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A Review: Proactive and Reactive Routing Protocols of MANET in a Grid using Mobility

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Abstract: *The objective is to evaluate the performance of Table Driven and On-Demand routing protocol's behavior namely, Destination Sequenced Distance Vector (DSDV), Ad-hoc On-Demand Distance Vector (AODV) and Dynamic Source Routing (DSR) based on the performance and comparison on the basis of their properties like throughput, packet delivery ratio (PDR), End to End Delay(E2E) and data packet loss with respect to four different scenarios- one by varying the number of nodes, again by varying mobility, other by varying number of connecting nodes at a time and by varying pause time. Discuss the result of the proposed work and concluding by providing the best routing protocol in different circumstances.*

Keywords- *AODV, DSDV, DSR, MANET, NS-2.*

1. INTRODUCTION

Mobile ad-hoc networks (MANET) is one that comes together as needed, not necessarily with any support from the existing infrastructure or any other kind of fixed stations. It is an autonomous system of mobile hosts also serves as routers connected by wireless links, which dynamically form a temporary network, without using any existing network infrastructure or centralized administration. These are often called infrastructure-less networking since the mobile nodes in the network dynamically establish routing paths between themselves. Current typical applications of a MANET include battlefield coordination and onsite disaster relief management.
Ad-hoc is a Latin word, which means "for this or for this only."Mobile ad hoc network is an autonomous system of mobile nodes connected by wireless links; each node operates as an end system and a router for all other nodes in the network. If a node wants to communicate with another node that is located outside its radio range then data packets are relayed over a sequence of intermediate nodes using a store and forward (multi hop transmission principle) Thus, a mobile ad hoc network is sometimes also called a multi hop wireless network.

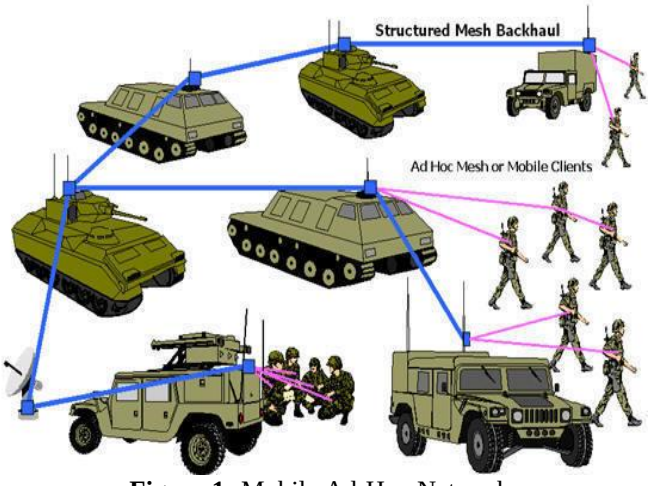

Figure 1: Mobile Ad-Hoc Network

A number of applications of MANETs are:

1. Personal Area Networking
   - Cell phone
   - Laptop
   - Ear phone
   - Wrist Watch
2. Military Environments
   - Soldiers
   - Tanks
   - Planes
3. Civilian Environments
   - Taxi cab network
   - Meeting rooms
   - Sports stadiums
   - Boats
   - Small Aircraft
4. Emergency operations
   - Search and Rescue
   - Policing and Fire Fighting

Disadvantages of MANET

- Limitations of the Wireless Network
- Packet loss due to transmission errors
- Frequent disconnections/partitions
- Limited communication bandwidth
- Broadcast nature of the communications
- Limitations Imposed by Mobility
- Dynamically changing topologies/routes
- Lack of mobility awareness by system/applications
- Limitations of the Mobile Computer
- Short battery lifetime
- Limited capacities
- Limited resources and physical security.

1.1 AD-HOC ROUTING PROTOCOL

A routing protocol is a protocol that specifies how routers communicate with each other, disseminating information that

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enables them to select routes between any two nodes on a computer network, the choice of the route being done by routing algorithms. Each router has a priori knowledge only of networks attached to it directly. A routing protocol shares this information first among immediate neighbors, and then throughout the network. This way, routers gain knowledge of the topology of the network.

DESCRIPTION OF PROTOCOLS

(i) Ad-hoc On-demand Distance Vector (AODV) Routing Protocol

AODV is a routing protocol builds on the DSDV algorithm. AODV is an improvement on DSDV because it typically minimizes the number of required broadcasts by creating routes on an on-demand basis, as opposed to maintaining a complete list of routes as in the DSDV algorithm. AODV is a pure on-demand route acquisition system, as nodes that are not on a selected path do not maintain routing information or participate in routing table exchanges. When a source node desires to send a message to some destination node and does not already have a valid route to that destination, it initiates a path discovery process to locate the other node. It broadcasts a route request(RREQ) packet to its neighbors, which then forward the request to their neighbors, and son on, until either the destination or an intermediate node with a "fresh enough" route to the destination is located. Each node maintains its own sequence number, as well as a broadcast ID.

(ii) Dynamic Source Routing (DSR) Protocol

DSR protocol is an on-demand routing protocol that is based on the concept of source routing. Mobile nodes are required to maintain route caches that contain the source routes of which the mobile is aware. Entries in the route cache are continually updated as new routes are learned. The protocol consists of two major phases: route discovery and route maintenance. When a mobile node has a packet to send to some destination, it first consults its route cache to determine whether it already has a route to the destination. If it has an unexpired route to the destination, it will use this route to send the packet. On the other hand, if the node does not have such a route, it initiates route discovery by broadcasting a route request packet. This route request contains the address of the destination, along with the source node's address and a unique identification number. Each node receiving the packet checks whether it knows of a route to the destination. If it does not, it adds its own address to the route record of the packet and then forwards the packet along its outgoing links. To limit the number of route requests propagated on the outgoing links of a node, a mobile only forwards the route request if the mobile has not yet seen the request and if the mobile's address does not already appear in the route record. A route reply is generated when the route request reaches either the destination itself, or an intermediate node, which contains in its route cache an unexpired route to the destination. By the time the packet reaches either the destination or such an intermediate node, it contains a route record yielding the sequence of hops taken.

(iii) Dynamic Destination-Sequenced Distance-Vector Routing Protocol (DSDV)

DSDV is a table driven algorithm based on the classical Bellman Ford routing mechanism. Every mobile node in the network maintains a routing table in which all the possible destinations within the network and the number of hops to each destination are recorded. Each entry is marked with a sequence number assigned by the destination node. The sequence number enables the mobile nodes to distinguish stale routes from new ones, thereby avoiding the formation of routing loops. Routing table updates the periodically transmitted throughout the network in order to maintain table consistency. To help alleviate the potentially large amount of network traffic that such updates can generate, route updates can employ two possible types of packets. The first is known as a "full dump". This type of packet carries all available routing information and can require multiple network protocol data units (NPDUs). During periods of occasional movement, these packets are transmitted infrequently. The mobile nodes maintain an additional table where they store the data sent in the incremental routing information packets. New route broadcast contain the address of the destination, the number of hops to reach the destination, the sequence number of the information received regarding the destination, as well as the new sequence number unique to the broadcast. The route labeled with the most recent sequence number is always used. In the event that two updates have the same sequence number, the route with the smaller metric is used in order to optimize the path.

2. PROBLEM STATEMENT

The objective is to compare the performance of three routing protocols based on Table Driven and On-Demand behavior namely, Destination Sequenced Distance Vector (DSDV), Ad-hoc On-Demand Distance Vector (AODV) and Dynamic Source Routing (DSR), for wireless ad hoc networks based on the performance , and comparison on the basis of their properties like throughput, packet delivery ratio (PDR), End to End Delay and data packet loss with respect to four different scenarios- one by varying the number of nodes, again by varying number of nodes, other by varying number of connecting nodes at a time and by varying pause time.

The general objectives can be outlined as follows:

1) Generate a simulation environment that could be used for simulation of protocols.
2) Simulate the protocols on the basis of different scenarios: by varying the number of nodes, varying the traffic in the network by varying mobility.
3) Discuss the result of the proposed work and concluding by providing the best routing protocol.

3. LITERATURE SURVEY

Preeti and Sunil [1] evaluated performance of AODV, DSDV and DSR routing protocols with respect to performance metrics such as Normalized Routing Load & Throughput. As per their scenario DSR shows best performance than AODV &

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DSDV in terms of Throughput & Normalized Routing Load.

Datuk and Md. Hairil [2] presented an overview of Mobile ad hoc network and examine the routing protocols by presenting their characteristics and functionality and evaluate them on a given set of parameters. Each protocol has definite advantages and disadvantages and has certain situations for which it is well-suited.

Narul and Wilford [3] gives a study of MANET routing protocols on different perspective, using simulation model the combined effect of node density and packet length for OLSR, AODV, DSR and TORA which is a realistic scenario where nodes move around, join and leave the network at any time.

Asma, Rajneesh and Sunil [4] compared the performance of three protocols together giving the performance matrix includes Packet delivery ratio, Throughput, End-to-end delay, Routing overhead and generated the graph comparing the performance of routing protocols when packet size changes, when time interval between packet sending changes, when mobility of nodes changes. There is no effect on the performance of DSDV protocol at varying packet size, Performance of AODV protocol is decreasing with increase in packet size, Throughput of DSR protocol is decreasing as packet size is increasing.

Md. Arafatur and Jannatul [5] present the detailed simulation based performance study and perform the analysis on routing protocols over MANET such as Proactive, Reactive and Hybrid and relative performance is reported over simulation environment.

Md. Bouhorma, H. Benataouit and A.Boudhir [6] proposed a comparison of AODV and DSR in terms of packet loss ratio, end to end delay, with mobile nodes varying number of nodes and speed and conclude that AODV performs well when mobility increases. In DSR, overhead increases when the size of the network increases.

Kapil and Durgesh [7] proposed a comparison of AODV and DSR on the parameters like packet delivery fraction i.e. throughput, average end to end delay and normalized routing overhead using network simulator-2. Performance analysis is done by varying mobility pattern (pause time and speed) and traffic pattern (sending rate) and shows that DSR performs well for performance parameters and poor in term of Average Delay.

Kil, Sung and Yeon[8] proposed a performance comparison of On-Demand routing protocols such as DSR, AODV and TORA with varying the application data such as sensor, text, voice and video data. Analysis based upon the simulation results with respect to packet delivery fraction, average end to end delay and routing load for application data.

Nidhi, Balasubramanian ad Indra [9] compared the existing on demand routing protocols and recently developed protocols such as AODV with break avoidance and scalable multipath on demand routing and concludes that recently proposed multipath extension of AODV has more advantageous over conventional routing protocols in terms of routing overhead, latency introduced in route discovery and route repair.

Rajiv and C.R. Mandal[10] proposed a comparison of AODV outperforms DSR in normal situation using various performance metrics. To improve the performance of AODV it needs to trigger the local corrective mechanisms which are quick relative to local route repairs to overcome from local congestion situation.

Vincent, Houda, Laurent and Yvon [11] proposed the performance comparison of Multipath Reactive Ad hoc Routing protocols that includes node disjoint and untrusted node disjoint path scheme. Multipath routing scheme enhances the robustness of routing protocols. Performance could be improved if unnecessary signatures were avoided.

Makota, Elis, Masahiro [12] proposed a comparison study between simulation and experimental results for MANETs by considering two models, stationary and mobility model. Result shows that AODV protocol has a good performance when the relay node is moving and it provides a flexible and effective routing for indoor environment.

Qinting and Hong [13] proposed the efficiency evaluation and comparison of AODV and DSDV based on simulations in different network scenarios with various nodes mobility, number of nodes and terrain size. AODV performs worse than DSDV in an inconsistency MANETs environment.

Bhavesh, Ajith, Crina and Sugata [14] analysed the comparison of DSR and DSDV protocols for different mobility models like random wayward mobility, group mobility, freeway and manhattan models and shows that DSR gives better performance for highly mobile network than DSDV.

Seungjin and Seong [15] proposed a routing table maintenance algorithm that respond to the the changes in network topology and adjust the paths so that their lifetime could be maximized. The algorithm reduces number of packet transmissions, and saves bandwidth and battery power.

Sandeep Gautam and Shashank Dwivedi [16] evaluated the performance of Adv.-AODV, AODV, DSDV and DSR using ns-2. Comparison was based on the packet delivery fraction, throughput and end-to-end delay. They concluded that in the static network (pause time 50 sec), Adv.-AODV gives better performance as compared to AODV, DSDV and DSR in terms of packet delivery fraction and throughput and end-to end delay.

4. RESEARCH METHODOLOGY

4.1 Selection Techniques for Network Performance Evaluation

There are three techniques for performance evaluation, which are analytical modeling, simulation and measurement [6]. Simulation is performed in order to get the real-event results with no assumption as in case of analytical modeling.

4.2 Random Waypoint Mobility Model

A node, after waiting a specified pause time moves with a speed between 0 m/s and Vmax m/s to the destination and waits again before choosing a new point and speed [6].

NS-2 SIMULATOR

NS (version 2) is an object oriented, discrete event driven network simulator written in C++ and Otcl."

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Features of NS-2

- Protocols: TCP, UDP, HTTP, Routing algorithms etc
- Traffic Models: CBR, VBR, Web etc
- Error Models: Uniform, bursty etc
- Radio propagation, Mobility models
- Energy Models
- Topology Generation tools
- Visualization tools
- Extensibility

Motivation for Simulations

- Cheap - does not require costly equipment.
- Complex scenarios can be easily tested.
- Results can be quickly obtained – more ideas can be tested in a smaller timeframe.
- The real thing isn't yet available.
- Controlled experimental conditions.
- Repeatability helps aid debugging.

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