A Study on The Comparative Analysis Of MANET Routing Protocols In Nomadic Community Scenario

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Abstract: Mobile Ad-hoc Network is a wireless Network that allows mobile devices to connect without the need of any pre-established infrastructure or access point. To carry out synthetic modeling in Mobile Ad-hoc Network, entity and group mobility models are used. These models are used to handle Node Mobility. However, majority of the studies used entity mobility models for generating node movement traces applicable in the scenario being investigated. For nodes in MANET to engage in multi-hop communication, routing algorithms are used for transporting packets from source to destination node.This workperforms comparative evaluation ofDestination-Sequenced Distance Vector (DSDV)and Ad-hoc On-Demand Distance Vector (AODV) routingprotocolsin a Nomadic Community Scenario.This study makes use ofNomadicCommunity Model for handling the mobile node movement patterns in group communicationsimilar to nomadic movement in real life situations. Network Simulator-2 and BonnMotion 3.0.0 are used as the simulation and mobility scenario generation tools respectively. Then,Network throughput and End-to-end delay among nodes are chosen as the performance metrics in the study. The study identified that AODV routing algorithm performs better than its DSDV counterpartunder the scenarios experimented.

Keywords: Nomadic Community Model, Ad-hoc network,Node Mobility, Scenario Generation

1.0 INTRODUCTION

The growing markets for smart and handheld devices has brought about their varying usage in military, businesses, education and other sectors of economy (Rajabhushanam&Kathirvel, 2011). MANET is an infrastructure-less network that allows these mobile devices to wirelessly connectwithout using any pre-established infrastructure(Perkins &Royer, 2003; Baruch & Amitabh, 2008; Muhammad, Rameez&Atif, 2016).This network been found to have various application scenarios for which it can be usedin real life situations.One of such is the deployment of MANET to be used by nomads. In MANET, the nodes (mobile devices) receive packets and move these packets to next hop, until all packets are forwarded to the final destination (Abolhasan, Wysocki&Dutkiewicz, 2004; Abdalla, Abu-Rgheff&Senouci, 2007).The specialised routing protocols in MANET are used for the transfer of packets from the source to the destination node.These routing protocols have been proposed for Ad-hoc networks by different authors in the past. As an example, DSDV was proposed by (Perkins &Bhagwat, 1994), DSR was proposed by (Johnson &Maltz, 1996), while AODV was proposed by (Perkins, 2001; Perkins, Belding-Royer & Das,2003).This work focuses on modeling how information is routed among nodes in a Nomadic environment. Performance comparison of selected protocols are then carried out using Nomadic Community scenario.

(Roy, 2011) pointed out that a mobility model is used to mimic the movement of the real mobile nodes that change the speed and direction with time. Nomadic mobility model falls into the group mobility model that is used for representing how members of nomadic community interact. Also, Hong, Gerla, Pei, and Chiang (1999) describes group mobility as another way to simulate group behavior in where each node belongs to a group where every node follows a logical center (group leader) that determines the group's motion behavior. The nodes in a group are usually randomly distributed around the reference point. In group mobility models, the different nodes use their own mobility model and are then added to the reference point which drives them in the direction of the group.Boukerche and

Bononi(2003) have pointed out that modeling users' movements is an important aspect in ad hoc network simulation.

The choice of the nomadic community mobility model is to achieve node movement traces that are similar to movement patterns of nomads in real life situations.The study then investigates the performance characteristics of DSDV and AODV routing protocols in thenomadic community scenario. Like other group mobility model, Nomadic Community Model gives a better modeling of mobile users who participate in group communication in the scenario under investigation.

1.1 MANET Routing Algorithms

In Mobile Ad-hoc Network, a routing protocol (algorithm) is used to find valid routes between communicating nodes. MANET Routing protocols are generally classified as Proactive, Reactive and Hybrid. This study considers one proactive and one reactive routing protocols (DSDV and AODV). A Proactive Routing Protocol is the kind of protocol that is table-driven. The protocols maintain at all times routing information regarding the connectivity of every node to all other nodes that participate in the network. They work on the principle that every node is allowed to have clear view of the network topology by propagating periodic updates. Thus, all nodes using Table-driven protocol in MANET environment are able to make immediate decisions regarding the forwarding of a specific packet in the network. The protocols under proactiveclassification include DSDV, OLSR and so on. In reactive routing protocols, routing of packets is carried out in an on-demand basis. Examples of protocols under Reactive Routing Protocol classification include Ad-Hoc on Demand Distance Vector (AODV), Destination Source Routing (DSR), and Temporally Ordered Routing Algorithm, Associatively Based Routing (ABR) and so on. AODV is a very popular reactive routing protocol for MANET and other ad hoc networks (Perkins, Belding-Royer & Das, 2003). It initiates a route discovery process only when it has data packets to send and it does not know any route to the destination node (Das, Perkins & Royer, 2001;Broch, 1998;David,2003; Perkins, Royer &Das ,2002).

1.2 NomadicCommunity (Mobility) Model

The mobility of nodes in MANET is classified as entity-based or group-based (Aschenbruck, et al. ,2008; Singh, Duvvuru& Singh, 2014). Nomadic Mobility Model is a good example of group mobility model in Mobile Ad-hoc Network. In Nomadic environment, mobile nodes (mobile users) move from one location to another and this affects the network topology very greatly. In a group mobility model when the point of reference changes, the whole group moves to a new area and start wandering in that area and the roaming of the group is defined by picking random locations within some predefined roaming radius of the reference point while the maximum roaming distance is defined by the -r flag(Camp, Boleng& Davies, 2002).Good example of Nomadic Community Model scenario is as follows: A scenario model that simulates a guide tour of a city is a real life example of nomadic mobility (Camp,Boleng, Davies, 2002; Aschenbruck,2015; Aschenbruck, Gerhards-Padilla & Martini, 2008). In a Nomadic community model, each group of mobile nodes has an invisible reference node that they follow around the simulation.This general description of group mobility can be used to create a variety of models for different kinds of mobility scenarios in real life situations.

2.0 REVIEW OFRELATED WORKS

Natarajan and Mhadevan (2017) performed a simulation study that nvolves performance evaluation of seven selected MANET Routing Protocols using Scalability Scenario. The study identified that the number of nodes in MANET causes severe impact on the simulation performance, since the mobile node density decides the network connectivity. However, the simulated comparison laid emphasis on entity mobility models. Furthermore, Oyelakin and Jimoh(2017) carried out a study that surveyed varying application scenarios that are found in MANET as well as how they are modeled and simulated. The study highlighted some of the simulation tools and mobility models that have been reported inMANET researches .However, the work did not involve evaluating the performances of MANET routing protocols.Jha andKarga (2015) in their work studied four routing protocols (AODV, OLSR, DSR and DSDV) and then carried out performance comparison using NS3 simulator. The results of the simulation indicated that the performance of AODV is certainly superior to the other protocols in terms of throughput for network having varying number of node while OLSR performed better result than other two remaining protocols while considering the packet delivery ratio, packet drop , jitter and end-to-end delay. However, the work used entity mobility model to handle node mobility.

Sharma, Kansal and Bhatia (2015) in their studies, investigated how the choice of the mobility models impact on the performance results of ad-hoc routing protocols. The emphasis of the work is onsimulated comparisons among the selected mobility models.Cherry, Bon, Mingyang, Ling, and Peter (2015) carried out a study involving a survey of Group Mobility Models in Mobile Ad-hoc Networks. The survey is comprehensive but the work did not involve any simulation or performance evaluation of the models. Pandey and Srivastava (2014) carried out a study to evaluate routing protocol performances in MANET through NS2 simulation. The performance comparisons of DSR, AODV and DSDV were carried out by considering Packet Delivery Fraction, Throughput and Round Tip Time with constant mobility in an entity mobility model. The study further has its limitation in the fact that MANET is mostly charaterised by mobility

changes as the mobile users participating in the temporary network may need to move in and out of the network.

Khaimar and Pradhan (2014) equally carried out a work to identify the routing protocols used in Vehicle ad-hoc Network (VANET) had better performance. This was achieved through simulation technique. However, the authors used only entity mobility model as well.Som and Singh (2012) compared the performance of three on-demand routing algorithms (AODV,DSR and TORA) with respect to average end-to-end delay, throughput and packet delivery fraction. The work used node density as the differential factors. Aggarwal (2009) classified routing algorithms in MANET and then performed simulation performances of some selected simulation tools in respect of the routing protocols.The simulation tools used in the study are OPNET Modeler, NS-2 and GlomoSim.Geethaand Gopinasth (2008) evaluated the performances of two On-Demand routing protocols (AODV, DSR) in respect of the selected performance metrics. The simulation was carried out in respect of mobility variation of reference point group mobility model and random waypoint model.

3.0 METHODOLOGY

3.1 Introduction

This work involves generating mobile movement files randomly and then simulates their connectivity processes in scenario similar to a nomadic environment. NS2 is used as the simulation tool while BonnMotion 3.0.0 was used as the mobility scenario generation tool. The parameters used for the random node movements generation are as follows:

model=Nomadic
ignore=3600.0
randomSeed=1520875469913
x=2000.0
y=2000.0
duration=180.0 (the simulation time)
nn=40
circular=false
J=2D
avgMobileNodesPerGroup=5.0
groupSizeDeviation=12.0
maxdist=1.0
refmaxpause=6.0
minspeed=0.5
maxspeed=1.5
maxpause=60.0

3.2 Materials and Methods

3.2.1 Materials

The materials used for the work can be categorised as Hardware and Software.

a. The hardware configurations are:

Hewlett Packard (HP) Presario Dual Core 32bit processor (2.0GHZ), 320 GB Hard Disk Drive, 2GigabyteMemory, 4GB USB Drive (for the installation of Ubuntu 16.04 Linux)

b. The software environment consists of the following:

Ubuntu Linux 16.04 LTS (Long Term Support), NS-2 (ns-allinone-2.35), BonnMotion tool (BonnMotion-3.0.0),webupd8 (a Third Party Repository Software), Oracle Java 8 on Ubuntu Linux and XGRAPH tool

3.2.2 Methods

A flat topological space of two dimensions (X and Y) measuring2km(2000m) by 2km(2000m) is defined as the nomadic environment. Given a set of mobile devices that have wireless interfaces, the devices are used for communication and information sharing among the nomadic users. These devices are connected and packets are routed among them without any need for central access point. The devices follow nomadic patterns and are useful for various uses in group communications scenario.Thenomadic mobility patterns of nodes participating in the network were generated with the use of mobility scenario generation tool namedBonnMotion.Theparameter and movement files generated are named**groupNomadic_ns.params** and **groupNomadic_ns.movements**. They are then converted into the format usable in NS-2 with the useNSFile command for the simulations. The Ns-2 is used to simulate the routing of information in the network with the selected routing protocols.The routing protocols used for comparison in the study are: DSDV and AODV. Their behavioural patterns are measuredin respect of the targeted performance metrics: Throughput and End-to-end Delay.The trace files generated from the simulation are useful for the graphical analysis produced under the result section.

a. Nomadic Mobility Scenario Generation using BonnMotion

Nomadic community (mobility) model as proposed by (Aschenbruck et al., 2008; Aschenbruck , 2015) is used to guide this study. BonnMotion 3.0.0 is used as the mobility and scenario generation tool. The scenario generator writes all parameters used to create a certain scenario to a file. These files include movement and network scenario parameter files. The number of nodes used in the simulation is 40 while the simulation duration lasted

for 180 seconds. For the seed generations, the following command was used in BonnMotion/bin directory:

./bm –f groupNomadic1 Nomadic –n 40 –d 180 –i 3600 –x 2000 –y 2000 –a 5 –r 1 –s 12 –c 60

b. Simulation of the proposed usage Scenario in NS-2

The scenario used40nodes that are randomly distributed within a topological space of 2km by 2km (X=2000m,Y=2000m where Z=0) and the simulation stops at time 180seconds.The nomads who are the mobile users are assumed to be connected within that geographical topology. When a nomad leaves or comes within that region, the network is updated as network topology changes. In the study experiments, each mobile node is a CBR source and has constant transmission range. It is also assumed that the packet size s 512Kbps and nomadic mobilty model is used to specify the possible movement paterns of the mobile devices participating in the network. For the random BonnMotion files generated above to be exported into NS-2 it has to be converted to NS-2 format using the following command:

bmNSFile –f groupNomadic1

Scenario Simulation Parameters

The scenario parameters used for the experimental simulations and analysis in this study are as shown in tables 1 and 2.

Table 1:SimulationParameters involving DSDV Routing Protocol

S/N	Parameter	Value
1	Simulation Topology Area (X and Y)	2000m by 2000m
2	No of Nodes (devices participating in the communication)	40
3	Node Mobility (Distribution) Models	Nomadic Community Model
4	Routing Protocols	DSDV
5	Traffic Patterns	Constant Bit Rate (CBR)
6	Simulation Time	180 seconds
7	Packet Size	512bytes
8	MAC Protocol	802.11g

Table 2:Simulation Parameters involving AODV Routing Protocol

S/N	Parameter	Value
1	Simulation Topology Area (X and Y)	2000m by 2000m
2	No of Nodes (devices participating in the communication)	40
3	Node Mobility (Distribution) Models	Nomadic Community Model
4	Routing Protocols	AODV
5	Traffic Patterns	Constant Bit Rate (CBR)
6	Simulation Time	180 seconds
7	Packet Size	512bytes
8	MAC Protocol	802.11g

4.0 RESULTS AND DISCUSSION

a. Simulation Files

The files generated from the BonnMotion utility are usually of two categories: the parameter files and the movement files and. The movement file always contains the random positions of node participating in the MANET at a point in time.

The two files were generated using the following:

groupNomadic1.ns_paramsand**groupNomadic1.ns_movements**

b. Graphical Results

Graphical results of simulating DSDV and AODV Routing Protocols inNetwork Simulator-2 (NS-2) under the Nomadic scenario investigated.

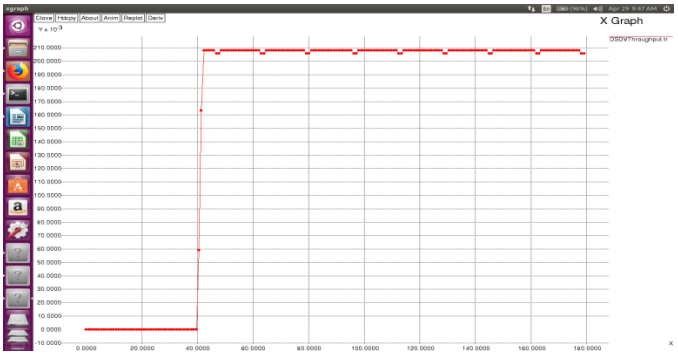

Figure 1: Network Throughput in DSDV Routing Protocol

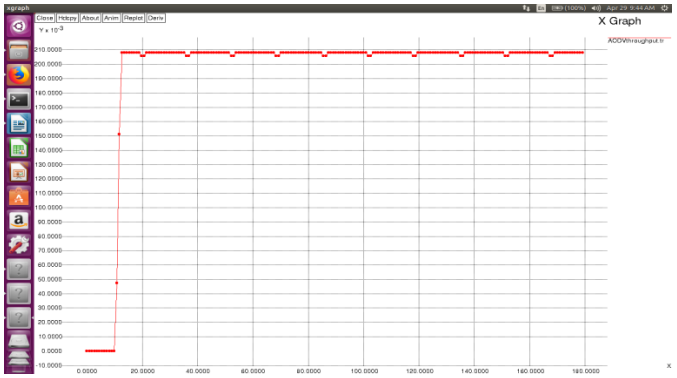

Figure 2: Network Throughput in AODV Routing Protocol

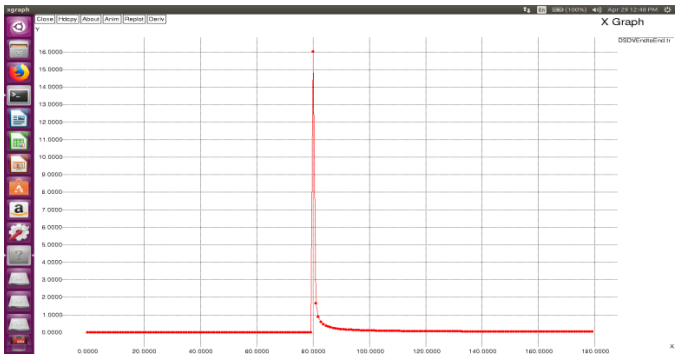

Figure 3: End-to-End Delay in DSDV Routing Protocol

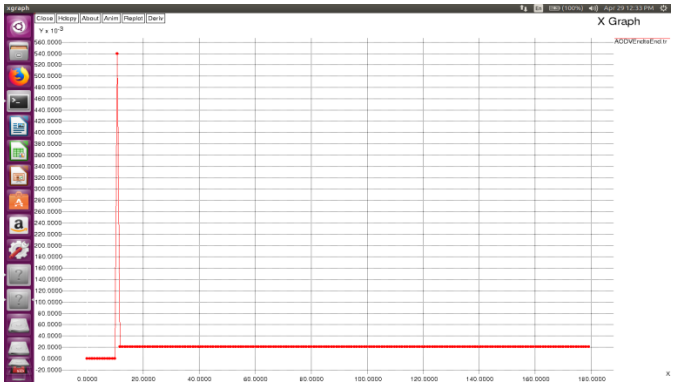

Figure 4: End-to-End Delay inAODV Routing Protocol

c. Discussions of simulated results

The results of Network Throughput from DSDV and AODV algorithm simulations were captured graphically as shown in figures 1 and 2 respectively. It was observed that the average network throughput obtained in AODV protocol is slightly higher than that of DSDV.Similarly, the results of End-to-End Packet Delay among nodes in the selected MANET algorithmswere captured graphically as shown in figures 3 and 4 respectively.The averageend-to-end delay among nodes in DSDV algorithm is higher compared to the value obtained in AODV protocol simulation.It is evident from the comparison of the results obtained in the simulations that AODV protocol outperforms DSDV protocol with the use ofNomadic Community Model in the experimentation.

5.0 Conclusion

This study simulated Mobile Ad-hoc Network (MANET) as it can be applied for network connectivity in a fairly large nomadic environment. The study established that the typical scenario where this can be applicable in real life situation is among nomads who need to engage in wireless connectivity without necessarily use central network facility, due to their operating environments.The study then carried out comparative performances of DSDV and AODValgorithms in the scenario. The targeted performance metrics used are: Network Throughput and End-to-end delay. This is done to determine which of the two protocols perform better in the circumstances used for the experiment. The studygives another insight into the simulation of MANET as it simulates how an infrastructure-less network can be used in such nomadic environment where group node mobility movements are randomly handled with the ad of Nomadic Community Model.

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