Evaluation performance of proactive and reactive routing protocol for mobile networks

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ABSTRACT:

MANETs are generally classified in three categories namely proactive, reactive and hybrid standardized. Moreover, it is self-organized and self-configured, they does do not depend on any fixed infrastructure, each node in the their network operates as a router that stores and forwards data packet from other nodes, therefore the task of routing is a challenging task in MANETs. The article are interests in reactive and proactive Ad-Hoc routing protocols, it studies the performance of reactive and proactive routing protocol which are AODV and OLSR routing protocols respectively in MANET by different scenario to find out the efficient routing protocol for routing, as well as, we will present a comprehensive performance evaluation study AODV and OLSR routing protocols to understand the nature of the routing protocols performance in different scenarios with variable amount of payload and number of nodes. The article are Focused to simulate the routing protocol AODV and OLSR routing protocols using network simulator-NS2 (ver-2.34). The simulation is done to evaluate and analyze the performance of protocols based on protocol behavior, packet lost, end-to-end packets delay and throughput. The AODV routing protocol is showed good performance in displayed results, it showed maximum PDR, small delay and normalized routing load in low mobility.

Keywords: Reactive, Proactive, Routing Protocol, Performance, Mobile, Networks.

الملخص:

يتم تصنيف MANET عمومًا في ثلاث فئات هي الاستباقية والتفاعلية والهجينة الموحدة. علاوة على ذلك ، فهي منظمة ذاتيًا ومكونة ذاتيًا، ولا تعتمد على أي بنية أساسية ثابتة، حيث تعمل كل عقدة في شبكتها كموجه يقوم بتخزين وإعادة توجيه حزمة البيانات من العقد الأخرى، وبالتالي فإن مهمة التوجيه مهمة صعبة في مانيه. تهتم الورقة بدراسة بروتوكولات التوجيه المخصصة التفاعلية والاستباقية، وتدرس أداء بروتوكول التوجيه التفاعلي والاستباقي وهما بروتوكولات التوجيه AODV و OLSR على التوالي في MANET بواسطة سيناريو مختلف لاكتشاف بروتوكول التوجيه الفعال للتوجيه، وكذلك سنقدم دراسة شاملة لتقييم الأداء بروتوكولات توجيه AODV و OLSR لفهم طبيعة أداء بروتوكولات التوجيه في سيناريوهات مختلفة مع مقدار متغير من الحمولة وعدد العقد. تركزت المقالة على محاكاة بروتوكول التوجيه AODV وبروتوكولات توجيه OLSR باستخدام محاكي الشبكة NS2 (الإصدار 2.34). يتم إجراء المحاكاة لتقييم وتحليل أداء البروتوكولات بناءً على سلوك البروتوكول، والحزم المفقودة، وتأخير الحزم من طرف إلى طرف والإنتاجية. أظهر بروتوكول التوجيه AODV أداءً جيدًا في النتائج المعروضة، وأظهر الحد الأقصى من PDR، وتأخيرًا بسيطًا وحمل التوجيه الطبيعي في التنقل المنخفض.

1. INTRODUCTION

In the new era of wireless communication, Wireless Local Area Network (WLAN) has emerged as one of the key players in the wireless communication family. Recently, research interests in Mobile Ad-Hoc Networks (MANETs), have increased because of the proliferation of small, inexpensive, portable and mobile personal computing devices. The IETF MANET working group has standardized its reactive and proactive ad hoc routing protocols [1].

MANET is a collection of mobile devices dynamically forming a communication network without any centralized control and pre-existing network infrastructure. Due to the presence of mobility in the MANET, the interconnections between stations are likely to change on a continual basis, resulting in frequent changes of network topology [2]. Consequently, routing becomes a vital factor and a major challenge in such a network.

Over the last few years, wireless computer networks have evoked great interest from the public. Universities, companies, armed forces, and governmental and nongovernmental organizations and agencies are now using this new technology [3,4]. Generally, classify wireless networks into two categories that is defined as, Infrastructure mode and ad-hoc mode. The Infrastructure mode; has allows wireless devices to communicate with each other or to communicate with a wired network. In this mode, an IEEE 802.11 WLAN comprises one or more Basic Service Sets (BSS), the basic building blocks of a WLAN. The BSS includes an AP (Access Point) and one or more STAs (Associated Stations). The AP controls the stations within that BSS. The AP in a BSS connects the STAs to the DS (Distribution System) as shown in Figure 1.

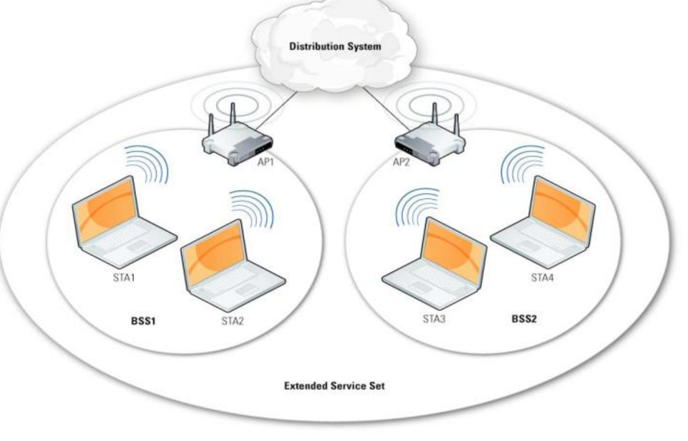

Figure 1. Infrastructure Mode Architecture

The DS is the means by which STAs can communicate with an organization’s wired LANs and external networks, such as the Internet [2,4].

The Ad-Hoc mode; that allows the radio Network Interface Card (NIC) to operate in an Independent Basic Service Set (IBSS) network configuration [2]. In this mode the network is called A Mobile Ad-Hoc Network (MANET). As shown in Figure 2. MANET is a wireless network in which all nodes can freely and arbitrary move in any direction with any velocity. It does not require access points, devices communicate directly with each other in a peer-to-peer mode. Routing takes place without the existence of fixed infrastructure. The network can scale from tens to thousands of nodes in an Ad-Hoc fashion, providing the nodes are willing to take part in the route discovery and maintenance process [2,3].

Figure 2. Ad-Hoc mode Architecture

There are still many open issues concerning MANETs. They involve efficient routing due to frequent changes in the network topology over time, all nodes move freely without enforcing any network topology. Moreover, a node is free to leave or join the

MANET without any notification. This behavior causes the breakup and automation of topology. MANETs are self-organized and self-configured. It does not depend on any fixed infrastructure. Also each node in the network operates as a router that stores and forwards data packet from other nodes. So the task of routing is a challenging task in MANETs [3,4].

This article aims to study the performance of Reactive and Proactive Routing Protocol in MANET by different scenario. In addition to, we are going to present a comprehensive AODV and OLSR performance evaluation study to understand the nature of the routing protocols performance in different scenarios with variable amount of payload and number of nodes. The paper concentrates to analyze and simulate the routing protocol AODV and OLSR using NS-2 simulator. he simulation is done to evaluate the performance of each those protocols based on protocol behavior, packet lost, end-to-end packets delay and throughput.

2. MOBILE AD-HOC NETWORK ROUTING PROTOCOLS

Routing in Ad-Hoc Networks has become an interesting area of research within industrial and academic circus. Several routing protocols have been designed for multi-hop ad hoc networks. These protocols cover a wide range of design choices and approaches, from simple modifications of internet protocols, to more complex multi-level hierarchical schemes. Although the ultimate end goal of a protocol may be operation in large networks, most protocols are typically designed for moderately sized networks of 10 to 100 nodes. Routing protocols are categorized as reactive, proactive and hybrid (combination of both is called hybrid) [5].

In the same context, the protocol is a set of rules that multiple peers comply with when communicating to each other. As long as the peers abide to a protocol, the communication performance would be consistent and predictable. As an example, consider an error detection protocol. When a transmitter sends out a data packet, it may wait for an acknowledgment from the receiver. The receiver, on the other hand, may be responsible for acknowledging to the transmitter that the transmitted packets are received successfully. The beauty of this layering concept is the layer independency. That is, a change in a protocol of a certain layer does not affect the rest of the system as long as the interfaces remain unchanged. Here, we highlight the words services, protocol, and interface to emphasize that it is the interaction among these components that makes up the layering concept [6].

Figure 3. Show the graphically shows an overall view of the layering concept used for communication between two computer hosts: a source host and a destination host. In this figure, the functionality of each computer host is divided into four layers. When logically linked with the same layer on another host, these layers are called peers.

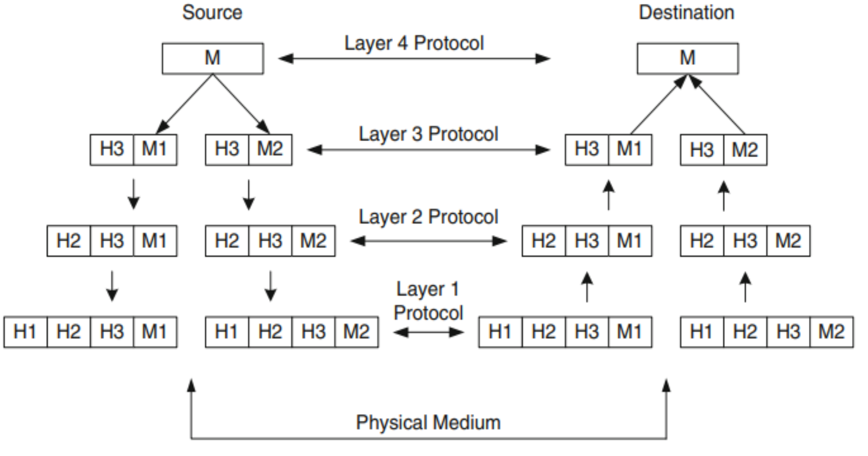

Figure 3. Data flow in a layered network architecture

Although not directly connected to each other, these peers logically communicate with one another using a protocol represented by an arrow. As mentioned earlier, the actual communication needs to propagate down the stack and use the layering concept [5,6].

2.1. Proactive routing protocols

This type of protocols has to construct and maintain fresh routing information to all the nodes. This is free of whether or not the route is needed. For this achievement control message are transmitted periodically. Proactive routing protocols are not bandwidth well-organize. Even if there is no data flow, the control message is broadcasted. This type of protocols has some advantages and disadvantages. One of the main advantages is that nodes can get easily routing information and easy to set up a session. The disadvantage is: There is too much data kept by the nodes for route protection and restructure is slow when there is a failure in exacting link [4,5]. OLSR and DSDV are examples of proactive routing protocol. In proactive routing protocols we describe in detail OLSR, which is a protocol used in mobile Ad-Hoc Networks. It is often called table-driven protocol as it maintains and updates its routing table frequently. OLSR exchanges the topology information always with other nodes. A Few nodes are selected as MPRs (Multi point relays) [6].

The MPRs are responsible for transmission of broadcast messages during flooding and generating link state information. MPRs technique used in OLSR protocol will reduce the message overhead and even minimize the number of control messages flooded in the network. Nodes maintain the information of neighbors and MPR's by sending and receiving HELLO messages from its neighbors [5,6].

2.2. Reactive routing protocols

Reactive routing protocols are specially planned for Ad-Hoc Networks. Permanent routing information is not kept by these protocols. Routes are built when the source needed. Route request is sending across the network to achieved. DSR (Dynamic Source Routing) protocol, AODV (Ad Hoc On-demand Distance Vector) protocol, and TORA (Temporally Ordered Routing Algorithm) protocol is an examples of reactive routing protocols [4]. In reactive routing protocols we describe in detail AODV. The mobile nodes in the ad hoc network are dynamic and they use multi-hop routing by using Ad-Hoc On-Demand Distance Vector algorithm. AODV will not maintain the routes unless there is a request for route. AODV routing protocol is developed as an improvement to DSDV routing algorithm. It is designed for ad hoc mobile networks and of both routing, that is unicast and multicast routing. The purpose of AODV is to reduce the number of broadcast messages sent throughout the network. This is achieved by discovering routes on-demand instead of keeping complete up-to-date route information. AODV uses Destination Sequence Numbers (DSN) for every route entry [3,6]. DSN is created by the destination this DSN and the respective route information have to be included by the nodes while finding the routes to destination nodes. Routes with the greatest DSN are preferred in selecting the route to destination. AODV uses the message types Route Request (RREQ), Route Replies (RREP) and Route Error (RERR) in finding the route from source to destination by using UDP (user datagram protocol) packets [4,6].

3. SIMULATION PROCESSES

3.1. Simulation environment

The simulation experiment is carried out in LINUX environment by Cygwin under windows 7. The detailed simulation model is based on network simulator-NS2 (ver-2.34), is used in the evaluation. The NS2 instructions are used to define the topology structure of the network and the motion mode of the nodes, to configure the service source and the receiver.

The NS2 classifies communication networks into three main categories. First, wired networks are characterized by wired communication links. The second category is pure wireless networks, which contain no wired links. All communications are carried out via "wireless" communication channels only. One category of wireless networks in which there is no central node or coordinator such as a base-station (BS) or an access-point (AP) is known as wireless mobile ad-hoc networks. In this type of networks, there is no infrastructure and the mobile nodes generally communicate on a peer-to-peer basis. This is in contrast to an infrastructure-based network where mobile nodes communicate via the controller node, which is generally connected to a wired network infrastructure. Due to the absence of any physical wired communication links, all nodes in a wireless ad hoc network are able to move freely during simulation. NS2 incorporates both wireless communication and node mobility into regular nodes, and defines a new type of nodes called Mobile Nodes [6,7].

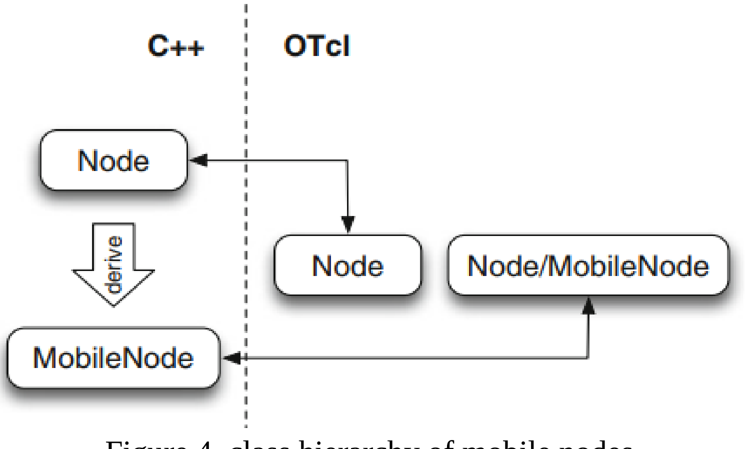

Figure 4. class hierarchy of mobile nodes

In Figure 4. The Mobile Nodes are represented by a CCC class Mobile Node which is bound to an OTcl class Node/Mobile/Node.

The class hierarchy is defined in the CCC domain only, where the CCC class derives Mobile Node from class Node, but the OTcl class Node/Mobile/Node is a top level class.

3.2. Traffic type

Constant bit rate (CBR) traffic sources are used [7]. 512-byte data packets are used. The number of source-destination pairs and the packet sending rate in each pair is varied to change the offered load in the network.

3.3. Mobility models

Identical mobility and traffic scenarios are used across protocols to gather fair results. Mobility models were created for the simulations using 30 nodes, maximum speed of 50 m/s, topology boundary of 500 × 450 and simulation time of 200 seconds.

3.4. Performance metrics

3.4.1. Packet delivery fraction

The ratio of the data packets delivered to the destinations to those generated by the CBR sources is known as packet delivery fraction [8]. It is calculated by the following equation.

$$\text{Packet Delivery Ratio} = \frac{\text{Total data packets received}}{\text{Total data packets sent}} \tag{1}$$

3.4.2. Average End-To-End Delay (E2E Delay)

Average end to end delay includes all possible delays caused by buffering during route discovery latency, queuing at the interface queue, retransmission delays at the MAC, and propagation and transfer times of data packets [7,8]. For every packet is sent, we search its sequence number in the received side and store the transmission time. For each successful matching, we extract the receiving time of that packet and calculate the end-to-end delay.

$$\text{Average End-to-End Delay} = \frac{\Sigma\,(\text{ Time received Time sent})}{\text{Total data packets received}} \tag{2}$$

3.4.3.Total normalized routing loads

The number of routing packets transmitted per data packet delivered at the destination. Each hop wise transmission of a routing packet is counted as one transmission. The first two metrics are the most important for best effort traffic [9,10]. The routing load metric evaluates the efficiency of the routing protocol. The bigger this fraction is the less efficient the protocol.

$$\text{Total Normalized Routing} = \frac{\text{Total routing packets sent}}{\text{Total data packets received}} \quad (3)$$

4. RESULT AND DISCUSSIONS

AODV and OLSR protocols were chose as proactive and reactive routing protocols respectively in MENT to these protocols are studied and analysed by some parameters such as PDR, End-to-End delay and normalized routing load in this simulation.

4.1. Packet delivery ratio

AODV and OLSR routing protocol PDRs are showed in Figure 5. PDR average of AODV protocol is higher than in OLSR protocol, they are 66.65 % of AODV and 37.51 % of OLSR. This Figure depicts AODV better performed OLSR.

AODV is not maintain the routes unless there is a request for route, its purpose is reduced the number of broadcast messages sent throughout the network, it discovers routes on-demand instead of keeping complete up-to-date route information. It uses Destination Sequence Numbers (DSN) for every route entry and uses the message types Route Request (RREQ), Route Replies (RREP) and Route Error (RERR) in finding the route from source to destination by using UDP (user datagram protocol) packets. The Routing table of OLSR is updated frequently as its nodes flooded information then its topology is changed, this make overheads which reduced by multi point relays (MPR) by few nodes are selected which responsible for transmission of broadcast messages during flooding and generating link state information.

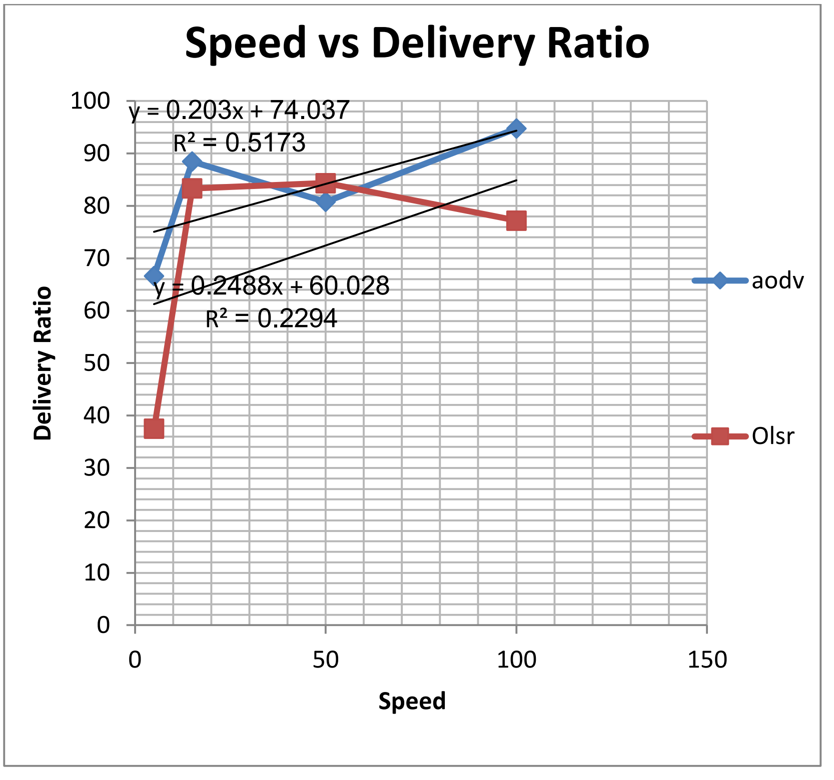

Figure 5. Packet delivery ratio

4.2. End-To-End Delay

Figure 6 illustrates End-To-End delay average of AODV and OLSR routing protocols. OLSR routing protocol maintains equal End-to-End delay value with 0.0044 sec. On the other hand, AODV routing protocol has lowest End-to-End delay average with 0.0035 sec in the beginning and maintains End-to-End delay average with little high than in OLSR routing protocol in the end.

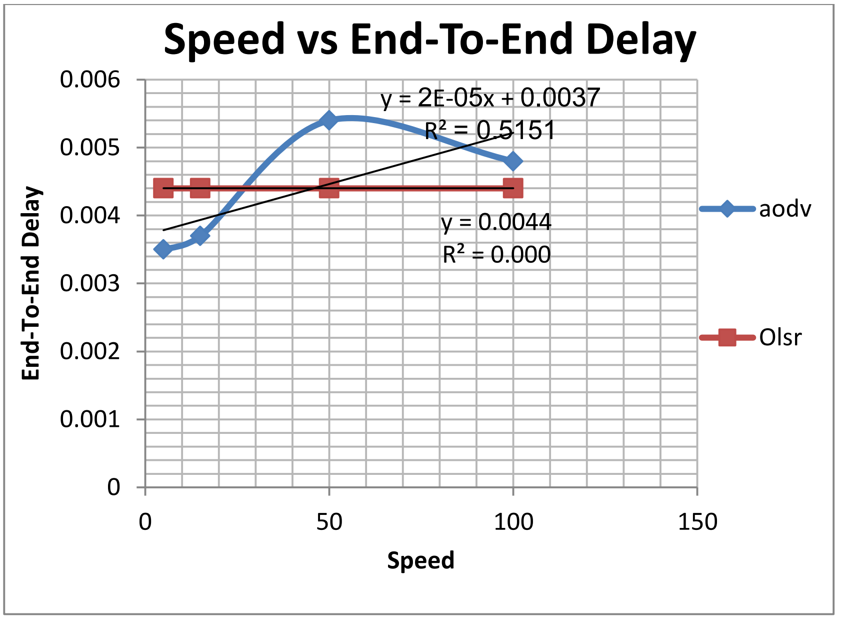

Figure 6. End-To-End Delay

OLSR routing protocol exchanges the topology information always with other nodes by buffering during route discovery process, queuing at queue of the interface, delays of the retransmission and transfer times of data packets and propagation.

AODV routing protocol is designed for Ad-Hoc Mobile Networks and unicast and multicast routing that is achieved by discovering routes on-demand instead of keeping complete up-to-date route information. AODV uses Destination Sequence Numbers (DSN) for every route entry. The relate route information of DSN should be included by the nodes while finding the routes to destination nodes.

4.3. Normalized routing load

The normalized routing load of AODV and OLSR routing protocol as showed in figure 7. The OADV routing protocol maintains lowest and OLSR routing protocol maintains highest average routing of load for all mobility models. The routing load of OLSR routing protocol is more comparatively. AODV routing protocol performs better than OLSR as it is an on-demand protocol.

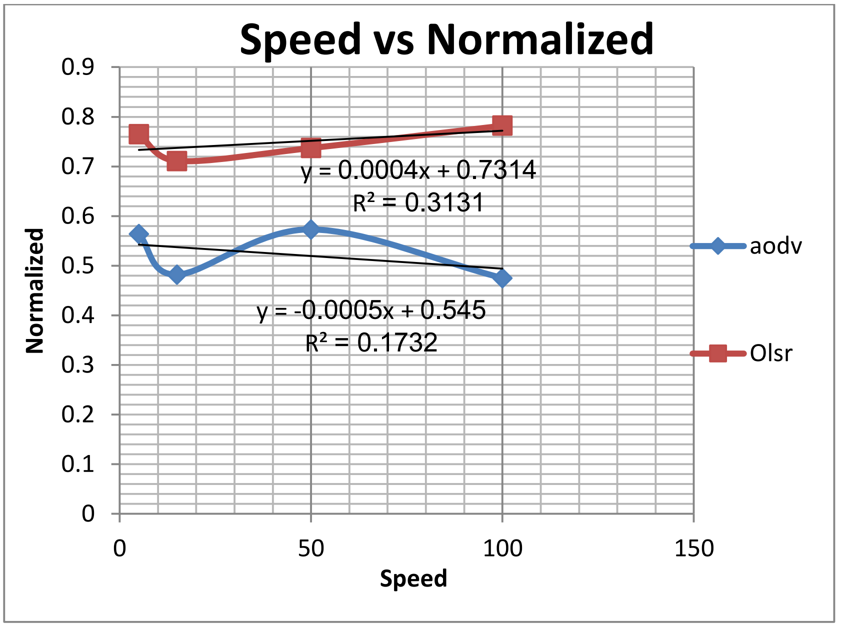

Figure 7. Normalized routing load

In additional, The totally numbers of routing packets transmitted per data packet delivered at the each destination. Therefore, Each hop wise transmission of a routing packet is counted as one transmission. Moreover, The first two metrics are the most important for best effort traffic. As well as, The routing load metric evaluates the efficiency of the routing protocol. The biggest fraction is the less efficient the routing protocol.

5. CONCLUSION

The article is discussed the evaluation performance of reactive and proactive Ad-Hoc routing protocols which is AODV reactive routing protocols and OLSR proactive routing protocol in MANET, the simulation is executed on the network simulator-NS2 (ver-2.34) software. The performance of these protocol is tested by some parameters such as PDR, E2E delay and normalized routing load.

The results discussion of simulation indicated that the relative ranking of routing protocols may depend on the node speed and the analysis of PDR in OLSR routing protocol was little at low mobility but it was almost same with increase mobility on both routing protocols. Moreover, the OLSR routing protocol shows the same E2E delay average which was higher than on AODV routing protocol in the low mobility but it was lower than on AODV routing protocol in the high mobility. The article is summarized that, the AODV routing protocol shows lowest normalized routing load values than on OLSR routing protocol and the AODV routing protocol shows good performance, it showed maximum PDR, small delay and normalized routing load in low mobility.

THE RECOMMENDATION & FUTURE WORK

The suggestion recommendation and future work have to take into account for extending simulation by other routing protocols with different parameters to build up an skillful performance routing protocol then the well describe routing method is picked by research.

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