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Performance Evaluation of Demand Driven Routing Protocols (Reactive Protocols Ad-hoc on-demand Distance Vector, Dynamic Source Routing Protocol and Optimized Link State Routing Protocol as A Proactive Protocol)

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ABSTRACT

Many protocols have been developed for handling the problems of wireless networks. Performance evaluation of demand driven routing protocols AODV Ad-hoc On-Demand Distance Vector Routing), DSR (Dynamic Source Routing) and OLSR (Optimized Link State Routing Protocol) are the main concerns of this paper. Previous researches have focused on the applications of the “Ad hoc on-demand Distance Vector” for wireless networks. Main aim behind this paper is to evaluate the recent development in routing protocols and compare the performance of these protocols under various analysis metrics. Applying the performance evaluation metrics, AODV protocol outperformed the OLSR and DSR protocols. This paper looks into original AODV, DSR and OLSR protocols designed for avoidance of delay, throughput, PDR and NLR in wireless networks.

Keywords: *AODV, DSR, OLSR, RERR, RREQ, RREP, AOMDV, Security, Congestion.*

1. INTRODUCTION

Ad-hoc and mobile as wireless networks have serious challenges of limited bandwidth. Multiple hops and nodes mobility create the unreliable channel conditions. These characteristics of wireless networks pose challenging conditions for developments and performance evaluation of the protocols for securing the wireless networks. Standardization and protocol developments cannot completely mitigate the security concerns. Industrial wireless networks also lack the effective protocols for security concerns. This paper aims to discuss the existing demand driven routing protocols AODV and DSR as Source Limited on demand and OLSR as Table driven protocols. It looks defects in the existing routing protocols in the context of reliability and other security concerns.

2. RELATED WORKS

In [1] it was found that multipath routing algorithm separated the network traffic in different paths in order to minimize the delay, congestion, and provide the improved security. Proposed algorithm was intended to focus upon the heterogeneous networks. One of the most important protocols used was the “Ad-Hoc on-demand Distance Vector” protocol. Reactive routing concerned with the AODV used three types of messages as route error (RERR), route request (RREQ) and route reply (RREP).

The Adaptive multi-metric AOMDV [2] as a novel routing scheme was proposed for the ad-hoc wireless networks. This protocol was intended to increase the throughput by exchanging information on hop-to-hop to decrease the latency and also avoid the hotspots’ creation. Their study showed that performance of AM-AOMDV was higher than AOMDV in terms of network security.

Malicious attacks on the wireless networks particular for the ZigBee were studied in the work of [3]. They used the AODVjr protocol for a ZigBee wireless network to enhance the security of the reactive routing protocol. In an earlier work [4] Marina and Das also developed a protocol for ad-hoc

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mobile networks. Protocol (AOMDV) computed the paths in the form of loop-free and link-disjoint. The AODV protocol shares most of the common features for security of wireless networks. AODV protocol discovers the routes before data transmission. Route information in case of AODV is stored in a table. However, this protocol cannot utilize the links, which have asymmetric association between nodes. In current usage of technology, this AODV protocol cannot secure the routing as it has no secure mechanism against the varying routing threats. Periodic propagation for data transmission also causes the network overhead [5]. Zhou et al proposed the NS-AOMDV protocol based on the introduction of node states for improvement in the performance of AOMDV protocol. A path with the largest weight was selected for data transmission. In circumstances of heavy load and dynamic network topology NS-AOMDV shows improvement in throughput, packet delivery rate and overhead [6]. In a recent research work [7] Jambli et al., found that use of the collection tree protocol for Mobile WSNs showed the degradation in performance of networks because of high speed mobile nodes. According to [8] DSDV showed better performance as compared to AODV under the security attacks. In same work of [8], was found that DSDV showed better performance than DSR in streamlining of MPEG4 traffic. Overall performance of these routing protocols varied under different network conditions. Performance of proactive protocol OLSR and reactive protocol AODV was conducted on limited number of metrics. Overall performance of OLSR was found to better than AODV on consideration of all metrics. However, results needed more justification on future studies [9].

3. RESEARCH METHODOLOGY

In the following, a comprehensive scenario of research method is given.

A. Simulation Parameters

Simulation parameters are given in the following table 1.

Table 1: Performance metrics

Parameters	**Value**
Protocols	AODV, OLSR, DSR
Simulator	NS-2.35
Traffic Source	UDP
MAC	802.11
Simulation Area	900 x 900
Nodes number	20, 40, 60, 80, 100

B. Evaluation Method

Performance evaluation of the routing protocol is conducted in two different environments: 1) under attack and 2) without attack. A simulation setup was used, and normal AODV protocol modeled the node behavior as a malicious node or a normal node. In the simulation model, network used the IEEE 802.11 MAC layer as used in many previous studies [10].

Performance metrics as throughput, routing overhead, end to delay, and packet delivery ratio were studied briefly. Efficiency and security of the concerned protocols was also evaluated.

4. ANALYSIS AND DISCUSSION

This section presents the results and comparative analysis of the routing protocols in the context of performance measuring metrics.

A. **Throughput:**

It tells us about the successful transmission of average data packets in terms of bytes per seconds within the runtime.

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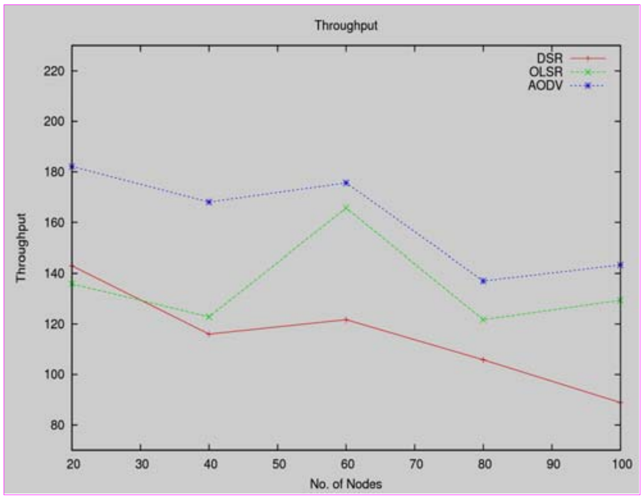

Figure 1: Throughput

Average throughput for three protocols AODV, OLSR and DSR vary greatly as depicted in figure 1. Throughput for AODV is higher than OLSR and OSR at node 40. However, OLSR shows improvement afterward and increases to a peak at node 60 but cannot cross AODV in terms of throughput throughout the simulation. All three protocols show decrease in throughput as network density increases. This makes things worse as network load increases. In high density networks, throughput performance of DSR protocol decreases rapidly from throughput performance of AODV and OLSR. AODV achieves its saturation point earlier than OLSR.

B. **Routing Overhead**

NRL represents the average ratio of total data packets received at the receiver end and total routing control data packets transmitted in bytes [10].

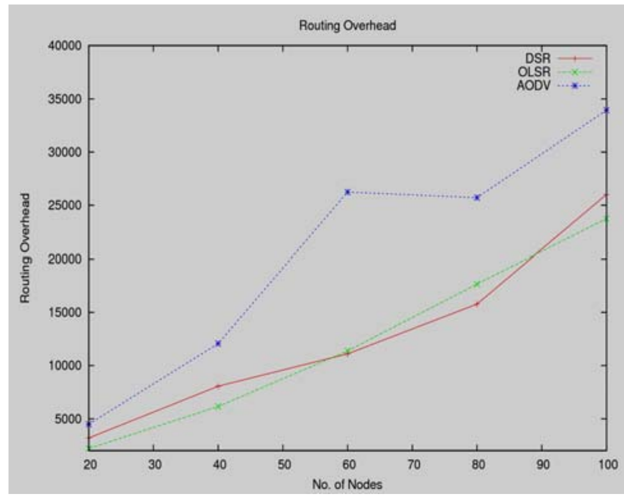

Figure 2: Routing overhead

In figure 2, we can see the routing overhead of protocols AODV, OLSR and DSR. Results show that routing overhead of AODV is more than OLSR and DSR protocols. On then other hands, OLSR and DSR show comparatively equal performance in some extent, but overall performance of OLSR is best of all three protocols. Reason of reduced routing overhead is the restriction of route search in the given area. Routing overhead reduction results into saving of resources as well as bandwidth.

C. **End to End Delay**

It is the average time in seconds that data packets take across the network from sender node to a destination node. The average time also includes the possible delays in the form of queuing, buffering, propagation, retransmission and transfer times.

End to end delay parameter gives the routing speed of the concerned routing protocols AODV, OLSR and DSR. In case of large end to end delay, protocols are less efficient as congestion in network also increases. Results show that DSR protocol has higher end to end delay as compared to other two protocols. Both AODV and DSR have same value of

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end to end delay at node 80, but OLSR is efficient than other two protocols as shown in figure 3.

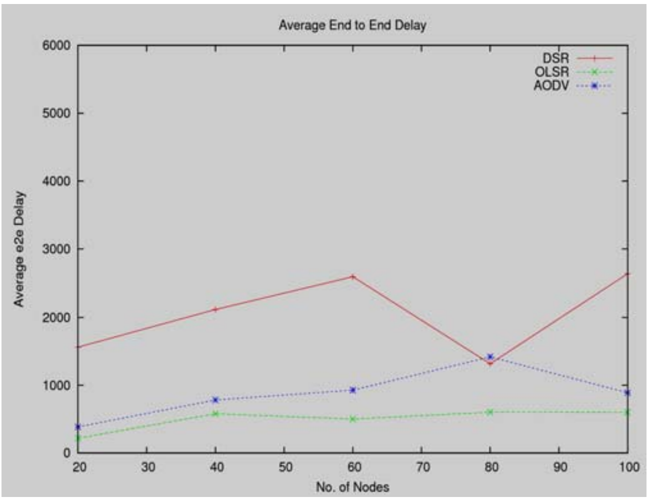

Figure 3: End to End Delay

D. **Packet delivery ratio**

Average ratio between the total data packets received and total number of data packets sent from source is known as packet delivery ration. It is determined as given the following.

$$\text{Packet Delivery Ration (PDR)} = \frac{\sum \textit{Number of data packets received}}{\sum \textit{Number of data packets sent}}$$

By splitting the single path into multiple paths, the usage of bandwidth from the source to destination is effectively done. Limited utilization of bandwidth results into a reduced number of packet losses during the transmission [1].

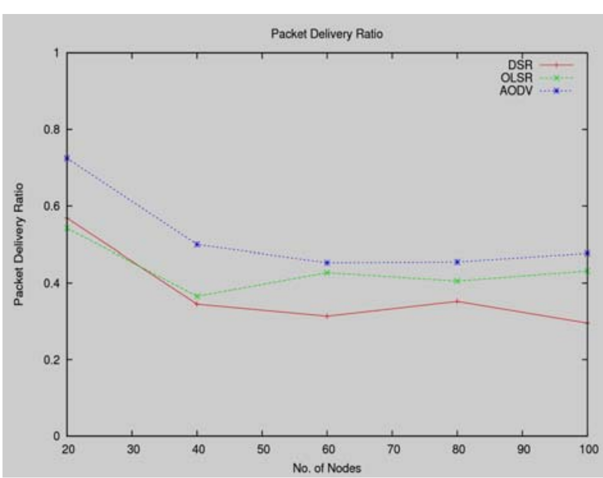

Figure 4: Packet Delivery Ratio

In simulation work, packet delivery ratio in the AODV is greater than its two competing protocols OLSR and DSR. When nodes limit is low (less than 20) in the network, DSR protocol is efficient than OLSR but increasing with network size the DSR shows low performance in PDR. From this figure 4, we can see that at node 20 both OLSR and DSR are almost equal in their respective PDRs but lower than AODV.

5. CONCLUSION AND FUTURE WORK

This paper presented performance evaluation of the routing protocols AODV, OLSR and DSR. Existing literature on routing protocols showed the further improvements in the existing protocols or development of a new protocol for securing the wireless networks. Performance evaluation of AODV, OLSR and DSR protocols was based on four performance measuring metrics.

Finally, from behavior of routing protocols, and result graphs, AODV is more efficient than other two protocols in our simulation results. At the end, we have come to conclusion that performance of routing protocols vary with the selection of protocols and networks. In future works, a hybrid protocol can be developed that shows best performance in all performance measuring metrics i.e. end to end delay, throughput, routing overhead and PDR.

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