Comparison of Routing Protocols with Performance Parameters in MANET Using NS3

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Abstract. A provisional network known as (MANET) Mobile Ad-hoc Network (MANET) that can be set up voluntarily in the event of a disaster to communicate between participants. MANETs are used in various potential applications like communication, search and rescue operations in battlefield, in home and industrial networks, in entertainment, and in sensor networks. Numerous routing protocols of different types are advised for use with mobile ad-hoc networks to get optimal routing performance. Dark side of this technology is that it poses a variety of challenges, including variable topology, resource constraints, and unreliable connectivity. In this paper, significant evaluation analysis has been carried out with four different routing protocols like Ad hoc On Demand Distance Vector Routing protocol (AODV) Dynamic Source Routing protocol (DSR.), Destination Sequenced Distance Vector (DSDV), and Link State Routing Protocol (OLSR). In this study, performance parameter throughput is included and NS3 simulator is used to simulate these routing protocols.

Keywords: MANET · Data transmission · Routing · Throughput · NS3 simulator

1 Introduction

In this particular type of ad-hoc network, the nodes are portable, like mobile phones, laptops, digital devices are used as participants to form infrastructure spontaneously as shown in Fig. 1 [1]. Co-operation of participants is the key of successful communication. So, MANET offers the advantage of rapid infrastructure-free deployment and no centralized management. Main applications of MANETs are in disaster areas, military, war areas, instant business meetings and so on. [2] People and automobiles will appreciate the convenience of the controller. These can be used to work on the internet in regions where there isn't already one. When it comes to communication infrastructure, or when it comes to the use of such, Wireless expansion is required for infrastructure. By enlarging Multi-hop is supported by a wide range of mobile nodes in ad hoc networks.

They can enhance the range of Wi-Fi by using routing networks. The range is determined by the concentration of wireless signals. All MANET nodes act as senders as well as receivers.

The different features of MANET are

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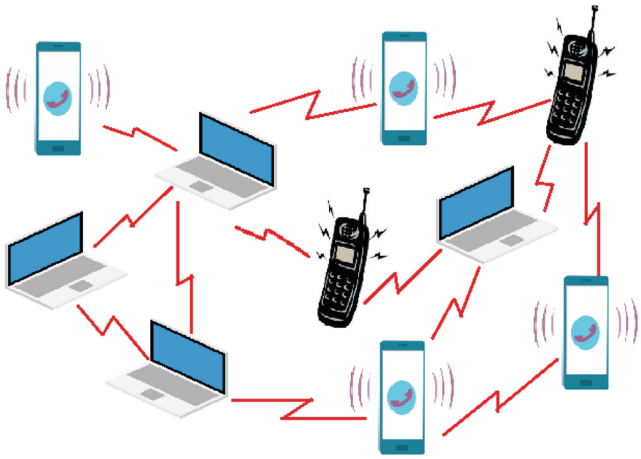

Fig. 1. Infrastructure of MANET

– Infrastructure-less-as there is no centralized authority
– wireless link-frequent breakage occurs
– Frequently disconnected network topologies
– Resource constrained-due to small size, it has limited energy and storage power

The focal goal of the paper is to estimate the performance of proactive and reactive protocols by measuring performance parameter throughput.

There are five sections in this paper; first section presented the introduction followed by a description of MANET and various routing protocols in Literature Review Section. The section three elaborates routing process in MANET. Fourth section describes the simulation followed by a conclusion in the preceding section.

2 Literature Review

In normal conditions, AODV outperforms DSR significantly, while in a limited context, DSR outperforms AODV [8]. The author examined three routing protocols: DSDV, DSR, and AODV, taking into account factors like Path disclosure, network Overhead, Regular Broadcast, Node Overhead, and so on. Author concluded that DSR/AODV performs better than proactive protocol like DSDV [9].

The study [10] compares several routing protocol types, such as proactive, reactive, and hybrid routing protocol. Author concludes that hybrid protocols are better in scalability than other types of protocol. It also reduced bottlenecks and single point of failure problems. In paper [11] the author concluded that for moderate sized network, AODV performs low than DSR protocol.

Reactive routing protocols are employed to reduce control traffic overhead and increase scalability [8].

In [3], using performance measures such as control overhead, Packet Delivery Ratio, latency, and throughput, the effectiveness of reactive and proactive routing systems is

examined by the author. Author concluded that in case of average PDR, DSR protocol is best and OLSR also performs well in case of mobility conditions.

2.1 Routing Protocols in MANET

The core categories of the protocol for the MANET are On-demand and Table driven.

Routes are identified only when they are truly needed with reactive or on-demand routing. So, if node wants to interact with the another node, the response protocols will look up the route on demand and provide a path for packet transmission and reception. A sequence of network-wide request messages is often used for route finding. In table driven routing, every node maintains the path between two nodes indefinitely. As a result, constructing and sustaining routes is accomplished by a combo of periodic routing updates initiated by a distance vector or link status method event [3].

2.2 AODV (Ad Hoc on Demand Distance Vector Routing)

The DSR and DSDV protocols are combined in this routing protocol. Whenever, a node wishes to transmit packets towards its intended recipient, to keep it under control. RREQs are broadcast over the network, and the source node using the ring search approach is being expanded. The forward path establishes itself in intermediary nodes with a lifetime association in its route table RREP is a protocol for recording and replaying events. When a source node moves, a route error (RERR) is communicated to the impacted nodes. A source node could resume the routing procedure after receiving a (RERR). Information about the area is retrieved from a Hello packet broadcast over the network [4].

2.3 DSR (Dynamic Source Routing Protocol)

DSR is supposed to enable on-demand routing, but it does not keep account of frequent topology changes. The process of discovering and maintaining routes results in a rise in bandwidth consumption. These events take place when observed routes become inactive or when the network topology changes. By using effective caching techniques at each node, this cost may be reduced in DSR at the expense of memory and CPU resources. The source route header, which is present in every package, is the last place where bandwidth costs are incurred. DSR requires a lot more routing information because it depends on source routing. Before actual packet transmission, one route must be discovered in the DSR. In interactive applications, this initial search time might degrade performance. Furthermore, the path's quality is unknown until the call is made. Only during path construction can it be identified. All intermediary nodes in a session must keep an eye on the performance of this route.

This increased costs due to latency and additional expenses. DSR has significant scalability issues due to source routing. To reply to routing queries, nodes employ routing caching. As a result, the hosting server experiences uncontrolled feedback and repeated updates. Furthermore, the first requests are unstoppable and spread all the required messages everywhere in the network. Therefore, as the network grows, performance may degrade after a certain period of time [5].

2.4 DSDV (Destination Sequenced Distance Vector)

A well-known proactive or table-driven routing technique for MANET is DSDV [5]. The DSDV routing method's basis is the amount of hops required to reach the target node. The DSDV protocol makes use of routing updates, which is stored in each node, to transmit data packets between entire networks. The DSDV protocol has three primary characteristics: it eliminates high routing cost, solves the "count to infinite" problem, and prevents loops. Each mobile node stores a routing table that holds all the routes to the targets as well as some additional information [5].

2.5 OLSR (Link State Routing Protocol)

OLSR is proactive routing technique that communicates by using multipoint relaying [6]. Optimization techniques in O.L.S.R. can be made in two ways: first, by reducing the volume of control packets and second, by reducing the total of associations used to promote link state messages. As you may know, each node keeps the network's topology knowledge up to date by replacing link state communication with the other nodes on a regular basis. Neighbor sensing, capable flooding, and computing an ideal route using a variety of shortest-path algorithms are the three main strategies that make up the OLSR routing class. Neighbor sensing is the assessment of changes in the node's immediate vicinity. Using this topological knowledge, each node determines the optimum route to every known target and records it in a routing table. The most constructive path is then calculated using the shortest path algorithm. When data broadcasting begins, routes to all destinations are immediately available and remain so for a set length of time until the information is finished [7].

3 Routing in MANET

In a computer network, routing is the process of determining data transmission paths. This method is used to switch topology and connectivity information. Routing method actually computes the pathways and the distance between nodes. Mobile Ad-hoc Networks are multi-hop wireless networks that self-organize and configure themselves. The network's state changes on a regular basis. This is primarily due to the fact that the nodes' mobility. All nodes in these networks leverage multi-hop forwarding by working together over a shared random access wireless channel. The nodes of the network perform both hosting and server responsibilities.

Routers transport data to and from other network nodes. Due to lack of foundation in MANET, a routing mechanism is usually required in wireless networks since a destination node may be out of range of a source node releasing packets, making it difficult to transport the packets between the source and the destination in an efficient manner. In a typical wireless network, a ground station may communicate with every mobile node inside a cell without requiring broadcast routing.

Each node in an ad-hoc network has to be able to interact with the others [9]. In addition to the limitations of dynamic topology, this introduces other issues including unexpected connection changes. Routing is challenging because mobility necessitates frequent changes to the network design and requires a strong and adaptable route-finding and maintenance technique [12, 13].

4 Simulation

In this section, four different routing protocols are simulated specifically AODV, DSR, DSDV, and OLSR in a particular network including mobile nodes. Random waypoint model is used for mobility in the 300 m × 1500 m topology boundary. Node mobility scenarios are created for 25, 50, 75, 100 and 125 Nodes for simulation time of 200 s. Each node begins at the top and traveling from a random starting point to a random destination at a random pace.

As indicated in Table 1, several simulation parameters were employed using the NS3 simulator.

Table 1. Simulation parameters

NS3 parameters	Values
Connection type	UDP
No. of nodes	25/50/75/100/125
The transmit power	7.5 d Bm
Traffic flow	CBR
Node speed	20 m/s
Routing protocols	AODV, DSR, DSDV,OLSR
Pause time	0 s
Mobility model	Random waypoint

The performance metric aids in the identification of networks that are severely impacted by routing algorithms in order to reach the desired level of service (QoS). The following performance metric is taken into account in this study.

The percentage of all data packets arriving at the recipient from the source over the course of a certain period is known as throughput. Throughput is measured in bytes or bits per second (byte/sec or bit/sec).

Table 2. Throughput in percentage for different number of nodes

No of Nodes	OLSR	AODV	DSDV	DSR
25	4.096	6.656	4.096	6.144
50	1.536	7.68	2.048	4.096
75	6.144	13.312	4.096	6.144
100	4.096	7.168	2.048	6.144
125	5.12	3.072	4.096	2.048

Table 2 shows study shows that in a network with a reasonable number of nodes, AODV and DSR perform well.

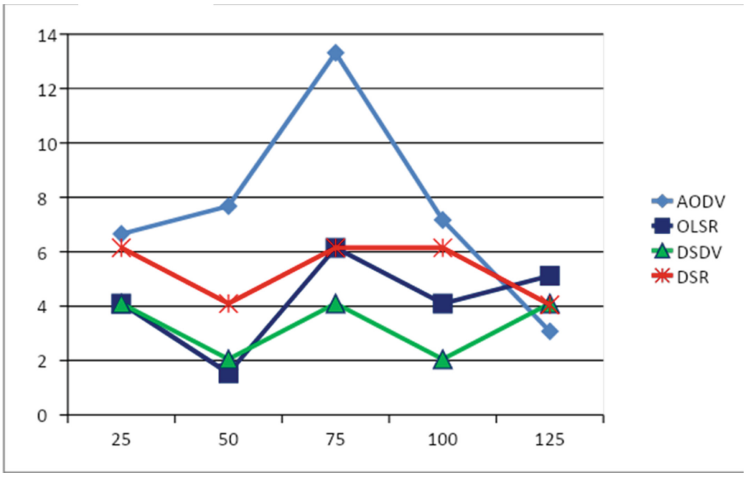

Fig. 2. Throughput vs. number of nodes

Figure 2 indicates that AODV and DSR significantly improved than DSDV and OLSR in simulation for moderate range of nodes. OLSR works well in dense network.

5 Conclusion

In this paper, the proposed work illustrates the performance of reactive routing protocols. The paper demonstrated the simulation of reactive and proactive protocols using NS3 simulation. In this work, we have created scenarios by varying the number of nodes with 0 s pause time. The study shows that throughput varies with different numbers of nodes. When it came to the evaluation metrics throughput, AODV and DSR outperformed other routing protocols such as DSDV and OLSR Even when the network had a moderate number of nodes, AODV and DSR outperformed DSDV. Overall, the study found that in a network with a moderate number of nodes, AODV and DSR perform better as compared to others. In the future, research will extend with different performance parameters.

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