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# Performance Evaluation of Wormhole Attack In AODV

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**ABSTRACT**
The Mobile Ad hoc Networks (MANETs) is a collection of wireless nodes which interact with each other by sending packets to one another or on behalf of another node, without any central network infrastructure to control data routing. For communication, the nodes cooperatively forward data packets to other nodes in network by using the routing protocol. But, these routing protocols are not secure, thus paving the way for the MANET to be open to malicious attacks. A malicious attack which is commonly observed in MANET environment is wormhole attack. The objective of this work is to analyze the performance parameters of throughput, delay and packet loss in AODV with the existence of wormhole attack. Simulation results have shown that the performance parameters are affected very much when there is an attack due to wormholes.
***Keywords*** **-** Wormhole, MANET, AODV etc

## I. INTRODUCTION

Advancement of mobile device technology has led to a huge use of wireless network. Thus, ever-present communicating capability and information access are granted to mobile users. Mobile Ad-hoc Networks (MANET) is a collection of mobile nodes enabling users to communicate without any physical infrastructure regardless of their geographical location. A MANET has a dynamic, continuously changing network topology due to mobility of nodes. It is more vulnerable to attacks due to the mobile nature of nodes, threats due to compromised nodes and absence of centralized management.

MANETs can be broadly classified as table-driven/proactive or on-demand/reactive. Table driven protocols exchange routing information periodically, thus they are called proactive protocols.Hence, routes are created prior to their being required, but this results in increase in overhead. Reactive protocols create routes only when connection is required to be established. Adhoc On Demand Distance Vector (AODV) is an example of reactive protocol for MANETs.

In this paper we analyze the throughput, delay and packet loss parameters of AODV protocol in a MANET in the presence of wormhole attack. Simulation results are used to obtain the impact of wormhole attack on AODV protocol in a MANET.

## II. MANETs SECURITY ISSUES

MANET is quite more vulnerable than the wired networks to attacks due to the following major issues:

### ii.i De-centralized management

MANET does not have any centralized management control. Since management control is not available in MANET, the detection of attacks is difficult because it is not easy to monitor the traffic in a highly dynamic and large adhoc network. Trust management for nodes is broken due to lack of centralized management.

### ii.ii Unavailability of Resources

Resource availability is another issue in MANETs. Obtaining secure communication in such a dynamic environment as well as protection against specific threats and attacks has kindled development of a number of security schemes and architectures.

### ii.iii Ever-changing topology

In MANETs, nodes can join and leave the network dynamically and can move independently. This nature of nodes leads to an ever-changing topology in MANETs. Moreover, nodes do not remain static. The trust relationship that exists among nodes could be disturbed by the above factors.

The trust may also be impeded if some nodes are found to be compromised. This dynamic behaviour can be better protected with distributed and adaptive security mechanisms.

### ii.iv Lack of scalability

Due to mobility of nodes, the ad-hoc network scale can change and may not remain constant always. Thus, scalability becomes a major concern concerning security. The employed mechanism of

security must be capable of handling large as well as small networks equally well.

### ii.v Limited Power Supply

The nodes in mobile ad-hoc network do not have access to unlimited power supply. Also, a node may behave in a selfish manner when it observes that power supply is restricted.

### ii.vi Lack of Cooperation

MANET Routing algorithms usually assume that all the nodes are cooperative and contribute actively for secure communication. But, in practice, some nodes become malicious nodes. As a result, they easily become important routing agents and disrupt secure network operation by refusing to comply with all the routing protocol specifications.

## III. WORKING PRINCIPLE

### iii.i Adhoc On Demand Distance Vector (AODV) Routing Protocol

Adhoc On Demand Distance Vector (AODV) protocol, designed for a mobile ad hoc network, is a very efficient, simple and effective reactive routing protocol. In AODV, paths are found only when required. AODV discovers and maintains a route between source and destination nodes only when the two need to communicate or when the former node is offering its services as an intermediate forwarding station to maintain connectivity between two other nodes. AODV employs the following control message types:

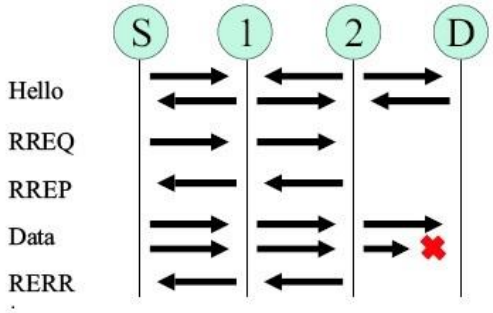


Fig. 1. AODV Message types

When a data packet is to be sent by a source node S to a destination node D and node S does not have a route to node D, the route discovery process begins by broadcasting a route request (RREQ) to its neighbors. The immediate neighbors on receiving this RREQ rebroadcast the same RREQ to their neighbors. Forwarding of this RREQ is carried out until the destination node or until an intermediate node with a "fresh enough" route to the destination is located. As soon as the first arrived RREQ is received, the destination node or a node with a route to the destination sends a route reply (RREP) to the source node through the reverse path where the RREQ arrived. If the destination node obtains the same RREQ later, it will be ignored. AODV also permits intermediate nodes having sufficiently fresh routes (with destination sequence number equal or greater than the one in the RREQ) to generate and send an RREP to the source node.In case if a node realizes that the route is damaged or broken it transmits a route error (RERR) message to the source and destination nodes separately.

AODV assumes that all the nodes in the network are trusted nodes. However, this is not true all the time. Some node may take the posture of a malicious node and may break trust by indulging in various types of attacks, thus adversely affecting AODV performance characteristics. Few type of attacks could be used to compromise AODV but in this paper the focus is only on Wormhole and Sybil attack.

### iii.ii Wormhole Attack

The attacks can be categorized based upon the source of the attacks as Internal or External, and as Passive or Active attack depending on the behavior of the attack. A pair of nodes that are linked together in some way is employed by an attacker for wormhole attack. An attacker may tunnel a request packet directly to the destination node without increasing the hop-count value. Two colluding nodes that are not close to each other are linked by a high speed tunnel thus giving an illusion of being neighbors. Each of these nodes receive route request and topology control messages from the network and send it to the other colluding node through the newly created tunnel which will then replay it into the network. By using this tunnel, these nodes are able to advertise that they have the shortest path through them and that the RREQ packet through them reaches the destination faster compared to usual path. AODV routing protocol is susceptible to be affected by wormhole attack. Wormhole could be classified as in- band or out-band, and self-sufficient or extended wormhole.

## IV. EXPERIMENTAL SETUP

We have taken 60 nodes and the traffic model taken is CBR (constant Bit Rate). We have taken two wormhole nodes. The simulation parameters used in this paper are listed in table given below:

TABLE 1. SIMULATION PARAMETERS

| Parameter | Value |
|---|---|
| Simulator | Ns-2(ver.2.35) |
| Number of Nodes | 60 |
| Simulation time | 30 seconds |
| Traffic Type | Constant Bit Rate |
| Packet Size | 512 |
| Routing Protocol | AODV |

## V. RESULTS

### v.i Packet Delivery Ratio

It is the ratio of number of packets at destination node to the number of packets sent by source node. Figure2 illustrates network PDR of AODV with 60 nodes. In the figure, the x-axis denotes time in seconds and the y-axis PDR. Packet delivery ratio is lower in case of wormhole attack as shown in figure below:

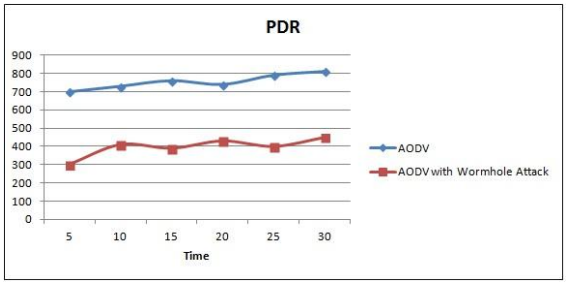


Fig. 2. PDR Vs. time

### v.ii Throughput

The network throughput gives the fraction of the channel capacity used for useful transmission of data. It is measured in bits per second. Figure 3 illustrates network throughput of AODV with 60 nodes. In the figure, the x-axis denotes time in seconds and the y-axis throughput. Throughput is lower in case of wormhole attack as shown in figure below:

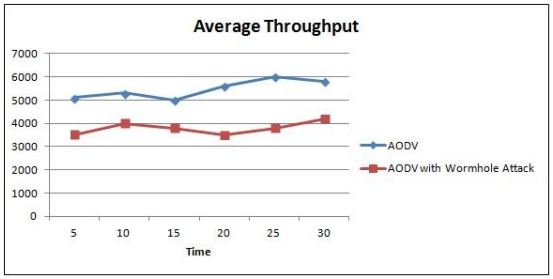


Fig. 3. Throughput Vs. time

### v.iii End to End Delay

This parameter indicates the average time taken for a data packet to reach destination. It is measured in seconds. Figure 7 illustrates delay of AODV with 60 nodes. In the figure, the x-axis denotes time in seconds and the y-axis end-to-end-delay. The End-to-End-delay is higher in case of wormhole attack as shown in figure below:

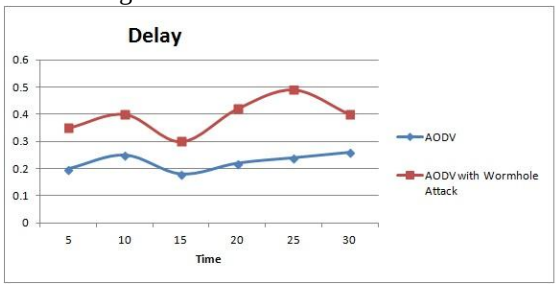


Fig. 4. Delay Vs. time

## VI. CONCLUSION

The performance of an on- demand routing protocol i.e. AODV (Ad hoc on demand distance vector routing) is evaluated with and without wormhole attack. Three parameters of performance i.e packet delivery ratio, throughput, and average end to end delay have been considered. Results show that AODV performance gets badly affected by the wormhole attack.

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