Multimedia Transmission in MANETs and its impact when using AODV based Routing Protocols

Meena Rao
[1]*Department of Electronics & Communication Engineering, Maharaja Surajmal Institute of Technology C-4, Janak Puri, New Delhi, INDIA*
Ph. No. +919868404685
Email:meenarao@msit.in

Abstract - A mobile ad hoc network (MANET) is a self-configuring network of several independent nodes with each node acting as a router also. The network can be single hop or multihop and are characterized by frequent node movements. Various MANET applications include military deployment, formation of network in meetings and conferences, electronic classrooms etc. As the popularity of these devices increase, it becomes necessary for these devices to support real time and multimedia applications. These applications require stringent Quality of Service parameters and to support these parameters an efficient routing protocol with back up routing is necessary. The popular reactive routing protocols like AODV and DSR do not have an efficient back up routing system and hence any route failure in such systems makes it difficult for multimedia applications to be supported. In this paper AODV nthBR protocol, which has been proposed and implemented by the author previously for data transmission, is now implemented for multimedia transmission. This paper proposes AODV nthBR routing protocol for transmission of multimedia traffic. AODV nthBR routing protocol provides multiple backup routes in case of a node failure resulting in better QoS parameters for transmission of packets. Here, AODV nthBR has been implemented for transmitting an image and the results are compared with other reactive routing protocols.

I. INTRODUCTION

Popularity of wireless devices has increased tremendously in recent years as they provide availability and connectivity anytime and anywhere. Mobile ad Hoc Networks (MANETs) are one of the major networks in the wireless criteria. They are a collection of self configuring nodes that can dynamically be set up anywhere to provide services to users [1]. Non requirement of infrastructure support tremendously contribute to the popularity of these devices as the setup cost is minimized and time required for network establishment is also negligible. Due to so many features, MANETs support a host of applications like video conferencing between different nodes, data and multimedia packet transfer between users, electronic classrooms, communication in emergency area etc. With an increased demand for these networks, they need to support all kinds of data transfer. Also, with the various technological advancements, it becomes imperative for these devices to support multimedia transmission. Multimedia involves text, image, audio, video and multimedia transmission helps in supporting varied range of applications [2]. Due to the above factors, it becomes quite necessary to provide nodes or devices in MANETs that support multimedia transmission. Enabling MANETs to support multimedia transmission is a challenging task as MANETs connect devices that work on low bandwidth, less energy and less storage capacity.

For an efficient transmission of multimedia packets, it needs to be ensured that packet flow is continuous, packet loss is minimal and time required for the transmission is also minimal. To ensure this, it is necessary to provide acceptable Quality of Service (QoS) parameters in multimedia applications for MANETs. Mostly packet loss in multimedia transmission takes place due to route failure. So, MANETs should be supported by an efficient routing algorithm. Traditional routing algorithms like Ad Hoc On Demand Distance Vector (AODV), Dynamic Source Routing Algorithm (DSR) provide only single routes from source to destination resulting in packet loss when any intermediate node fails [3]. A variant of AODV protocol called Ad Hoc On Demand Distance Vector Backup Route (AODV BR) attempts to solve this problem by providing a backup route in case of a node failure [5 of Meena]. However, the problem of packet drop persists when the backup route also fails.

This paper proposes the transmission of multimedia data with Ad Hoc On Demand Distance Vector nth Backup Route (AODV nthBR) that provides multiple backup routes in case of a node failure for transmission of data to destination[4][5]. Nodes are selected based on their distance from the failed node and energy efficiency. AODV nthBR routing ensures delivery of packets even in case of multiple route failures and also avoids duplicity of packets.

The paper is organized as follows:

II. SIMULATION SETUP AND IMPLEMENTATION

Fig.1 shows a rectangular field area of size $100m \times 100m$ with a destination that is initially placed in the centre. At the start of the data transmission all nodes including the destination node moves randomly. A system with 10 nodes and node mobility of 20m/s has been considered. All the nodes are randomly placed in the field area and initial energy of a node is 0.5J and total packets to be transmitted are 4000 with each packet of size 1 bit and number of transmission rounds being 6000. The simulation set up is such that value of node density and node mobility can be changed to show a sparse, medium or densely populated system. However, in this paper, a system with 10 nodes is considered to show a MANET. A bitmap image of size 611KB is chosen to be transmitted for simulation purpose.

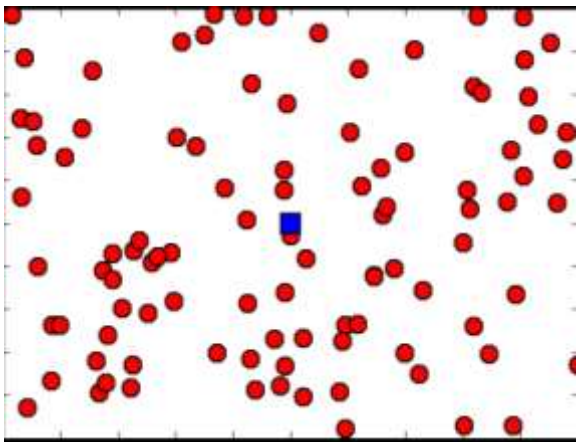

Figure 1. MANET simulation setup

III. IMPLEMENTATION OF AODV NTHBR

Distances between all the nodes are calculated using distance vector calculation [6] [7].

Average distance between the transmitting device and destination D_{bs}

D_{bs}= (one dimension of field)/$\sqrt{2\pi k}$ (k=1) (1)

D_{bs}= (0.765×one dimension of field)/2 (2)

Also, the calculated average energy E_a of a node after a particular round is given by

$$E_a = E_t \times \left(\frac{1-(r/R_{max})}{n}\right) \quad (3)$$

R_{max}=Maximum number of Rounds

E_t = Total Energy

At the start of the data transmission, packets are sent to the destination through multihop transmission. In case of a node failure, the node that is nearest to the failed node is found out using distance vector calculation as given in equation 1 and 2. If energy of the selected node is within the threshold value required for packet transmission then node is selected for backup route else the next nearest node is found out using distance vector and energy calculation method. If the next nearest node fulfills the criteria of distance and energy requirements, then the node is selected for packet transmission otherwise the process of finding the suitable node continues. Here, an image is chosen for transmission and the transmission of an image using AODV nthBR protocol is referred as AODV nthBR with mixed traffic.

TABLE I. Network Specifications

Simulation Parameters	
Field Size	100mX100m
Number of Nodes	10
Number of Packets	4000
Number of Rounds	6000
Speed of the nodes	20m/sec
Data traffic	CBR(Constant Bit Rate)
Protocols	AODV, DSR, AODVBR, AODV nthBR, AODV nthBR with mixed traffic

IV. SIMULATION RESULTS

Simulations were performed in MATLAB, an open source package and QoS parameters were obtained in terms of throughput, end to end delay and packet delivery fraction.

4.1 Throughput

It is defined as the total number of data packets received by the destination over the total simulation time. As seen from Fig. 2, throughput is maximum for AODV nthBR protocol, followed by AODV BR, then AODV and least for DSR protocol. While transmitting a multimedia image through AODV nthBR the number of bits transmitted reduces comparatively. However, our aim is to find back up routes to avoid link failure, so that transmission of packets of any type is achieved and AODV

nthBR protocol supports this. From Fig. 2, it is observed that at round 1000, throughput is 7601 bits for AODV, 4343 for DSR, 9487 bits for AODV BR, 9959 bits for AODV nthBR, 59 bits for AODV nthBR with mixed traffic. Also, for 6000 rounds, throughput is 7601 bits for AODV, 4343 bits for DSR, 13810 bits for AODV BR, 15480 for AODV nthBR and 59 for AODV nthBR with mixed traffic.

4.2 **End to end delay**

End to end delay is the total node delay that includes the protocol processing time and the queuing delay at each node.
As seen from the results obtained (Fig.3), end to end delay as shown through the pink line is the highest compared to other protocols. This is because, multimedia transmission takes more time compared to normal data for transmission. So, although we are able to achieve our task of finding out n backup routes to avoid path loss, the delay will be more in case for multimedia transmission.

4.3 Packet Delivery Fraction

Packet Delivery Fraction (PDF) is defined as the ratio of the total number of data packets received by the destination to the total number of data packets transmitted.

$$PDF = \frac{Data\ received\ by\ destination}{Data\ sent\ by\ transmitter} \quad . \qquad (5)$$

From Fig. 4 it can be seen that PDF is again maximum for AODV nthBR. While transmitting an image (AODV nthBR with mixed traffic), the PDF comparatively decreases but the aim of having an uninterrupted transmission by finding out n backup routes is achieved.

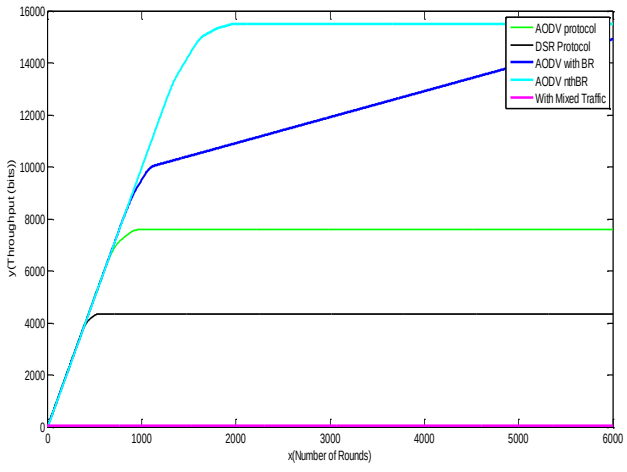

Figure 2. Throughput v/s number of rounds

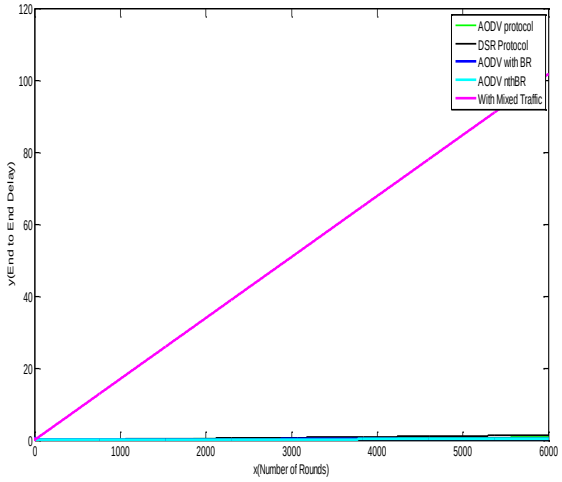

Figure 3. End to end delay v/s number of rounds

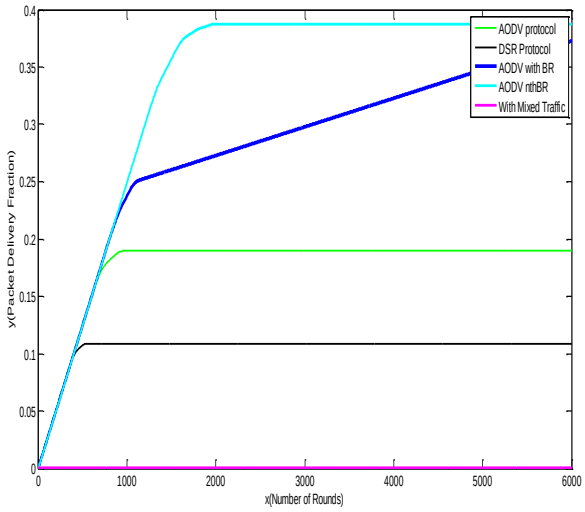

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Figure 4. Packet delivery fraction v/s number of rounds

V. SUMMARY

In this paper an AODV nthBR protocol is simulated for transmitting an image (AODV nthBR with mixed traffic). Various QoS parameters have been simulated and the results compared with existing routing protocols. AODV nthBR achieves best possible results and hence transmitting mixed traffic with AODV nthBR protocol helps to achieve an uninterrupted transmission due to the provision of n backup routes.

VI. REFERENCES

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