Performance investigations of internet protocol versions for mobile Ad-hoc network based on qualnet simulator

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ABSTRACT

A mobile ad hoc network (MANET) can be seen as a mobile nodes collection having no support of fixed infrastructure and therefore its communication is totally dependent on the network's nodes. As a result of the mobility of nodes, rapid and unpredictable changes occur within the mobile ad hoc network (MANET) arrangements. Therefore, this makes the analysis of routing protocols very crucial so as to enhance efficient communication between the wireless nodes. IPv4 and IpV6 within the MANET is another issue of concern. IPv4 which has been traditionally used for ages and IPv6; predicted to be the forthcoming network architecture model is investigated because of its protection which has been improved as well as its enormous address space provision. The analysis on Ad Hoc On Demand Vector and Dynamic Manet On Demand routing protocols are performed using Qualnet simulator under the IPv4 and IPv6 standards. A thorough evaluation of the usability and functionality of the simulator software is carried out. The metrics for performance are; Throughput, End-to-End Delay and Average jitter. Afterwards, analyses and summary of the results is conducted and summarized in order to make available an assessment of their performances.

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1. INTRODUCTION

The Mobile ad hoc networks (MANETs) is a representation of distributed systems that are complex and are made up of wireless nodes consisting mobile nodes, which operates without wires, and are able to organize themselves effectively and easily into temporary and arbitrary “ad-hoc” network topologies, thereby letting devices and people perform seamless internetworking within areas that lack communication infrastructure, e.g. environments of disaster recovery. The concept of ad hoc networking has been in existence for more than 20 years in different forms. The sole communications networking application adhering to the ad hoc model are the tactical networks. The eventual utilization of MANET outside the military domain, has been enabled by the recent novel and innovative technical discoveries like as IEEE 802.11, Bluetooth and Hyperlan being introduced [1, 2]. As a result of such new evolutions, the interest in MANET research and development has increased [3].

1.1. Internet protocol

Internet protocol is defined as a major communication protocol that is utilized in sending data packets from source to destination within network as shown in Figure 1 which explains the IP in TCP /IP protocol suite location. Here the transmission of data is conducted in the form of data gram. The delivery of data in internet protocol is not guaranteed because of its lack of connection. Internet protocols exist in two versions which are; Internet Protocol Version 4 (IPv4) and Internet Protocol Version 6 (IPv6) [4]. The former is a protocol which is commonly used and was used in early 1990 by Internet Engineering Task Force(IETF) [5].

IPv4 possesses 32 bits address space and offers 4,294,467,294 addresses, with non-public utilisation for several of them, and only stored for specific utilisation. The IPv4 network can be easily attacked due to lack of encryption and authentication. In IPv4, secure routing which is performed is made optional. Understanding the IPv4 header format is difficult as a result of its complexity. Even though the IPv4 depends on 8 bits type of service (TOS) field and identification payload as shown in Figure 2, it supports Quality of Service (QoS) [6]. However, the performance of the IPv4 type of service(TOS) is inadequate and detection is impossible with encrypted IPv4 packet is encrypted [7].

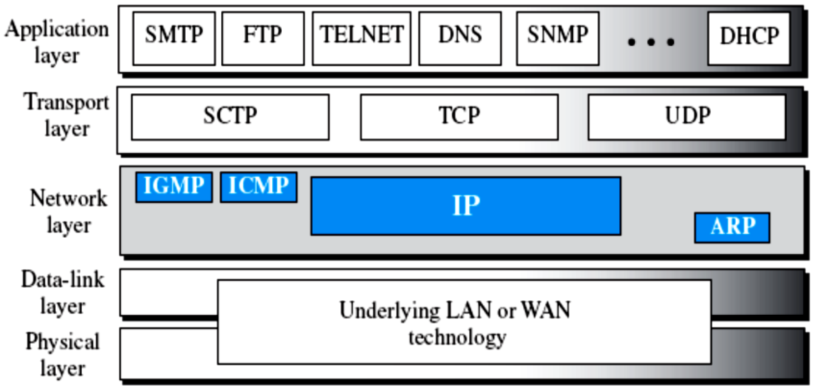

Figure 1. Internet Protocol and other network-layer protocols in TCP /IP protocol suite location

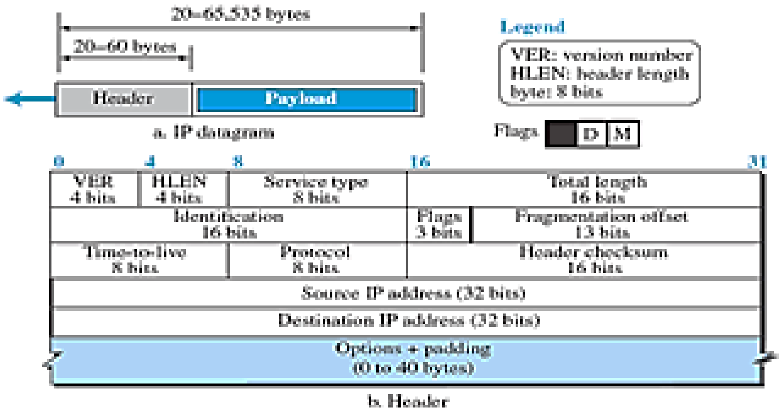

Figure 2. IP datagram

There are five classes of IPv4 address spaces and they are A, B, C, D and E. Classes A, B, C are on offer for the utilisation by the mass, while the preservation of class D is designated with multicasting operations in mind. Additionally, the storage of class E is designated with forthcoming experiments and research in mind [8]. The consequence of this may address exhaustion.

This IP Address exhaustion problem related to IPv4 is the reason why the use of IPv6 is increasing among users, since the demand of internet users cannot be fulfilled by IPv4 [9]. The retrieval of IP address from regional address registries for internet connection is impossible as a result of the problem of address depletion of IPv4 mobile nodes. Therefore, the realisation of a novel Internet Protocol is predicted to materialised in the immediate year after 1998, by IETF through the mobilisation of IPv6; regarded to be the Internet Protocol for next generation (IPng) arose [10]. IPv6 possesses 128 bits address space is able to offer an estimation of 3.4×1038 addresses.

The security of IPv6 is higher in comparison to that of IPv4 due to the use of several authentication and encryption techniques such as ESP. in IPv6, IPSec is not optional [11]. Flow label mechanism is used in IPv6 for router easy recognition of the destination that information should be sent to. In comparison to IPv4, IPv6 header size is 40 bytes, thereby making IPv6 header small in size, with lesser complexity. Multicasting and multi-homing as well as efficient routing are supported by IPv6 as against IPv4 [12]. Based on the discussion above, it is concluded that IPv6 is the internet protocol of the future and the technology of future internet relies on it. Thus, the execution capability evaluation of the respective mentioned routing protocols under IPv6 becomes very important. The results of this evaluation can be of great use when the change from IPv4 environment to IPv6 environment becomes necessary [13-15].

This paper have been throwing light on relative outcomes of AODV and DYMO protocols of Mobile Ad-hoc network with QualNet Simulator for an average throughput and end to end delay in addition to the jitter time in the existance of the most two internet protocols.

2. MANET ROUTING PROTOCOLS

Comprising of a group of linked mobile devices which is joined by connections without wires, Manet is also self- configured. Simply put, it entails an assemblage of non-wired nodes for mutual communications between the nodes, however it lacks fixed infrastructure as well as a predetermined topology of wireless links. In mobile ad hoc network, all mobile nodes serve as host and router. A proposal of different proactive, reactive and hybrid routing protocols is being made for the purpose of achieving this. The identification of routes in Ad hoc On Demand Distance Vector (AODV), reactive routing protocols and Dynamic Source Routing (DSR) only occurs during endeavours by nodes to transmit a message [16-18].

The consumption of energy is lesser because frequent link and routes updates is not required when the traffic load is low or mobility of network is high. Routes between source and destination are maintained by Optimized Link State Routing Protocol (OLSR) and Destined Sequenced Distance Vector (DSDV) irrespective of data traffic, unlike proactive and reactive routing protocols [19]. The need for locating routes for each message is avoided by this strategy, while efficiency is increased when the nodes are relatively stationery and traffic relatively heavy [20]. The use of reactive and proactive techniques is employed by hybrid routing protocol.

2.1. Ad-hoc on demand distance vector protocol (AODV)

AODV is tailored with specifically ad hoc mobile networks in mind. and it has the capability of unicast and multicast routing. Routes between nodes are built and maintained by AODV according to the desire of the source nodes. AODV is made up of a routing table in which the next hop information and number of sequence is contained. There are two processes contained in the protocol, and they are route discovery and route maintenance. The process of route discovery involves the broadcast of a route request (RREQ) packet by a source node across the network [21]. The IP address of the source node, broadcast ID, current sequence number and latest source node destination sequence number where they are contained in the RREQ packet. A route reply (RREP) may be sent by a destination node to the source node after receiving the RREQ. When the source node receives the RREP, it begins sending data packets to the destination. The presence of data packets that travel occasionally from the source to the designated point throughout the course of a route makes the route an active one. The moment the source stops sending data packets, time out of links occurs as well as their eventual removal out of the transitional node routing tables. In the process of route maintenance, the occurrence of a link breakage during the active stage of the route, causes the propagation of route error (REER) message by the node upstream of the breaking link to the source node informing it of the destinations that cannot be reached. At the time of source node accepts the RERR, route discovery can still be reinitiated by the source node [22, 23].

2.2. Dynamic MANET on-demand (DYMO)

A protocol utilised for routing, DYMO enables the routing between those respective nodes involved and the reactive multi-hop unicast routing. It functions in like manner with the AODV with minor modification. Route discovery and maintenance processes are also contained in the protocol. The process of route discovery here involves the initiation of dissemination of a Route Request (RREQ) in the entire network by the source node for the purpose of identifying a route that leads to the destination [24]. In the course of the hop by-hop dissemination process, a route to the source is recorded by each intermediate node. Upon the receipt of the destination by RREQ, a Route Reply (RREP) is sent in a hop-by-hop manner to the source. A route to the target is created by every intermediate node that has received the RREP, while the unicasting of the RREP toward the source occurs hop-by-hop. At the time when the source node receives the RREP, the establishment of routes between the source and destination are emplaced [25, 26].

This paper focuses on the investigation of the performance of AODV and DYMO routing protocols in Mobile ad hoc network based on IPv4 and IPv6 internet protocols and to analysis the functionality of internet protocols in terms of network performance.

2.3. Methodology

The Figure 3 depicts the overall methodology for the simulation project,

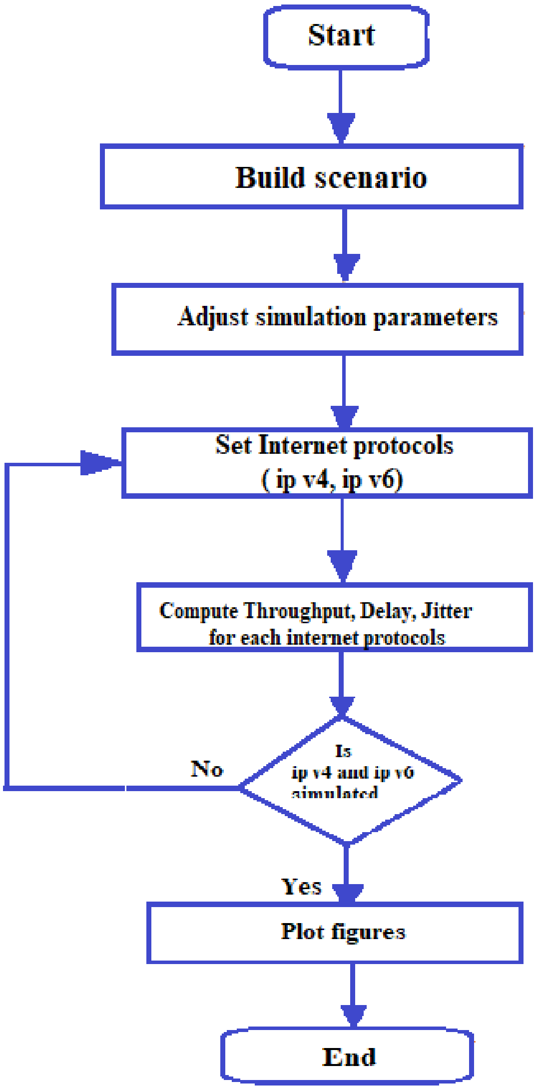

Figure 3. Overall methodology

3. EXPERIMENTAL MODELING

In order to conduct the simulation experiments, the routing protocols average end-to-end delay as well as throughput and average jitter were used as the control parameters. One crucial element characterized by orientation, pace and rate change is nodes movements. Discussions about many mobility models that are based on random speeds and directions. The exemplar chosen for the evaluation of results due to its production of real potential customary movement schemas of individuals is the Random Waypoint Mobility Model. Each node in this model remains inactive during its pause time. When the pause time ends, a node begins to move within the network terrain in a direction which is randomly selected as shown in Figure 4. The moment a node gets to its new destination, it remains inactive during its subsequent pause time. When the new pause time elapses, another begins moving within the network in a direction that is randomly selected as explained in Figure 5.

a) Design simulation scenario

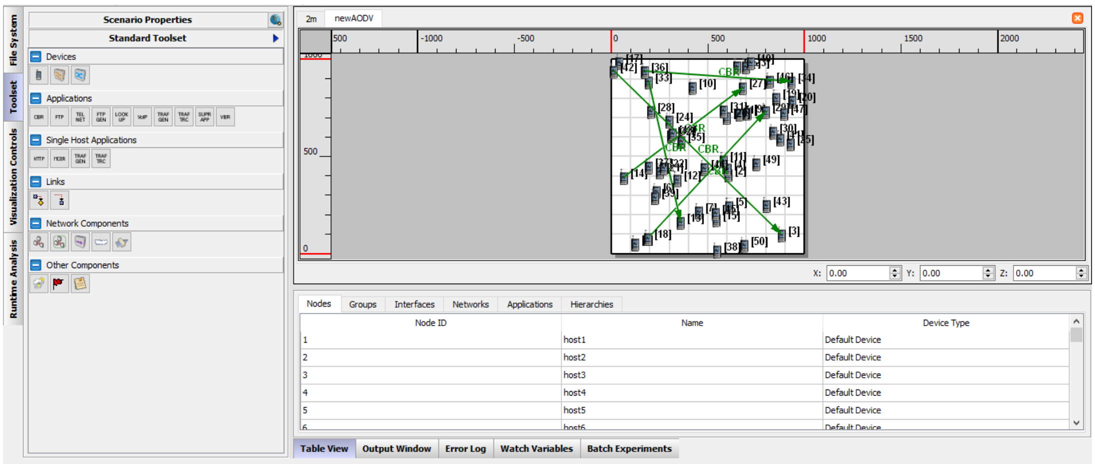

Figure 4. Simulation scenario demonstration

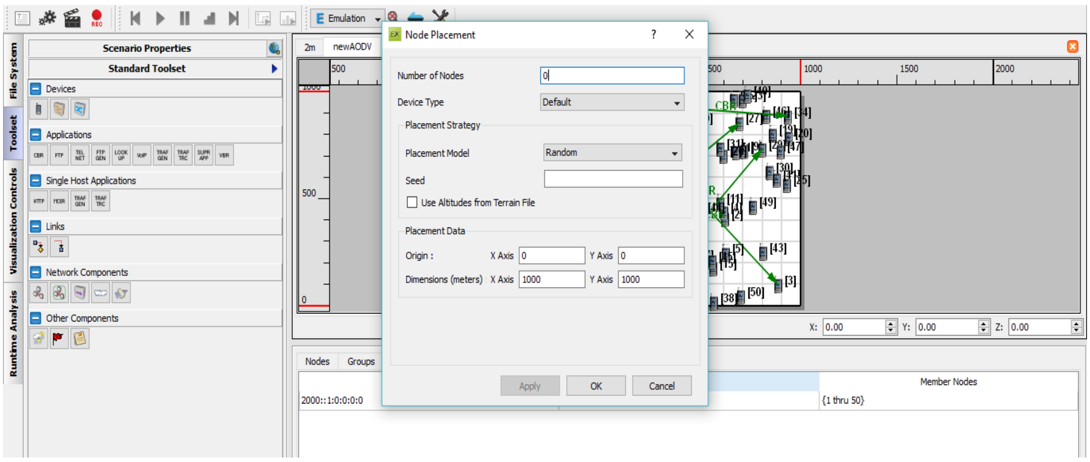

Figure 5. Set scenario nodes

b) Define all simulation parameters as shown in Table 1 for the designed network:

Table 1. Simulation parameters

PARAMETER	VALUE
Network type:	Ad hoc wireless network
Nodes Quantity	60
Terrain:	1000 *1000
Simulation time:	200 sec
Traffic application:	CBR
CBR Quantity:	5
Entity to send:	1
Packet size:	512B
Interval:	0.1 sec
CBR start-end:	5 – 0 sec
Network Protocol:	IPv4 and IPv6
MAC Protocol:	IEEE 802.11
Mobility Model:	Random Waypoint
Speed (Min-Max):	(0-3) m/s
Pause time:	20 sec
Physical Layer Model:	PHY 802.11b
Data Rate:	11 Mbps
Transmission Power:	25dBm
Wireless Channel Freq.:	2.4 GHz
Routing Protocols:	AODV, DYMO

c) Define the network protocol either IPv4 or IPv6 as shown in Figure 6 for adjusting the IP.

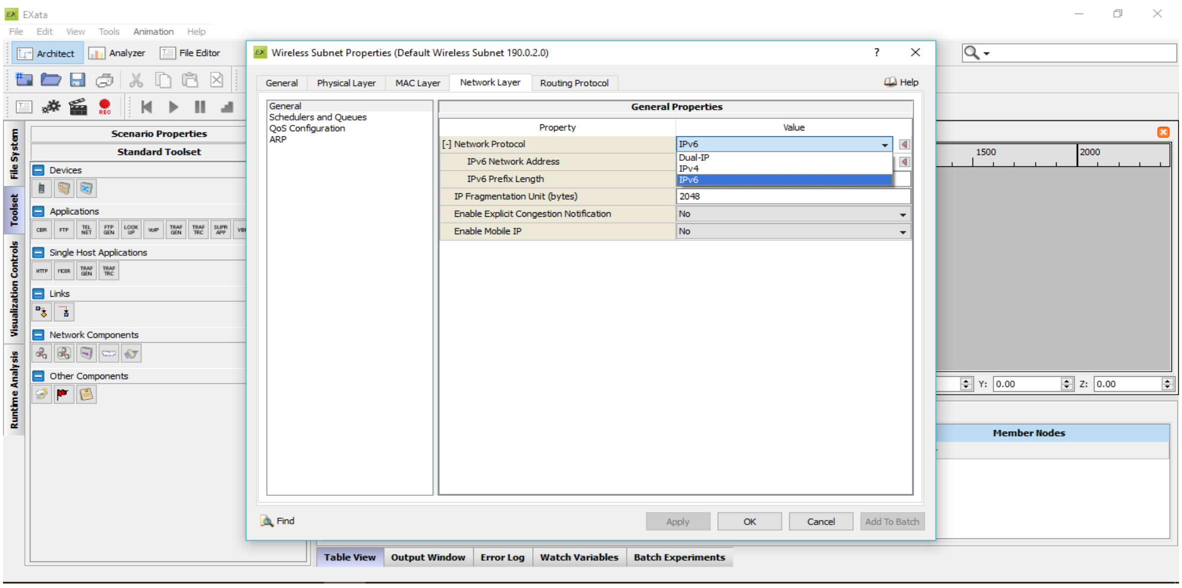

Figure 6. Internet protocol adjusting

4. RESULTS AND ANALYSIS

4.1. Average throughput

The definition of average tthroughput is the average rate of successful data packets that the destination accepted. The throughput of AODV and DYMO under IPv4 and IPv6 are shown on Figure 7 below. Based on observation, the performance of DYMO shows optimum results for each of IPv4 and IPv6 equally well. However, IPv6 internet protocol exhibited a more superior performance.

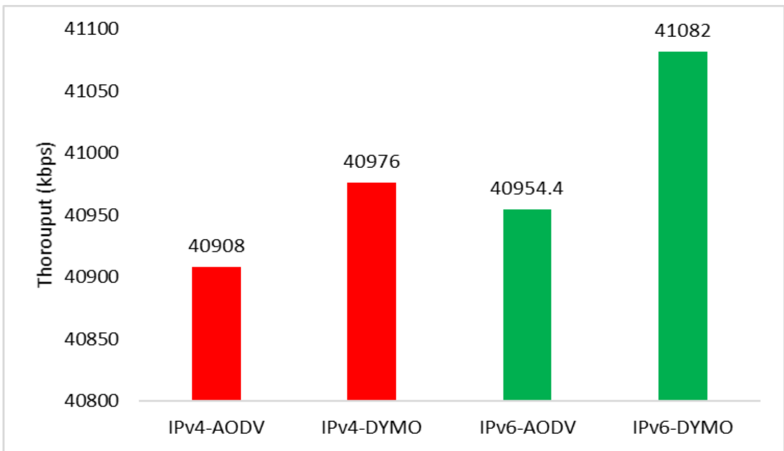

Figure 7. Average throughput of internet protocols

4.2. End-to-end delay

Average end-to-end delay = Total Time span taken by the packets to be transmitted to the destination / Total number of packets accepted. Figure 8 presents the IPv4 and IPv6 average end-to-end delays. Based on observation, the average end-to-end delay is found to be greater in AODV. More so, the delay in AODV routing protocol is more than that of DYMO in IPv4 and IPv6.

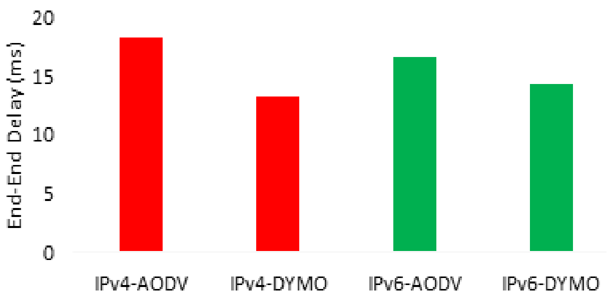

Figure 8. End-End delay of internet protocols

4.3. Average jitter

In simple terms, jitter is the difference in packet delay. Simply put, jitter can be described as the measurement of time difference in the arrival time of packet. This is a phenomenon that is specifically present in bigger packet switched networks. Since it is a time shift phenomenon, it often does not have an adverse effect on communication. In the actual sense, the jitter impact on communication is handled by TCP/IP, and the jitter impact on the both IP protocols can be shown in Figure 9 for AODV and DYMO.

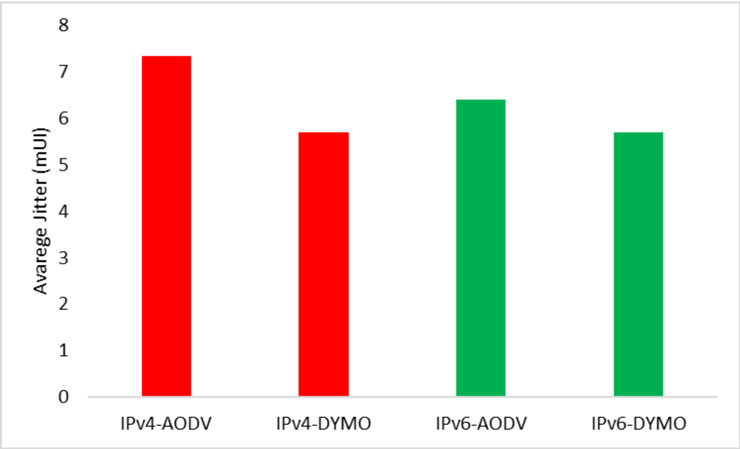

Figure 9. Average jitter of internet protocols

5. CONCLUSION

Based on the results obtained for the proposed routing protocols using QualNet 7.4v simulator which are mainly concentrates on proactive, reactive, and hybrids routing protocols (AODV, DYMO) in behaviors term of average throughput, end-to-end delay, and average Jitter of these protocols vary along with scenarios. The DYMO results in IPV4 and IPV6 proved higher Packet delivery ratio and Throughput as well as higher End-to-End delay was revealed by all AODV compared to DYMO. The analysis performances demonstrated higher average jitter in all protocols of DYMO and AODV. It was observed that in terms of jitter and delay, AODV has the worst performance, and DYMO have the best performance compared to AODV.

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