MQOS-AODV: Improved AODV Protocol for Achieving Quality of Service in MANET

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Abstract—*Mobile ad hoc networks (MANETs) can be arranged in various situations but the presence of variable degree of resources, movement of nodes and the lack of load-balancing competences in MANETs (Mobile Ad Hoc Networks) poses a large challenge for such networks to scale. Load imbalance is one of the critical issues in these networks and network performance can be reached by fairly allocating load among nodes within the network. In the given paper, special devotion has been given to the load balancing and congestion control in network. The various load-balancing schemes are discussed gives an ability to improve congestion by distribution of traffic of excessive load and to support better performance, taking different parameters into consideration.*

Keywords:-Load Balancing, Efficient Routing, Congestion, MANETs

I. INTRODUCTION

Ad hoc networks have gained more attention these last decades, with the explosion of mobile processing stages and small sized wireless tools. MANETs hold the promise of future, with the ability to launch networks at anytime, anywhere without assistance of any central authority. All the nodes are mobile but possess their own set of capabilities including their communication and computation power, energy resources etc, thus offer heterogeneity among nodes. Thus, a mobile ad hoc network (MANET) can be defined as an autonomous distributed system where node communicates over moderately bandwidth-constrained wireless links with other nodes which resides within its transmission range. Multi-hoping improves the problem of limited radio spread range and thus is an imperative feature of mobile networks. Limited security, dynamic topology, variable rate and limited bandwidth of connections and power consumption are some of the new limits imposed by ad hoc networks. Packet transmissions suffer from interference and fading due to the shared wireless channel and dynamic topology. As the demands for the support of multimedia communication has been increasing recently, bandwidth intensive, large amount of real time traffic tends to be in bursts and is liable to congestion [1].

II. LOAD BALANCING AND MANETS

MANETs enable one or more mobile units to communicate with each other without the survival of physical connection and any established infrastructure. All nodes have to make decisions jointly. In such environments imbalance of load over the nodes can occur. The competences of a MANET node is a function of its resources, battery power etc. A powerful node finishes its allotted jobs quickly and becomes idle before a less powerful node, allotted with extra work load or engaged most of the time, consuming more energy. The flow of data between the source and the destination nodes could be speed up if its efficiency split on multiple paths between them. Load balancing is surely one of the solutions for refining the efficiency of the applications and the life of the network nodes i.e. network lifetime. The significance of an efficient load balancing technique is to minimize the difference between the overloaded and underloaded nodes in terms of their workload by keeping other parameters in consideration. As these parameters changes time to time using different parameters, the process of balancing the network becomes more complicated [2]. Imbalance of load in mobile networks results in packet dropping, end to end delay, inefficiency and imbalanced energy consumption. MANET has a dynamic network topology, and constraint resources, such as bandwidth, buffer space, battery and transmission power and so on. Distributing traffic fairly among the mobile hosts, based on measurement of path statistics, is beneficial in order to take full advantage of the limited resources and to use network resources better so that the congestion and end-to-end delay are minimized. Load balancing schemes allocate the network loads, which can prevent network from getting into the state of congestion, and avoid the resources of congested node to be drained. The routing algorithms in MANET that choose the shortest route to build up the communication path may incur traffic imbalanced problems in the network. During data communication the interference between two or more multiple paths located physically close enough to interfere with each other, refers to route coupling [3].

III. PURPOSE OF LOAD-BALANCING SCHEMES AND CLASSIFICATION OF LOAD-BALANCING PROTOCOLS

The overall purpose of various load-balancing schemes is to:

- Select non-congested paths or to disseminate excessive load
- of a node to its neighbors
- Balances energy consumption of the network
- Ensure efficiency and robustness
- Reduce end to end delay and number of packet lost by queue overflow
- Enhance the utilization of resources (buffer, radio channel)
- Improve the overall network performance and reduce collision by load distribution.

IV. QUALITY-OF-SERVICE PROVISIONING: DEFINITION AND OVERVIEW

According to RFC2386 [5], QoS is a set of service requirements to be met by the network while transporting a flow. A flow is a packet stream from a source to a destination (unicast or multicast) with an associated (QoS). The associated QoS could, in fact, be ‘best effort’. A fundamental requirement of any QoS mechanism is a measurable performance metric. Typical QoS metrics include available bandwidth, packet loss rate, estimated delay, packet jitter, hop count and path reliability. Analogous to today’s Internet, ad hoc networks are being designed to provide best-effort service (i.e. do not provide any guarantees regarding packet loss or delay, available bandwidth, jitter etc.). In a best-effort service model, packets are dropped regardless of their importance. If a packet is lost, the sender can simply retransmit the lost packet. This method is efficient for applications that do not require bounds on packet delay or other QoS metrics. However, real-time applications, such as video-on-demand (VoD), videoconferencing and Internet telephony have, are sensitive to packet loss and delay and may have minimum bandwidth requirements Consequently, the best-effort service may not be suitable for these applications. Technically, there are two ways in which QoS can be achieved: (1) over-provisioning and (2) traffic engineering. Over provisioning utilizes the best-effort approach and simply increases the available resources (e.g. bandwidth, buffers etc.). For example, network designers could simply increase the capacity of a congestion link or network from 10 to 100 Mb. The second approach, traffic engineering, tries to utilize resources efficiently and to make the network QoS aware. This could include additional service classes, admission control, resource reservations and so on. In this paper, we focus on the traffic-engineering approach. Research and development efforts are under way to enhance the Internet with QoS components that will allow the transport of real-time data (e.g. digitized audio and video). However, these enhancements may not be suitable for ad hoc networks. For example, current QoS routing algorithms require accurate link state (e.g. available bandwidth, packet loss rate, estimated delay etc.) and topology information. The time varying capacity of wireless links, limited resources and node mobility make maintaining accurate routing information very difficult if not impossible in an ad hoc networking environment. Thus, while providing QoS support in addition to flexibility and mobility is a tremendously challenging task for the Internet as well as cellular networks, in which the mobile node is only a single hop from a wired fixed infrastructure, supporting QoS in ad hoc networks is an even more difficult challenge.

V. QoS Service Models For Mobile Ad Hoc Networks

Generally, a QoS model does not define specific protocols or implementations. Instead, it defines the methodology and architecture by which certain types of services (e.g. per-flow or class-based) can be provided in the network. Protocols such as routing, resource reservation/signaling and MAC must cooperate to achieve the goals outlined by the QoS model. Two QoS models, which have been proposed for the Internet, are Integrated Services (IntServ) and Differentiated Services (DiffServ). IntServ aims to emulate a connection-oriented, virtual circuit connection for each flow admitted to the network. This approach requires maintaining specific state information for every flow in every router. The actual state information could include bandwidth requirements, packet delay and loss bounds or delay variation. The Diff-Serv architecture is intended to provide scalable service differentiation in the Internet without the need for maintaining per-flow state information and signaling at every router. As such, Diffserv proposes a service model and algorithms to support QoS for aggregated traffic classes. Under the DiffServ model, an application does not explicitly signal the network (i.e. the routers) before transmitting data. Instead, the network tries to deliver a particular kind of service based on the QoS specified by each packet. IntServ and DiffServ were proposed for static networks and thus cannot be applied directly to the mobile ad hoc environment. A QoS model designed for ad hoc networks must consider the unique features and challenges associated with mobile ad hoc networks—in particular, node mobility (dynamic topology) and time-varying link capacity. The remainder of this section describes the first QoS service model designed specifically for ad hoc networks. This model is called Flexible QoS Model for Mobile ad hoc Networks (FQMM) and is a hybrid of the IntServ and DiffServ service models. FQMM consist of three key features: dynamic roles of nodes, hybrid provisioning and adaptive conditioning.

Dynamic roles of nodes

FQMM defines three types of nodes: (1) an ingress node is a mobile node that sends data, (2) an interior node is a node that forwards data for other nodes and (3) an egress node is a destination node. Since nodes are free to move resulting in topology changes, a single host may have multiple roles.

Hybrid provisioning: Provisioning is used to determine and allocate needed resources at various points in the networks—these points are mobile host in Mobile ad hoc Networking (MANETs). The provisioning approach in FQMM consists of a hybrid per-flow (IntServ) and per-class (DiffServ) scheme in which traffic of the highest-priority is given perflow treatment, while other traffic is given per-class provisioning.

Adaptive conditioning: The adaptive traffic conditioner includes several components: a traffic profile, meter, marker and dropper. The traffic conditioner, which polices the traffic according to the traffic profile and is responsible for marking the traffic streams and discarding packets, is placed at the ingress node at which the traffic originates. In contrast to an absolute traffic profile, the traffic profile proposed in FQMM is defined as the relative percentage of the effective link capacity. In FQMM, bandwidth allocation is used as the relative service differentiation parameter. FQMM assumes that the larger proportion of traffic does not belong to the highest-priority class; thus, preserving the per-flow granularity for a small portion of traffic in MANETs. Since state information is maintained only for a small portion of traffic, the scalability problem of IntServ is expected to improve.

VI. Load-Balancing Scheme For Supporting QoS In MANETs

Load-Balancing Scheme for supporting QoS in MANETs

Whenever the offered traffic load exceeds the available capacity in a network, can leads to the problem of congestion and causes overall channel quality to degrade and increases packet loss rates. In the load-balancing algorithm given below, the messages used are: QUEUE_INFO, REPLY and INFORM. When a node receives data packet, it broadcasts a QUEUE_INFO message to its neighbors if this node is congested, node 6 here (in fig.1). All its neighbor nodes, after receiving the message send a REPLY message only if they have the available buffer space. The congested node chooses the one within the transmission range of the sender node, and having least load among all, node 7 (in fig.1) and preserve the rest of the information for further assistance for a particular time period and send INFORM message to the sender node, 4 to inform the address of the selected node, node 7. The new route will be constructed, excluding the congested node as shown in fig.1 [4].

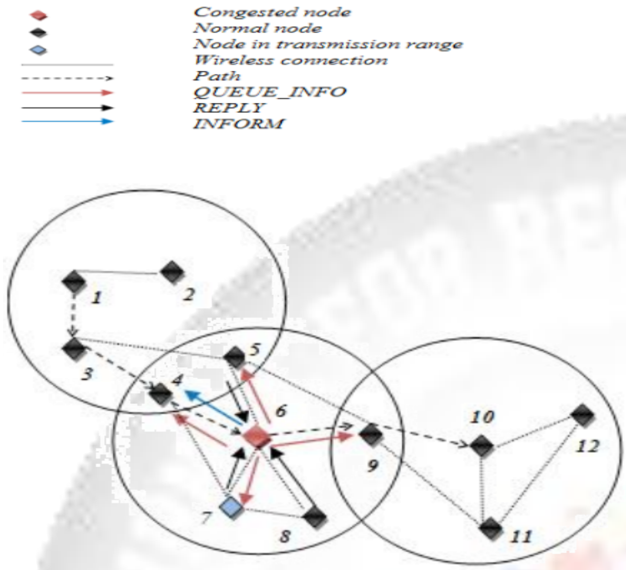

Fig.1: Exchange of messages when congestion occurs.

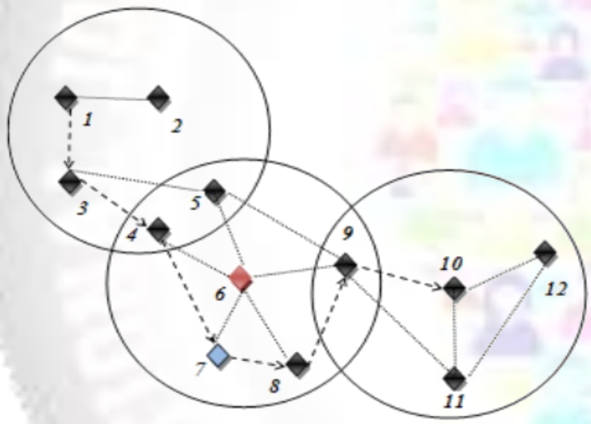

Fig. 2: Route through less congested node.

VII. Present Work

The new MQOS-AODV protocol establishes paths on-request using a reliable reverse path establishment method. During path establishment phase, the source node first sends the route requests through all available paths to the destination. The destination node upon receiving the path requests, in return rebroadcasts the reverse path requests as like sender node has done. Upon receiving the multiple route replies from the destination, a path with high reliability is chosen by the source node on the basis of AODV protocol. After the link establishment, the source node will issue command to put the neighboring nodes in sleep state; hence the node remaining energy will expand for long period. This proposed protocol includes the following phases.

- Route Discovery
- Route Selection
- Route Maintenance using Multi path QOS-AODV

Pseudo code: Generation of RREQ in the Source node Input: Source node S want to communicate with destination D.

1. For each path from source to destination broadcast the RREQ packet to the neighbors then
2. For every path from D to S generate RREP.
3. select the appropriate path as primary path for current communication.Check path is completely node disjoint path with all other available paths in path
4. Calculate the threshold value of queue length of each node.
5. check the queue length of intermediate node in the current communication

    If
        Queue length > threshold value
        then
        Transmission continue
    Else
        Check for alternate route for current communication from S to D.
        And communication will continue through both the paths current as well as previous one.
    end if

6. If the node want to communicate with any other nodes repeat step 1 to 5.
7. end.

VIII. Simulation Model

The simulations were performed using Network Simulator 2 (Ns-2.34), particularly popular in the ad hoc networking community. The traffic sources are TCP. The source-destination pairs are spread randomly over the network. During the simulation, each node starts its journey from a random spot to a random chosen destination. This process repeats throughout the simulation, causing continuous changes in the topology of the underlying network. Different network scenario for different number of nodes and clusters are generated.

The model parameters that have been used in the following experiments are summarized in Table 1.

Table 1: Simulation Parameters

Parameters	Value
Simulator	NS 2.34
Simulation Area	800X800
Number of Mobile Nodes	40
Channel	Wireless
Routing Protocols	AODV &MQOS-AODV
Simulation Time	500 Sec
Traffic Class	TCP
MAC Layer	802.11

A. *Methodology*

As NS2 (Version 2.34) tool is used for the simulation which can be installed on Linux platform. Using VM virtual Box, Linux can be used on windows platform which the author is using in the dissertation. So, the methodology can be given as follows:

Go to desktop, click on oracle VM virtual box & then click on start to start the Virtual Box Manager.

Click on user’s button; enter the password & then login.

Click on terminal.

To find the list of different files enter a command ls which display the names of different files.

Enter the command gedit name of the file QOS.tcl, the command will shows the window in which coding can be done.
After running the command ns qos.tcl, the running environment will be displayed on the terminal.
After this the nam console will run automatically, which will simulate the purposed model.
7.2Simulation
The simulation is performed to fulfill the research objective. The following figures show the simulation result AODV & Multi path QOS-AODV wireless routing protocols.
Transfer of packets for 40 Nodes using AODV protocol is shown in fig 3 in which normal transition is taken place whereas Transfer of packets for 40 Nodes using Multi-path QOS-AODV approach is shown in fig 4.

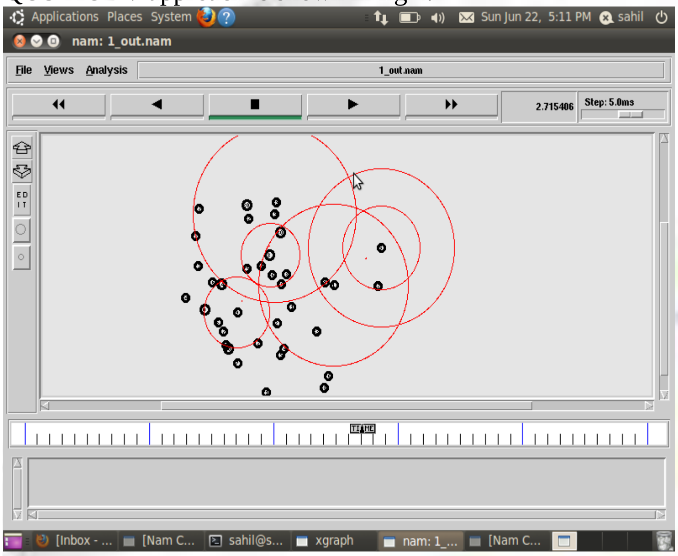

Fig 3: Transfer of packets for 40 Nodes using AODV

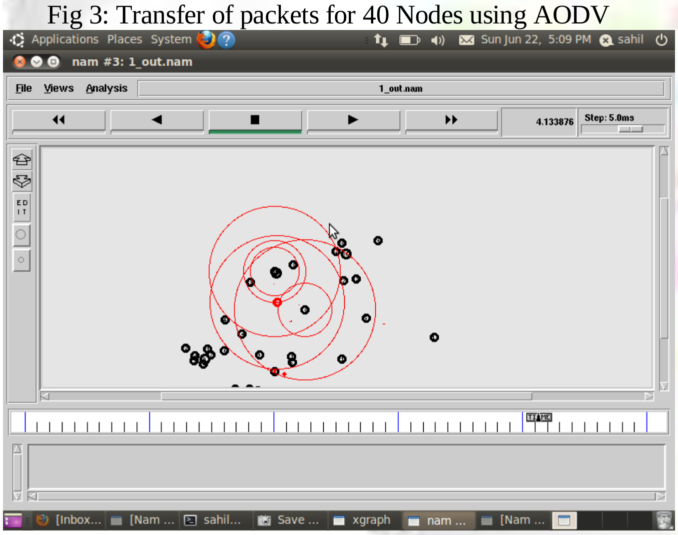

Fig 4: Transfer of packets for 40 Nodes using Multi path QOS-AODV

B. Results

Graph representation of packet received over packet drop for 30 Nodes using AODV approach is shown in fig 5 and for 40 Nodes using Multi path QOS-AODV approach is shown in fig 6.

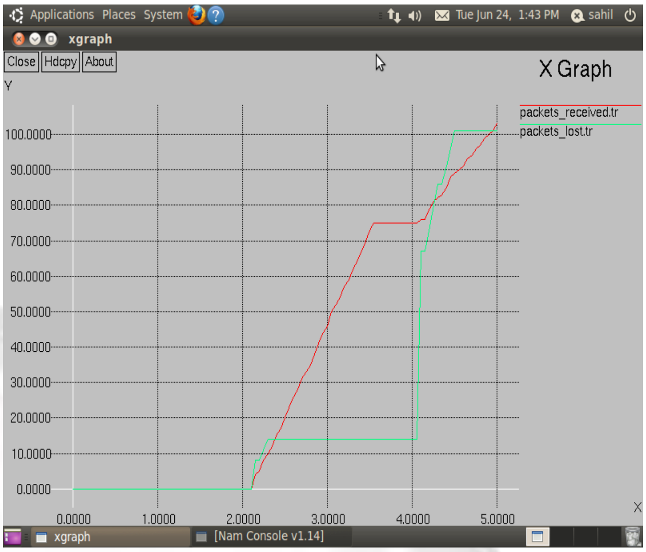

Fig 5: Transfer of packets for 30 Nodes using AODV

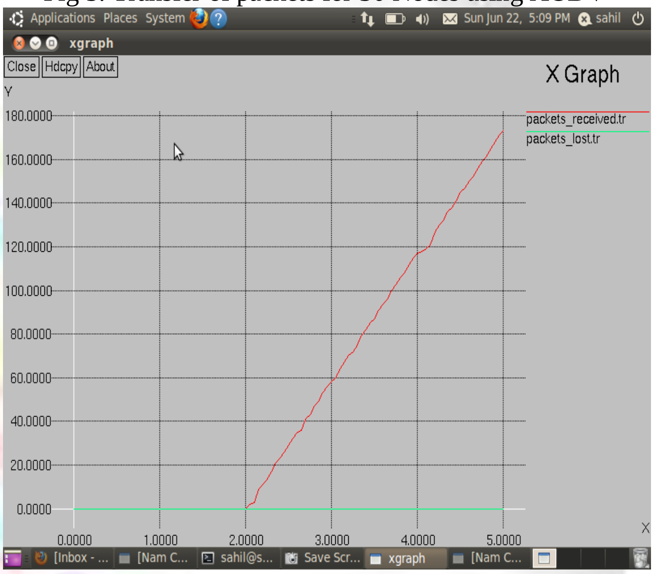

Fig 6: Transfer of packets for 40 Nodes using Multi path QOS-AODV

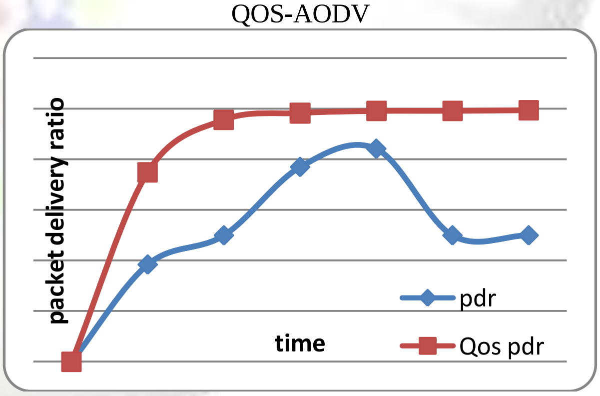

Fig 7: PDR v/s time for 30 nodes using AODV & Multi Cluster-AODV

Packet delivery ratio for 40 nodes has been depicted using fig 7 as function of Time. As time increases, there is slight variation in loss of packets .In AODV, the variation in loss of packet is more than Multi path QOS-AODV.

IX. CONCLUSION& FUTURE WORK

This paper presents an AODV-based Multi path QOS and routing scheme for MANETs. The scheme is used for integrated routing and message delivery in wireless networks. The main aim of the proposed protocol Multipath QoS aware reliable routing protocol is to send multiple route replies and establishes multi path data transmission between source and destination and achieves high reliability, stability, low latency and outperforms AODV by less energy consumption, overhead and delay. We evaluated the purposed architecture using simulation experiments.

A. Future Work

The future scope of the purposed work can provides high energy efficiency, security and load balancing thus prolongs the network life time and makes up high reliability communications. If one path fails, the data transmission will be continued in the backup path automatically. Simultaneously, finding multiple paths in a single route discovery reduces the routing overhead incurred in maintaining the connection between source and destination nodes and reduces the routing process overhead.

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