Performance analysis of Routing protocols in MANET

By

Birol kilic

(bk252)

Supervisor: Professor Nathan Gomes

School of Engineering and Digital Arts

University of Kent

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Declaration:

I certify that I have read and understood the entry in the School Student Handbook on Plagiarism and Duplication of Material, and that all material in this assignment is my own work, except where I have indicated appropriate references.

Signed:

Date: 17.04.2020

Statement

Due to emergency closing of the Jennison building, I couldn't access the lab as much as I needed. For the simulation program that I used in the project only I was able to access in jennison building. The experiments that has been made for this research are not completely finished especially the last experiment where additional parameters were in the plan to obtain better and more accurate results also the I couldn't take the most of the screenshots that I needed where it was going to help me better to explain the simulation results and conclusion and extra parameters information. In experiment 3 I couldn't able to get the full result that I wanted due to parameters I couldn't add my simulation pause time which most crucial parameter that were going to create difference in the result. Where I want to test pause time from starting second 1 until to second 10 for each scenario while I was able to do only 1 secong. Apart from this much more simulation scenarios where going to be added like much higher velocity and higher number of nodes as well as changing the properties like different network simulation area size. Also in the results I was going to add network load parameters which also an important element. I know that Jenison building closed only the approximately last three weeks. I was so confident about my project. I planned my experiments accordingly. But as soon as the closing procedure announced for the Jennison building I could not entered the Jenison building but I did my best to obtain everything that I needed in 3 days from 9 to 5 but especially closing it 3 days earlier than planned time ,effected all the experiments and results .Also I returned to my country so urgent where I stayed quarantine more than 3 weeks where it was really hard to concentrate on the project. I I hope you will understand my situation . I believed that I tried my best during this difficult times. I thank you in advance for your kind understanding.

ACKNOWLEDGMENT

I would like to thanks especially for Prof.Nathan gomes for helping me through whole year in finding my way on the project whenever I got stuck in some parts and giving advice on how to study on computer network and letting me to meet him whenever I needed a support and guidance.

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Terminologies

MANET = Mobile ad hoc network

TCP = Transmission control protocol

IP = Internet protocol

AODV = Ad hoc On-Demand Distance Vector

DSR = Dynamic Source Routing

RWP =Random Way Point mobility

RWM = Random walk mobility

RREQ = route request packet

RREP = Route Reply

RRER = Route error message

NODES = Mobile devices

ABSTRACT

When wireless networks introduced to our life, most of the challenges that we faced when we have the wired network are solved and introduced us new challenges. The way we live ,the time that we spent internet drastically changed, where no other generations in human change their the way of life in this amount of time. Changing the way of how we interact with computer bring along much more obstacles. Routing issues, surrounding environment, signal strength, blockage of signals, and deciding the correct signal path are the big challenges we introduced when we start to connect on internet without cable. Manet is the latest technology in the wireless network which able us to connect on internet in any situation. Manet is an area where day by day improvements are done and there are lots to do. Manet is basically mobile ad hoc network. These type of networks has special features like multi hop connectivity, constantly changing topology this features let manet very useful but at the same time gives lots of drawback in terms of the quality and the performance on the network. From these research we want to explore why and how this features have individual effects on different parameters where shows us the quality of the internet , we are going to compare these values according to the routing protocols that we are going to use in simulation .These routing protocols will be aodv and dsr. Netsim simulation environment is used to done the simulations.

1. INTRODUCTION

Nowadays our life compare to older generations are completely different due to internet. Internet is now available for most of the people in earth. Wireless network is the most popular type of network among the internet users in the world. One type of wireless network is called MANET (Mobile ad hoc network).This type of network is used in many areas in our daily life. So what is MANET and why it's so popular. Main properties of MANET are in their infrastructure. MANET infrastructure is decentralised type of network. Decentralised means this type of network does not have pre-existing infrastructure. Like don't need extra router like in wired nodes also doesn't need access point to connect on internet like wireless networks. This features makes MANET so useful in different applications like battlefield grounds, medical emergency, military communications another really important situation where MANET can be used when the electricity is off due to natural disasters it can be built quickly. In MANET each nodes (mobile devices) acts as a both router like in wired networks and as an access point in wireless network. In these research we are going to investigate how MANET manage to both act like as a routing device and an access point. Each nodes in a MANET can be a client, server or just a node. This applications can all be done by the routing protocols which are created especially for to improve the performance of the MANET. In MANET nodes are free to move this is the one of the main reasons why the MANET are so popular but this property brings lots of drawbacks to quality of the service in network, constantly changing network topology means nodes should also constantly evolve by the needs of the network. In a basic MANET there is one source node and destination node and each node has a transmission range where nodes can sends and receive data packets to another node if the node is in its transmission range if not it's have to use other nodes as a bridge. Our main aim in this research is investigate and understand how routing protocols work in MANET and how their performance change according to different environment conditions. These different environment conditions can have huge influence on performance of MANET. In these research our environment conditions that we tested the performance of the MANET ROUTING PROTOCOL are mobility models, node density, node velocity, and routing protocols that we used in this experiments is AODV and DSR. According to the simulation results routing protocols are compared by different node metrics which details are explained in later sections. To understand the importance of the routing protocols, performance of MANET is decided by the results of different parameters. To explain each section in these paper. First background research is done where our aim is to understand how routing protocols in MANET works and functions of mobility models where we compare them in experiments. First we test routing protocols in different velocity values. These will able to us how purely just to see effect of velocity in the efficiency of network while in the second experiment only variable that we change is the number of nodes in the simulation area and this experiment allow us to see how routing protocols work in different node density . Last experiment which main aim of these paper is to see how different mobility models and their effects to performance of network in different scenario. In summary these paper will allow us the explore MANET in different perspectives and allow us to understand their position in Networking. [1]

2. Background Research

2.1 What is TCP/IP?

TCP/ IP is called for the entire protocol suite that makes the internet where allows the each of the computers in the world to communicate with each other. TCP/IP sets specific rules and provides one packet to transmit safely from source node to destination node. The whole internet protocols are divided in two parts. TCP stands for transmission control protocol and IP stands for internet protocol. IP specifies how devices exchange data over the internet with each other. TCP specifies how applications create a communication channel. TCP converts the packets into specific forms where they can transmit safely and then remakes them to available to other devices by remaking there are encoding and decoding the packets while IP gives the specific address of the source and the destination devices to be sure all the data packets sends and received by the right address. Basically it's essential for network reliability and repair in failed connections. From the Figure 1 you can see that TCP/IP has four different layers.

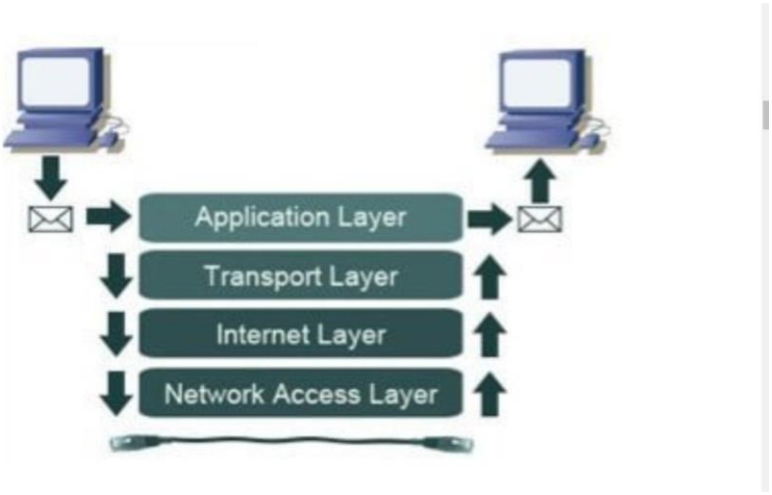


Figure 1

- Application Layer=Makes all the applications data exchange standard. Example : HTTP, FTL .
- Transport Layer=Provides end to end communication across the network.
- Internet Layer=Connects network to each other where enables packet to go through the network. Ex: IP, ICMP.

- Network Access Layer=Function is connect hardware devices like nodes to the network. [2]

2.2 fixed Infrastructure network

In normal standards wireless networks are based on fixed structure of infrastructure. Where each fixed network structure has a connection to base station and with the help of these base station all the fixed network structure can start a communication with each other. Some example of these type of network is listed below also figure is provided to see how infrastructure less network looks like. The figure 1.1 below contains base station, laptop, desktop computer and access points.

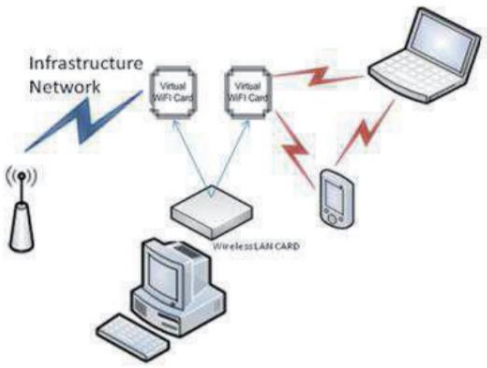


Figure 2

2.2 Infrastructure less network

Infrastructure less network is a terminology where it's used in MANET (mobile ad hoc network) .There structure is opposite of the infrastructure less network, they don't have a fixed structure. This makes them so different from any other network technologies that created until these days. Their main properties are listed below

- Nodes (mobile devices) can move freely these makes them unique where these property bring lots of obstacles like constantly changing network topology.
- There no central point in the network

- Communication between the devices are weaker compared to less infrastructure networks.
- Their security approach is not safer as the other fixed structure networks.

These properties allows them to use in so many different areas in real life. [2]

2.3 Routing protocols in MANET

MANETs are network where consists of mobile devices. These mobile devices biggest advantage compared to other wireless devices they can move freely. Due to MANETs nature which is movement its need to be portable so instead of extra routing devices to perform routing ,each mobile device has its routing protocol in their system. Routing allows the information to send from source to destination. As we know MANETs are new technology and is constantly improving while still routing protocols have some challenges which needs to be overcome to have better quality of communication between devices. Routing protocols main aim is to find optimal path between source and destination node to exchange data packages with each other. To find these optimal path routing protocols need to discover the nodes in its range where these nodes are used as a hub or bridge by routing protocols to reach the data packages from source nodes to destination nodes. Each routing protocol have its unique algorithm, different algorithms means each routing algorithm has its own behaviors according to their environmental situations so in this paper we are going to look deeply in these behaviors. Routing protocols are categorized in classes by their network structure and routing strategy.

2.4 Classification of routing protocols in MANET

There are different kinds of routing protocols in MANET. These routing protocols can be categorized in 3 types. These are reactive, proactive and hybrid routing protocols. In these paper our focus will be in the AODV and DSR which IS classified as Reactive routing protocol.

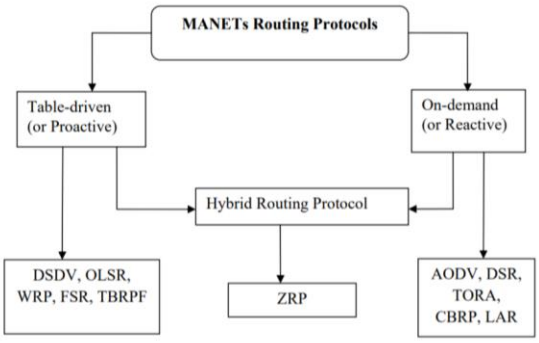


Figure 3

2.4.1 Proactive Routing protocol

Our main area that we interested in this research is reactive routing protocols but understanding the other types of routing protocols will help to get better foundation before going into further details about the AODV and DSR protocols which are reactive routing protocol. In proactive routing protocols each node in a network stores the routing table information which is updated as

the network topology changes. Nodes can understand if there is a change or not by sending broadcast message through the other nodes. So in theory these all means that nodes should know whole topology of the network. One significant thing that proactive routing protocols is known for it's continuously knows the new up to date routing table information, and each nodes save this routing table information into their routing heads, but this sometimes contributes too many unused, no need table information's to be saved in routing head where, its causes to memory of the routing head to be full so quality of the service can be lower because of fulling the capacity of router head.

2.4.2 Hybrid Routing Protocol

As you can understand from its name Hybrid Routing protocols this protocol can be both Proactive or Reactive routing protocol. Zone routing protocol is one example of Hybrid routing protocol where it uses both proactive and reactive protocols when sending information in network. ZRP routing protocol consist of 2 sub routing protocols called Intra-zone Routing Protocol (IARP) and : Inter-zone Routing Protocol (IERP) which is proactive and reactive routing protocols respectively.

2.4.3 Reactive Routing protocols

Reactive Routing protocols can be also known by the name on demand routing protocols. The reason why it's called on demand routing protocol is, it's only activate its features when there is a demand for that and this is also one of the common main features of reactive routing protocols which makes the difference between other types of routing protocols. This means that reactive routing protocols unlike proactive routing protocols doesn't work continuously this helps to increase the efficiency of the service while in some situations it can create problems as well. So it's only starts to work when one node wants to communicate with another node. These feature makes Reactive routing protocols on of the most popular routing protocols in MANET. Reactive Routing protocols consists of two parts, Route discovery and route maintenance .To explain these procedure one node wants send data packages to another node. Source first checks its route table if there is a route to the destination node. By these checking if the node sends data packages before to destination nodes it can find the route from its route table otherwise its need to start route discovery process. This is where one of the drawbacks of reactive routing protocols occurs where if the route is not in the route table of the nodes, sometimes finding the route to destination node can create delay in the whole process and this cause to some data packages lost during the transmission between source node and destination. Two reactive routing protocol that we are going to look further is dsr and aodv the main difference between them is when they are in the phase of route discovery dsr use source routing while aodv use hop to hop method. If we obtain any performance difference between these two routing protocol the reason that create this difference is their route discovery method. [3]

2.4.3.1 WHAT IS DSR?

The dynamic source routing (dsr) is categorized in on demand routing protocol. This is because they find and save the routes to nodes when there is a demand for it. Dsr protocol routine has two main part one is route discovery and route maintenance. If a node wants to send data packages to another node first thing it does, determine the saved routes in its route cache and after searching if saved routes find in its route cache for that destination data packets are ready to send otherwise it should start the route discovery process. To start this process route request packets are send as a broadcast through the network. Route request packets are consist of address of both destination and the source node as well as unique id number. By broadcasting this route request packets each node that received this packets check if its have the route to that destination node, this packets send through the nodes until one of the node knows the route to the destination node also address of every intermediate nodes is saved to its route cache. Source nodes waits until it received route reply packets. Route reply packets are send by the destination node or one of the intermediate node. There are two ways where this reply packets can be send through the source node .One way is the using the route that is already establish by the route request packets if this way is still available if not its creates own route discovery. Second part is route maintenance. You can think route maintenance as a last check before sending data packets to the destination node. It check if route that is going to use to send data packets changes its topology or any other link failure. In summary its check if there are any transmission problem in the route between destination node and source node and if any problem is find Route error packets are received this let to delete that address in route cache which creates a problem in data transmission. . To understand whole process better you can see is from the list provided which shows step by step.

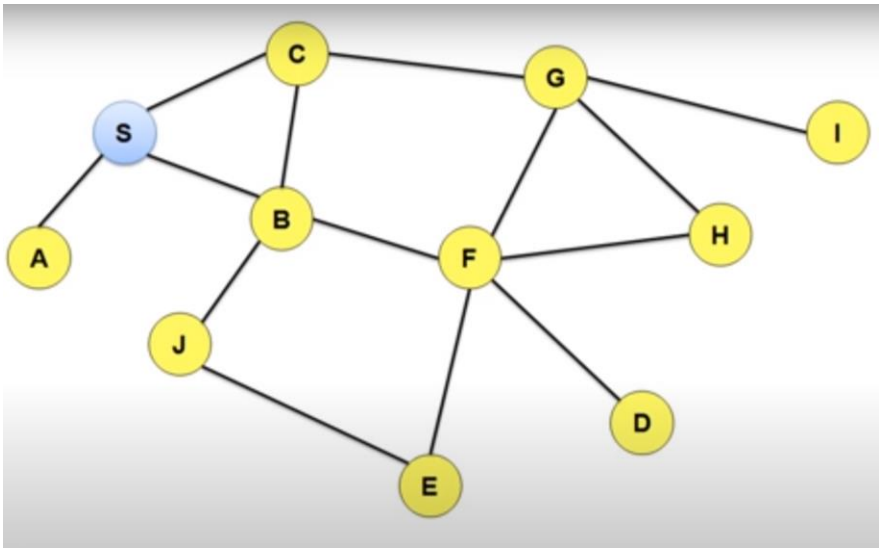
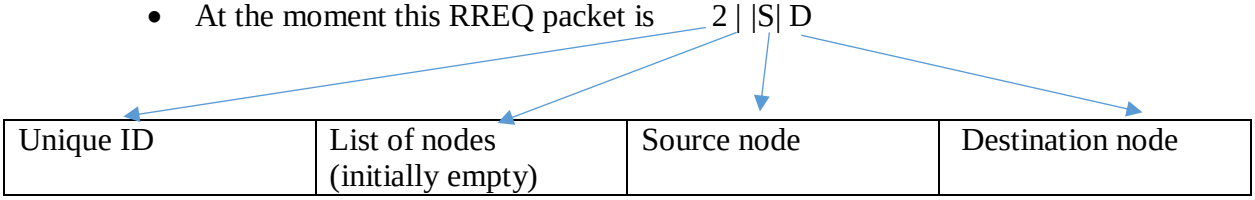


Figure 4

- Node S wants to send data to Node D
- First it needs discover the route to Node D. This is done by sending RREQ packet by broadcast to its neighbour nodes.

- At the moment this RREQ packet is 2 | |S| D



Unique ID	List of nodes (initially empty)	Source node	Destination node

Table 1

- As this RREQ packet reaches to node C the packet becomes 2|C|S|D.O
- The list of nodes section in the package is constantly upgraded by the nodes that is passed by RREQ packet. This helps to when RREQ package reach to NODE D, where node D able to see reverse path to source node.
- By this method this RREQ packet is send through the all nodes in the network. Until it reaches to node D.
- When RREQ packet reaches to node D, Node sends RREP(Route reply packet) by the same route.
- After a time if node S wants to send data to again node D. The route is saved in is Route cache.
- If the topology in the network change, route maintenance phase is applied. This is where RERR package is send back. This allows to nodes to delete to previous route and find the again a new route to destination node. [4]

2.4.3.2 WHAT IS AODV?

The ad hoc on demand distance vector (aodv) is a routing protocol which consist of both algorithm of DSDV an DSR. It's basically better version of DSDV routing protocol. Like dsr, aodv has two parts as well route discovery and maintenance. For route discovery part aodv has sequence number and a broadcast id where sequence number can be seen as a time stamp.IN aodv routing protocol the number of RREQ packages that are sent through the nodes are much lower than the dsdv protocol this is due the it's a reactive routing protocol where doesn't have the complete names of the routes in its route cache also doesn't have any route information and they do not change their route cache information with other nodes. To learn the route to the destination node aodv sends broadcast RREQ (route request).This packages forwarded by each node until the package find the destination node.You can see from the figure below how this packages forwarded. aodv has destination sequence number. Destination sequence number is used as if the route information is fresh or not. It's introduce lots of advantages like prevention of routing loops and avoid of old and broken routes. So with aodv routing protocol each nodes has its own broadcast id and nodes ip address. Broadcast id is the unique number that able node to see which nodes RREQ is went through. Every time rreq passes through a node, broadcast id is incremented as well as the ip address, this makes unique rreq packages. This rreq packages send through to nodes until if the packet reaches to destination node or one of the intermediate nodes have a freshly available route to reach the destination node. Once it reaches to destination node, an RREP packages send to source node to let it know that there is an available route to destination node and what is this route. One big difference is that RREP is send by unicast not like broadcast as RREQ. From the figure below you can see how RREP is send back to source node. For the route maintenance this RREP can send back by only symmetric so while rrep is going through the source node and if the nodes in the route changes its position, this movement can be captured by the neighbourhood nodes and nodes sends failure message, if the route is still desired the route discovery process is repeated. To understand whole process better you can see is from the list provided which shows step by step. [4]

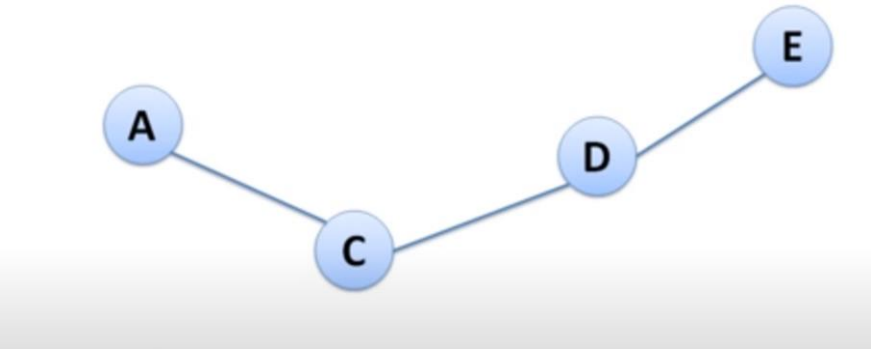


Figure 5

- A is the source destination wants to establish connection to node E, which is a destination node in this scenario.
- A sends RREQ packet to its all neighbour nodes.

In this scenario RREQ packet is <A,1,1,E, ,0>.

Source address	Source sequence number	Destination sequence number	Destination address	Destination sequence number	Hop count

Table 2

- The only neighbour of the node A in this scenario is c. So when RREQ reaches to node c the hop count is incremented by 1 then C checks if it's have available route to node E and finds nothing. C add an entry for reverse path to source node. Current RREQ packet situation is <A,1,1,E, ,1>.
- Then C broadcast RREQ packet to node D. From previous step reverse path is added also by this way node d knows that if it wants send packet to source A the packets need to pass node C and the current RREQ packet situation is <A,1,1,E, ,2>.
- Using same method node D broadcast this RREQ packet to node E.Another thing like node C,node D also creates entry for routing table wich provides the route information of this packet.This able node E to see it has to send RREP packege back to node D in order to this package is succesfully transmitted to source node which is A.So the new RREP packet is

<E,A,120, 0>.

Source address	Destination address	Destination sequence number	Hop count

Table 3

- This RREP packet send through the node A as the same process of how RREQ packet send to the destination node.

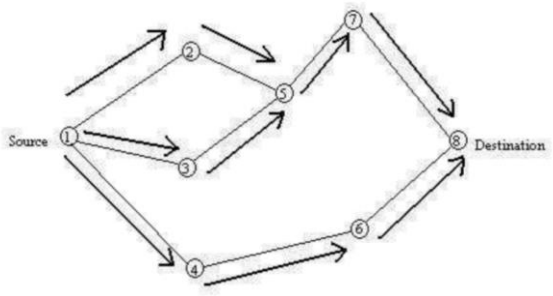


Figure 6

RREQ

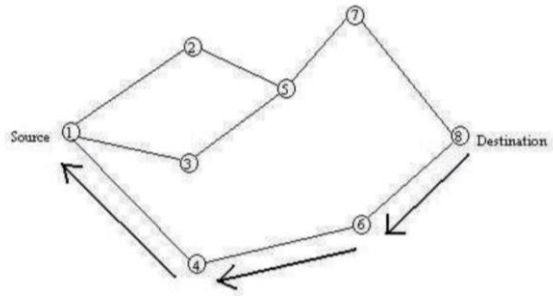


Figure 7

RREP

2.5 Mobility models in MANET

Mobility models are really important factor in according to movement behaviours of the nodes. In order to test a MANET in a simulation environment it should if not same but similar as possible to the real world environments. Different types of mobility models has huge influence on performance of the routing protocols. There are lots of different types of mobility models where most of them are synthetic ones. Synthetic mobility models are models which they are created for simulation environments. The figure below show some of the different type of mobility models. We will be concentred on random based mobility models.

[5]

2.5.1 Why synthetic mobility models?

Synthetic mobility models are the opposite of the trace based mobility models. Trace based mobility models gives as results from people who use network in real life. To create an experiment from trace based mobility it's have lots of drawbacks but results are more obtainable and more realistic. First of all to test a trace based mobility model you need to have huge number

of participants in your experiment and you need to create a real life scenario. This will need huge amount of budget as well as consume lots of time. That's why most of the research about mobility models are done according to synthetic mobility models. [6]

2.5.2 Categorization of mobility models

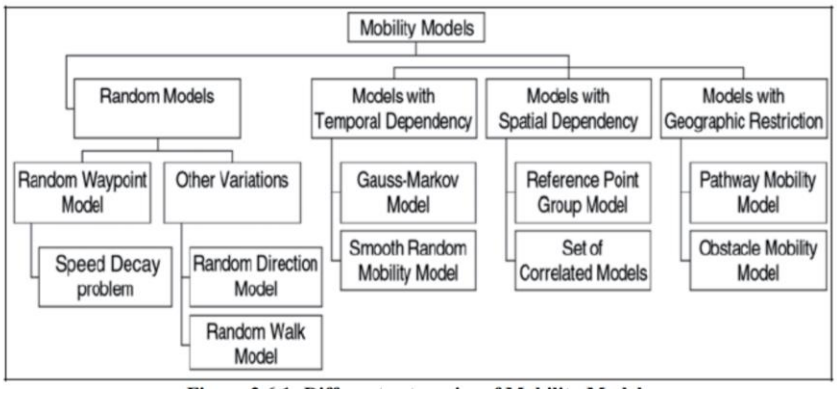


Figure 8

2.5.3 RANDOM BASED MOBILITY MODELS

2.5.3.1 RANDOM WALK

Random walk is a mobility model where nodes moves randomly. Direction and speed of nodes are randomly chosen. Randomly direction moves node can move direction from 0 to 2pi and velocity between 0 to max velocity. Every movement of the node is randomly, the previous movement of the node doesn't have any effect in the further movement. So every movement of the node is randomly and independent. Most of the time the direction and the speed of node is changed after specific time but in some cases their movement can change after a specific distance. This happens when the node reach the boundaries of the simulation area. The figure below shows the movement of random walk mobility model. [7]

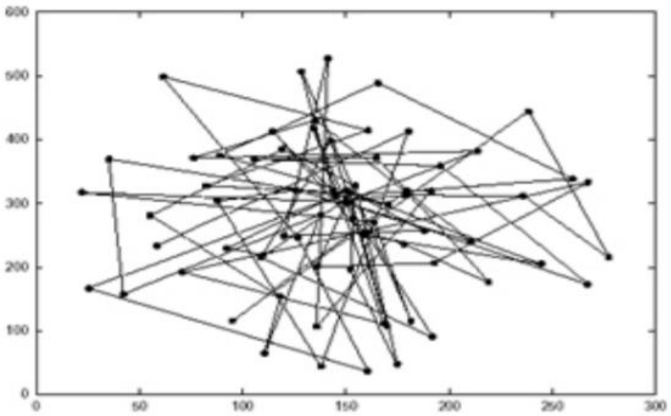


Figure 9

2.5.3.2 RANDOM WAY MODEL

Same as the random walk model, in this model the movement on the nodes are randomly by acceleration, velocity and the direction of the node. One big difference is random way model has a pause time .Pause time is a range of time that is introduced to nodes after a random movement is done. In random way model speed can be 0 to Vmax. Another thing in random way model , let assume we set the Vmax to to nodes , we want to be these value always constant so the experiment results will be more realistic but that's not the situation most of the time. The speed is chosen uniformly between 0 and Vmax so we assume the velocity value is Vmax/2.Annother problem in the simulation environment can occur is as we know Velocity is chosen randomly between 0 and Vmax but the thing is as the time passes the average velocity will be closer to 0 so after point velocity will be 0.To overcome this problem Vmin can be change to 1m/s instead of 0. [8]

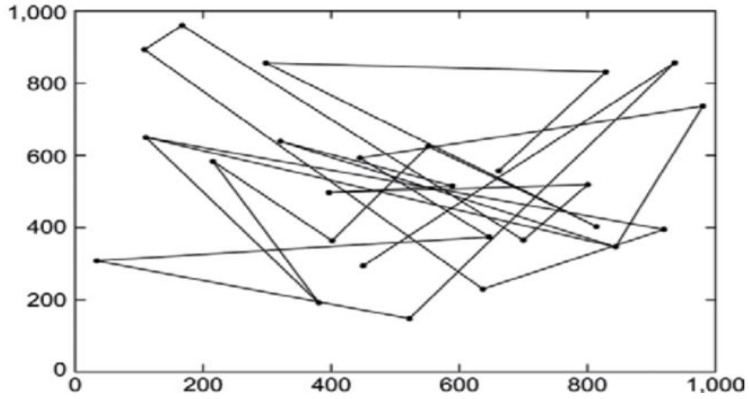


Figure 20

3. Methodology

3.1 Simulation Overview

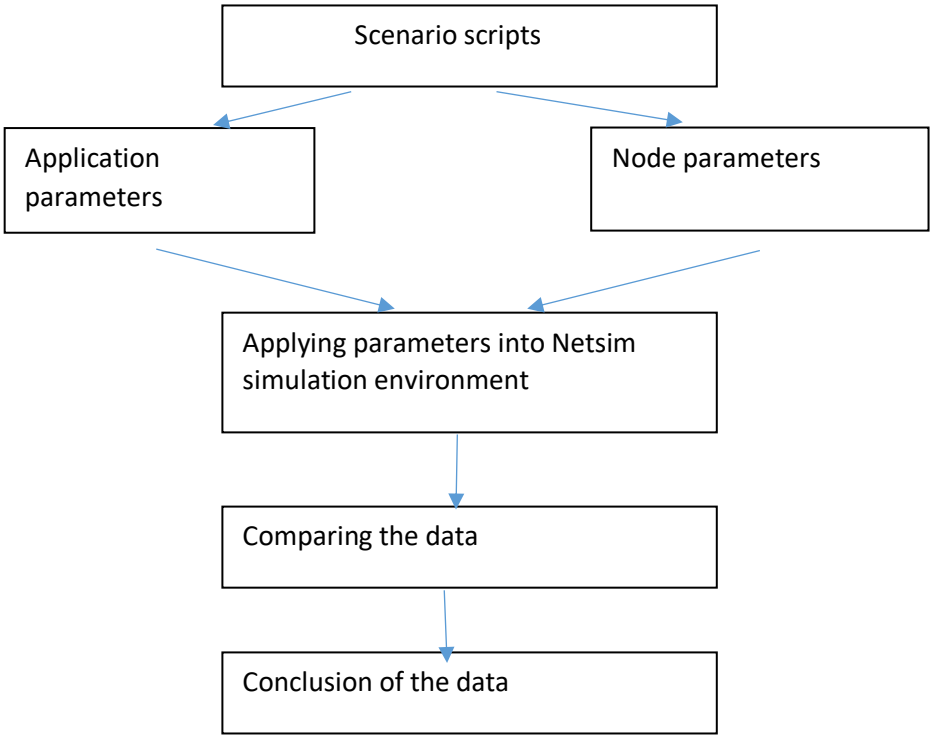


TABLE 4

3.1.1 Netsim simulation environment

Scenario scripts gives us the brief introduction about the scenario that is going to be applied in the simulation environment. Scenario scripts basically divided in to two parts one script gives us information about application and the other part gives us information about the nodes. Application parameters are the values of the link that enables the connection between individual nodes. Example to application parameters can be the type of the connection unicast or broadcast, size of the packets that send through the nodes and Inter arrival time of the packet. Node parameters are the properties of the each node in the simulation and how this nodes are places in the simulation area. This can be the velocity, number of nodes or area of the simulation. Netsim simulation environment is chose to this experiments because of its capabilities. As we this research is concentrated on wireless networks. Some of its functions are listed below.

- Mobile Adhoc Networks - DSR, AODV, OLSR, ZRP
- Wireless Sensor Networks - 802.15.4
- Cellular Networks - GSM, CDMA

These are the main functions that can be used for testing MANET (Ad hoc network).

4. Experiments

Protocols	Performance Metrics	Variable parameters
AODV,DSR	End to End Delay, Packet Delivery Ratio, Throughput	Node density
AODV,DSR	End to End Delay, Packet Delivery Ratio, Throughput	Node velocity
AODV,DSR	End to End Delay, Packet Delivery Ratio, Throughput	Mobility model

Table 5

4.1 Performance Metrics

To evaluate which routing protocol shows better performance in different scenarios we need to calculate and compare some values which can show us the quality of network. In these experiment we used 4 different of performance metrics. These metrics are data drop rate, average

end to end delay, media access delay and Throughput. To understand what these values refer to well explain further details below.

4.1.1 DATA DROP RATE

Data drop rate shows us the rate of transmission of data packages between source node and the destination node. It can be calculated by

Number of loss data packages / Total number of data packages * 100 = Data drop rate

The number of loss data packages during transmission can increase by due to congestion on the network and buffer overflows. Congestion usually happens when network device is overloaded and cannot accept additional packets at a given moment and to explain what is buffer is,it's a some part of the memory of your device where it's a temporary holding place for data when your device has a network between another external device in these network your device can be both sender or the receiver. Overflow of buffer happens any time more information is written into the buffer than there is space allocated for it in the memory.

4.1.2 End to End Delay

End to end delay is average time taken for a packet transmit through source node to destination node. End to end delay is a popular term in ip monitoring. To don't get confuse with RTT (Round trip time) one simple difference between them is End to End Delay time is measured only one way where RTT is complete trip time of packet transmission both sending and receiving. As we said end to end delay is only One way we have to assume that it's the half of RTT, by this we also accept the fact that the forward and back paths are the same in terms of congestion, number of hops, or quality of the service. Average delay = Σ (tr - ts) /Pr, where ts is the packet send time and tr is the packet receive time.

4.1.3 Jitter

Jitter is mainly one kind of latency that happens when receiving data packets. Jitter can be caused by several reasons. These reasons can be network congestion, improper queuing, or configuration errors, this steady stream can become lumpy, or the delay between each packet can vary instead of remaining constant. At the sending side, packets are sent in a continuous stream with the packets spaced evenly apart. [9]

From figure below you can understand what happens to packets when jitter occurs.

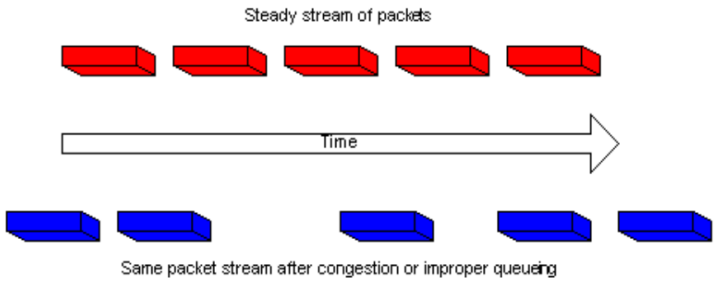


Figure 11

The packets that are steady stream has minimal value of jitter while packets have different gaps between them occurs because of the jitter.

4.1.4Throughput

Throughput is one of the most crucial values in the network system that can determine the speed and the quality of the network. Throughput shows the amount of data packages that successfully transmit from destination node to source node . Througput is calculated in a limited amount of time. Generally throughput is calculated bits/sec or byte/sec even in some other studies throughput values are shown by megabits per second (Mbps) or gigabits per second (Gbps).In manet network throughput can be effected by lots of factors such as mobility of nodes, traffic load, limited bandwidth, and power constraint .

The throughput can be calculated as follows:

Throughput (bps) = $Number\ of\ Delivered\ Packets * Packet\ Size * 8\ /\ Total\ Duration\ of\ Simulation$

[10]

4.2 Experiment 1

Performance analysis of routing protocol in varying node velocity

The aim of these experiment is too see how different velocity will have impact on the different routing protocols performances. As the velocity increase nodes will have higher probability to have a neighbour node. What me meant as a neighbour node is , nodes that are transmission range to other nodes but at the same time this can be disadvantage as some packets will lost through the transmission. From the result of this experiment we'll able to have clue about what is the real effect of different velocity to the performance of the network. Detailed simulation parameters can be seen from the table below also screenshot of how nodes are distributed is provided below the tables.

4.2.1 Node Parameters

Node parameters	Values
Area	250 m x 250 m
Mobility model	Random way point
Traffic type	CBR(constant bit rate)
Number of nodes	24
Packet size	512 bytes
Simulation time	100 sec
Node velocity	1 m/s ,10 m/s 100 m/s

Table 6

4.2.2 Application Parameters

Application parameters	Values
Packet size	512 bytes
Inter arrival time	20000 micro second
Application type	unicast

Table 7

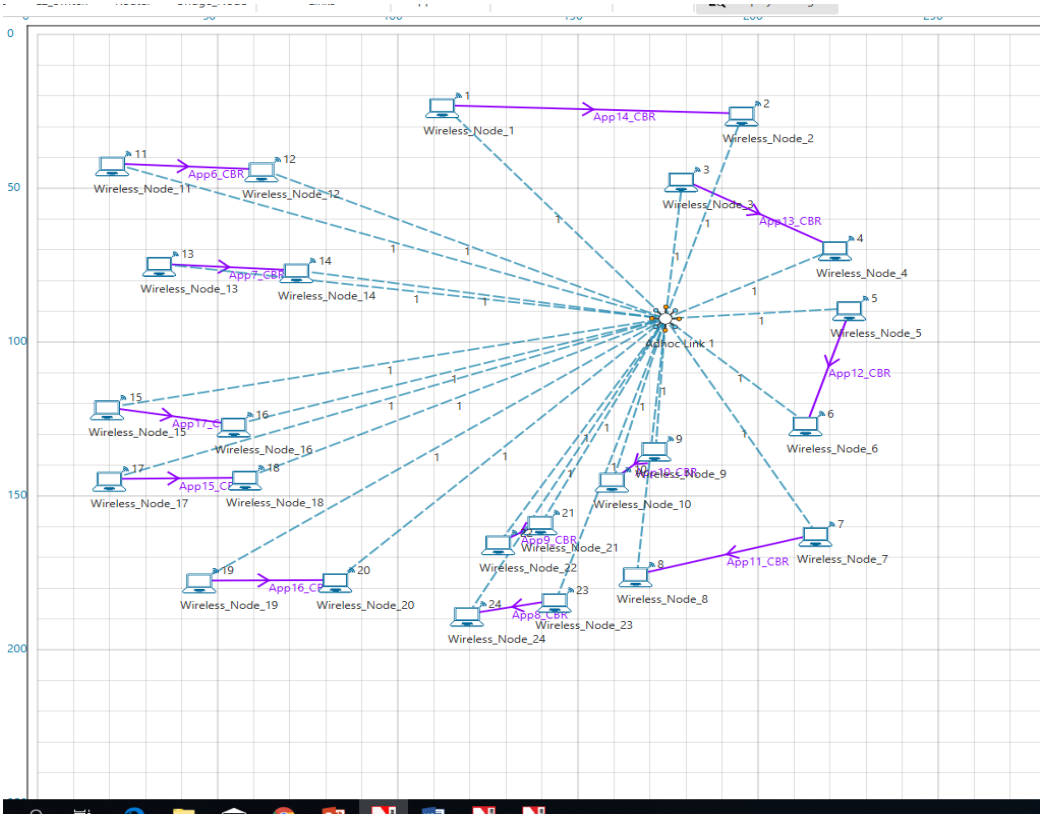


Figure 12

4.2.3 Results of experiment 1

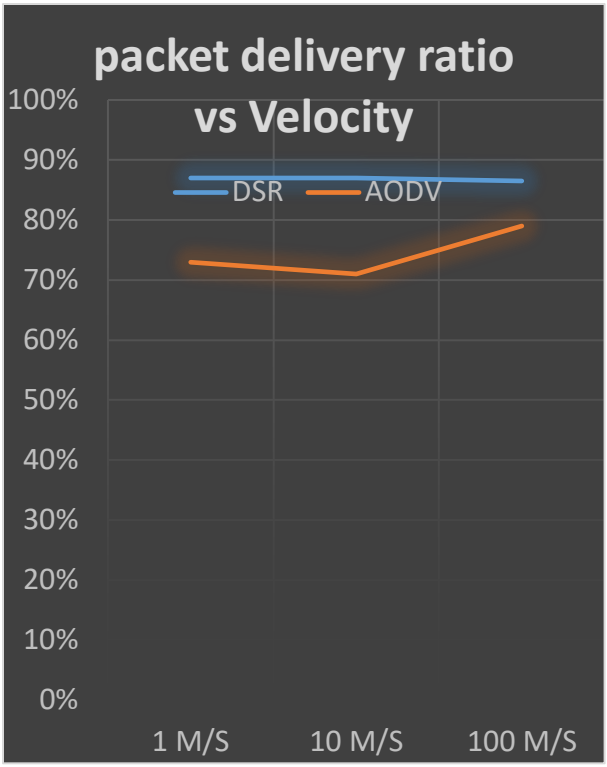


Figure 13

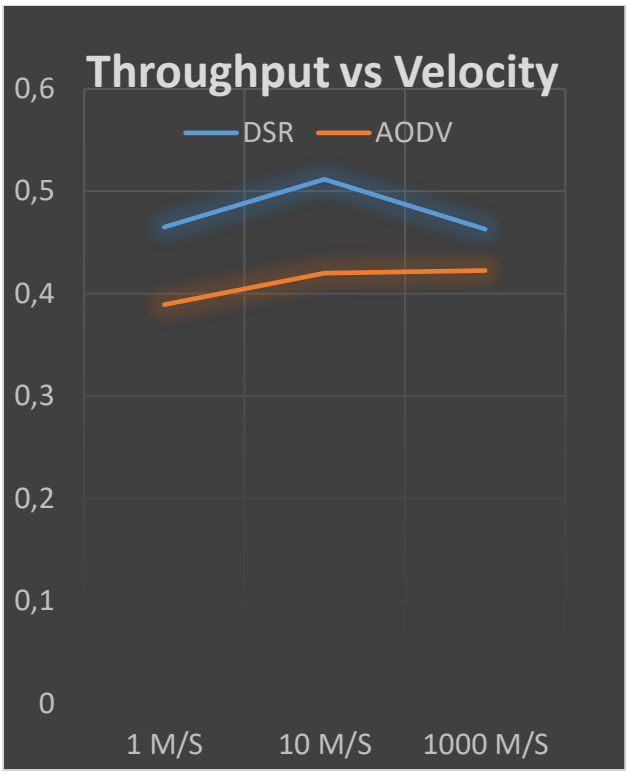


Figure 14

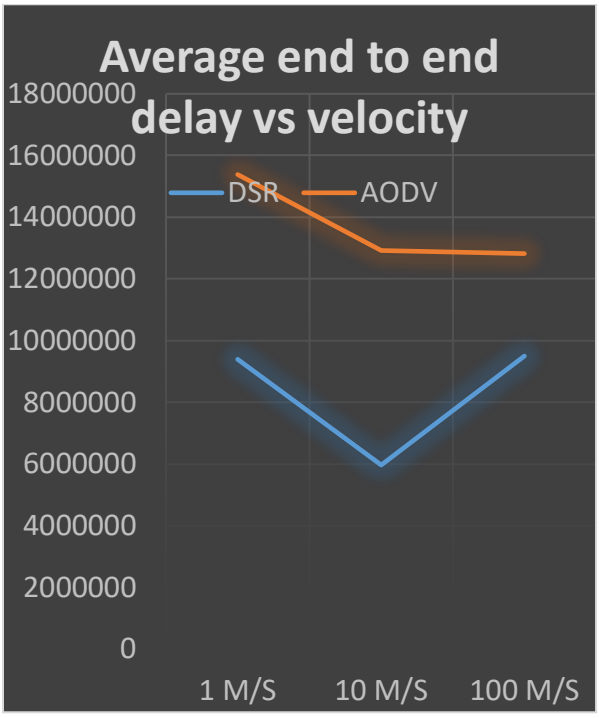


Figure 15

4.3 Experiment 2

Performance analysis with varying node density

In this section simulation is done by netsim simulation environment where performance of two routing protocols are compared on different node numbers. To be a fair comparison other parameters like pause time, velocity , size of the packets and other parameters that keep constant can be seen from the table below. Like other experiments result parameters that we are going to compare is end to end delay, packet delivery ratio and throughput.

4.3.1 Node parameters

Node parameters	value
Protocols	Aodv , Dsr
No of nodes	10 , 24, 50, 100
Area size	100 x 100
Mobility model	Random walk
Traffic type	Cbr (constant bit rate)
Packet size	512 bytes
Simulation time	100 sec
Node velocity	1 m/s

Table 8

4.3.2 Application parameters

Application parameters	Value
Inter arrival time	20000 ms
Application time	Unicast.

Table 9

4.3.3 Results of experiment 2

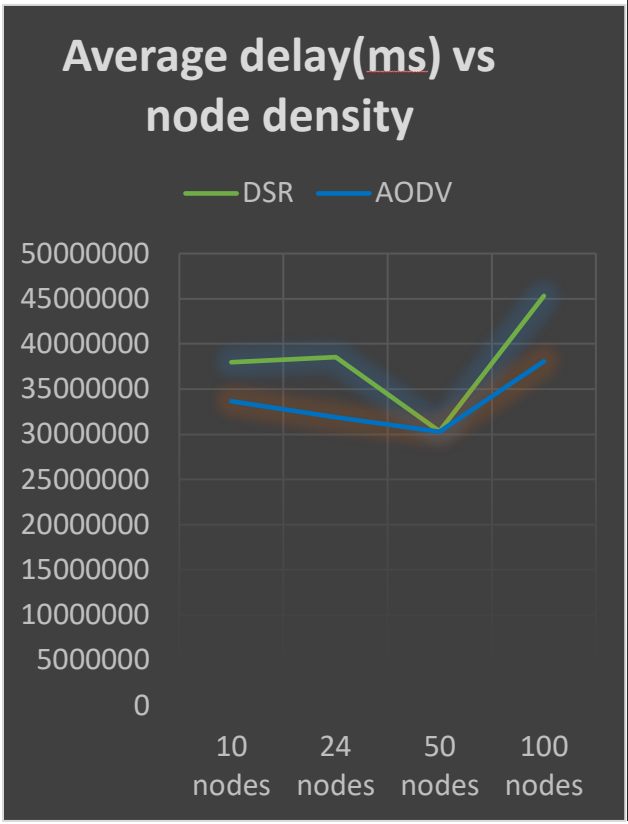


Figure 16

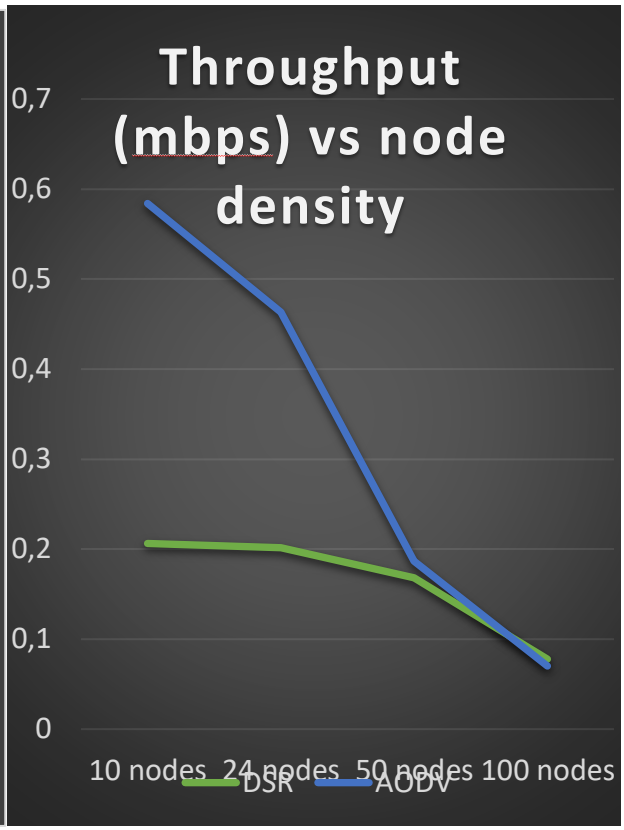


Figure 17

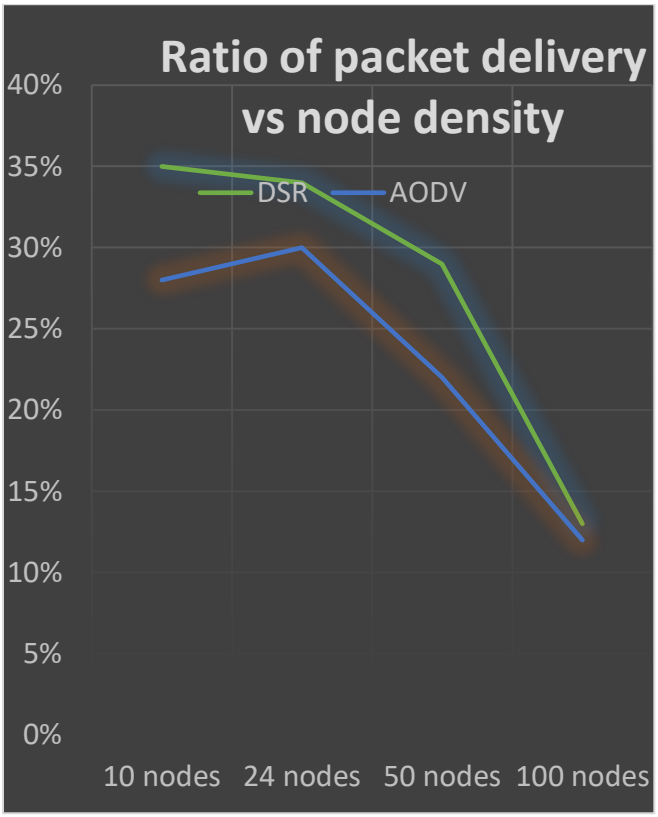


Figure 18

4.4 Experiment 3

Mobility models and their influence on Routing protocol performances

In this experiment we compared the different mobility models in various mobility speeds. Aim of these experiment is test different mobility models in different velocity. The mobility models that we use in this experiment is Random walk model and random way model As we can understand from the name the logic behind these two mobility model is so similar. Direction that picked up by mobile device chose randomly but after reaches the boundary in the simulation area or excess the distance of the transmission, mobile nodes introduced by pause time in random way model while in random walk without picks randomly a direction without waiting a certain amount of time. These property of random way model can effect better on some circumstances also can effect bad on the performance. From these experiment we want to have conclusion about what and how these pause time have effect on performance. To be a fair experiment and the conditions to be similar as the real life. We put our nodes in 3 different velocity values. First value of velocity is 1m/s which can be considered as human walking speed. Second value is 10m/s which we think these value as human as running or cycling.Last velocity 0value that we test the performance of nodes is 30m/s which these value can be considered as a human in a vehicle like car, bus or any other transportation.

4.4.1 simulation parameters

In this part results of the experiment will analyzed respectively to different parameters jitter, end to end delay, data drop rate and throughput. Table below shows us the properties of the simulation environment and changing these properties can really effect the performance of the routing protocols so these are the constant values.

Environment size	500 m x 500 m
Number of nodes	10
Protocols	AODV ,DSR
Wireless Radio	802.11
Packet Size	512 bytes
Application type	CBR(constant bit rate)
Simulation time	100 seconds
simulator	Netsim
Mobility models	Random walk m

Table 10

Mobility model	PAUSE TIME (SEC)	Routing Protocol	VELOCITY M/S	DATA DROP RATE	End to end delay (sec)	Jitter(msec)	Throughput
RANDOM WALK MODEL	0	AODV	1 M/S	2.08%	**0.004030**	**9614,10035**	**0,4819501**
RANDOM WALK MODEL	0	DSR	1 M/S	1.80%	**0.004800**	**11600,05813**	**0,583731**
RANDOM WAYPOINT	1 SEC	AODV	1 M/S	2.05 %	**0.004043**	**9620,05813**	**0,4813731**
RANDOM WAYPOINT	1 SEC	DSR	1 M/S	1.80%	**0.004809**	**11686,062891**	**0,5832621**
RANDOM WALK MODEL	0	AODV	10 M/S	2.75%	0.003904	10032,341	0.5230161
RANDOM WALK MODEL	0	DSR	10 M/S	2.63%	0.004631	**11767.543**	**0,5624142**
RANDOM WAYPOINT	1 SEC	AODV	10 M/S	2.84%	**0.004011**	**10048,90106**	0,5207282
RANDOM WAYPOINT	1 SEC	DSR	10 M/S	2.72%	**0.004566**	**11668,782**	**0,5730286**
RANDOM WALK MODEL	0	AODV	30 M/S	3.12%	0.004154	11999,000	0.5630161
RANDOM WALK MODEL	0	DSR	30 M/S	2.99%	**0.004376**	**12166,29438**	**0,5623528**

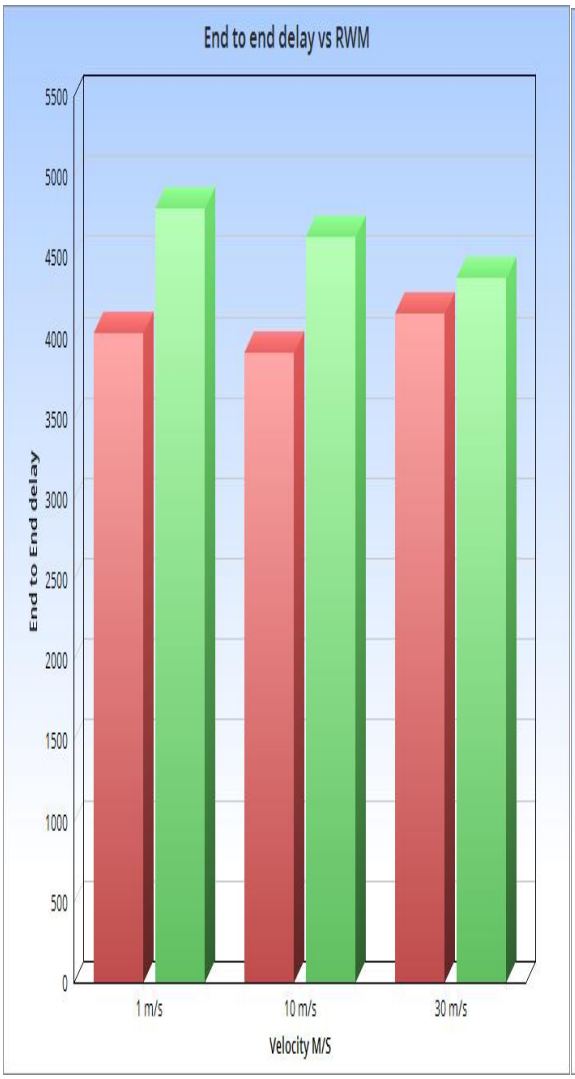
RANDOM WAYPOINT	1 SEC	AODV	30 M/S	3.25%	**0.004119**	**11991,05896**	**0,5672159**
RANDOM WAYPOINT	1 SEC	DSR	30 M/S	3.15%	**0.004340**	**12319,26359**	**0,5632005**

Table 11

4.4.2 Results of experiment 3

= AODV

= DSR



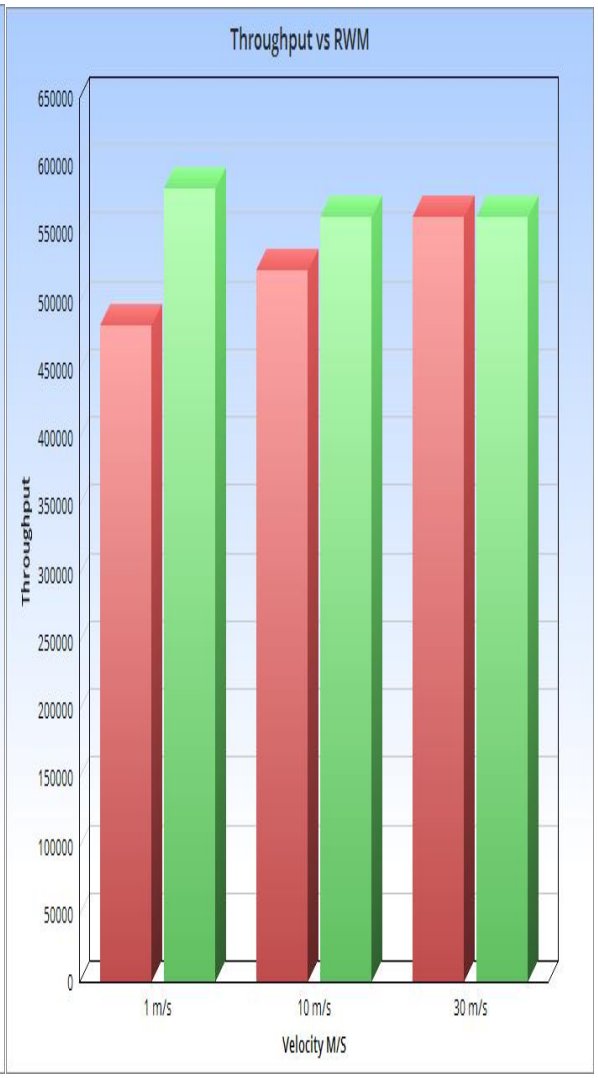


Figure 19

Figure 20

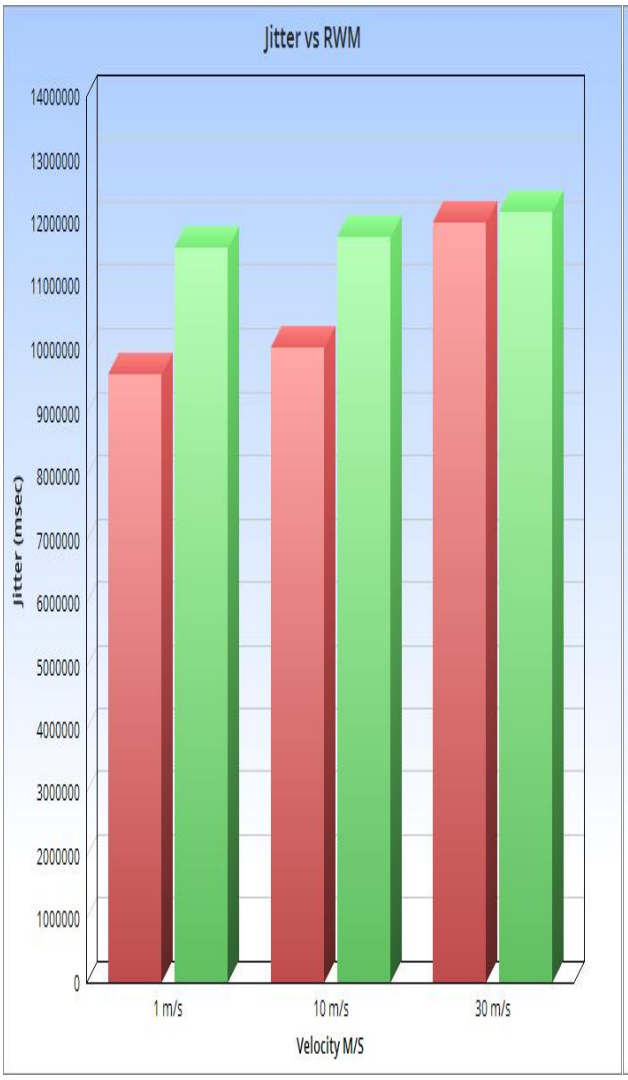


Figure 21

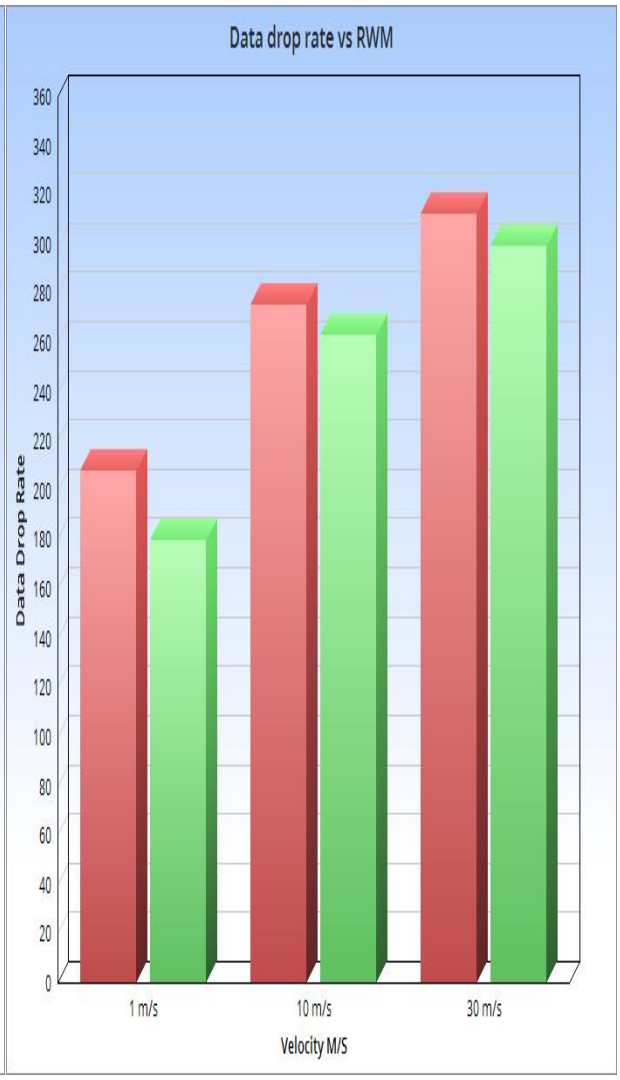


Figure 22

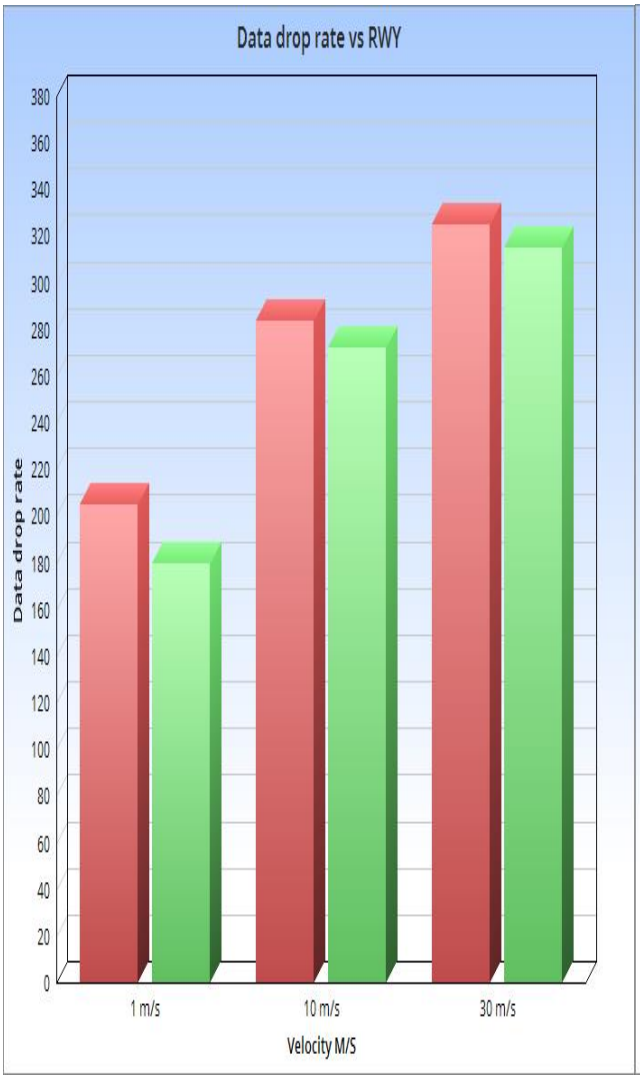


Figure 23

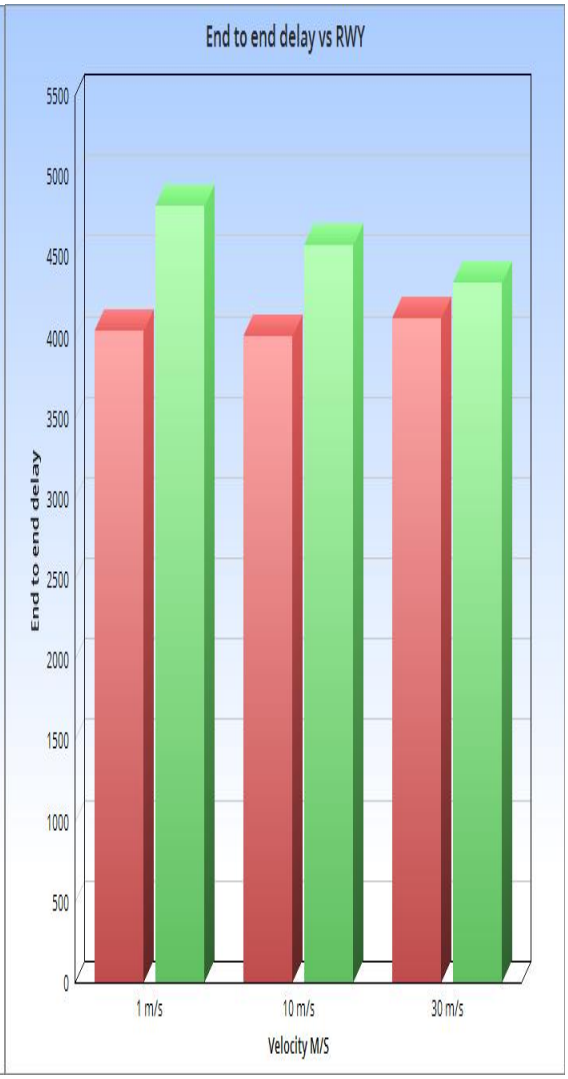
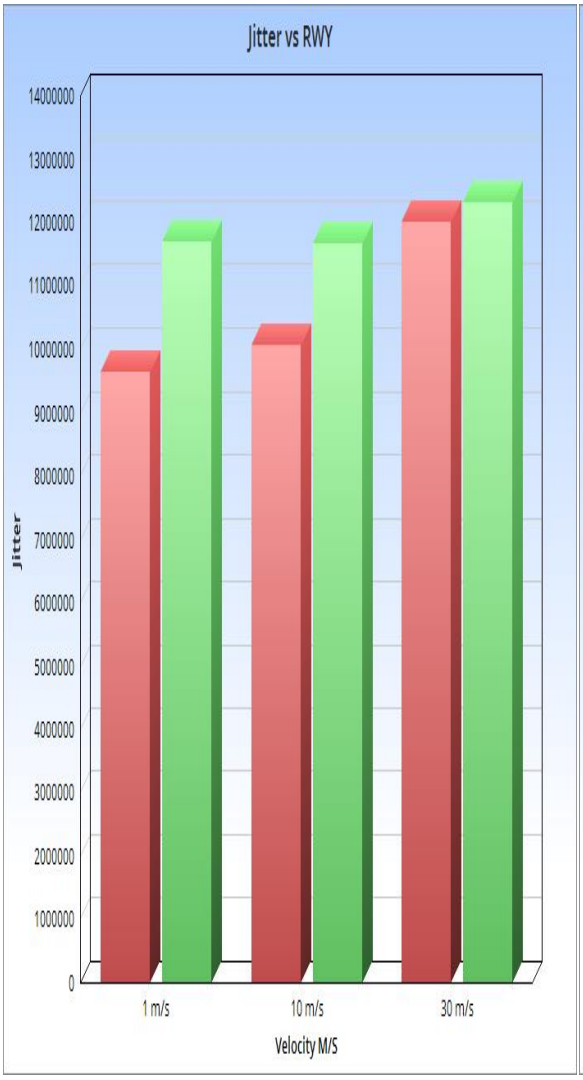


Figure 24



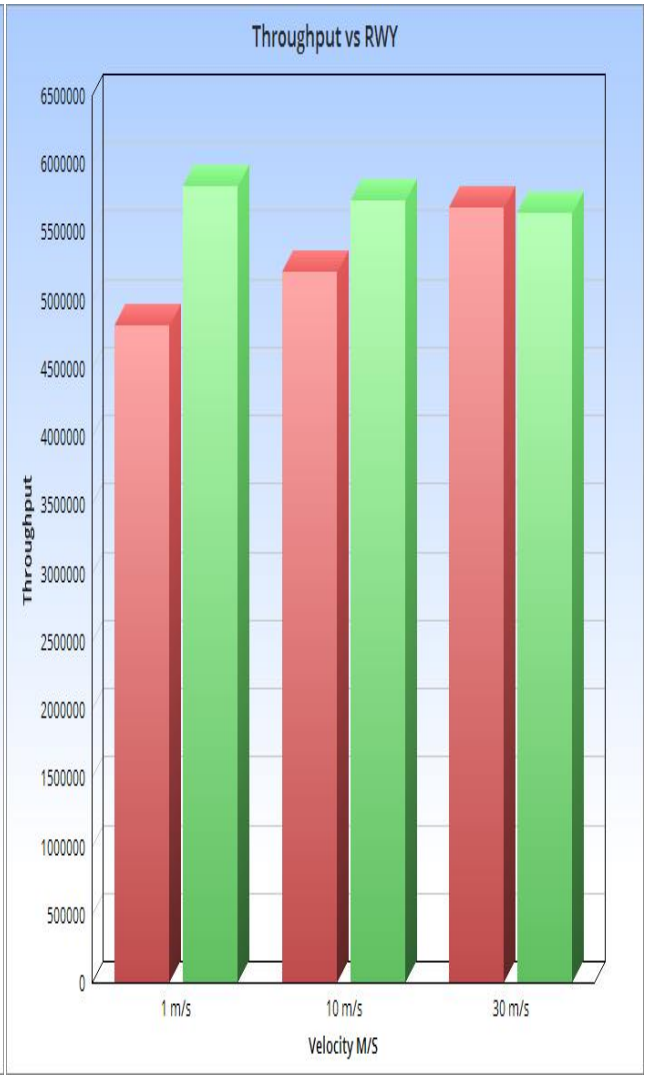


Figure 25

Figure 26

5 Experiments Analysis and conclusions

5.1 Results Analysis and Conclusion of experiment 1

5.1.1 Packet delivery ratio vs velocity

From the graph we can understand that overall DSR shows better performance in packet delivery ratio ,but as the velocity increase the performance of AODV in delivering the packets is increases, so in higher velocity AODV shows better performance while DSR shows decrease in the packet delivery ratio.

5.1.2 Throughput vs velocity

From the graph th0e efficiency of the network with aodv routing protocol gets better as the velocity increases while performance of the reaches peak point at 10m/s and than decreases while the velocity of the node is 100m/s.

5.1.3 Average end to end delay vs Velocity

From the graph we can see that DSR has lower end to end delay while this situation is changing as the velocity increases. DSR shows the peak performance on 10 m/s and AODV show its peak performance at 100m/s.

5.1.4 Conclusion of experiment 1

Overall we understand from these experiment is Dsr shows better performance in AODV in all velocity .This is due to aodv has destination sequence number which prevents of routing loop and avoidance of old and broken routes this creates an overall decrease in the performance where not much of connection lost happens in lower velocity while at higher velocity much more connection problems occurs so at these situations AODV recovery part works better.

5.2 Results Analysis and Conclusion of experiment 2

5.2.1 Average delay (ms) vs Node density

In terms of average delay there is not much difference between AODV and DSR performances but AODV show better performance while both routing protocols reach their peak efficiency in 50 nodes while as the number of nodes increases AODV has lower trend in the increase of average delay on the other side Dsr has higher trend. This let us to conclusion in higher number of nodes AODV performance is better then Dsr but in terms of lower number nodes using Dsr protocol will be a better option.

5.2.2Throughput vs Node density

In terms of Throughout low on number of nodes lead significant performance difference between aodv and dsr where aodv shows much better performance while as the number of nodes increases
The gap of throughput value decreases where at 100 nodes both routing protocols gives us the same value.

5.2.3 Packet delivery ratio vs Node density

According to ratio of packet delivery when the nodes number are 10, DSR show better performance but as the number of nodes increases Dsr value is getting lower while Aodv reaches its peak point when there are 24 nodes .After this point aodv values has a constant decrease while dsr has much more trends especially when the nodes number selected as 50 nodes .In 100 nodes both routing protocols shows similar amount of ratio of packet delivery.

5.2.4 Conclusion of experiment 2

Overall conclusion is that performance of DSR is good for lesser number of nodes, while AODV performs well for larger number of nodes. This is due to difference between route discovery part where dsr use source routing technique while aodv uses hop by hop routing. Source routing has couple of disadvantages. One of the biggest disadvantage is each data packets have the complete routes from source through the destination node. So as the number of nodes grows in the area, the data packets that are sent to find the destination node will pass by much more intermediate nodes. This causes increase in the amount of overhead in this data packets and this led to increase in delay and the probability of the link failures.

5.3 Results Analysis and Conclusion of experiment 3

5.3.1 Throughput vs RWM and RWP

In terms of throughput, at lower speed DSR shows better performance then AODV but as the velocity increases the gap between AODV and DSR decreases .This means that at high speed AODV shows better performance.

5.3.2 Jitter vs RWM and RWP

In terms of jitter Dsr has higher jitter compared to AODV .Increasing the velocity cause both of the jitter values of the routing protocols to increase but AODV shows little more increase compared to DSR.

5.3.3End to end delay vs RWM and RWP

Dsr has larger end to end delay comparted to AODV. Rising up velocity cause decrease in the delay of the Dsr but at the same time AODV values stays at similar points.

5.3.4 Data drop rate vs RWM and RWP

In terms of data drop rate both aodv and dsr shows same trend whereas the velocity increases there is a slight increase in the percentage of the dropped data packages.

5.3.5 RWM vs RWP

Both mobility models work under the similar principles, so random walk model and random waypoint doesn't have different effects on the performance of routing protocol. But changing the pause time may give different results. Changing the pause time can led to decrease in the mobility so path breakage might occur. Increase in the path breakage can have effect on the performance. AS more path breakage routing protocols have to spend more time on maintenance in this broken paths.

5.3.6 Result analysis

In conclusion both random way point and random walk model shows similar in terms of the all performance parameters. This is due to only difference between rwm and rwp is pause time and in this experiment we kept pause time difference only one second. Increasing the velocity has effected decrease in the performance of DSR while slight increase in the performance of AODV. This led us to conclusion that in terms of higher velocity AODV has better performance while Dsr has decrease in the performance. Performance difference between these two routing protocol occurs due to Dsr needs much more time to get the routing information. Increasing the velocity enables Dsr to obtain all the routing information of the other nodes in smaller amount of time. Dsr consumes much more time because of the source routing. Two main reason of source routing compared to hop to hop routing consumes much time is ,as the intermediate routes increases the percentage of getting failure between link is also increase another reason is increase overhead in each data packet this let also decrease in general performance of DSR routing protocol. In summary getting all the routing information led delays and due to delays some packages through the transmission are lost. [13]

6 Further work

Further simulation needs to be done to understand better each of the routing protocols. Not only the velocity but changing the parameters like pause time, different mobility model and comparing mobility models in different number of nodes and network load may give us different results. To be much clearer about witch protocol shows better performance number of different scenarios should be increase as well. Security aspect in Manet remains one big problem in MANET networks , creating a security attack scenario can give us which routing protocols has better security algorithm where security is one of the biggest challenge. Another parameter can be add to these simulation scenarios is applying in a different network area.

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