International Journal on Future Revolution in Computer Science & Communication Engineering
Volume: 4 Issue: 4
ISSN: 2454-4248
818 – 826

Performance Analysis between OLSR and FSR Protocols under Black Hole Attack Using FPGA

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Abstract **-** Security is an important part of wireless ad hoc network or mobile ad hoc network. A mobile ad hoc network (MANET) is an infrastructure less category of wireless network. Routing protocols in Mobile ad hoc network is divided into three categories, Reactive (also known as on demand) routing protocol, Proactive (also known as table driven) routing protocol and Hybrid protocol. Security is an important part in MANET because when we send data source node to destination node in mobile ad hoc network, we want protection in path between source to destination and complete transfer data packet between source node to destination node. In this research paper we use two proactive routing protocol known as OLSR (Optimized Link state Routing) Protocol and FSR (Fisheye State Routing) Protocol. OLSR is a flat routing and Unipath protocol based on multipoint relay not multipath. FSR is a hierarchical routing and multipath protocol based on multiple paths. In this research work we check the performance of these two protocols under five different performance matrices known as Packet delivery ratio (PDR), Packet loss (PL), Average end to end delay (AEED), Normalized Routing load (NRL) and Throughput on black hole attack. Black hole attack is an active attack, in this attack attacker node absorbs the data packet and give the fake reply. In this research paper we analysis the performance two protocol one is unipath known as OLSR and second is Multipath known as FSR under Black hole Attack. The performance of FSR is better than OLSR, because OLSR is unipath and maximum data packet is absorbs in OLSR single path. FSR is better because FSR is Multipath and minimum data packet is absorbs in FSR multi path.

Keywords*-Mobile adhoc network (MANET), OLSR, FSR, Black Hole Attack, FPGA*

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I. INTRODUCTION

MANET (Mobile Ad hoc Network) is a infrastructure less category of wireless network. In this category of wireless network all nodes are connected without central device called Access Point (AP). In mobile ad hoc network all nodes communicates with different category of protocol. There are Three Category of Routing Protocols

Reactive Routing Protocol **–** These protocols are also called On- Demand Routing Protocol, because when the demand arises, find a routing path. Examples of these protocols are AODV, DSR etc.

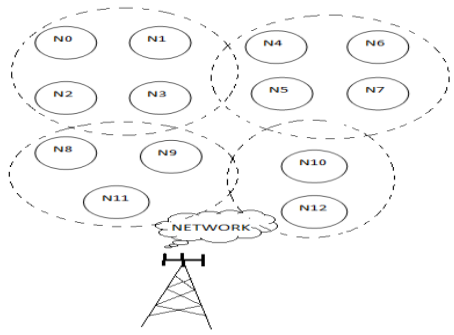

Fig.1: Mobile Ad Hoc Network (MANET)

Proactive Routing Protocol **–**These Protocols are also called Table-Driven Routing Protocol, because each node in network maintains one or more tables containing routing information to all other present in network. Examples of these protocols are OLSR, FSR, DSDV etc.

Hybrid Routing Protocol **–**These Protocols are also called Combination of table driven and on- demand protocol, because in this protocol has both property of on – demand and table driven protocol. It used to route discovery property of On-demand protocol and Route maintenance property of Table-driven protocol . hybrid protocol is used for large network. Examples of these protocols are ZRP, LANMAR etc.

II. RELATED WORK OR LITERATURE SURVEY

The research is going on in this filed/ The work done by some researchers is given.

Nilesh N. Dangare et al (2015),introduced the Design and Implementation of Trust Based Approach to Mitigate Various Attacks in Mobile Ad Hoc network. In this experiment considered two attack vampire and DDos Attacks. The vampire attack is not any protocol specific.

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Single vampire attack can increase the network wide energy usage. DDos attacks exhaust the resources available to a network. Both the attacks drain the energy of nodes. The result of this experiment is these two attacks are resources consumption attacks, which drain the energy of node in the network. If energy of nodes drain, packets forwarding process may affect which may degrade the performance of network. The future work is to use the proposed technique to mitigate vampire and DDos attacks with more number of nodes and increasing the simulation area and also for other types of attacks **[19].**

Banoth Rajkumaret al (2016) proposed to develop a CA distribution and a Trust based threshold revocation method. Initially the trust value is computed from the direct and indirect trust values. And the certificate authorities distributes the secret key to all the nodes. Followed by this a trust based threshold revocation method is computed. Here the misbehaving nodes are eliminated. Drawback in this work is this technique not used in different category of attacks. Future work is this technique is apply on various attack in MANET and focus on security **[20].**

A.A. Chavan et al (2016),compared first between two MANET protocol known as AODV and DSDV against Blackhole Attack. The comparison result is performance of AODV is better than DSDV. But The performance of AODV gets affected by black hole attack. After the modification in AODV which helps to improve the performance of AODV in presence of black hole attack. The drawback in this work is the packet of AODV and DSDV is reduced in blackhole attack then used Modification of AODV in this work. As we know that AODV and DSDV protocol is unipath protocol in MANET. The future work is blackhole attack implement on multipath protocol, and Performance comparison between unipath and multipath protocol **[21].**

Jefin Liza James et al (2016), proposed a Preventing Node Isolation Attack in OLSR Protocol. In this work, various methods used to prevent a type of Denial of Service (DoS) attack called the node isolation attack that is capable to compromise OLSR protocol. There are three preventive measures in this work. Checking TC message, usage of additional control messages and DCFN are the methods a suggestion to use authentication in this work. The drawback in this research work is these three technique is not used on another attack. Future work of this research work is these three technique used in another various attack on OLSR protocol **[22].**

Praveen K S, Gururaj et al (2016)Compared two MANET routing protocol known as OLSR and AODV protocol against blackhole attack under two performance matrices, packet delivery ratio(PDR), and Average throughput . In this work focused on security. The result of this work is performance of AODV protocol is better than OLSR protocol on black hole attack. The drawback is these two protocol not check on another performance matrices. The future work is consider different parameters and different attacks of application layer to check the performance the AODV and OLSR routing protocols **[23].**

III. PROPOSED WORK

In this research work, we have two types of routing protocol in MANET, Unipath and multipath protocols. The two main routing protocol we are focusing on OLSR (Optimized Link State Routing) and FSR (Fisheye State Routing) protocol. OLSR protocol is a Unipath and FSR is a Multipath protocol. These two protocols are based on Link state Routing algorithm. These two protocol are category of Proactive or Table driven protocol in MANET. We analyse the performance of these two protocol under Black hole attack, and check who is better. Black hole attack is an active attack.

The basic idea of OLSR and FSR protocol is based on Unipath and Multipath protocol.

OLSR (Optimized Link State Routing) Protocol

OLSR (Optimized Link State Routing) Protocol is a table driven or Proactive Routing protocol. This Protocol is based on link state routing algorithm. OLSR protocol is based on three main concept

- HELLO
- MPR (Multi-Point Relay)
- TC (Topology Control)

The main concept of OLSR protocol used in this research work is this protocol is based on Multi Point Relay and send message HELLO in multipoint, but it is Unipath not Multipath. That means when every node is arranged in OLSR protocol, HELLO message send one or more node, This is Multipoint Relay Concept. All node arranged in any topology, this is Topology Control (TC) concept. In this research work, we arranged all node in Mesh Topology shown in fig.2.

FSR (Fisheye State Routing) Protocol

FSR (Fisheye State Routing) is a table driven or Proactive Routing Protocol. This protocol is a Multi-path routing protocol. FSR protocol is a hierarchical routing protocol in MANET. It is based on Link state routing algorithm in effect with reduced overhead to keep network topology information. FSR utilized a function similar to a fish eye. The all fish eye represents all nodes in Network, that can be

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connecting to multiple path. The main concept of FSR protocol used in this research work is Hello Message passed to Multiples nodes with Multiple Path. The FSR is suggested in fig. 3

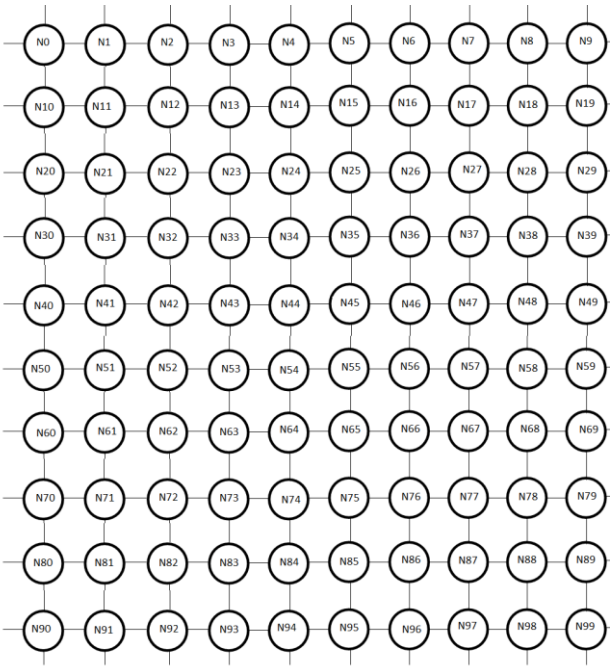

Fig. 2: Multi-point Relay in OLSR Protocol

Fig. 3: Fisheye State Routing (FSR) Protocol

Black Hole Attack

Black Hole is an active and routing attack method where attacker node promotes itself as a best node path to reach the destination and all other nodes. In this attack, the attacker node waits until neighboring nodes initiate the RREQ packet. When the attacker node gets the request it sends a fake reply packet RREP with a new sequence number. In a black hole attack, a malicious node sends fake routing information, claiming that it has an optimum route and causes other good nodes to route data packets through the malicious one.

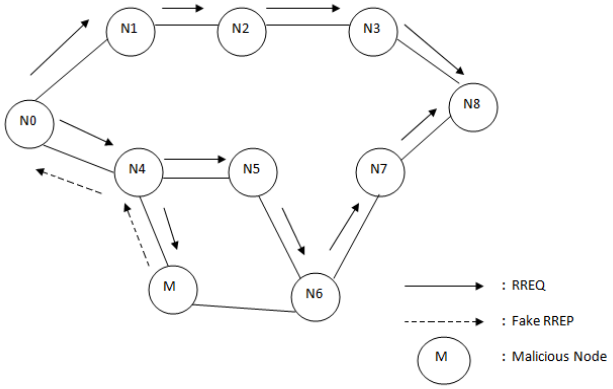

Fig. 4: Black hole Attack in MANET

IV. PERFORMANCE PARAMETERS

In this research work we use five Performance Matrices:

***Packet Delivery Ratio (PDR)*:** Packet delivery ratio (PDR) is a ratio of total no of packet received by destination and total no of packet send by source node. The mathematical formula of PDR is

Total No of Packet received by destination Node / Total No of Packet send by Source Node.

Packet Loss (PL): Packet Loss (PL) is a difference of Total no of Packet send by Source Node and Total Number of packet received by destination node. The mathematical formula of PL is

Total No of Packet Send By Source Node – Total No of Packet received by Destination Node

Average End to End Delay (AEED): Average End to End delay (AEED) is a ratio of time difference and total no of packet received by destination. The mathematical formula of AEED is

Tr – Ts / Pd

Tr = Received time in packet delivered by destination.

Ts = Sending time in packet sending by source.

Pd = Total no of Packet received by destination.

Normalized Routing Load (NRL): Normalized Routing Load (NRL) is a ratio of Total number of Routing Packet and Actual received Packet. The mathematical formula of NRL is

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Total No of Routing Packet / Actual received Packet

Throughput: Throughput is a ratio of Total number of Packet Received and taken time. The mathematical formula of throughput is

Total No of Packet Received / Time Taken.

V. METHODOLOGY

In this research work we use Field Programmable Gate Array (FPGA) Xilinx methodology, work in this methodology using VHDL language. Xilinx Tools is a suite of software tools used for the design of digital circuits implemented using Xilinx Field Programmable Gate Array (FPGA) or Complex Programmable Logic Device (CPLD). The design procedure consists of design entry, synthesis and implementation of the design, functional simulation and testing and verification. Digital designs can be entered in various ways using the above CAD tools using a schematic entry tool, using a hardware description language (HDL), Verilog or VHDL or a combination of both.

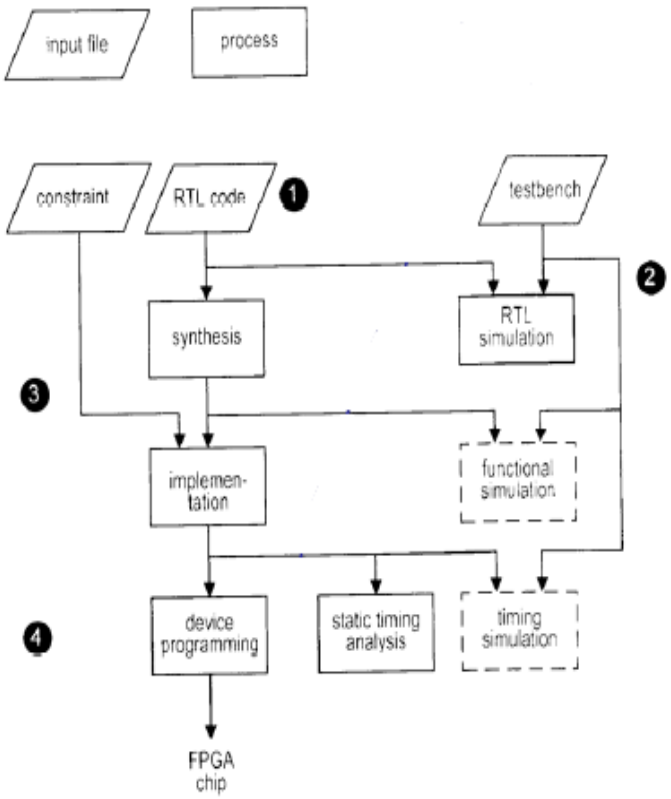

Fig. 5: FPGA XILINX process

VI. RESULTS & ANALYSIS

In this research work we analysis to OLSR and FSR protocol under black hole attack with five different Performance matrices define above proposed design.

Simulation Environment: Research work is based on following simulation environment table.

Table 1: Simulation Table

Parameter	**Value**
Simulator	Xilinx FPGA
Mobility Model	Random Way point model
Traffic	CBR(Constant Bit Rate)
Number of Nodes	100
Channel type	Wireless Channel
Size of packet(bits)	40
Routing Protocol used	OLSR, FSR

Performance Analysis of OLSR Protocol Under Black Hole Attack:

Algorithm of OLSR protocol under Black hole Attack

Identify source node 'S' and destination node 'D'.
Step1. Send the request signal from destination to source node.
Step2. Reply to the destination node to send the data if the source node is free.
Step3. Check the intermediate node source node Intermediate node destination node. Send RTRPLYN or CHCKVRFY signal to destination.
Step4. If it is verified then store the controls of data in destination memory with Write and Read signal.
Step5. When D received signal it send the verify signal to OLSR source node.
Step6. Null Reply in case of match address.

Step7. Send Final Reply when black hole is detected, but data is not received on the destination of OLSR node.

Synthesis Report of OLSR Protocol Under Black Hole Attack

```
=========================================================================
HDL Synthesis Report

Macro Statistics
# FSMs                          : 1
# Registers                     : 102
  40-bit register               : 102
# Latches                       : 2
  40-bit latch                  : 2
# Multiplexers                  : 2
  40-bit 128-to-1 multiplexer   : 1
  2-to-1 multiplexer            : 1

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RTL Schematic of OLSR Protocol under Black hole Attack

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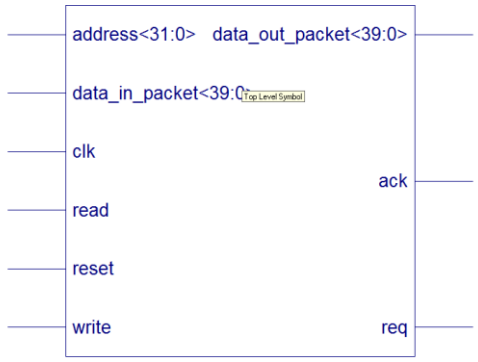

Fig.6: RTL Schematic of OLSR Protocol under black hole attack

Working Process of OLSR Protocol under Black hole Attack

In this research work we analysis a proactive flat routing protocol OLSR. In this protocol process we take 100 nodes, and send 40 bits packets. When this protocol is under black hole attack, maximum bits is reduced or absorbs, and reply is fake in this protocol. We calculated a receiving bits and related time. OLSR is a Unipath protocol and based on multipoint relay, we use Mesh topology in this work, and send data, source address to destination address with message 'HELLO'.

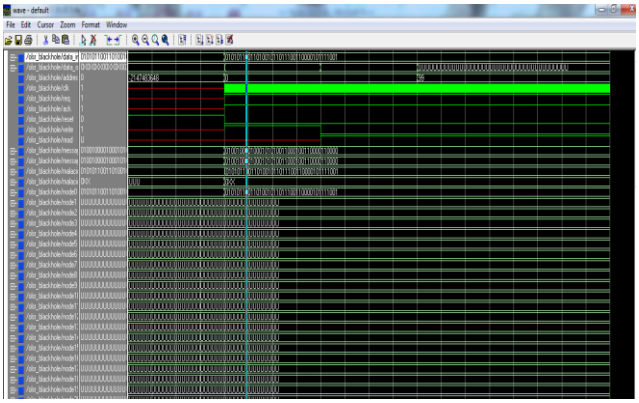

Fig. 7: Process of OLSR with data transfer in form of Bits

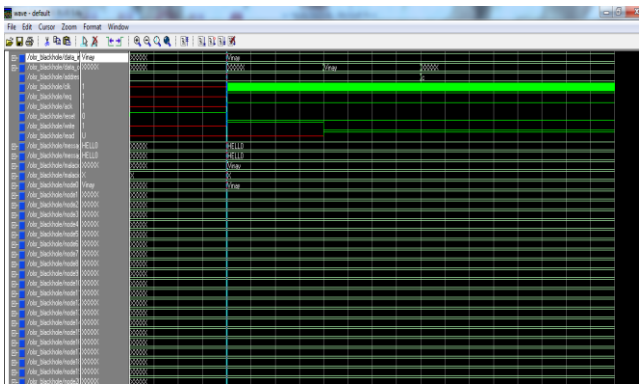

Fig. 8: Process of OLSR Protocol with Data transfer in form of character with 'HELLO' message

Performance Analysis of FSR Protocol under Black Hole Attack: Algorithm of FSR protocol under Black hole Attack

ALGORITHM. Identify source node 'S' and destination node 'D'

STEP1. Send the request signal from destination to source node.

STEP2. Check the status of intermediate node.

STEP3.Reset = 0 the send Hello, all nodes will get "Hello" including malicious node. Malicious node may be any destination node.

STEP4. Source node → Intermediate node → destination node. Send RTRPLY message to destination node.

STEP5.Store the contents of destination node in memory after "CHKVRF" the signal then Write = '1' and Read = '0'.

STEP6. After receiving data, it will send "Verify signal"

STEP7. It will send NULL RPLY in case of matching target Address.

STEP8. When Read = 1 and Write = 0 it will send Final data to the destination "FINALRPLY" with activating all nodes.

Synthesis Report of FSR Protocol Under Black Hole Attack

```
=========================================================================
HDL Synthesis Report

Macro Statistics
# FSMs                          : 1
# Registers                     : 102
  40-bit register               : 102
# Latches                       : 2
  40-bit latch                  : 2
# Multiplexers                  : 102
  40-bit 128-to-1 multiplexer   : 1
  2-to-1 multiplexer            : 101

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RTL Schematic of FSR Protocol under Black hole Attack

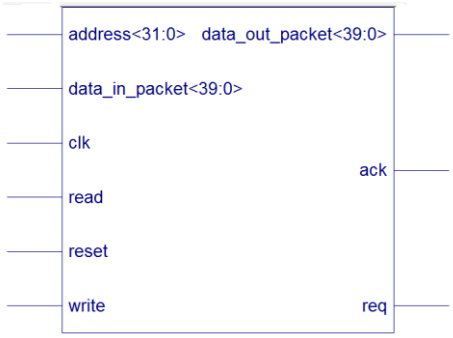

Fig.9: RTL Schematic of FSR Protocol under black hole attack

Working Process of FSR Protocol under Black hole Attack

In this research work we analysis a proactive Hierarchical routing protocol FSR. In this protocol process, we take 100 nodes, and send 40 bits packets. When black hole attack in

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this protocol, maximum bits is reduced or absorbs, and reply is fake in this protocol. We calculated a receiving bits and related time. FSR is Multipath protocol and based on multiple path, we use Mesh topology in this research work, and send data, source address to destination address with message 'HELLO'.

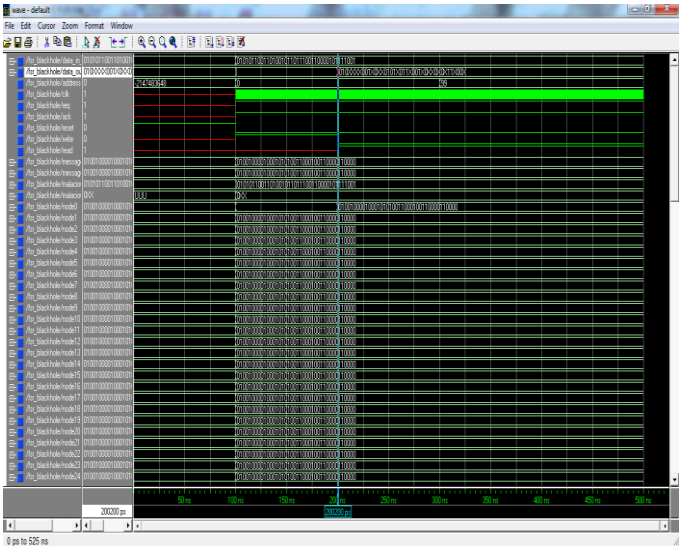

Fig. 10: Process of FSR protocol with data transfer in form of Bits.

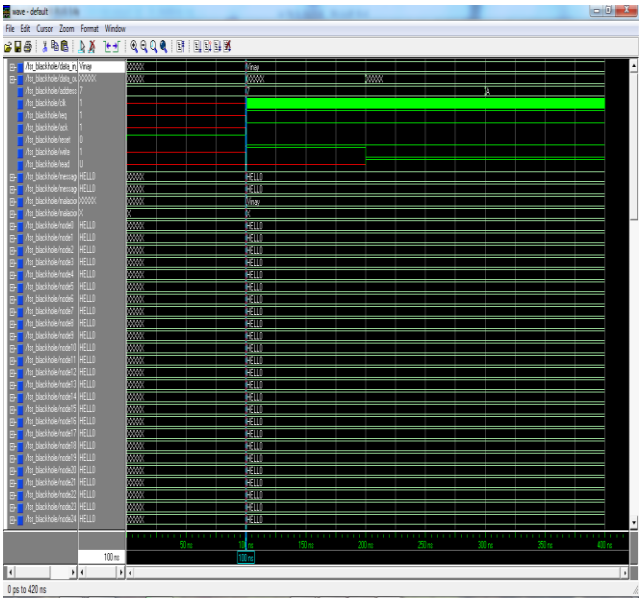

Fig. 11: Process of FSR Protocol with Data transfer in form of character with 'HELLO' message

VII. PERFORMANCE EVALUATION

Result of this research work define in following performance table and Performance graph. In this research work we analysis performance between two MANET protocol under black hole attack, called OLSR and FSR protocol. The result of this work in below:

Performance Result Table

Table 2: Simulation result of OLSR and FSR Protocol under black hole attack.

Total Number of Nodes	**Performance Parameter**	**OLSR Protocol under Black hole Attack**	**FSR Protocol under Black hole Attack**
100	Packet Delivery Ratio (PDR) (Bits)	0.475	0.6
100	Packet Loss (Bits)	21	16
100	Average End to End Delay (AEED)(ns)	10.526	8.33
100	Normalized Routing Load (NRL) (Bits)	2.105	1.66
100	Throughput (Bits/ns)	0.095	0.12

Table 3: Performance Comparison result of OLSR and FSR Protocol under black hole attack

Performance Parameter	**OLSR Protocol**	**FSR Protocol**
Packet Delivery Ratio (PDR)	Low	High
Packet Loss (PL)	High	Low
Average End to End Delay (AEED)	High	Low
Normalized Routing Load (NRL)	High	Low
Throughput	Low	High

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Performance Graph

Packet Delivery Ratio (PDR)

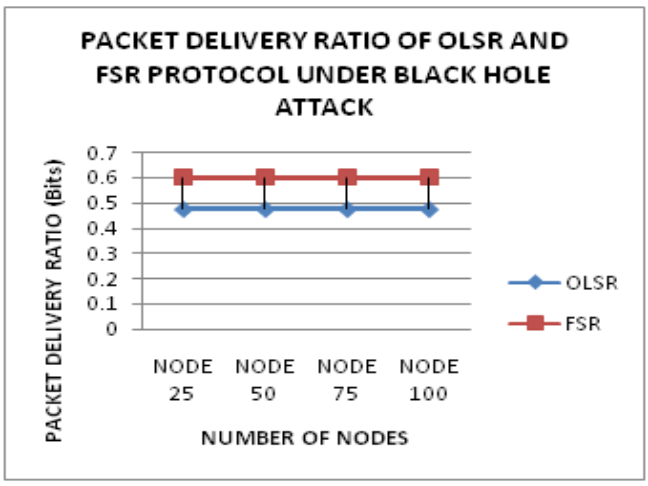

Fig. 12: Packet Delivery Ratio (Bits)

Packet Loss (PL)

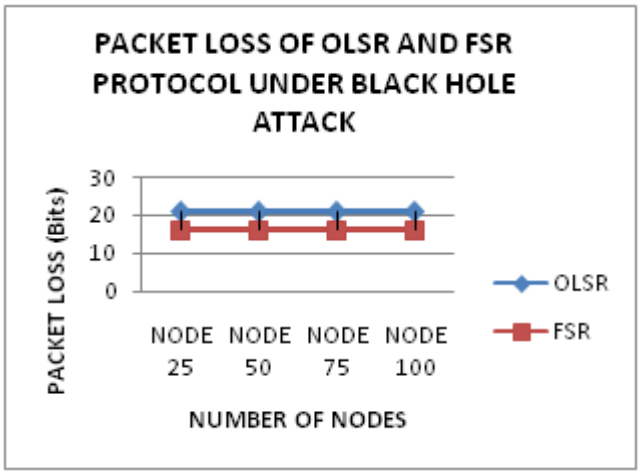

Fig. 13: Packet Loss (Bits)

Average End to End Delay (AEED)

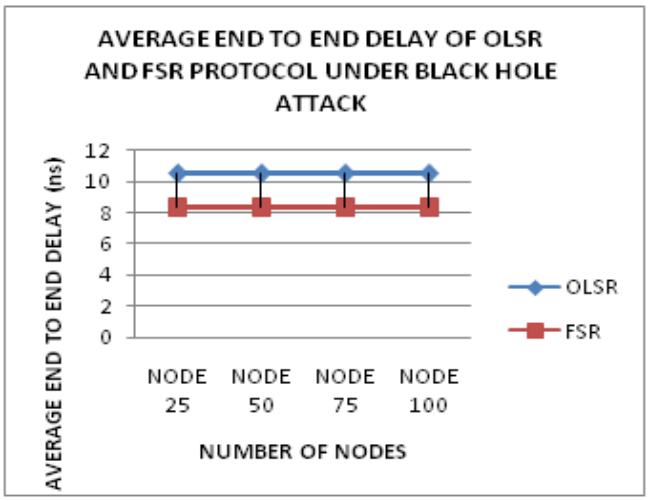

Fig. 14: Average End to End Delay (ns)

Normalized Routing Load (NRL)

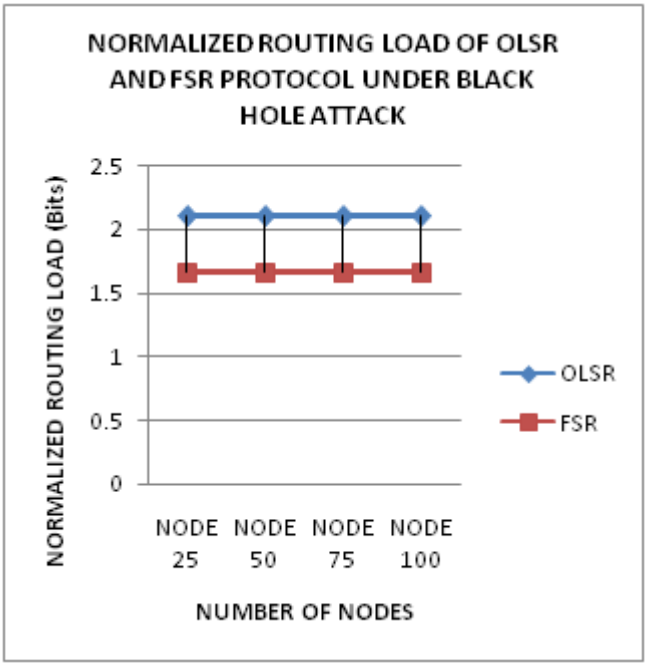

Fig. 15: Normalized Routing Load (Bits)

Throughput

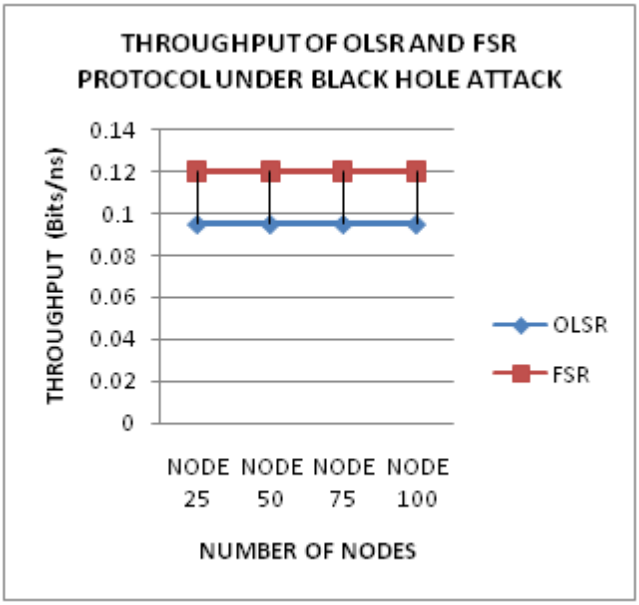

Fig.16: Throughput (Bits/ns)

VIII. CONCULSUON & FUTURE SCOPE

Mobile ad hoc network (MANET) is an infrastructure less network category of wireless network. There are three categories of routing protocols in MANET, Reactive, Proactive and Hybrid Routing protocol. Two protocols used in this research work OLSR (Optimized Link State Routing) and FSR (Fisheye State Routing) with considered black hole attack. OLSR and FSR protocol is Proactive Routing or

Table Driven Routing protocol based on link state Routing protocol. In this research work we check the performance of these two protocol using performance parameter under black hole attack. The result is performance of FSR protocol is better than OLSR protocol because FSR is Multipath protocol and OLSR protocol is Unipath Protocol, means in case of black hole attack FSR protocol done better work than OLSR protocol. We use the concept of unipath and multipath in this research work because we check the performance under black hole attack who is better OLSR (unipath) or FSR (Multipath) . From the above result analysis we can say that the FSR protocol outperforms when we consider the black hole attack. When we consider without attack the Performance of OLSR protocol is better because, OLSR is Unipath protocol. In unipath protocol packet send easily sender to destination but multipath is complex in MANET.

In future work is considered security to other protocol in Communication of MANET. Security is most important point in MANET Communication in wireless network. In this research work we use OLSR and FSR protocol, in future we use other protocol in MANET. In this research work we implement Black hole attack, in future we implement other attack in MANET. In this research work we analysis the performance of protocol under black hole attack, in future we focused on security under Different type of attack in MANET. Future scope of Mobile Ad Hoc Network in Various field on Computer Science, because many algorithms of Mobile Ad hoc network useful. Different type of routing protocol in MANET used on cyber security. Various attacks related to MANET used in many security research work. MANET protocols are used in other field of wireless networking. When focus on security mostly points of MANET used in security work.

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