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Performance Analysis of Reactive Routing Protocols over IEEE 802.11n

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Abstract

Every node in A Mobile Ad hoc Network (MANET) is free to move independently any direction, and will therefore change its links to other devices continuously and unpredictably. Mobile devices can communicate with each other without the use of a predefined infrastructure or centralized administration; Some MANETs are restricted to a local area of wireless devices (such as a group of laptop computers). In this paper, a comprehensive simulation based on three types of reactive routing protocols Ad Hoc On-demand Distance Vector (AODV), Dynamic Source Routing (DSR), Temporally-Ordered Routing Algorithm (TORA) over IEEE 802.11n using OPNET (Riverbed) 17.5 simulation, over and above the performance of these routing protocols will be measured on the metrics such as of delay, throughput, retransmission attempts (packets).

Keywords: *AODV, DSR, TORA.*

1. Introduction

Wireless network has been used in many situations including business enterprises and homes. The main characteristics and advantages of wireless network are mobility, simplicity, scalability, the location of devices is flexible, easy to setup, and cost effectiveness and users do not need to worry about cabling. Wireless networks sometimes called short-range networks; in view of they are temporary and permanent they are an autonomous system and do not have the previous infrastructure to pass and route packets between the components of this network contract. Wireless networks consist of a set of perpetual motion devices are called nodes. These nodes communicate with each other via wireless communication. As a result of the ongoing contract and unexpected movement of the network topology it is hourly changing accordingly and unexpectedly as well. This contract and cooperate with each other to perform routine tasks in the network.

Briefly, wireless network allows nodes to communicate with each other wirelessly and it can be configured in two ways: infrastructure less mode and infrastructure mode. In the first mode which is called Ad hoc or peer to peer (P2P) network, there is no fixed point and each node can directly communicate with all other nodes. On the other hand, the second method of wireless is where the transmission between two or more nodes goes through a third node called Access Point (AP) . Thus when any terminal wants to send packets to other terminal, packets would be sent to the AP first which will forward them to their destination. In each terminal, one of the IEEE 802.11 WLAN standards protocols is deployed. So WLAN networks systems are expected to deliver broadband access services to residential and enterprise customers in an economical way. It is necessary to provide Quality of Service (QoS) guaranteed with different characteristics.

This focuses the interest to the question that is analyzed in this paper. What are the best routing protocol used in terms of delay, throughput and retransmission in IEEE 802.11n?

This paper is organized as follows. First, in section II brief introduction of IEEE 802.11n, then, Section III three routing protocols which are used for the research work is presented. Simulation results and analysis are discussed in Section IV. Finally, Section V gives the conclusion.

2. Brief of IEEE 802.11n

Transmission technology used in the evaluation is the IEEE 802.11n WLAN. The 802.11n technology was selected in view of it is still the most vastly used WLAN technology, IEEE 802.11n was published in 2009. Compared to 802.11b/g, it introduces server new features; include (multiple input multiple output) MIMO and 40MHz channel (Flickenger, 2009). MIMO allows wireless devices to use multiple antennas to reach higher throughput (Yarali & Ahsant, 2007). It supports four MIMO streams. When 40MHz channel enabled, each MIMO stream can reach a 150Mb/s data rate in theory. Therefore, the maximum raw data rate of 802.11n is 600 Mb/s. 802.11n can operate on either 2.4GHz or 5GHz ISM band. When it operates on 2.4GHz (Industrial, Scientific, and Medical) ISM band and 40MHz channel, each 40MHz is a combination of two 20MHz channels. IEEE 802.11n also improved in MAC (Hegde, 2006). Manufactures started to produce product support for 802.11n, when it was in draft form. Even now, there are many products supporting 802.11n (draft 2.0) and not the 802.11n-2009 version.

The Key Performance Benefits of 802.11n is Companies migrating to a next-generation 802.11n wireless network can expect to experience an improvement in performance that is up to nine times faster than 802.11g technology for the mobile applications used today. Furthermore, many applications, such as scheduled data backups and large file transfers that were previously performed over the wired network, will now be mobilized. These performance improvements increase overall employee effectiveness and productivity and in turn shorten the 802.11n investment payback period, while increasing the return on investment. There is no doubt that the emergence of 802.11n will also bring about an influx of bandwidth hungry mobile applications that could not be enabled wirelessly until now. Companies that have refreshed their wireless infrastructure will be in a position to take full advantage of those mobility applications and empower their users with an increasing number of productivity-enhancing tools.

3. Routing Protocols in WLAN Networks

Mobile Ad-hoc Networks (MANET) routing protocols can be categorized into three categories: reactive, proactive, and hybrid, the first three protocols are selected and considered in this paper from Reactive category namely AODV, DSR and TORA. The main characteristic of reactive protocols is that they set up the routes on-demand. When a node wants to start communication with a node to which it does not have any route, the routing protocol will try to establish such a route. Below is a brief description of each protocol:

3.1. AODV

Ad Hoc On-Demand Distance Vector Protocol is a reactive or on-demand routing protocol since the routes are established and maintained only when required. It permits the users to find and maintain routes to other users in the network. The routing decisions are made based on distance vectors, i.e., distances measured in hops to all available routers. The protocol supports uncast, broadcast, and multicast communications. The method of traditional routing tables is used, which includes one entry per destination as a mechanism to maintain routing information. The freshness of the routing information is determined by the sequence numbers, which are maintained at each destination. This is done to avoid routing loops. These sequence numbers are carried by all the routing packets.

The time stamp is saved in the sequence number, and routes to the destination are saved in the routing table. Each node maintains a sequence number and a routing table. The freshness of the route is determined with the help of sequence numbers: the higher the number, the fresher is the route. This allows discarding the older number.

The routing table consists of a number of entries. Each entry in the table contains the address of the next hop (next node to the destination), a hop count (number of hops to the destination), and a destination sequence number. The variety in data traffic and any kind of mobility can be dealt by AODV. Each route that is active is linked with a time that is stored in the table. Once this time has elapsed, route timeout is triggered and the route is marked as invalid and eventually removed.

3.2. DSR

Dynamic Source Routing is a Pure On-Demand routing protocol, where the route is calculated only when it is required. It is designed for use in multi hop ad hoc networks of mobile nodes

.DSR allows the network to be self-organized and self-configured without any central administration and network infrastructure. It uses no periodic routing messages like AODV, thus reduces bandwidth overhead and conserved battery power and also large routing updates. It only needs the effort from the MAC layer to identify link failure.DSR uses source routing where the whole route is carried as an overhead.

3.3. Temporally Ordered Routing Algorithm (TORA)

The Temporally Ordered Routing Algorithm (TORA) is a highly adaptive, efficient and scalable distributed routing algorithm based on the concept of link reversal. TORA is proposed for highly dynamic mobile, multi-hop wireless networks. It is a source-initiated on-demand routing protocol. It finds multiple routes from a source node to a destination node. The main feature of TORA is that the control messages are localized to a very small set of nodes near the occurrence of a topological change. To achieve this, the nodes maintain routing information about adjacent nodes. The protocol has three basic functions: Route creation, Route maintenance and Route erasure.

TORA can suffer from unbounded worst-case convergence time for very stressful scenarios. TORA has a unique feature of maintaining multiple routes to the destination so that topological changes do not require any reaction at all. The protocol reacts only when all routes to the destination are lost. In the event of network partitions the protocol is able to detect the partition and erase all invalid routes.

4. Simulation Result and Analysis

In this section we discusses about the following network components used in the suggested network models running on OPNET (Riverbed) 17.5 to simulate three types of reactive routing protocols AODV, DSR , TORA over IEEE 802.11n for analysis of the traffic between source and destination, three parameters (delay , throughput ,retransmission) Has considered to evaluate the network performance for each.

We used in the network at 50 WLAN station, wireless server, application server. The Application_ Config includes a name and a description table that specifies various parameters for the different applications (i.e. web browser HTTP, EMAIL and FTP applications). The specified application name is used while creating user profiles on "Profile_ Config" object. The Profile_ Config is used to create user profiles. These user profiles can be specified on different nodes in the simulation run for 3min (180 sec): this time had been enough to acquisition an overview of the proposed network performance.

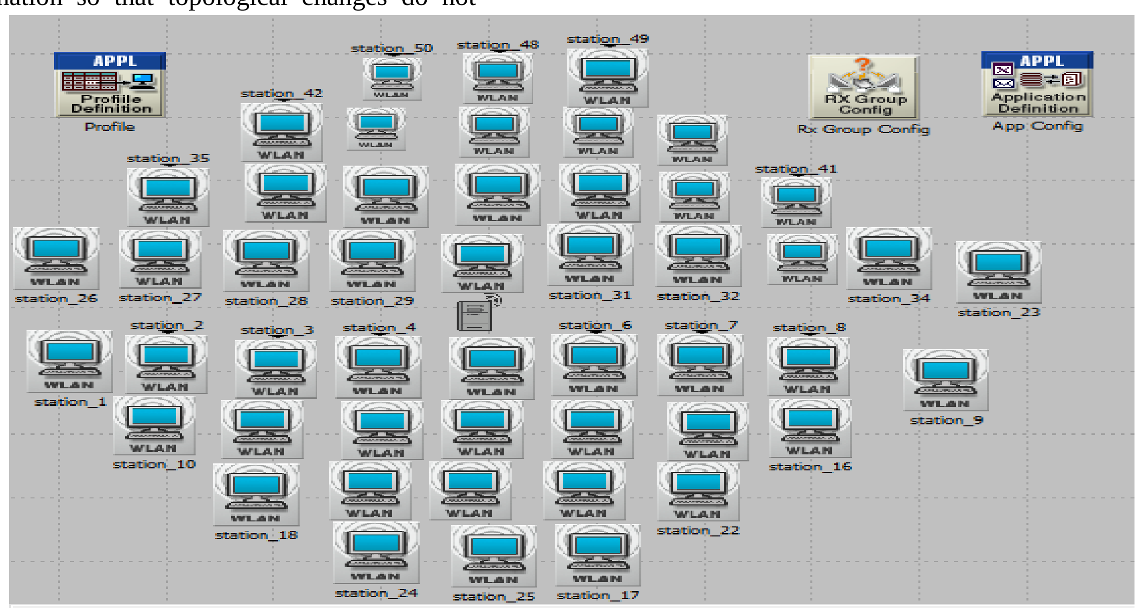

Figure 1: Simulation setup of reactive routing protocols

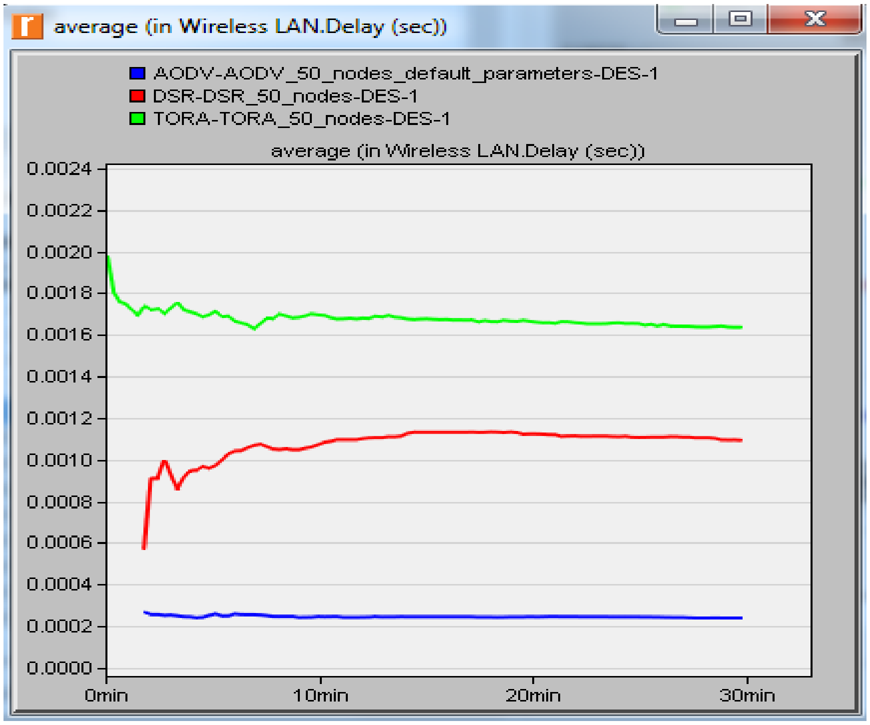

Figure 2: Delay of reactive routing protocols

A. Delay

The delay of nodes for IEEE 802.11n networks is shown in Fig.2 with reactive routing protocols AODV, DSR and TORA. The best performance is shown by AODV having lowest delay and DSR, TORA by respectively.

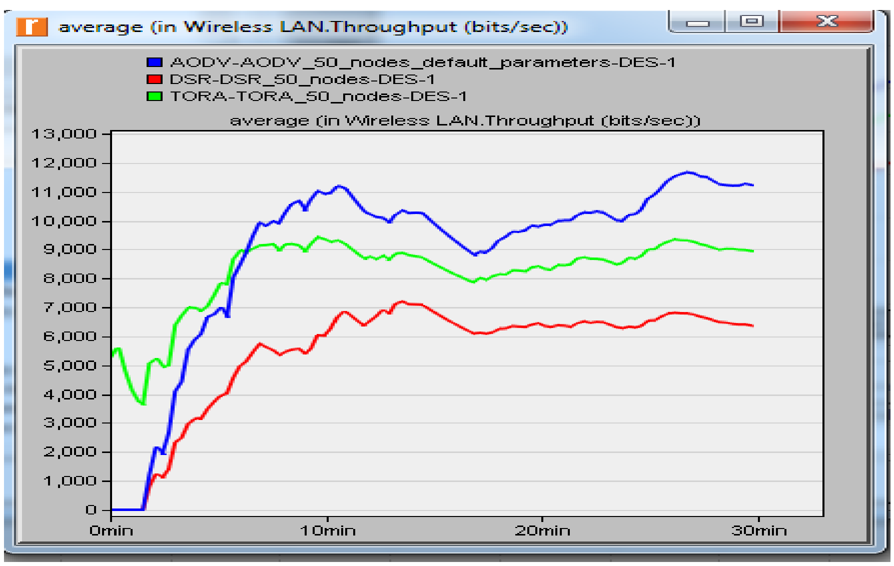

Figure 3: Throughput of reactive routing protocols

B. Throughput

From the graph show in fig 3 that AODV routing protocol have the greatest throughput compare to other routing protocols, which mean it have better performance in case of high traffic volume, in addition to, the graph show DSR have the lowest throughput, it indicates that the performance in heavy traffic conditions will be lowly more and more when the traffic volume is increase.

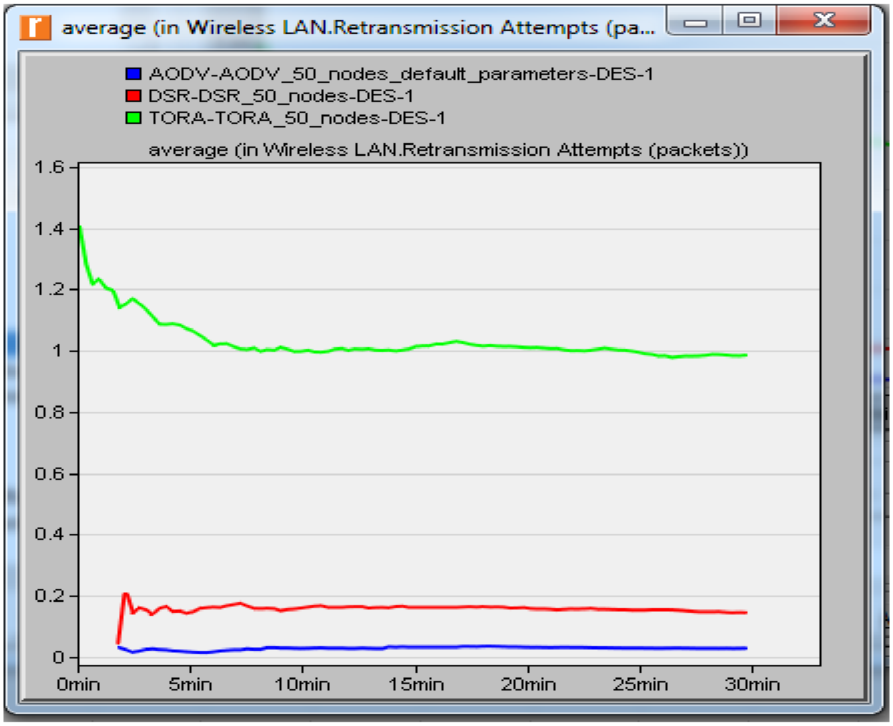

Figure 4: Retransmission of reactive routing protocols

C. Retransmission Attempts (Packets)

Retransmission attempts packets: It is the total number of attempts of retransmission for reactive routing protocols in this network until either packet is successfully transmitted or it failure as a result of reaching short or long retry limit. Fig 4 Shown AODV has the highest retransmission rate, whereas DSR is slightly lower than it especially in this network, nevertheless TORA has the least packet retransmission attempts.

5. Conclusion

The goal of this paper is show the best reactive routing protocols. From the result of our studies, the choice of protocol depended on the network, applications and parameters concentrate. We show AODV has lowest delay, greatest throughput and highest retransmission. TORA protocol shows low delay, great throughput but least packet retransmission. While DSR protocol has low delay, low throughput and good retransmission in large network. Widely we can say that for FTP applications and large networks, AODV routing protocol is better than other protocols. Future study may include the simulation of the security reactive routing protocols in WLAN.

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