast into the network of multi hop neighbors. The neighbor node which receives the LWMSRREQ packet will look up the route table and neighbor table for the entry about the node id requested. If anything found then the node construct a LWMSRREP packet and sends in the reverse direction. Otherwise the node adds the address of its own and rebroadcast the packet to other neighbors. Finally when the source node receives the LWMSRREP packet will extract the hop addresses from the reply packet and update the routing table.

Algorithm

Step1: Read route table RT.

Step2: construct LWMSRREQ packet with the destination and source address.

LWMSRREQ = {Packet Id, Node Id, Destination ID, TTL}.

Step3: Broadcast LWMSRREQ packet into the network.

Step4: Receive LWMSRREQ

if $\int_1^N RT \in LWMSRREQ(DestId)$

then

construct LWMSRREP packet = {Node Id, Destination Id, Hop Id}.

Else

Rebroadcast LWMSRREQ to other neighbours.

end.

Step5: stop.

Short Memory Sharing Scheme

The memory between nano nodes will be shared between nodes whenever it receives the route reply and has a valid route to reach the destination. The node which receives the new route constructs the route update packet which specifies a valid available route to reach some destination far from here and sends to its two hop neighbor. The nodes which receive this packet will extract the route information from the packet and verifies with the available routes in the route matrix and checks for shortest path, if so the route will be updated to get more valuable route to reach the destination.

Algorithm:

Input: LWMSRREP packet

Output: Updated Route matrix RT.

Step1: Extract Routes available RA =

$\int_{i=1}^{N} \sum Routes(LWMSRREP) \nexists RT$

Step2: construct LWMSRU packet

LWMSRU = { Nodeid, RA}.

Step3: Broadcast packet to neighbors.

Step4: Receive LWMSRU packet

Extract Routes available RA =

$$\int_{i=1}^{N} \sum Routes(LWMSRU) \nexists RT$$

Step5: Update route table RT.

Rt = ΣRoutes (Rt) + Routes (RA)

Step6: Stop.

Packet Forwarding

The packets are forwarded towards destination using the route selected. The source node identifies shortest route from the route table and selects the most efficient route according to energy constraints. The packet will be forwarded to the selected node towards the destination, the intermediate node which does not have any route will perform route discovery phase and updates its own route table before forwarding the packet to the destination

4. Results and Discussions

The proposed method has been implemented in Network Simulator with version 2, and the protocol has been evaluated with various simulation parameters as shown in table 1 below. The simulations were carried out using a MANET environment consisting of 80 wireless mobile nodes roaming over a simulation area of 1000 meters x 1000 meters flat space operating for 10 seconds of simulation time. The radio and IEEE 802.11 MAC layer models were used. Nodes in our simulation move according to Random Waypoint mobility model, which is in random direction with maximum speed from 0 m/s to 20 m/s. A free space propagation channel is assumed for the simulation. Hence, the simulation experiments do not account for the overhead produced when a member leaves a group. Sources start and stop sending packets; each packet has a constant size of 512 bytes. Each mobile node in the network starts its journey from a random location to a random destination with a randomly chosen speed. The table1 shows the simulation parameters used to evaluate the proposed method.

Table 1 Simulation Parameters used in this Protocol

Parameters	Value
Version	NS-allinone 2.34
Protocols	LWMS Routing
Area	1000m x 1000m
Transmission Range	250 m
Traffic model	UDP,CBR
Packet size	512 bytes

Table 2 Qos comparison of Different Protocols

S.No	No. of Nodes	Protocol	Throughput	Avg Delay (ms)	PDF
1	50	DSR	0.43	21	81.23
2	50	Aodv	0.5	18	86.70
3	50	LWMS	0.86	6	94.60

The table 2 shows the comparison of different quality of service metrics and it shows that the proposed LWMS method has higher efficiency than other methods.

Throughput

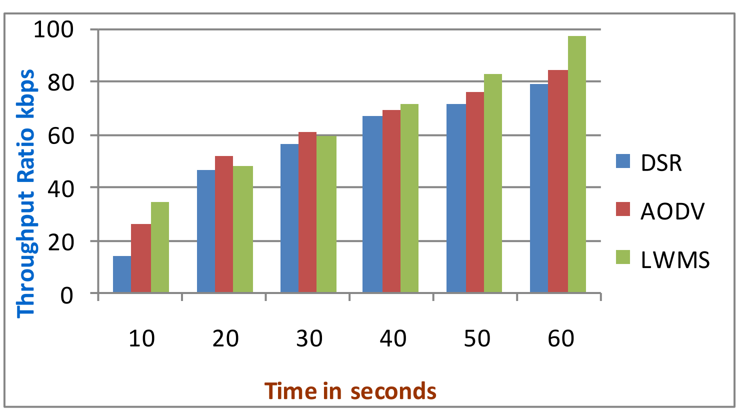

Fig.2. Throughput performance

Fig 2 shows the overall throughput ratio of different methods and it is clear that the proposed LWMS method has achieved higher throughput than other methods.

Packet delivery ratio

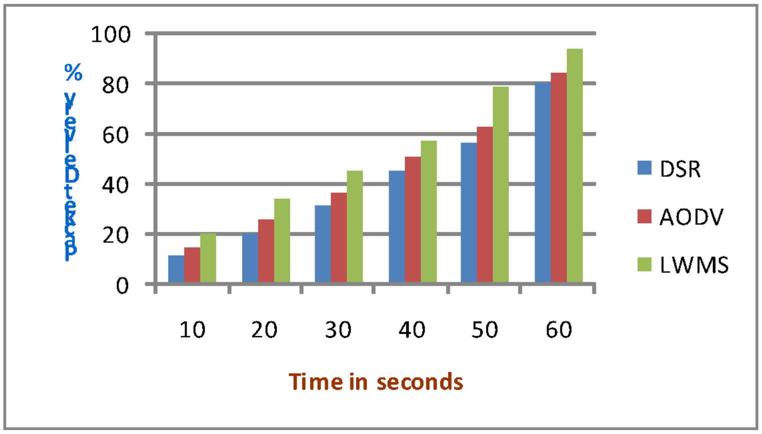

Fig.3 . Packet delivery ratio performance

Fig 3 shows the performance of packet delivery ratio of different algorithms and it shows that the proposed LWMS method has higher packet delivery ratio than other methods.

Average end to end delay

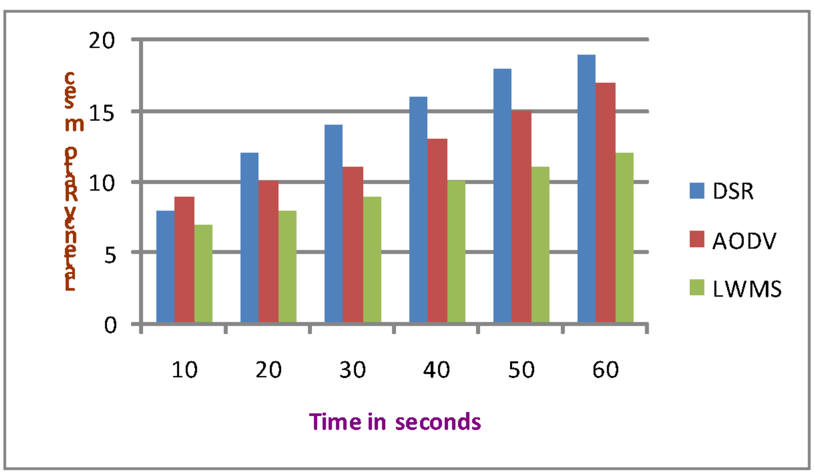

Fig.4. Latency performance

Average end to end delay includes all possible delay caused by buffering during route discovery latency, queuing at the interface queue, and delay at the MAC due to retransmission, propagation and transfer time. It is defined as the time taken for a data packet to be transmitted across a MANET from source to destination.

Delay = tR - tS

Where tR is the receiving time and tS is the sent time.

Fig 4 shows the latency ratio of different methods and it shows clearly that the proposed method has lower latency ratio than others.

5. Conclusion

The proposed light weight memory sharing scheme has been tested and evaluated for its performance for various simulation parameters. The proposed scheme discovers the available routes to reach the destination and shares the route memory between other neighbors of the network by two hop method. This overrides and avoids the unnecessary broadcasting of route discovery phase and reduces the frequency of route discovery. The proposed approach reduces the network overhead which arises through route discovery also. The performance and lifetime of the overall network has been improved using the proposed approach.

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