QoS Routing For Mobile Ad Hoc Networks

Sonali L. Gaiakwad #
Electronics Department, Pune University
MAE Alandi, Pune,India
Sonaligaikwad11@gmail.com

Prabha Kasliwal##
Associate Professor, pune University
MAE Alandi, Pune,India
prabha.kasliwal@gmail.com

Abstract— The main motivation of this work is to enable QOS based routing protocol and compare its performance with existing normal routing protocol in wireless ad hoc networks. Our results will illustrate how QOS enabled routing improves the consumption of resources, at the same time reducing the unnecessary signals, and avoiding all the irrelevant sessions that fail to satisfy QOS requirements. The performance of both the protocols is compared by using the information obtained from link layer. QOS enabled protocol shows a significant improvement in terms of QOS parameters that we applied such as protocol overhead and packet delay. The results thus achieved helped us to analyze our proposed mechanism, and add link layer information in control routing messages. Measuring bandwidth causes both the routing and QOS routing to react slowly to topology changes. Thus we plan to provide the QOS enabled routing service by employing the standard AODV protocol available under NS2.

Keywords— **Wireless networks, ad hoc networks, routing protocols, Routing load, Quality of Service.**

INTRODUCTION

Wireless ad-hoc networks are composed of autonomous nodes that are self-managed without any infrastructure. In this way, ad-hoc networks have a dynamic topology such that nodes can easily join or leave the network at any time. They have many potential applications, especially, in military and rescue areas such as connecting soldiers on the battlefield or establishing a new network in place of a network which collapsed after a disaster like an earthquake. Ad-hoc networks are suitable for areas where it is not possible to set up a fixed infrastructure. Since the nodes communicate with each other without an infrastructure, they provide the connectivity by forwarding packets over themselves. To support this connectivity, nodes make use of routing protocols [1]. As far as routing protocols are to be considered, there exist a lot many of them such as AODV (Ad-hoc On-Demand Distance Vector), DSR (Dynamic Source Routing) and DSDV (Destination-Sequenced Distance-Vector). We make use of the AODV routing protocol Besides acting as a host, each node also acts as a router to discover a path and forward packets to the correct node in the network. Although there are a lot of routing protocols available to perform routing in Wireless ad hoc networks, but none of these protocols provide Quality of Service [2]. Although routing in wireless networks informs the source node about the bandwidth and QOS available at the destination.However considering the mobile ad hoc networks the conception of QOS needs to be redefined or modified.The remainder of this paper is organized as follows: In section I we summarise brief Introduction of Ad Hoc Networks and QoS. In section II we describe the QoS extension for AODV routing mechanism. Next in section II we present simulation analysis of AODV and QoS-AODV protocol comparison with respect to traffic rate. In section III we summaries Conclusion.

I.A brief Introduction of Ad Hoc Networks and QoS

What is Mobile Ad Hoc Networks – The concept of Mobile Ad Ad Hoc network is pretty old, and has been a topic of research since 1970s, it is kind of difficult to clearly indicate what it means. The organization which is responsible for guiding the evolution of the internet, IETF (Internet Engineering Task Force) has given the definition as follows –"A mobile ad hoc network (MANET) is an autonomous system of mobile routers (and associated hosts) connected by wireless links. The routers are free to move randomly and organize themselves arbitrarily; thus, the network's wireless topology may change rapidly and unpredictably. Such a network may operate in a stand-alone fashion, or may be connected to the larger Internet"The fact that MANETs don't need any infrastructure support makes it highly useful in many applications. The areas where the MANETs can be used are, Collaborative Computing (where several users, or several systems are expected to work in parallel), Communication within a building, organizations, meets, etc., Communication during a disaster recovery, Communications on a battlefield, etc.

What is Quality of Service (QoS)- Quality of Service (QoS) is defined as the set of requirements (service) which need to meet (by the network) in the process of the transportation of a packet stream from the source to a destination. Service requirements of end user applications govern the network needs [3]. The network also guarantees a set of measurable attributes of service in terms of end to end performance, such as packet loss, delays, bandwidth etc. Another QoS attribute is Power Consumption, and is more specific to MANETs. QoSprotocols are implemented by most vendors while keeping in mind specific scenarios and considering different parameters, variables and network topologies.

Another definition of QoS, as given by The United Nations Consultative Committee for International Telephony and Telegraphy (CCITT) is - "The collective effect of service performance which determines the degree of satisfaction of the user of a service."

II .QoS ROUTING FOR AODV

Based on QoS objects the AODV routing decision is enabled in order to add extension to the route messages during the time of route discovery [4]. Changes are required in order to handle the extensions in QoS, and these changes are actually needed in routing tables, it has been observed that four new fields are required to be added in the QoS-AODV in order to fulfill this purpose – [1] Minimum Available Bandwidth [2]Maximum Delay[3]List of sources requesting bandwidth guarantee[4]List of sources requesting delay guarantee The routing table should have records in terms of sessions, not in terms of destination nodes, as a node may be the destination of some other session.

A .Route establishment with a QoS Parameter

The field, known as minimum bandwidth is actually the representation of requested amount of bandwidth for a specific route. When a node gets a RREQ, it should compare the link capacity it already has with the capacity of bandwidth requested route request. If it finds that the requested bandwidth isn't available with it, it will simply ignore it without any further processing. Further processing of the request in only possible if the bandwidth is available, and this processing continues till the destination node is reached. Later the response is send using a route reply message, i.e. RREP. This message RREP is initialized with a bandwidth value as huge as infinity. Every node that forwards RREP compares the own link capacity and bandwidth field in RREP, and before forwarding it maintains the minimum of two in bandwidth filed.

B. Loosing QoS Parameters

If it is observed after route establishment a node in the path detects that QoS cannot be maintained anymore an ICMP-QoS-Lost message is triggered to all nodes which are affected by QoS parameters, this is the basic reason behind keeping a list of source nodes requesting delay or bandwidth guarantee.

II.SIMULATION RESULT

Here, in order to use QoS parameters to choose a path, we have extended the AODV codes under ns2. Mac 802.11b Bandwidth measurement and reservation is the base of this work [5]. Here the bandwidth is considered as the QoS metric in the measurements. Performing several tests, and experiments, researchers define three QoS evaluation metrics.

A.Simulation Evaluation Metrics

Very few QoS ad hoc routing protocols for evaluation are well known; since this study is based upon the bandwidth measurement a new evaluation metric is proposed, this metric expresses the bandwidth efficiency, can also be termed as BWER (Bandwidth Efficiency Ratio) –

$$\text{BWER} = \frac{\text{Transmitted Packets}}{\text{Received Packets}}$$

Sent packets and Transmitted packets are altogether a different terms, because there could be several reasons due to which every packet that has been sent is not successfully transmitted to the destination. BWER actually represents the amount of total bandwidth that is used by the source nodes to deliver the data, however the packet which have been routed to invalid routes are not included in this [6]. Packet delay is also considered as anevaluation metric which can be used for measurements. Packet delay Evaluation Metric actually displays the average packet latency required to successfully deliver to the node set as the destination[9]. Value of Packet Delay Evaluation Metric is able to evaluate the performance of protocols for real time applications.

Now, in order to measure the cost of Quality of Service extension another metric is proposed which is actually a metric to evaluate the overhead of QoS-AODV. Overhead measurement is performed by the number of transmitted control packets which are used to maintain and establish the paths in the network. The hidden side of overhead is actually the amount of wasted resources due to inappropriate routing information, like dropped packets and the sub-optimal routing overhead[7]. Here, in addition to the control routing overhead, focus is also on the second mean of overhead. Normalized Overhead Load is defined as -

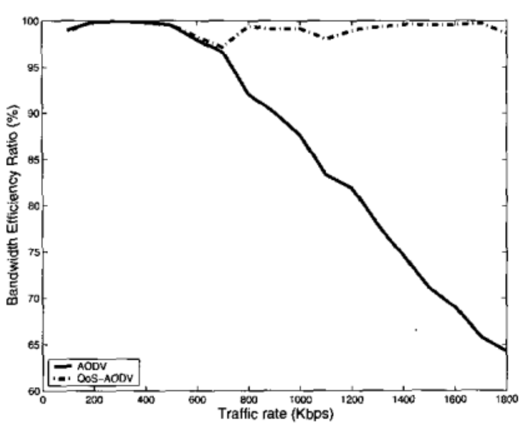
$$\text{NOL} = \frac{\text{Total Overhead (bytes)}}{\text{Delivered Packets (bytes)}}$$

ISSN 2229-5518

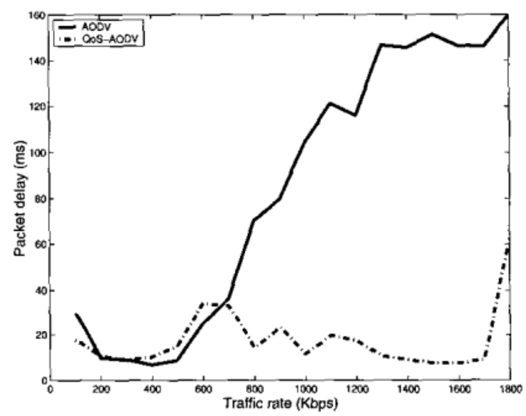
Here, the total overhead is the collection of amount of wireless bandwidth wasted in transmitting which are dropped in other links and control routing packets, this is the case of AODV, where as if we talk about QoS-AODV, it also includes QoS routing control packets like the ICMP-QoS-LOST.

B.A quick comparison of AODV and QoS-AODV

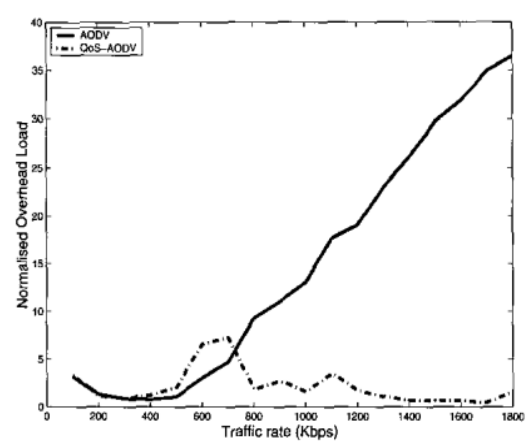
It has been observed through experimental analysis that as the total traffic sent to traffic increases, the Bandwidth Efficiency Ratio for the QoS-AODV keeps its performance and rounds up almost to 100%, while in case of AODV the Bandwidth Efficiency Ratio decreases due to the packet drops and link congestion like phenomenon, and this drop is about 5% with every 300kbps increase in traffic rate. If the demanded QoS of a session is affected by the link congestion, in such case the QoS enabled AODV pauses the session, and any packet drop is prevented as well until and unless another path is found which has the ability to carry the session. Bandwidth Efficiency Ratio increases for higher traffic in QoS enabled AODV as the sessionwhich cannot be sent are stopped[8]. This whole mechanism as explained above can be understood by the graph shown below –



The graph clearly indicates that, more latency is not added on delivering the packets on pausing the sessions in QoS-AODV, however only bandwidth congestion is the thing which is prevented and these results in shorter packet delay[10,11]. The time span when the demanded QoS is not available is the only time which results into delay, and the information carried is not lost. Results for packet delay can be seen in graph below –



The packet delay in case of QoS-AODV is lower than in case of AODV because the path selected to run the session in QoS-AODV is has bandwidth efficiency and higher enough to avoid the congestion. Cost of Routing Protocol increases, if QoS objects are added. Have a look at the graph below.



This clearly displays that the normalized overhead load in QoS-AODV and AODV have similar performance under 700kbps traffic rates, whereas for the higher traffic rate range, normalized overhead load in AODV increases proportionately whereas in case of QoS-AODV, this value decreases, with almost same rate. The reason behind this behavior in AODV is because of the packets that use bandwidth resources, and also the packets which are dropped[14]. In case of higher rates of traffic the number of packets likely to be dropped is more in case of congested links, as we already are aware of the fact that packet transmission is not done while the resource availability in the path is not sufficient.

Conclusion

Herein we present a Quality of Service Routing Protocol for Ad Hoc Networks. The suggestion applies to the Quality of Service functionality to deal with the restricted existing resources in a dynamic environment indicating a modified metric for such a mobile wireless networks. The purpose of such performance assessment is to confirm the improvement of our projected work performing the variousconditions and analyzing the assessment of the output step by step. Ad hoc On-demand Distance Vector codes under ns2 to use Quality of Service parameters are extended to choose a route. The work has been done and based on specific bandwidth reservation and measurement. We have assumed bandwidth as the Quality of Service metric in our measurement. We put forth the evaluation of Ad hoc On-demand Distance Vector and Quality of Service -Ad hoc On-demand Distance Vector for various data traffic rates. We also recommend an answer to propagate Quality of Service objects such as immediate bandwidth details of nodes in the network and show the outcome of this alteration in both Ad hoc On-demand Distance Vector and Quality of ServiceAd hoc On-demand Distance Vector protocols. We have given detailed information how putting in Quality of Service metrics in routing decisions in ad hoc networks facilitates bandwidth utilization. Quality of Service enable Ad hoc On-demand Distance Vector mechanism allows ongoing traffic sessions when links are crowded and the paths in operation do notmaintain the Quality of Service level that is necessary.

References

1. A. Lo H. Xiao,W.K.G. Seah and KC Chua. A Flexible Quality of Service Model for Mobile AdHoc Networks. In *IEEE Vehicular Technology Conference Fall 2000*, pages 445.449, May 2000.
2. Jaalam Technologies, "The Apparent Network : Concepts and Terminology,"http://www.jaalam.com/, Jan. 2003.
3. S. McCreary and K. C. Claffy, "Trends in Wide Area IP Traffic Patterns," Tech. rep., CAIDA, Feb. 2000.
4. S. Floyd and T. Henderson, "The NewReno Modification to TCP's Fast Recovery Algorithm," RFC 2582, Apr. 1999.
5. M. Mathis et al., "TCP Selective Acknowledgment Options," RFC 2018, Oct.1996.
6. M. Allman, S. Floyd, and C. Partridge, Increasing TCP's Initial Window, RFC3390, Oct.2002.

7. M. Mathis and M. Allman, A Framework for Defining Empirical Bulk TransferCapacity Metrics, RFC 3148, July 2001.
8. Differentiated Services (diffserv) IETF Working Group.
9. Integrated Services (intserv) IETFWorking Group.
10. Derya H. Cansever, Arnold M. Michelson, and Allen H. Levesque. Quality of service support in mobile ad-hoc IP networks. In *MILCOM 1999 - IEEE Military Communications Conference*, number 1, pages 30.34, Oct 1999.
11. Introduction to Network Simulator NS2 by TeerawatIssariyakul and EkramHossain (http://www.springerlink.com/content/mr5452/front-matter.pdf)
12. Network Simulator 2 (official website) http://www.isi.edu/nsnam/ns/
13. Overview of NS-2; History; Current Status; Platforms Supported; Discrete Event Simulator; NS-2 Environment; NS-2 Hierarchy; *NS-2 Architecture [Download link]*
14. What to do with NS 2 – A seminar report by Steffen Reidt (http://www.isg.rhul.ac.uk/~prai175/ISGStudentSem07/NS2.pdf)
15. NS 2 Architecture http://bharathi.posterous.com/ns2-architecture