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ENERGY CONSUMPTION AND QoS PERFORMANCES TO COMPARE COMBINED ROUTING PROTOCOL AND MOBILITY MODEL FOR CBR TRAFFIC IN MANET

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ABSTRACT

A Mobile Ad-hoc Network (MANET) has the property to be formed dynamically by a system of mobile nodes which are connected via wireless links with no centralized administration. All nodes can be mobile resulting in a possibly dynamic network topology. Two of the major problems in this network are energy consumption and Quality of Service (QoS) related to traffic requirements.

This paper aims to explore the performances of the combination of routing protocol and mobility model in terms of QoS relating to CBR traffic and to network lifetime. Hence, simulations have been performed to evaluate the performance of AODV, DSR and DSDV routing protocols under various mobility models. The mobility models used in this work are Random Waypoint, Reference Point Group and Manhattan Grid. Obtained results show that the best combination protocol/mobility depends on the average speed of nodes.

Keywords: *MANET, Routing Protocols, Mobility Models, CBR Traffic, Energy Consumption, QoS Parameters, NS-2.*

1. INTRODUCTION

In the past few years, Mobile Ad hoc Networks (MANET) becomes a more popular technology. Its quick and easy deployment makes this type of networks feasible to use in a wide range of applications as in battlefield environment, disaster relief and conference.

Mobile Ad hoc Networks have the property to be formed dynamically by a system of mobile nodes which are connected via wireless links with no centralized administration [1]. This property leads to the following limitations:

- Limitations due to wireless nature: packet losses, variability of link capacity, limited bandwidth, disconnections, security…
- Limitations due to mobility: dynamic topologies, routes dynamically changing, lack of recognition of mobility…
- Limitations due to equipment: limited battery life, limited capabilities…

These limitations make the study of Quality of service (QoS) in MANET an active research area. Indeed, the QoS in MANET is influenced by several factors such as routing, mobility, energy, traffic nature…

Routing is one of the most important factors to handle. Indeed, routing protocols must take in consideration the dynamic nature of MANET topology. Therefore, it is necessary to develop routing protocols that can efficiently find routes between two communicating nodes.

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Moreover, the mobility of nodes in a MANET has an impact of the network performances. This is because mobility of nodes may cause link failures and broken paths.

The QoS management in MANET is also influenced by the resource constraints of the nodes. One of the critical resources is energy. Therefore, energy must also be treated as an indirect measure of QoS, because if a link on the path is broken due to energy depletion of a node, the route needs to be repaired.

Furthermore, as Mobile Ad Hoc networks can support various applications with different levels of QoS, it is critical to adapt the different factors in the network to guarantee the performances requirements for each application.

In the literature, performance evaluation of MANET networks was the subject of several researches. The majority of this works were interested to evaluate the performance of routing protocols by interesting to energy consumption [2, 3, 4] or to QoS parameters for a type of traffic [5, 6, 7, 8]. And these works generally adopted a fixed mobility model.

To the best of our knowledge, there is no study addressed comparison between routing protocols combining energy consumption and QoS parameters to determine the suitable routing protocol when the mobility model is varying.

The objective of this work is to determine the best combination protocol/mobility model that provides the best performances in terms of energy consumption and QoS parameters when the CBR traffic model is used.

This paper is organized as follows. Section 2 reviews the related work and introduces the problem statement. In section 3 we give a brief description of CBR traffic. Section 4 presents the studied routing protocols. Section 5 presents the mobility models. In Section 6 the details of the simulation environments and the QoS parameters are presented. Simulation results and analysis are described in section 7. Finally, section 8 is devoted to the conclusions.

2. RELATED WORK AND PROBLEM STATEMENT

2.1 Related Work

In the literature, many researchers have been interested in performance evaluation of MANET routing protocols, the evaluation is done by considering various parameters such as traffic model, mobility model, speed, pause time, number of nodes …

In [5] the authors have used random waypoint mobility model to design the network and performed simulations for CBR traffic in MANET. Performance of AODV, DSR and DYMO are evaluated based on Average end-to-end delay, Packet delivery ratio, Throughput and Average Jitter. They showed that there is no protocol which performs better than others in all situations.

The authors in [6] studied the behavior of the reactive routing protocols DSR and AODV under Exponential and Pareto traffic sources for nodes moving with Reference Point Group Mobility model (RPGM). To compare these protocols they used the Normalized routing load, Packet Delivery Fraction and Throughput. They found high Normalized Routing Load for both Exponential and Pareto traffic compared to CBR traffic in both DSR and AODV protocols. The Packet Delivery Fraction is comparable in all types of traffic patterns and routing protocols. Throughput is high for AODV routing protocol across all traffic models.

A comparative study of reactive and proactive routing protocols including AODV, DSR, DSDV, OLSR and DYMO is done in [7] with respect to various mobility models. The comparison is drawn by measuring Packet Delivery Ratio, Average Delay and Normalized Routing Load. The results indicate the significant impact that node mobility pattern has on routing performance. The authors conclude also that an increase in network size and number of nodes has similar impact on all protocols under various mobility patterns, i.e. a degradation of the network performance. However, the degree of degradation varies for different combinations of protocols and mobility models.

In [9], the authors evaluate the performance of MANETs in terms of Control traffic received, Control traffic sent, Data traffic received, Data traffic sent, Throughput and number of retransmission attempts to compare DSDV, AODV and DSR routing protocols. The results of simulations showed that AODV routing protocol performs better than other two protocols.

In [10], the authors have studied the impact, respectively, of mobility models and the density of nodes on the performances (End-to-End Delay, Throughput and Packet Delivery ratio) of routing protocol OLSR by using VBR and CBR traffic models. They considered the three mobility models as follows Random Waypoint, Random Direction and Mobgen Steady State. The results illustrate that

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the behavior of OLSR change according to the mobility model and the used traffic.

In [11], the performance of AODV, DSR and DSDV protocols are studied in high mobility case under low, medium and high density scenario. This performance is analyzed with respect to Average End-to-End Delay, Normalized Routing Load (NRL), Packet Delivery Fraction (PDF) and Throughput. Obtained simulation results verify that AODV gives better performance as compared to DSR and DSDV. A Random Waypoint Mobility model has been used in this study.

In [12], the authors simulated AODV, DSR and DSDV routing protocols using Manhattan Grid Mobility Model and their performances are analyzed in terms of Packet Delivery Fraction (PDF), Average end-to end Delay and Throughput, in different environments specified by varying network load, mobility rate and number of nodes.

A performance comparison of DSR and AODV routing protocols with respect to average energy consumption and routing energy consumption are explained in [2]. In this work the Mobility Model RWP, and Traffic Model CBR are considered, and the behaviour of the power consumption in these two protocols is discussed by varying different parameters of the network.

In [3] the energy consumption in traffic models (CBR, Pareto and Exponential) is measured using routing protocols namely AODV, OLSR and AOMDV. Simulation and computation of energy consumed, received and transmitted energy were done with ns-2 simulator with parameter variation: number of nodes, pause time, average speed and send rate.

In [4], the authors compare the energy consumption of AODV, DSR and DSDV protocols under different mobility models using CBR, Pareto and Exponential traffic models. They determine the combination of routing protocol, traffic model and mobility model which allows a minimum of energy consumption with various average speeds.

To evaluate the performances of DSR, AODV DSDV routing protocols with multimedia traffic source in the network, the authors in [1] based their evaluation on the performance metrics: jitter, packet delivery ratio, and packet drop, control overhead , delay added to energy consumption, but their study is done without varying the random way point model for the mobility model.

A new protocol named PAQMR is proposed for disaster recovery network in [13]. Its performances in terms of energy consumption, average end to end delay and packet delivery ratio are evaluated and compared to those for AODV and AOMDV routing protocols in the scenario where the traffic load and pause time in the network are varying and the mobility random waypoint model in a rectangular field is considered. The obtained results show that the proposed protocol minimizes the power, delay, congestion and maximize the packet delivery ratio.

Work in [8] proposes a protocol called energy and delay aware TORA (EDTORA) based on extension of Temporally Ordered Routing Protocol (TORA). Simulation, using the random waypoint model for mobility shows that the proposed protocol has a higher performance than TORA in terms of network lifetime, packet delivery ratio and end-to-end delay.

In [14], the authors have analyzed the performance of AODV and DSR protocol when Group Mobility Model and CBR traffic sources are used; they investigated the behavior of average delay when the mobility and the number of groups are varying.

2.2 Problem Statement

The previous works where interested in comparing routing protocol. In general, the point of view adopted by researchers is divided in two classes:

- Works based on energy consumption criteria;
- Works based on QoS parameters relating to traffic requirements (PDF, throughput, delay…) criteria.

In the majority of researchers, the mobility model involving in analysis is considered to be random way point (RWP).

However, to the best of our knowledge, there is no study addressed such comparison combining energy consumption and QoS parameters to determine the suitable routing protocol when the mobility model is varying.

The objective of this work is to determine the best combination protocol/mobility model that provides the best performances in terms of energy consumption and QoS parameters when the CBR traffic model is used.

The choice of CBR model is based on the results of previous work [4], where it is shown that this type of traffic consumes more energy than others. Moreover, the CBR traffic model can be used in dedicated MANET networks where the exchanged traffic is suitable to this model (network dedicated to voice traffic for example) [15].

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Based on this traffic model, we evaluate the energy consumption, the delay and the throughput for AODV, DSR and DSVD routing protocols using three mobility models: Manhattan, RWP and RPGM.

2.3 Adopted Methodology

Simulation approach is commonly used to evaluate the performance of MANET networks in terms of different metrics. Therefore, in this work, simulation scenario was performed, and for each one of the proposed mobility models:

- We compare the three protocols from energy consumption point of view when the speed of nodes is varying;
- The same comparison is done from a QoS parameters point of view (throughput and delay).

The objective to achieve is to find the suitable combination protocol/mobility that performs the best performance parameters when the two points of view are combined.

3. CBR TRAFFIC DESCRIPTION

Constant Bite Rate (CBR) traffic is a terminology borrowed from the ATM world [15]. It implies that data are sent at a fixed bit rate. Therefore, CBR traffic is characterized by data being sent in packets of fixed size with fixed interval between each packet [16].

CBR is tailored for any type of data for which the end-systems require predictable response time and a static amount of bandwidth continuously available for the life time of the connection [17]. Consequently, the most important QoS parameters required by CBR traffic will be limited end-to-end delay and stable throughput.

Applications supported by CBR model include services such as video conferencing, telephony (voice services) or any type of on-demand service, such as interactive voice and audio. For telephony and native voice applications CBR provides low-latency traffic with predictable delivery characteristics [17].

In simulation, CBR is generally used to simulate multimedia traffic on limited capacity channels, or to fill in background traffic to affect the performance of other applications being analyzed. Simulation tools can setup CBR traffic between mobile nodes using a specific traffic scenario generator script [18].

4. THE STUDIED ROUTING PROTOCOLS

Many routing protocols have been proposed for ad hoc mobile networks [19]. There are two main categories of routing protocols, proactive protocols and reactive protocols. In the proactive protocols [20], all the routes are computed in advance and each node maintains a routing table containing information about the best route to any node in the wireless network. The obvious advantage is that the route is already known when packets need to be sent. The disadvantage is that nodes need to update their tables periodically. Therefore, the nodes consume some network bandwidth exchanging routing information even when no data needs to be sent. In the reactive protocols [21], the route to any destination is constructed only when necessary, and then cached in the routing table. The advantage is avoiding proactive routing information exchange. The disadvantage is an increased, possibly large latency at the beginning of the transmission.

Figure 1 shows the routing protocols studied in this paper:

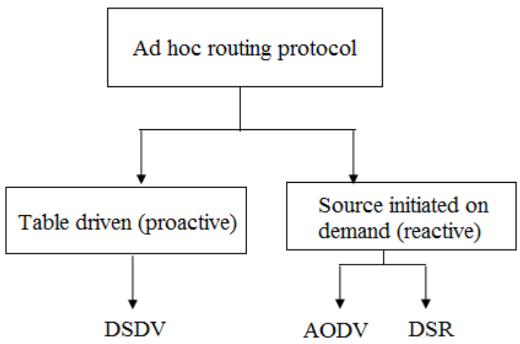

Figure 1: Routing Protocols Classification

4.1 Ad Hoc on-Demand Distance Vector Routing

The AODV (Ad Hoc on Demand Distance Vector) is a routing protocol for MANETs and other wireless ad-hoc networks that provides on-demand route discovery [22, 23]. It is a reactive routing protocol, meaning that it establishes a route to a destination only on demand. Whenever the nodes need to send data to the destination, if the source node doesn't have routing information in its table, route discovery process begins to find the routes from source to destination. A node requests a route to a destination by broadcasting an RREQ message to all its neighbors. RREQ message comprises broadcast ID, two sequence

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numbers, and the addresses of source and destination and hop count. The intermediary nodes which receive the RREQ message could do two steps: If it isn't the destination node then it'll rebroadcast the RREQ packet to its neighbors. Otherwise it'll be the destination node and then it will send a unicast replay message, route replay (RREP), directly to the source from which it was received the RREQ message. This RREP is unicast along the reverse-routes of the intermediate nodes until it reaches the original requesting node. This process repeats until the RREQ reaches a node that has a valid route to the destination.

As long as the route remains active, it will continue to be maintained. A route is considered active as long as there are data packets periodically travelling from the source to the destination along that path. Once the source stops sending data packets, the links will time out and eventually be deleted from the intermediate node routing tables. When a source node wants to send data to some destination, first it searches the routing table; if it can find it, it will use it. Otherwise, it must start a route discovery to find a route [24]. It is also Route Error (RERR) message that used to notify the other nodes about some failures in other nodes or links [25].

4 . 2 Dynamic Source Routing

The DSR (Dynamic Source Routing) is a reactive routing protocol designed specifically for use in multi-hop wireless Ad hoc networks of mobile nodes [26]. In this protocol each source determines the route to be used in transmitting its packets to selected destinations. There are two main components, called Route Discovery and Route Maintenance. Route Discovery is the mechanism by which a node wishing to send a packet to a destination obtains a path to the destination. Route Maintenance is the mechanism by which a node detects a break in its source route and obtains a corrected route. The sender knows the complete hop by hop route to the destination. These routes are stored in a route cache [26]. The protocol allows multiple routes to any destination and allows each sender to select and control the routes used in routing its packets, for example for use in load balancing or for increased robustness. The DSR protocol is designed mainly for mobile ad hoc networks of up to about two hundred nodes, and is designed to work well with even very high rates of mobility.

4 . 3 Destination Sequenced Distance Vector

The DSDV (Destination Sequenced Distance Vector) is a proactive routing protocol based on the Bellman-Ford routing algorithm to find the routes with improvements [27]. It was developed by C. Perkins and P. Bhagwat in 1994 [21]. This protocol adds a new attribute, sequence number, to each route table entry at each node. Each node in the mobile network maintains a routing table in which all of the possible destinations within the non-partitioned network and the number of routing hops to each destination are recorded. In this protocol, packets are routed between nodes of an ad-hoc network using routing tables stored at each node. Each routing table, at each node, contains a list of the addresses of every other node in the network. Along with each node's address, the table contains the address of the next hop for a packet to take in order to reach the node. This protocol was motivated for the use of data exchange along changing and arbitrary paths of interconnection which may not be close to any base station.

5. MOBILITY MODELS

To evaluate the performance of routing protocol for MANET, It is necessary to test the protocol under realistic conditions, especially including the movement of the mobile nodes. Mobility models are based on setting out different parameters related to node movement. Basic parameters are the starting location of mobile nodes, their movement direction, velocity range, speed changes over time. Several mobility models are presented in [28]. In this section we briefly review the description of the studied mobility models.

5 . 1 Random WayPoint Mobility Model

The Random WayPoint Mobility Model (RWP) is very widely used in simulation analysis of MANET [29]. This mobility model includes pause times between changes in direction and/or speed [30]. Upon expiry of this pause, the node arbitrary selects a new location to move towards and a new speed which is uniformly randomly selected from the interval [Min, Max], where Min is the minimum allowable velocity for every mobile node, and Max is the maximum velocity. If it selects a far destination and a low speed around Min value, it travels for a long time with low speed. If it selects a speed near Max value the time traveling with this high speed will be short. After reaching the destination, the node stops for a duration defined by the 'pause time' parameter. After this duration, it again chooses a random destination and repeats the whole process again until the simulation ends.

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5.2 Reference Point Group

Reference Point Group Mobility Model (RPGM) represents the random motion of a group of mobile nodes as well as the random individual motion of each mobile node within the group [30]. All group members follow a logical group center that determines the group motion behavior. The entity mobility models should be specified to handle the movement of the individual mobile nodes within the group. Here, each group has a group leader that determines the group's motion behavior. Initially, each member of the group is uniformly distributed in the neighborhood of the group leader. Subsequently, at each instant, every node has a speed and direction that is derived by randomly deviating from that of the group leader.

5.3 Manhattan Mobility Model

Manhattan Mobility Model has originally been developed to emulate the Manhattan street network, i.e. a city section which is only crossed by vertical and horizontal streets on an urban area, where the streets are in an organized manner [31]. The trajectories of mobile nodes are confined to a grid road topology. The Manhattan Mobility Model can be described by the following parameters: mean speed, minimum speed, a probability to change speed at position update, and a probability to turn at cross junctions. The mobile node is allowed to move along the grid of horizontal and vertical streets on the map. At an intersection of a horizontal and a vertical street, the mobile node can turn left, right or go straight. The probability of moving on the same street is 0.5, the probability of turning left is 0.25 and the probability of turning right is 0.25.

6. SIMULATION ENVIRONMENT AND QOS PARAMETERS

6.1 Simulation Model

We performed simulations on NS-2 simulator for the performance comparison and evaluation of AODV, DSR, and DSDV routing protocols. This network simulator was originally developed by the VINT project research group at the University of California at Berkeley and was recently extended to provide simulation support for ad hoc network by Carnegie Mellon University [32]. In our simulation, we consider a space of 500m X 500m in which 50 nodes are placed randomly to form a network. The simulation runs for 120 seconds with mobility patterns generated for six different average speeds. For simulation we chose a Linux platform i.e. UBUNTU 10.10, as Linux offers a number of programming development tools that can be used with the simulation process. We analyzed the experimental results contained in generated output trace files by using the AWK command. We have generated mobility scenarios for Mobility Models using the BONNMOTION tool [33] and have converted generated scripts to the supported NS-2 format so that they can be integrated into TCL scripts. For simulation we have used mobility models that are random waypoint, Reference Point Group and Manhattan, traffic source for network is Constant Bit Rate (CBR).

The random traffic connections of CBR can be setup between mobile nodes using a traffic-scenario generator script (cbrgen.tcl) [18]. It can be used to create CBR traffic connections between wireless mobile nodes. In order to create a traffic-connection file, we need to define the type of traffic connection (CBR), the number of nodes and maximum number of connections to be setup between them.

The simulation parameters are listed in Table 1 bellow.

Table 1: Simulation parameters

Parameter	Value
Simulator	NS-2 (Version 2.34)
Channel type	Channel/Wireless channel
Protocols	AODV, DSR and DSDV
Simulation duration	120 second
Packet size	512 kb
Traffic rate	128 bytes
Mobility Models	*Random Waypoint, Reference Point Group, Manhattan Grid*
MAC Layer Protocol	802.11
Traffic Model	CBR
Network size	50 nodes
Topology	500 m x 500m

6.2 Energy Consumption Model

The following equations are used to compute energy required to transmit/receive the packets of given packet size:

$$Energy_{Tx} = (Transmitted\ Power \times Packet\ Size)/2\times10^{6}$$

$$Energy_{Rx} = (Receiving\ Power \times Packet\ Size)/2\times10^{6}$$

We have used energy model as given in the following table:

Table 2: Energy Model Parameters

Parameter	Value
Initial Energy	150 Joule
Idle Power	1.0 w
Receiving Power	1.1 w
Transmission Power	1.65 w
Transition Power	0.6 w
Sleep Power	0.001 w
Transition Time	0.005 s

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6 . 3 QoS Parameters

There is several metrics which we can be used to measure the performances of the routing protocols. In this paper we have chosen the most important for our context where the CBR traffic model is considered.

6.3.1. Average end-to-end Delay

It represents the average time from the transmission of data packet at a source node until packet delivery to a destination. It is an important metric which is very significant with CBR traffic.

6.3.2. Throughput

It is the average number of messages successfully delivered per unit time. It is a measure of effectiveness of a protocol.

7. SIMULATION RESULTS AND DISCUSSION

All simulation results presented in this section show the variation of studied parameters when the average speed is varying. The node speed refers to the average speed with which nodes move in the simulation area.

The results are presented in the following order: for each of the third considered mobility models, we evaluate the energy consumption, the average end-to-end delay and the average throughput for the three protocols AODV, DSR and DSDV.

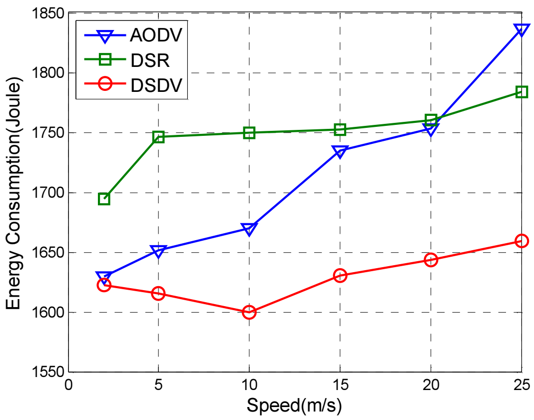

Figure 2: Energy Consumption of Manhattan Mobility Model versus Average Speed.

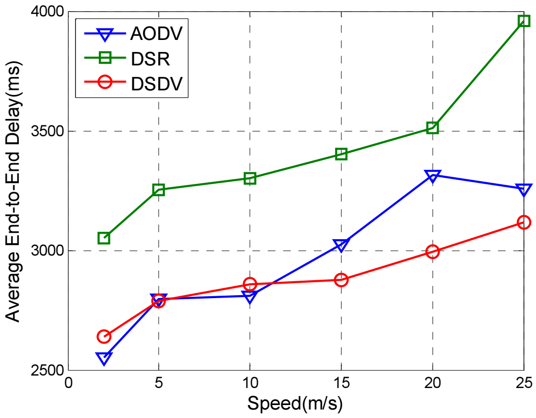

Figure 3: Average End-to-End Delay of Manhattan Mobility Model versus Average Speed.

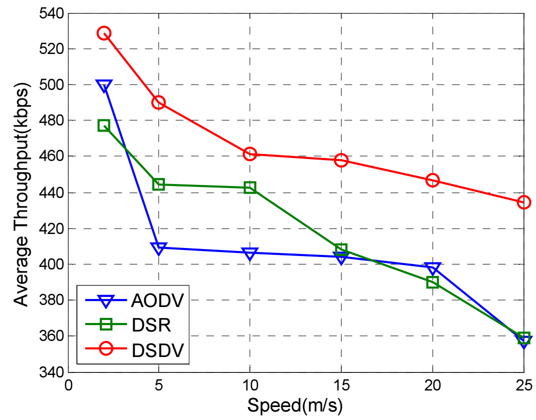

Figure 4: Average Throughput of Manhattan Mobility Model versus Average Speed.

Figure 2, Figure 3 and Figure 4 present the variation of parameters when the Manhattan mobility model is considered.

The DSR protocol displays the worst results both in terms of QoS parameters and in terms of energy consumption; moreover its throughput varies quickly.

For medium values of speed (between 5 m/s and 12 m/s), the AODV protocol provides a medium energy consumption and a good performance in terms of QoS. In fact, it performs the best values in end-to-end delay and provides a throughput that remains almost constant throughout the simulation, a matter that is crucial to the CBR traffic.

The DSDV protocol can be used for very large or very small values of speed. Indeed, in such situations this protocol provides good throughput, minimum delay and minimum energy consumption compared to the other protocols.

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In the case of Manhattan mobility model, it can be concluded that:

• For very large or very low values of speed, the DSDV performs other protocols;
•For speed with medium values the AODV protocol is preferred to others.

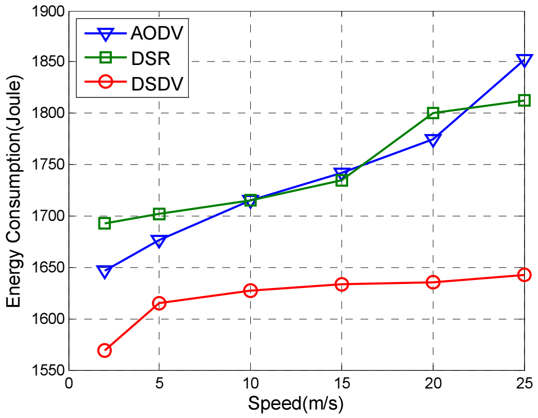

Figure 5: Energy Consumption of RWP Mobility Model versus Average Speed.

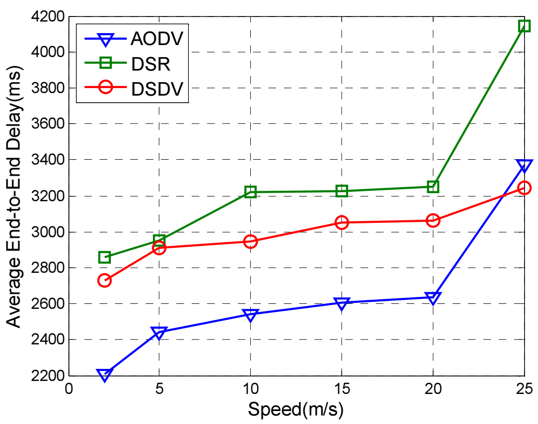

Figure 6: Average End-to-End Delay of RWP Mobility Model versus Average Speed.

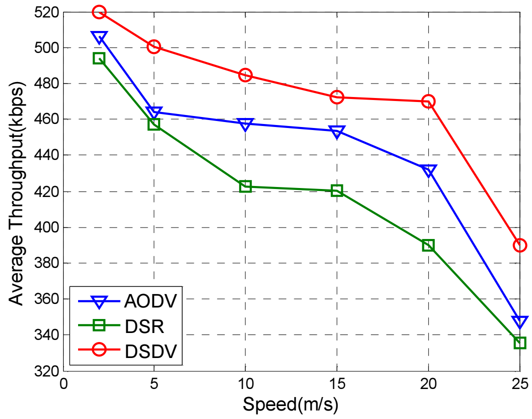

Figure 7: Average Throughput RWP Mobility Model versus Average Speed.

Figures 5, 6 and 7 present the variation of parameters when the Random Way Point (RWP) Mobility Model is considered.

In terms of QoS, the DSR protocol performs the poorest performance (the longest delay and a very fast throughput variation) which is not suitable to CBR traffic. In addition, this protocol consumes the maximum of energy compared with DSDV and AODV protocols, especially when the values of speed are not very large (less than 22m/s).

The DSDV protocol is one that requires the least amount of energy compared to the other studied protocols and, at the same time, DSDV ensures a good quality of service by guaranteeing the best throughput with a low variation and an acceptable delay, especially when the speed becomes large.

The AODV protocol exhibits a rapid variation of throughput and longer delay than DSDV as soon as the speed becomes high. In addition, this protocol consumes the largest amount of energy in comparison with the DSR and DSDV protocols as soon as the speed growth.

In conclusion, we can say that the DSDV protocol appears most appropriate for CBR traffic in the case of RWP mobility model, both in terms of energy consumption or in terms of QoS parameters.

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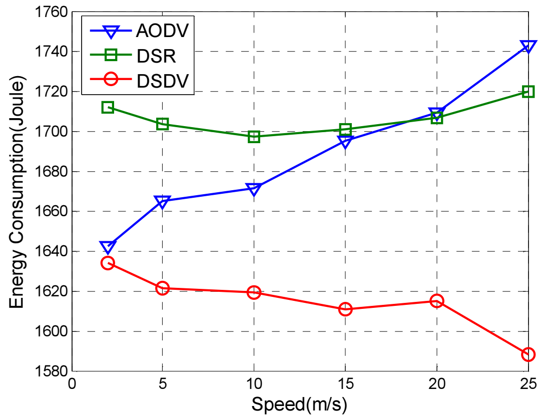

Figure 8: Energy Consumption of RPGM Mobility Model versus Average Speed.

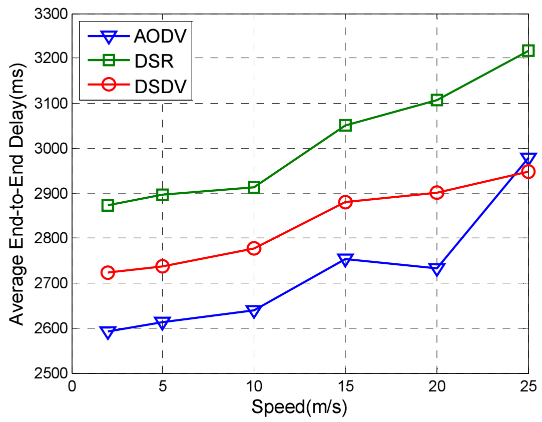

Figure 9: Average End-to-End Delay of RPGM Mobility Model versus Average Speed.

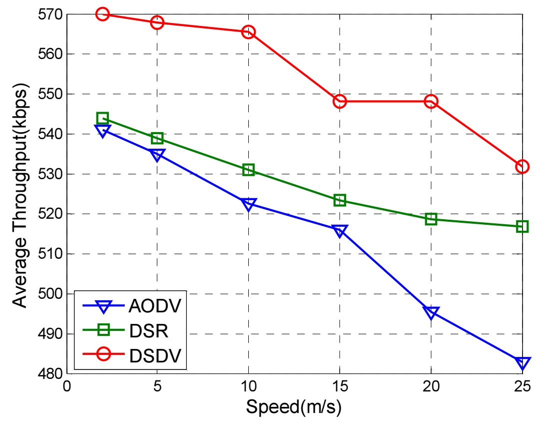

Figure 10: Average Throughput RPGM Mobility Model versus Average Speed.

Figure 8, Figure 9 and Figure 10 present the variation of parameters when the Reference Point Group model (RPGM) is considered for nodes mobility.

The DSR protocol achieves the worst delay compared to the other protocols. However, from the point of view of energy consumption, when the speed is high DSR is more efficient than AODV; in addition the variation of its throughput is very low compared with DSDV and AODV.

It then appears that the DSR is preferred in the case of high speed (greater than 18m/s) and is less efficient for the speeds which are not large.

The DSDV protocol is the most efficient in terms of energy consumption. Even if the delay provided by this protocol is better than AODV, this protocol has the advantage of having a throughput whose variation is not very fast. It is then preferable to AODV protocol which has lower performances either in QoS performances or in energy consumption.

It can be concluded that when the mobility model RPGM is adopted we can:

• Prefer the DSR protocol in the case of very high speed

• Prefer DSDV protocol in the case where the speed is not very high

The preceding simulation results are summarized in the table 3 below:

Table 3: summary of simulation results

	Low speed values	Medium speed values	High speed values
Manhattan	DSDV	AODV	DSDV
RWP	DSDV	DSDV	DSDV
RPGM	DSDV	DSDV	DSR

For low values of speed, the DSDV protocol provides the best performance for CBR traffic. Indeed, in such a situation the use of a reactive routing protocol will require updates of routing tables which adds more time to the end-to-end delay and requires more energy when the network topology does not change much.

For very high speeds, the choice of protocol is strongly related to mobility model. The DSR protocol is preferred over other protocols in the case of RPGM mobility. Indeed, this protocol has route maintenance phase which ensures a throughput that does not change especially with RPGM mobility

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where the motion of the center of group defines the entire group's motion behavior

For Manhattan mobility, topology is defined in an organized manner; hence, when the speed has medium values, the updating of routing tables by the AODV protocol improves performance of QoS in terms delay and throughput, despite its cost in energy.

8. CONCLUSION

This paper aimed to explore the performances of the combination of routing protocol and mobility model in terms of QoS relating to CBR traffic and to network lifetime.

The simulations are investigated when the speed of nodes is varying, under the combination of three mobility models (Manhattan, RWP and RPGM) and three routing protocols (AODV, DSR and DSDV).

Simulation results show that with lower values of speed, and with any mobility model, DSDV performs better than AODV and DSR in terms of considered QoS parameters (end-to-end delay and throughput) and energy consumption.

However, when the value of speed grows there is no protocol which performs others, and for any mobility model there is a specific protocol to use in order to perform both QoS parameters and energy consumption.

REFRENCES:

[1] Ajinkya. D. Kadam, Sharad. S. Wagh, "Evaluating MANET Routing Protocols Under Multimedia Traffic", *Proceedings of IEEE Fourth International Conference on Computing Communications and Networking Technologies (ICCCNT)*, Tiruchengode, 4-6 July 2013, pp. 1 – 5.

[2] Mehdi Barati, Kayvan Atefi, Farshad Khosravi and Yashar Azab Dafial, "Performance Evaluation of Energy Consumption for AODV and DSR Routing Protocols in MANET", *Proceedings IEEE International Conference on Computer & Information Science (ICCIS)*, Kuala Lumpeu , 12-14 June 2012, pp. 636 – 642.

[3] Shivendu Dubey and Rajesh Shrivastava, "Energy Consumption using Traffic Models for MANET Routing Protocols", *International Journal of Smart Sensors and Ad Hoc Networks (IJSSAN)*, Volume-1, Issue-1, 2011, pp.84-89.

[4] Said EL KAFHALI and Abdelkrim HAQIQ, "Effect of Mobility and Traffic Models on the Energy Consumption in MANET Routing Protocols", *International Journal of Soft Computing and Engineering (IJSCE)*, Volume-3, Issue-1, March 2013, pp. 242-249.

[5] Ashish K. Maurya, Dinesh Singh, Ajeet Kumar, Ritesh Maurya, "Random Waypoint Mobility Model based Performance Estimation of On-Demand Routing Protocols in MANET for CBR Applications", *Proceedings of IEEE International Conference on Computing for Sustainable Global Development (INDIACom)*, New Delhi, India, 5-7 March 2014, pp. 835 – 839.

[6] Arindrajit Pal, Jyoti Prakash Singh, Paramartha Dutta, Paulomi Basu and Doyel Basu ,"A Study on The Effect of Traffic Patterns on Routing protocols in Ad-hoc Network Following RPGM Mobility Model", *Proceedings of IEEE International Conference on Signal Processing, Communication, Computing and Networking Technologies (ICSCCN 2011)*, Thuckafay, 21-22 July 201, pp. 233 – 237.

[7] Fahim Maan, Nauman Mazhar, "MANET Routing Protocols vs Mobility Models: A Performance Evaluation", *Proceedings of IEEE Third International Conference on Ubiquitous and Future Networks (ICUFN)*, Dalian, 15-17 June 2011, pp. 179 – 184.

[8] R. Asokan and A. M. Natarajan, "An Approach for Reducing the End-to-end Delay and Increasing Network Lifetime in Mobile Adhoc Networks", *International Journal of Information Technology* , Volume 4 Number 2, 2008, pp.121-127.

[9] Nalin Gahlaut, Jaya sharma, Pankaj Kumar and Kaushal Kumar, "Comparative Analysis and study of different QoS parameters of wireless ad-hoc Network", *International Journal of Advances in Engineering & Technology*, Vol..1, Issue.2, May 2011, pp.176-182.

[10] Mohamed Amnai, Youssef Fakhri and Jaafar Abouchabaka," QoS Routing and Performance Evaluation for Mobile ad hoc Networks using OLSR Protocol", *International Journal of Ad hoc, Sensor & Ubiquitous Computing (IJASUC)*, Vol.2, No.2, June 2011, pp.12-23.

[11] Akshai Aggarwal, Savita Gandhi and Nirbhay Chaubey, "Performance Analysis of AODV, DSDV and DSR in MANETs", *International*

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Journal of Distributed and Parallel Systems (IJDPS), Vol.2, No.6, November 2011, pp. 167-177.

[12] Youssef SAADI, Said EL KAFHALI, Abdelkrim HAQIQ and Bouchaib NASSEREDDINE, "Simulation Analysis of Routing Protocols using Manhattan Grid Mobility model in MANET", *International Journal of Computer Applications (IJCA) (0975 – 8887)*, Volume 45– No.23, May 2012, pp. 24-30.

[13] S.Santhi and Dr.G.Sudha Sadasivam, "Power Aware QoS Multipath Routing Protocol for Disaster Recovery Networks", *International Journal of Wireless & Mobile Networks (IJWMN),* Vol. 3, No. 6, December 2011, pp. 47-57.

[14] S. R. Biradar, Hiren H D Sharma, Kalpana Shrama and Subir Kumar arkar, "Performance Comparison of Reactive Routing Protocols of MANETs using Group Mobility Model", *IEEE International Conference on Signal Processing Systems*, 15-17 May 2009, pp.192-195.

[15] The ATM Forum, "Traffic Management Specification Version 4.1", March 1999.

[16] T. Clausen, P. Jacquet, and L. Viennot, "Comparative study of CBR and TCP performance of MANET routing protocols," Workshop MESA, 2002, INRIA Roquencourt, HiPERCOM project.

[17] Ferguson P., Huston G., "Quality of Service: Delivering QoS on the Internet and in Corporate Networks", *John Wiley & Sons, Inc*., ISBN 0-471-24358-2, January 26, 1998.

[18] T. Issariyakul and E. Hossain, "Introduction to Network Simulator-NS2", ISBN: 978-0-387-71760-9, Springer, 2008.

[19] E. Royer and C.-K. Toh. A review of current routing protocols for ad hoc mobile wireless networks. *IEEE Personal Communication*, 6(2): April 1999, pp.46-55.

[20] S. Murthy and J. Garcia-Luna-Aceves, "An Efficient Routing Protocol for Wireless Networks", *ACM Mobile Networks and Applications Journal, Special issue on Routing in Mobile Communication Networks*, Oct.1996.

[21] C. Perkins and E. Royer, "Ad Hoc On Demand Distance Vector (AODV) Routing", *In Proc. IEEE Workshop on Mobile Computing Systems and Applications*, Feb.1999.

[22] E. P. Charles, M. R. Elizabeth, "Ad hoc on-demand distance vector routing", *Proceedings of the 2nd IEEE Workshop on Mobile Computing Systems and Applications*, February 1999, pp. 80–100.

[23] N.S.M. Usop, A. Azizol and A.F Amri Abidin," Performance Evaluation of AODV, DSDV & DSR Routing Protocol in Grid Environment", *IJCSNS International Journal of Computer Science and Network Security*, VOL.9 No.7, July 2009, pp.261-268.

[24] R. Al-Ani, "Simulation and performance analysis evaluation for variant MANET routing protocols", *International Journal of Advancements in Computing Technology*, Volume 3, Number 1, February 2011, pp. 1-12.

[25] M.S. Murty and M.V. Das, "Performance evaluation of MANET routing protocols using reference point group mobility and random waypoint models", *International Journal of Ad hoc, Sensor & Ubiquitous Computing (IJASUC)*, Vol.2, No.1, March 2011, pp. 33-43.

[26] D.B. Johnson and D.A. Maltz, "Dynamic source routing in ad hoc wireless networks", *Mobile Computing* (Kluwer Academic, 1996) chapter 5, pp. 153–181.

[27] E. P. Charles, Pravin Bhagwat, "Highly dynamic destination-sequenced distance-vector routing (dsdv) for mobile computers", *Proceeding of the conference on Communications architectures, protocols and applications (SIGCOMM'94)*, Volume 24 Issue 4, Oct. 1994, pp. 234-244.

[28] V. Timcenko, M. Stojanovic and S.B. Rakas, "MANET Routing Protocols vs. Mobility Models: Performance Analysis and Comparison", *Proceedings of the 9th WSEAS International Conference on APPLIED INFORMATICS AND COMMUNICATIONS (AIC '09)*, Moscow, Russia, August 20-22, 2009, pp. 271-276.

[29] M. Zonoozi and P. Dassanayake, "User Mobility Modeling and Characterization of Mobility Patterns", *IEEE Journal on Selected Areas in Communications*, 15(7): September 1997, pp. 1239-1252.

[30] T. Camp, J. Boleng, V. Davies, "A Survey of Mobility Models for Ad Hoc Network Research," *in Wireless Communications & Mobile Computing (WCMC): Special issue on*

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Mobile Ad Hoc Networking: Research, Trends and Applications, vol. 2, no. 5, 2002, pp. 483-502.

[31] F. Bai, N. Sadagopan, A. Helmy, “IMPORTANT: A framework to systematically analyze the Impact of Mobility on Performance of RouTing protocols for Adhoc NeTworks,” *in IEEE INFOCOM*, 2003.

[32] K. Fall and K. Varadhan, (Eds.) “ns Notes and Documents”, *the VINT Project. UC Berkeley, LBL, USC/ISI, and Xerox PARC*, February 25, 2000.

[33] Christian de Waal and Michael Gerharz, “BonnMotion: a mobility scenario generation and analysis tool,” *Communication Systems group, Institute of Computer Science IV*, University of Bonn, Germany. 2003.