Analysis of Queue management Techniques in Ad-hoc networks

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ABSTRACT : MANETs present many challenges, in particular when real-time traffic must be supported in terms of providing Quality of Service (QOS) guarantees Providing QOS for real-time applications is still an open issue. MANETs present the worst-case scenario for QOS guarantees due to their distinct characteristics, such as contention from multiple users (when using 802.11) and limited bandwidth. The objective of this project is to develop new active queue management schemes for MANETs that are more efficient compared with existing algorithms. Using simulation, the new queuing schemes are evaluated in a MANET surroundings, and their performance is compared with other existing QOS schemes, such as Random Early Discard (RED) and Drop tail. Results indicate that Proposed RED minimizes the burst errors due to buffer overflow, in that way of improving the performance for real-time traffic compared to traditional Drop tail.

Keywords *-Active queue management, RED, Drop-tail, Ad-hoc networks, QOS, Throughput.*

1.INTRODUCTION

In these networks, person-to-person communication can be enhanced with high quality images and video, as well as access to information and services on public and private networks will be enhanced by higher data rates, quality of service (QOS), security actions, location-awareness, energy efficiency, and new flexible communication capabilities. These features will create new business opportunities not only for manufacturers and operators, but also for providers of content and services using these networks. Providing QOS guarantees to various applications is an important objective in designing the next-generation wireless networks. Different application can have very diverse QOS requirements in terms of data rates, delay bounds, and delay bound destruction probabilities, among others. For example, applications such as power plant control demand reliable and timely delivery of control Commands hence, it is critical to guarantee that no packet is lost or delayed during the packet transmission. This type of QOS guarantees is usually called deterministic or hard guarantee. On the other hand, most multimedia applications including video telephony, multimedia streaming, and Internet gaming, do not require such stringent QOS. This is because these applications can tolerate a certain small probability of QOS violation. This type of QOS guarantee is commonly referred to as statistical or soft guarantees. For wireless networks, since the capacity of a wireless channel varies randomly with time, an attempt to provide deterministic QOS (i.e., requiring zero QOS violation probability) will most likely result in extremely conservative guarantees.

Since then, mobile wireless networks have developed into two main technologies: mobile IP networks and Mobile Ad-Hoc Networks (MANETs). Figure 1shows the conceptual differences between the existing wireless networks today. First, the mobile IP networks or cellular networks consist of fixed, wired gateways known as base stations. A mobile host within these networks communicates with the nearest base station. One of the major tribulations related to cellular networks is called “handoff,” which is the process of transferring a mobile station from one channel or base station to another without noticeable delay or packet loss. Another problem is the mobile nodes are able to connect to the network only if the base station is within its communication range, thus nodes are limited to spaces where such a cellular infrastructure exists. In contrast, MANETs do not rely on pre-existing infrastructure, such as base stations.

They are self-organizing wireless networks consisting of a number of mobile nodes. Each mobile node in a MANET can send, collect or forward a packet [1], [2].

MANETs have four distinct characteristics [1]: dynamic topologies, bandwidth constraints, energy-constraints and limited physical security. The first characteristic allows the nodes to move arbitrarily as well as unpredictably causing possible failures in links or routes. The second concerns the wireless links typically having a significantly lower capacity than their wired counterparts. Moreover due to argument from multiple users, fading, noise and interference, the capacity is highly time variable.

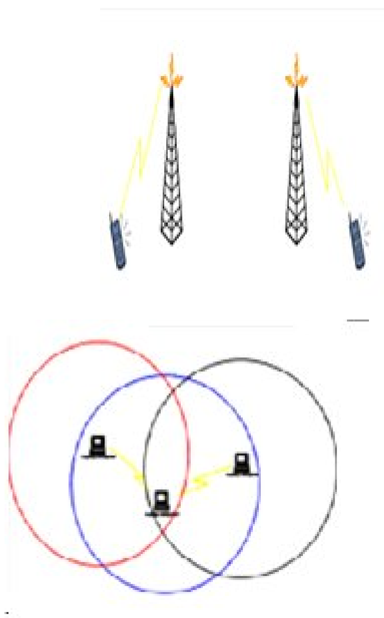

Fig 1.1 : Existing Mobile Communication Networks:
(a) Mobile IP (cellular) and (b) Mobile Ad-hoc Networks

Third, the nodes are usually battery-operated; therefore, management of the power is needed. Finally, wireless links are in general vulnerable to security threats like eavesdropping, spoofing, and denial-of-service attacks. Together these characteristics pose a challenge in providing quality of service.

Currently, one of the areas of interest in mobile ad hoc networks is the provision of QOS guarantees. The first aspect of QOS is related to routing for which much research has been done and many different routing protocols have been proposed in the current literature. Secondly, QOS is affected by the Medium Access Control protocol (MAC). Although the most commonly used MAC protocol in MANETs is the 802.11, it appears to be unsuitable, especially under high traffic loads. In this thesis QOS algorithms are developed for real-time traffic over IP-based networks. The algorithms are then applied to a MANET environment as a means to evaluate the proposed algorithms as these networks present the worst-case scenario for providing QOS guarantees.

The MANET routing protocols must guarantee compatibility and interoperability with Internet standards in the other layers [1]. A MANET node may act as a source if the traffic is being originated within the node or as a relay if it is an intermediate node. The proposed protocol stack from the IETF MANET working group for a mobile node is depicted in Figure 2. Each packet is sent to the wired or wireless MAC protocol in order to be forwarded via the wired or wireless network interface, respectively, to the next hop.

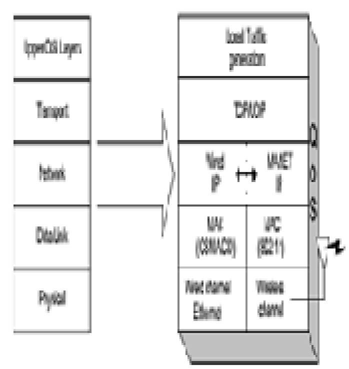

Fig 1.2 : Mobile Node Protocol Stack

2. RELATED THEORY

A Service Differentiation Stateless Wireless Ad-hoc Net-works (SWAN) is a stateless network QOS model which uses distributed control algorithms (AIMD) control rate mechanism to deliver service differentiation in mobile wireless ad-hoc networks. The SWAN model incorporates several mechanisms that are used to support rate regulation of BE traffic and admission control regulation of RT traffic, as illustrated in Figure.

A classifier and a shaper operate between mainly on IP and also MAC layers. The classifier is capable of differentiating RT and BE packets, forcing the shaper to process BE packets but not RT packets. The shaper represents a very simple and ordinary leaky type bucket traffic shaper. The main goal of the shaper is to delay BE packets related that of with the rate calculated by the rate controller.

When a new RT session about to admitted, the packets that were associated with the admitted flow are marked as RT. The classifier looks at the marking and, if the packet is marked as RT, the packet will bypass the shaper mechanism, remaining unregulated. We can conclude that SWAN tries to maintain delay and bandwidth requirements of RT traffic by admission control of UDP traffic and rate control of TCP and UDP traffic. Since achieving QOS in MANETs not only rely on these models, all the components such as QOS-aware routing algorithms, QOS signalling and QOS MAC protocol must also work together to ensure this. In the next section, different QOS-aware routing mechanisms are presented and compared.

QOS Schemes

The implementation of QOS protocols involves specific rules based on queuing algorithms that sort the arriving packets and/or prioritize them onto output links. These algorithms, called congestion control algorithms, can be divided into two categories: queue management and scheduling. Queue management QOS algorithms drop packets, when necessary or appropriate in order to manage the length of the queue. Scheduling algorithms manage the allocation of the bandwidth among flows by determining which packet to forward next [7].

Existing Systems

There are several schemes for dealing with congestion at a gateway. They differ in whether they use a control message they view control of the end-systems as necessary, but none of them in itself lowers the demand of users and consequential load on the network. Some of these are:

Drop Tail Router

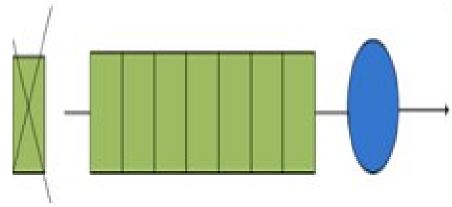

Fig 2.1: Drop Tail Router

The DT queue management mechanism drops the packet that arrives when the buffer is full as shown in the fig.

Drawbacks

FIFO queuing mechanism drops the packets from the tail of buffer when the queue starts overflows.

DT introduces global synchronization in several connections, when the packets are dropped [4].

3. PROPOSED SYSTEM

RED is one of the active queue management control mechanism deployed at gateways. The RED detects initial congestion by computing the average queue size [3]. RED gateways keep the average queue size low while allowing occasional bursts of packets in the queue. The router could notify connections of congestions either by setting a bit in packet headers or by dropping packets arriving at the router. When the average queue size exceeds a preset threshold, the gateway drops or marks each arriving packet with a certain probability, where the exact probability is a function of the average queue size. RED gateways keep the average queue size low while allowing occasional burst of packets in the queue. Fig. 4 shows a network that uses RED gateway with a number of source and destination host.

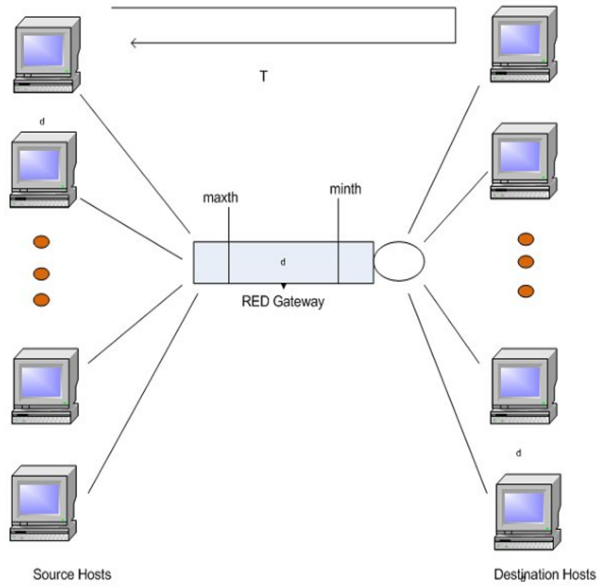

Fig 2.2: Network with RED gateway

RED Algorithm

Generally the RED gateway has two widely algorithms. One for computing the average queue size pa determines the degree of burstiness allowed in the gateway queue and the second one for calculating the packet -marking probability or drop probability pb determines how frequently the gateway marks packets, given the current level of congestion. The goal for the gateway is to mark the packets at fairly evenly spaced intervals, in order to avoid biases and global synchronization, and to mark packets sufficiently frequently to control the average queue size as shown in fig. The second algorithm is for computing the drop or marking probability, which determines how frequently the gateway drops or marks arrival packets. This algorithm can avoid global synchronization by dropping or marking packets at fairly evenly spaced intervals. Furthermore, by dropping or marking packets, this algorithm can maintain a reasonable bound of the average delay, if the average queue length is under control.

The higher throughput for the connections with shorter RTT is due to the bias of TCP□S window increase algorithm in favour of connections with shorter round-trip times [7], [5].Because RED gateways can control the average queue size while accommodating transient congestion, RED gateways are well suited to provide high throughput and low average delay in high-speed networks with TCP connections that have large windows.

The RED algorithm is as follows

Implementation

Avg-----------0

Count--------------1

For each packet arrival

Calculate the average queue size avg

If minth <= *avg* < *maxth*

Calculate the probability paWith probability pa:

Mark the arriving packet Else if maxth <= avg

Mark the arriving packet

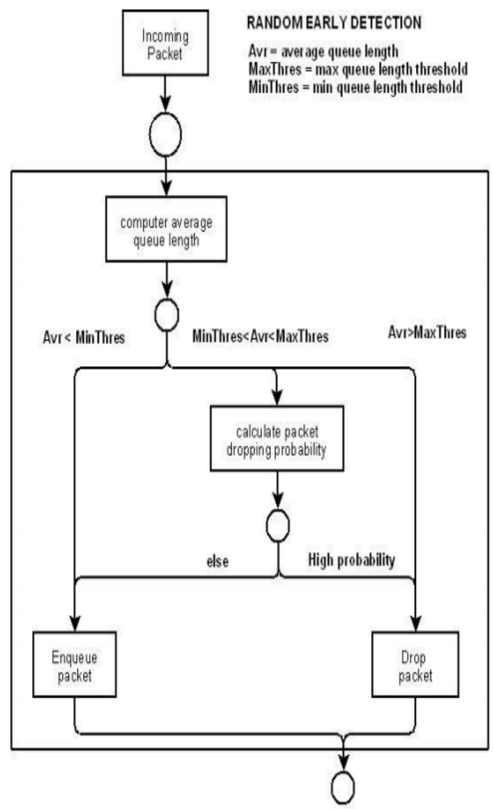

Fig 3.1: RED Algorithm

Performance metric (Data *Throughput)*

It is average rate of packets that are successfully delivered over a communication channel is called network throughput. The throughput is usually measured in bits per second (bit/s or bps), and sometimes in data packets per second or data packets per time slot. The proposed methodology provides a very accurate

calculation of the end-to-end throughput capacity when compared to existing work, and yet it is more practical to implement.
To calculate throughput, you need to calculate [num of received packets/num of sent packets.

4. SIMULATION ENVIRONMENT

The simulation software used for evaluation of the proposed QOS schemes was the Network Simulator 2 (NS2) version 2.1b6 running on a Linux Fedora platform. At the time of writing this thesis, NS2 seems to be the standard tool to simulate ad hoc networks.

A typical simulation in NS2 includes several steps. First the user creates the OTCL scripts, which are the input files to the simulator. These files consist of a scenario file that describes the movement pattern of the nodes and a communication file that describes the traffic in the network. Then the simulator initiates an event scheduler and sets up the network topology using the network objects and the plumbing functions in the library. Also, it informs the traffic sources when to start and stop transmitting packets through the event scheduler. The result of this procedure is the generation of a trace file. The granularity of the trace files is determined prior to simulation in the OTCL scripts. Typically, the trace files are parsed using Perl or another Linux shell script allowing the performance metrics of interest to be obtained. Finally, the analysed data from the trace files can be used for further manipulation and plot generation using other languages like Mat lab.

In this section, we also discussed about network configuration used over the network simulator ns2 to simulate the two algorithms RED, and Drop tail and after that we analysed about the results obtained from our simulations. The algorithms compared here are first deployed into the ns2 architecture then following simulation scenario has been generated to compare their performance on the simulation setting as shown in Fig.

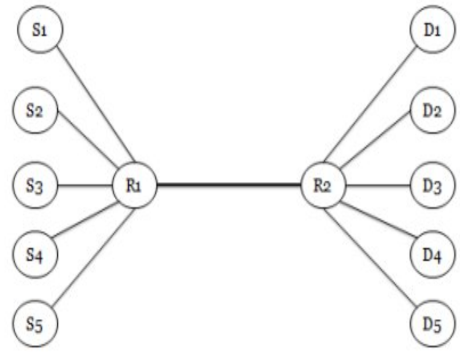

Fig 4.1: Simulation Scenario

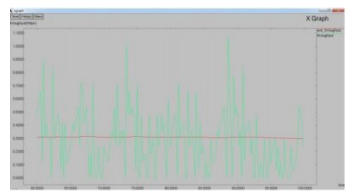

Fig 4.2: Drop tail

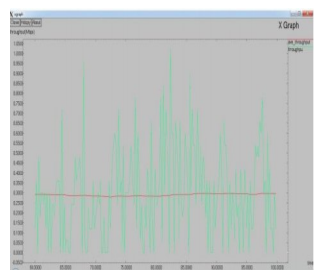

Fig 4.3 RED

It has been observed that RED had a best throughput and Drop tail had least throughput among all these two algorithms for the simulation achieved at 1.5 Mbps of bandwidth. Fig 8 shows comparatively to fig. that RED gets the good result and Drop tail gets the poor result. It could be observed one point on throughput graph whenever smooth growth in throughput has been broken. It indicated about a starting point when dropping of packet took place. This achieved point in each algorithm has a same ratio as compared to their maximum achieved throughput.

5. CONCLUSION

A Typically, the performance of a network is measured by using as metrics delay, the packet loss and the throughout. All these metrics are used for the evaluation of the proposed algorithms. However, the traffic under investigation is real-time voice as the packet loss distribution significantly affects its quality; in particular, consecutive packet losses are of interest here. The goal of this project is to avoid the congestion at the gateways. RED gateways are designed to accompany a transport layer congestion control protocol such as TCP. The RED gateways have no bias against bursty traffic and avoid the global synchronization of many connections decreasing their window at the same time.

6. REFERENCES

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