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BEHAVIOR OF AD HOC ROUTING PROTOCOLS IN MULTISERVICE TRAFFIC

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ABSTRACT

The present paper joins within the framework of research to optimize the Quality of Service (QoS) in the Mobile Ad Hoc Networks (MANET).

In this paper, we have studied the impact of real-time VBR (H.263) traffic on the performances (End-to-End Delay, Throughput and Packet Delivery ratio) of routing protocols DSDV (Dynamic Destination-Sequenced Distance-Vector) and AODV (Ad Hoc On-Demand Distance-Vector).

By using Random Waypoint mobility model, we have studied the performances of network according to the density of nodes in the first time and according to the mobility in the second time.

Experimentally, we have discovered that the proactive DSDV protocol gives good results in high mobility environment.

Keywords: *MANET, QoS, VBR, DSDV, AODV*

1. INTRODUCTION

Mobile Ad Hoc Network (MANET) is a collection of wireless devices called "nodes". The MANET is a self-configuring wireless network without using any fixed or centralized infrastructure.

The potential applications of MANET include, among others, multimedia conferencing, emergency services, the battlefields and construction sites [5, 6].

In order that a source could exchange messages with a remote destination, intermediate nodes act as routers to ensure the transmission.

Determining the route connecting two nodes is assured by several routing protocols.

To guarantee the QoS in mobile ad hoc networks, it is necessary to determine the routing protocol adapted to each application [7].

The QoS is influenced by a combination of factors such as network size, density of nodes, node mobility (mobility model, pause time) and the nature of traffic (CBR: Constant Bit Rate or VBR: Variable Bit Rate) used.

Therefore, several researches have been done to study the effect of these factors on the performances of different routing protocols [3, 4, 8].

This document is organized as follows: In the next section, we present the related works relating to our subject. The problem formulations and simulation environment are treated in third section. The fourth sections describe the simulation results and their interpretations. The last section is devoted to the conclusion and our attitude towards the next work.

2. PROBLEM FORMULATION AND RELATED WORK

Because the inherent dynamic of the MANETs, the QoS is not guaranteed especially with VBR traffic. For this reason we have proposed the use of compressed video traffic (H.263). This latest is designed for videoconferencing and recommended generally for communications at low throughput (incorporating the standard formats used in H.261 but using less bandwidth) [2].

The aim of this paper is how to guarantee the QoS in a network of dynamic topology and traffic VBR.

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Many researchers dedicated their works to determine, analyze and interpret the parameters that influence the QoS.

The authors of the document [1] evaluate the performances of OLSR and AODV protocols based on mobility models for a multiservice traffic. They have concluded that the protocol AODV associated with the mobility model Mobgen leads to significant performances.

In [10], Grossglauser and Tse showed that the mobility of nodes has a remarkable influence on the throughput variations.

The paper [11] concluded that the throughput and the delay are characterized by the number of hops, the transmission range and speed of node.

The paper [12] is devoted to study the delay. The authors have shown that it is influenced by various network parameters such as channel, transmission power and node density.

The authors of [14] compared the performances of routing protocols OLSR and AODV, using a mobility model Freeway. They concluded that the AODV protocol assures better performances for static traffics.

The performances of the protocol (DSR), in terms of delay, for a multiservice traffic are evaluated in [16]. The authors proposed in [15] a routing problem formulation and the implementation of an adaptation protocol (DSR).

We note that the works that have studied the traffic multiservice are based on networks of fixed size and stable pause time. But these factors cannot be without effect on performances (delay, throughput and packet delivery rate), especially, for a real-time VBR traffic [1].

Our work is based on the H.263 video traffic and it allows a detailed comparison between the proactive routing protocol (DSDV) and reactive (AODV) according to density of nodes (number of nodes) and mobility (pause time).

3. ROUTING PROTOCOLS

3.1 AODV

The ad hoc reactive routing protocol considered Ad-Hoc On-Demand Distance Vector Routing (AODV) [4] as a dynamic multi-hop on-demand routing protocol for mobile wireless ad hoc networks. AODV discovers paths without source routing and maintains table instance of route cache. This is loop free and uses destination sequence numbers. In AODV a node informs its neighbors about its own existence by constantly sending "hello messages" at a defined interval. This enables all nodes to know the status about their neighbors, i.e.if they went down or moved out of reach. To resolve a route to another node in the network AODV floods its neighbors with a route request (RREQ). The receiving node checks if it has a route to the specified node. If a route exists then the receiving node replies to the requesting by sending a route reply (RREP). If on the other hand a route does not exist the receiving node sends a RREQ itself to try to find a route for the requesting node. If the original node does not receive an answer within a time-limit the node can deduce that the sought nodes are unreachable. To be sure that the route still exists, the sender has to keep the route alive by periodically sending packets. All nodes along the route are responsible for the upstream links which means that a broken link will be discovered by the closest node. This node signal the broken link by sending an error message (RERR) downstream so that the using nodes can start to search for a new route.

3.2 DSDV

Destination-Sequenced Distance-Vector Routing protocol is a proactive table driven algorithm based on classic Bellman-Ford routing. In proactive protocols, all nodes learn the network topology before a forward request comes in. In DSDV protocol each node maintains routing information for all known destinations. The routing information is updated periodically. Each node maintains a table, which contains information for all available destinations, the next node to reach the destination, number of hops to reach the destination and sequence number. The nodes periodically send this table to all neighbors to maintain the topology, which adds to the network overhead. Each entry in the routing table is marked with a sequence number assigned by the destination node. The sequence numbers enable the mobile nodes to distinguish stale routes from new ones, thereby avoiding the formation of routing loops [13].

4. SIMULATION ENVIRONNEMENT

So as to get our aim we need to evaluate the effect of density of nodes and their mobility on the routing protocols based on traffic VBR (H.263).

Thus we compare the behavior of reactive routing protocol (DSDV) and proactive (AODV) under a Random Waypoint mobility model, by

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varying the parameters "pause time" and "number of nodes."

Our simulations have been done by the Network Simulator NS-2 (version 2.34). Table 1 present all the simulation parameters.

Table 1: Simulation parameters

parameter	*Value*
Routing Protocols	DSDV, AODV
Simulation Time	1200 Sec
Number of nodes	15, 30, 45, 60, 75, 90
Pause Time	0, 20, 40, 60,120, 180, 240, 420, 600, 780 Sec
Environment Size	500 m X 500 m
Traffic Type	Video VBR (H.263)
Maximum Speeds	10m/s
Mobility Model	Random Waypoint Model

4.1 Performance Metrics

There is several metrics which we can use to measure the performances of the routing protocols. We have chosen those considered most important for our context:

- Average End-to-End Delay: is the time lag between sending a packet from the source and its reception by the destination [9]. This metric represents the efficiency of the protocol in terms of response time and in terms of choice of optimal paths. The average end-to-end delay TAVG is calculated as showing in equation (1):

$$T_{AVG} = \frac{\sum_{i=1}^{Nr} \left(H_r^i - H_t^i\right)}{Nr} \qquad (1)$$

H_t^i : Emission instant of package *i*.

H_r^i : Reception instant of package *i*.

Nr: The total number of packets received.

- Throughput: The ratio of successfully transmitted data per unit of time. The Throughput is calculated as showing in equation (2):

$$T = \frac{L - C}{L} Rf(\gamma) \qquad (2)$$

R (b/s): Binary transmission rate,
L: Packet size,

C: Cyclic Redundancy Check,

$f(\gamma)$: is the packet success rate defined as the probability of receiving a packet correctly. This probability is a function of the signal-to-noise ratio (γ).

- Packet Delivery Ratio (PDR): is the ratio between the numbers of packets received (for all destinations of the traffic) and the number of packets transmitted [9]. The metric away from PDR is the packet loss ratio. A high packet delivery ratio is equivalent to a reduced loss ratio. This metric represents the reliability of the protocol to send all data packets

5. SIMULATION RESULT

In this section we present our simulation results and the performance analysis of the routing protocols ADOV and DSDV.

5.1 Variation Of The Number Of Nodes

The simulation results have been carried out by fixing the pause time and increasing the density of nodes.

- *End-to-End Delay*

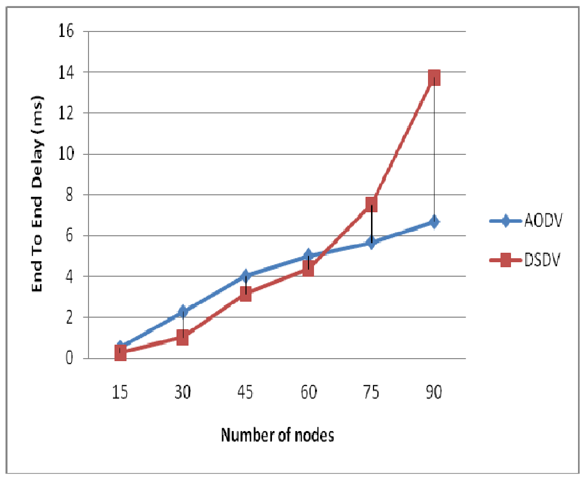

Figure 1. End-to-End Delay vs. Number of Nodes

According to the Figure 1, as far as the number of nodes increases, the average End-to-End Delay increases for both protocols. On the other hand, when small density of nodes is used, the DSDV protocol outperforms the AODV protocols. Inversely, when density becomes heavy the best performance of delay is got by using the AODV routing protocols. This latest result of DSDV delay can be explained by the impact of the generated control packets of maintenance roads.

Therefore, to optimize the average End-to-End Delay of the real time applications, we propose to use the DSDV protocol in small density of nodes and AODV protocol in heavy ones.

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- *Throughput*

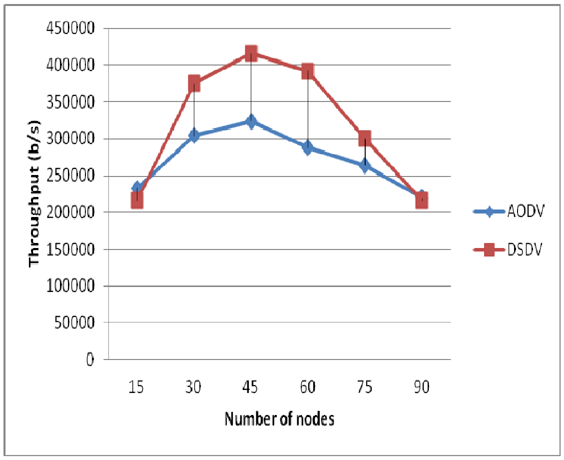

Figure 2. Throughput vs. Number of Nodes

The Figure 2 shows the throughput behavior of AODV and DSDV routing protocols with H.263 video traffic.

When density of nodes increase the throughput shall increases. But the Figure 2 shows that when density become heavy the throughput decreases.

Based on Figure 2, the best performance of throughput is achieved with DSDV protocols over all used density of nodes.

Consequently, to optimize the performance of the real time applications (H.263) which requires a minimum level of throughput we encourage the use of the protocol DSDV rather than AODV especially when density is not too heavy.

- *Packet Delivery Ratio*

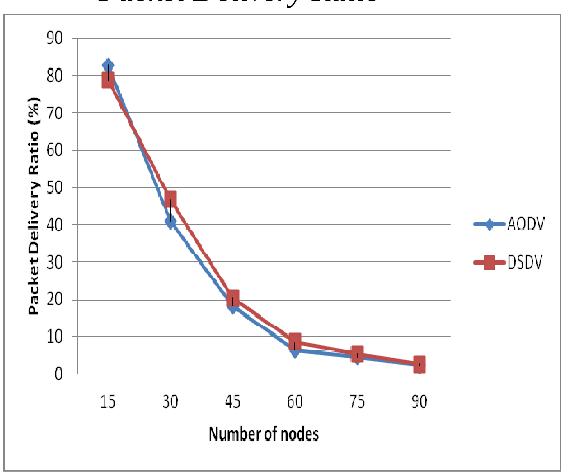

Figure 3. Packet Delivery Ratio vs. Number of Nodes

The figure 3 shows the Packet Delivery Ratio of the AODV and DSDV routing protocols according to the density of nodes with a H.263 video traffic.

According to the Figure 3, the two routing protocols give the same performance in term of PDR. Furthermore, the PDR achieved decrease when the number of nodes increases.

Moreover, if we consider the delay and throughput got by DSDV the PDR limits the use of this latest (DSDV) with the applications which tolerate a small amount of packet loss.

5.2 Variation Of Pause Time

In this section we studied the impact of the mobility on the performances (delay, throughput, PDR) of network. To achieve this aim we fixed the number of nodes at 60 sources and we increased the pause time.

- *End-to-End Delay*

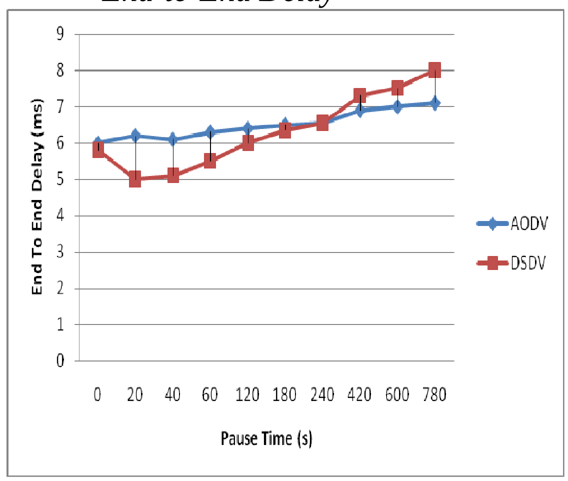

Figure 4. End-to-End Delay vs. Pause Time

In this figure (refer Figure 4) we present the behavior of routing protocols (AODV and DSDV) in term of average End-to-End Delay with a H.263 video traffic.

In the beginning, the results show that the Average-en-to-end-Delay of the two routing protocols increases when the pause time increase especially in case of DSDV protocol. In the second place, the average delay of DSDV protocol performed better compared to that of AODV in case of high and medium mobility. Inversely, when the mobility becomes slower the AODV protocol performs better than the DSDV protocol. To conclude, so as to maximize the End-to-End Delay in a high mobility environment the results suggest the use of DSDV protocol and the use AODV protocol in a slower mobility.

- *Throughput*

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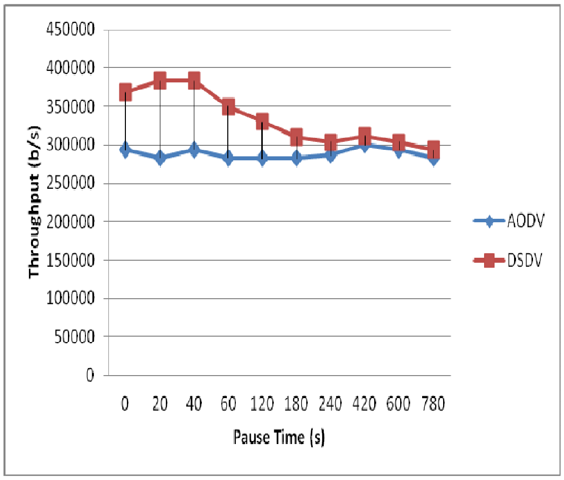

Figure 5. Throughput vs. Pause Time

The Figure 5 shows the achieved throughput by the routing protocols AODV and DSDV with the same H.263 video traffic.

In the first one, the results (Figure 5) show that the AODV protocols keep the same behavior and it's still stable over a higher and a slower mobility. In the second one, the results (Figure 5) shows that the DSDV protocols give the best performance of throughput than the AODV protocol specifically in high and medium mobility. Consequently, the DSDV protocol can optimize the throughput of the real time applications which uses H.263 traffic in high and medium mobility.

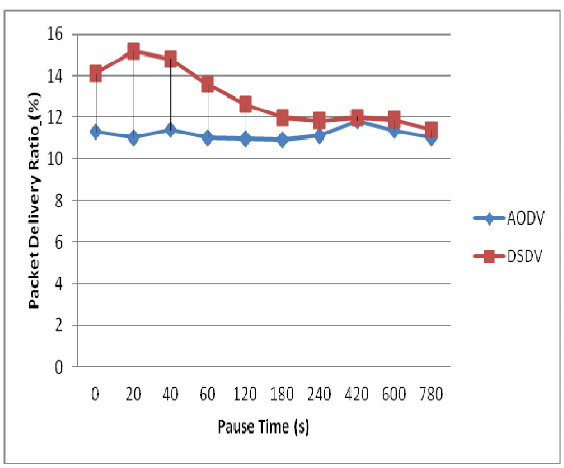

Figure 6. Packet Delivery Ratio vs. Pause Time

The Figure 6 represents the PDR of routing protocols considered previously in associating with a H.263 video traffic.

As shown in the figure 6, the DSDV protocol delivers the packets to the destination more than the AODV protocol.

Because the DSDV protocol performed in high mobility, this result confirm that this protocol can optimize the real time applications in high mobility and medium mobility considered.

6. GENERAL CONCLUSION AND PERSPECTIVES

In this paper we have studied in the first one the impact of density of nodes and in the second one the effect of mobility on the performances (Average En-to-End delay, Throughput, Packet Delivery Ratio) on MANETs.

This study was done in order to optimize the performances of the real time applications which use the H.263 traffic in a high mobility environment.

The achieved results show that the DSDV protocol performs well in small networks and high mobility. Inversely, AODV is more efficient in terms of the End-to-End Delay in a weak mobility environment.

Our work can be extended to various other types of traffic multiservice such as H.264.

In the future, further studies should be devoted to analyze the performances of other protocols (DREAM, OLSR, TORA) based on other metrics such as standard deviation and energy consumption.

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