TRANSMISSION POWER AND QUALITY OF SERVICE IN MANET ROUTING PROTOCOLS

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ABSTRACT

Wireless communication is significantly influenced by the Mobile Ad Hoc Network (MANET), which consists of nodes like mobile phones, tablets, computers, or other devices that can connect with one another. MANET is a decentralized network that communicates without using any specified infrastructure. The lack of battery power in this multihop network with no infrastructure is problematic. As a result, proper transmission power utilization must be considered. Transmission power significantly impacts the data dissemination of different routing protocols used in this MANET environment. By taking this issue into account, the performance of routing protocols is examined based on different transmission power settings. The packet delivery ratio (PDR), packet loss (PL), jitter, and Dealy all play a role in determining network service quality. This study investigates how transmission power impacts MANET routing protocols' quality of Service (QoS). The MANET routing protocols investigated in this study include AODV, OLSR, DSDV, and DSR. NS3 is used to create the simulation environment. According to this analysis, AODV outperforms other routing protocols in overall performance.

KEYWORDS

MANET, Routing Protocols, Transmission Power, QoS, PDR, Jitter.

1. INTRODUCTION

Mobile Ad Hoc Network (MANET) is a self-originating network and comprises nodes with autonomous nature. Deployment costs are low, and no special infrastructure is needed for data distribution. Each node can determine paths for data packet dissemination as they can work both as node and router. MANETs are used in a variety of applications, including natural disaster rescue missions, military domains, emergency network formation, event like conferences etc. [1]. Nodes mobility and transmission power are vital factors for data dissemination in MANET. Topology in the case of MANET is not fixed because of nodes' mobility. Sometimes this issue makes data dissemination challenges. As previously said, MANET suffers from node mobility. For successful data dissemination, MANET does not require end to- end connectivity or no predefined communication channel. Moreover, MANET suffers from the scarcity of bandwidth, dynamicity of network topology, insufficient transmission power, security of data dissemination, etc. [2]. Predominantly the nodes in MANET suffer from limited battery power which reduces the longevity and overall performance of the network.

Transmission power during data dissemination should be taken into concern. Proper transmission power and routing protocol management can lead to efficient performance. Reactive, proactive, and hybrid are the three types of MANET routing protocols, with each type employing various processes for route discovery and management [3]. Since nodes in an AdHoc network are mobile, their state is constantly changing. Scalability consequently presents a serious security risk.

Dynamic topology is one of MANET's most significant problems. If certain nodes are revealed to be compromised, the confidence could be destroyed. Using distributed and adaptive security techniques, this dynamic behavior may be more safely protected. MANET nodes have low-capacity data dissemination links. It also makes this Ad Hoc network environment more challenging. MANET has some security difficulties, such as availability (access to services when needed), confidentiality (only authorized staff can access data), integrity (only authorized personnel can modify, delete, and create data), authentication, authorization, and so on. Traditional security measures for wired networks are challenging to apply to wireless networks. MANET has become much more vulnerable to attacks as a result. Nodes in a mobile Ad Hoc network must deal with a limited power supply, which can cause a range of problems. When a node in this network realizes that its power source is limited, it may act selfishly. In the case of data dissemination, proper transmission power utilization should be considered. This may help to strengthen the network's resilience. QoS refers to the employment of techniques or technologies on a network to control traffic and guarantee the performance of critical applications with constrained network capacity. Packet delivery ratio (PDR), Packet loss (PL), jitter, and Delay can be considered as the evaluation metrics of QoS. The performance of multiple MANET reactive and proactive routing protocols is examined on different transmission power levels, and the QoS is also tested in this paper.

2. LITERATURE REVIEW

By modifying the settings, the number of sources, and the transmission power, the authors contrast the functionality of the reactive routing protocols AODV and DSR. The findings demonstrate that, in the case of PDR, AODV outperforms the DSR routing protocol, and that performance increases when mobility diminishes [4]. The authors investigate three reactive routing protocols, AODV, DSR, and TORA, corresponding to transmission power values. They apply transmission power at high mobility. All of the results show that the TORA protocol outperforms the AODV and DSR routing protocols [5]. The authors examine the influence of transmit power on MANET routing protocols using three protocols in the NS3 simulator: AODV, DSDV, and OLSR. This analysis resultant an increase in performance for all protocols with the rise in transmission power [6]. A. Nabou, M. D. Laanaoui, and M. Ouzzif, the effect of transmit power on MANET routing protocols using AODV, DSDV, DSR and OLSR in NS3, vol. 915. Springer International Publishing, 2019.Variable packet size and transmission are used to analyze the performance of the AODV routing protocol. When the transmission power of nodes is high, the throughput is high [7]. [8] Analyze the performance of MANET on the different routing protocols and found DSR and OLSR as the best performers than other routing protocols along with the increase of transmission power.

3. MANET ROUTING PROTOCOLS

Routing protocols govern the data distribution across the network. As was already noted, MANET uses three different types of routing protocols: reactive, proactive, and hybrid. A proactive routing strategy employs a table-driven method, a reactive routing protocol generates a path when data transfer is required, and a hybrid routing protocol combines reactive and proactive routing strategies. The effects of transmission power on reactive and proactive protocols are discussed in this work.

3.1. Reactive Routing Protocols

When the data transfer is required, a routing path is established in the reactive routing approach. The reactive routing protocols AODV and DSR belong to this category. In these two routing protocols, the routing paths are created on-demand.

- Ad-hoc On-demand Distance Vector (AODV): [9] suggested AODV is a reactive routing protocol that includes both unicast and multicast communication, according to [10]. Node information needs to be addressed in the subsequent hop because this protocol does not keep track of the entire route. AODV has two primary mechanisms: route search and route maintenance, according to Corson. et.al [11].The data-sending node will broadcast the RREP packet to neighboring nodes to locate the destination node. As a result, the RREQ package (which includes information such as the sender and destination node addresses, the hop counter, the source and destination sequence numbers, and the broadcast ID [12] is used to start building the destination route. The broadcast ID will rise with each RREQ transmission.
- Dynamic source routing (DSR): DSR [13] allows for minimal loop-free routing and eliminates the necessity for upto- date intermediate node routing information. DSR, like AODV, uses route discovery and maintenance methods for data dissemination, according to Corson.at.el [11]. The routing characteristic established by the origin node, which retains all routing information, is the primary difference between DSR and AODV.

3.2. Proactive Routing Protocols

The data routing route is predefined in a proactive routing strategy, and the routing information is updated regularly. This strategy is also known as a table-driven strategy. Proactive-based routing protocols include DSDV and OLSR.

- Destination Sequenced Distance Vector (DSDV): The DSDV is a distance vector routing protocol that works from hop to hop. [14]. The Bellman-Ford routing algorithm [15] is mainly used for periodically broadcasting routing updates for each node. Each node in the network must inform its neighbors about its routing table entries, according to the DSDV protocol. The advertisement must be sent regularly to guarantee that any new or mobile nodes can discover one other. The routing database includes information about the next hop, the number of hops for each reachable destination, and a sequence number preventing loop formation. [16] [17] [18] [19]. Each node maintains this routing table and shares it to its neighbors at the same time [8] [20].
- Optimized link-state routing protocol (OLSR): OLSR is a proactive routing protocol that regularly exchanges topology information with other nodes. [21]. OLSR employs the concept of multipoint relays. Multipoint relay nodes have chosen nodes responsible for forwarding routing messages during the flooding process. Multipoint relay nodes can reduce the message overhead transmitted in classic flooding systems by reducing redundant retransmissions in the same spot. OLSR uses a hello message and a topology control mechanism for overall forwarding processing.

4. SIMULATION SETUP

The MANET environment is generated by using the NS3 [22] simulator. The impact of transmission power on several MANET routing protocols is investigated in this study. This experiment considers AODV, DSR, DSDV, and OLSR as MANET routing protocols. As previously stated, these routing protocols are classified into respectively reactive and proactive routing methods. The packet delivery ratio (PDR), packet loss (PL), jitter, and Delay are employed as network QOS measuring factors in this study.

- PDR, which is measured in percentages, represents the ratio of the total received data packets to total transmitted data packets. A routing protocol's PDR should be high in order to obtain decent performance.
- The total number of packets lost throughout the network during data dissemination is referred to as packet loss. The number of lost packets is lower with an efficient routing protocol.
- The difference in latency between each data packet received is referred to as jitter. The volatility in packet arrival time should be minimal in a Mobile AdHoc Network to improve performance.
- The average time it takes a data packet to reach its destination is called delay. For overall efficient routing protocol performance, the delay should be reduced.

Many mobility models are utilized to determine MANET node mobility, one of which is the Random waypoint model [23]. This mobility model is being used to detect node mobility in this study. The random waypoint model determines the location, velocity, and acceleration of nodes using a time-varying model. In this mobility model, nodes are randomly distributed throughout the network and wait for a pause time. The node then travels at random to its destination, which is a waypoint. The propagation model estimates the magnitude of received signal power at a given distance from the transmitter [10]. In this simulation environment, the Friis propagation loss model is applied. When there is no barrier between the transmitter and receiver, this model is used to estimate the strength of the received signal. The received power is determined by the transmission power, antenna gain, and the distance between the transmitter and receiver. The received signal power is computed using the equation below [24].

$$P_r(dis)=P_t\ (GtGr\lambda^2)/((4\pi dis)^2L) \qquad (1)$$

Here Pr − The strength of the signal received (Watts).
Pt − The transmitted signal power (Watts).
dis − The distance between the transmitter and receiver (Meters).
λ − The carrier wavelength (meters).
L − Miscellaneous losses.

Table 1. Simulation Setup.

Parameters	**Values**
Network Simulator	NS-3.29
Number of node	50
Simulation Time (s)	200
Speed (ms)	20
Mobility Model	Random Way Point Mobility Model.
Transmission Power (dBm)	3.5,5.5,7.5,10.5.
Propagation Loss Model	Friis propagation Loss Model .
Data Transmission Rate(bps)	2048 .

5. Result and Discussion

This section shows the simulation results for different transmission powers of reactive (AODV, DSR) and proactive (DSDV, OLSR) routing protocols. The primary purpose of this analysis is to assess the effect of transmission power variances. Different transmission powers are used in the MANET environment to conduct the overall performance. Figure 1 depicts the performance of several routing protocols based on transmission power vs PDR parameters. According to the simulation results, the protocols' performance improves as transmission power increases. Throughout the experiment, the AODV protocol performs consistently. As a result, transmission power has no discernible impact on performance. In the case of OLSR, the PDR grows as transmission power increases. The PDR is low at the start of the experiment, but as the transmission power grows, it increases. With a lower transmission power than OLSR, the performance of DSDV improves as well. Overall, AODV outperforms the others when it comes to PDR.

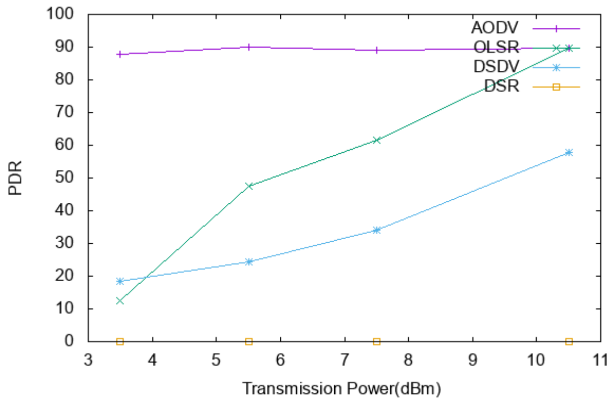

Figure 1. Transmission Power Vs PDR.

Figure 2 shows the performance of different routing protocols based on the metrics of transmission power vs Packet Loss. The total number of packet losses should be lower to achieve efficient performance by a network. The simulation results show that AODV has a lower number of packet losses than other routing protocols. In the case of OLSR, the number of packet losses increases between the transmission power 3 dBm to 5.5 dBm. But it started decreasing at the transmission power 7.5 dBm and then rapidly decreases during the simulation. In the case of DSDV, the number of packet loss is started increasing between the transmission power 3 dBm to 5.5 dBm. But it started decreasing at the transmission power 5.5 dBm and then rapidly decreases during the simulation.

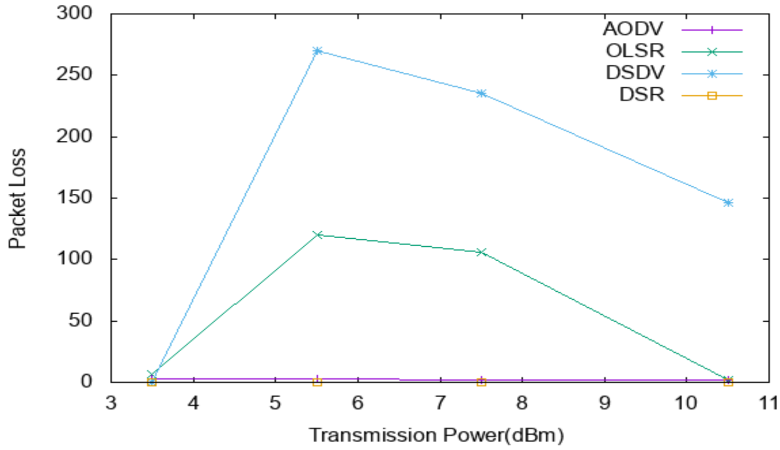

Figure 2. Transmission Power Vs Packet Loss.

Figure 3 shows the performance of different routing protocols based on the metrics of transmission power vs Jitter. AODV has a lower jitter value than other routing protocols. At the beginning of the simulation, the jitter value of OLSR is lower but it started increasing at the transmission power of 5.5 dBm and achieve the highest jitter value at 7.5 dBm and then decreases rapidly. In the case of DSDV, the overall jitter increases with the increasing transmission power.

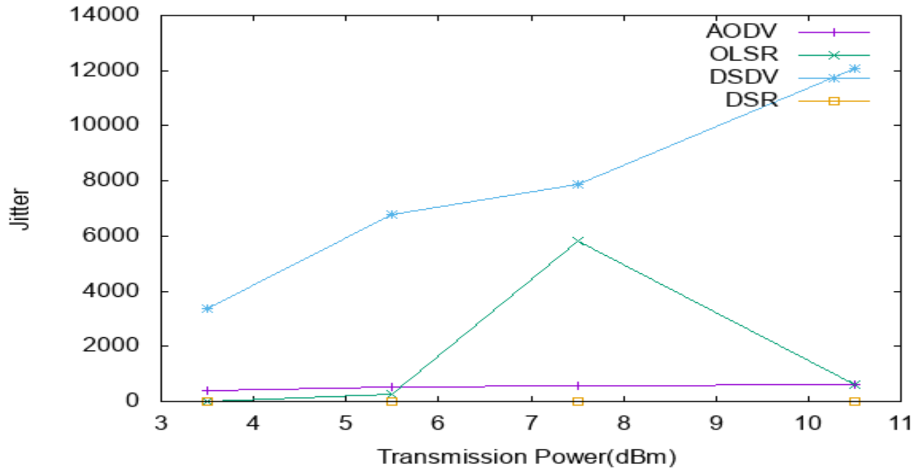

Figure. 3. Transmission Power Vs Jitter.

Figure 4 shows the performance of different routing protocols based on the metrics of transmission power vs delay for AODV the transmission power does not have a significant effect on delay and almost remains the same throughout the simulation. The delay is started to be higher from the transmission power of 3.5 dBm and gets the highest value at 7.5 dBm and then decreases rapidly. On the other hand, for OLSR the delay increases with the increase of transmission power. In this overall simulation scenario, the performance of DSR for these four-performance metrics is almost zero. For routing, DSR uses the source routing approach, which means that all routing data is kept at the nodes which have mobility. In this source routing approach, the sender node determines the node through which the packet must disseminate. DSR can properly work in such a network where nodes have lower mobility. This protocol uses a route maintenance mechanism but this mechanism does not properly rebuild the intermittently connected or broken links. These features may degrade the performance of this routing protocol for this simulation scenario.

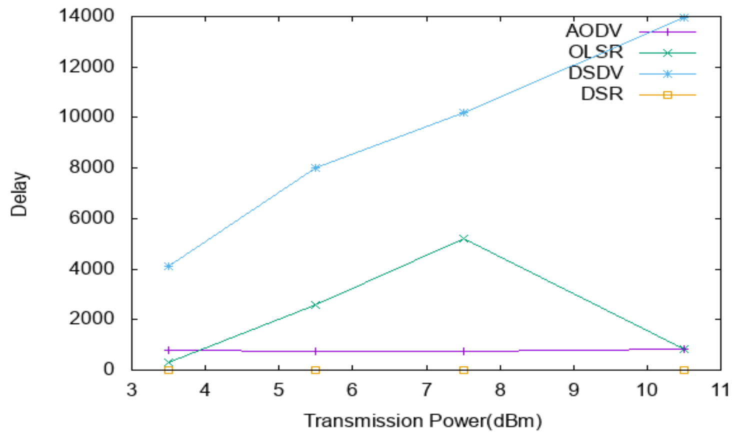

Figure. 4. Transmission Power Vs Delay.

6. CONCLUSIONS

The performance of various MANET routing protocols is examined throughout a wide transmission power range. For this investigation, the transmission power range is 3.5 dBm to 10.5 dBm. Multi-hop routing systems provide acceptable performance only for specified transmission powers. As previously stated, transmission power is a critical issue in MANET because nodes have limited power resources. Transmission power has a substantial impact on the network's overall QoS. PDR, Packet loss (PL), jitter, and delay are all considered while determining QoS. According to the findings, PDR increases as transmission power increases, and AODV outperforms all other routing protocols in consistency and performance. Packet loss, jitter, and Dealy are all lower with AODV. In this study, AODV outperformed other routing protocols in overall performance. The entire investigation also revealed that transmission power has a substantial impact on routing protocol performance and network QoS. As a result, the transmission power of each node should be considered in order to achieve overall high MANET performance.

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