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Comparative Analysis of GRP and TORA Manet Routing Protocols using OPNET

Naveen Bilandi, Harsh K Verma, Suryakant
Department of Computer Science and Engineering,
NIT Jalandhar
naveenbilandi77@gmail.com

Abstract— Ad-hoc networks have opened a new dimension in wireless networks. It allows wireless nodes to communicate in absence of centralized support. It does not always follow any fixed infrastructure due to high mobility of nodes and multipath propagations. Routing protocols of mobile ad-hoc networks differ from the existing internet protocols which are designed for the fixed structure based wireless networks .The main classes of MANET routing protocols are Proactive, Reactive and Hybrid. In this paper we compare performance of Hybrid routing protocol by focusing on Gathering-based Routing Protocol (GRP) and Reactive Routing Protocol by focusing on Temporally-Ordered Routing Algorithm (TORA) we use the OPNET to establish the simulation models of GRP and TORA protocols in MANET. These protocols are compared on the basis of their throughput, delay, and network load by increasing number of nodes in the network

Keywords— MANET, GRP, TORA, OPNET, Routing Protocols.

I. INTRODUCTION

A MANET [1] is a collection of mobile nodes that can communicate with each other without the use of predefined infrastructure or centralized administration. Nodes communicate with each other without any centralized base stations. In such a network, each node acts both as a router and as a host. Mobile ad-hoc network have the attributes like wireless connection, different types of topology, distributed operation and some communication protocol. There are three categories of MANET routing protocols [8][9] such as table driven (Proactive Routing Protocols), on-demand (Reactive Routing Protocols) and hybrid. In proactive protocols, each node maintains individual routing table containing routing information for every node in the network, each node maintains consistent and current up-to-date routing information by sending control messages periodically between the nodes which update their routing tables.

In Reactive routing protocols, when a source wants to send packets to a destination, it invokes the route discovery mechanisms to find the route to the destination ,the route remains valid till the destination is reachable or until the route is no longer needed, and the Hybrid routing protocol combines the advantages of both proactive and reactive routing protocols, the routing is initially established with some proactively prospected routes and then serves the demand from additionally activated nodes through reactive flooding.

Mobile ad-hoc network is sometimes called a Mobile Mesh Network when its self configuring network of mobile devices connected by wireless links during communication of wireless network. Each device in a MANET is free to move independently in any direction. This paper present the comparative study of two manet routing protocols name TORA (Reactive Routing Protocol) and GRP(Hybrid Routing Protocol)

II. AD-HOC ROUTING PROTOCOLS

This section describes the main features of two protocols GRP [4](Gathering-based Routing Protocol) and TORA [2][3] (Temporally Ordered Routing Algorithm) deeply studied using OPNET 14.5 .

An ad-hoc routing protocol is a convention, or standard, that it improves the scalability of wireless networks compared to infrastructure based wireless networks because of its decentralized nature. Ad-hoc networks are best suited due to minimal configuration and quick operation.

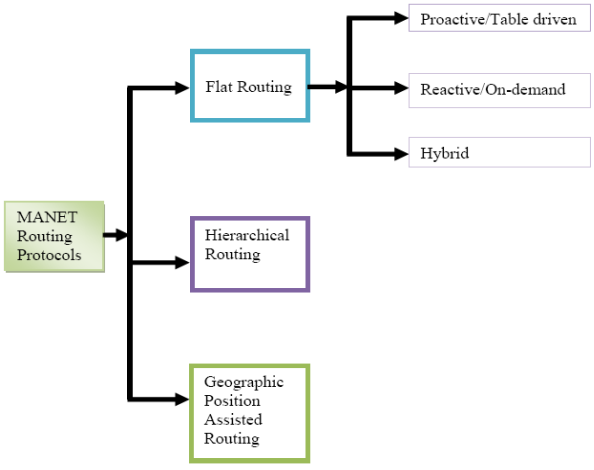

Figure 1: Classification of MANETs Routing Protocols

A. GRP (Gathering-based Routing Protocol)

Gathering-based Routing Protocol combines the advantages of Proactive Routing Protocol (PRP) and of Reactive Routing protocol(RRP). PRP are suitable for

supporting the delay sensitive data such as voice and video but
it consumes a great portion of the network capacity. While RRP is not suitable for real-time communication, the advantage of this approach is it can dramatically reduce routing overhead when a network is relatively static and the active traffic is light. However, the source node has to wait until a route to the destination can be discovered, increasing the response time.

The function of Gathering-based Routing Protocol (GRP) for mobile ad hoc network is to gather network information rapidly at a source node without spending a large amount of overheads. It offers an efficient framework that can simultaneously draw on the strengths of Proactive routing protocol (PRP) and reactive routing protocol (RRP) collects network information at a source node at an expense of a small amount of control overheads. The source node can equip promising routes on the basis of the collected information, thereby continuously transmitting data packets even if the current route is disconnected, its results in achieving fast (packet) transfer delay without unduly compromising on (control) overhead performance.

B. *TORA (Temporally-Ordered Routing Algorithm)*

TORA is designed to discover routes on demand, provide multiple routes to a destination, establish routes quickly, and minimize communication overhead by localizing the reaction to topological changes when possible. Route optimality (shortest-path routing) is considered of secondary importance, and longer routes are often used to avoid the overhead of discovering newer routes. It is also not necessary (nor desirable) to maintain routes between every source/destination pair at all times. In TORA, each node broadcasts a query packet and the recipients broadcast an update packet. It supports the loop-free, multiple route facilities. Using "Flat" a non-hierarchical routing algorithm, it also provides better scalability. To discover a route, it uses the DAG (Directed Acyclic Graph) and also uses a set of totally-ordered heights at all times. In this approach, information flood only in one direction, hence there is no chance to fall in infinite loop. The protocol has three basic functions: Route creation, Route maintenance and Route erasure

III. EXPERIMENTAL SET UP

We carried out simulations on Opnet simulator. The simulation parameters are summarized in table 1.

Statistic	Value
Simulator	OPNET 14.5
Scenario Size	2.5×2.5 km
Simulation Time	10 min
Nodes	10,25,50
802.11 data rate	11mbps
Routing protocols	GRP and TORA

Table 1. Simulation parameters

Figure 2. Shows a sample network created with 50 Nodes, one static FTP server, application configuration and profile configuration for the network in which FTP (File Transfer Protocol) has been chosen as an application. Figure 2 depicts a network with 50 fixed nodes whose behaviour has to be analysed nodes in the network with respect to time to determine the effecting features of each protocol

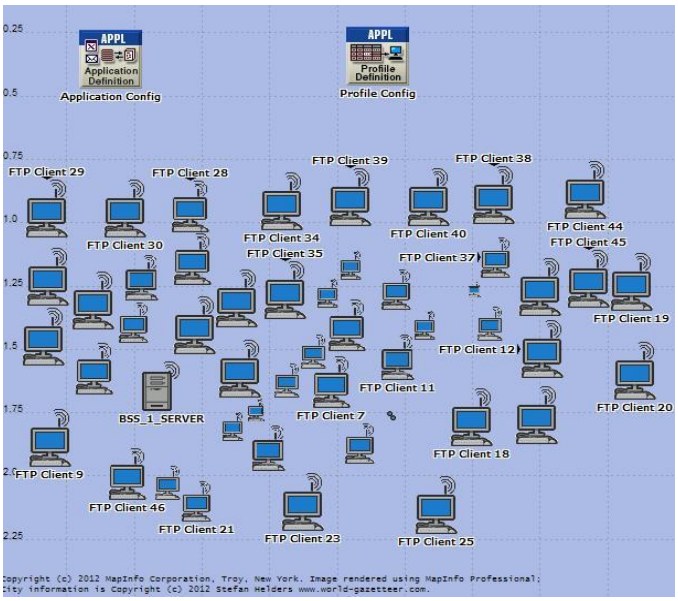

Figure 2. Network created with 50 nodes

IV. PERFORMANCE PARAMETERS

OPNET modeler 14.5[6][7] is used to investigate the performance of routing protocols GRP and TORA with varying network sizes, data rates, and network load. We evaluate three parameters in our study on overall network performance. These different types of parameter show the different nature of these Protocols,the parameters are throughput, delay and network load.

A. *Throughput*

Throughput [5] is measured by the total amount of packets which is received by a destination node. It is measured by byte/sec or bit/sec. High throughput is always expected for any routing protocol

B. *Delay*

The end-to-end delay is the time from the generation of a packet by the source up to the destination reception. It includes all possible delay caused by buffering during route discovery latency, transmission delays at the MAC, queuing at interface queue, and propagation and transfer time. This time is expressed in seconds (sec).

C. *Network Load*

Network load represents the total load in bit/sec submitted to wireless LAN layers by all higher layers in all WLAN nodes

of the network [20]. When there is more traffic coming into the network, it is difficult for the network to handle all this traffic, it is called the network load. An efficient network can easily cope with large traffic coming in, and to make the best possible network.

V. RESULTS

We carried out simulations on Opnet simulator14.5. The results show differences in performance between considered routing protocols, which are the consequence of various mechanisms on which protocols are based. We carried out our simulations with 10, 25 and 50 nodes.

Figures 3,4 and 5 depicts the throughput, delay and network load of this network with respect to total simulation time which is taken as 10 minutes for which the simulation was run.

A. *Simulation and analysis of TORA*

In this simulation, the networks is set to 10,25 and 50 nodes, the traffic is FPT mode, the data transmission rate is 11 Mbps and the simulation time is 10 minutes.

In Fig.3 it is shows that the network throughput of TORA becomes low with the increase of the node number. The reason is that the increase of the node number will lead to the reducing of data packets' receiving in the network due to collision and delay in the network, hence that the network throughput is low.

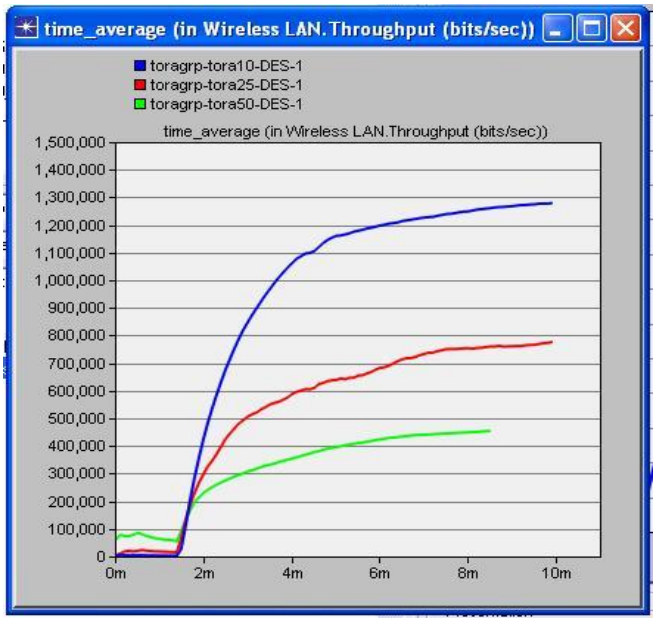

Figure 3. Network throughput of TORA

The Fig.4, shows that the network delay for TORA becomes low with the decrease of the node number. The reason is that the decrease of the node number will lead discover the route path in very short period.

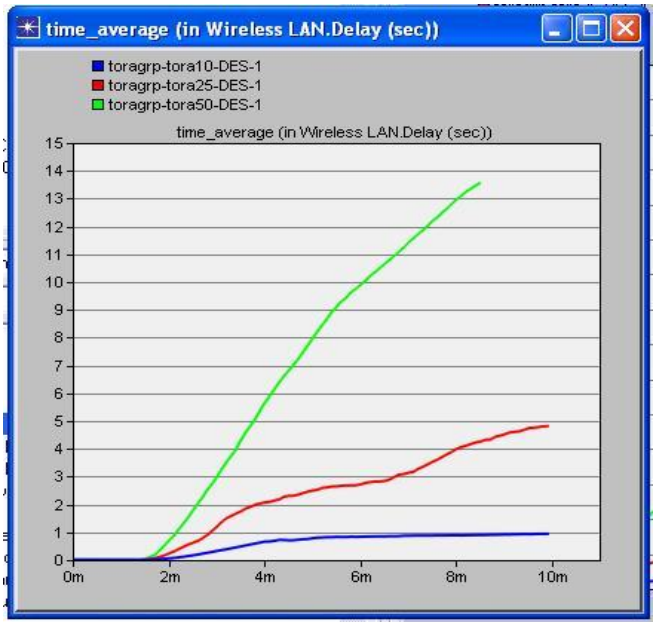

Figure 4. Network delay of TORA

B. *Comparison between GRP and TORA*

In Fig. 5 we can see that the network throughput of GRP is higher than TORA. The reason is that the routing mechanisms of the two protocols are different in which TORA is based on purpose-driven and GRP is based on Hybrid source routing.

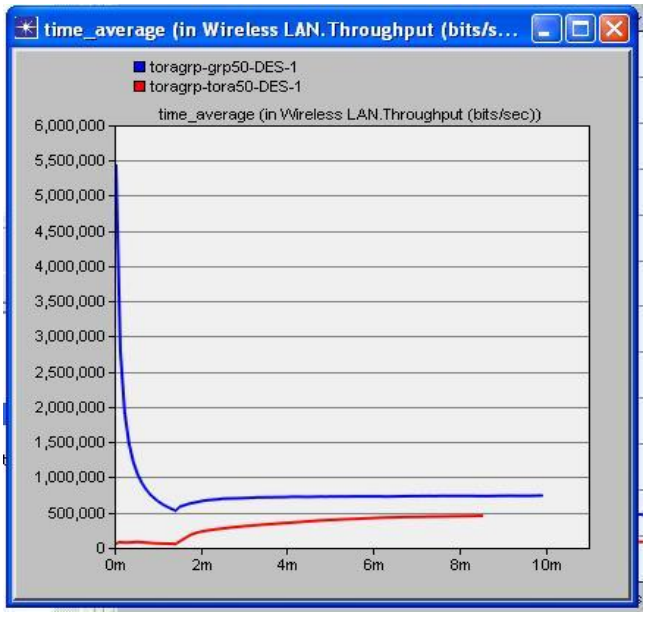

Figure 5. Network throughput of TORA and GRP

In Fig. 6, we can see that the network delay of TORA is significantly longer than GRP. It is because the head of

each data packet will carry the routing information which Will increase the length of packet and the time delay for Processing and queuing. Therefore, the entire network delay Of TORA is significantly longer than GRP

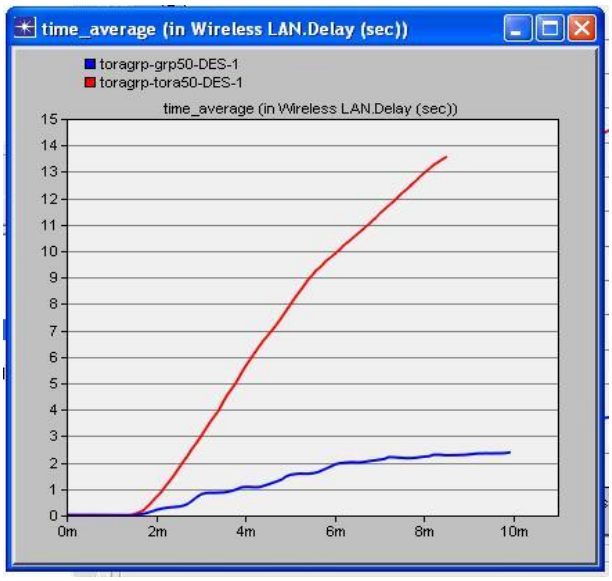

Figure 6. Delay of TORA and GRP

In Fig. 7, we can see that under the GRP, the value of network load start with peak value equal to 300,000 bit/sec and start to decrease for some duration of simulation period and after that start to increase along the simulation period to reach the peak value 720,000 bit/ sec.
Under the TORA, the load begins with its smallest value to 40,000 bit/ sec until the 120 sec of simulation period than start to increase to reach its peak value which is equal to 250,000 bit/sec

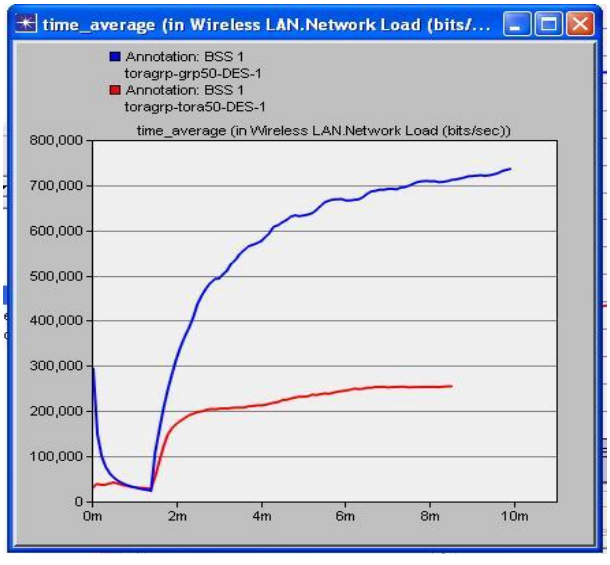

Figure 7. Network load of TORA and GRP

VI. CONCLUSION

In this paper, we present the comparative study of MANET On-demand Routing Protocols (TORA) and Hybrid Routing Protocols GRP. We use OPNET to establish the simulation models of TORA and GRP protocols. At the end we came to the point from our 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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