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Performance Analysis of Routing Protocols (AODV, DSR, GRP) in Indoor and Outdoor Surroundings

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Abstract: ***The main focus of this paper is to do comparative analysis for mobile ad-hoc protocols based on the area of the coverage with indoor and outdoor surrounding communications. We have taken three routing protocols AODV, DSR, GRP to evaluate the performance by using OPNET simulator. We have evaluated the parameters like delay, throughput and network load to see the performance. It is interesting to see the communication coverage variation in indoor scenarios where obstacles are comparatively high as compared to outdoor surroundings.***

Keywords: MANET, AODV, DSR, GRP, OPNET, Delay, Throughput, Network Load.

1. Introduction

A Mobile Ad Hoc Network (MANET) is an autonomous network that can be formed without any established infrastructure. MANET stands for Mobile Ad hoc Network is a dynamic distributed system of arbitrarily moving wireless devices with limited battery power [1][2].It consists of mobile nodes equipped with a wireless interface that are free to move and establish communication on the fly. It is also sometimes called a mobile mesh network, and is a self-configurable wireless network. The mobile nodes act as hosts and routers, having routing capabilities for multi-hop paths connecting nodes which cannot directly communicate. Wireless Communication technology is exploring at very fast rate which lead to the increase in demand of infrastructure with such demand it is very difficult to have that much of fixed infrastructure.

In Ad-hoc network, the solution of wireless communication lies as ad-hoc network nodes doesn't required any intermediate infrastructure and nodes in itself moving from one place to another place frequently. Nodes use to send messages to each other for connectivity with limited range. Nodes usually broadcast in unidirectional form not in bidirectional due to behaviour of adhoc network. If one host is sending message to another host which not in its range, then this message will be transferred through the network using other hosts. This network of hosts usually acts as routers for delivering the message throughout the network.

2. Routing Protocols in MANET

Routing protocols in MANET are divided into four categories: proactive, reactive, hierarchical and geographic routing protocols [3]. We have focussed in this paper on the following MANET routing protocols:

2.1 Ad-hoc On Demand Vector Routing Protocol (AODV)

AODV provides on-demand route discovery in mobile ad hoc networks. Like most reactive routing protocols, route finding is based on a route discovery cycle involving a broadcast network search and a unicast reply containing discovered paths. Similar to DSDV, AODV relies on per-node sequence numbers for loop freedom and for ensuring selection of the most recent routing path. AODV nodes maintain a route table in which next-hop routing information for destination nodes is stored. Each routing table entry has an associated lifetime value. If a route is not utilized within the lifetime period, the route expires. Otherwise, each time the route is used, the lifetime period is updated so that the route is not prematurely deleted. When a source node has data packets to send to some destination, it first checks its route table to determine whether it already has a route to the destination. If such a route exists, it can use that route for data packet transmissions. Otherwise, it must initiate a route discovery procedure to find a route [4].

2.2 Dynamic Source Routing (DSR)

DSR [1] is a simple and efficient routing protocol designed specifically for use in multi-hop wireless ad hoc networks of mobile nodes. The protocol is composed of the two main mechanisms of "Route Discovery" and "Route Maintenance". In route discovery, route request (RREQ) message is broadcast to discover the route. The route request message contains the address of the source and the destination, and a unique identification number and route reply (RREP) message send by the destination node Route Maintenance is used to handle route breaks.

2.3 Geographic Routing Protocol (GRP)

Geographic routing [5] (also called georouting or position-based routing) is a routing principle that relies on geographic position information. It is mainly proposed for wireless networks and based on the idea that the source sends a message to the geographic location of the destination instead of using the network address. Geographic routing requires that each node can determine its own location and that the source is aware of the location of the destination. With this information a message can be routed to the destination without knowledge of the network topology or a prior route discovery.

3. Simulation Tool

OPNET (Optimized Network Engineering Tool) Modeler 14.5 is used for the design and implementation of our thesis work.

3.1 OPNET

We have used the Optimized Network Engineering Tool (OPNET v14.5)[6] software for our simulations. OPNET is a network simulator. It 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.

Now a day OPNET is very useful software in research fields. The OPNET usability can be divided into four main steps. The OPNET first step is the modeling, it means to design network model. The sec step is to choose and select statistics. Third step is to simulate the network. Fourth and last step is to view and analyze results as shown in fig3.1.

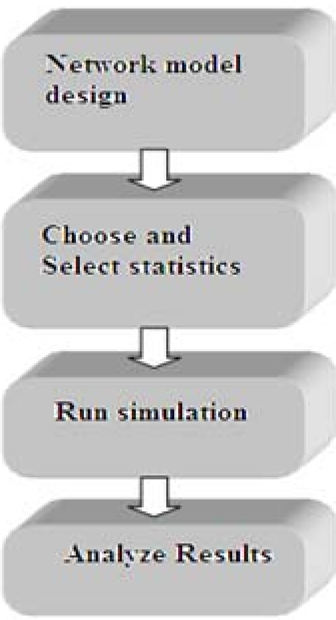

Figure 1: Simulation steps

4. Performance Evaluation Parameters

4.1 Delay

The packet delay is the time of creation of a packet by the source node up to the destination node reception. At this time a packet starts to move across the working network. Time usually expressed in seconds. Hence all the delays in the network are called packet end-to-end delay [7].

4.2. 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 [8]. Throughput is expressed as bytes or bits per sec (byte/sec or bit/sec).

4.3 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 [9].

Table1: Simulation Parameters

Parameters	Values
Network Size	1000x1000 meters
Type of Service	FTP
Number of Nodes	110
Routing Protocols	AODV, DSR, GRP
Node Model	WLAN_wkstn
Altitude	0.0 meters
Area of Movement	Within network
Traffic Source	Discrete
Data rate	1 Mbps
Node Transmission Power	.005(default)
Performance Parameters	Throughput, delay, network load
Simulation Time	3600 sec

5. Simulation Results

Performance comparison is evaluated based on the Indoor and Outdoor Scenario.

5.1 Delay

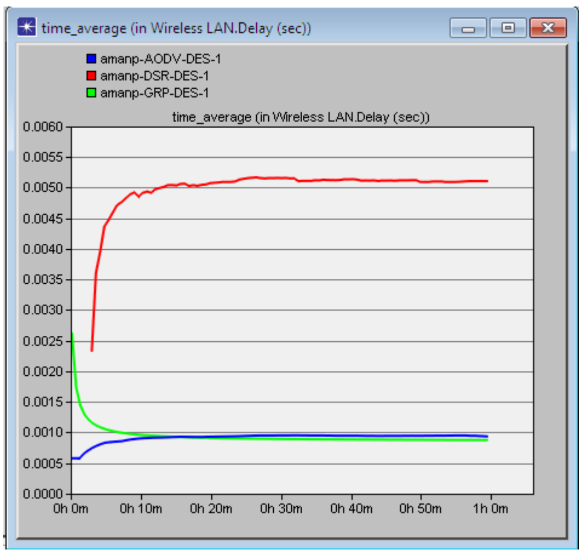

Figure 2: Delay for 110 nodes (AODV, DSR, GRP) in outdoor scenario

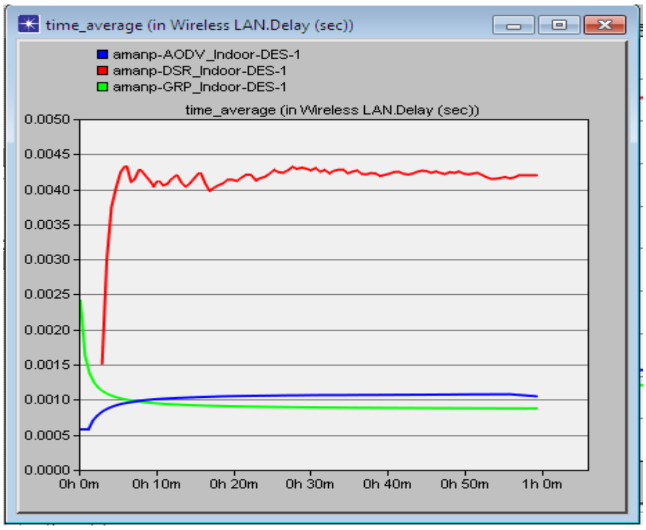

Figure 3: delay for 110 nodes(AODV,DSR,GRP) in indoor scenario

5.2 Throughput

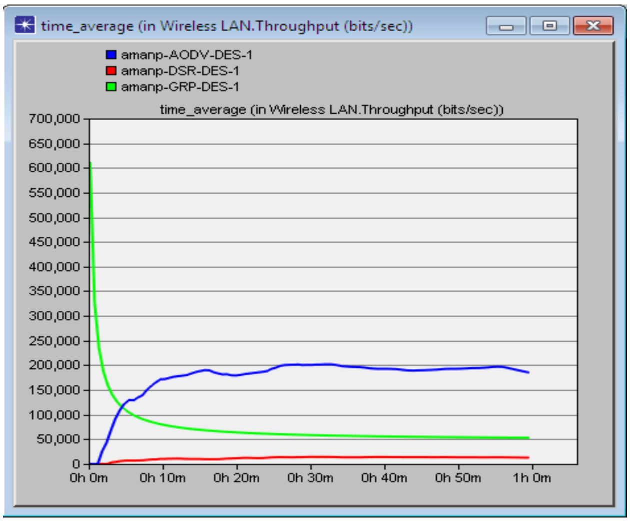

Figure 4: Throughput for 110 nodes (AODV,DSR, GRP) in outdoor scenario

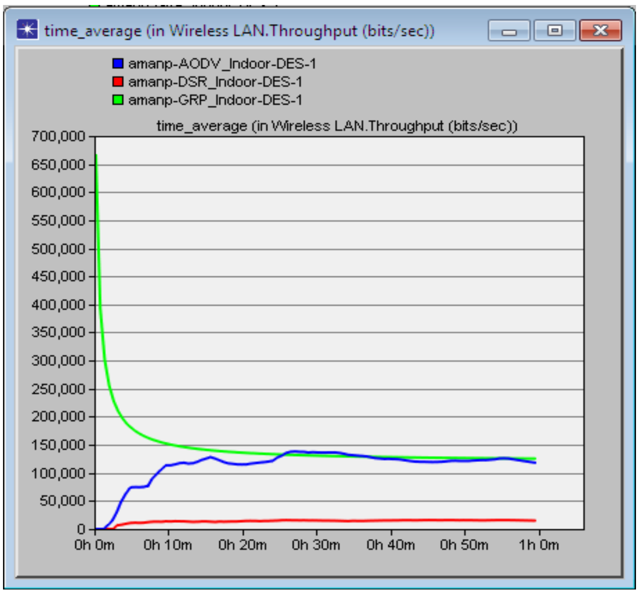

Figure 5: Throughput for 110 nodes (AODV, DSR, GRP) In indoor scenario

5.3 Network Load

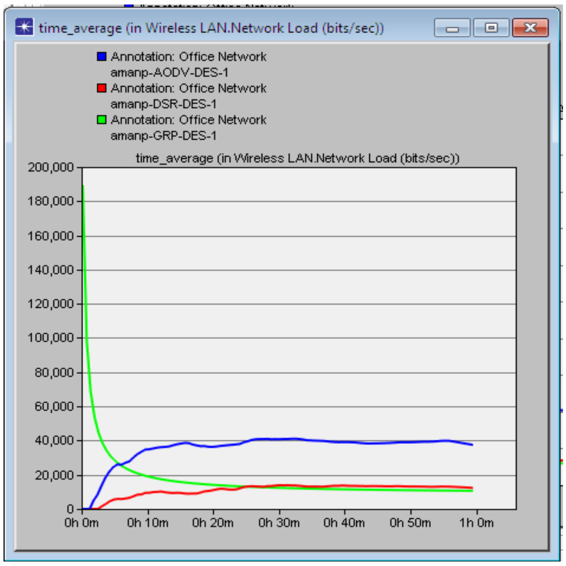

Figure 6: Network Load for 110 nodes (AODV,DSR, GRP) in outdoor scenario

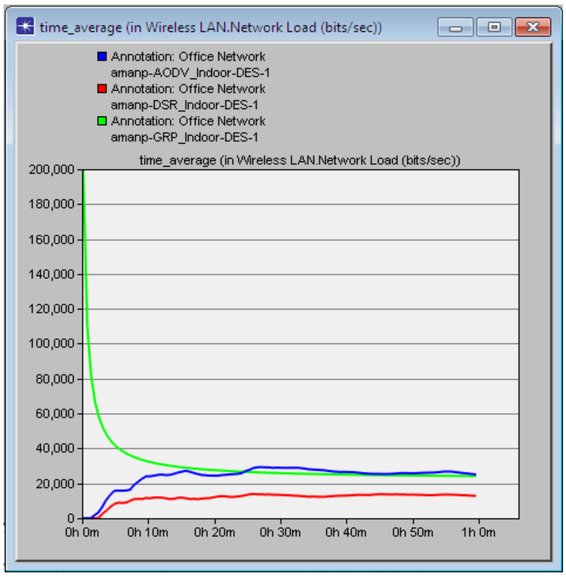

Figure 7: Network Load for 110 nodes (AODV,DSR, GRP) in indoor scenario

Table 2: Result Summary

Attributes/ Protocols	*Simulation Time (sec.)*	*Delay (sec.)*	*Throughput (bits/sec)*	*Network Load (bits/sec)*
AODV	3600	.00095	200000	40000
AODV Indoor	3600	.0011	130000	30000
DSR	3600	.0051	5000	14000
DSR Indoor	3600	.0043	5000	13800
GRP	3600	.0085	50000	13000
GRP Indoor	3600	.0085	135000	28000

6. Conclusion and Future Work

Mobile ad-hoc communication in different environments is a challenging task to maintain and especially when it comes to indoor and outdoor properties addition to environment. Indoor environment have a lot of obstacles and can be difficult for mobile ad-hoc devices to communicate. In outdoor environment mobility and protocol variation in area could be the challenges to maintain. In our proposed work, we have considered three mobile ad-hoc protocols which include AODV, DSR and GRP for comparative study and found that AODV provide high throughput around than DSR and GRP protocol. When, we process these protocols in indoor scenarios, and then performance of the AODV is decreased around 25% as compared to original value of AODV. In case of DSR, throughput value decrease to 90% as compared to original DSR value. In case of GRP, values decreases by 75% as compared to original value of GRP. In case of delay, GRP has less delay than AODV and DSR. In indoor scenario, GRP has same performance as in outdoor scenario. AODV provides 20% more delay than original AODV and DSR provides 15% more delay than original DSR. In case of network load, AODV has better performance than the other two. In indoor scenario, the performance of AODV is decreased by around 33% then original AODV. In case of DSR, the performance decreased by 2% then the original DSR. In case of GRP, the performance increased by around 54% then the original GRP. Overall with addition of indoor properties network performance is decreased as discussed above.

In this work, we have consider the indoor nature for default values of the mobile ad-hoc protocols but still much work need to consider on delay factors such as jitter in network, frequency of network and number of users variable for communication.

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