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An Augmentation in a Readymade Simulators Used for MANET Routing Protocols: Comparison and Analysis

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Abstract- A Mobile ad-hoc Network (MANET) is a collection of self oriented mobile nodes dynamically organize a temporary network without any fixed infrastructure and centralized administration control stations wirelessly. In this paper we discuss various readymade simulators and their disadvantages over simulation methodology. Here we are introducing a new simulator and its advantage over traditional one. The various routing protocols are widely analyzed and compared using various simulating environment. The proposed work is basically emphasized on the augmentation in the NS-2 and the Qualnet for standard simulation.

Keywords: MANET, DSDV, DSR, AODV Routing protocol, NS-2, Qualnet

1. INTRODUCTION

MANET is a collection of self distributed mobile nodes which are connected through a wireless network in an infrastructure less environment without any centralized administration. There is a lot of work being done on the simulation of various routing protocols viz. DSDV, DSR, AODV etc. but there are some problems with the existing and traditional simulator which is necessary to rectify. It is not easy to understand the procedure of implementation of any protocol in existing simulators (ns-2, qualnet) due to complex mechanism of implementation. Here the new simulator is proposed and also analyzing various parameter like no. of hopes, no. of retransmission, and throughput and power dissipation in transmission from source to destination. So this could be easily augmented in the ns-2 and Qualnet.

The paper is divided into four sections. In section 1 we will have an overview of various existing simulators. In section 2 we discuss about the problems with these existing simulators. In section 3 there is a comparison and analysis of performance of the augmentation made in readymade simulators .In section 4 there is a conclusion.

2. READYMADE MANET ROUTING PROTOCOL SIMULATORS

a) NS-2: NS2 [1, 2, 3] is an object oriented simulator, written in C++, with interfaced with a TCL interpreter as a front-end. Ns-2 is a discrete event simulator, which means that events (e.g. packets to send, timeouts, etc.) are scheduled in a global event queue according to their time of execution. When a simulation is run the simulator removes events from the head of the queue and moves the simulator time to that of the currently removed event and executes it. It continues to the next event when finished and so forth. Each simulation is defined by a scenario that contains a number of predefined events that define the scenario. The simulator supports a class hierarchy in C++ and a similar class hierarchy within the TCL interpreter. The two hierarchies are closely related to each other from the user's perspective. There is a one-to-one association between a class in the interpreted hierarchy and one in the compiled hierarchy. The origin of this hierarchy is the class TclObject. Users generate new simulator objects through the interpreter. These objects may have instance within the interpreter, and are closely reflected by a corresponding object in the compiled hierarchy.

Ns-2 scenarios are implemented in TCL-scripts that contain the commands to initialize the simulator and to create the nodes and their configuration. Every simulation executes generates a trace file containing all the data packets that are sent between the nodes during the course of the picture. After analyzing this file it is possible to determine the performance effect of parameter variations, diverse routing protocols and more. It runs from a UNIX terminal window. To edit the scripts used in this assignment you need a text editor, e.g., Emacs, Vi or similar.

The interpreted class hierarchy is automatically established through methods defined in the class TclClass. User instantiated objects are displayed through methods defined in the class TclObject. There are other hierarchies in the C++ code and TCL scripts. These other hierarchies are not mirrored in the manner of TclObject.

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b) Qualnet: QualNet Simulator [5, 4] is a state-of-the-art simulator for outsized, diverse networks and the dispersed applications that execute on those networks. QualNet Simulator is an exceptionally scalable simulation engine, accepting high-fidelity models of networks of tens of thousands of nodes. QualNet makes high-quality use of computational resources and models large-scale networks with heavy traffic and mobility, in rational simulation times.
The striking features of QualNet Simulator are as follows:
- The model set up are fast with a powerful Graphical User Interface (GUI) for custom code development and reporting options
- Instant playback of simulation results to minimize unnecessary model executions.
- Simulation results are fast thorough investigation of model parameters.
- Scalable up to 10 thousands of nodes.
- Concurrent simulation for man-in-the-loop and hardware-in-the-loop models.
- Multi-platform support Qualnet contains different tools that provide some features. These tools are classified as -
- QualNet Scenario Designer: QualNet Scenario Designer is a graphical tool that provides an intuitive model set up capability and is used to create and design experiments in QualNet. The Scenario Designer enables a user to define the geographical division, physical associations and the functional parameters of the network nodes, all using spontaneous click and draw tools, and to define network layer protocols and traffic characteristics for each node.
- QualNet Animator: QualNet Animator is used to execute and animate experiments created in the Scenario Designer. Using the Animator a user can watch traffic flow through the network and create dynamic graphs of critical performance metrics as a simulation is running.
- QualNet 3D Visualizer: QualNet 3D visualizer is similar to QualNet Animator, but it provides the added capability of visualizing scenarios in 3D.
- QualNet Analyzer: QualNet Analyzer statistical graphing tool that displays network statistics generated from a QualNet experiment. Using the Analyzer, a user can view statistics as they are being generated, as well as evaluate results from various experiments.
- QualNet Packet Tracer: It is a packet-level visualization tool for viewing the contents of packets as they travel up and down the protocol stack.
- QualNet Protocol Stack: QualNet uses a layered architecture similar to that of the TCP/IP network protocol stack. Within that architecture, data migrates between neighboring layers. QualNet's protocol stack consists of, from top to bottom, the Application, Transport, Network, Physical Layers and Link (MAC). Adjacent layers in the protocol stack communicate via well-defined APIs, and generally, layer communication occurs only between adjacent layers. For example, Transport Layer protocols can get and pass data to and from the Application and Network Layer protocols, but cannot do so with the Link (MAC) Layer protocols or the Physical Layer protocols.

3. THE PROBLEMS WITH EXISTING MANET SIMULATORS

Problems with NS2
- To implement a routing protocol in NS2 we have to create too many files that are not easy to implement.
- In NS2, open source is used. To use this open source we must know the programming used.
- It is freeware so training is not easily available.
- Editing is very difficult in NS2.
- Compilation and Execution is tough.
- AWK file is created for output. To see output we have to change awk file.
- TCL script language is to be learned to change the parameters.

Problems with Qualnet
- In Qualnet, there is very long and complex code for the protocols. E.g. AODV codes are of 196 pages.
- The change of output parameter is not allowed.
- Editing is not an easy task in Qualnet.

4. THE NEW SIMULATOR

As per the discussion we have analysed the various problems and limitation is associated with the readymade simulators. So there is a new simulator which is designed in C++ which can decrease the understanding complexcities of above simulators and can be easily augmented with the existing one. This will deal with some parameter as input and some are as output. The input parameter are number of nodes that a network contains, Number of iterations, Transmission radius or range that is used to find out the neighbor list of each node, Source node and destination node and the output parameter are Average number of hopes, Average number of retransmission, Average number of throughput, Average power decapitated per node.
Results: A network is having 10 nodes and the neighbor position are given below in table

Nodes	Neighbor list				
1	4				
2	3				
3	2				
4	9	5	1	8	10
5	9	4	10	8	7
6	8				
7	5	9	10		
8	4	9	10	6	5
9	5	4	10	8	7
10	9	5	4	7	8

Table 1

Hope count: Defined as the number of intermediate nodes between a source and destination. As shown in the Figure below with the increase in the transmission radius, the hop count gets increased the analysis is made on some assumption i.e. no. of nodes are N=20, 25 and 30.

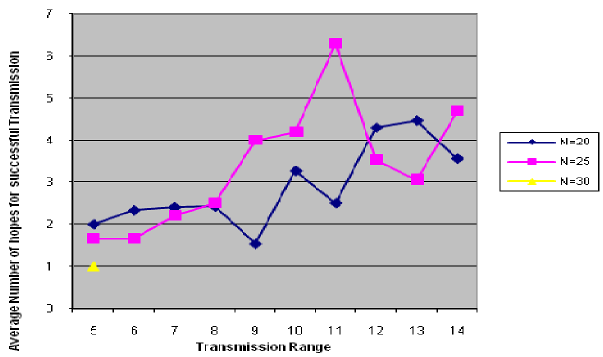

Fig. a

Throughput: It may be defined as the number of successful transmission to the total number of transmissions. The average throughput increases as the transmission range increases due to the fact that the information regarding neighboring nodes gets increased as shown in Figure below:

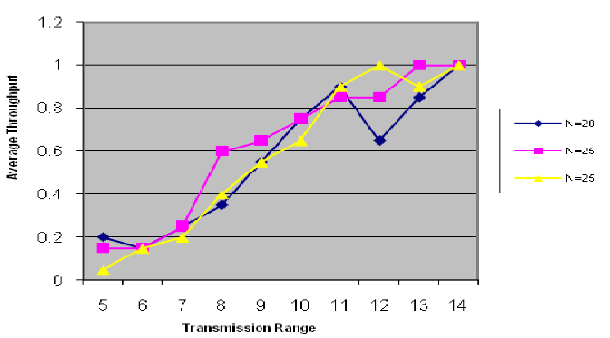

Fig. b

Average power left per node: For measuring average power the following assumption was made

- Each node is assigned 100 units of power
- The node consumes 2 units of battery for transmitting a packet
- The node consumes 1.5 units power in receiving a packet

The average power decreases for lower transmission radius but as the transmission radius is increased the average power left per node also get increased as shown in Figure below.The reason for such behavior is at lower transmission radius the number of retransmission is quite large.

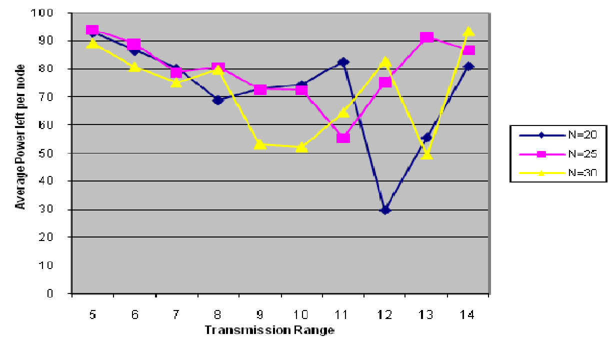

Fig. c

Average number of retransmission: The average number of retransmission is more when the transmission radius is low since there are limited numbers of neighbor but as the transmission radius is increased the probability to reach destination gets increased and hence retransmission reduces as shown in Figure below.

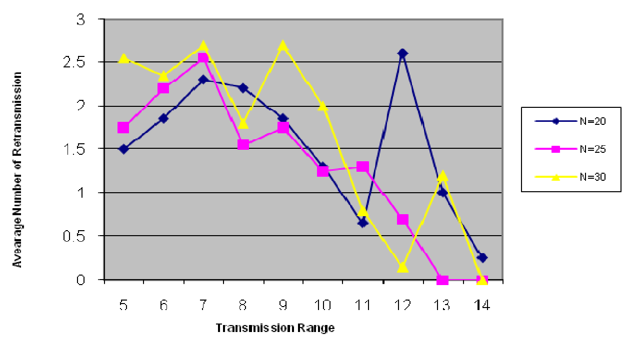

Fig. d

The power consumption in transmitting a packet is directly proportional to the square of the distance between the source and destination, more is the distance more is the power consumed and lesser is the effective network life time. The nodes thus tries to select their intermediate nodes to relay the packets in order to increase its effective life time, reduce average power consumption of the overall network but at the same time introduces congestion since the number of nodes involved in routing process gets increased by adopting the strategy proposed

5. CONCLUSION

In this work a new routing protocol has been proposed for implementing routing protocol for ad hoc network. The proposed protocol is power aware keeping in view the power constraint of nodes being used in the ad hoc network. To test the performance of the protocol a program has been designed in C++. This implementation in C++ has allowed us to check the performance of the protocol under various conditions. This performance has been illustrated in the forms of the graphs and tables in this paper. The results are quite satisfactory indicating that the proposed protocol has feasible implementation.

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