

Assessment Of Throughput Performance Under NS2 In Mobile Ad Hoc Networks (MANETs)

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Abstract—Providing QoS in the context of Ad Hoc networks includes a very wide field of application from the perspective of every level of the architecture in the network. In order for simulation studies to be useful, it is very important that the simulation results match as closely as possible with the test bed results. In this Paper, we study the throughput performance (parameter QoS) in Mobile Ad Hoc Networks (MANETs) and compares emulated test bed results with simulation results from NS2 (Network Simulator). The performance of the Mobile Ad Hoc Networks is very sensitive to the number of users and the offered load. When the number of users/offered load is high then the collisions increase resulting in larger wastage of the medium and lowering overall throughput. The aim of this research is to compare the throughput of Mobile Ad Hoc Networks using three different scenarios: 97, 100 and 120 users (nodes) using simulator NS2. By analyzing the graphs in MANETs, it is concluded When the number of users o nodes is increased beyond the certain limit, throughput decreases.

I. INTRODUCTION

Ad hoc networks (MANET) are formed by a group of mobile nodes (the host, router), they can autoorganize themselves to communicate among them. All these devices that belong to Networks transmit packages and each of their nodes have to take decisions when they communicate with other nodes. The MANET Networks do not have a static infrastructure. [1] In the Mobile Ad Hoc Networking paradigm there is no fixed infrastructure and packets are delivered to their destinations through wireless multi-hop connectivity. Nodes often act not only as hosts but also as routers, relaying the traffic by other Nodes. The topology of an Mobile Ad Hoc Network can change because nodes may not be fixed or, equally, they may fail. Mobile Ad Hoc Networks have to satisfy high throughput requirements over a relatively wider bandwidth. A gross estimate of the throughput over that interval can then be computed using the ratio of the sent packet count to the received packet count. This ratio is used to estimate the characteristics of the path between the ingress egress node pair over the opaque network segment over that period of time. [3]

II. SIMULATION FRAMEWORK

Computer simulation has become one of the primary tools for evaluating the throughput performance of Mobile Ad-hoc networks. [5] In this paper we report on simulation results of different scenarios. One of our motivations here is to validate the simulation process and results for Ad-hoc networks using NS2.

The throughput in the Mobile Ad Hoc Network needs to be expressed. Figure 1 The throughput for each active connection in the network is computed as follows: For each connection, the ratio of the sum of the arrival rates of each path used in that connection to the input rate given at each path used in the given connection is computed. [5] Using NS2 a general framework has been developed to test MANET throughput performance for network topologies, and nodal mobilities. However, when optimizations are performed on the throughput of each connection, the probability distribution will change as will the input rate of each path.

A. Network Simulator-NS2

NS2 is an object oriented simulator, written in C++, with an OTcl interpreter as a frontend. The simulator supports a class hierarchy in C++ (also called the compiled hierarchy in this document), and a similar class hierarchy within the OTcl interpreter (also called the interpreted hierarchy in this document). The two hierarchies are closely related to each other; from the users perspective, there is a one-to-one correspondence between a class in the interpreted hierarchy and one in the compiled hierarchy. The root of this hierarchy is the class TclObject. Users create new simulator objects through the interpreter; these objects are instantiated within the interpreter, and are closely mirrored by a corresponding object in the compiled hierarchy. The interpreted class hierarchy is automatically established through methods defined in the class TclClass. user instantiated objects are mirrored through methods defined in the class TclObject. There are other hierarchies in the C++ code and OTcl scripts; these other hierarchies are not mirrored in the manner of TclObject.

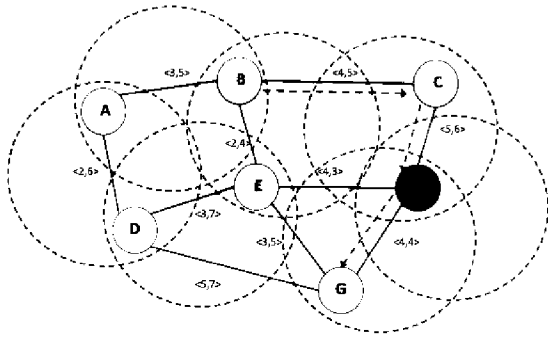


Figure 1. Communication routing protocols for Ad Hoc Networks

The application areas include:

- Local Area Networks
- Mobile Networking
- Satellite Networking
- Radio Propagation Models
- Energy Model
- Directed Diffusion
- XCP: eXplicit Congestion control Protocol
- Unicast Routing
- Multicast Routing
- Network Dynamics
- Hierarchical Routing
- Web cache as an application

B. Parameter QoS in the Mobile Ad-hoc Networks

Quality of Service Support (QoS): It is a set of service requirements that needs to be met by the network while transporting a packet stream from a source to its destination. Its needs are governed by the service requirements of end user applications and expected to guarantee a set of measurable pre-specified service attributes to the users in terms of end-to-end performance, such as delay, bandwidth, throughput, probability of packet loss, delay variance (jitter), etc. Power consumption is another QoS attribute which is more specific to MANETs. [11]

Then describe three important parameters of the quality of service in the MANET:

- Throughput.- Is the quantity of information got for the destination in a time determined across a physical or logical way in a network.
- Latency.- This parameter is measured in units of time and refers to the total passed time, since the package is transmitted by the origin until it comes to its destiny.
- Loss of packages.- This happens for the congestion of channels of transmission and because of this the packages do not reach their final destination.

The protocols that are object of study and simulation are AODV and DSR considered inside their classification as

reactive protocol.

- AODV.- is a combination of both DSR and DSDV protocols. It has the basic route-discovery and route-maintenance of DSR and uses the hop-by-hop routing, sequence numbers and beacons of DSDV. The node that wants to know a route to a given destination generates a ROUTE REQUEST. The route request is forwarded by intermediate nodes that also creates a reverse route for itself from the destination. [11] When the request reaches a node with route to destination it generates a ROUTE REPLY containing the number of hops requires to reach destination. [6] All nodes that participates in forwarding this reply to the source node creates a forward route to destination. This state created from each node from source to destination is a hop-by-hop state and not the entire route as is done in source routing. See ns/aodv and ns/tcl/lib/ns-lib.tcl for implementational details of aodv. [10]

Characteristics

- Only when it needs to communicate, the process of discovery of route begins.
 - Major time in the delivery of packages.
 - Low utilization of resources and it introduces few over-charge in the network due to the fact that it doesnt do a constant update of routes.
 - It supports a locally table of routing for the already known destinies.
 - It only supports the use of unidirectional links.
 - It uses HELLO messages (they are used to support the information of local conectivity of a node to other one).
 - They use a unique number of sequence for every destination.
 - AODVs functioning depends on that every node keeps his own number of sequence updated.
- DSR.- The DSR agent checks every data packet for source-route information. It forwards the packet as per the routing information. Incase it doesnt find routing information in the packet, it provides the source route, if route is known, or caches the packet and sends out route queries if route to destination is not known. Routing queries, always triggered by a data packet with no route to its destination, are initially broadcast to all neighbours. Route-replies are send back either by intermediate nodes or the destination node, to the source, if it can find routing info for the destination in the route-query. It hands over all packets destined to itself to the port dmux. In SRNode the port number 255 points to a null agent since the packet has already been processed by the routing agent. [7]

Characteristics

- Has routing in the origin.
- The packages include a head-board of information about the nodes that they are going to cross.
- It diminishes the overcharge avoiding messages of control.
- It obtains multiple possible ways towards the destination.
- Every node keeps a cache memory of routes of its neighbors.
- It detects the loss of conectividad and requests a new immediate discovery of route.
- Uses intermediate memory for the routing.
- It does discovery of routes for broadcast.
- The origin node floods the network with a plot of exploration.
- There doesnt exist any type of periodic message avoiding traffic of control in the network taking advantage of the packages for useful resources.
- It does nt use periodic HELLO packages to notify the state to its companions.

C. Node density

The calculation of the node density P_{node} is supported by information obtained from the census of Ecuador in 2010.¹ An important factor for the calculation of the nodes is the percentage of the PEA (Economically Active Population).

To calculate the density of nodes the following formula has been proposed:

$$P_{nodes} = \frac{z_{ul} * F_{uel} * F_{PEA} * F_{us}}{A_{zu}} * A_s \quad (1)$$

$$P_{nodes} = 97 \quad (2)$$

Where:

- z_{ul} - Number of people in the urban areas is 70% (128910)
- z_{rl} - Number of people in the rural areas is 30% (85940).
- F_{uel} - urban factor specified for the simulation area
- A_{zu} - Urban area - 6Km x 12Km = 72Km².
- F_{PEA} - LOJA - PEA is 62% for urban area.
- F_{us} - urban smartphone factor is 25% .
- A_s - Chosen area for simulation 0.5km².

It is important to describe the city of Loja for which this study has been done, it is a city in the southern part of Ecuador. Populatio it the city increases during the holidays, and it grows also due to arriving of tourists attracted by its location and biodiversity. Given this premise, we established percentages of 25.75% (F_{us})and 30.8% (F_{us}) to calculate

¹National Institute of Statistics and Censuses (INEC). <http://www.inec.gob.ec>

the other two densities nodes P_{nodes} , substituting these values into the formula(1) we find that the rearsong nodes are equal to 100 (25.75%) and 120 (30.8%), respectiving.

Consequently the number of nodes for the simulation is: 97, 100 and 120.

D. Parameters of routing protocols and generals for simulation scenarios

To define the simulation scenarios were used as the basis used in [8], [9]. The values of each one of these values are shown in the Table I and Table II.

Table I
GENERAL PARAMETERS FOR THE SIMULATION

Parameter	Value	Observations and related works
Simulation area	500m x 1000m	Area established within the centre of the city of Loja
Mobility model	Obstacle Models	Obstacle models [2], [4]
Number of nodes	97,100 and 120	To determine the behaviour of protocols for different node density
Number of connections	20, 40	random connections
Time of simulation	97	In seconds
Network layer protocols	DSR and AODV	Reactive protocols
Transport layer protocols	Transmission control protocol (TCP)	A connection-oriented communication is needed
Propagation model	TwoRayGround	For flat and unobstructed scenarios.
Type of antenna	Omnidirectional	Indispensable quality of mobile network nodes

E. Creating scenarios

To create the scenarios we enter via a terminal the following directory: ns-allinone then we will ns2.34/indeputils/cmugen/setdest/setdest to find in order to create a scenario of 120 nodes the following command ./setdest-v 120-2-n-m 2 s 1 m 6-t-150-P-1-p 2 x 1000-and 500 and the example Scenario1 scenario name. This is what makes each type of scenario you need to create.

In the command shown run-v 2 which is the version of the scenario generator, nodes which means the number of nodes, represented SpeedType lowercase s is the kind of speed (1 = Uniform), then minspeed represented with lowercase m is the minimum speed in m/s, maxspeed represented with uppercase m is the maximum speed in m/s,-t simulationtime indicating the simulation time in seconds,-P is the pause pausetime simulation seconds, maxX that Dimension X determines the area in which nodes move in meters, maxY

Table II
VARIABLES AND PARAMETERS FOR THE SIMULATION OF PROTOCOLS
AODV AND DSR.

Variable	Value	Observations
set val(chan)	Channel	Channel Type
set val(prop)	Propagation	radio-propagation
set val(netif)	Phy/WirelessPhy	network interface type
set val(mac)	Mac/802_11	MAC type
set val(ifq)	Queue/DropTail	interface queue type
set val(ll)	LL	link layer type
set val(ant)	Antenna/ Omni-Antenna	antenna model
set val(ifqlen)	100	max packet in ifq
set val(nn)	156	number of mobile nodes
set val(rp)	AODV	routing protocol
set val(rp)	DSR	routing protocol
set val(x)	1000	area
set val(y)	500	area
set	"scenconextcp40"	connections
val(conexiones)		
set	"scen120total"	scenario
val(scenario)		
set val(stop)	97	time simulation

that determines the size and the area in which nodes move in meters and finally [outdir = file] Filename motion itself scenario name. And to see that was created entered the same directory and must have created the corresponding scenarios.

F. Creating connections

First ns-allinone enters then the next route ns2.34/indeputils/cmugen/setdest / in this direction is cbrgen.tcl file, this file serves me as a basis to create the connections, it should be emphasized that for this type scenarios we created two types of connections 20 and 40 for the amount of 97, 100 and 120 nodes. To generate the connections in this specific case study we accessed via a terminal ns2.34 and have executed the following command to create the connections, ns cbrgen.tcl-type tcp-nn 120 seed-mc 40-rate rate 2 ; scenconextcp40. Where tcp - is the type of traffic, nn - indicates the number of nodes in the simulation, random seed seed, mc - connections number of connections, - rate indicates the baud rate in pkts/sec and finally [outdir = file] that becomes the file name connections.

III. PERFORMANCE EVALUATION AND ANALYSIS

Throughput analysis is one of several important parameter of network performance; it attracts the attention of many researchers. In contrast to the transmission of small messages, new application can consume as much network bandwidth as is available. It is the end-to-end throughput rather than the per packet end-to-end delay that is the main performance concern Figure 2 and Figure 3. In this section we compare the

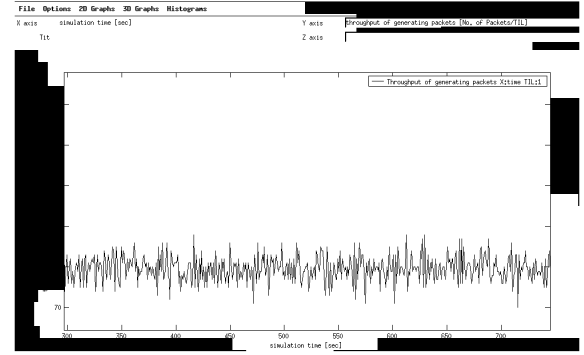


Figure 2. Throughput of generation packets-AODV

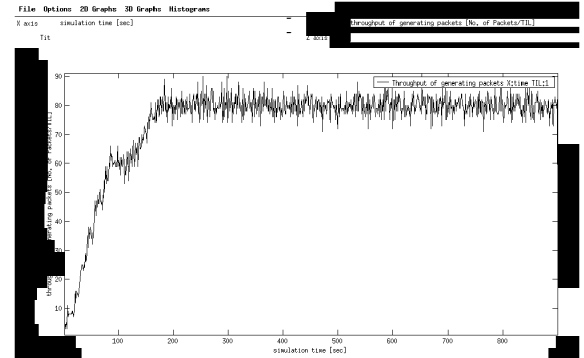


Figure 3. Throughput of generation packets-DSR

throughput of Mobile Ad Hoc Networks using three different scenarios: 97,100 and 120 users using simulator NS2.

A. Simulation for 97 usuarios o nodes

Setup for a Mobile Ad Hoc Network model operating at a data rate of 10Mbps using NS2 with 97 users or nodes is as shown in Figure 4.

Similarly this baseline Network can be expanded for other two scenarios with 100 and 120 nodes.

In Figure 4, it is observed that the maximum throughput when 97 nodes are employed is 427 packets/sec. In this case, it increases and decreases relative to collision count and traffic at that time. During large traffic, the rate of collision count increases which further affects the throughput of the system.

B. Simulation for 100 usuarios o nodes

Setup for a Mobile Ad Hoc Network model operating at a data rate of 10Mbps using NS2 with 100 nodes is as shown in Figure 5.

When the number of nodes is increased to 100, the throughput in that case is increased. So, increasing the number of users will increase the performance and throughput of the network.

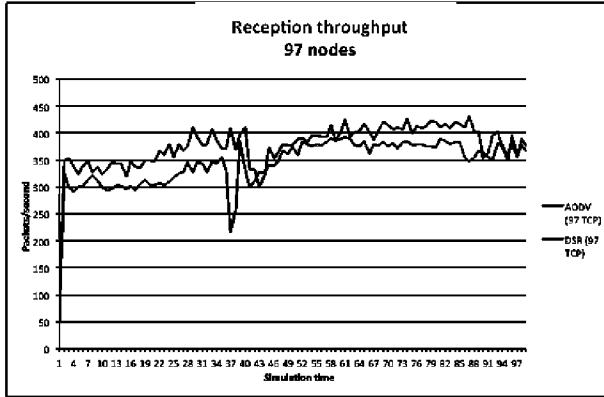


Figure 4. Throughput AODV and DSR with 97 nodes

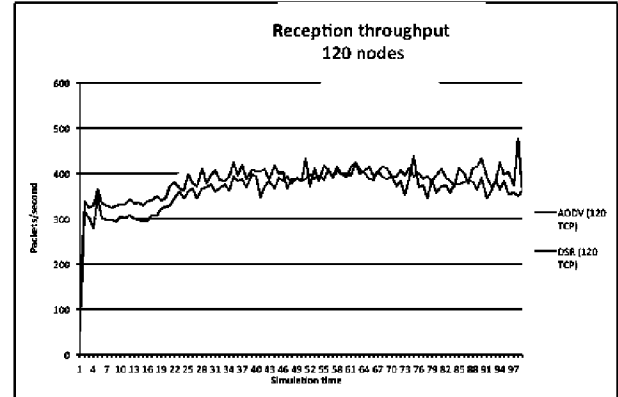


Figure 6. Throughput AODV and DSR with 120 nodes

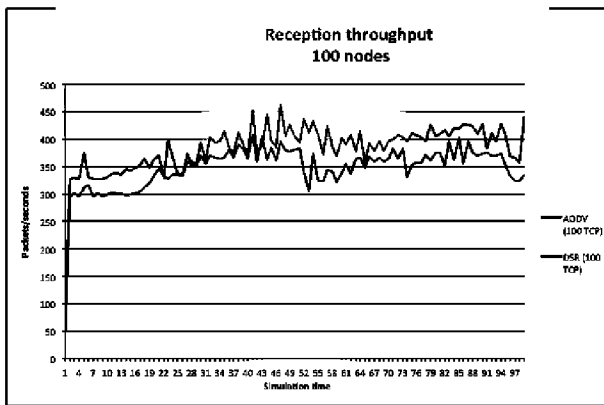


Figure 5. Throughput AODV and DSR with 100 nodes

C. Simulation for 120 usuarios o nodes

Setup for a Mobile Ad Hoc Network model operating at a data rate of 10Mbps using NS2 with 120 nodes is as shown in Figure 6.

When the number of nodes is increased to 120, its throughput will be more as compared to that of 100 nodes.

By analyzing these graphs, it is observed that the throughput of Mobile Ad Hoc Network increased when the number of nodes is increased.

IV. RESULTS AND CONCLUSIONS

By analyzing the graphs, it is observed that throughput of MANETs is increased When the number of nodes is increased at transmission speed of 10 Mbps. The MANETs throughput begins with the small value, after that it keeps on increasing and decreasing within some specific range. At the same time, the throughput of Mobile Ad Hoc Networks begins with large value. After some time it decreases sharply, and again increase sharply within some specific range. The reason for this increasing and decreasing is propagation delay and overhead collisions affecting at that time. During

large traffic, the rate of collision count increases which further affects the throughput of the system.

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