Problem Analysis of Routing Protocols in MANET in Constrained Situation

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Abstract— **A Mobile Ad-hoc network (MANET) consists of a number of mobile wireless nodes, among which the communication is carried out without having any centralized control. MANET is a self organized, self configurable network having no infrastructure, and in which the mobile nodes move arbitrarily. The mobile nodes can receive and relay packets as a router. Routing is a critical issue and an efficient routing protocol makes the MANET reliable. The AODV out-perform DSR in the normal situation but in the constrained situation DSR out-performs AODV, the degradation is as severe as (30%) in AODV whereas DSR degrades marginally (10%) as observed through simulation in Glomosim. This problem has been analyzed in both on-demand protocols and the improvements, has been suggested in a proposed local congestion control algorithm.**

Keywords- MANET, AODV, DSR, Glomosim.

I. INTRODUCTION

A Mobile Ad-Hoc Network (MANET) is a self-configuring network of mobile nodes connected by wireless links, to form an arbitrary topology. The nodes are free to move randomly. Thus the network's wireless topology may be unpredictable and may change rapidly. Minimal configuration, quick deployment and absence of a central governing authority make ad hoc networks suitable for emergency situations like natural disasters, military conflicts, emergency medical situations etc [1] [2]. DSR (Dynamic Source Routing) is on-demand, simple and efficient routing protocol for multi-hop wireless ad hoc networks of mobile nodes. DSR uses source routing and protocol composed of two main mechanisms-'Route Discovery' and 'Route Maintenance', which works together entirely, on-demand. The protocol allows multiple routes to destination, loop-free routing, support for unidirectional links, use of only 'soft state' in routing, rapid discovery when routes in the network change, designed for mobile ad hoc networks of up to about two hundred nodes and to work well even with high rates of mobility. The DSR internet draft 10 is accepted by IETF Manet working group for the release of experimental RFC. AODV (Ad hoc on-demand distance vector) enables dynamic, self-starting, multi-hop on-demand routing for mobile wireless ad hoc networks. AODV discovers paths without source routing and maintains table instead of route cache. It is loop free using destination sequence numbers and mobile nodes to respond to link breakages, changes in network topology in a timely manner. It maintains active routes only while they are in use and delete unused routes (stale). The IETF Manet working group has accepted AODV specifications as experimental RFC (3561).

The advantage of DSR is allowing it to reduce routing load by storing routing information using route caching. AODV on the other hand manages to avoid stale routing information by means of sequence numbers.

The dynamics of AODV and DSR on the route maintenance is different which shall be considered in this paper under constraint environment.

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II. REVIEW OF AODV/DSR

A. AODV

The Ad hoc on demand Distance Vector routing protocol (AODV) joins mechanisms of DSR and DSDV. The periodic beacons, hop-by-hop routing and sequence numbers (guarantee of loop-freedom) of DSDV and the pure on-demand mechanism of Route Discovery and Route Maintenance from DSR are combined. This protocol performs Route Discovery using control messages route request(RREQ) and route reply(RREP) whenever node wishes to send packet to destination. To control network wide broadcasts of RREQs, the source node use an

expanding ring search technique. The forward path sets up in intermediate nodes in its route table with a lifetime association using RREP. When either destination or intermediate node moves, a route error (RERR) is sent to the affected source nodes. When source node receives the (RERR), it can reinitiate route discovery if the route is still needed. Neighborhood information is obtained from broadcast Hello packet.

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B. DSR

The Dynamic Source Routing Protocol (DSR) is a reactive routing protocol .By the means of this protocol each node can discover dynamically a source route to any destination in the network over multiple hops. It is trivially loop free owing to the fact that a complete, ordered list of the nodes through which the packet must pass is included in each packet header. The two main mechanisms of DSR are Route Discovery and Route Maintenance, which work together to discover and maintain source routes to arbitrary destinations in the network. Dynamic Source Routing protocol is a reactive protocol i.e. it determines the proper route only when a packet needs to be forwarded. The node floods the network with a route-request and builds the required route from the responses it receives. DSR allows the network to be completely self-configuring without the need for any existing network infrastructure or administration.

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III. OBSERVED PROBLEM

On conducting experiment with four CBR traffic sources sessions between different to common destination using AODV and DSR. The performance metric is Average Packet delivery rate. It was observed that AODV performs better than DSR in normal case. The Fig 1 reflects the performance comparison.

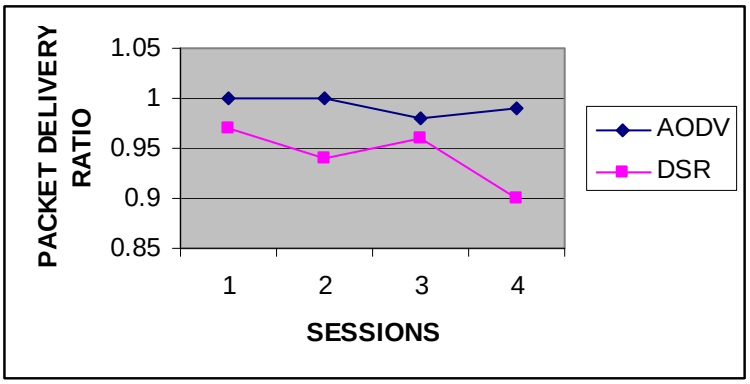

Fig 1 Packet Delivery Ratio vs Sessions 1

In another experiment four different CBR traffic sources started sessions with a common destination. The performance comparisons, as shown in graph-2, reflects that AODV suffers degradation of 30% whereas DSR suffers 10% compared to the normal situation (shown in Fig 1). On comparing their performances, it was observed that DSR performs better than AODV under the constrained situation. The performance degradation in Average Packet Delivery ratio is due to packet drops by the routing algorithm after being failed to transfer data in the active routes. The packet drops are due to network partitioning, link break, collision and congestion in the ad hoc network. Assuming that quick link recovery through the route maintenance is desirable property of routing algorithm, there DSR has shown fast reaction in compared to AODV in the given situation which is clear from the Fig 2.

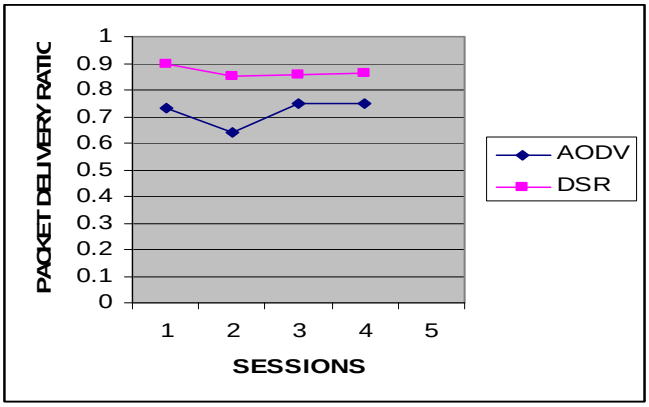

Fig 2. Packet Delivery Ratio vs Sessions 2

IV. ANALYSIS AND PROPOSED SOLUTION

A. Analysis

Assuming that problem is due to routing protocols. The reactive routing protocol triggers its operation on route break to initiate the route repair mechanism. In case of AODV, the alternative routes are limited due to fact that protocol keeps only the active routes and removes the stale ones. Therefore, unavailability of alternative routes it is referred to source node for route discovery. In the constrained situation case of multiple constant bit rate traffic sources to single destination, the congestion on routes to single destination triggers route recovery provisions of AODV in the wake of situation that intermediate nodes are unable to send the data packets, link break situation perceived by AODV sends route error of finding new route through source will result in packet drops eventually resulting in degradation of packet delivery ratio. This situation will result to localized congestion. The existing congestion control mechanism of AODV ie back off in route request requires additional provisions for fast reactions to such congestion and route maintenance. Understanding the provisions of alternative routes in route cache in DSR, the AODV can also adopt the fast route repair locally. However, AODV keeps only active routes and do not keep alternative routes, therefore the active routes of neighbor nodes will also serve as alternative routes in local route repair mechanisms. In the situations of congestion, there is high possibility of existence of alternatives routes in the neighborhood. The proposed algorithm for local route repair in AODV exploits the by-pass route to the destination through one of the neighbor having fewer loads. The alternative routes thus creates in the increase of the temporary capacity and diffuse the local congestion which would otherwise result in packet drops. This results to an improved performance in the packet delivery metrics.

On the other hand in DSR, the route caches have more alternative routes and in the constrained environment when most of the routes are fresh, therefore the route repair is localized. Further, DSR has provision of more than one mechanism for local route repairs such as replying to Route Requests using Cached Routes, Packet Salvaging, Queued Packets Destined over a Broken Link besides route maintenance. Thus DSR invokes the local route repair using the alternative routes in route cache.

B. Solution-I Adjustment of AODV Parameters

Increase the values of following AODV parameters and values each to ensure the high availability of alternative routes and reduce rate of stale route removal process:-

Active_route_timeout, rrep_wait_time, rev_route_life,ttl_start, ttl_increment, ttl_threshold, delete_period

The overall AODV performance can be improved to extent of 5% in the constrained situation. In the following Fig 3 it is observed that AODV1 indicates an improved performance by applying change in AODV parameters to make available more alternative routes.

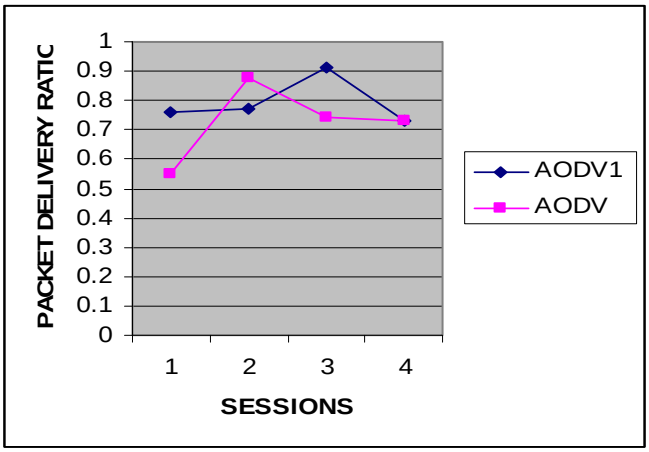

Fig 3. Packet Delivery Ratio vs Sessions 1

C. Solution-II The Algorithm

The Algorithm is invoked as the last option before the packet dropping in AODV. This mechanism will create alternative route out of neighbor's available routes .The RREQ to the neighbor will obtain the routes to destination through neighbor nodes. This will create bye-pass temporary routes for the packets considered for dropping in AODV. It will also attempt to diffuse local congestion by creating alternative routes.

The solution to improve AODV protocol due to constrained environment (congestion) :-

Local Load Balancing Congestion Control Algorithm for AODV

/* Algorithm is invoked when link failed event has occurred in data transfer while using the active route */

1. Query neighbors for route to destination

2. Select route with minimum queue length.

3. Send the data packets through alternative by-pass route

4. If no route is available then drop packet.

The performance of AODV with local congestion control algorithm is 81%(average packet delivery ratio) in the constrained environment. This improvement of 10% performance registered in AODV is almost same as the performance of DSR in the same situation. In the Fig 4 AODV2 is improved using the algorithm as compared to general AODV without having considered for local route repairs.

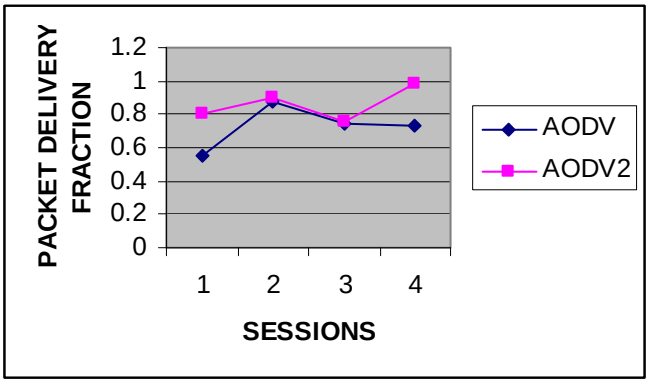

Fig 4. Packet Delivery Ratio vs Sessions 2

V. SIMULATION ENVIRONMENT

We simulated on **GloMoSim** [17], a scalable discrete-event simulator developed by UCLA. This software provides a simulation for Mobile wireless communication with detailed propagation, radio and MAC layers.Table1 describes the detailed setup for our simulation.

TABLE I. SIMULATION SETTING

Routing Protocol	AODV, DSR
MAC Layer	802.11
Bandwidth	11 Mb/s
TERRAIN	2000x2000 m
Node	20,30,40,50
Node Placement	Uniform/Random
Simulation time	100S – 10 M
Mobility Model	RWP
Traffic Type	CBR

In our evaluation, we compare the performance of two different routing algorithms: AODV [2], DSR [1].In our evaluation, we present the set of results: end-to-end packet delivery ratios under two different scenarios, the experiments were repeated 18 times with different random seeds.

CONCLUSION

The performance of reactive routing protocol depends upon the scenario. In normal cases AODV performs better than DSR using various performance metrics. In this paper we observed DSR working better than AODV in constrained situation of several CBR traffic sources leading to same destination in the mobile communicating nodes. In the earlier works, local route repairs were not considered as important[2] for performance comparison of ad-hoc routing protocols, but importance of local route repairs was highlighted in this work. To improve the AODV performance it needs to trigger the local corrective mechanisms which are quick reactive to local route repairs to overcome from the local congestion situation ie in constrained conditions. This paper has proposed improvements using mechanism for local congestion control in AODV.

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