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QUALITATIVE ANALYSIS AND PERFORMANCE EVALUATION OF OLSR, RIP, OSPF USING OPNET

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Abstract - In this paper, the work done is the investigation of the impact of network size and simulation area on OLSR, RIP, and OSPF proactive routing protocol with mobility of nodes. The protocol was simulated using virtual hosts on a discrete-event network simulator: modeler 17.5A. The protocol was run on a simulation setup of 10, 20 and 30 nodes as well as 500m x 500m, 1000m x 1000m and 1500m x 1500m simulation areas and also the protocol are simulated with const speed mobility model in dynamic scenario (i.e., in MANETs) on a simulation setup of 20 nodes (network size) and 1000m x 1000m simulation area (i.e., playground dimensions). A performance study of the protocols is done based on available parameters which are Qos metrics viz. end-to-end delay, throughput and more. We are trying to find out which protocol suits the best for the network and through a thorough analysis.

Keywords: **OLSR, RIP, OSPF, MANETS QOS Metrics, Routing protocols**

I. IINTRODUCTION

The main aim of this thesis is to compare the performance of OLSR, RIP routing protocol under different configurations. In MANETs based on various parameters and also to investigate the impact of network area (i.e., simulation area) and VBR variable bit rate and CBR constant bit rate on the performance of reactive routing protocol. And finding the impact by changing the parameters of OLSR, RIP, OSPF routing protocol in Ad-hoc networks.

In this paper, the main contribution is to analyze the performance of reactive routing protocol in ad-hoc networks under different configurations based on different parameters by using and OPNET simulator.

Using OPNET simulator by varying Qos parameters and analyzing the performance of OLSR, RIP, OSPF reactive routing protocol.

II. RESEARCH FINDINGS

To analyze various parameters of Qospings sent, pings received, ping loss rate and standard parameters of application layer. We analyze different parameters of MAC layer such as droppedPkNotforUs:sum,PassedUpPk:sum,RcvdPkFromHL:s um, RcvdPkFromLL:sum, SentDownPk:sum under shortest path and static configurations by varying bitrate using OMNET++. We also extended our analysisvarious parameters of Qos like throughput, delay, load using OPNET.

- The impact of transmission bit rate.
- The impact by varying network size and simulation area.
- The impact by varying Threshold under TTL Parameter.

III. CLASSIFICATION OF ROUTING PROTOCOLS IN MANET'S

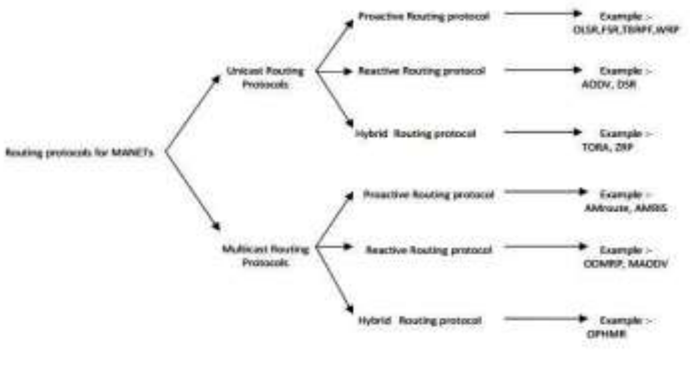

Fig1 Classification of Routing protocols for MANET's

3.1 PROACTIVE UNICAST ROUTING PROTOCOLS

Traditional routing protocols such as Optimized link state routing protocol (OLSR), The Fisheye State Routing (FSR), and Topology Broadcast Based on Reverse-Path Forwarding Routing Protocol (TBRPF) are proactive unicast routing protocols. Periodic broadcast of network topology updates (e.g., distance vector or link state information) is necessary to compute the shortest path from the source to every destination, which consumes a lot of bandwidth.

3.1.1 OPTIMIZED LINK STATE ROUTING PROTOCOL (OLSR)

Optimized link state routing protocol (OLSR) is a proactive (table-driven) routing protocol for MANETs. A route between sources to destination is available immediately when needed. OLSR is based on the link-state algorithm. Conventionally, all wireless nodes flood neighbor information in a link-state protocol, but not in OLSR node. It is advertise information only about links with neighbor who is in its multipoint relay selector set. Its reduce size of control packets reduces flooding by using only multipoint relay nodes to send information in the network and reduce number of control packets by reducing duplicate transmission. This protocol does not expect reliable transfer, since updates are sent periodically. OLSR used hop-by-hop routing. Routes are based on dynamic table entries maintained at intermediate nodes.

3.1.2 OPEN SHORTEST PATH FIRST (OSPF)

Open Shortest Path First (OSPF) is a very widely used link-state interior gateway protocols (IGP). This protocol routes Internet Protocol (IP) packets by gathering link-state information from neighboring routers and constructing a map of the network. OSPF routers send many message types including hello messages, link state requests and updates and **database descriptions. Dijkstra's algorithm is then used to find** the shortest path to the destination. Shortest Path First (SPF) calculations are computed either periodically or upon a received Link State Advertisement (LSA), depending on the protocol implementation.

3.1.3. ROUTING INFORMATION PROTOCOL (RIP)

The Routing Information Protocol (RIP), which is a distance-vector based algorithm, is one of he first routing protocols implemented on TCP/IP. Information is sent through the network using UDP. Each router that uses this protocol has limited knowledge of the network around it. This simple protocol uses a hop count mechanism to find an optimal path for packet routing. A maximum number of 16 hops are employed to avoid routing loops. However, this parameter limits the size of the networks that this protocol can support.

3.2. REACTIVE UNICAST ROUTING PROTOCOLS

Due to the frequently changing topology of the Mobile Ad-hoc Network, the global topology information stored at each node needs to be updated frequently, which consumes lots of bandwidth, because the link state updates received expire before the route between itself and another node is needed. To minimize the wastage of bandwidth, the concept of on demand or reactive routing protocol is proposed. In on demand protocols the routing is divided into the following two steps: first one is route discovery and second one is route maintenance. The most distinctive On Demand unicast routing protocols are Dynamic Source Routing (DSR) protocol, Ad-hoc on Demand Distance Vector Routing (AODV) protocol and Temporally Ordered Routing Algorithm etc., in Table 2, gives the Characteristic comparison of Reactive Unicast Routing Protocols

3.2.1 DYNAMIC SOURCE ROUTING PROTOCOL (DSR)

Dynamic Source Routing (DSR) is an On Deman unicast routing protocol that utilizes source routing algorithm. In source routing algorithm, each data packet contains complete routing information to reach its dissemination. Additionally, in DSR each node uses caching technology to maintain route information that it has discovered. For example, the intermediate nodes cache the route towards the destination and backward to the source. Furthermore, because the data packet contains the source route in the header, the overhearing nodes are able to cache the route in its routing cache.

3.2.2 AD-HOC ON-DEMAND DISTANCE VECTOR ROUTING PROTOCOL (AODV)

The Ad Hoc On-demand Distance Vector Routing (AODV) protocol is a reactive unicast routing protocol for mobile ad hoc networks. As a reactive routing protocol, AODV only needs to maintain the routing information about the active paths. In AODV, routing information is maintained in routing tables at nodes. Every mobile node keeps a next-hop routing table, which contains the destinations to which it currently has a route. A routing table entry expires if it has not been used or reactivated for a pre-specified expiration time. Moreover, AODV adopts the destination sequence number technique used by DSDV in an on-demand way.

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	AMRoute	AMRIS	CAMP
Structure of Multicast delivery	Tree	Tree	Mesh
Loop free	No	Yes	Yes
Dependency on Unicast routing protocol	Yes	No	Yes
Scalability	Fair	Fair	Good
Control Packet flooding	Flat	Flat	Flat
Periodic message Requirement	Yes	Yes	Yes

Table: Characteristic Comparison of Reactive Unicasting Routing Protocols

3.3 PROACTIVE MULTICAST ROUTING PROTOCOLS

Conventional routing protocols such as Ad-hoc Multicast Routing (AM Route), Core-Assisted Mesh Protocol (CAMP) and Ad-hoc Multicast Routing Protocol Utilizing Increasing id-numbers (AMRIS) are proactive multicast routing protocols. Periodic broadcast of network topology updates are needed to compute the shortest path from the source to every destination, which consumes a lot of bandwidth. In Table 3, gives the Characteristic comparison of proactive Multicast Routing Protocol.

3.3.1. AD-HOC MULTICAST ROUTING (AM ROUTE)

Ad-hoc Multicast Routing (AM Route) is a tree based multicast routing protocol for mobile ad hoc networks. AM Route creates a multicast shared-tree over mesh. AM Route relies on the existence of an underlying unicast routing protocol. AM Route has two key phases: mesh creation and tree creation. This protocol can be used for networks in which only a set of nodes supports AM Route routing function. It is only one logical core in the multicast tree, which is responsible for group member maintenance and multicast tree creation. In this routing protocol builds a user- multicast tree, in which only the group members are included; because non-members are not included in the tree, the links in the tree are virtual links.

3.3.2. CORE-ASSISTED MESH PROTOCOL (CAMP)

Core-Assisted Mesh protocol (CAMP) is a proactive multicast routing protocol based on shared meshes. The mesh structure provides at least one path from each source to each receiver in the multicast group. CAMP relies on an underlying unicast protocol which can provide correct distances to all destinations within finite time. Every node maintains a Routing Table (RT) that is created by the underlying unicast routing protocol. CAMP modifies this table when a multicast group joins or leaves the network. A Multicast Routing Table (MRT) is based on the Routing Table that contains the set of known groups. Moreover, all member nodes maintain a set of caches that contain previously seen data packet information and unacknowledged membership requests. The creation and maintenance of meshes are main parts of CAMP.

	DSR	AODV
Updating of Destination at	Source	Source
Multicast Capability	No	Yes
Control HELLO Message requirment	No	No
Design structure	Flat	Flat
Unidirectional link	Yes	No
Multiple route	Yes	Yes

TABLE: Characteristic of Proactive Multicast Routing Protocol

3.4 REACTIVE MULTICAST ROUTING PROTOCOLS

Traditional routing protocols such as On-Demand Multicast Routing Protocol (ODMRP) and Multicast Ad-hoc on-demand Distance Vector (MAODV) are Reactive multicast routing protocols. Reactive routing that means discovers the route when needed. Reactive routing protocols are well suited for a large-scale, narrow-band MANET with moderate or low mobility. In Table 4 gives the Characteristic comparison of Reactive Multicast Routing Protocol.

3.4.1. ON-DEMAND MULTICAST ROUTING PROTOCOL (ODMRP)

On-Demand Multicast Routing Protocol (ODMRP) is a reactive mesh based multicast routing protocol. ODMRP is not only a multicast routing protocol, but also provides unicast routing capability. The source establishes and maintains group membership and multicast mesh on demand if it needs to send data packets to the multicast group, which is somewhat similar to MAODV. A set of nodes, which is called forwarding group, participate in forwarding data packets among group members. All the states in ODMRP are soft states, which are refreshed by the control messages mentioned above or data packets, which achieves higher robustness.

3.4.2. MULTICAST AD-HOC ON-DEMAND DISTANCE VECTOR (MAODV)

Multicast operation of Ad-hoc On-demand Distance

Vector (MAODV) is a reactive tree-based multicast routing protocol. MAODV is an extension of the unicast routing protocol Ad-hoc On-demand Distance Vector (AODV). Using MAODV, all nodes in the network maintain local connectivity by broadcasting "Hello" messages with TTL set to one. Every node maintains three tables, a Routing Table (RT), a Multicast Routing Table (MRT) and a Request Table.

The main drawbacks of MAODV are long delays and high overheads associated with fixing broken links in conditions of high mobility and traffic load. Also, it has a low packet delivery ratio in scenarios with high mobility, large numbers of members, or a high traffic load. Because of its dependence on AODV, MAODV is not flexible. Finally, it suffers from a single point of failure, which is the multicast group leader.

	ODMRP	MAODV
Multicast delivery structure	Mesh	Core based tree
Loop free	Yes	Yes
Periodic messages requirement	Yes	No
Routing Hierarchy	Flat	Flat
Scalability	Fair	Fair

TABLE : Characteristic of Reactive Multicast Routing Protocol

IV. QOS METRICS

LOAD, AVERAGE END-TO-END DELAY, THROUGHPUT, MEDIA ACCESS DELAY, ROUTE DISCOVERY TIME, STANDARD DEVIATION

V. IMPLEMENTATION ON BASIC ALGORITHM

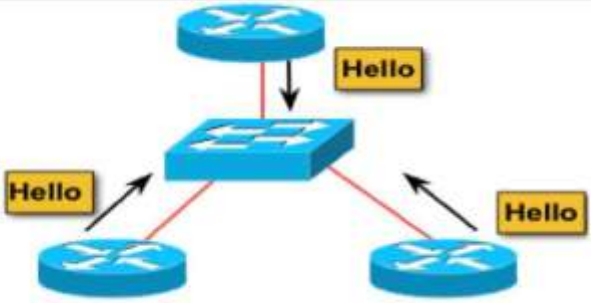
5.1. ROUTING INFORMATION PROTOCOL (RIP)

Send: Each t seconds or when T1 changes, send T1 on each non-faulty outgoing link.

Receive: Whenever a routing table Try is received on link n: For all rows Rr in Try

```
{
if(Rr.link<>n)
{
Rr.cost=Rr.cost+1;
Rr.link=n;
if (Rr.destination is not in T1) add Rr to
T1; //add new destination to
T1
else for all rows R1 in T1 {
if (Rr.destination=R1.destination and (Rr.cost<R1.cost
or Rl.link=n)) R1=Rr;
//Rr.cost<R1.cost remote node has better
route // Rl.link=n: Remote node is more
authoritative
}
}
}
```

5.1.1. OPEN SHORTEST PATH FIRST(OSPF)




```
for(I=0;i<count;i++)
{
for(j=0;j<count;j++)
{
    printf("\n%d->%d:",i,j);
    scanf("%d",&cost_matrix[i][j]);
    if(cost_matrix[i][j]<0)
    {
        cost_matrix[i][j]=1000;
    }
}
printf("\n Enter the source router:");
scanf("%d",&src_router);
for(v=0;v<count;v++)
{
    flag[v]=0;
    last[v]=src_router;
    dist[v]=cost_matrix[src_router][v];
}
flag[src_router]=1;
for(i=0;i<count;i++)
{
    min=1000;
    for(w=0;w<count;w++)
    {
    if(!flag[w])
    if(dist[w]<min)
    {
        v=w;
        min=dist[w];
    }
```

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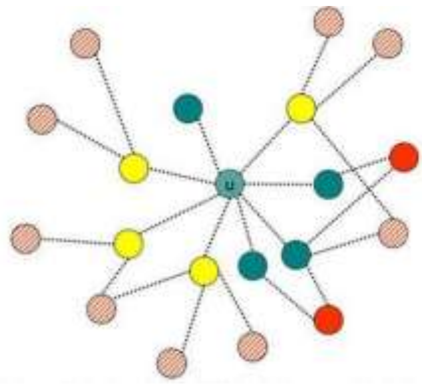
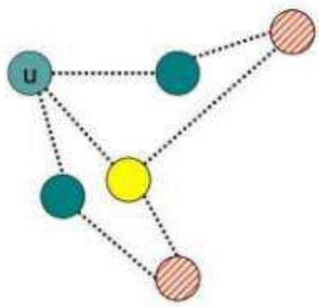
```
}
        flag[v]=1;
        for(w=0;w<count;w++)
        {
         if(!flag[w])
               if(min+cost_matrix[v][w]<dist[w])
                   {
                              dist[w]=min+cost_matrix[v][w
                              ];
                              last[w]=v;
                   }
        }
}
for(i=0;i<count;i++)
{
printf("\n%d==>%d:Path taken:%d",src_router,i,i);
        w=i;
        while(w!=src_router)
        {
               printf("\n<--%d",last[w]);w=last[w];
        }
        printf("\n Shortest path cost:%d",dist[i]);
```

5.1.2. OPTIMIZED LINK STATE ROUTING PROTOCOL (OLSR)

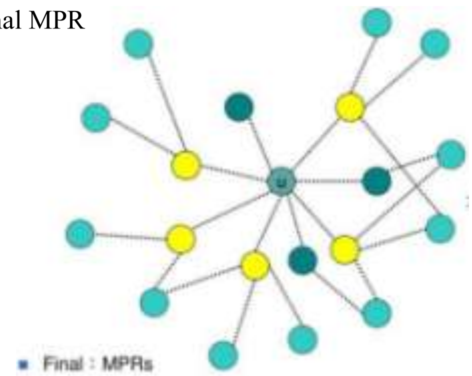
STEP-1: Select nodes in N1 (u) which cover isolated points of N2 (u).



STEP-2: Consider in N1 (u) only points which are not already elected at the first step NPR1 (u) and point in N2 (u) which are not covered by the NPR1 (u). While there exits point in N2 (u) not selected by the MPR, select in N2 (u), the node which covers the highest number of non-covered nodes in N2 (u).



Final MPR

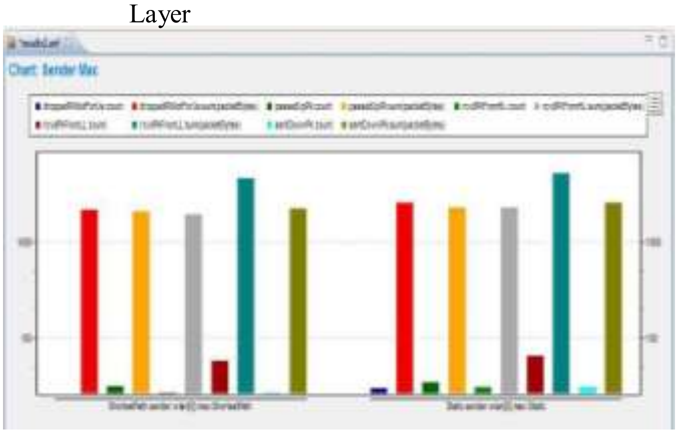


VI. SIMULATION RESULTS AND ANALYSIS

6.1. PERFORMANCE COMPARISON IN SANET SCENARIOS

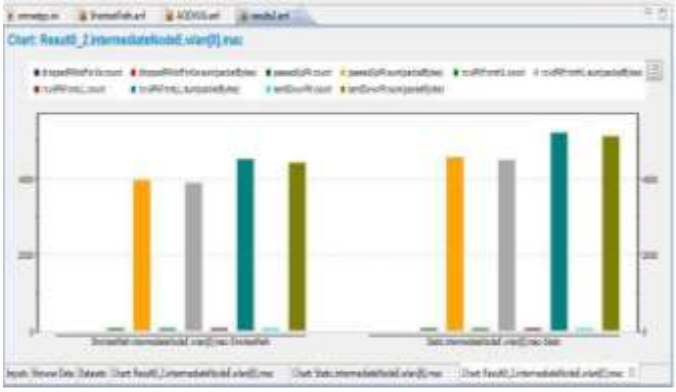
Scenario1: Shortest Path Configuration Vs Static Configuration

(i) Bit-Rate: **0.2MBPS** Sender Application Layer



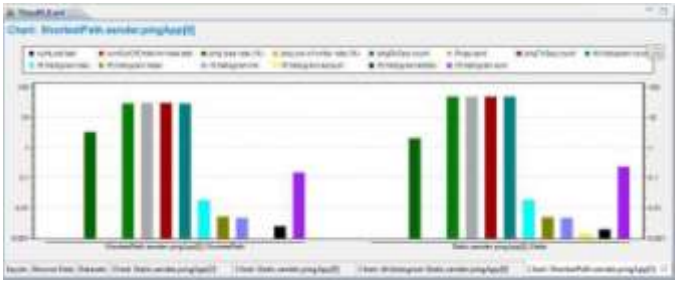
1. Sender MAC Layer

2. Intermediate node (E) MAC Layer



3. Receiver MAC Layer

Scenario2: Shortest Path Configuration Vs Static Configuration
(i) Bit-Rate : **0.6 MBPS** Sender Application Layer

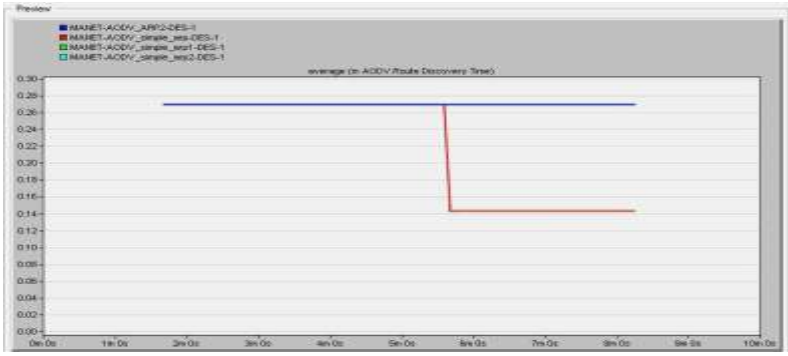


Impact of performance by varying ART parameter in AODV by using OPNET

Seconds, 9 Seconds

Attribute	Value
AD-HOC Routing Protocol	AODV
AODV Parameters	(...)
Route Discovery Parameters	(...)
Active Route Timeout (seconds)	3
Hello Interval (seconds)	uniform (1, 1.1)
Allowed Hello Loss	3
Net Diameter	35
Node Traversal Time (seconds)	0.04
Route Error Rate Limit (pkts/sec)	10
Timeout Buffer	2
TTL Parameters	(...)
TTL Start	1
TTL Increment	2
TTL Threshold	5
Local Add TTL	2
Packet Queue Size (packets)	Infinity
Local Repair	Enabled
Addressing Mode	IPv4

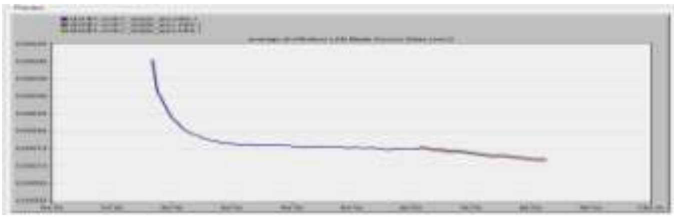
Route Discovery Time



Throughput

Delay

Media Access Delay

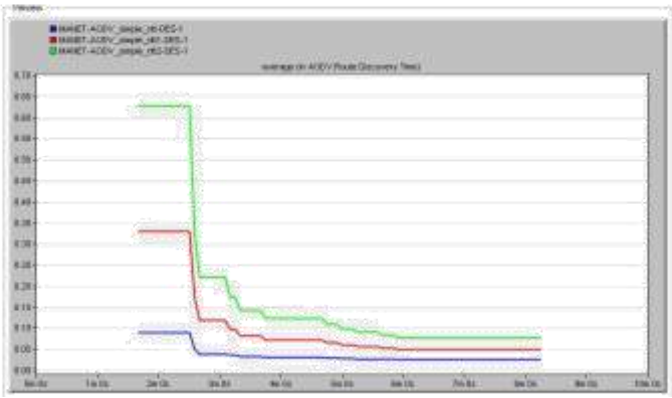


Load:

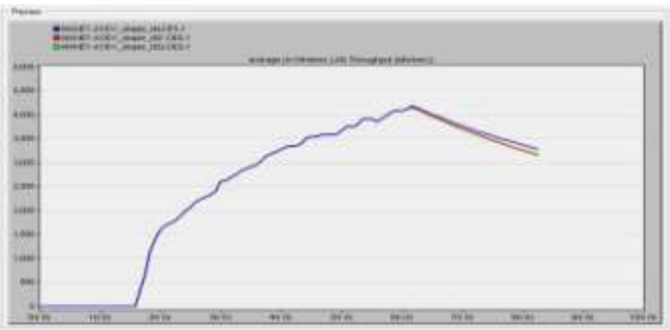
(i) Node Traversal Time : 0.01 Seconds, 0.05 Seconds, 0.10 Seconds

Attribute	Value
AD-HOC Routing Protocol	AODV
AODV Parameters	(...)
Route Discovery Parameters	(...)
Active Route Timeout (seconds)	3
Hello Interval (seconds)	uniform (1, 1.1)
Allowed Hello Loss	3
Net Diameter	35
Node Traversal Time (seconds)	0.01
Route Error Rate Limit (pkts/sec)	10
Timeout Buffer	2
TTL Parameters	(...)
TTL Start	1
TTL Increment	2
TTL Threshold	5
Local Add TTL	2
Packet Queue Size (packets)	Infinity
Local Repair	Enabled
Addressing Mode	IPv4

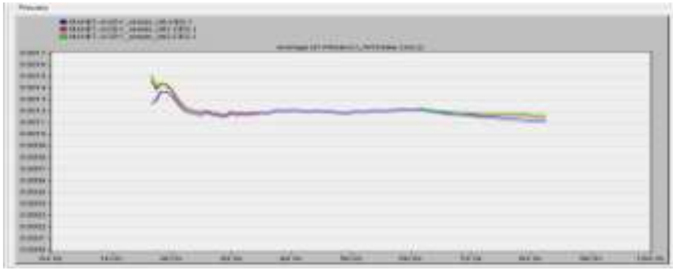
Route Discovery Time



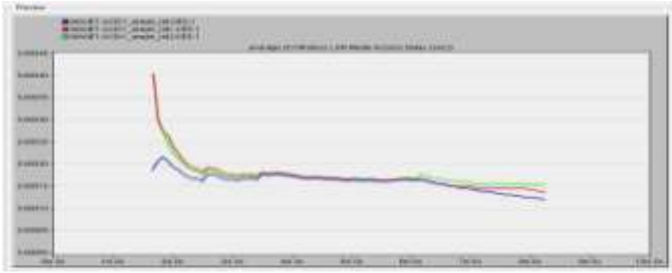
Throughput



Delay



Media Access Delay



Load

Results

TTL Parameter : TTL Threshold 5, 7, 9

Ad-HOC Routing Protocol	AODV
Route Discovery parameters	Default
Active Route Time(seconds)	Default **4.**
Hello Interval(seconds)	Uniform(1,1,1)
Allowed Hello Loss	3
Net Diameter	35
Node Traversal Time(seconds)	**0.01, 0.05 and 0.10**
Route Error Rate Limit	10
Timeout Buffer	02

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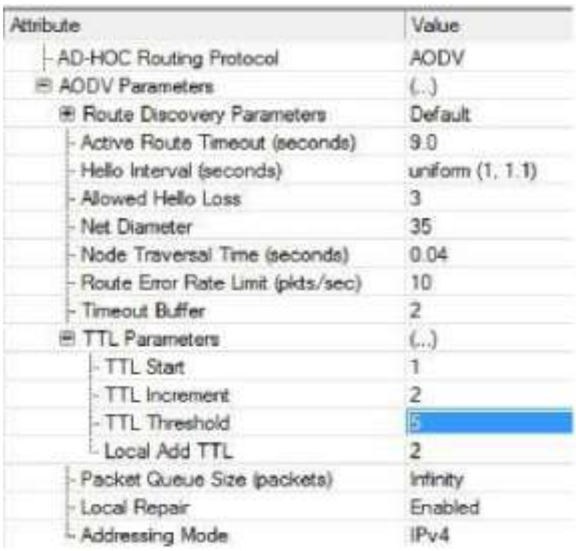
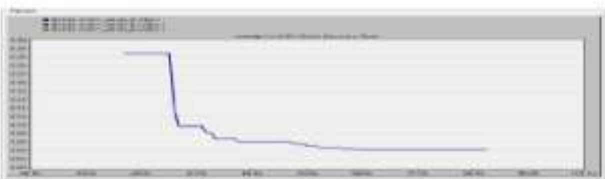
TTL Parameters	(..)
Packet Queue Size	Infinity
Local Repair	Enabled

Ad-HOC Routing Protocol	AODV
Route Discovery parameters	Default
Active Route Time(seconds)	**3,6 and 9**
Hello Interval(seconds)	Uniform(1,1,1)
Allowed Hello Loss	3
Net Diameter	35
Node Traversal Time(seconds)	0.04
Route Error Rate Limit	10
Timeout Buffer	02
TTL Parameters	(..)
Packet Queue Size	Infinity
Local Repair	Enabled



Attribute	Value
AD-HOC Routing Protocol	AODV
AODV Parameters	(...)
Route Discovery Parameters	Default
Active Route Timeout (seconds)	9.0
Hello Interval (seconds)	uniform (1, 1.1)
Allowed Hello Loss	3
Net Diameter	35
Node Traversal Time (seconds)	0.04
Route Error Rate Limit (pkts/sec)	10
Timeout Buffer	2
TTL Parameters	(...)
TTL Start	1
TTL Increment	2
TTL Threshold	5
Local Add TTL	2
Packet Queue Size (packets)	Infinity
Local Repair	Enabled
Addressing Mode	IPv4



TabTable (a) Varying ART by 3 seconds 6 Seconds and 9 Seconds.

Qos	MIN at ART	MAX at ART
Route Discovery Time	3 Seconds	9 Seconds
Delay	9 Seconds	3 Seconds
Load	3 and 6 Seconds	9 Seconds
Access Media Delay	9 Seconds	3 Seconds
Throughput	3 Seconds	9 Seconds

(b) Analysis of result by varying Active Route Timeout

Qos	MIN at NTT	MAX at NTT
Route Discovery Time	0.01 Seconds	0.10 Seconds

Table (c) varying NTT with 0.01, 0.05 and 0.10 Seconds

Delay	0.01 Seconds	0.10 Seconds
Load	0.10 Seconds	0.01 Seconds
Access Media Delay	0.01 Seconds	0.05 Seconds
Throughput	0.10 Seconds	0.01 Seconds

Table(d) Analysis of result by varying Node Traversal Time

Qos	MIN at TTL Threshold	MAX at TTL Threshold
Route Discovery Time	5	9
Delay	5	9
Load	5	9
Access Media Delay	9	5

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Throughput	5	9

Table(e) Analysis of result by varying TTL Threshold

Ad-HOC Routing Protocol	AODV
Route Discovery parameters	Default
Active Route Time(seconds)	Default
Hello Interval(seconds)	Uniform(1,1,1)
Allowed Hello Loss	3
Net Diameter	35
Node Traversal Time(seconds)	**0.04**
Route Error Rate Limit	10
Timeout Buffer	02
TTL Parameters	(..)
Packet Queue Size	Infinity
Local Repair	Enabled

VII. CONCLUSION AND FUTURE WORK

From this thesis, we conclude that AODV routing protocol performance in shortest path configuration gives better performance than static configuration in ad-hoc networks **(SANET's). By increasing t**he transmission bit rate (VBR) parameters AODV shows the better performance of shortest path configuration than static configuration. From the observation of experimental results based on the changes in the default parameters like(ART, NTT, TTL Threshold) of AODV routing protocol effects the performance of the networks(Qos metrics).

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