Analysis and Detection of Black Hole Attack in MANET

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Abstract: An Ad hoc network is the network with no fixed infrastructure. There is no central administrator so any node can come and move in and outside of the network in a dynamic manner. This makes it more dynamic and complex which makes it more prone to attacks. They can attack either active or passive. Some effects of malicious nodes are Denial of service, Routing table overflow, Impersonation, Energy consumption, Information disclosure etc. A black hole attack node attracts all packets by falsely claiming a fresh route to the destination node and absorbs them without forwarding them to destination. In this paper a mechanism based on FUZZY LOGIC is proposed to detect the black hole attack in MANET with AODV protocol. An introduction of black hole in MANET with NS2 (2.35) is done, after applying the detection technique result reflects the performance. This paper is intended for audience having prior knowledge about network routing protocols and its related quantitative performance metrics.

Keywords: Ad hoc Network, Black hole Attack, AODV, NS2.35, Detection Technique

1. Introduction

Ad hoc network has no predefined structure and no any fixed topology. All nodes can move freely in network. There is no any centralized control to control transmission and movement of nodes. All the nodes in network participate in network management task, Hence network management is done in distributed manner. Each node in the network works both as router and host. As all nodes are movable so this changes topology of the network dynamically, that brings more challenges in security of Ad hoc network.

2. Black Hole Attack

A black hole node that attracts all the packets by falsely claiming that it has valid route to destination node. [8] It disturbs the routing protocol by deceiving other nodes about the routing information. A black hole node works in the following scheme: once receiving RREQ messages, the attacker replies RREP messages directly and claims that it is the destination node or had valid route to destination node. Under these circumstances, the source node sends data packets to the black hole instead of the destination node. When the source node transmits data packets through the black hole, the attacker discards them without sending back a RERR message.

3. AODV (Ad hoc On-Demand Distance Vector)

AODV is reactive protocol Routing information is collected only when it is needed, and route determination depends on sending route queries throughout the network. When a route to a new destination is needed, the node broadcasts a RREQ to find a route to the destination. Each node receiving the request caches a route back to the originator of the request, so that the RREP can be unicast from the destination along a path to that originator. A route can be determined when the RREQ reaches a node that offers reach ability to the destination (e.g., the destination itself).

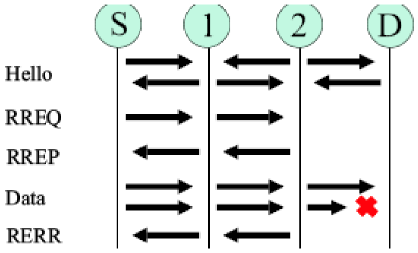


Figure 1: AODV Protocol Messaging

The route is made available by unicasting a RREP back to the origination of the RREQ. For nodes monitoring the link status of next hops for active routes, when a link break in an active route is detected, the broken link is invalidated and a RERR message is typically transmitted to notify other nodes that the loss of that link has occurred. The RERR message indicates the destination that is no longer reachable by way of the broken link.

4. Related Works

Shafinaz Buruhanudeen, Mohamed Othman, Mazliza Othman, Borhanuddin Mohd Ali [1] discuss about the existing MANET Routing Protocols in paper author highlight the important routing matrices required in evaluating the performance of the protocol in terms of reliability and efficiency. In paper they discuss some of the factor which affects the routing algorithm like such as variable wireless link quality, propagation path loss, fading; multi-user interference, power expended and topological changes become important issues.

Jiwen CAI,Ping YI,Ye TIAN, Yongkai ZOHU, Ning LIU [8] has proposed & simulated some of the attacks for DSR protocol using NS2.

Ioannis Broustis Gentian Jakllari Thomas Repantis Mart Molle[2] discuss the performance of routing protocols for large scale mobile ad hoc network larger throughput lower end to end delay fewer lost data packet. They perform the simulation on DSR, TORA, AODV, LAR in the paper discuss result derived from extended simulation and compare the efficiency of the above four protocols using NS-2 and Qualnet.

Satoshi Kurosawa, Hidehisa Nakayama [3] has been analyzed the blackhole attack which is one of the possible attacks in ad hoc networks. In a blackhole attack, a malicious node impersonates a destination node by sending a spoofed route reply packet to a source node that initiates a route discovery. By doing this, the malicious node can deprive the traffic from the source node. In order to prevent this kind of attack, it is crucial to detect the abnormality occurs during the attack. After analysis he proposed an anomaly detection scheme using dynamic training method in which the training data is updated at regular time intervals.

Md. Anisur Rahman, Md. Shohidul Islam [4] compared the performance of two prominent on-demand reactive routing protocols for mobile ad hoc networks: DSR and AODV, along with the traditional proactive DSDV protocol. A simulation model with MAC and physical layer models have been used to study interlayer interactions and their performance implications. The On-demand protocols, AODV and DSR perform better than the table-driven DSDV protocol.

Lidong Zhou [5] studied the threats an ad hoc network faces and the security goals to be achieved. After that he identified the new challenges and opportunities posed by this new networking environment and explore new approaches to secure its communication.

Rajan Shankaran, Vijay Varadharajan, Michael Hitchens [6] presented a scheme for providing security services for routing of control messages in an ad-hoc network. Our focus is on on-demand routing protocols for ad-hoc networks, specifically the Dynamic Source Routing Protocol.

5. Proposed Work &Methodology

In this paper an implementation of black hole in wireless network is presented and the analysis is performed using AODV protocol with fuzzy logic detection system. The performance metric is based on different fuzzy parameters 1)Packet lost 2)Last packet time 3) Bitrate 4)Packet loss rate5)Packet delay. After analysis of result effect of black hole attack in network is observed and also analyzed how detection technique helps to detect them..X-Graphs are generated for different parameters and comparison is done between existing and proposed work. All simulation has been performed withNS2.35 simulator.

5. Simulation Environment

In this paper work all the simulation work is performed in network simulator version 2.35. The movement proceeds for a specific amount of time or distance, and the process is repeated a predetermined number of times. We choose Min speed = 10 m/s, Max speed = 50m/s, and pause time = 10s to 50s. All the simulation work was carried out using TCP variants with AODV routing protocol .Network traffic is provided by using TCP.

Wireless network which we have used have following values for different parameter:

Mobility model Random Way Point
Minimum speed 0 mps
Maximum speed 10 mps, 20 mps, 30mps, 40 mps, and 50 mps
Pause time 10s, 20s, 30s, 40s, 50s.
Simulation Time 200s
Terrain
Coordination 800*800 m
Connection
TCP: 41 (client) to 1 (server)
Item size 512(byte)
Radio/physical layer parameters:
Radio type: 802.11b Radio
Data rate: 2Mbps
Packet reception model: Bit error rate (bpsk.ber)
MAC Protocol: 802.11
Routing Protocol: AODV
Transport Protocol: TCP
Node: 50
Node Placement: Random

6. Detection Technique

The proposed work is about the prevention of blackhole attack. The proposed system is based on fuzzy based parametric analysis while performing the next node selection. The fuzzy parameters taken here are the loss rate, transmission rate and the network delay. The fuzzification on these all parameters is performed to identify the critical node as well as the safe node. On each node, the fuzzy rule is implemented to identify the safe path. The process is repeated on each node till the destination is not achieved. The system is providing better throughput and less packet loss over the network. The system is implemented in a wireless network with AODV protocol. In this system a neighbor node analysis is performed under different parameters to provide the network security in case of blackhole attack.

6.1Algorithm for Detection of Blackhole Attack

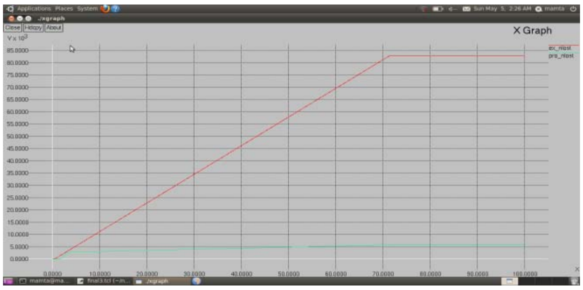
```
/* S is the source node and D represents the Destination Node over the network*/
{
1. As transmission begins it will search for all the
   intermediate nodes and send data on to it.
2. The intermediate node failed forwarding the probe
   message to the next node;
3. It will check the RESPONSE time for the intermediate
   node

If (Response Time> HopTime +Threshold)
 {
```

The Attacker Node is detected.

Update Neighbor Node Table & Routing Table for the Intermediate Nodes
}
4) The unresponsive node is incapable of responding to the probe message.
5) The diagnosis algorithm will then be called to decide which one is the case.
}

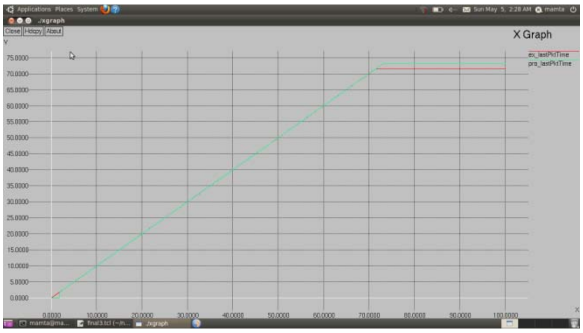
7. Result Analysis after Applying Detection Algorithm

7.1Analysis of Packet Lost



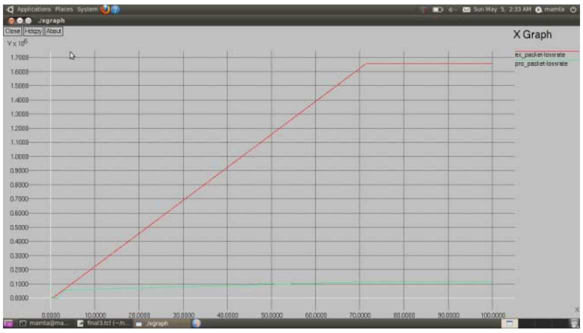
The figure is showing the comparison graph to represent the number of packets lost over the network. Here X Axis represents the simulation time and the y axis represents the number of packets lost in the network. In case of proposed network, the fuzzy logic is implemented. The results shows that the presented work gives the packet lost initially, but as the algorithmic approach is implemented and the route reconfiguration is done, after that no more data lost is there

7.2Analysis of Last Packet Time



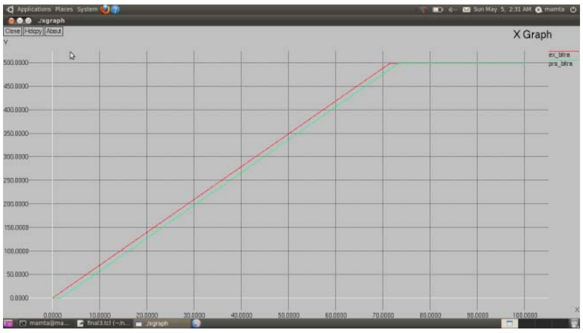
The figure is showing the graph to represent the analysis on last packet time over the network. Here X Axis represents the simulation time and the y axis represents the last packet time. The results here shows that the in both kind of network the communication is performed on same rate but the difference is in terms of packet forwarding and rerouting of the network.

7.3Analysis of Packet Loss Rate



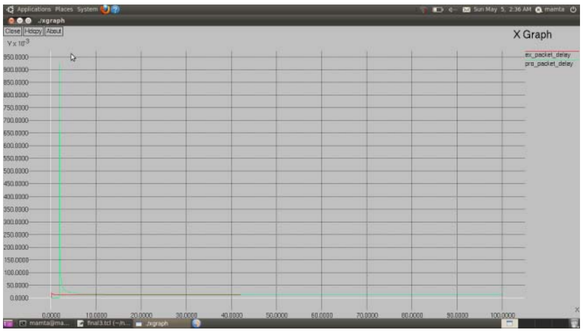
The figure is showing the comparison graph to represent the number of packets lost over the network. Here X Axis represents the simulation time and the y axis represents the loss rate in the network. The results show that the presented work gives the packet loss initially, but as the algorithmic approach is implemented and the route reconfiguration is done, after that no more data lost is there.

7.4Analysis of Bit rate



The figure is showing the graph to represent the bit rate over the network. Here X axis represents the simulation time and the y axis represents the bit rate of data transmission.

7.5Analysis of Packet Delay



The figure is showing the comparison graph to represent the number of packets delay over the network in Existing and Proposed Approach. Here X Axis represents the simulation time and the y axis represents the number of packets delay in the network. The results shows that the packet delay in proposed work is reduced

8. Conclusions

This paper presents a fuzzy based detection analysis with black hole attack by using AODV routing protocol in different scenario. This analysis is performed in wireless ad hoc network. After completion of all simulation results were analyzed in X-graph. The system is providing better throughput and less packet loss over the network. Hence detection is supported.

9. Future Work

The proposed system can be enhanced in future by other researchers in the following ways. We have performed the work only with black hole attack; the work can be enhanced by implementing some other attack such as worm hole, DOS etc. We have presented the work with a clustered approach in a wireless network. The work can be implemented on some specific network such as PAN, WiMax etc.

References

[1] Danny Dhillon," Implementation & Evaluation of an ID to Safeguard OLSR Integrity in MANETs", IWCMC'06, July 3–6, 2006, Vancouver, British Columbia, Canada. ACM 1-59593-306-9/06/0007

[2] Ahmed Khurshid," VeriFlow: Verifying Network-Wide Invariants in Real Time", HotSDN'12, August 13, 2012, Helsinki, Finland. ACM 978-1-4503-1477-0/12/08

[3] Evan Cooke," Toward Understanding Distributed Blackhole Placement", WORM'04, October 29, 2004, Washington, DC, USA. ACM 1-58113-970-5/04/0010

[4] Umair Sadiq," CRISP: Collusion–Resistant Incentive–Compatible Routing and Forwarding in Opportunistic Networks", MSWiM'12, October 21–25, 2012, Paphos, Cyprus. ACM 978-1-4503-1628-6/12/10

[5] Mauro Conti," A Randomized, Efficient, and Distributed Protocol for the Detection of Node Replication Attacks in Wireless Sensor Networks", MobiHoc'07, September 9-14, 2007, Montréal, Québec, Canada. ACM 978-1-59593-684-4/07/0009

[6] Garima Gupta," Reference based approach to Mitigate Blackhole Attacks in Delay Tolerant Networks", Q2SWinet'12, October 24–25, 2012, Paphos, Cyprus. ACM 978-1-4503-1619-4/12/10

[7] Abhijit Das," Energy Aware Topology Security Scheme for Mobile Ad Hoc Network", ICCCS'11, February 12–14, 2011, Rourkela, Odisha, India. ACM 978-1-4503-0464-1/11/02

[8] Peter J. J. McNerney," A 2-Dimensional Approach to QoS Provisioning in Adversarial Mobile Ad Hoc Network Environments", MSWiM'12, October 21–25, 2012, Paphos, Cyprus. ACM 978-1-4503-1628-6/12/10

[9] Kevin A. Li," PeopleTones: A System for the Detection and Notification of Buddy Proximity on Mobile Phones", MobiSys'08, June 17-20, 2008, Breckenridge, Colorado, USA. ACM 978-1-60558-139-2/08/06

[10] M.Shobana," GEOGRAPHIC ROUTING USED IN MANET FOR BLACK HOLE DETECTION", CCSEIT-12, October 26-28, 2012, Coimbatore [Tamil nadu, India]

[11] ACM 978-1-4503-1310-0/12/10