AVOIDING PACKET DROP FOR IMPROVED THROUGHPUT IN THE MULTI-HOP WIRELESS N/W

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ABSTRACT

Mobile ad hoc networks (MANETs) are infrastructure less and intercommunicate using single-hop and multi-hop paths. Network based congestion avoidance which involves managing the queues in the network devices is an integral part of any network. QoS: A set of service requirements that are met by the network while transferring a packet stream from a source to a destination.Especially in MANETs, packet loss results in increased overheads.

This paper presents a new algorithm to avoid congestion using one or more queue on nodes and corresponding flow rate decided in advance for each node. When any node attains an initial value of queue then it sends this status to its downstream nodes which in turn uses the pre-decided flow rate of packet transfer to its upstream nodes. The flow rate on each node is adjusted according to the status received from its upstream nodes. This proposed algorithm uses the existing infrastructure to inform to other nodes about its current queue status.

Keywords: Mesh Networks, MANET, Packet Count, Threshold, Throughput.

I INTRODUCTION

Mesh networks are becoming increasingly popular and standardization process for development of IEEE 802.11 based mesh networks. However, by use of an existing CSMA/CA MAC in such networks, application sources inject as many packets as possible into the network with no regard for whether the packets reach their final destination; hence, in presence of a bottleneck link, queue build-up and packet-drop happen which result in waste of the system resources utilized to deliver packets halfway through the network.

The increased demands for mobility and flexibility in our daily life are demands that lead the development from wired LANs to wireless LANs WLANs). Today a wired LAN can offer users high bit rates to meet the requirements of bandwidth consuming services like video conferences, streaming video etc. With this in mind a user of a WLAN will have high demands on the system and will not accept too much degradation in performance to achieve mobility and flexibility. This will in turn put high demands on the design of WLANs of the future. As mobile networks are resource constrained in terms of memory, processing power and battery life, therefore dropping packets in case of queue overflow increases the burden on the network.

During the last few years Wireless mesh networking has become increasingly ubiquitous and the preferred mechanism to provide coverage to campuses, small towns, etc. In Wireless mesh networks a subset of the wireless nodes are connected to the wired backbone and provide connectivity to the other nodes in the network through multi hopping over the wireless links. As a natural extension to WLANs, the medium access mechanism of choice for these networks is the CSMA/CA based IEEE 802.11 distributed MAC protocol.

While IEEE 802.11 MAC protocol was designed for and provides a reasonable performance in a single hop network, it results in severe performance degradation in a multi-hop setting. In a single hop 802.11 network, all nodes contend for the channel with equal opportunity and act as greedy as possible to increase their one hop throughput which directly results in increase of the network aggregate throughput. In a congested network packets might be dropped in an intermediate node. Such a behavior will result in waste of the system resources used to deliver the packets to the intermediate node.

A congestion control scheme insures that the nodes place only as many packets on the wireless channel as can be delivered to the final destination. End-to-end schemes like TCP are the preferred solution in the Internet due to their scalability characteristics. In a wireless mesh network, however, a hop-by-hop congestion control scheme can be more appropriate as such a network does not have the scalability problems of the large-scale Internet. A layer 2 hop-by-hop solution reacts more quickly to congestion and is effective regardless of the traffic type.

While a network of only single-hop flows can also suffer from congestion due to overload, the focus of this work is on the congestion caused due to multi-hopping. We design a congestion control scheme which releases the resources that are wastefully used to transmit packets halfway through the network.

II EXISTING SYSTEM

2.1 Wireless local area network (WLAN)

A wireless local area network (WLAN) links two or more devices using some wireless distribution method (typically spread-spectrum or OFDM radio), and usually providing a connection through an access point to the wider internet. This gives users the mobility to move around within a local coverage area and still be connected to the network.

A wireless LAN is based on a cellular architecture where the system is subdivided into cells, where each cell (called Base Service Set or BSS) is controlled by a Base station (called Access point or AP).

2.2 Wireless Mesh Network (WMN)

WMNs, generally described, consist of two types of nodes: mesh routers and mesh clients. The difference between a conventional router and a mesh router, apart from the mesh functionality, is that the latter can achieve the same coverage with lower transmission power through multi-hop communications. As regards to mesh clients, they also have necessary mesh functions and can thus behave as a router. On the other hand, gateway or bridge functions do not exist in these nodes. Additionally, mesh clients have only one wireless interface. [15]

Figure 1: Infrastructure/backbone WMNs. [15]

2.3 HCF Contention-Based Channel Access (EDCA)

The EDCA mechanism provides differentiated, distributed access to the WM for STAs using eight different UPs. The EDCA mechanism defines four access categories (ACs) that provide support for the delivery of traffic with UPs at the STAs. The AC is derived from the UPs. For each AC, an enhanced variant of the DCF, called an enhanced distributed channel access function (EDCAF), contends for TXOPs using a set of EDCA parameters from the EDCA Parameter Set element or from the default values for the parameters when no EDCA Parameter Set element is received from the AP of the BSS with which the STA is associated, where

a) The parameters used by the EDCAF to control its operation are defined by MIB attribute table at the AP and by MIB attribute table at the non-AP STA.

b) The minimum specified idle duration time is not the constant value (DIFS) as defined for DCF, but is a distinct value assigned either by a management entity or by an AP.

2.4 Multi-Hop Networks

Multi-hop wireless networks such as Mobile Ad-hoc Networks (MANETs) can be divided into two main categories: 1) organized or closed networks, and 2) self-organized or open networks [2]. In a self-organized network, nodes are autonomous; they may free ride and may not cooperate properly in network operations to save their resources. Such nodes are called selfish or misbehaving nodes and their behavior is termed selfishness or mis-behavior [3]. In this paper, we consider a rather dense self-organized MANET with a variable percentage of misbehaving nodes that attempt to free ride by dropping the data packets they should forward.

Data packet dropping not only affects the network connectivity, but also can widely waste the network resources such as battery power of network nodes and available bandwidth of network links [4].

Several techniques have been proposed to encounter such misbehavior in MANETs. These methods can be classified into two main categories: 1) Incentive-based schemes, and 2) Detection and Punishment-based schemes. Incentive-based schemes use some mechanisms such as virtual (electronic) currency [5] to provide incentives for nodes to perform network operations whereas Detection and Punishment-based models use detection tools such as watchdog [6] and two hops ACK [7] to detect misbehaving nodes and cut them off from the network with the use of mechanisms like reputation systems [8].

Our approach can be categorized as a Detection and Punishment-based approach. We use overhearing of MAClayer acknowledgments1 [9] as a novel detection tool to detect misbehaving data packet-dropper nodes; so, in our system, such misbehaving nodes can be isolated from the network using the common reputation systems as used in previous methods. Since we describe and analyze our technique as an add-on for Dynamic Source Routing (DSR) protocol [10], the main idea of our detection system is as follows; when a forwarder node on a source route sends back a MAC-layer ACK for a received data packet that should forward it, this ACK packet can both be received by the transmitter of related data packet and be overheard by all nodes in the transmission range of both ACK-transmitter and its successor node on the source route. We call such ACK-transmitters and MAC-layer ACK packets, which will be sent back for a packet to be forwarded, observed node (ON), and forwarding-ACK respectively. We also call overhearing nodes as observer nodes and their behavior as observation. Therefore, when an observer node overhears a forwarding-ACK packet, it will log this ACK and wait for another ACK packet; this time, from ON's successor node. If no ACK is overheard from successor node after sometime, it means that ON has not forwarded the received data packet to its successor node successfully. Then, this misbehavior will be observed and reported to ON's predecessor node by the observer nodes. Predecessor node will collect, filter, and combine these reports to calculate the deviation of the behavior of its next node on the source route.

If its calculated deviation is greater than some value, it will send back a report to the source of the route. With the receipt of this misbehavior report, source node will look for another route, containing no misbehaving node, to send its packets toward the destination node.

III PROPOSED SYSTEM

This work proposes to design a simple and efficient multi-hop congestion control mechanism which relies on local information available at nodes to detect possible congestion and modifies 802.11 channel access parameters to adjust the MAC transmission rate of congested flows to a value that avoids the congestion.

In the process of protocol designs and deployments, it is important to understand the performance of the protocol so that the protocol parameters can be tuned to achieve an optimum operation in an actual network environment. To make the performance analyses tractable, most presented performance analyses introduce some assumptions to simplify the protocol operation and/or the traffic arrival process. As a result, the obtained analytical results may not be realistic and their applications are somewhat limited.

A lot of work has been done in the area of wireless multi-hop networks, where packet dropper node is punished by evaluating the network. In this proposed algorithm a scenario is being taken in which a new mechanism will be added to slow down the downstream nodes to get high throughput by adjusting flow rate dynamically. This will not only provide a high throughput but will also save the energy on nodes by avoiding sending unnecessary packets in a congested network.

In this work, the performance of EDCA has been improved by providing an algorithm which is based on the pre decisions related with the congestion in the network. This not only improves the performance but also increases the throughput of the network.

3.1 Proposed Algorithm will work as follows

1. Queue threshold Value and acceleration /deceleration rates are decided on each node.
2. Base station will start sending data packets towards destination at its full speed.
3. Packets will follow the available dynamic route to reach towards destination.
4. If queue at any intermediate node reaches to threshold value then it informs to its downstream node about the congestion.
5. Downstream node slowdowns the flow of data packets to maintain the queue filling rate on its upstream node.
6. We can set multiple queue thresholds and acceleration / deceleration rates for managing flow of data packets more efficiently.
7. If the congestion is released on the upstream node(s) then they inform the same to the downstream nodes to increase the flow rate of packets towards the upstream nodes.

Following Flow Chart depicts the flow of working of the proposed algorithm

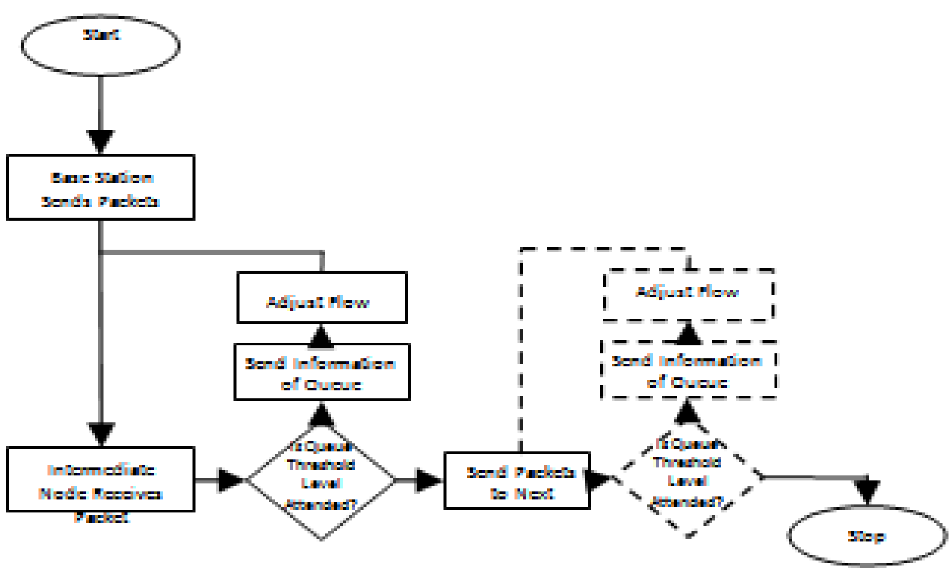

Fig 2. Proposed Algorithm

For implementation of the proposed system, it is required to communicate about the current queue status to all the nodes to each other. To achieve this a slight modification has been done in ACK of DCF named as QT (Queue

Threshold) which shall be received on each predecessor nodes. The predecessor node if communicating further with this node then will slow down communicating to the successor node about this information.

This technique is worth, as a small modification in existing system is required to implement this for communication. Each node will additionally carry a fixed table of queue threshold values and corresponding flow rate of the nodes to be attained at maximum.

The algorithm works as follows:

Every node by default carries a QT of value 0 indicating full queue is available for communication. If the incoming packets are more than the outgoing packets on a particular node than the QT field is set to the particular value from the QT-FR (Queue Threshold-Flow Rate) table. This QT value is received by the predecessor and successor nodes both. The successor nodes will ignore this but predecessor nodes will use the QT value to decide the flow rate for communication to its successor nodes.

IV RESULTS

The proposed algorithm is being implements using NS2/NS3 simulation environment and it is expected that the results shall be improved. Existing IEEE 802.11 algorithm shall be used to compare in the similar environment with the proposed algorithm. Throughput and End-To-End Delay shall be used for comparison of the performance of the existing algorithm and proposed algorithm. Simulation shall be performed using scenarios created by increasing the no. of stations (2, 4, 8, 16, 32, 64,128 and 256). Simulation shall be performed for every scenario for packet sizes of 128, 256 bytes. A traffic generator with CBR distribution to provide offered load in this simulation shall be applied.

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