Awareness in Congestion for Multipath Load Balancing in MANET

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ABSTRACT
Mobile communication plays a vital role in disaster recovery management during emergency situations. It is helpful in situations where the system has less robust and less flexible infrastructure. However, the rapid growth in number and multiplicity of real-time network applications has made it imperative to consider the impact of end-to-end delay requirements of traffic on network. The research papers are published to increase the network performance on the network layer. In this paper, we propose a Reliable and Efficient Load balancing Technique in presence of congestion. It is based on AODV Protocol in Mobile Ad hoc Networks. In this protocol, a weight function based on route length, traffic load, energy level and freshness of each route is calculated and stored in the route cache. We propose a congestion aware multi-path routing protocol for load balancing in MANET. When the source node wants to forward the data packet to the destination, it uses the reactive route discovery technique where the multiple paths are well-known using multi-path Dijkstra algorithm. This paper combines a multipath routing protocol with load balancing concept and presents a new protocol called AC-AODV. We use NS-2.34 to simulate the scenario. The simulation's result shows the significant performance enhancement of the network for the multipath routing protocol with load balancing. The simulation results illustrate that the proposed load balanced routing protocol improves packet delivery ratio and reduces the delay.

Keywords
Mobile Ad-Hoc Networks; routing protocols; load balancing; multi-path; Dijkstra algorithm.

1. INTRODUCTION
[1] Defines computer networks as a system for communication among the computers. These networks may be permanent (cabled) or temporary. The communication networks and other infrastructures got destroyed during natural and manmade disasters. These may direct to network components failure, physical destruction of supporting network infrastructure and these two together may cause network congestion. The main aim of our framework is to create a new topology and protocol by which the several systems of the network connected and power will be saved, in order to be able to carry on transmitting the important information. A heterogeneous network comprise of collection of wired as well as wireless nodes. This paper develops a new protocol for congestion awareness. By examining congestion, the important factors are the protocol behaviors and network-layer issues in the ad hoc environment. Multipath routing divide the traffic among different paths to minimize congestion in terms of multiple alternative paths through a network which can provide many of the benefits such as minimize delay as well as congestion, maximize bandwidth and improved security.

Congestion is one of the most popular factors of packet loss in MANETs [2]. When the requirements become greater than maximum capability of the communication link mainly during multiple hosts attempting to get into a shared media, congestion occurs in the network. Congestion may also be caused during the following conditions.

1. When the load in the link goes further than the carrying capacity.

2. When the broadcasting packets are excess in nature.

3. When more number of packets areas has becomes time out and retransmitted.

4. When the number of node increases.

5. During standard deviation of the packet delay [3].

6. The congestion detected in the network can rigorously worsen network throughput [4].

The AODV [5] protocol based on the reactive routing discovery uses three different kinds of messages: Route request (RREQ), Route Reply (RREP) and Route Error (RERR). In addition, destination sequence numbers are used to make sure loop freedom at all times. In AODV, each source node finds a new route by the limited flooding of RREQ and acquires a route to its destination through RREP. The AOMDV [6] protocol is the extension of AODV routing protocol, in which the source node keeps different alternative routes from multiple RREPs. The static route selection is used in AOMDV; it cannot handle the dynamic modification of the network due to severe congestion caused by biased traffic. AODV is based on both DSDV and DSR algorithm. It uses the route discovery and route maintenance implementation of DSR. DSR packet hold the entire route information, while the packet of AODV only hold the destination address, it has less routing overhead than DSR. At the same time, AODV employs routing messages and sequence numbering.

AODV protocol is a reactive routing protocol which finds out route to destination when mandatory. AODV comprise of routing table which facilitate to discriminate between expiry and fresh routes. The routing tables at node add the sequence number and next hop information.

The working of protocol is consists of two phases:

1. Route discovery and

2. Route maintenance.

In route discovery process, the source node produce RREQ packet, if the path to destination is not stored in the routing table, and route it to the neighboring nodes. The neighboring nodes will direct it to their neighbor and so on. When the packet come to the destination node, then destination node generates RREP (Route Reply) packet and pass it back to the source node. Thus the path is generated between source and destination node. In route maintenance procedure, the source node is up to date by RERR (Route Error) message in case of link failure. Also the connectivity between the nodes is upholding using Hello messages. There is one of the main factors that cause link failures are: Congestion in network.

When the routing protocols in MANET are not aware about the congestion, it results in the following issues:

1. Long delay: This maintain up the process of detecting the congestion. When the congestion is more meticulous, it is better to select an alternate fresh path.

2. High overhead: More processing and communication attempts are necessary for a new route discovery. If the multi-path routing is utilized, its needs additional attempt for upholding the multi-paths despite the existence of alternate route.

3. Packet losses: The congestion control technique try to minimize the excess load in the network by either reducing the sending rate at the sender or by dropping the packets at the intermediate nodes or by executing both the process. This results in increased packet loss rate or minimum throughput.

The paper is organized as follows. Section II surveys the related work to estimation congestion aware Ad hoc routing protocols for MANET. Section III briefly describes the idea and procedure of AODV routing protocols which improve the congestion with load balancing of MANET. Section IV introduces the proposed method. Section V makes the congestion measurement under our proposed models. Section VI draws the conclusion of the paper.

2. RELATED WORK

Earlier research on ad hoc network routing focused on the protocol devise and performance evaluation in terms of the message overhead and loss rate.

Shruti Sangwan et al [7] have proposed an adaptive and efficient load balancing schemes to get fair routing in mobile ad hoc networks (MANETs). They explain several load balancing mechanisms that controls congestion. Their efficient optimization techniques facilitate in deciding best route in the ad hoc networks. They have mainly focused on presenting a better performance in terms of the processing time of the loads, nodes stability, throughput and lifetime of the network.

Multipath Routing with Load Balancing QoS in Ad hoc Network [8] gives novel protocol for AdHoc routing. It deals with only delay that does not fulfill the bandwidth and energy restraint. But in this paper they had taken into account bandwidth and energy constraints for selecting best path from source to destination node.

P. P. Tandon et al [9] have proposed a novel load balanced routing method that can efficiently diminish the data collision or route coupling. By this method they reduced the packet loss because of the collision and interference. Next the mechanism requires additional improvement to reduce the amount of flooding as more successive flooding can result in performance depression. They targeted the route adaptation and maintenance as their future work.

Wu et al. [8] proposed the power-aware method in leading set-based routing. Their idea is to use rules support on energy level to extend the lifetime of a node in the refining process of reducing the number of nodes in the dominating set.

Kawak and Song [9] investigate the inherent scalability problem of ad hoc networks which start from their multi hop nature. They accomplished that the packet traffic at the center of a network is linearly correlated with radius of the network.

Vinh Dien Hoang et al [10] have proposed an innovative load balancing solution in MANET. The major idea in this solution is the probe packets used for bandwidth estimation are sent by the destination node. By doing so, these packets only have to go one time on the path, which will minimize consumed network resource and increase the accuracy of the estimation. A fresh formula for available bandwidth judgment in IEEE 802.11 network based on the gaps between probe packets is also presented.

Asis Nasipuri et al [11] illustrate how intelligent use of multi-path technique in DSR protocol can diminish the frequency of query floods. They also developed an analytic modeling framework to find out the comparative frequency of query floods for various techniques.

3. PROPOSED WORK

In our previous work, we have built-up a reliable and effective cache management technique for the AODV protocol. For enhanced service of the resources of the MANET and also to increase the performance of the MANET, load balancing technique is employed which is the significant tool. Using the load balancing technique, the network can decrease the traffic congestion and imbalance of the load. Load balancing is a technique to give out workload uniformly across two or more computers, network links, in order to acquire optimal resource utilization, maximize throughput, minimize response time, and avoid overload. Using multiple components with load balancing, rather than a single component, may enhance reliability through redundancy. In order to minimize the routing overheads with improved route discovery latency, on-demand routing protocols for mobile ad hoc networks make drawing on of the route caching in different forms. AC-AODV is a multipath routing protocol for MANET. In AC-AODV, The congested node on a route warns its neighbor nodes when prone to be congested. The congested nodes' neighbors when aware of this situation, try to find an optimal alternate path from multiple routes available. The AC-AODV consists of the following steps:

3.1 Congestion Detection

Instead, every node sending the Hello packet towards the congested node, the node which is likely to be congested is broadcasting a Hello packet. This will prevent the dissemination of control packets and thus saving the network bandwidth and battery power depletion in processing.

3.2 Optimal Route Discovery

Optimal Route Discovery: The purpose of an Optimal Route discovery from multiple paths is to reduce the traffic load on any single path and prevent broadcast storm problem associated with flooding.

4. SIMULATION MODEL

We implement proposed concept in a network simulator called NS2. To create a realistic simulation environment, one configures NS2 based on our work. A collision occurs if a node receives two overlapping packets with signal strengths in excess of the receiver's sensitivity. In this mobility model, a node goes in the direction of the destination with a speed uniformly chosen between the minimal speed and maximal speed.

Table 1: Simulation parameters

Type	Values
Channel	Channel/Wireless Channel
Radio Propagation Model	Propagation/TwoRayGround
Network Interface	Physical/WirlessPhy
MAC	MAC/802_11
Interface Queue	Queue/DropTail/PriQueue
Antenna	Antenna/OmniAntenna
Link Layer	LL
Interface Queue Length	50
Routing Protocol	AODV
Simulation Time	100s

5. RESULTS

As the network load is increased all the protocols show major reduction in the network performance. For streaming multimedia application, throughput alone cannot be notable as performance indicator and that traffic load may have a deceive effect on other parameters.

To calculated performance of AC-AODV with that of AODV protocol, one compares them using these metrics:

5.1 Packet Delivery Rate:

The ratio of packets reaching to the destination node to the total packets produced at the source node.

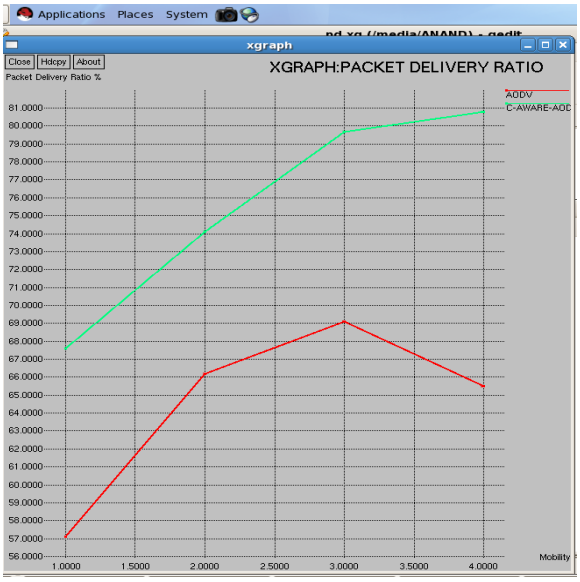

Fig 1: Packet delivery rate vs. mobility scenario

5.2 Packet Loss Rate

First, one can see performance according to position of nodes or by increasing number of nodes brings obvious difference between the two protocols.

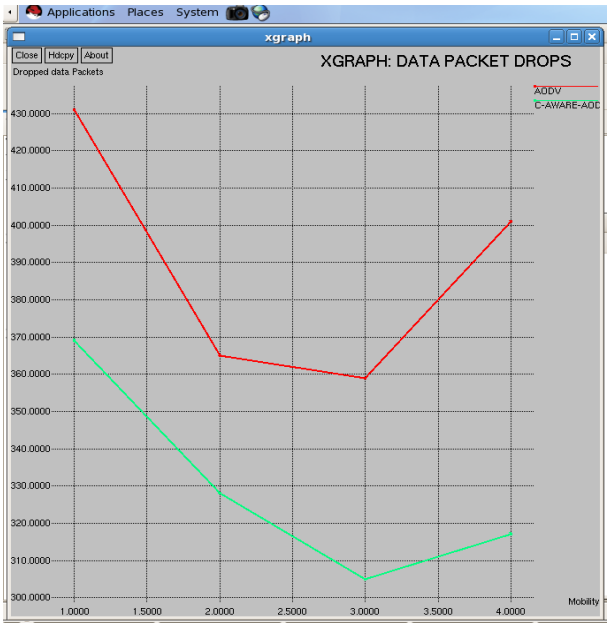

Fig 2: Packet drop rate vs. mobility scenario

6. CONCLUSION AND FUTURE WORK

In this work, we offering a new multipath AC-AODV routing protocol for MANET with load balancing mechanism. There are two main contributions in this work. One is load balancing mechanism to honestly distribute the traffic on different active routes; the other is the route discovery mechanism parameters such as. Delivery Rate and Packet lost Rate. First, we have proposed a new multipath routing protocol called AC-AODV with a new metric which is the buffer size to select the less congested routes. The goal of our scheme to find a congestion less path. Performance evaluation has been done using NS2 simulator tool and comparison with AODV, AC-AODV shows that our protocol can effectively reduce end to end delay while maintaining a good packet delivery ratio.

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