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A SCHEME TO DETECT INTRUSION IN MOBILE AD HOC NETWORKS

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ABSTRACT

Mobile Ad Hoc Network (MANET) is collection of multi-hop wireless mobile nodes that communicate with each other without centralized control or established infrastructure. The attacker can attack the path or route established very easily as security measures are very less in case of mobile adhoc networks. In this paper two types of attacks has been introduced. One changes number of hops that are used to reach destination and other tried to create denial of service. The algorithm proposed has been implemented on AODV and results are simulated on NS2.

KEYWORDS
MANET, DSR, DSDV, AODV, routing, security, intrusion.

1.0 INTRODUCTION
The wireless network can be classified into two types: Infrastructured or Infrastructure less. In Infrastructured wireless networks, the mobile node can move while communicating, the base stations are fixed and as the node goes out of the range of a base station, it gets into the range of another base station. The figure 1, given below, depicts the Infrastructured wireless network.

In Infrastructureless or Ad Hoc wireless network, the mobile node can move while communicating, there are no fixed base stations and all the nodes in the network act as routers. The mobile nodes in the Ad Hoc network dynamically establish routing among themselves to form their own network 'on the fly'.

A Mobile Ad Hoc Network (MANET) is a collection of wireless mobile nodes forming a temporary/short-lived network without any fixed infrastructure where all nodes are free to move about arbitrarily and where all the nodes configure themselves. In MANET, each node acts both as a router and as a host & even the topology of network may also change rapidly.

2.0 ROUTING PROTOCOLS
A routing protocol is needed whenever a packet needs to be transmitted to a destination via number of nodes and numerous routing protocols have been proposed for such kind of ad hoc networks. These protocols find a route for packet delivery and deliver the packet to the correct destination. The studies on various aspects of routing protocols have been an active area of research for many years. Many protocols have been suggested keeping applications and type of network in view. Basically, routing protocols can be broadly classified into two types as (a) Table Driven Protocols or Proactive Protocols and (b) On-Demand Protocols or Reactive Protocols

Table Driven or Proactive Protocols: In Table Driven routing protocols each node maintains one or more tables containing routing information to every other node in the network. All nodes keep on updating these tables to maintain latest view of the network. Some of the existing table driven or proactive protocols are: DSDV [6, 19], DBF [7], GSR [24], WRP [23] and ZRP [28, 13].

On Demand or Reactive Protocols: In these protocols, routes are created as and when required. When a transmission occurs from source to destination, it invokes the route discovery procedure. The route remains valid till destination is achieved or until the route is no longer needed. Some of the existing on demand routing protocols are: DSR [8, 9], AODV [4, 5] and TORA [26, 27].

2.1 ADOV (AD HOC ON DEMAND DISTANCE VECTOR) [4, 5]
AODV is a variation of Destination-Sequenced Distance-Vector (DSDV) routing protocol, which is collectively based on DSDV and DSR. It aims to minimize the requirement of system-wide broadcasts to its extreme. It does not maintain routes from every node to every other node in the network rather they are discovered as and when needed & are maintained only as long as they are required.

The key steps of algorithm used by AODV for establishment of unicast routes are explained below.

ROUTE DISCOVERY

When a node wants to send a data packet to a destination node, the entries in route table are checked to ensure whether there is a current route to that destination node or not. If it is there, the data packet is forwarded to the appropriate next hop toward the destination. If it is not there, the route discovery process is initiated. AODV initiates a route discovery process using Route Request (RREQ) and Route Reply (RREP). The source node will create a RREQ packet containing its IP address, its current sequence number, the destination's IP address, the destination's last sequence number and broadcast ID. The broadcast ID is incremented each time the source node initiates RREQ. Basically, the sequence numbers are used to determine the timeliness of each data packet and the broadcast ID & the IP address together form a unique identifier for RREQ so as to uniquely identify each request. The requests are sent using RREQ message and the information in connection with creation of a route is sent back in RREP message. The source node broadcasts the RREQ packet to its neighbours and then sets a timer to wait for a reply. To process the RREQ, the node sets up a reverse route entry for the source node in its route table. This helps to know how to forward a RREP to the source. Basically a lifetime is associated with the reverse route entry and if this entry is not used within this lifetime, the route information is deleted. If the RREQ is lost during transmission, the source node is allowed to broadcast again using route discovery mechanism.

EXPANDING RING SEARCH TECHNIQUE

The source node broadcasts the RREQ packet to its neighbours, which in turn forwards the same to their neighbours and so forth. Especially, in case of large network, there is a need to control network-wide broadcasts of RREQ and to control the same; the source node uses an expanding ring search technique. In this technique, the source node sets the Time to Live (TTL) value of the RREQ to an initial start value. If there is no reply within the discovery period, the next RREQ is broadcasted with a TTL value increased by an increment value. The process of incrementing TTL value continues until a threshold value is reached, after which the RREQ is broadcasted across the entire network.

SETTING UP OF FORWARD PATH

When the destination node or an intermediate node with a route to the destination receives the RREQ, it creates the RREP and unicast the same towards the source node using the node from which it received the RREQ as the next hop. When RREP is routed back along the reverse path and received by an intermediate node, it sets up a forward path entry to the destination in its routing table. When the RREP reaches the source node, it means a route from source to the destination has been established and the source node can begin the data transmission.

ROUTE MAINTENANCE

A route discovered between a source node and destination node is maintained as long as needed by the source node. Since there is movement of nodes in mobile ad hoc network and if the source node moves during an active session, it can reinitiate route discovery mechanism to establish a new route to destination.

Conversely, if the destination node or some intermediate node moves, the node upstream of the break initiates Route Error (RERR) message to the affected active upstream neighbors/nodes. Consequently, these nodes propagate the RERR to their predecessor nodes. This process continues until the source node is reached.

When RERR is received by the source node, it can either stop sending the data or reinitiate the route discovery mechanism by sending a new RREQ message if the route is still required.

Benefits and Limitations of AODV

The benefits of AODV protocol are that it favors the least congested route instead of the shortest route and it also supports both unicast and multicast packet transmissions even for nodes in constant movement. It also responds very quickly to the topological changes that affects the active routes. AODV does not put any additional overheads on data packets as it does not make use of source routing.

The limitation of AODV protocol is that it expects/requires that the nodes in the broadcast medium can detect each others' broadcasts. It is also possible that a valid route is expired and the determination of a reasonable expiry time is difficult. The reason behind this is that the nodes are mobile and their sending rates may differ widely and can change dynamically from node to node. In addition, as the size of network grows, various performance metrics begin decreasing. AODV is vulnerable to various kinds of attacks as it based on the assumption that all nodes must cooperate and without their cooperation no route can be established.

3.0 PROPOSED SCHEME

The present proposal is to enhance the performance of existing system with the incorporation of SRR. With this if the nodes behave maliciously during route reply phase, say, by giving a wrong hop count, such nodes will be flagged off from the network and salvaging route reply packet commences immediately. Changes are made in REQEST Phase and REPLY phase of the protocol.

The implementation of NEW Scheme is based on two algorithms. Algorithm 1- Route Request and Algorithm 2 involves RREP packets, is modified for SRR implementation. Each node in order to participate in any network activity, says Route Request RREQ, has to announce it's token. as described in algorithm 1. If status bit is "1" indicating "red flag" protocol does not allow the node to participate in any network activity.

Algorithm 1: While sending a RREQ packet

1: **for** each umpire RREQ packet (P) sent do
2: **if** each node status is green flag then
3: broadcast RREQ
4: prevhop ← currenthop [node address]
5: repeat step 2 until it reaches the destination node
6: **else**
7: drop RREQ packet (P) sent
8: **endif**
9: **endfor**

In the self-umpiring system, all the nodes have dual roles – packet forwarding and umpiring. In the forward path during data forwarding, each node monitors the performance of immediate next node. That way, node A can tell correctly whether B is forwarding the packet sent by it, by promiscuously hearing B's transmissions. Similarly during reply process RREP as given in algorithm 2, C can verify whether B is unicasting the route reply RREP and whether the hop count given by B is correct. Thus during forward path A is the umpire for B and C is the umpire for B during reverse path operations.

Algorithm 2: While sending an Umpire RREP packet

1: **for** each umpire RREP packet (P) sent do
2: **if** node status is green flag then
3: unicast RREP to previous node
4: nexthop □□ prevhop [node address]
5: repeat step 2 until it reaches the source node
6: **if** currenthopcount is equal to nexthopcount then
7: process this RREP as specified in the standard protocol
8: **else**
9: ***save current RREP message in the buffer***
10: it broadcast MERR packet to 1-hop or 2-hop node distance
11: nextnode status is marked as red flag
12: ***currentnode is the source node and the source node becomes a destination node, thus, start MRREQ procedure***
13: ***Process this MRREQ and MRREP as specified in the standard protocol***
14: ***it reaches the MRREP to the currentnode***
15: ***retrieve previous saved RREP message from the buffer***
16: send RREP message in newly identified path to the source node
17: **end if**
18: **endif**
19: **endfor**

4.0 PERFORMANCE METRICS

There are number of qualitative and quantitative metrics that can be used to compare reactive routing protocols. Most of the existing routing protocols ensure the qualitative metrics. For this paper packet delivery ratio has been used.

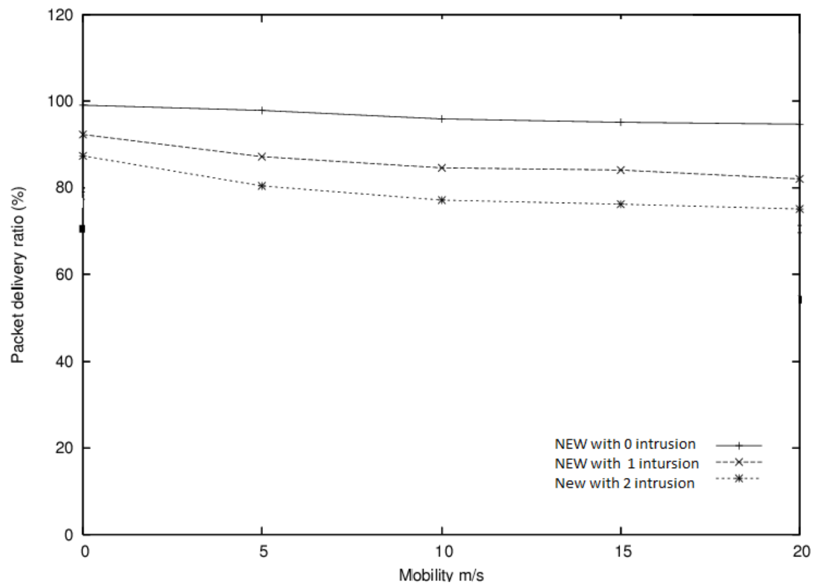
Here in this present paper only the attack of modification of hop count by the malicious nodes. Each flow did not change its source and destination for the lifetime of a simulation run. For all our studies the simulation time has been kept as 900s.

Simulation Time	900 seconds
Propagation model	Two-ray Ground Reflection
Transmission range	250 m
Bandwidth	2 Mbps
Movement model	Random way point
Maximum speed	0 – 20 m/s
Pause time	0 seconds
Traffic type	CBR (UDP)
Payload size	512 bytes
Number of flows	10 / 20

Table 1 Parameter Settings

Packet Delivery Ratio: The ratio between the amount of incoming data packets and actually received data packets.

CHART 1



Clearly there is some loss in PDR with intruders, but still algorithm is able to repair the scheme as early as possible. Most important is that the attack cannot produce Denial of service. Performance can be evaluated based on end to end delay and throughput as well.

5.0 CONCLUSION

In this research paper, an effort has been made to generate a new scheme that has been proposed as an algorithm to introduce a flag system for malicious cases. The implementation has been done on NS2 and all efforts have been made to make it biasless. The ultimate goal for adhoc network security is to develop a multifold security solution that results in in-depth protection that offers multiple lines of defense against both known and unknown security threats. The results are with the theory proposed. The results clearly indicate some fall in packer delivery and then recovery is done at the earliest possible. More results will be calculated using different scenarios and more metrics will be made into effect like delay, throughput, jitters etc.

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