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**A study of AODV and DSR protocols**

A meta-analysis of AODV and DSR protocols

**George Ludwig Maalouf**
Abstract

There is a big number of people dying every year from car accidents and not solving this problem is a big issue. Communication protocols have been created in mobile ad-hoc network (MANET) to be able to solve this issue. AODV and DSR are two protocols that are used in this communication. The fact that there is mobile nodes makes it hard to keep track of the efficiency of this communication. This study has for objective giving a better understanding as to which protocol performs better and answering four important questions to know to be able to evaluate what protocol is better according to those parameters or criteria. The implemented method to solve this problem is through a meta-analysis and this meta-analysis is done through a qualitative research, literature review for critical literature reading and data collection to select the appropriate studies and excluding the irrelevant studies based on other criteria. The evaluation of these parameters are based on others’ work and reading the work from critical eyes. This study compares AODV and DSR from the criteria that are chosen. The study has a critical analysis of the results collected through the different papers show that AODV has outperformed DSR in most of the cases and answering the proposed questions in the study. Finally concluding that AODV is more effective in the case of high congestion compared to DSR but making a bit hard to have a clear cut answer when it comes to the criteria but AODV performed better in all the cases in high congestion.

Keywords: MANET, AODV, DSR, Meta-analysis.
Acknowledgements

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My special thanks goes to the people that have supported me during my studies and thesis first and foremost my family and girlfriend that has been my support all the way. My friends that have been there are: Bashar Deesha, Karrar Al Khalidi, Reza Moossavi, Rula Talal, Sebastian Persson, Anton Flodin, Carl Abiad, Adil Farid.
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George Ludwig Maalouf

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Terminology

Abbreviations

IoT Internet of Things
ITS Intelligent Transportation Systems
VANET Vehicular ad-hoc network
AODV Ad-hoc on demand distance vector
DSR Dynamic Source Routing
1 Introduction

The Internet of Things (IoT) is an ever growing technology that is being implemented in many various domains such as home appliances, cities, vehicles and others. The reason that Internet of Things is growing so fast is that the ease and the technology behind it. A user will find it easy to control what that person owns on distance, meaning through the Internet for example: opening and closing your garage door with your mobile phone while sitting in your room or at your work space. The IoT has many sub-parts; one aspect is the transportation systems, the subject of this study will be about: Intelligent transportation system (ITS) which is a part of the IoT in particular the vehicle to vehicle aspect.

1.1 Background and problem motivation

The Internet of Things is a new technology that has been fast growing all around the world and along its way it has raised questions about the use and other various questions that is involved, the area of interest in this study is about intelligent transportation in particular and the different protocol applied to vehicle to vehicle communication system and how to possibly give a better result. According Wai and Shengwei [1] there is a high rate of deaths and accident that happened alone in the year of 2000 (41000 deaths and 5 million injuries) this can be counted as a high number especially if the amount of drivers and cars have increased in the past years. According to Sumra, Hasbullah, Lail and Rehman [2] says that the human lives are being lost every year in the thousands during road accidents all over the globe, the introduction of Vehicular Ad hoc Network (VANET) has for goal; is to have a certain range of safety messages between vehicles to make sure that people are safe. This provides a message to the network as a whole such as in case of an accident that has occurred notifying the authorities about the location and the drivers around that area. That is why this study will answer the question:” What can be improved in the protocols of AODV and DSR that are used in VANET?”

1.2 Overall aim

The project’s overall aim is to identify some of the parameters to be able to evaluate which of the following protocols that are used in Ad Hoc On-demand Distance Vector (AODV) and Dynamic Source Routing (DSR) are better in certain cases and coming forward to a possible solution or an improvement for the current communication protocols.

Objectives:

- Summarizing the results of the two protocols based on certain parameters.
- Making a meta-analysis for several chosen authors’ works.
- Concluding the study and analyzing the collected data.
1.3 Research Question

To reach the objectives in a better way four questions that need to be researched are created:

1- Which protocol between DSR and AODV has better delivery and receiving data per number of nodes?

2- Which protocol between DSR and AODV has better average end to end delay?

3- Which protocol between DSR and AODV has better throughput of data?

4- Which protocol between DSR and AODV has lower jitter?

1.4 Scope

The study has its focus on different parameters that are taken into focus and these parameters are:

- Number of packets delivered and received per number of nodes.
- Average end to end delay.
- The throughput of the data.
- The average jitter

These parameter are chosen for the study because of the importance they show in communication from node to node. These parameters are what defines the effectivity of the packets reaching from one node to the other. Studying the delay and jitter are of high importance to show what routing protocol route is best to be taken during congestion and communication problems as well as the time for information packets to reach the destined node. The throughput is of importance to know the amount of data the different protocols can absorb throughout the communication.

The parameters that have been excluded from this study are of such:

- Security measures
The speed of the nodes movements and how it may affect the packet delivery.

The reason this study excludes such parameters is because the security issues are a big part of a different field thus making it hard to implement or take up security challenges in this study. This study does not have any interest in the energy consumption or the movement of the nodes and how it may affect the different parameters that are included, the reason is that as important as these the parameters there may be many other factors that may come to play and affect the communication which are difficult to control or keep track off. Thus this does not mean that they don’t play a role but choosing to ignore these factors gives a clearer image to what is in perspective.

1.5 Concrete and verifiable goals

A meta-analysis study between the two protocols AODV and DSR from the chosen criteria that are packet ratio, end-to-end delay, jitter and throughput.

1.6 Outline

This study is divided into six different chapters. The first chapter motivates why this topic was chosen including the problem formulation. The detailed information of the objectives of this research and questions are presented. Chapter two explains and gives a background information to the reader to have a better understanding of what is being studied. Chapter three explains the methodology for this whole study and how the data is collected and analyzed. Chapter four presents the results of the meta-analysis through using the different research papers. Chapter five analysis the different results that are presented and the final chapter concludes this research and presenting ideas for future studies.
2 Theory

This part of the study is describing and giving the necessary information to understand what the study has for information.

2.1 Internet of Things

Atzori, Lera and Morabito writes [3] about Internet of things (IoT) as the new technology of the era. It has a strong impact on the daily life of people, where the application of this technology can be used at home and at work. It is originally thought of as the “Thing” as to be connected with help of Radio-Frequency IDentification.

Gubbi, Buyya, Marusic and Palaniswarni explains [4] that the connection should be done with already existing networks for making IoT work. With help of Wifi and 4G-LTE networks it is possible then to communicate wirelessly and the difference between IoT and mobile phones is the connectivity of everyday appliances with the help of embedded systems. The wireless technology that is used varies from Bluetooth, to RFID and other wireless communication systems. There are different elements that exists in IoT such RFID that uses microchips which helps identify the objects that they are connected to. Wireless Sensor Networks are an efficient and effective way easing the process of data collection and analysis.

According to Babar, Stango, Prasad, Sen and Prasad [5] the Internet of Things is a form of connection between digital devices, people and the different type of advantages they offer. It is possible to retrieve and deliver different type of information about their surroundings. The idea is to simply the life of the users, the different belongings that the user may have can be transformed to connect through the network connectivity with the help of sensors, embedded systems. Cars, cards and other daily used objects can be transformed to connect to the web to deliver some type of information to their owners thus in the process revealing a lot of personal and private details that the owner may not wish to share.

Abomhara and Koien describes [6] how the Internet of Things is a set of entities that are connected within each other as the figure 1:
This figure is a representation of how the device is attached to the entity and this entity can be a human or a car or something else. The service has access to resources which are the same as the one from the devices that use making this service to device connected. Security threats are a visible in the Internet of Things applications and these devices that are connected are vulnerable to attackers. There are several reasons that can lead to security reasons such as: Unattended devices are easy targets for attackers to physically take over them. Wireless communication and networks are a good media for attackers to try to obtain some type of data that is send through the net. IoT devices can communicate with other devices through different mediums such as 3G or WLAN and others. These devices that uses Internet of Things have a low security complex due to their low power and limited resources in computing capabilities. Cyber threats are able to create some type of danger and damages through systems, in homes and other embedded systems on small and big scales. Opening the door for IoT technology is possibly facing security problems. Devices that are connected to the IoT must be protected from threats but since most devices are open to external and internal threats because of their properties so this will impose a challenge to be able to put in place some certain security measures due to the limitations that are from memory, computational power and the power from batteries.

2.2 Intelligent Transportation System
Barfield and Dingus writes [7] that the Intelligent Transportation System (ITS) is a crucial element to reducing traffic jams or crashes. The solution that is based on information to be delivered to drivers is a cheap and effective solution. The ITS has a vast range of technology that is done to enhance the safety and
efficiency of drivers. The technology has a need for advanced sensors, computer and communication the ITS tried to make a significant improvement in the world of transportation.

Cardoso, Mastelari and Bassora writes [8] that cities that have a big population and are considered big cities, are facing today a big problem with infrastructures leading to chaos in traffic. Intelligent Transportation Systems (ITS) are a communication between systems of computers. These Systems are implemented to give a safer and more efficient transport system for the people.

2.3 Ad Hoc Network

According to Abushiba and Johnson [9] Ad Hoc network is a group of nodes that are connected, this connection is made through wireless communication that can organize themselves with the help of protocols and algorithms. The information or data is transmitted through processors that is built in every node and this processor decides which part of the information is important to send. Ad Hock network faces many problems a few are worth naming such as: extension of the life span of the network to a maximum value by using energy saving algorithms. There are a lot of bandwidth that needs to be allocated to send messages on a high speed. The battery life is an issue as well.

2.3.1 Ad-Hoc Routing Protocols

Shaheen, Gaamel and Bahaj describes [10] the routing protocols’ job by transferring packets from the start node to the final node that should be reached. They continue saying that ad-hoc networks does not have the same behavior as LAN routing protocols, the reason is that ad-hoc networks contains nodes that are mobile making it hard to follow one defined topology. There are three categories in Ad-hoc networks that are: Proactive, Reactive and Hybrid. Describing shortly every type of routing protocols: Proactive is such a type like Destination Sequenced Distance Vector (DSDV), reactive protocols such as Ad-Hoc on Demand distance vector (AODV) and Dynamic Source Routing (DSR).

2.3.2 Reactive Protocols (Source-Initiated On-Demand Driven)

Nayak and Gupta writes [11] about the behavior of the protocols through taking the same routes that are being used this way the protocols are minimizing the weight of the network, they are known as On Demand Routing Protocols meaning that the roads are not known before starting to route. The main node that sends out the data is called “source node” and it asks for a discovery of a route in case data needs to be transferred. Latency is common among On-demand routing but have lower routing overheads. Known protocols that are Reactive Protocols are: AODV and DSR.
2.3.3 Ad Hoc On-demand Distance Vector Routing Protocol (AODV)

Nayak and Gupta explain [11] that the reactive nature of the routing protocol means that a route is requested upon a need, meaning that mobile nodes have no need to keep routes active while no data is being send. AODV uses a sequence number showing the “age” of the route which means that it is a loop-free routing is in use. A routing table is used to keep track of the entry route for each destination route. Some information is saved on these routing tables such as:

- The destinations IP address which contains the necessary data for which a route is established.

- Next Hop: A node that is chosen to help carry the data or the final node itself.

- Hop count: Is the amount of hops needed to reach from the starting to the finishing node (Start IP address and destined IP address).

The advantage of using AODV is routes that are chosen and started are depending on the demand, the newest route used is used and the least delay is there for connection setup. The disadvantages are that using unidirectional links is not allowed, Multiple Route Reply is a reason for overhead and periodic beaconing consumes extra bandwidth.

2.3.4 Dynamic Source Routing Protocol (DSR)

Nayak and Gupta writes [11] about DSR that it gives a list which contains all the hops that need to be followed to reach its’ destination, this list is added in the data packet header given that the final destined node is known. To be able to know this destination node, DSR protocol checks the cached routes in case the destination is not found, a path search will be initiated. The route finding starts with the help of Route Request message (RREQ) packets through a broadcast which is send. RREQ has sender and destination address, this facilitates for the nodes in between to check the designated address and check if the path is known, if the address is unknown the intermediate node attaches its address to the route record and sends it to the following. Looping is prevented through the fact that a node throws away the request it has recently received from the initiator in case the same initiator has saved the address of the receiving node. The route maintenance is done with the help if route error packets and acknowledgments. When the broadcast is send, the node awaits an acknowledgment, in case an error occurs and a certain acknowledgment is not returned a request for acknowledgment is send. After a pause a route-error (RERR) is produced and is sent to the initiator of the packets.

2.4 Performance parameters metrics

This part explains the different parameters that have been chosen for this study out of an ad-hoc routing protocol perspective.
2.4.1 Average jitter
According to Dixit and Shrivastava [12] Jitter shows the unclear behavior of the data transportation for the mobile ad-hoc network, showing that the data does not behave in a correct manner. The lower the jitter the better the protocol performs.

2.4.2 Average End-to-End delay
Dixit and Shrivastava continues explaining [12] the end-to-end delay saying that it is the time required for a packet data to reach from the start node or known as the source node to reach the final node that is needed also known as the destination node. This average end-to-end delay should be as small as possible.

2.4.3 Throughput
Dixit and Shrivastava writes [12] that the throughput is the median rate which the messages are delivered. The type of communication used is usually wireless communication channels. The method the throughput is calculated is the successful transmission of the data in a single unit time. The throughput is usually calculated in bits/seconds.

2.4.4 Packet delivery ratio
Nayak and Gupta explains [13] that the packet delivery ratio is the number of packets that has successfully reached the destined node to the ones sent from the source node it is calculated by this way: Packet delivery ratio = (received packets/sent packets) * 100. This is usually expressed in percentage.
3 Methodology

This chapter is to describe the method of addressing the research at hand and explaining why this approach is a suitable way to reach the set goals. This part of the research explains the way the data is collected and the techniques that are used for analysing data.

This study will not have any interviews, it will be only based on research papers and facts will be taken from these research papers to be able to evaluate the results and see how accurate these results are through doing a meta-analysis. The results that will be taken are what are relevant and interesting to the parameters named in chapter 1, the parameters that are not related to the study or the results from the research papers will be disregarded in such case. To answer the question proposed in chapter 1.3 a literature review will be done and information will be collected from various research papers. Thus conducting a meta-analysis.

Choosing the right method to research and having the right research methodology is primordial finding the right material for supporting this study. According to Walliman [14] research methods are the tools and they provide the correct ways to get, sort and analyse the data to reach the right results. The table (table 1) contains the necessary information for the method and the details will follow afterwards.

Table 1: Research Strategy

<table>
<thead>
<tr>
<th>Type of research</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Objectives:</td>
<td>Review and Meta-analysis of protocols AODV and DSR.</td>
</tr>
<tr>
<td>Type of Research:</td>
<td>Qualitative Research</td>
</tr>
<tr>
<td>Research Method:</td>
<td>Literature Review</td>
</tr>
<tr>
<td>Research Scope:</td>
<td>The scope is based on publications and taking into consideration the parameters/criteria chosen</td>
</tr>
<tr>
<td>Data Collection:</td>
<td>Data collection through: Published papers and journals (Google Scholar, MIUN Database)</td>
</tr>
</tbody>
</table>

3.1 Qualitative Research

According to Creswell [15] a qualitative method is based on the constructivist perspectives as he would call it and the person inquiring gets new information and trying to develop it. The person doing this study collects the data in the intent
of doing a development. This approach has different roles/goals to achieve like participatory knowledge claims, grounded theory, collecting data from studies, studying these studies, validating the accuracy of the findings and bringing personal gain to the study.

Bowen explains [16] triangulation which is a combination of different methods which studies the same study, through studying the same objective according to different methods the person studying can come to findings through a set of data and this will lead to a reduction of personal regard/input that is present in a single study. It is of high importance to say that qualitative research should have a strong data collection technique and that the documentation of the procedure to research is clear.

This type of research is so the most appropriate methodology to apply for reaching the set goals, a summary of DSR and AODV behaviour from a certain criteria checking the different studies and taking into consideration the different results. To be able to achieve the required set of goals one should have a good understanding of the material and the studied area, the research’s scope is based on studying facts and results not doing a statistical study which justifies why a qualitative method is a better choice than a quantitative study in this meta-analysis case.

3.2 Systematic Literature Review

Okoli and Schabram writes [17] about the different reviews that are concerned in a research literature and believes there are a variety of reasons: such as answering some important questions that are practical by studying existing research on that topic. The writers believe that a literature review is a based on previous studies and researches, describing and explaining the work. Leading to a contribution in that field is something of a must, but one must be critical of the work. There is a necessity in literature review that is presented in a thesis: it gives a clear idea of how well the student has understood the subject that is being researched, the capabilities and dedication that the student has for this study, it contributes to future research and it teaches the student educational tradition and etiquette. Some guidelines has been set to have and to follow especially in the case of a scientific study: “Purpose of the literature review” in the first step is to identify and define the purpose and goals of this review. “Protocol and training” the persons/researchers should be in agreement of how they will proceed. “Searching for the literature” explaining how the literature search has been done and justifying how the search was done. “Practical screen” the researcher is required to be explicit about which studies are included and which ones are excluded, explaining why they were not taken. “Quality appraisal” the reviewer has to explicitly tell the criteria for judging the articles, explaining both why some studies are included and others are excluded. “Data extraction” a systematic extraction of data and information from each study has to be done. “Synthesis of studies” using either a qualitative or quantitative or both to analyze the taken data. “Writing the review” the systematic literature review has to be detailed so that the study can be redone.
Fink has defined [18] that literature review should be done systematically and following a certain methodology, it should be very well explained and follows a certain procedure, the scope should be understandable and containing relevant material believing that others that are to do the same study should be able to follow the same steps. But one should be critical of the work through a good analysis.

Through this data collection scientific articles are chosen to help write a meta-analysis. Finding and collecting the research so a review can be conducted. Parameters that have been chosen are taken into consideration and the papers that include parameters that are not wanted will be excluded with an explanation. This study has included researches done from 2015 and over to keep track of the latest technology and advancement in this field considering that it is a very advanced and actual topic. Studies that has possibly 1 or 2 parameters out of the 4 chosen will also be excluded, the scenario is not something that interests the part of excluding but it is advised to use close enough scenarios such as real time simulations with well-known programs to avoid weird results.

### 3.3 Data collection

The chapter about Systematic Literature Review explains that one should have a purpose and a scope for doing this research thus helping the researcher determining the literature. This study has for purpose a comparison study of AODV and DSR protocols in vehicle to vehicle communication from the following parameters: Jitter, packet delivery ratio, end-to-end delay and throughput. Considering which one of the protocols is better in certain a case or scenario. The search has for criteria:

1- Literature that contains AODV and DSR.

2- Literature that has its focus on the different criteria mentioned in the scope.

3- Literature that has taken up AODV and DSR while adding a specific word like "performance".

The data has been collected though using the filter for the years they were published and the chosen year is 2015 and above, the reason is to keep up to date to the latest development. Searches on Google Scholar and MIUN Library database are the main way to have collected the information. Table 2 is a statistic of the 3 different type of searches that has been conducted and the amount of papers available. Reading through the titles and reading quickly the abstract of every study and taking the closest to what is needed to analyze the 4 named parameters.

**Table 2: Search result [14]**

<table>
<thead>
<tr>
<th>Type of search</th>
<th>Google Scholar</th>
<th>MIUN database</th>
</tr>
</thead>
<tbody>
<tr>
<td>AODV DSR protocols</td>
<td>2030</td>
<td>2714</td>
</tr>
</tbody>
</table>
There is a considerable amount of data and information to be used but for the purpose of specifying, being concrete and critical of the articles that are to be chosen the processing method is based on: Recent papers since 2015, Academic/scientific sources such as the IEEE database and the studies that has included the criteria mentioned. Thus leaving us with a good number of papers still so the method applied was to go in every paper and find 8 that was talking about the subject and criteria at hand. Papers that had nothing to do with the study or relatively remote were excluded from the search. Table 3 shows the chosen papers and who their authors are.

Table 3: Chosen papers for analysis

<table>
<thead>
<tr>
<th>Authors/Researchers</th>
<th>Papers chosen</th>
<th>Publisher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Himani Pathak, Dr. Sanjay Singh, Sudhir Jugran</td>
<td>comparing the item size of aodv, dsr &amp; zrp routing protocols in mobile ad hoc network using qual-net simulator 5.0.2</td>
<td>International Journal of Engineering &amp; Science Research</td>
</tr>
<tr>
<td>Abhishek Dixit, Laxmi Shrivastava</td>
<td>performance analysis of aodv, dsr and zrp routing protocols in manet using directional atenna</td>
<td>International Research Journal of Engineering and Technology (IRJET)</td>
</tr>
<tr>
<td>Keshav Nayak, Neelesh Gupta</td>
<td>energy efficient consumption based performance of aodv, dsr and zrp routing protocol in manet</td>
<td>International Journal of Engineering and Innovative Technology (IJEIT)</td>
</tr>
<tr>
<td>Bharath Chandra Mummadisetty, Astha Puri, Shahram Latifi</td>
<td>Performance Assessment of MANET Routing Protocols</td>
<td>Int. J. Communications, Network and System Sciences</td>
</tr>
<tr>
<td>Hou Songfan, Wu Muqing, Liao</td>
<td>Performance Comparison of AODV and DSR</td>
<td>IEEE</td>
</tr>
<tr>
<td>Wenxing, Wang Dongyang</td>
<td>in MANET Test-bed Based on Internet of Things</td>
<td></td>
</tr>
<tr>
<td>------------------------</td>
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<td>---</td>
</tr>
<tr>
<td>Walid Abushiba Princy Johnson</td>
<td>Performance Comparison of Reactive Routing Protocols for Ad Hoc Network</td>
<td>IEEE</td>
</tr>
<tr>
<td>Ahmad Shaheen, Awadh Gaamel, Abdulqader Bahaj</td>
<td>Comparison and Analysis Study between AODV and DSR Routing Protocols in VANET with IEEE 802.11b</td>
<td>Journal of Ubiquitous Systems &amp; Pervasive Networks</td>
</tr>
</tbody>
</table>

Finally a conclusion can be draw that the method applied will require critical research and data gathering afterwards the data should be carefully chosen depending on what is wanted and what is to be excluded. Once this step is over the different results are to be extracted from the papers and finally studied. This will in the end give a good concrete answer to the problem and reviewing the literature.
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4 Results

This part of the study is done to present the different results that are taken out of diverse studies chosen, these results will be evaluated later in the analysis chapter:

4.1 Pathak, Singh and Jugran’s study
Pathak, Sing and Jugran has listed [11] in their study the parameters are constant throughout the simulation where the number of nodes is 30 and CBR communication, the run time of the experiment is 30 seconds, and the packet size being sent is 512, 1024 and 2048 bytes. The different routing protocols tested are between AODV, DSR as well as the network size is 1500x1500.

**AODV:** Jitter has gotten on package size 1024 the average value of 0.016 seconds, the amount of packets received is 16 per node, the amount of average End-to-End delay is 0.1 seconds for 30 nodes and finally the throughput has been registered as 3500 bits/second.

**DSR:** The jitter has been presented with the value of 0.018 seconds, the received packets for 30 nodes for this protocol were 24 while as the average delay for the simulation is 0.07 seconds and the throughput is 4500 bits/second.

**Method:** The method to reach the results is a software analysis simulation called QualNet, the comparison was based upon 4 different parameters, which are: Average End-to-End delay, throughput, jitter and an average value of packet jitter.

4.2 Dixit and Shrivastava’s study
Dixit and Shrivastava has talked about [12] this study has chosen to have different parameters which are listed as follow: 40 mobile nodes and CBR communication. This study uses a Metamaterial antenna where the amount of data send is 100 packets, the packet sizes are 512 bytes, the start and end time are 1 second to 150 seconds, this is a wireless communication, the antenna frequency is 1.382 Ghz and the network size is 1500x1500.

**AODV:** The Jitter average varies on the amount of time that has gone by starting from 30, 60, 90, 120 and 150 seconds has respectively registered the values of: 0.0049, 0.0025, 0.0018, 0.0016 and 0.0016 seconds. The average End-to-End delay is presented also according to the same time interval as previously, registering the values respectively: 0.0115, 0.0092, 0.0085, 0.0083 and 0.0083 seconds. The throughput has also been presented in the same method giving the results: 4115.5, 4105.6, 4102.4, 4142.9 and 4142.9 bits/second.

**DSR:** The Jitter average values are presented under the same time interval which is 30, 60, 90, 120 and 150 seconds the respective values in the study are: 0.0052, 0.0027, 0.0019, 0.0017 and 0.0017 seconds. The average End-to-End delay for the same respective time gave results respectively as follows: 0.0117, 0.0093, 0.0085, 0.0083 and 0.0083 seconds. The throughput has the following values respective to the time: 4116.2, 4105.9, 4102.6, 4143 and 4143 bits/second.
A Study of AODV and DSR protocols – A meta-analysis of AODV and DSR protocols
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**Method**: Simulation is done with the help of QualNet 6.1 simulator having an antenna. This simulation was done on the basis of performance analysis for the different routing protocols.

4.3 **Nayak and Gupta’s study**

Nayak and Gupta includes [13] in this study is concentrated on the throughput and routing load as a main topic but different parameters are taken in this study such as the different pause time, different node mobility, random mobility and the different node density. Some of the parameters are: 800x600 the simulation area, the number of nodes varies between 20, 40, 50 and 60 nodes. The traffic type is CBR and FTP communication as well as the packet size is 512 bytes. This study has a big part of it a focus on the energy consumption of the different routing protocols.

**AODV**: The throughput is studied in diverse mobility case from the time 5 seconds to 30 seconds, starting from 600 packets reaching to 1200 packets per unite time. The throughput was then studied through the random mobility case taking in consideration the node amount, the amount starts from 20 nodes to reach 50, the results of the throughput varies from 400 packets per unite time at 20 nodes going up to 800 packets per unite time at 30 nodes and then going down to 500 packets per unite time at 40 and 50 nodes.

**DSR**: The same case is done here for the DSR protocol where the throughput is studied in the diverse mobility through the time interval of 5 seconds to 30 seconds varying from 1600 packets per unite time maximizing at 1800 packets per unite time at 25 seconds and finally 1600 packets per unite time at 30 seconds. The throughput analysis in random mobility depending on the node amount is 1100 packets per unite time at 20 nodes, 1700 packets per unite time at 30 nodes then dropping drastically to 800 packets per unite time when it is 40 nodes and finally 1000 packets per unite time at 50 nodes.

**Method**: The network simulator called NS-2 is used to analyze different scenarios with different parameters such as the energy cost and the normalized routing load.

4.4 **Mummadissety, Puri and Latifi’s study**

Mummadissety, Puri and Latifi worked [19] in this study has based itself on different parameters notably on having a wireless interface, an antenna, the area being 500x400, the number of nodes are between 50 and 300, the number of mobile nodes are 9, the simulation time is 150 seconds and taking into consideration the queue type present such as queue, drop tail and priority queue. This study focused on average delay, control overhead, dropping ratio, jitter, normal overhead, packet delivery ration and throughput.

**AODV**: The packet delivery ration depending on the number of nodes has given results that at 50 nodes giving a ratio of 82% peaking at 100 nodes with 88% and then dropping between 150 nodes to 300 on an average of 84%. For the average End-to-End delay starts at 0.58 seconds with 50 nodes and then peaking at 0.6
seconds for 100 nodes and finally dropping to 0.43 seconds average from 150 to 300 nodes. The average jitter starts at 0.01 seconds for 50 nodes then increases to 0.11 seconds at 100 nodes and decreases to 0.0055 approximately between 150 and 300 nodes. The throughput for 50 nodes is $5.1 \times 10^5$ bits/second, decreasing to $4.5 \times 10^5$ bits/second for 100 nodes and finally increasing and stabilizing at an approximation of $6.8 \times 10^5$ bits/second between 150 and 300 nodes.

**DSR:** DSR in this case has a ratio of 91.8% for 50 nodes decreasing to 86% for 100 nodes and increasing dramatically up to 95.5% for 250 nodes but finally dropping to 86% at 300 nodes. The average end-to-end delay starts off at 0.5 seconds for 50 nodes varying slightly between 100 to 250 nodes 0.4 seconds and going up to 0.82 seconds for 300 nodes. The jitter in this case is at 0.01 seconds for 50 nodes holding an approximate constant value of 0.0055 between 100 and 250 nodes and rising to 0.014 for 300 nodes. The throughput starts at $4.95 \times 10^5$ bits/second for 50 nodes increasing to $6.4 \times 10^5$ bits/second to 100 nodes and between 150 to 250 nodes the values are $5.5 \times 10^5$ bits/second and afterwards decreasing to $3.9 \times 10^5$ bits/second for 300 nodes.

**Method:** The operating system Ubuntu including the NS2 simulator version 2.35 was the program used to come to the previous results.

### 4.5 *Songfan, Muqing, Wenxing and Dongyang's study*

Songfan, Muqing, Wenxing, and Dongyang have decided [20] to study the performance of AODV and DSR in the perspective of multi-hop, end-to-end, packet loss, delay and taking an IoT perspective with the help of radio frequency identification service, voice and temperature.

**AODV:** This analysis was done on pre-selected multiple hop using a MAC filtering giving results based on end-to-end hops showing that the packet loss percentage increases from 0% to around 28% at the 9th hop. While the average delay time is from 5 milliseconds at 1 end to end hop and increases to 40 milliseconds at 9th end to end hop.

**DSR:** The packet lost is 0% throughout the whole experiment and the average time delay results are at 5 milliseconds for 1 end to end hop while it reaches to 58ms at the 9th hop to hop end delay.

**Method:** The experiment used a test-bed using laptop and twenty PDAs, as well as Arm-Linux and using IEEE 802.11b standard. A software based on Java for network management is installed with the help of QT-based Graphic user Interface and RFID are used.

### 4.6 *Abulshiba and Johnson’s study*

Abulshiba and Johnson has included [9] in this study a comparison of the 2 protocols in question based on their performances in the different areas of packet loss, energy consumption, throughput, packet delivery fraction and average end-to-end delay. The metric parameters are a wireless channel communication, the
node number between 10, 110, 210, 310, 410, 510, the simulation time is 60 milliseconds, the chosen area size is 1000x1000, the traffic type is CBR, exponential and the queue length is 50 bytes.

**AODV:** The packet delivery ratio (taken just for CBR, exponential traffic not taken) is low around 5% for 10 nodes but starts increasing slowly to 16% for 110 nodes and having an average of 75% for 310, 410 and 510 nodes. The average end-to-end delay is non present at 10 nodes but starts increasing to 600 milliseconds for 110 nodes, peaking at 1400 milliseconds with 210 nodes and then decreasing to 500 milliseconds between 310, 410 and 510 nodes. Average throughput starts from 0 to increase to 5 packets when the number of nodes increase from 10 to 110 nodes. Reaching up to 85 packets at 510 nodes.

**DSR:** The packet delivery ratio (taken just for CBR, exponential traffic not taken) is at around 5% for 10 nodes increasing 10% for 110 nodes holding a constant of 50-55% for the amount of nodes between 310, 410 and 510. The average end-to-end delay is at 1250 milliseconds for 10 nodes peaking to 2400 milliseconds for 100 nodes and slowly decreasing from 2000 to 1000 milliseconds from 210 nodes to 510 nodes. The number of throughput data is low (around 5 packets) when the amount of numbers of nodes is between 10 to 110 nodes. This amount increases to reach a maximum of around 55 packets per 510 nodes.

**Method:** NS2 simulator is used to perform the network simulation.

### 4.7 Sharma and Shrivastava’s study

Sharma and Shrivastava [21] has studied the different criteria (throughput, average end to end delay and jitter) of AODV and DSR based on their power consumption. The number of nodes is fixed at 50, the simulation time is 150 seconds, the item sent are 100 and the size is 512, the size is 1500x1500.

**AODV:** This part of the results are based on 10 decibel-milliWatts(Dbm) where the results are varying drastically from 1750bit/s for 45 nodes to 3300 bits/s at 47 node decreasing to 400 bits/s for 49 nodes. The average end-to-end delay is from 0.5 seconds to 0.1 seconds varying between nodes 45-49. The average jitter is swinging from 0.37 to 0.1 reaching finally 0.58 seconds for the same nodes.

The same experiment is done for AODV protocol but with 16 decibel-milliWatts the throughput is at 4000bits/s dropping to 3000bits/s for 45 to 49 nodes. The average end to end delay is increasing from 0.05 to 0.25 seconds for the same nodes. Average jitter registered is from 0.05 to 0.6 seconds in the same scenario.

**DSR:** The first part is calculated according to 10 Dbm, the throughput is moving from top to bottom respectively to every node from 500 bits/s to 2500bits/s down to 500bits/s and the final value at 1000bit/s from node 45 to 49. The average end to end delay fluctuates from 2 seconds down to 0.25 up to 1 second from node number 45 to 49 and in the end average jitter changes from 0.2 to 0.6 and decreasing to reach finally 0.3 seconds from node number 45 to 49.
Now the experiment increases the value to 16 Dbm showing that the throughput is quite high from 4000 bits/s from start to end except at the node number 47 where it dropped to 1000 bits/s. The average end to end delay is changing between 0.2 to 0.1 seconds. The average jitter is given at the node number 45 has a value of 0.1 seconds growing to 0.4 seconds at node number 46 then dropping to 0.3 average at node 49.

**Method:** Simulation using QualNet.

### 4.8 Shaheen, Gaamel and Bahaj's study

Shaheen, Gaamel and Bahaj have chosen to study [10] the protocols AODV and DSR this protocols with the help of a dedicated short range communication (DSRC) which is working on 5.9 GHz band and on 802.11b, the chosen parameters are 10 seconds of simulation start time, the packet size is 1024 bits the node range is 80 meters, the number of nodes are 25 and 50 nodes while the simulation area is 5000x5000 and the run time is 60 minutes. This study covers areas such as delay, packet delivery ratio, and throughput.

**AODV:** the simulation is divided into 2 parts where 25 nodes are used and 50. The results for the throughput of 25 nodes showed that the values were between 270000 up to 500000 maximum but in average of 250000 bits/second for around the time of 4000 seconds, the delay is almost on average of 0.0005 seconds. The package delivery ratio is around 40 to 60% for the same amount of time.

The same study is done but for 50 nodes. Where the throughput is changing the first 1000 seconds strongly between 200000 and 400000 bits/s but then stabilizing to a constant of 400000 bit/s. The average delay is quite high at the start with 0.0060 seconds but then dropping to a minimum of 0.0006 seconds but then being on a constant value between of 0.0017 seconds after 1000 seconds have gone by. The delivery ratio is also around 20% to 35% during this time.

**DSR:** This part of the simulation is also divided between 2 sets of nodes 25 and 50. The first part of results will be covered by 25 nodes where the value increases drastically from 130000 to almost 1410000 bits/second for the time of 0 to 1000 seconds and finally being constant on 910000 bits/second for the rest of the time. The delay starts from 0 and peaks at 8 seconds then dropping to 4.2 seconds and then a constant value of 7 seconds more or less. Finally the packet delivery ratio is between 60% and 95%.

The second part of the study was based on 50 nodes where the start of time between 0 to 1000 seconds is kind of slow then reaching a maximum of 7500000 bits/second but stabilizing at 1000000 bits/second. The delay is starts and changes from 0 to 20 seconds and further stabilizing at 15.5 seconds after 1000 seconds. The time between 0 and 1000 seconds is not stable yet so the packet delivery ration is between 55% and 85% but then has a constant of value of 20% to 30%.
**Method:** Two simulation scenarios where the nodes are either spread out or dense using the program OpNet.

### 4.9 Summary of the different results

Table 4 that is shown gives an overview of the results that have been presented. The first column will represent the author’s names, the rest of the columns will represent the parameters chosen in the introduction chapter (chapter 1) explaining the results meaning that telling if these parameters were studied or not for both AODV and DSR protocols.

**Table 4: Showing of the different results acquired**

<table>
<thead>
<tr>
<th>Authors/researchers</th>
<th>Packet delivery ratio</th>
<th>Average end-to-end delay</th>
<th>Throughput of the data</th>
<th>Average jitter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pathak, Singh and Jugran</td>
<td>Not the ratio directly but the amounts of packets received is shown</td>
<td>End-to-end delay has been covered</td>
<td>Throughput is written</td>
<td>Jitter is taken</td>
</tr>
<tr>
<td>Dixit and Shrivastava</td>
<td>Delivery ratio is not available</td>
<td>Results available</td>
<td>Results available</td>
<td>Results available</td>
</tr>
<tr>
<td>Nayak and Gupta</td>
<td>Non available</td>
<td>Non available</td>
<td>Available for 2 different scenarios</td>
<td>Non Available</td>
</tr>
<tr>
<td>Mummadissety, Puri and Latifi</td>
<td>Available with variation of number of nodes</td>
<td>Available with variation of number of nodes</td>
<td>Available with variation of number of nodes</td>
<td>Available with variation of number of nodes</td>
</tr>
<tr>
<td>Songfan, Muqing, Wenxing and Dongyang</td>
<td>Packet lost is presented instead of delivery ratio but not concretely from start node</td>
<td>Shown also according to the number of hops taken from node to node</td>
<td>Non-available</td>
<td>Non-available</td>
</tr>
<tr>
<td>Authors</td>
<td>Availability</td>
<td>Availability</td>
<td>Availability</td>
<td>Availability</td>
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<tr>
<td>-------------------------------</td>
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<td>----------------------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Abulshiba and Johnson</td>
<td>Available with CBR traffic</td>
<td>Available with CBR traffic</td>
<td>Available with CBR traffic</td>
<td>Non-available</td>
</tr>
<tr>
<td>Sharma and Shrivastava</td>
<td>Non available</td>
<td>Available for 2 cases: one with 10 dbm and the other 16 dbm</td>
<td>Available for 2 cases: one with 10 dbm and the other 16 dbm</td>
<td>Available for 2 cases: one with 10 dbm and the other 16 dbm</td>
</tr>
<tr>
<td>Shaheen, Gaamel and Bahaj</td>
<td>Available for 2 scenarios: once with 25 nodes and the other when 50 nodes are implemented</td>
<td>Available for 2 scenarios: once with 25 nodes and the other when 50 nodes are implemented</td>
<td>Available for 2 scenarios: once with 25 nodes and the other when 50 nodes are implemented</td>
<td>Non-available</td>
</tr>
</tbody>
</table>
5 Discussion

This chapter covers the analysis part of the results that has been presented previously in chapter 4, this study will take each parameter in its own and study it accordingly to the 8 named studies. In the reason for simplicity I will name the studies 1 to 8 according to the authors, where the authors of the chapter 5.1 are referred to as study 1 etc.

5.1 Jitter analysis

Taking as the first parameter to study is jitter where it has been presented in 4 studies (studies 1, 2, 4 and 7) and experiments where performed for both AODV and DSR protocols. So it is noticeable to the fact that the jitter is not high in the AODV protocol with nodes around 40-50 where it is named in previous studies. According to study 1 the jitter Values around 0.0049 (study 2) seconds and 0.0016 seconds (study 1) are considered to be fine. One noticeable point is that the more nodes implemented in study 4 the better the jitter became meaning the value decreased. The study case number 7 shows 2 different power amount was given where one was lower than the other and that in the end the jitter was almost the same towards the end meaning not much difference was noticed for different amount of decibel-milliWatt increases. Moving to the DSR protocol the same studies (1, 2, 4 and 7) has performed the same simulation scenarios as AODV and it is worth noticing for the same amount of time and same amount of nodes the DSR had very close results as the AODV protocol according to study 1 and 2 they both ran a value of 30 and 40 nodes both for 30 seconds and over leaving the same close result between AODV and DSR. Looking at the study number 4 a big amount of nodes has been added from 100 to 300 and the results have fluctuated in this case showing a better jitter for AODV and the reason is that AODV performs better under a big amount of nodes close to each other. For the power case in study number 7 the amount of power has no big effect on DSR either where 2 different values of power gave close enough jitter. Comparing the study number 7 between AODV and DSR the jitter is better for DSR at a higher electrical value which was 16 Dbm asking the question is if higher electrical power does affect the jitter performance of AODV more or DSR. One point that is worth noting is that study 1 and study 2 has used close enough amount of nodes (30 and 40 respectively) for the same amount of time (30 seconds) did not give close results a 0.01 second difference it is still considered negligible. It is sensible to take a conclusion by saying that AODV performance is better under many node scenario the reason behind it is the close range communication which is better and the favourable communication setup but it is hard to make a big difference, it is hard to say that the difference is noticeable thus making them almost similar for this parameter.

5.2 End-to-end delay Analysis

The next parameter to be analysed end-to-end delay most of the studies (1, 2, 4, 5, 6, 7 and 8) have analysed it and worked to get values for this parameter. The end-to-end delay is noticeably high for AODV when the amount of nodes is not
big like in studies 1 and 3 where 30 nodes and 50/100 nodes are studied the average varied between 0.1 and 0.58 seconds. Study 6 for AODV has also 110 nodes giving a conclusive result with the 2 previous studies of around 0.6 seconds. In study 5 for AODV the average end to end is not directly addressed but rather talked about the delay that occurs in the packets from hop to hop in a very different scenario making this paper un-interesting for this study. There is a remarkable difference between study 4 and 6 for AODV where both have nodes around 200 and 300 in use which in comparison the difference is around 1 second more in study number 6. This could be due to the factor of the size of the area making the nodes closer in study number 4 than 6. In study number 7 for AODV the power difference shows for lower power the better the average end to end become meaning that higher power does not necessarily lead to a better result or faster communication so one can save the power. For AODV in study 8 the difference between 25 and 50 nodes visible although 0.01 second may not be much but establishing routes takes some time and discovery also, explaining the big start for AODV in 50 nodes case but then dropping when the route is found. Changing to DSR the study number 1 shows a good delay, better than the AODV in that particular simulation. Looking at study number 2 the amount of nodes is close to study number 1 and the results are kind of close to the ones received for AODV protocol in study 2, showing no big difference between both protocols in this case. The difference is more noticeable between AODV and DSR when there is 300 nodes in use as it is visible in study number 3 that AODV is faster. Once again research paper 5 has talked about end to end hop showing that it reaches 58 milliseconds a bit more than AODV where as the result was 40ms. Looking at the study number 6 the start for DSR communication establishment requires a lot of time to be able to find the right path and with a little amount of nodes the difference is big. The difference for AODV and DSR in this case (study 6) is the fact that the more nodes available the performance have been better for AODV by a good margin, which is reflect-able at 210 nodes up to 510 nodes. Study 7 covers the power difference for DSR showing that for 10 Dbm is a significant difference than the one for AODV where AODV gave better results but for 16Dbm the results were mixed thus leading to not making a concrete conclusion for this case. In the last study (study 8) the DSR didn’t perform at all well where results where 4.2 seconds for 25 nodes and 15.5 seconds for 50 after a while. The results of study 8 are not in accordance with the rest of the results, it is a possibility to consider that the elapsed time is much more significant than the other studies where the simulation registered over 2000 to 4000 seconds. Thus leaving the reader wondering if it is possible for the rest of the studies to reach such results after a while. These results show us a clear pattern that DSR is less efficient when it comes to average end to end delay for a big amount of nodes but again a very slight margin between the two protocols leaving it hard to make a difference between them.

5.3 Throughput Analysis

The next parameter to be studies is throughput which most of the studies except study 5 has covered this area in different scenarios and perspective. It is a clear point to draw for AODV protocol that for a relative low amount of nodes (30-50)
like in study 1 and 2 the registered sent bits is around 3500 to 4100 bits/s, the result is kind of similar in sense of stabilizing the amount sent data, but the amount is not the same where in this case (study 3) for AODV protocol the amount of bits is much higher for 40 to 50 nodes changing a bit this is due in this scenario to the undefined behaviour of the node’s movement. The amount of throughput in the study number 4 for AODV protocol is quiet high even for 50 nodes which does not concur with the results from study 1 and 2. The number of packets in the throughput is high in study 6 for AODV protocol showing that the more the nodes the higher the throughput got. The results in the study 7 for AODV protocol gives a good image that the higher the power the better the throughput become because a bigger chunk of data has been sent. Finally in study number 8 for AODV protocol there is a huge difference in the throughput between 25 and 50 nodes which shows that 50 nodes gave very big results. In the case of DSR there is a strong relation with the values acquired from the studies 1 and 2 where results are quite similar. The difference is that study 2 has close results for DSR and AODV but in study 1 the difference is 1000 bits/second. The DSR protocol has a better performance than AODV when the number of nodes increased but that was not a big amount either according to study 3. According to study 4 the throughput is better for DSR except in the case of 100 nodes elsewise the results were in favour of AODV a possible analysis is the congestion of nodes leads to faster communication in favour of AODV. The study 6 agrees with the previous study (number 4) by showing that more throughput is gained by AODV and the difference was most noticeable when the amount of nodes started to increase above 100. The bit amount send is not the same for AODV and DSR when the power is 10 Dbm and neither for 16 Dbm where in both cases DSR had a slighter advantage over the AODV. But the amount of bits send was higher in DSR when the energy used was higher showing a correlation in both cases that higher electricity power showed better results in the case of throughput. In the last study for 25 nodes the first 1000 seconds (DSR) are not stable since the connection is being established but afterwards the results were better than AODV, the amount of nodes increased to 50 and again the first 1000 seconds are not stable because of route discovery thus changing a lot. But this time the results were in favour of AODV showing better throughput, this shows once again the more the nodes the better AODV was in this case. Most of the studies has showed the higher amount of nodes the better AODV performed, the DSR was delivering better results in smaller networks.

5.4 Delivery ratio analysis
The final parameter is packet delivery ratio, the studies that has covered this part are studies 1, 4, 5, 6 and 8. Study one is in favour of DSR this showing better that the amount of packets received is higher. In the study number 4 AODV shows good numbers of 82% and having an average of 84% but DSR has had higher and more stable number with 86% delivery ratio. Study 5 has gone to the length and showed that DSR has no packet lost for a small amount of hops showing a 0% contrary to AODV that had up to 28%. In study 6 some interesting numbers showed that for the first 100 nodes the packet delivery ratio was very poor for
both AODV and DSR but AODV had a slightly worse performance of 6% difference, once the scenario ran 310-410 and 510 nodes the AODV performed better. To see how good this theory works study 8 shows in fact better performance for DSR for 25 nodes with respect to AODV, but once the nodes increased to 50 (relatively to this study it is much) the number of packet delivery ratio for DSR dropped and AODV had an edge again. Both protocols did not have a good delivery ratio once the nodes increased. It is acceptable to conclude that AODV had better performance for a higher amount of nodes but a low amount of nodes is better to use DSR protocol. DSR creates multiple routes to discover the paths letting a big amount of data to be sent thus showing a better ratio. The problem with big networks is the route maintenance meaning more packet loss.

5.5 Summary

To summarize the work done out of all the 4 parameters for the jitter part AODV was close to DSR making slight differences in slight scenarios it was not very clear to as to categorically say which was better but in higher amounts of nodes AODV showed better results. For the end-to-end delay most of the studies showed a positive aspect for the AODV protocol again when a lot of nodes are present. Throughput was not as easy at the rest of the studies to see some kind of pattern since there was some different data presented, the short period of times simulated and the amount of nodes showed some different results but the results were clearer towards more nodes better results are received for AODV. The final parameter is that the delivery ratio varied differently DSR showed good numbers when it was a low amount of nodes but AODV did better with higher node numbers. When it came to power consumption from study number 7 the only clear-cut patter or conclusion that could be taken is that better power gives better packet transmission and that AODV performed better in that part but the rest was hard to say if the power had any affection or not.

Study number 3 and 5 had no relation or a non-helpful relation to what was presented in this thesis thus these papers can be discarded because they had no correlation to the chosen parameters. Study 5 has no direct or remote correlation to how the nodes are moving in the simulators thus making it hard to evaluate it the same way and not including the necessary parameters. Study 3 talks about the different node movements such as diverse and random, this part is not either relevant to this thesis. Study number 7 has taken up the energy consumption problem which is not a criteria that is looked at this study is also discarded. Looking at the rest of the studies not all of them included all the required parameters but it is acceptable to take a study that includes 3 out 4 parameters, in total 5 papers were of use to this thesis.

After this study it is possible to answer the questions proposed in the chapter 1.3:

1- Which protocol between DSR and AODV has better delivery and receiving data per number of nodes?

The delivery ratio of the packets varied according to the studies and according to the node number leaving the answer not clear cut but
making it possible to withdraw a conclusion that AODV performs better on a bigger amount of nodes than DSR would.

2- Which protocol between DSR and AODV has better average end to end delay?

Once again the data gathered showed favouritism towards AODV when it came to a dense node area.

3- Which protocol between DSR and AODV has better throughput of data?

Throughput data extraction was harder because results were mixed, time was a factor so was the amount of nodes present. The network simulator was in favour of AODV for big networks.

4- Which protocol between DSR and AODV has better jitter?

No clear answer was given from all the studies a bit of mixed results but in the end both were very close, edging it was AODV for big amounts of nodes.

5.6 Ethical aspect

The ethical aspect of this study is about the danger of this technology because it is possible to access this communication between the nodes. Thus leading to taking sensitive information about the nodes and the nodes location possible and other data that can be harmful to the people. These are lives of people that can be in danger because of the risk that the information or sensitive data falls in the wrong hands and be used to damage or kill someone. These data and information should be well encrypted and kept up to date against attackers and malicious users.
6 Conclusion

The focus of this study was on the performance of the AODV and DSR protocols for mobile Ad-Hoc networks based on 4 parameters of my choosing. In the end I have presented and analysed the results of the research that take into consideration the jitter, the packet data ratio, the end-to-end delay and the throughput. The study started because there is a big demand on having a good protocol for mobile Ad-Hoc networks and evaluating these 2 protocols could give a better insight in what is better and what protocol to use.

The method use is a reasonable method and has delivered some results that have been later analysed. The fact of including and excluding has been mentioned making this study more accurate. The steps according to the systematic literature review is also applied for optimizing results. Finally the data collection has been done in a proper way leaving the reader able to understand what is done and how it could be re-done.

The contributions of this study are:

1- Taking 8 studies that other researchers have made in this field and summarizing them.

2- A meta-analysis was done for these studies out of 4 parameters. Excluding the studies that are not interesting and evaluating the reality of the results gotten.

3- An analysis of the results leading to a conclusion of which protocol is better in some certain cases and providing information answers to the question proposed.

It is wise to have a combination of both protocols for short range and long range communication, something of a mix between AODV and DSR. Since AODV has results for a dense area of nodes so it would be advised to use the routing table performances but taking some parts of DSR where it would be more efficient to use for a small amount of nodes. The route upkeep and discovery are a hard process for both and would be advisable to have faster communication. The protocol that could combine should use the caching route method of DSR to keep track of the road, having also a route failure detection system is advised like AODV and a better performance when more nodes are present. Finally route establishment to be faster and more effective at the start.

For further related work loop detection and route establishment is something that needs to be improved so improving this part is of high importance. AODV performs better than DSR but it is still advised to find better protocols for a high density since a lot of packets are lost. Looking into power consumption and the effects of adding power may be a good field to research and finally considering the security of these protocols since there is a big responsibility on these protocols.
to help lives of humans since today we face a problem of cars being hacked and controlled on distance.
A Study of AODV and DSR protocols – A meta-analysis of AODV and DSR protocols
George Ludwig Maalouf 2016-05-25

References


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