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Stable energy proficient and load balancing based QoS routing in mobile Ad-Hoc networks: Mobile software based approach

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Abstract

Mobile ad-hoc network (MANET) is an infrastructure-less, self-organizing and autonomous network with the advantage of being low-cost and having on-demand setup. Its inbuilt unique characteristics like self-organization, frequent topology change, the high mobility of nodes, and resource scarceness make Quality of Service (QoS) routing is an exigent task. Congestion arises in the networks with constrained resources. Unfair distribution of traffic density is one of the reasons of congestion in the network and leads to higher packet losses, additional delay and earlier battery exhaustion on certain nodes. Link breakage due to node mobility and limitation of mobile node's energy are other key factors which make it difficult to design & develop QoS routing in MANET. To overcome these issues, we propose an energy efficient Quality of service (QoS) routing for uninterrupted communication from source to the destination node using Mobile software agent (MSA) paradigm. Software Mobile agents collect and calculate queue length, stability of neighbour nodes, remaining battery power and queuing delay of each node. Finally, the route is calculated based on the estimated parameters. This protocol is highly efficient for balancing load and discovering stable route meeting the delay needs. In this research study, we provide a summary of existing proposal, their key ideas, and our proposal also a simulation study of DSR Routing (Dynamic Source Routing) and modified DSR using Matlab simulator on the basis of shortest path, Path hop and average trust value of path.

Keywords

Mobile ad-hoc networks, Quality of Sevices(Qos), Mobile Software Agents(MSA).

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1. Introduction

Infrastructure-less, mobile ad-hoc network (MANET) is composed of mobile nodes, communicating with each other using single and multi-hop over radio links [1]. In Traditional MANET network protocol design Information is exchanged only between adjacent layers of protocol stack because of direct dependencies between physical layers and upper layers. In MANET, using Cross-layer design there exist direct coupling between the physical layer and the upper layers, which can improve network performance [11].A large amount of real-time traffic involves high bandwidth, liable to congestion. Due to the high mobility of nodes in a network, routing in MANET is a challenging task [1]. Traditional routing proto-

col such as AODV, DSR etc. route data packet with min hop count without considering explicit QoS constraints [2], thus, there is lack of intelligence in path discovery and less flexibility in relay node selection. Traditional ant agent routing select next hop randomly so this type of selection does not provide optimized route [6]. Even in modern wireless networks the component carriers present in spectrum aggregation doesn't require to be adjacent and symmetric [17].

1.1 Reactive Routing in Mobile Adhoc Network

DSR is a reactive routing composed of two parts; route discovery and route maintenance. It is based on source routing which means, a sender node has in the packet header the complete list of the path that the packet must travel to the destination node [2]. That is, each and every mobile node in the path just forwards the data packet to its next hop specified in the header without having to check its routing table as in table-driven routing protocols like DSDV. So, it maintains less overhead than DSDV. Multi-paths are obtained in DSR Routing .AODV routing protocol routes are discovered on demand. AODV protocol also uses the sequence number system to determine the freshness of the received information and uses the same method route discovery like the DSR protocol uses [2]-[3].In Route Discovery mechanism when a source node has a data packet, it searches its routing table for the destination entry. If such an entry is not available in the routing table the source initiates a route discovery process by broadcasting the RREQ message in the network. The RREQ contains the following fields : sourceaddress, sourcesequence#, broadcastid, destaddress, destsequence#, hopcount [3]. Destination itself or any intermediate node who knows the path to the destination node can send Route RREP.

1.2 Mobile Software Agent

Mobile Software engineers continually struggle to design and develop tools and techniques to manage the complexity that is likely in software systems due to their distributed and dynamic environments [4]-[5]. The traditional programming paradigm uses functions, procedures, structures and objects to develop software for performing a given task [4]. This paradigm does not support development of Flexible, intelligent and adaptable software's, and also does not facilitate all the requirements of Component Based Software Engineering (CBSE) [4]-[5]. Mobile Agents are such tool with the features of autonomy, learning ability and most important, mobility feature [4].

The rest of the paper is organized as Section 2 gives Existing works; Section 3 explains proposed mechanism; Section 4 shows simulation results and conclusion is drawn in Section 5.

2. Literature Review

Using mobile agent technique, different load balancing metrices for congestion control are used like interface queue size and MAC drops [8], current cache buffer queue length

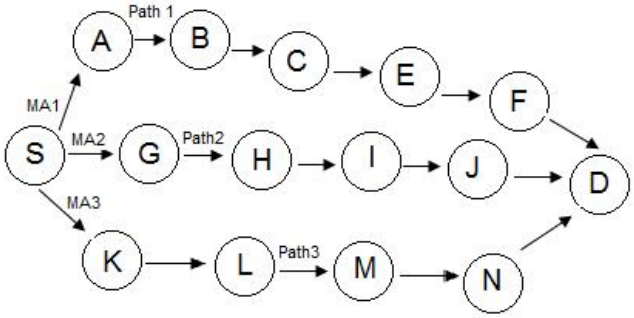

Figure 1. Mobile Agent Based stable energy proficient and load balanced routing design for MANET.

[9], and ratio of number of paths passing the assessed node to the number of paths established in the network [10]. Multiple metrices likes packet forwarding behaviour of mobile nodes, current load along with the neighbour nodes and maximum bandwidth are used for providing reliable route [12]. Flow control mechanism combined with routing with stable route, energy efficiency, delay is presented in [13] & flow density and maximum life time is selected for packet transmission in [19]. Work done in [14], QoS monitoring agents based stable and energy-efficient routing technique with cross layering. Agents gather and estimate different link reliability metrics considering residual battery power. Work in [15], proposed protocol SEQCDR multiple metrics of received signal strength, queue length, draining, rate of nodes and the delay in order to enhance the system performance but it lacks in adaptability and intelligence in taking routing decision. In [7], authors proposed congestion and power control techniques based on mobile agent technology. In [21] ,Routing protocol called AMAODV presented by combining multiple matrices (relative velocity, queue length and hop count). It provides higher PDF and reduced delay than the traditional AODV. In [20], a weight based Load Balanced routing (WLBR) protocol developed using three matrices aggregate interface queue length, hop count and energy.

3. Our Proposed Mechanism

Flow or traffic density, which is unequally distributed is one of the source of congestion in MANET network [10]. From above mentioned protocol it is clear that load balancing and stable routing in conjunction with QoS metric is not used with integration of Mobile agent paradigm. The concept of software Agent technology for calculating and updating information in the network, minimize the control message packets over the network.

3.1 Used Metrices

Node Stability (NS): Neighbour node stability shows the consistency of a node in the network Signal to Noise ratio with integration Received Signal Strength using cross layer approach is good metric for calculating node stability [14]. *Remain-*

ing Energy (RE): Energy Spent in transmission and reception mode is consideration for sending and receiving and receiving packets. Idle mode is not considered here. *Congestion Level (CL):* It is the ratio of number of packets in the queue to the buffer size. *Queuing Delay (Qdelay):* In MANET, processing and transmission delay is constant [18]. Queuing delay is the waiting time in the queue.

3.2 Mobile Agent based stable energy proficient and load balanced routing in MANET

Step 1 : The source node S checks the number of existing one hop neighbours and clones the Mobile agent to that neighbour. Step 2 : The Mobile agent (MA) selects the shortest path of the route to travel towards the destination node D. Step 3 : The MA1 (Mobile agent) moves towards path P1 by hop manner, MA2 in path P2 and MA3 in path P3. Mobile agents carry its own history of movements and calculate and update routing table entries (NS, RE, CL, Qdelay) of the node it is visiting. So, total path selection index (PSI) is calculated by:

$$PSI_{max} = \frac{\sum_{i=0}^{N}(NS_i \times RE_i \times (1-CL_i) \times (1-Qdelay_i))}{N} \tag{3.1}$$

Where, N= total number of nodes in selected route. Step 4: The Destination node D send total Path selection Index (PSI) using eq1 of path Path1, Path2, Path3 respectively to the source node. Step 5: Now, the source node S select the path with max PSI.

4. Simulation Based Study & Results

In this Simulation study will find path from soured to destination of Dynamic Source Routing (DSR) using Matlab simulation. In simulation input parameters like number of mobile nodes, number of source node as well as destination node, X and Y co-ordinates of mobile nodes, mobile node transmission range & node trust values are taken in to consideration.

Table 1. INPUT PARAMETERS

Input Parameter	Value
Total number of nodes/hopes used	10
Index of source nodes	1
Index of source node	10
Node transmission range	5
Node X-coordinates	1, 2, 3, 4, 8, 6, 7, 9, 10 ,10
Node Y-coordinates	6, 2, 5, 8, 5, 1, 10 ,2 ,8 ,5
Nodes Trust Value	1, 1 ,0.7 ,0.4 ,0.1 ,0.1 ,0.1 ,1, 1 ,1
Nodes Trust Value	1,1,1.0,1.0,1.0,1,1,1[Modified]
Node transmission range	5

5. Expermental Result

Fig-2 shows the shortest route from source 1 to destination node 10 of DSR protocol and fig-3 describes trusted path, trust value and path hop. If we modified trust values of the

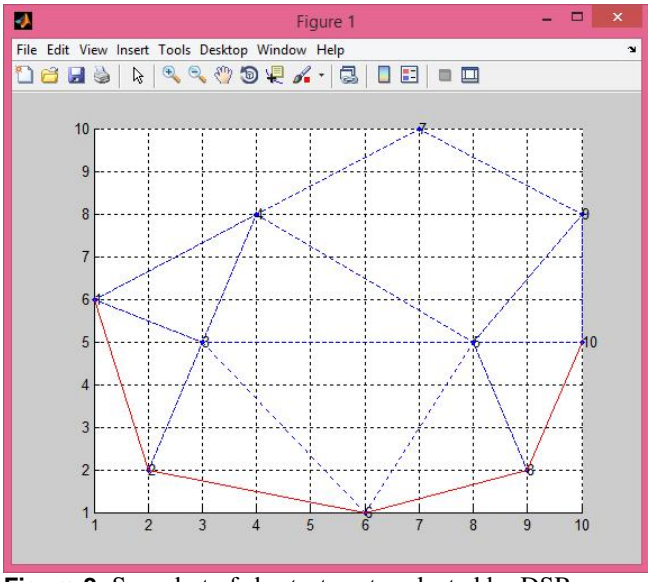

Figure 2. Snapshot of shortest route selected by DSR protocol.[Yi Wing 2005]

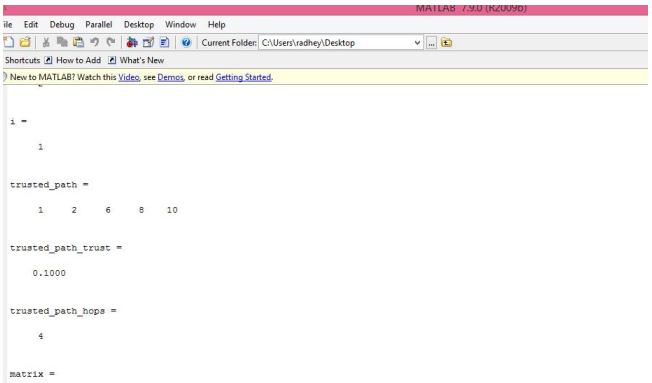

Figure 3. Snapshot of output parameters related to Trusted Path TDSR protocol.

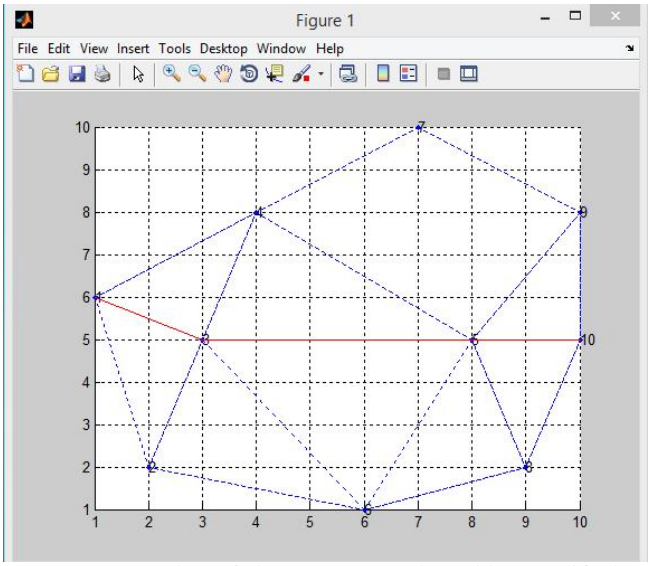

Figure 4. Snapshot of shortest route selected by Modified DSR protocol.

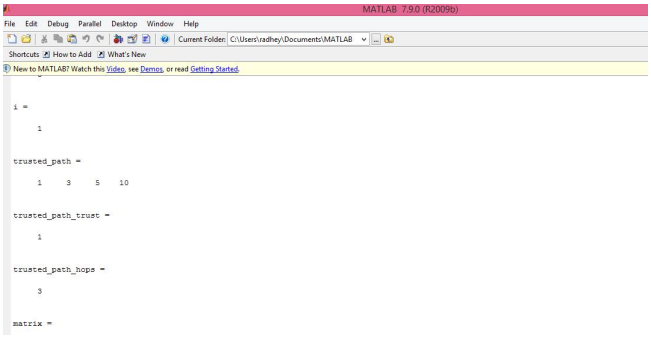

Figure 5. Snapshot of output parameters related to Trusted Path TDSR protocol

Table 1. COMPARISION OF DSR AND MODIFIED DSR

Parameters	DSR	Modified DSR
Path	1-2-6-8-10	1-3-5-104
Path hops used	4	3
Average Trust value Path	0.1	1

nodes then shortest path, Average trust value of selected path and path hop also changes and we can find more trusted path. Modified value of mobile node'trust values have been taken in table -1. Fig 4 & 5 explains about modified DSR and output proves shortest, more average trust value of selected path.

6. Conclusion

In this research paper, we have talked about Mobile Agent based stable energy proficient and load balancing based QoS Routing in MANET. In this mechanism, Software Mobile agents collect and calculate queue length, LET and remaining battery power and queuing delay of each node. The present mechanism can be able to reduce control packet overhead, increases Packet Delivery Fraction and reduces delay as compared to existing routing techniques. Simulation study shows selected shortest path, average trust value of selected path and path hop of DSR and modified DSR.

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