QOS parameter comparison of AODV for CBR, VoIP, and Video traffic over MANETs

Poluboyina Lavanya, V. Siva Kumar Reddy, A. Mallikarjuna Prasad

Abstract— Mobile ad hoc networks (MANETs) are becoming the prominent class of ad hoc networks with their distinctive characteristics and rang-ing several fields of applications. In MANETs, the nodes are mobile devices changing their positions with time, resulting in dynamic topologies of the network. In such dynamic environments, routing the data packets from source to destination through multi hoping is a challenging issue. With the growing popularity of mobile devices, the demand for multimedia traffic over MANETs is also increasing. On the other hand, it is making the routing further challenging to provide the quality of service (QoS) in the environment of MANETs. This paper focuses on the simulation comparison of an eminent on-demand routing protocol i.e., ad hoc on-demand distance vector rout-ing protocol, for CBR, voice over IP, and video traffic for a set of QoS parameters for the defined topologies and connections.

Keywords: AODV; CBR traffic; MANET; multimedia; QoS; video traffic; VoIP.

1. INTRODUCTION

Mobile ad hoc networks, abbreviated to MANETs, drawing atten-tion with the appreciable advancements in wireless networks, in specific, wireless ad hoc networks in recent past. Ad hoc networks are different from infrastructure networks in the way they form the network. They do not rely on any centralized administration or require any routing devices. The nodes themselves are capable of forming a network. It is intuitive in ad hoc networks that the nodes are complex in nature performing both host and routing functions. MANETs are one class of ad hoc networks where the nodes are mobile devices changing their positions with the time, leading to dynamic topologies of the network. The communication between any two nodes which are not in direct communication range of each other is through multi hoping. MANETs, having distin-guished features from other multi hop wireless networks finding applications in various fields e.g. battlefields, emergency situa-tions, where there is a need of having a temporary network with-out any underlying architecture; conferences/convections for ex-changing of information by forming a temporary network.

MANET, being a dynamic network making the routing of data packets in the network a challenging task. There has been a wide variety of routing protocols and algorithms are proposed and simulated for various parameters over mobile ad hoc environment in literature. One way of classifying the routing protocols based on route finding methodology is: proactive, reactive, and hybrid (combines the best features of proactive and reactive) [2]. This paper presents the simulation comparison of ad hoc on-demand distance vector routing protocol (AODV), for constant bit rate (CBR) traffic, voice over internetworking protocol (VoIP) traffic, video traffic, and a combination of all.

This paper is organized into 4 sections. The objective of the paper is discussed in section I. Section II describes the concept and the working of AODV protocol. Section III presents the simulation environment and QoS parameters. Results, and the graphs plotted are discussed in section IV. In section V, conclusion and future scope of the work are outlined.

2. AD HOC ON-DEMAND DISTANCE VECTOR ROUTING PROTOCOL

AODV [3] is an efficient on-demand routing protocol by provid-ing the routes on need. Every node maintains a routing table that is not sophisticated as the case of table driven routing protocols. Only the routes each node communicates with are maintained. Hop count is the routing metric and sequence number ensures the freshness of the route.

Whenever a node initiates a communication process, first it searches for any predefined path available in its routing table. If there is no such entry for the route it is searching for, the source node starts the route finding process by flooding RREQ packet. Every node, in the direct communication range of source node, receives the RREQ packet and responds in two possible ways. One, the nodes along the path from source node to destination node forwards the packet if they do not have any route for in-tended destination node or two, if they have any, they respond with the reply packet carrying the route information. An RREQ packet sets up the reverse path during its travel from the source node to the destination. RREQ packet contains a TTL (time to live) to avoid the wastage of network resources. RERR (route error) messages are used to handle breaking of connections due to node movements, for maintaining the topology of the network up to date.

3. SIMULATION MODEL AND QOS PARAMETERS

Running applications on the wireless networks are broadly categorized into two: real and non-real time. Real time applications re-quire quality of service (QoS) parameters like delay should be low [1]. On the other hand non-real time applications demand high packet delivery ratio (PDR) values.

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Fig. 1 showing the network scenario of MANET for the simulation parameters listed in Table 1. Nodes in color represent sources of the communication process, in specific, nodes in red color rep-resenting video traffic, nodes in green color VoIP traffic, whereas, the nodes in blue color CBR traffic. For the work, the NS 2.34 is considered for simulation. The ITU-T standardized encoding scheme codec G.711 is used for the generation of VoIP traffic [6-8]. Video traffic is generated with EvalVid tool-set for evaluation of the transmission of video over the network [9].

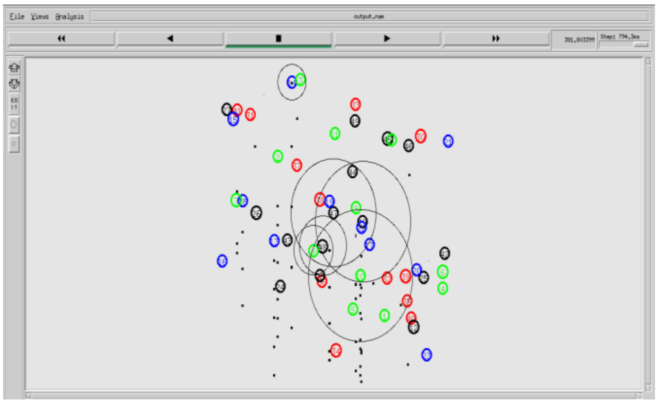

Fig. 1: Simulation environment of MANET for 50 nodes

Table 1: Network Specification Parameters

Examination time	500s
Mobility model simulation time	250s
Mobility model	Random way point
Area considered for simulation	1000X1000
Node speed	10m/s
MAC layer	802.11
Initial node placement	Random, and fixed
Nodes taken (n)	50
Number of connections	n/2 (Random, and fixed)
Traffic type	Constant bit rate, VoIP, Video and a combination of three
Transmission range	250m
Node data rate	500 Kbps
Transport layer protocol	UDP

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Packet delivery ratio is the measure of how successful the network is in transmitting data packets from source to destination. Routing overhead measures the number of control packets required for the transmission of data packets to the intended destination. End-to-end delay and the variation in delay parameters are required to check the suitability of the concerned routing protocol for multi-media traffic.

This paper examines the behavior of AODV for the three defined cases: Case-I, Case-II, and Case-III

- Case-I: a set of 20 random topologies generated using set-dest utility command (uses random waypoint mobility model) with 25 fixed traffic connections.
- Case-II: a set of 20 random topologies having fixed initial node placements with 25 fixed traffic connections.
- Case-III: fixed topology with 25 random traffic connec-tions generated using the program cbrgen.tcl.

Moreover, 20 simulations were executed and the averaged results are plotted for four schemes defined as,

- Scheme 1: only CBR traffic
- Scheme 2: only VoIP traffic
- Scheme 3: only video traffic
- Scheme 4: a combination of CBR, VoIP, and video traffic

The viability of the AODV for multimedia traffic is verified for the aforementioned QoS parameters. PDR expressed in % is the number of data packets received to transmitted in network and is the average value of the network. Number of routing packets to total number of packets is taken as the routing overhead and is expressed in %. Average time taken for a packet to travel from source to destination is the end to end delay. The network efficiency is measured by the throughput and it is expressed in bps. Jitter is the variation in delay which is an annoying factor when the real time multimedia transmission is considered [4-5]. Simula-tion parameters are identified based on the work in [10].

4. RESULTS AND PERFORMANCE ANALYSIS

Fig. 2 showing the routing overhead in % plotted for the defined three cases and four schemes. From the graphs, it is observed that routing the video traffic in taking more overhead packets in spe-cific, when the random traffic connections are taken. For scheme 4, the AODV is performing well compared to other schemes.

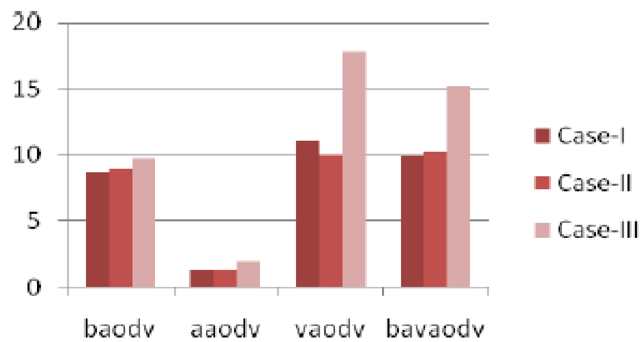

Fig. 2: Routing overhead expressed in %

Packet delivery ratio in % is shown in the fig. 3. The graphs re-vealed that the packet delivery ratio of video traffic is good when the video traffic alone is considered, whereas very poor when only the CBR traffic is taken due to the mobility of the nodes and the continuous traffic flow for the total simulation time. This, as a whole lowered the packet delivery ration when the scheme 4 is examined.

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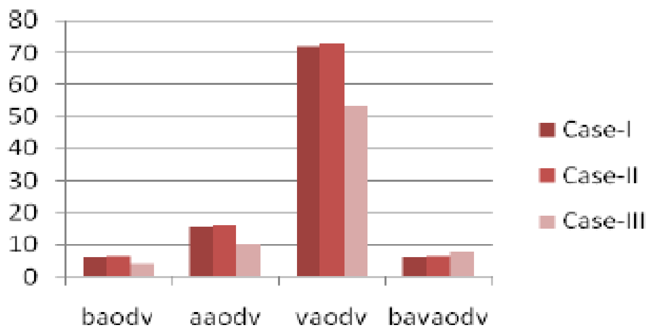

Fig. 3: Packet delivery ratio expressed in %

Throughput against the schemes and the cases is plotted in fig. 4. Relatively higher values of the throughput for CBR traffic alone indicates the efficiency of the network but the low buffer lengths are the reason for low packet delivery ratio values. The same is the case with scheme 4.

In fig. 5 delay in ms is shown. The considered worst case scenario is the reason for relatively high values of delay in the scheme 1 and 4. On the other hand, it does not have much impact on the scheme 2 and 3.

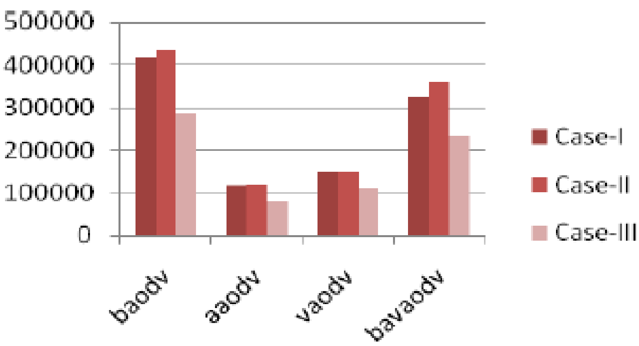

Fig. 4: Throughput

International Journal of Engineering & Technology 3

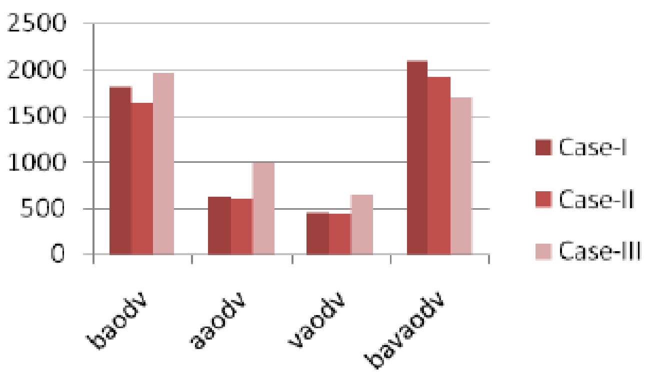

Fig. 5: Delay expressed in %

The variation in packet to packet delay i.e., jitter is plotted in fig. 6. The higher values of jitter is noticed in the case of scheme 2 and 3, on the other hand, the higher values of jitter are not acceptable for real-time traffic.

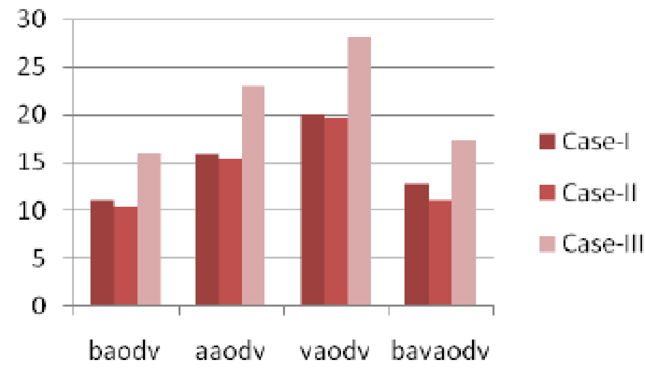

Fig. 6: Jitter expressed in ms

5. CONCLUSION

The work presented in this paper has shown the performance of AODV for the defined three cases and four schemes. The dynamic environment of mobile ad hoc networks has put its mark on the results. Each scenario is simulated for 20 times for worst case network parameters and the results are averaged. From the graphs, it is revealed that none of the scheme's performance is satisfactory. The smooth running of the plots can be observed for case-I and II for all the parameters. Moreover, the results are showing high values of jitter in the case of scheme 2 and 3 that is not acceptable to provide a good QoS. From the overall results, there is a need for a protocol which can satisfy QoS requirements for the transmis-sion of multimedia traffic. Furthermore, there is a scope of carry-ing this work further by incorporating multicast operation into the network.

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