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Performance Evaluation of WLAN network based TORA protocol using OFDM (802.11a) and Extended rate PHY (802.11g)

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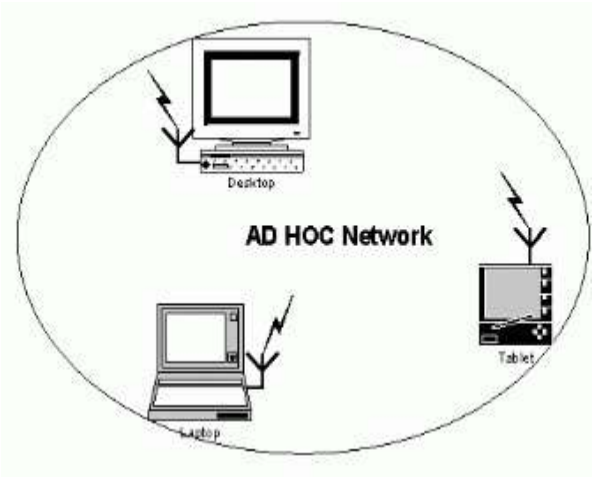
Abstract
A mobile ad hoc network is a wireless network which do not have centralized control or preplanned infrastructure. MANET is a self organized and self configurable network where the mobile nodes move arbitrarily. In WLAN network all mobile nodes can sent and receive packets through routing. Routing is a critical issue in MANET and focus of this paper along with the performance analyses and evaluation of TORA routing protocol .Our simulation tool will be OPNET modeler. The performance of TORA routing protocol is analyzed by different matrices i.e. delay, network load, throughput, retransmission attempts, traffic sent and traffic received using WLAN based IEEE802.11a and IEEE802.11g with data rate of 24mbps and 36mbps

Keywords: MANET, TORA, OPNET

1. Introduction

Mobile ad hoc network (MANET) which is shown in fig with three nodes



is one of the recent active fields and has received spectacular consideration because of their self-configuration and self-maintenance. Mobile ad hoc network is a wireless network which do not have centralized control or preplanned infrastructure. MANET forms dynamic network so the topology keep changes. All the nodes in MANET communicate with each other by making dynamic paths among themselves [1].
Node mobility in mobile ad hoc networks (MANETs) can cause frequent topology changes therefore finding and maintaining the route(s) in such an environment is a challenging problem. To have reliable data transmission in MANET efficient routing protocol should be used. Two types of routing are static routing and dynamic routing [4].In static routing a network administrator enters the route manually in routing table. Route setting is automatic in dynamic routing, optimized route is selected automatically. MANET uses dynamic routing. Dynamic routing have three types of protocols that are responsible

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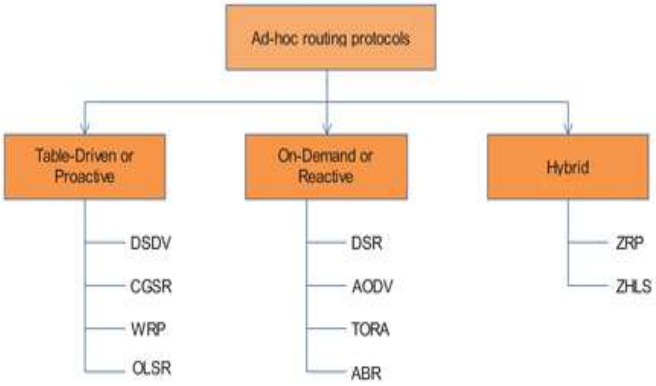
for data transmission between mobile nodes as in above Fig [2].



Routing information update mechanism protocols

A) Proactive protocol:

In proactive protocol if a node wants to send data to other node path is known already. Proactive protocol approach maintains table of routes for each node. So this approach is called table driven approach. This method is not efficient for large networks as they have to maintain route information for each node [3].

B) Reactive protocol:

Reactive protocol approach is also called on demand approach .It does not maintain route information as like proactive protocol. Whenever a node wants to send data to other node then it discover the path on demand for sending the data packets [3][5].

C) Hybrid protocol:

Hybrid protocols are the combination of merits of both proactive and reactive protocols. Now a days Hybrid protocols are most widely used in ad hoc networks [3][1].

2. TORA

Which is Temporally Ordered Routing Algorithm (TORA) is a routing algorithm, comes under reactive routing protocol. The basic concept of TORA on which it works is link reversal, so it is also called link reversal protocol. TORA routing protocol can create multiple paths to destination from source. Because of higher mobility of nodes in the network, congestion is one of the major problems in MANETs. Traditional shortest path algorithm, adaptive shortest path algorithm, and link state routing cannot work properly in mobile networks. It is difficult to update the routing tables of dynamic nodes. To solve this problem TORA is used which is proposed to operate in highly dynamic mobile networking environment. It provides localization of control messages to a very small set of nodes. Nodes maintain routing information about their immediate one-hop neighbors In TORA, each node broadcasts a query packet and the recipients broadcast an update packet. It supports the loop-free, multiple route facilities. To discover a route, it uses the DAG (Directed Acyclic Graph) and also uses a set of totally-ordered heights at all times [6][1]. In this approach, information may only in one direction. Hence it is only unidirectional. It performs four basic operations route creation, route maintenance, route deletion and optimizing routes

TORA uses three different control messages. It uses:

1. QRY for creating a route.

2. UPD for both creating and maintenance routes.

3. CLR for erasing a route.

2.1 Properties of TORA

1. Distributed routing - each router needs to maintain information about the adjacent routers only.

2. Loop free routing- due to using the DAG, information always flows in one direction.

3. Multiple routes establishment to improve congestion.

4. Minimize communication overheads to minimize bandwidth utilization.

In figure 4.2, the source node is „*a'* and the destination node is „*g'*

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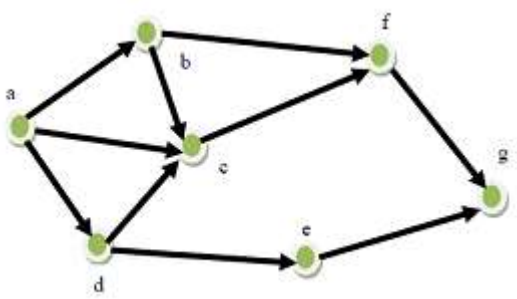
Fig Modus Operandi – OPNET [4]



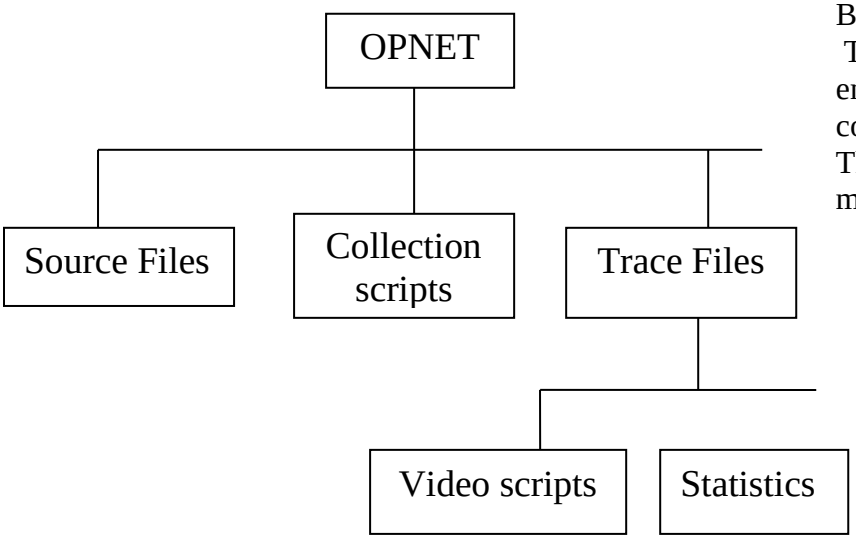
.
Figure: Directed Acyclic Graph.

Using the DAG, we can express all possible routes in following ways,

H(a)>H(b)>H(f)>H(g);
H(a)>H(b)>H(c)>H(f)>H(g);
H(a)>H(c)>H(f)>H(g); H(a)>H(d)>H(e)>H(g)

3. Simulation tool and parameter

OPNET tool is used to carry out the simulation. OPNET provide technologies, protocols, communication devices for academic research, assessment and improvement. It is efficient, robust and highly reliable and as it was available for us in our labs so it was the obvious choice for us to select the appropriate simulation tool [7][8].



All the OPNET project files with scenarios, topologies and applications are contained in the OPNET subfolder Source Files. The scripts used to collect the statistics coming from OPNET simulations are in the subfolder Collection Scripts and all the collected statistics and the video scripts are contained in the subfolder Trace Files.

3.1 OPNET Modeler

We are using the Optimized Network Engineering Tool (OPNET v14.5) for simulation of our networks which is one of the most powerful simulation tools regarding wireless communications. OPNET is a research oriented network simulation tool which provides a development environment for modeling and simulation of deployed wired as well as wireless networks and also provides multiple solutions for managing networks and applications e.g. network operation, planning, research and development (R&D), network engineering and performance management. OPNET 14.5 is designed for modeling communication devices, technologies, protocols and to simulate the performance of these technologies. User can create customized models and simulate various network scenarios. It is possible to simulate various wireless communication technologies such as MANET, 802.11, 3G/4G, Ultra Wide Band, WIMAX, Bluetooth, ZigBee using OPNET tool.

The OPNET modeler is object oriented and employs a hierarchical approach to model communication networks as shown in fig below. The OPNET usability can be divided into four main steps.

1. Modeling : This module is used to build or create a network model
2. Choose and select statistics: We can choose different statistics to collect from each network.
3. Simulate the network.
4. View and analyze results.

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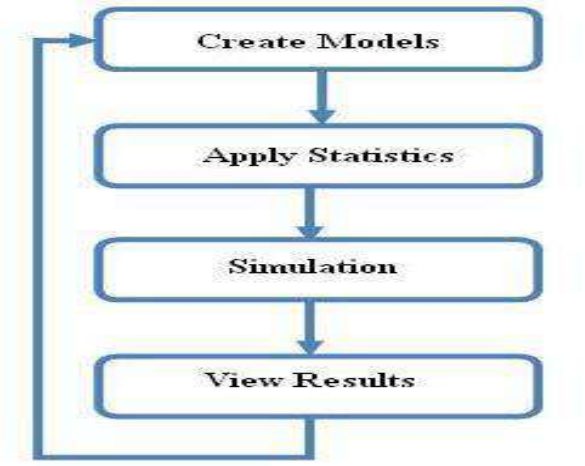
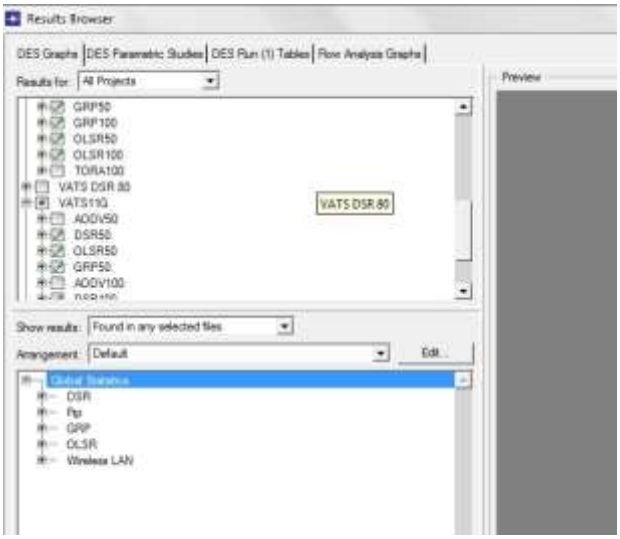


Flow chart on executing network model using OPNET.

3.2 Simulation Statistics

In OPNET there are two kinds of statistics, one is Object statistics and the other is Global statistics. Object statistics can be defined as the statistics that can be collected from the individual nodes. On the other hand Global statistics can be collected from the entire network. When someone choose the desired statistics then run the simulation to record the statistics. These collected results are viewed and analyzed. To view the results right click in the project editor workspace and choose view results or click on DES, results then view results. Then a browser pops up as shown in this figure .



Result browser

3.3 Simulation parameter

The parameters that have been used in the following experiments are summarized in Table I.

WLAN Parameter

Parameters	Value
Operation Mode	802.11a/g
Node Position	Rectangular
No. of Nodes	100
Speed	100 m/s
Simulation Time	1000 sec
BSS identifier	Auto assigned
Data rate	24,36 mbps
Transmit power (W)	0.020
Addressing Mode	IPV4
Routing protocol	TORA
Buffer Size	1024000
Packet reception-power threshold	-95

Physical characterstics	OFDM(802.11a),Extended Rate PHY (802.11g)
Packets	-95

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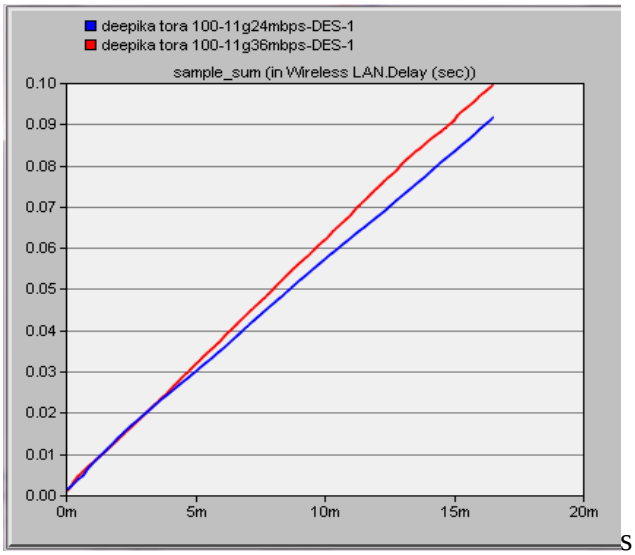
reception Power threshold	
Long retry limit	4
AP beacon interval (Sec)	0.02
Max receiver lifetime (Sec)	0.5
Large Packets processing	Drop



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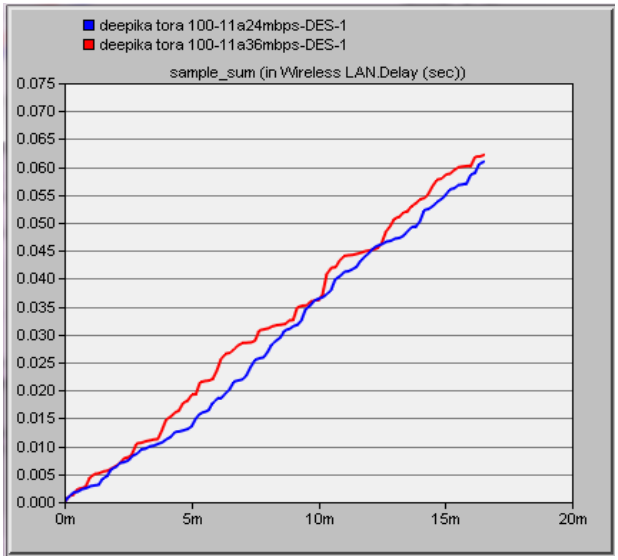
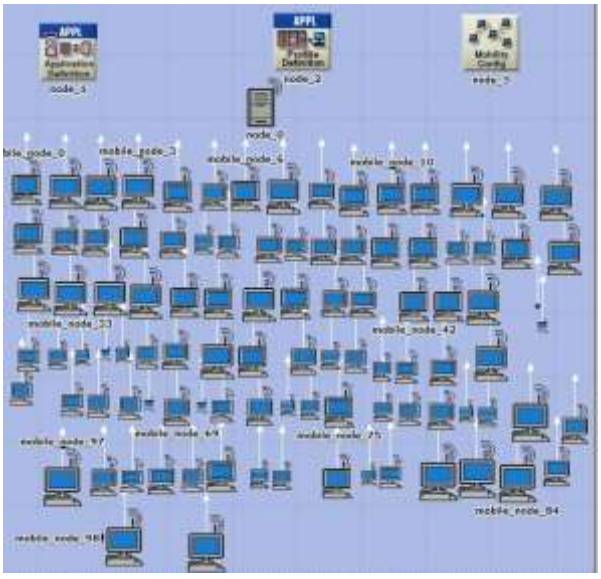
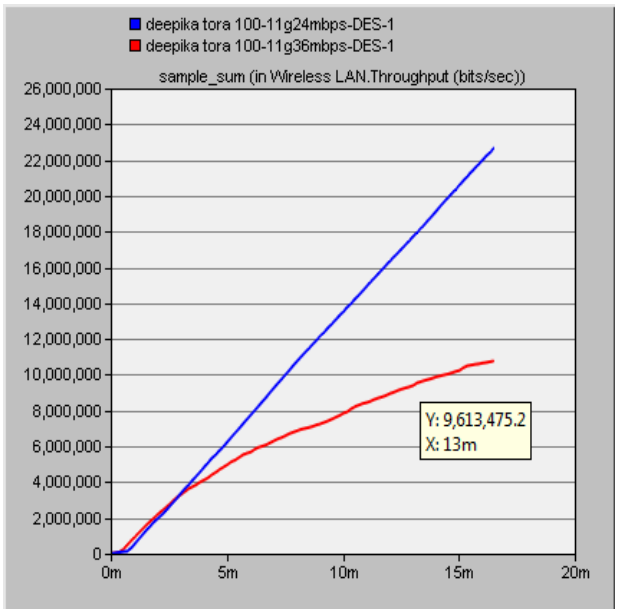


4. Simulation result and analysis

This paper contains a network of 100 nodes in a square meter area. It represents the scenarios of 100 nodes by using reactive protocol TORA and analyses its results graphically .It shows End to end Delay ,Throughput ,Retransmission attempts ,network load ,traffic sent ,traffic received [7].



Simulation scenario having 100 nodes



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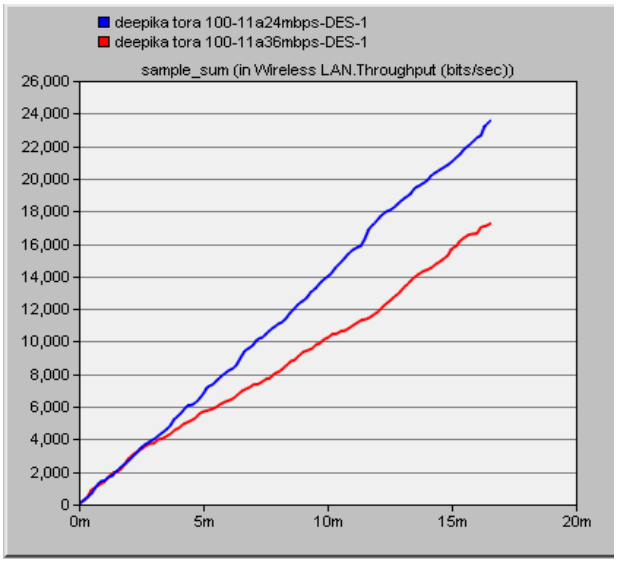

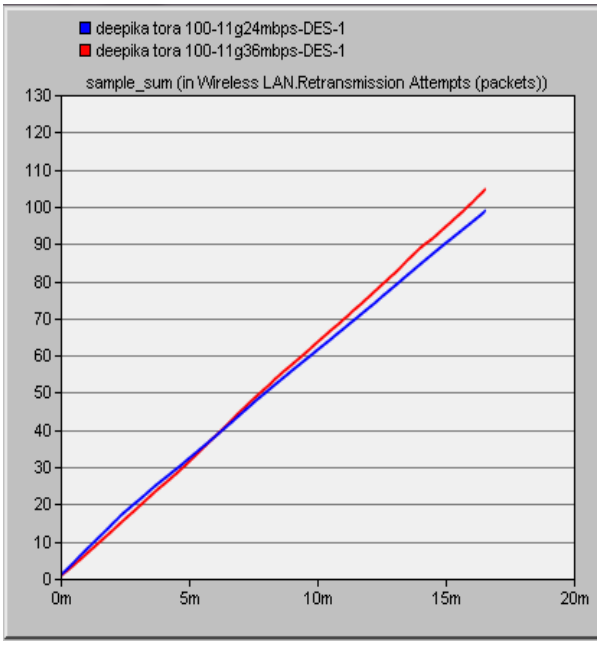

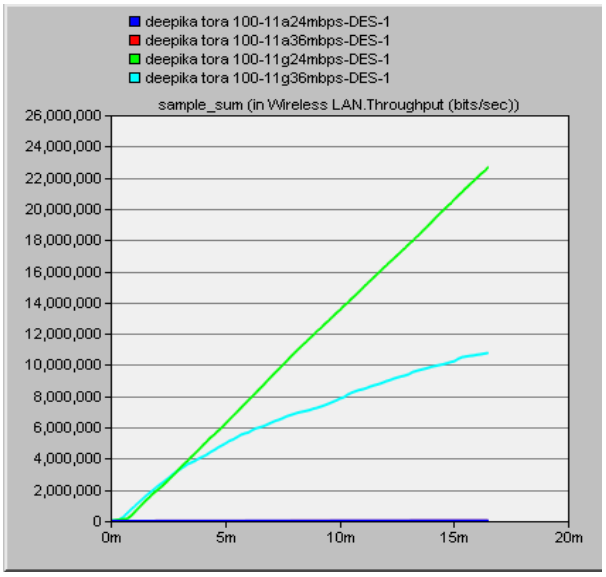

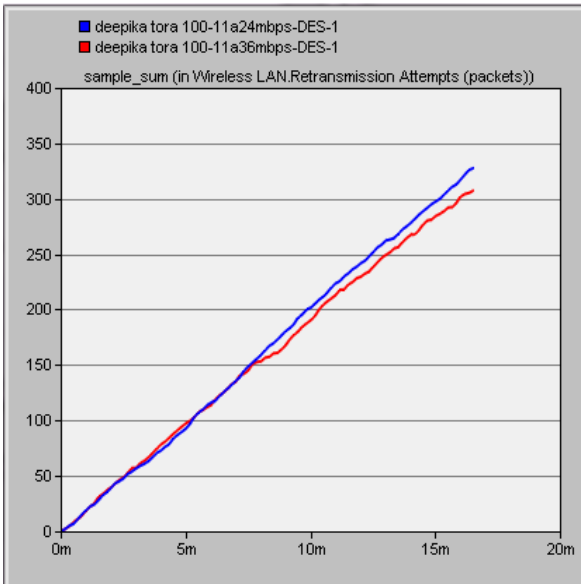

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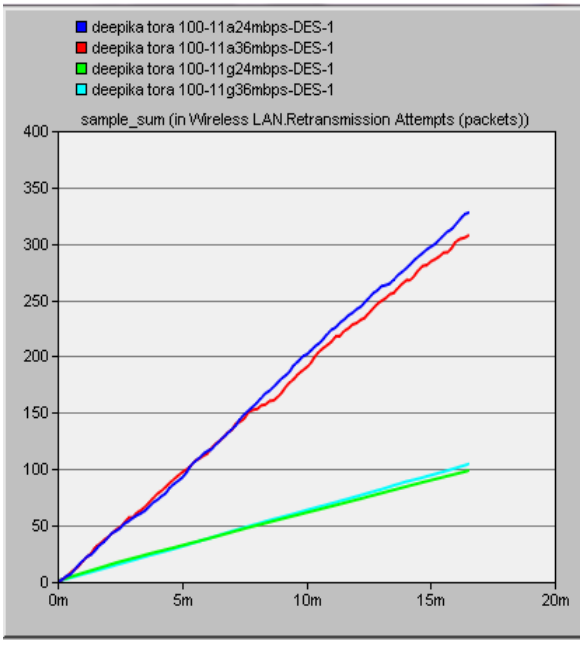

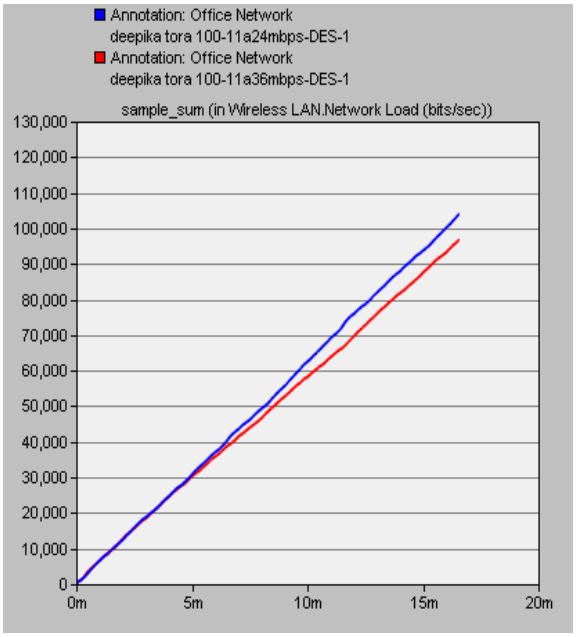

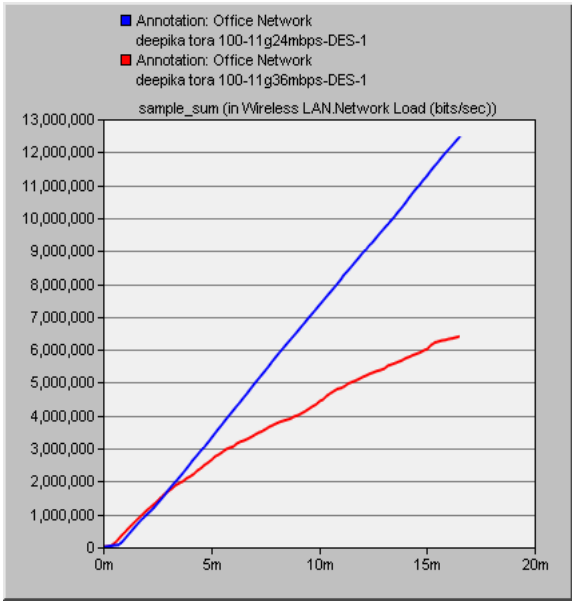

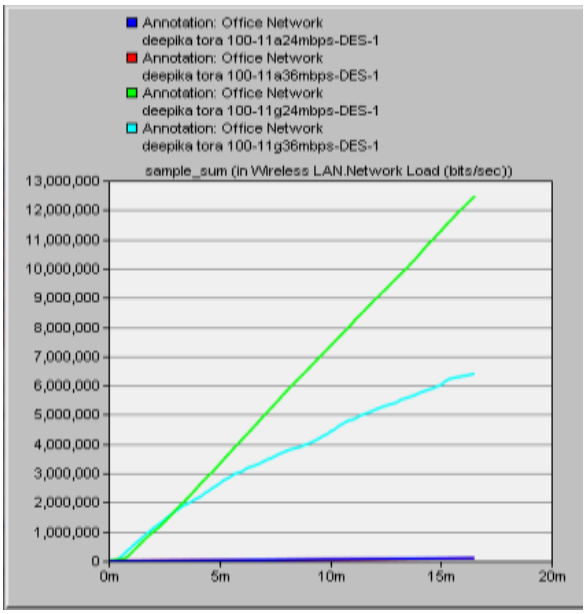

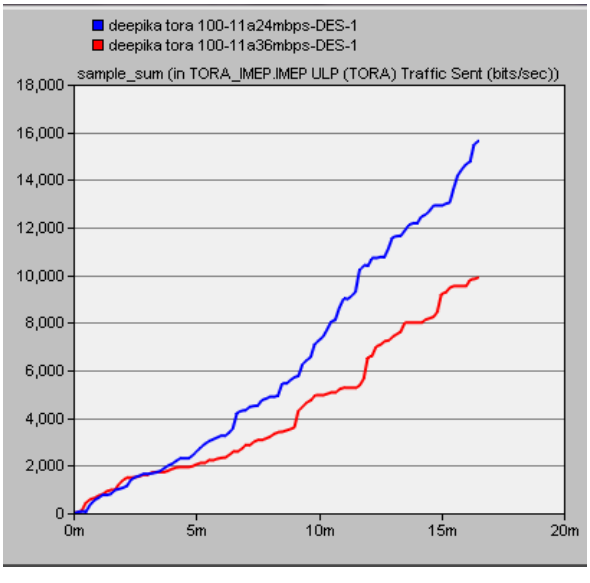

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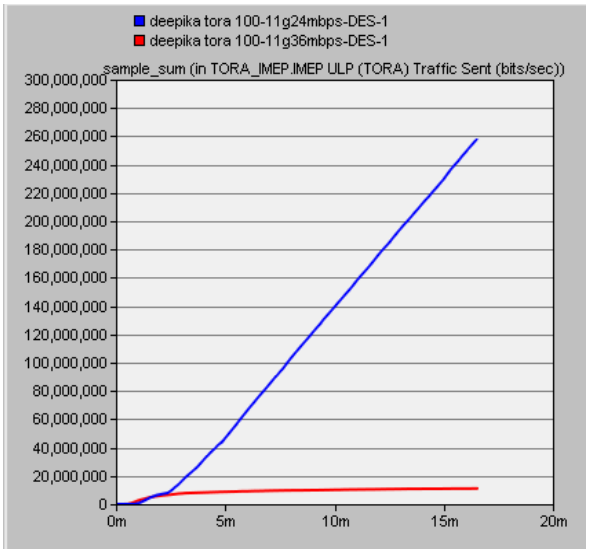

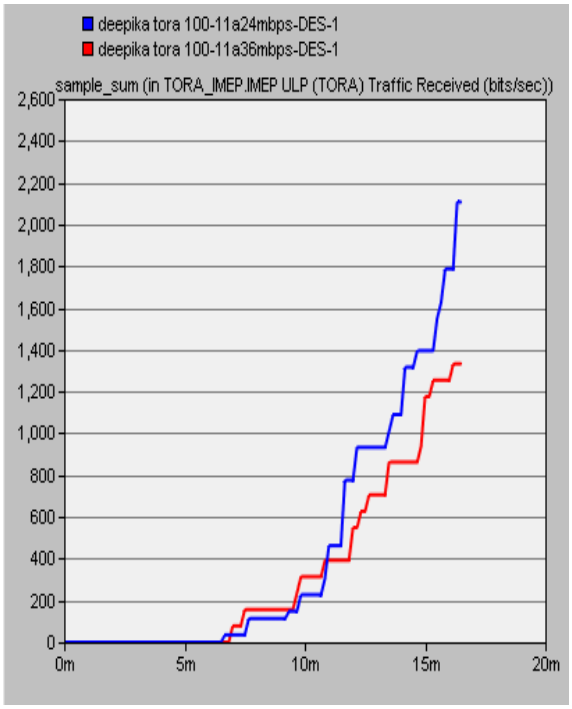

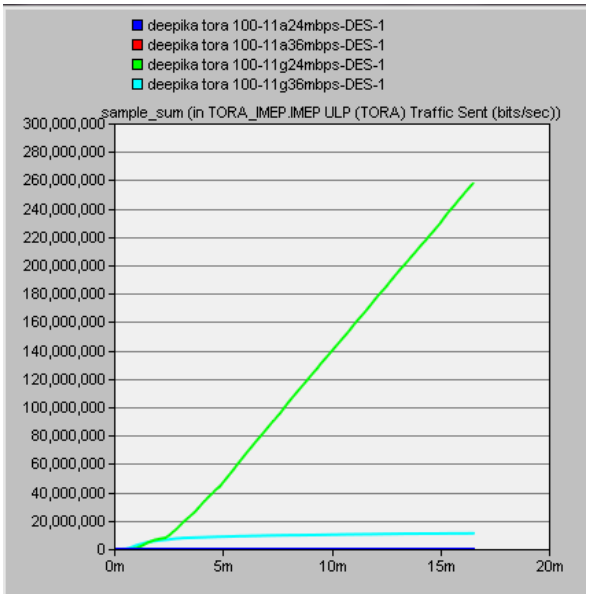

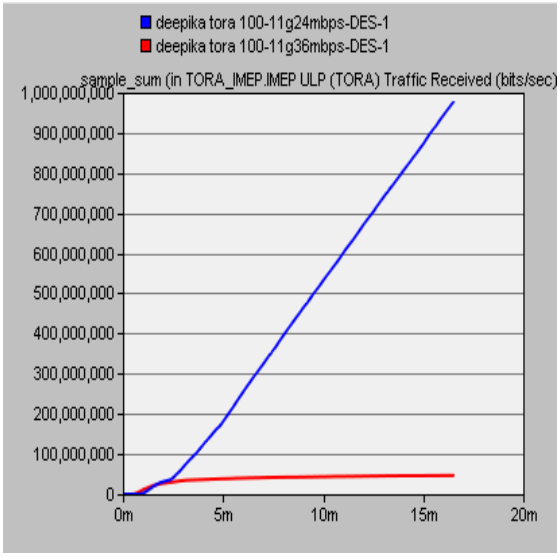

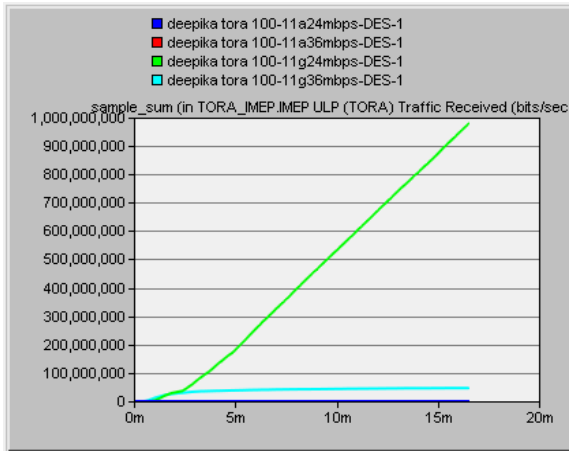

5. Conclusion

Thesis report is mainly consists of two types of studies, one is analytical study and other is simulation study. In analytical study we conclude that routing protocols in new modern arena of telecommunications, internet systems and in seamless communication play prominent role to develop better communication between end users. Different routing protocols have different attributes according to their environmental scenarios. The selection of suitable protocol according to the network definitely increases the reliability of that network, for example in case of mobile ad hoc networks routing protocols should be loop free according to our research. Categorically it has been analyzed that there are two categories of routing protocols used in mobile ad hoc networks that are reactive routing protocols and proactive routing protocols, both categories have their own usage, so the selection of these categories in ad-hoc networks is very important. The simulation study of this thesis consisting of TORA routing protocol deployed over MANET with respect to six parameters, delay, retransmission attempts, traffic sent, traffic received, network load and throughput. Our motive was to check the performance of this TORA routing protocol in MANET in the above mentioned parameters. The selection of efficient and reliable protocol is a critical issue. In this simulation work we get simulation graphs and from graphs we can conclude that the performance of TORA routing protocol with respect to different matrices i.e. delay, network load, throughput ,retransmission attempts ,traffic sent and traffic received using WLAN based IEEE802.11g with data rate of 24mbps outperforms well in 100 nodes network, but it is not necessary that this perform always better in all the networks, its performance may vary by varying the network. At the end we came to the point from this simulation and analytical study that the performance of routing protocols vary with network and selection of accurate routing protocols according to the network, ultimately influence the efficiency of that network in magnificent way.

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