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An Examination of HTTP Traffics against Proactive, Reactive and Hybrid Routing Protocols in MANET

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Abstract-*A MANET consists of mobile nodes, a router with multiple hosts and wireless communication devices. The wireless communication devices are transmitters, receivers and smart antennas.This paper aims to compare performance of three routing protocols for Mobile Ad-Hoc networks (MANET's).In present study, a comparison of reactive routing protocols i.e. Ad Hoc On-Demand Distance Vector Routing (AODV), proactive routing protocols i.e. Optimized Link State Routing (OLSR) and hybrid routing protocol i.e. Gathering-based Routing Protocol has been made on the basis of throughput, delay, network load, traffic sent and traffic received by increasing number of nodes in the network. MANET routing protocols are evaluated under different scenarios using file transfer protocol (ftp).We compared three routing protocols i.e. AODV, OLSR and GRP. Our simulation tool will be OPNET modeler. All the three routing protocols are explained in a deep way with metrics. The comparison analysis will be carrying out about these protocols and in the last the conclusion will be presented, that which routing protocol is the best one for mobile ad hoc networks. The final evaluation is presented at the end of this paper.*

Keywords— MANET, AODV, OLSR, GRP, OPNET, HTTP, Routing Protocols.

1. INTRODUCTION

A mobile ad-hoc network (MANET) is a network formed without any central administration which consists of mobile nodes that use a wireless interface to send packet data. With current technology and the increasing popularity of notebook computers, interest in ad hoc networks has greatly peaked. Future advances in technology will allow us to form small ad hoc networks on campuses, during conferences and even in our own homes. Each MANET node can serve as a router, and may move arbitrary and dynamically connected to form network depending on their positions and transmission range. The topology of the ad hoc network depends on the transmission power of the nodes and the location of the MNs, which may change with time.

The presence of wireless communication and mobility make an ad hoc network unlike a traditional wired network, and requires the routing protocols used in an hoc network based on new and different principles. Routing in ad hoc environment is one of the important issues of the most challenging and interesting research areas in MANET. Since mobile ad hoc network change their topology frequently, routing in such network is a challenging task. Generally, the main function of routing in a network is to detect and maintain the optimal route to send data packets between source and destination via intermediate nodes.

In this paper, Proactive routing protocols, Reactive routing protocols, Hybrid routing protocols. Proactive protocols, such as Optimized Link State Routing (OLSR) [4] [5] attempt to monitor the topology of the network in order to have route information between any source and destination available at all time. Proactive Routing Protocols are also called table driven routing protocols as all the routing information is usually kept in tables. Reactive routing protocols such as Ad hoc On Demand Distance Vector (AODV) [6][7], find the route only when there is data to be transmitted and as a result, generate low control traffic and routing overhead. Hybrid protocols such as Gathering-

based routing protocol (GRP) [8] could be derived from the two previous ones, containing the advantages of both the protocols, using some quality of one type and enhancing it with the participation of the other one. In this paper we evaluate the performance of a Proactive Routing Protocol (OLSR), a Reactive routing protocol (AODV) and a Hybrid protocol (GRP).

This paper is organized as follows: Section 2 presents overview of Routing protocols in MANETs. Section 3 describes the related work. Section 4 simulation environment and discussion. Section 5 concludes this paper.

2. ROUTING PROTOCOLS IN MANETS

Routing protocols in MANET [9] [10] are divided into four categories: proactive, reactive and hybrid routing protocols. The most popular ones are AODV, DSR (reactive), OLSR (proactive) and GRP (hybrid).

This section describes the main features of three protocols AODV (Ad Hoc On-Demand Distance Vector Protocol), OLSR (Optimized Link State Routing) and GRP (Gathering-based Routing Protocol) 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.

2.1 Ad Hoc On-Demand Distance Vector Protocol (AODV)

AODV [11] is a reactive routing protocol that minimizes the number of broadcasts by creating routes on demand. The AODV algorithm is an improvement of DSDV [12] protocol. It reduces number of broadcast by creating routes on demand basis, as against DSDV that maintains mutes to each known destination. The main advantage of AODV protocol is that routes are established on demand and destination sequence numbers are used to find the latest route to the destination. The source broadcasts a route request (RREQ) packet when it wants to find path to the destination. The neighbors in turn broadcast the packet to their neighbors until it reaches an intermediate node that has recent route information about the destination or until it reaches the destination. When a node forwards a RREQ to its neighbors, it also records in its tables the node from which the first copy of the request came. This information is used to construct the reverse path for the route reply packet (RREP). AODV uses only symmetric links because the RREP follows the reverse path of the RREQ. An important feature of AODV is the maintenance of timer based states in each node, regarding utilization of individual routing table entries. A routing table entry is expired if not used recently. Another distinguishing feature of AODV is the ability to provide unicast, multicast and broadcast communication.

2.2 Optimized Link State Routing (OLSR)

OLSR [13] is a modular proactive hop by hop routing protocol. It is an optimization of pure link state algorithm in ad hoc network. The routes are always immediately available when needed due to its proactive nature. The key concept of the protocol is the use of "multipoint relays" (MPR). Each node selects a set of its neighbor nodes as MPR [8]. Only nodes, selected as such MPRs are responsible for generating and forwarding topology information, intended for diffusion into the entire network. The MPR nodes can be selected in the neighbor of source node. Each node in the network keeps a list of MPR nodes. This MPR selector is obtained from HELLO packets sending between in neighbor nodes. These routes are built before any source node intends to send a message to a specified destination In order to exchange the topological information; the Topology Control (TC) message is broadcasted throughout the network. Each node maintains the routing table in which routes for all available destination nodes are kept. Control traffic in OLSR is exchanged through two different types of messages: “HELLO” and “TC” messages. HELLO messages are exchanged periodically among neighbor nodes, in order to detect links to neighbors, to detect the identity of neighbors and to signal MPR selection. TC messages are periodically flooded to the entire network, in order to signal link-state information to all nodes. The best working environment for OLSR protocol is a dense network, where the most communication is concentrated between a large numbers of nodes.

2.3 Gathering-based Routing Protocol (GRP)

Gathering-based Routing Protocol [14] [15] 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) [16] 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.

3. RELATED WORK

Vishal Sharma et. al. "Performance evaluation of reactive routing protocol in MANET networks using GSM based voice traffic applications" Optik - Int. J. Light Electron Opt. Elsevier pp. 201-204 June 2012. [7]

In this paper, the researcher has evaluated the performance of AODV and DSR reactive routing protocols in MANET network using GSM quality voice traffic by calculating matrices such as voice end-to-end delay, network load, throughput and number of hops per route, route discovery time, and voice traffic-sent and -received using OPNET Modeler 14.5. From this paper it is concluded that AODV routing protocol has lowest end-to-end and lower network load as compare to DSR. Also, ADOV has maximum average throughput and traffic received as compare to DSR. The DSR routing protocol does not scale well with large sized networks. Simulation results also showed that AODV reactive routing protocol is the best suited for MANET networks in dense population of nodes, whereas, DSR has very poor QoS in high populated node networks with GSM voice traffic data.

Manijeh Keshtgary et. al. in "Performance Evaluation of Reactive, Proactive and Hybrid Routing Protocols in MANET" International Journal on Computer Science and Engineering (IJCSE) vol. 4, pp. 248-254 February 2012. [8]

The researchers have evaluated the performance of four MANET routing protocols using simulations: AODV, OLSR, DSR and GRP. In this research the evaluation metrics are End-to-End delay, network load, and throughput. Most of the papers consider the first three parameters, but here we also consider Jitter, MAC delay.

Priti Garg, et. al. "Comparative Performance Analysis of Two Ad-hoc Routing Protocols", International Conference on Network and Electronics Engineering IPCSIT vol.11, pp 99-104, 2011. [9]

The researcher in this paper addresses this issue by comparing the relative performance of Ad hoc routing protocols; we compared on-demand and hybrid protocol; temporally ordered routing algorithm (TORA) and Dynamic Source Routing (DSR). This subjected the protocols to identical loads and environmental conditions and evaluates their relative performance with respect to quantitative metrics; throughput, average delay, packet delivery ratio and routing load. From the detailed simulation results and analysis of presented, we use NS-2 simulator for simulation of DSR and TORA protocol and variation occurs in mobility of packets, time interval between the packets sent and packet size of packets sent in throughout the protocols.

A. Boukerche et.al. "Routing protocols in ad hoc networks: A survey "ELSEVIER /Computer Networks pp 3032-3080 OCT, 2011. [10]

In this paper, the wireless networking community designed hundreds of new routing protocols targeting the various scenario of the design space. This paper is to create taxonomy of the ad hoc routing protocol and to survey and compare representative examples for each class of protocols. The main differentiating factor between the protocols is the ways of finding and/or maintaining the routes between source–destination pairs.

Vasudha Arora et. al. "Performance Evaluation of Routing Protocol for MANETs under different traffic conditions" IEEE 2nd International Conference on Computer Engineering and Technology vol. 6, pp.79-84, 2010. [11]

The paper explains the performance of three routing protocols AODV, DSR and WRP for FTP, TELNET and CBR traffic in terms of packet delivery ratio, throughput, average end to end delay and routing message overhead. From the extensive simulation results, it is found that AODV shows the best

performance in terms of delivery ratio, throughput, routing message overhead, and end-to-end delay. Results show the superiority of reactive protocols over proactive protocols.

N. Adam et. al "Effect of Node density on performances of three MANET Routing Protocols" International Conference on Electronics Devices, Systems and Applications ICEDSA, IEEE pp 321-325,2010. [12]

This paper evaluates the routing performances of three MANET protocols: dynamic source routing (DSR), ad hoc on-demand distance vector (AODV) and temporally ordered routing algorithm (TORA) protocol. The performances had been analysed using the following metrics: packet delivery ratio, end-to-end delay, packet dropped, routing load and end-to-end throughput. Simulation results also showed that AODV reactive routing protocol is the best suited for given scenario.

Vahid Ayatollahi Tafti and Abolfazl Gandomi "Performance of QoS Parameters in MANET Application Traffic in Large Scale Scenarios" World academy of science, engineering and technology 72, pp. 857-860,2010. [13]

In this paper accessible a study on the QoS parameters for MANET application traffics in large-scale scenarios with 50 and 120 nodes. The application traffics analyzed in this study is File Transfer Protocol (FTP). In large scale networks (120 nodes) OLSR shows better performance and in smaller scale networks (50 nodes) AODV shows less packet drop rate and OLSR shows better throughput.

Monika Rajpoot et. al "Comparison of Ad-hoc Reactive Routing protocol using OPNET Modeler" IEEE International conference on computer Information systems and Industrial management Application (CISIM) pp 530-534 July 2010. [14]

The research in this paper have completed various reactive routing protocols such as Ad Hoc On-demand Distance Vector (AODV), Dynamic Source Routing (DSR) and Temporally Ordered Routing Algorithm (TORA), are compared on the basis of their throughput by increasing number of nodes in the network.

Pravin Ghosekar et. al "Mobile Ad Hoc Networking: Imperative and Challenges" IJCA MANETs pp 153-158,2010. [15]

This paper the recent evolutions have been generating a renewed and growing interest in the research and development of MANET and also attempt to provide a comprehensive overview of this dynamic field.

Md. Golam Kaosar a, Tarek R. Sheltami "Voice transmission over ad hoc network adapting optimum approaches to maximize the performance" ELSEVIER Computer Communications 32, pp 634–639, 2009. [16]

The research investigates the maximize the performance of MANET during voice transmission we choose some parameters and methodological approaches e.g. Method of media access, selection of audio codec, selection of routing protocol etc in efficient and optimum way.

Ravi Shankar et. al."Performance Analysis of Different Codecs in VoIP Using SIP", National Conference on Mobile and Pervasive Computing CoMPC-2008,pp 142-145. [17]

In this paper the integration of all types of traffic onto a single IP network has several advantages as well as disadvantages. While reducing cost and increasing mobility and functionality, VoIP may lead to reliability concerns, degraded voice quality, incompatibility, and end-user complaints due to changing network characteristics.

Zhan Huawai et. al. "Comparison Analysis AODV and OLSR Routing Protocol in Ad Hoc Network" IEEE 6th International Conference on Wireless and Mobile Computing, Networking transactions, pp 978-982, 2008. [18]

In this paper the characteristic of the ad hoc network were introduced and was explained how does it differs from the original fixed wired network and the focus on two well algorithms AODV and OLSR are analyzed and compared .

Phillippa Biggs "The Status of Voice Over Internet Protocol (VOIP) WORLDWIDE" the strategy and policy unit International Telecommunication Union (ITU) Geneva from 15-16, pp.1-37 January 2007. [19]

This paper describes summary overview of how VoIP technology works Drivers and Obstacles to VoIP deployment alongside other background material relevant to the debate on the future of voice and prepared under ITU new Initiatives Programme,

Eric Thibodeau el at. "Investigating MANET Performance in a VOIP Context" IEEE CCECE/CCGEI, Ottawa, pp 920-923, May 2006. [20]

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This results of this paper show that node mobility and node density have a limited influence on the performance of the protocol. However, the route length and the network load seem to be the critical factors deteriorating the performance of the routing protocol. This paper concludes that MAC layer misbehaviour (802.11) is responsible of a majority of false route loss detections. We finally suggest solutions in order to reduce MAC layer misbehaviour and to improve future MANET routing protocols for mobility support of VoIP.

Suhaib A. Obeidat et. al. "Towards Voice over Ad Hoc Networks: An Adaptive Scheme for Packet Voice Communications Over Wireless Links" IEEE International Conference on Wireless and Mobile Computing, Networking And Communications, WiMob. 2005, Montreal, Canada, August, , pp.419-425, 2005 . [21]

In this paper, an adaptation scheme that maintain acceptable quality while minimizes bandwidth consumption is proposed, it combines compression and modulation in a way to increase the chance of a connection survival throughout the lifetime of a call as opposed to focusing on short time quality. This paper also gives system model for generating HTTP traffic.

4.1 Simulation Environment

There are different kinds of parameters for the performance evaluation of the routing protocols. These have different behaviours of the overall network performance. We will evaluate three parameters for the comparison of our study on the overall network performance. These parameters are delay, network load, and throughput for protocols evaluation.

4.1.1 Delay: The packet end-to-end delay is the time of generation of a packet by the source up to the destination reception. So this is the time that a packet takes to go across the network. This time is expressed in sec.

4.1.2 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. When there is more traffic coming on the network, and it is difficult for the network to handle all this traffic so it is called the network load. The efficient network can easily cope with large traffic coming in, and to make a best network, many techniques have been introduced.

4.1.3 MOS (Mean Opinion Score): In voice and video communication, quality usually dictates whether the experience is a good or bad one. Besides the qualitative description we hear, like 'quite good' or 'very bad', there is a numerical method of expressing voice and video quality. It is called Mean Opinion Score (MOS). MOS gives a numerical indication of the perceived quality of the media received after being transmitted and eventually compressed using codec's. MOS is expressed in one number, from 1 to 5, 1 being the worst and 5 the best. MOS is quite subjective, as it is based figures that result from what is perceived by people during tests. MOS can simply be used to compare between VoIP services and providers. But more importantly, they are used to assess the work of codec's, which compress audio and video to save on bandwidth utilization but with a certain amount of drop in quality. MOS tests are then made for codec's in a certain environment.

Table 2: Mean Opinion Score (MOS)

Quality Scale	*Score*	*Listening effort Scale*
Excellent	5	No effort required
Good	4	No appreciable effort required
Fair	3	Moderate effort required
Poor	2	Considerable effort required
Bad	1	No meaning understood with reasonable effort

4.1.4 Throughput: Throughput is defined as; the ratio of the total data reaches a receiver from the sender. The time it takes by the receiver to receive the last message is called as throughput. Throughput is expressed as bytes or bits per sec (byte/sec or bit/sec).

5. CONCLUSIONS

In this paper, we discussed in the three routing protocols (AODV, OLSR and GRP), based on OPNET simulations. Our motive was to check the performance of these three routing protocols in MANET in the above mentioned parameters.

The simulation study of this paper consisted of three routing protocols AODV, OLSR and GRP deployed over MANET using HTTP traffic analysing their behaviour with respect to five parameters i.e. delay, network load, throughput, mos.

During literature review, it was observed that in most of the studies, the performance was qualitatively described

(indicating whether the experience is a good or bad one). But, there is also a numerical method called Mean Opinion Score (MOS) and throughput that gives a numerical indication of the perceived quality of the media received after being transmitted and eventually compressed.

Our motive was to check the performance of these three routing protocols in MANET in the above mentioned parameters. The study of these routing protocols shows that the AODV is better in MANET according to our simulation results but it is not necessary that AODV perform always better in all the networks, its performance may vary by varying the network.

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