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A Performance Analysis of MANET Routing Protocols

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Abstract A group of mobile nodes creates an arrangement connected to a remote media, forming a dynamic topology. In adhoc networks, Any time a device sends data to another node, that node uses energy, and occasionally the data transmission will halt when all the power is used up. The difficulty with MANET is reducing the energy consumption of the network's intermediary devices so that the network is active during data transmission because Mobile Adhoc Network (MANET) devices are often power-driven. Then, using performance measurements, a performance analysis is carried out across several routing protocols, including Dynamic Source Routing (DSR), Ad-hoc On-Demand Multipath Distance Vector (AOMDV), Destination-Sequenced Distance-Vector Routing (DSDV), and Ad-hoc On-Demand Distance Vector (AODV). The performance analysis is done using the NS2.35 simulator.
Keywords: AODV, AOMDV, DSDV, DSR and MANET.

1. Introduction

A MANET is made up of a number of electronic devices called nodes in a network, which may move openly within the network. Figure 1 represents an easy mobile unstructured system Each node receives the data, transmits it to the others, and in addition to performing its regular tasks, it may also act as an amplifier. Dynamic topologies, restricted energy, and infrastructure-less networks are some of the highlights of MANET. Because of these specific features, the infrastructure and routing protocols challenge the efficiency of MANET. As a result of these challenges, MANET research has come into existence by different researchers within the most recent couple of years. Because of these challenges, a large number of routing protocols like proactive, hybrid, and reactive have been introduced [1].MANET have the different features ,The devices are associated with remote connections and the correspondence among devices is remote.MANET is based onthe concept of dynamic topology as it changes topology arbitrarily and quicklywith time. The adhoc networks have low bandwidth capacity as compared to wired communication. MANET shows its independent behavior among the nodes as every node can turn as a host and router. MANET nodes depend on batteries for their energy, so conservation of energy is the vital task in adhoc networks. Due to MANET distributed nature, a centralized firewall is absent for the operations like security and routing therefore these networks are more liable to attacks. MANET have need less human intervention to form the network that is why they are free in nature. MANET is used as military battlefield, commercial sector and personal area network etc.

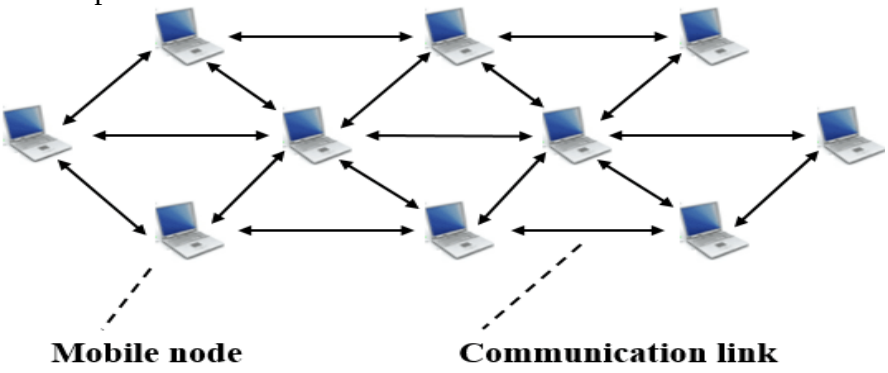

Figure 1: Architecture of MANET

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Organization of Paper

This research paper is structured as follows: In section 2, existing literature is described comprehensively. Section 3, we describe the MANET routing protocols with their advantages and disadvantages. Section 4, explains the simulation tool used for this research, performance evaluation parameter and results ofcomputational experiments. Section 5 explains the conclusion and work to be done in future.

2. Literature Survey

Anuj K. Gupta et al. [2] compared different mobility models, explained the features, demerits, and challenges of research in mobility modeling, and discussed the results of simulation that explain the significance of a mobility model in MANET. Bandana Kumari et al. [3] analysed the effects of malicious nodes on routing protocols for MANET. The simulation is performed on AODV, DSD, and ZRP routing protocols using the NS2 simulator. The network performance is analysed using various performance metrics such as throughput, PDR, and some other parameters. Ritesh Kumar Mohapatraet et al. [4] performed a performance analysis on various MANET routing protocols with respect to the static and dynamic nodes using various performance metrics. From simulations researcher concluded that DSR gives best results in terms of PDR and throughput However, AODV outperforms DSDV in small and medium networks. Muthukumaran et al. [5] Create a method to study the MANET throughput capacity with the least amount of packet loss. Each node uses the technique to try to send information to the sink nodes that are closest to it after which it receives an acknowledgement message. Tanweer Alam et al. [6] outlined a remedy that clarifies the function of MANET within the internet of things. Because MANET has the unique ability to create its own network or link to another large network, it is an essential strategy in the IOT for facilitating communication among smart items.. Qutaiba Razouqi et al.[7] stated the different MANET routing protocols and, after that, simulation is performed on protocols with the usage of density variation and speed, incorporating the different types of traffic. These protocols are studied against thevarious parameters such as energy consumed, PDR, and total packets dropped. Lubdha M. Bendale et al. [8] discussed the MANET routing protocols with their advantages and disadvantages. Priyambodo et al. [9] did research to optimize the performance in case of MANET. They did analysis of different Routing protocol in order to achieve their objective. Ahmed et al. [10] did evaluation of AODV,OLSR and GRP. Their research objective was to evaluate the performance during video conferencing in MANET. Kumaiwan et al. [11] did performance analysis for MANET. Author considered AODV, OLSR and DSDV protocol to achieve their objective. Mishra et al.[12] did research to compare MANET routing protocol with different simulation parameters. Zemrane et al. [13] considered MANET for intelligent transportation system and compared routing protocols. Abdullah et al. [14] investigated the influence of mobility model over routing protocols that have been used in MANET. Bai et al. [15] did performance comparison as well evaluation in case of proactive and reactive routing protocols that are used in MANETs. Azzuhri et al. [16] proposed better approach in case of link breaks detection. Author has focused on route repairs strategy in AODV. Harsimrankaur et al. [17] did comparison of AODV with DSDV protocols. Author also focused on improvement of AODV protocol. Sisodia et al[18] provided a review of performance of MANET routing protocols used within and between groups. The study took into account the nodes' changing speeds as an influencing factor.

3. Routing Protocols in MANET

The transmission of data in the network from one node to another is referred to as "routing." The routing protocol determines the optimal paths and sends the packets over the network [26]. The terms proactive and reactive protocols are used to describe the two different types of MANET routing protocols. Table-driven protocols are another name for proactive protocols, whereas on-demand protocols are another name for reactive protocols.

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3.1 **Reactive Protocols**

Adhoc networks that use reactive protocols for node-to-node data transfer will continue to provide on-demand access to all node routing data. The node must identify the next node before sending the packet since occasionally congestion results from broadcasting information to every surrounding node. The benefit of using reactive protocols is that the networks do not need to carry the routing overhead every time. AODV, AOMDV and DSR protocols are categorized as reactive protocols [27][28].

3.1.1 AODV Routing Protocol

The DSR protocol performs better when using the AODV protocol for route finding and maintenance. To maintain track of information for each destination, this protocol uses routing tables. To determine how frequently updated the routing information is, it uses sequence numbers stored at each sink node [27]. The protocol also consists of two phases which are as follows:

Route Discovery Phase

A node first searches the routing table for a route when it needs to send data to another node. If the route is discovered, information transfer takes place right away; otherwise, the node must begin the route discovery phase. During this phase, a Route Request Packet (RREQ) message is sent to every node, or broadcast, and if every node has a working route to the destination, an RREP packet is transmitted. If a node receives the same multiple route request, it will ignore future copies of the same RREQ packet and only take into account the first RREQ.

Route Maintenance Phase

In this, the protocol monitors the performance of thenetwork and when there is a link break because of any reason then the route error message (RERR) istransferred to the neighboring nodes which in turn forward the message to the next hop which results inremoving all the routes using the broken links. The Pros and Cons of above-mentioned protocols are as follows:

- Suitable for large networks.
- It needs less space to maintain the routeinformation.
- It supports multicasting.
- There is a problem of high route discoverylatency.

3.1.2 AOMDV Routing Protocol

When multipath is used in network then AOMDV comes into existence. The AODV protocol's features are improved by the AOMDV protocol. The AOMDV protocol locates all possible routes from a sender node to a destination node. Node maintained multiple paths to source or destinations. Every copy of RREQ is processed. When one route fail then other route is used for packet transfer. In AOMDV, multipath routing helps to increase the reliability of network and avoid the congestion overhead. In other words, we can say that multipath routing helps to handle theoverall load of the network [33]. The merits and demerits of AOMDV are as follows:

- It discovers the new routes on demand.
- Nodes created are loop free.
- Connectivity is maintained between nodes.
- It recovers from failure very quickly and efficiently.
- During new route discovery message overhead is there because of increased flooding.
- Destination node replies to the multiple route request messages corresponding to single RREQ packet which may lead to heavy traffic across the network.

3.1.3 DSR Routing Protocol

DSR requires no current network infrastructure because it is a self-organizing, self-configuring protocol.The DSR protocol employs the source routing approach, in which the source node assesses the entire path that the node must take to reach its destination. The core of this system is comprised of the Route Discovery Phase and the Route Maintenance Phase.Every mobile node keeps a source route cache in the earlier phase, which contains details on numerous routes that go to the same sink node. The source node initiates route discovery by broadcasting RREQ if it is unable to ascertain the route to sink from the cache node. When this RREQ packet reaches the surrounding nodes, each node

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retains a cache that holds the information on freshly identified pathways. After that, the source starts transmitting the data once the destination route is discovered and maintains the entry in the corresponding cache [32].

The task of Route Maintenance Phase is to detect the change in network topology and keep the updated information of already discovered source routes. If any failure occurs in the network, then a message is transfer to the related node. The merits and demerits of DSR protocol are as follow:

- DSR Protocol quickly adapts to topology changes that occurs when the nodes move fromone place to another.
- Suitable for nodes moving with moderate speed
- Less overhead because of cache.
- Not suitable for large networks.

3.2 Proactive Protocols

As implied by their name, table-driven protocols update routing tables, which contain a list of all mobile hosts in the network, whenever a packet or other piece of data is delivered from one node to another. This can be done in many ways, and therefore the proactive protocols can be divided into two subclasses named as event-driven routing protocol and regularly updated protocols

If the topology of the network has not changed, the topological network will not send any routing update packets; rather, routing information is only transmitted to other nodes when the topology of the network changes. Unlike regular updated protocols, which frequently convey topological information to other nodes. The overhead involved with maintaining the routing table is imposed in both subclasses even if many of its components are never used. There is no setup wait and the routes can be used immediately when using table-driven protocolsThe topological network will not send any routing update packets if the topology of the network has not changed; instead, routing information is only sent to other nodes when the topology of the network changes. As opposed to routinely updated protocols, which often communicate topological information to other nodes Even if many of its components are never used, both subclasses must bear the cost of maintaining the routing table. The routes can be utilised right away when employing table-driven protocols because there is no setup delay[29].

3.2.1 DSDV Routing Protocol

Every node in the DSDV protocol keeps track of a routing table that includes a list of all sink nodes that may be reached, the number of hops needed to get there, and their sequence number. A node will always choose the shortest route when sending a packet to a neighboring node. Every host in the network periodically broadcasts its routing table to each of its neighboring nodes to maintain the distance current. The revised distance information must be used to determine the shortest path algorithm to use when transmitting the packets.

Either a complete dump mode update or an incremental dump update mode must be used to update the routing tables in the DSDV protocol.

A full dump mode sends the entire routing table to the surrounding nodes, but an incremental update just sends the information that has been updated or changed, which causes less network traffic and overhead. Each routing table item in DSDV includes the sequence number, which prevents looping in the network[31]. The advantages and disadvantages of DSDV is as follows:

- DSDV routing protocol is suitable for small sizenetwork.
- It reduces the extra overhead and traffic over thenetwork by using incremental update approach
- DSDV protocol supports only single pathrouting from starting node to sink node.
- It always ensures the best routing path fortransferring data to the destination.

3.3 Hybrid Routing Protocols

The hybrid of on-demand routing and table-driven leads to the formation of routing protocols. The protocols maintain the balance among the various protocols [30]. Zone Routing Protocol comes under hybrid protocol.

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4. **Simulation Tools and Result Analysis**

A discrete event simulator called Network Simulator is employed in networking research. [34]. Simulation can be defined as estimating how events might occur in the support of technology.. For simulation purpose, we are using network simulator version 2.35. In this research, we emphasis on the various popular routing protocols, study about their advantages and drawbacks and analyze their performance using network simulator tool NS-2.35. We simulate the hypothetical network to analyze the behavior of different protocols. Based on result obtained, we conclude which protocol gives best result under which parameter. The metrics used in the simulation are throughput, consumed energy, packet delivery ratio(PDR) and end to end delay .

In which we take the mobility speed for the node minimum 10 and maximum 15. Here we compare the result of different parameters with varying number of nodes at constant speeds of nodes.

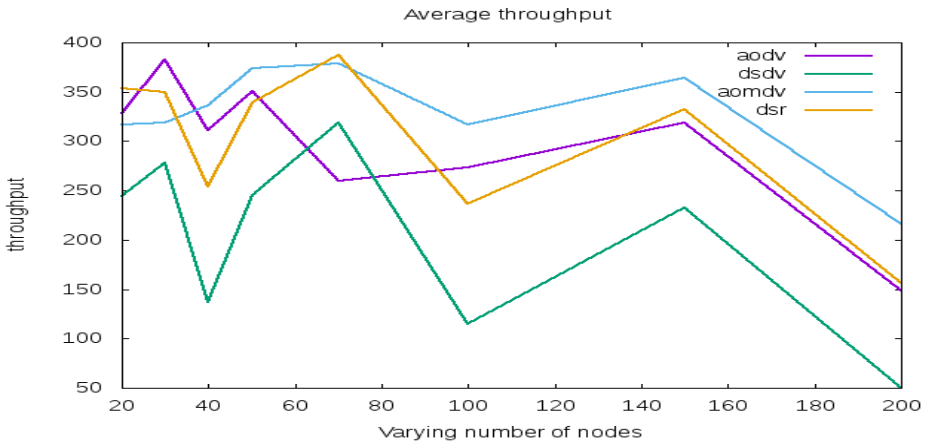

Figure 2: **Throughput**

Throughput is demonstrated in Figure 2 by altering the number of nodes throughout the simulation duration. AOMDV's throughput is superior than that of DSDV, DSR, and AODV in comparison. When there are 200 nodes instead of just 20. In terms of an increase in the number of nodes, AODV performs better than DSR & DSDV. DSDV has an extremely low throughput compared to all other routing protocols.

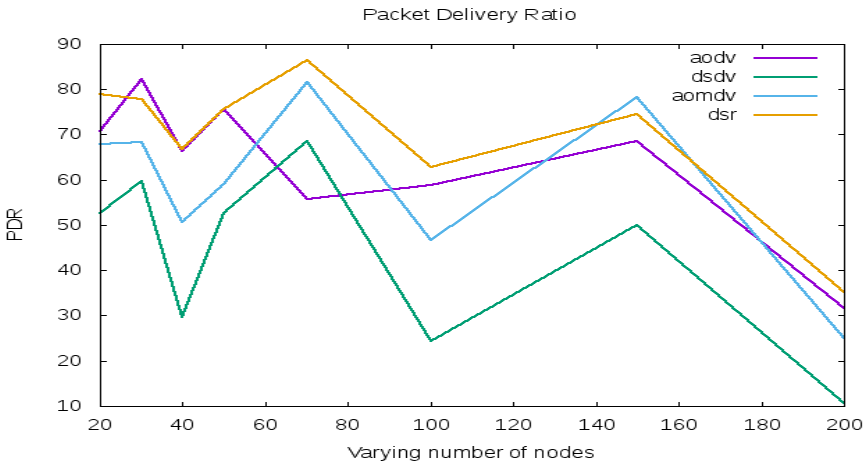

Figure 3: Packet Delivery Ratio

Through simulation, as shown in figure 3, we learned that when the number of nodes increases from 20 to 200, the DSR routing protocol performs better than AODV, AOMDV, and DSDV routing protocols in terms of PDR, while DSDV routing protocol performs the least well when compared to other routing protocols.

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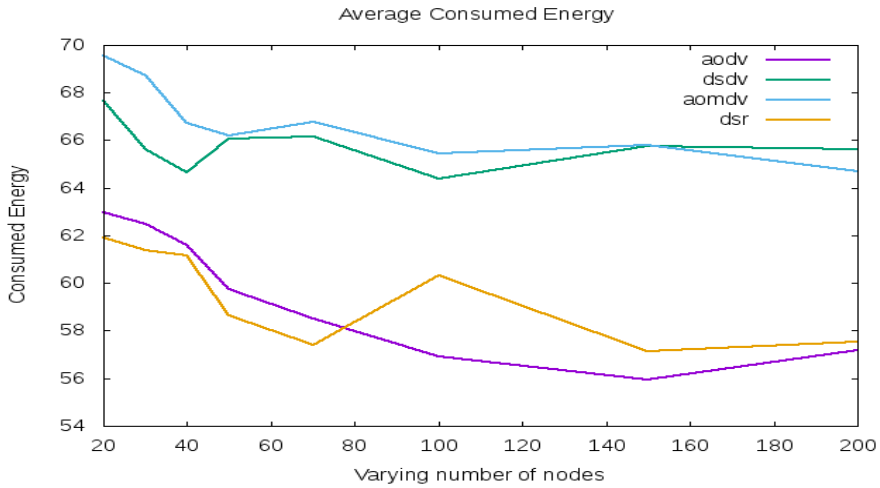

Figure 4: Average Consumed Energy

Figure 4 shows that, in contrast to AODV, DSR, and DSDV routing protocols, which have nodes that range in size from 20 to 200, the AOMDV routing protocol consumes a significantly smaller amount of energy during packet transmission through the network.

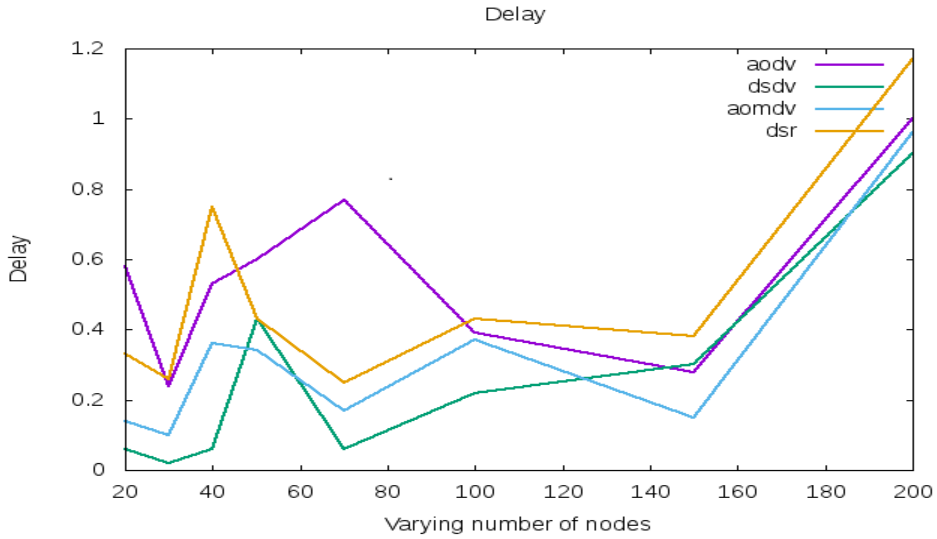

Figure 5: End-to-End delay

According to simulation results, the DSR routing protocol has a very large End-to-End delay, meaning that it takes a lot longer to move data from the sender node to the sink node than other protocols. In terms of End-to-End delay, DSDV routing protocol outperformed AODV, AOMDV, and DSR protocol.

5. Conclusion and Future Scope

This research study gives a brief overview of MANET and routing protocols. Then, based on different performance measures, a thorough examination of the routing protocols is carried out. Throughput, Energy Consumed, End-to-End latency, and PDR are the performance indicators utilised for simulation. The following observations are to be made based on the outcomes of the simulation:

- The performance of AODV is better than DSR and DSDV, and the throughput of AOMDV is better than AODV, AODV, DSR, and DSDV when the number of nodes is increased. In contrast, DSDV has a relatively low throughput compared to all other routing protocols.
- In terms of PDR performance, DSR routing protocol performs the best and DSDV performs the worst when compared to other routing protocols.
- For packet transmission over the network, AODV uses a relatively little amount of energy

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compared to the AOMDV routing system.

- In terms of End-to-End delay, the DSDV routing protocol performs the best..

Future simulations will be run with a variable number of nodes and variable node speeds.

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