COMPARATIVE PERFORMANCE ANALYSIS OF GZRP, AOMDV AND DSR IN MANETS

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Abstract: A MANET is an autonomous group of mobile users that communicate over reasonably slow wireless links. The network topology may vary rapidly and unpredictably over time, because the nodes are mobile. Routing is a significant issue and challenge in ad hoc networks and many routing protocols have been proposed like OLSR, AODV, AOMDV, DSDV, DSR, ZRP, GZRP and TORA, LAR so far to improve the routing performance and reliability. Genetic Zone Routing Protocol (GZRP) is a new multipath routing protocol for MANETs. It is an extension of ZRP which is a most promising, widely accepted and well proved hybrid routing protocol in Mobile Ad-hoc Networks (MANETs) for its performance when compared with table-driven and on demand protocols. AOMDV is another multipath routing protocol, which is extended from AODV, a source routing protocol. This paper aims to analyze the performances of AOMDV, GZRP and DSR routing protocols with respect to packet delivery ratio, end to end delay and control overhead.

Keywords: MANET, AOMDV, GZRP, DSR, routing, base stations, evaluation, simulation, Route Request, Route Reply.

INTRODUCTION

In an ad hoc network, mobile nodes communicate with each other using multi-hop wireless links. There is no stationary infrastructure; for instance, there are no base stations. Each node in the network also acts as a router, forwarding data packets for other nodes. A central challenge in the design of ad hoc networks is the development of dynamic routing protocols that can efficiently find routes between two communicating nodes. Every node in this network acts as a router or relay station to forward data to the designated node. In this type of network, nodes are mobile and constantly change their location from one MANET to another. The applications of this network are such as emergency situation, disaster recovery, crowd control, battle fields etc.

Many routing protocols have been proposed for the mobile ad hoc network. They are classified as Proactive or Table Driven routing Protocol, Reactive or On Demand Routing Protocol and Hybrid Routing protocol. Our goal is to carry out a systematic performance study of three dynamic routing protocols for ad hoc networks — Dynamic Source Routing protocol (DSR) [1,2], Ad Hoc On-Demand Multipath Distance Vector protocol (AOMDV) [3,4] and Genetic Zone Routing Protocol (GZRP).

This paper is categorized as follows. Section I presents the Introduction. Section II provides the overview of Routing protocols. Section III describes the simulation environment .Section IV presents the Experimental results and Section V concludes the paper.

OVERVIEW OF ROUTING PROTOCOLS

Dynamic Source Routing Protocol (DSR)

The DSR Protocol is a simple and efficient routing protocol designed specifically for the use in multihop wireless ad hoc networks of mobile nodes. Using DSR, the network is completely self-organizing and self-configuring, without requiring any existing network infrastructure or administration. Network nodes (computers) cooperate to forward packets for each other to allow communication over multiple “hops” between nodes not directly within wireless transmission range of one another. As nodes in the network move about or join or leave the network, and also wireless transmission conditions such as sources of interference change, all routing is automatically determined and maintained by the DSR Routing Protocol. Because the number or sequence of intermediate hops needed to reach any destination may change at any time, the resulting network topology quite rich and rapidly changing.

The DSR Protocol allows nodes to dynamically discover a source route across multiple network hops to any destination in the ad hoc network. Each data packet sent, then carries in its header the complete ordered list of nodes through which the packet must pass. The packet routing is allowed to be trivially loop-free and also it avoids the need for up-to-date routing information in the intermediate nodes through which the packet is forwarded. By including the source route in the header of each data packet, other nodes forwarding or overhearing any of these packets may also easily cache this routing information for future use. While designing DSR, it was needed to create a routing protocol that had very low overhead yet was able to react quickly to changes in the network, providing highly reactive service to help ensure successful delivery of data packets in spite of node movement or other changes in network conditions.

Advantages and Disadvantages

DSR uses a reactive approach which eliminates the need to periodically flood the network with table update messages which are required in a table-driven approach. The intermediate nodes also utilize the route cache information efficiently to reduce the control overhead.

The disadvantage of DSR is that the route maintenance mechanism does not locally repair a broken down link. The connection setup delay is higher than the delay in table-driven protocols. Even though the protocol performs well in static and low-mobility environments, the performance degrades rapidly with increasing mobility. Also, considerable routing overhead is involved due to the source-routing mechanism employed in DSR. This routing overhead is directly proportional to the path length.

Ad Hoc On- Demand Multipath Distance Vector protocol (AOMDV)

The Protocol AOMDV [5-6] is a multipath extension of existing reactive routing protocol AODV. This protocol propagates RREQ from the source towards the destination which establishes multiple reverse paths both at intermediate nodes as well as at the destination. Multiple RREPs traverse these reverse paths back to form multiple forward paths to the destination at the source and intermediate nodes. Note that AOMDV also provides intermediate nodes with alternate paths as they are found to be useful in reducing route discovery frequency. The core of the AOMDV protocol lies in ensuring that the multiple paths discovered are loop-free and disjoint, and efficient in finding such paths using a flood-based route discovery. AOMDV route update rules, applied locally at each node, play a key role in maintaining loop-freedom and disjointness properties. AOMDV relies as much as possible on the routing information already available in the underlying AODV protocol, thereby limiting the overhead incurred in discovering multiple paths. In particular, it does not employ any special control packets. In fact, extra RREPs and RERRs for multipath discovery and maintenance along with a few extra fields in routing control packets (i.e., RREQs, RREPs, and RERRs) constitute the only additional overhead in AOMDV relative to AODV.

The advantage of using AOMDV is that it allows intermediate nodes to reply to RREQs, while still selecting disjoint paths. But, AOMDV has more message overheads during route discovery due to increased flooding and since it is a multipath routing protocol, the destination replies to the multiple RREQs which results in longer overhead.

Genetic Zone Routing Protocol (GZRP):

Genetic Zone Routing Protocol (GZRP) [7] is a multipath extension of Zone Routing Protocol (ZRP) obtained by incorporating concepts from Genetic Algorithms (GA). Some of the performance evaluations on GZRP are done in [8-9]. The principle of GZRP is explained here under: GZRP makes use of IARP, to verify whether the intended target is within the routing zone of the source node. If the route to the destination is available in its routing table, it makes use of the same route and forwards the packet to the destination. If the route to the destination is not within its reach, it applies route discovery process using its sub protocols, IERP and BRP. IERP makes use of Route Request (RREQ) and Route Reply (RREP) packets in the route discovery process. The RREQ packets are border casted in to the network. In turn, these packets are supplementary border casted from the border nodes. Every border node searches for the destination node within its routing table. When a route to the destination is found, the Route Reply (RREP) packets are sent back to the source node.

The GZRP makes use of Genetic Algorithm at each border node and generates possible alternative paths which may be optimal or sub-optimal. These alternative paths are stored at the border nodes for two basic reasons: (a) they can utilize these routes as the alternative routes in case of the existing route fails or node fails (Fault Tolerance) (b) they can distribute the packets on multiple alternative routes to reduce the congestion and as well to balance the network load (load balancing). At each border node, instead of border-casting the RREQ packets on a primary path alone, they can be border-casted on many routes. Even though, GA produces many possible alternative paths, we make use of limited number of alternative routes which are either optimal or near optimal. The architecture of the GZRP is shown in Fig.1. While using GA in computing the shortest path or near shortest paths, it includes the process like crossover and mutation to produce the new routes.

The main advantage of the GZRP is that it confines the control overhead as it does not rediscover the routes when the route fails. It makes use of readily available routes which are generated using GA. The key features of GZRP are explained in the following sub-sections.

Routing Table of a Border Node

The routing table consists of the entries including destination, route, frequency, and metric. The default metric used all through the work is hop count and the destination entry indicates the destination node of packets. For each destination, it has a set of alternative routes. A route entry is a list of node IDs along the route. The frequency entry specifies the number of packets sent to the destination by the route.

Robustness: Fault Tolerance

Fault tolerance is essential in actual routing algorithms. It will take care of route maintenance. The routing algorithms must be robust for packet loss caused by unsteadiness of the network such as congestion and node/link failure. GZRP reduces this problem by providing a set of substitute Routes to a border node. The next best available alternative route at the border node is used for forwarding the packets. This gives robustness for the network and also reduces the control overhead that may occur in the network due to rediscovery of the routes.

Load Balancing

This frequency field in the routing table will be useful in order to balance the load of the network. This reduces the load on a single route by distributing the packet delivery through the available alternative routes. The first route to the destination in the list is considered as the default route. In initial state, the routing table is empty. When a packet is generated at a node, a default route is generated by the IARP routing framework and will be inserted in to the routing table. This not only reduces the end-to-end delay but also helps in reducing the overhead. Further, delivery of the packets will be done more efficiently.

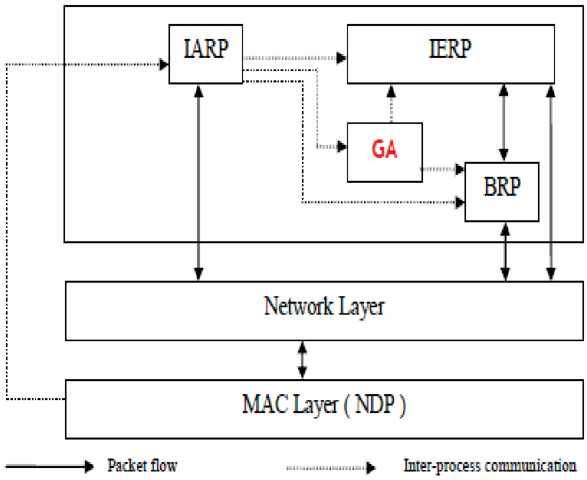

Fig.1 Architecture of Genetic Zone Routing Protocol [10]

SIMULATION ENVIRONMENT

The aim of this simulation study is to evaluate the protocols GZRP, AOMDV and DSR for their performance on factors like percentage of packet delivery, end to end delay and control overhead

Parameters used. The parameters used for the simulation to evaluate the protocol are summarized in Table I.

RESULTS AND PERFORMANCE ANALYSIS

In this paper we have compared the performance of GZRP, AOMDV and DSR based on various factors. Now an analysis is made on the achieved results based on various factors like percentage of packet delivery, average delay and control overhead during different mobility conditions. The experimental result of Fig:2 for packet delivery ratio infers that DSR shows better packet delivery than both GZRP and AOMDV. But the same is better for GZRP than AODV because GZRP has better load balancing capability. Fig 3 shows the effect of average delay on the mobility of the nodes. It indicates that DSR shows the least average delay over mobility. It also shows that the average delay of GZRP is less than AOMDV. The Figure 4 shows the effect of control overhead on the mobility of the nodes. It shows that the control overhead of GZRP is minimum.

Parameter	Value
Simulation Time	900 s
Number of experimented trials	6
Network Coverage Area	1500 x 300 m^2
Number of Nodes	50
Mobility Model	Model: Random Way Point Pause Time: 0s, 100s, …, 900s Minimum Speed: 1 m/s Maximum Speed: 20 m/s Node Placement : Random
Traffic	Source: CBR Number of Sources : 10 Rate: 1 packet/s Packet Size: 512 bytes
MAC	802.11
Bandwidth	2 Mbps
Transmission range	200m
Matrices	PDR, End to end delay, Control Overhead

Table 1 Parameters of Simulation

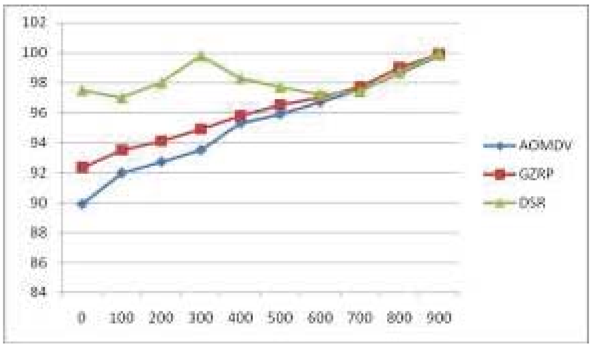

Fig. 2 Packet Delivery Ratio over Mobility

CONCLUSIONS

This paper presents the results of the experiments carried out on MANET routing protocols, GZRP, DSR and AOMDV. The performance analysis is made to verify the effect of mobility on the factors like packet delivery, control overhead and end to end delay. Experimental results show that GZRP better utilizes the readily available routes for load balancing and fault tolerance of the network.

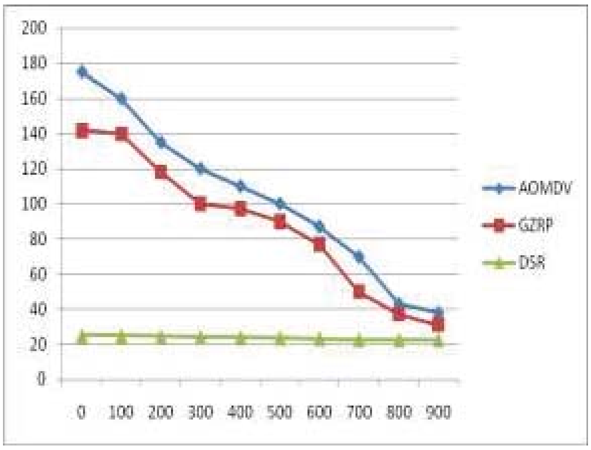

Fig.3 Delay over Mobility

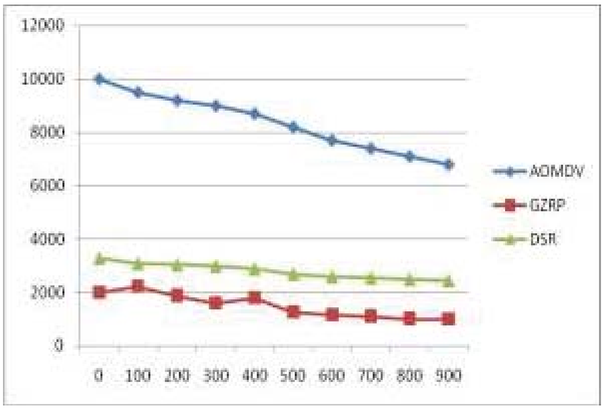

Fig. 4 Control Overhead over Mobility

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