



How to Increase Per-Session Throughput in Distress Hours if Grey Hole attack Is In-Avertible

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Abstract: A Mobile ad hoc network (MANET) is a decentralized type of wireless network. Perhaps the most widespread notion of a mobile ad-hoc network is a network formed without any central administration which consists of mobile nodes that use a wireless interface to send packet data. Since the nodes in a network of this kind can serve as routers and hosts, they can forward packets on behalf of other nodes and run user applications. The network is called ad-hoc because it does not rely on any existing infrastructure, such as routers in wired networks or access points in wireless networks. In addition to the classic routing, ad hoc networks can use flooding for forwarding data. In this paper, we explore the effect on per session throughput of an ad-hoc network consisting of fixed and mobile non-malicious-nodes, by mobile and fixed malicious nodes called grey hole. To simulate grey attack, 5, 10 and 14 malicious nodes were created for different scenarios. The simulation consists of 50 fixed/mobile non-malicious and 5, 10, 14 malicious nodes. All the simulations are made in same environment.

Key Terms - Ad-hoc network, Grey hole, AODV, per-session throughput.

I. INTRODUCTION

In today's world, Wireless Networks are getting more and more popular and are better and convenient alternative to wired networks. In today's life, we will find wireless networks everywhere e.g. at college campuses, at homes, airports offices, or at business places or even at libraries. The development of wireless networks offers a flexible, low cost solution for monitoring critical infrastructure [1,2,3]. The biggest concern with wireless network has been security. Security methods are designed in order to avoid unauthorized access to system assets and information. Though total security of total wireless network is doubtful. However, We can attempt to identify these Intrusion endeavors. This field of research is known as Intrusion detection. The main purpose of intruder is to hack the important information in the network, like using the bandwidth of node or increasing the delay time in providing the services over the network under consideration..

It includes:

1. Military Battle field
2. Sensor Networks
3. Medical Service.
4. Personal Area Network.

Security solutions are important issues for MANET, especially for those selecting sensitive applications, and have to meet the following design goals while addressing the above challenges. MANET is more vulnerable than wired network due to mobile nodes, threats from compromised nodes inside the network, limited physical security, dynamic topology, scalability and lack of centralized management. The primary focus of this work is to explore on the attacks particularly grey attack and wormhole attack that affect the fixed and mobile ad-hoc network's throughput performance due to mobile and fixed malicious nodes. We consider here mobile malicious nodes attacking on fixed adhoc network, and fixed malicious nodes attacking on mobile adhoc network.

MANETs have special limitation and properties such as limited bandwidth and power, highly dynamic topology, high error rates etc., as explained in [4]. Moreover, compared to infrastructure based networks, in a MANET, all nodes are mobile and can be connected dynamically in an arbitrary manner. Nodes of MANET behave as router and take part in discovery and maintenance to establish a reliable route of each other. Therefore, routing protocols for wired networks cannot be directly used in wireless networks and numerous protocols have been developed for MANETs. These routing protocols are divided into two categories based on management of routing tables. These categories are Table Driven Routing Protocols and On-Demand Routing Protocols, shown in the Table 1 and they are explained below.

Table 1: categories of routing protocols

MANET ROUTING PROTOCOLS	
Table Driven Routing Protocols	On Demand Routing Protocols
DSDV	AODV

WRP	CBRP
GSR	DSRP
FSR	TORA
HSR	ABR
ZHLS	SSR
CGSR	

In Table Driven Routing Protocols, each node has to keep up-to-date routing tables. To maintain reliable routing tables, every node propagates the update messages to the network when the network topology changes. Because every node has information about network topology, Table Driven Routing Protocols present several problems.

1. Periodically updating the network topology increases bandwidth overhead,
2. Periodically updating route tables keeps the nodes awake and quickly exhaust their batteries,

Many redundant route entries to the specific destination needlessly take place in the routing tables. Destination-Sequenced Distance Vector Routing Protocol (DSDV), Wireless Routing Protocol (WRP), Global State Routing (GSR), Fisheye State Routing (FSR), Hierarchical State Routing (HSR), Zone-based Hierarchical Link State Routing Protocol (ZHLS) and Clusterhead Gateway Switch Routing Protocol (CGSR) are Table Driven Routing Protocols[10].

II. ON-DEMAND ROUTING PROTOCOLS

These protocols take a lazy approach to routing [5] compared to Table Driven Routing Protocols. On-Demand Routing Protocols are not maintained periodically, route tables are created when required. When the source node wants to connect to the destination node, it propagates the route request packet to its neighbors. Just as neighbors of the source node receive the broadcasted request packet, they forward the packet to their neighbors and this action is happen until the destination is found.

Afterward, the destination node sends a replay packet to the source node in the shortest path. The route remains in the route tables of the nodes through shortest path until the route is no longer needed [10].

Cluster based Routing Protocols (CBRP), Ad-Hoc On-Demand Distance Vector Routing (AODV), Dynamic Source Routing Protocol (DSRP), Temporally Ordered Routing Algorithm (TORA), Associatively Based Routing (ABR), Signal Stability Routing (SSR) are On-Demand Routing protocols.

Since MANETs are networks with no fixed infrastructure and network functions are carried out by all available nodes, which are mobile and have constrained power resources. Consequently MANETs have increased sensitivity to node misbehavior in mobile ad hoc networks [11]. The first is external attackers, in which unauthenticated nodes can replay old routing information or inject false routing information to partition the network or increase the network load. The second type of attack is internal attack which comes from compromised nodes inside the network. Internal attacks are generally much harder to detect as compared to external attacks.

Various types of attacks that can usually be seen are as follows:

A. Passive Eavesdropping

An attacker can listen to any wireless network to know what is going on in the network. It first listens to control messages to infer the network topology to understand how nodes are located or are communicating with another. Therefore, it can gather intelligent information about the network before attacking. It may also listen to the information that is transmitted using encryption although it should be confidential belonging to upper layer applications.

B. Selective Existence (Selfish Nodes)

This malicious node which is also known as *selfish node* and which is not participating in the network operations, use the network for its advantage to enhance performance and save its own resources such as power. To achieve that, selfish node puts forth its existence whenever personal cost is involved. Therefore these selfish node behaviors are known as *selective existence attacks*. [7]. For instance, selfish nodes do not even send any HELLO messages and drop all packets even if they are sent to itself, as long as it does not start the transmission. When a selfish node wants to start a connection with another node, it performs a route discovery and then sends necessary packets. When the node no longer needs to use the network, it returns to the “silent mode” After a while, neighboring nodes invalidate their own route entries to this node and selfish node becomes invisible on the network

C. Gray Hole Attack (Routing Misbehavior)

Gray hole attack is an active attack type, which lead to dropping of messages. Attacking node first agrees to forward packets and then fails to do so. Initially the node behaves correctly and replays true RREP messages to nodes that initiate RREQ message.

Afterwards, the node just drops the packets to launch a (DoS) denial of service attack. If neighboring nodes that try to send packets over attacking nodes lose the connection to destination they may want to discover a route again, broadcasting RREQ messages. Attacking node establishes a route, sending RREP messages. This process goes on until malicious node succeeds in its purpose.

D. Black Hole Attack

The difference of Black Hole Attack compared to Gray Hole Attack is that malicious nodes never send true control messages initially. To carry out a black hole attack, malicious node waits for neighboring nodes to send RREQ messages. When the malicious node receives an RREQ message, without checking its routing table, immediately sends a false RREP message giving a route to destination through itself, assigning a high sequence number to settle in the routing table of the victim node, before other nodes send a true one. Therefore requesting nodes assume that route discovery process is completed and ignore other RREP messages and begin to send packets through the malicious node. Malicious node attacks all RREQ messages from other source nodes also and takes over all routes. Therefore all packets are sent to a point when they are not forwarded anywhere.

E. Impersonation

Due to lack of authentication in ad-hoc networks, only MAC or IP addresses uniquely identify hosts. These addresses are not adequate to authenticate the sender node. Therefore non-repudiation is not provided for ad-hoc network protocols. MAC and IP spoofing are the simplest methods to pretend as another node or hide in the network. Malicious nodes achieve impersonation only by changing the source IP address in the control message. Another reason for impersonation is to persuade nodes to change their routing tables pretending to be a friendly node, such as attacks against routing table.

F. Attacks against the Routing Tables

Every node has its own routing table to find other nodes easily in the network. At the same time, this routing table draws the network topology for each node for a period (max. 3 seconds, duration of ACTIVE_ROUTE_TIMEOUT is constant in AODV protocol). If a malicious node attacks against this table, attacked nodes do not find any route to other nodes that it wants to connect. This attack is always performed by fabricating a new control message. Therefore it is also named fabricating attack. There are many attacks against routing tables. Each one is done by fabricating false control messages.

G. Sleep Deprivation Torture Attack (Battery Exhaustion)

Many techniques are used to maximize the battery life and mobile nodes prefer to stay at the sleep mode, when they are not used. Sleep Deprivation Torture is one of the serious types of Denial of Service Attacks, which affects only nodes, especially handheld devices that have limited resources. In a period time, attacker can propagate some control messages through the network, in which other nodes are also affected. Other nodes pass to the operation mode from the sleep mode and start processing these unnecessary packets until their batteries completely run out [6].

H. Worm hole attack

The wormhole attack [6] is quite severe, and consists in recording traffic from one region of the network and replaying it in a different region. It is carried out by an intruder node *X* located within transmission range of legitimate nodes *A* and *B*, *A* and *B* are not themselves within transmission range of each other. Intruder node *X* merely tunnels control traffic between *A* and *B* (and vice versa), without the modification presumed by the routing protocol – e.g. without stating its address as the source in the packets header – so that *X* is virtually invisible.

III. IMPLEMENTING ATTACK SCENARIOS ON AODV ROUTING PROTOCOLS

For the simulations, we use ns-2 (v-2.32) network simulator. ns-2 provides faithful implementations of the different network protocols. At the physical and data link layer, we used the IEEE 802.11 algorithm. The channel used is Wireless Channel. At the network layer, we use AODV as the routing algorithm. Finally, UDP is used at the transport layer. All the data packets are CBR (continuous bit rate) packets. The size of the packet is 512 bytes. The packets transmission rate is 2 Mbps and then 3 Mbps. The connection pattern is generated using *cbrgen* and the mobility model is generated using *setdest utility*. *Setdest* generates random positions of the nodes in the network with specified mobility and pause time. The terrain area is 800m X 800m with 50 numbers of nodes with chosen maximum speed up to 10 m/s. The simulation parameters are summarized in table 2. Each data point represents an average of 100 runs. The same connection pattern and mobility model is used in simulations to maintain the uniformity across the protocols. The various simulation scenarios are as follows:

Table 2: simulation scenario 1

Parameter	Value
Simulator	NS 2.32
Simulation time	80 Sec
Number of nodes & mobility	50, Mobile
Routing protocol	AODV
Traffic model	CBR
Data Rate	2 Mbps & 3 Mbps
Mobility	10 m/s

Terrain area	800m x 800m
Transmission range	45 m
No. of malicious nodes & type	0

Table 3: simulation scenario 2

Parameter	Value
Simulator	NS 2.32
Simulation time	80 Sec
Number of nodes & mobility	50 , fixed
Routing protocol	AODV
Traffic model	CBR
Data Rate	2 Mbps & 3 Mbps
Mobility	10 m/s
Terrain area	800m x 800m
Transmission range	45 m
No. of malicious nodes & type	0

Table 4: simulation scenario 3

Parameter	Value
Simulator	NS 2.32
Simulation time	80 Sec
Number of nodes & mobility	50 , fixed
Routing protocol	AODV
Traffic model	CBR
Data Rate	2 Mbps & 3 Mbps
Mobility	10 m/s
Terrain area	800m x 800m
Transmission range	45 m
No. of malicious nodes, type & mobility	5, 10 & 14 mobile Grey hole

Table 5: simulation scenario 5

Parameter	Value
Simulator	NS 2.32
Simulation time	80 Sec
Number of nodes & mobility	50 , moving
Routing protocol	AODV
Traffic model	CBR
Data Rate	2 Mbps & 3 Mbps
Mobility	10 m/s
Terrain area	800m x 800m
Transmission range	50 m
No. of malicious nodes, type & mobility	5, 10 & 14 fixed Grey hole

IV. RESULTS AND DISCUSSIONS

The average per session throughput values for different simulation times, and for different simulation scenarios such as all the nodes are moving except the malicious ones at the data rate of 2 Mbps and 3Mbps , all the nodes are fixed except the malicious ones at the data rate of 2 Mbps and 3 mbps, are obtained for 100 simulation runs. Similarly, we also have simulated for all node moving ie. both malicious and non-malicious nodes moving as well as all nodes fixed. We have shown below plots of average per session throughput, average over 100 simulation runs, in Figs. 1 for scenarios without malicious nodes and DR 2 Mbps. This is done in order to show that with the introduction of malicious nodes in the network, throughput falls as shown in Figs. 3 to 6. For finding out the average per session throughput, simulations were run 100 times for each scenario. The plots for DR 3 Mbps are similar and skipped due to lack of space.

Table 7: per-session throughput for various scenarios

Malicious Nodes & their mobility	Non-Malicious Nodes & their mobility	Data Rate (DR)(Mbps)	Av. Per session throughput (Bps)
0	50, mobile	2	4.35e+07
0	50, fixed	2	3.56 e+07
5, Gh, fixed	50, fixed	2	9.42 e+06
10, Gh, fixed	50, fixed	2	8.60 e+06
14, Gh, fixed	50, fixed	2	7.73 e+06
5, Gh, mobile	50, fixed	2	3.02 e+07
10, Gh, mobile	50, fixed	2	2.93 e+07
14, Gh, mobile	50, fixed	2	2.49 e+07
5, Gh, fixed	50, mobile	2	4.06 e+07
10, Gh, fixed	50, mobile	2	3.70 e+07
14, Gh, fixed	50, mobile	2	3.14 e+07
5, Gh, Mobile	50, mobile	2	3.47 e+07
10, Gh, Mobile	50, mobile	2	3.26 e+07
14, Gh, Mobile	50, mobile	2	3.07 e+07

From Table 7, it is seen that average per session throughput is higher when non-malicious nodes are moving and malicious nodes are fixed, for grey attacks. The corresponding histogram for average per-session throughput plot over 100 simulation run is shown in Figs. 7 to 11. We plot the histogram to identify the different attack patterns and hence a signature for each pattern. The attack patterns that we observe are different for grey hole attack from that of black hole attack and worm hole attack[14]. And the plots vary over the number of malicious nodes but patterns remain alike. The histograms shown in the figures are self-explanatory and clearly showing the signature of each attack type. Histogram plots for both data rate 3 Mbps are being skipped here.

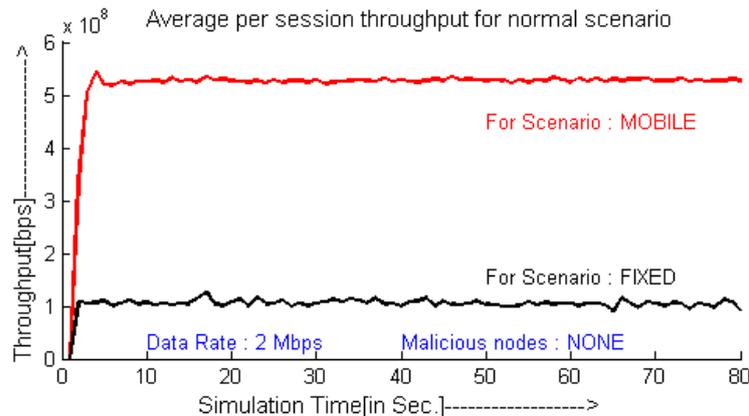


Figure 1. Average Per Session Throughput for All Nodes Moving Data rate (DR) 2 Mbps, Average over 100 simulation runs

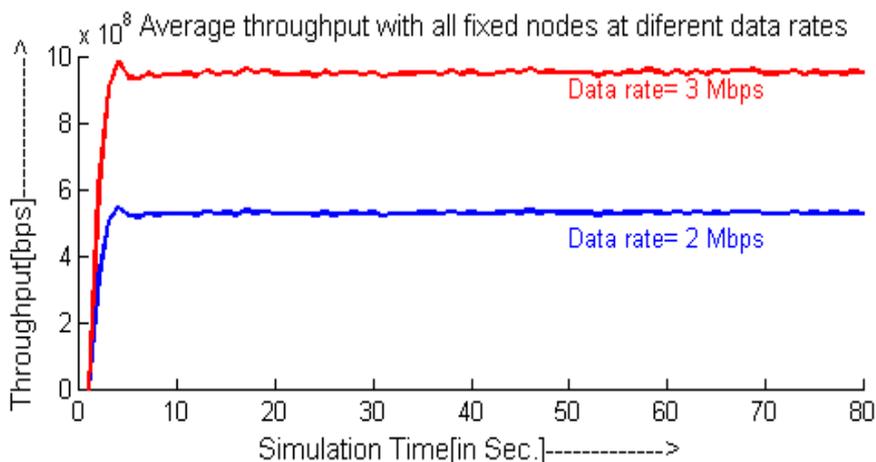


Figure 2 Average per session throughput with all fixed nodes at different data rates Average over 100 simulation runs

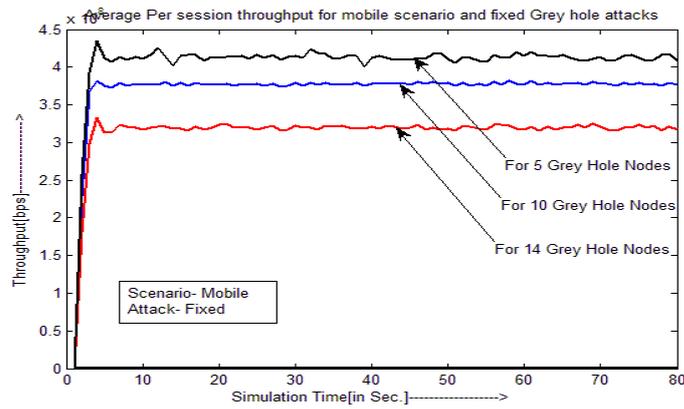


Figure 3 Average per session throughput with fixed 5,10& 14 fixed Greyhole nodes in Mobilescenario.DR 2 Mbps, Average over 100 simulation runs

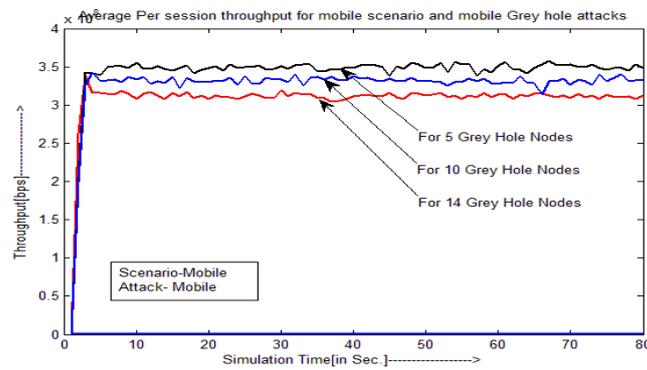


Figure 4Average per session throughput with mobile 5,10& 14 Greyhole nodes in mobile scenario. DR 2 Mbps, Average over 100 simulation runs

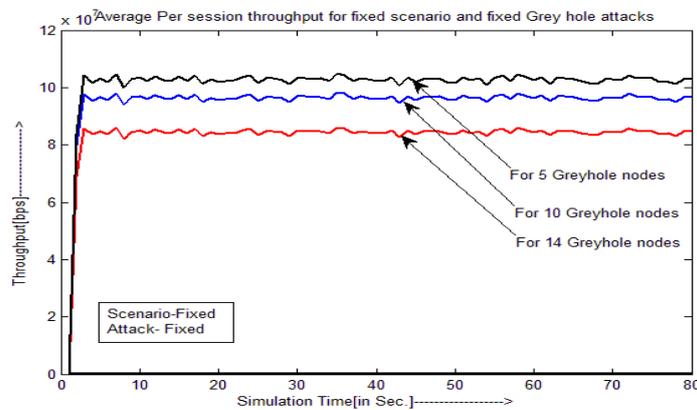


Figure 5Average per session throughput with fixed 5,10& 14 Greyhole nodes in fixed scenario. DR 2 Mbps, Average over 100 simulation runs

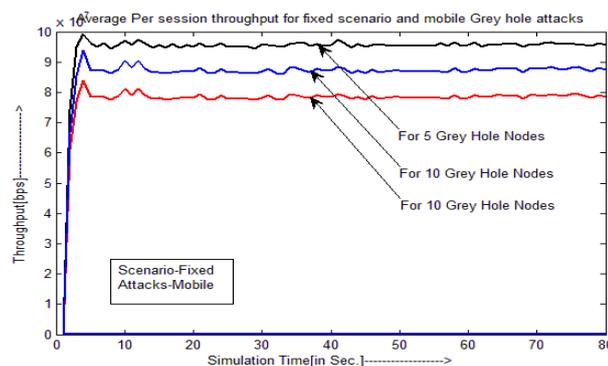


Figure 6Average per session throughput with mobile 5,10& 14 Mobile Greyhole nodes in fixed scenario.DR 2 Mbps, Average over 100 simulation runs

After doing careful study of the graphs above, we find that for a given fixed number of non-malicious nodes and malicious nodes, the per session throughput, for a scenario of non-malicious nodes being mobile and malicious nodes being fixed, are always greater than that for a scenario of non-malicious nodes being fixed and malicious nodes being mobile. This means the effect of malicious nodes with grey hole property are severe in case of static node scenario then mobile node scenarios. The above statements are justified by the table 8.

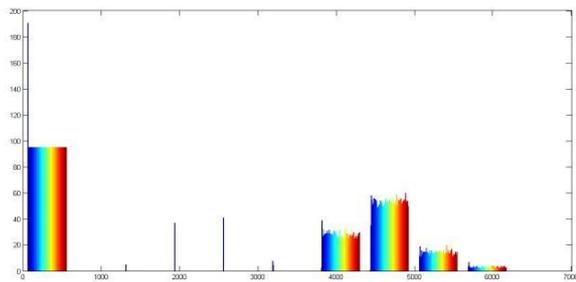


Figure 10 Histogram for per session throughput with 5 Fixed GH nodes DR 2 Mbps, Scenario: Mobile

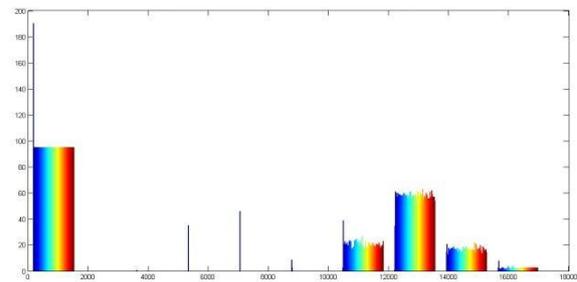


Figure 9 Histogram for per session throughput with 5 fixed GH nodes DR 2 Mbps, Scenario: Mobile

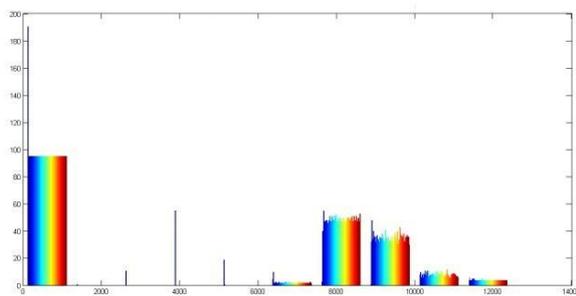


Figure 8: Histogram for per session throughput with 5 mobile GH nodes DR 2 Mbps, Scenario: Mobile

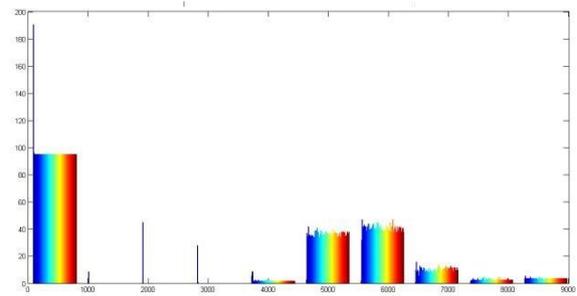


Figure 7 Histogram for per session throughput with 5 fixed GH nodes DR 2 Mbps, Scenario: Fixed

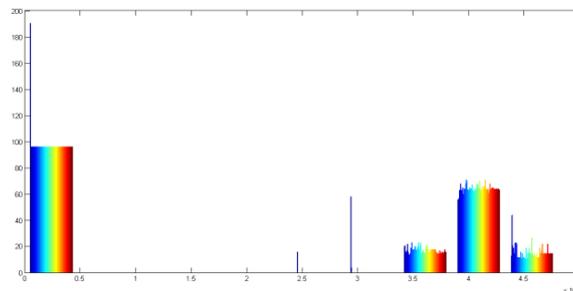


Figure 11 Histogram for per session throughput with 5 Mobile GH nodes DR 2 Mbps, Scenario: Fixed

V. CONCLUSIONS

In this paper, we have analyzed a prominent security threats named Grey hole attack on an ad-hoc network. Here we have simulated and analyzed Grey hole attack under various scenarios such as all the non-malicious nodes are moving and malicious nodes are fixed, all the non-malicious nodes are fixed and malicious nodes are moving, and source and destination communicating at data rates of 2 Mbps and 3 Mbps.

Here we are able to find out that for scenarios having numbers of non-malicious nodes and malicious nodes, the per session throughput, for a scenario of non-malicious nodes being mobile and malicious nodes being fixed, are always greater than that for a scenario of non-malicious nodes being fixed and malicious nodes being mobile. This means the effect of malicious nodes with grey hole property are more severe in case of static node scenario then mobile node scenarios. Besides this, we have also found that irrespective of the nodes moving or not, the grey hole attack have definite attack patterns which are visualized by the histogram plots of the results of scenarios and may considered as signature of the respective attack pattern.

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