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RESEARCH ARTICLE

Comparative Analysis of Routing Protocols AODV DSDV and DSR in MANET

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***Abstract*— Recent advances in wireless and micro electronic communications have enabled the development of a new type of wireless network called mobile ad hoc networks. MANETs are currently the greatest innovation in the field of telecommunications. A Mobile Ad hoc Wireless Network (MANET) is a collection of autonomous nodes that communicate with each other by forming a multi-hop network, maintaining connectivity in a decentralized manner. Routing protocols represent an essential aspect of the performance of mobile wireless networks. In this paper, we present the performance analysis of three prominent MANET routing protocols; DSDV, DSR, and AODV using NS2.**

***Index Terms*—Ad Hoc Networks Mobile, ad hoc Networks, AODV, DSDV, DSR, Performance evaluation, Routing protocols, simulation**

I. INTRODUCTION

Stands for "Mobile Ad Hoc Network. A MANET is a type of ad hoc network that can change locations and configure itself on the fly [1]. MANETs are useful in places that have no communications infrastructure or when that infrastructure is severely damaged. Typical applications are:

- Emergency rescue operations.
- Disaster relief efforts.
- Low enforcement.
- Military operations.

Many routing protocols have been proposed for MANETs view their emergence and varied characteristics. Protocols AODV, DSDV, DSR, and OLSR interest more research community [2].

The simulation has been the central focus of research in mobile ad hoc networks, since the simulation environment has enabled the study of new protocols and models. The simulator NS2 (Network Simulator) is widely used, and is the appropriate model for the academic research community. [1][2]

II. ROUTING PROTOCOLS

Generally, routing is the mechanism by which information is forwarding network traffic among networks. In mobile ad hoc networks routing role is to find and maintain routes between nodes in a dynamic topology with possibly uni-directional links, using minimum resources. However, the protocols used for wired network may in no case be implemented in the ad hoc given the characteristics of the latter (energy, CPU power, memory ...).

Several routing protocols have then been created to adapt the limits of the equipment of the ad hoc network. Some were derived from routing protocols wired and others were newly created. The purpose of the implementation of a routing protocol is to determine the optimal path through the packet network based on a certain criterion of performance. The problem lies in the context of ad hoc networks is the adaptation of the routing method used with the large number of existing units in an environment characterized by modest computing capabilities and rapidly changing topologies [4] [5]. The mobile ad hoc routing protocols can be classified into three categories:

- Proactive Protocols: Maintain routes to destinations even if they are not needed (OLSR, DSDV). [6] [7]
- Reactive Protocols: Maintain routes to destinations only when they are needed (AODV, DSR). [8] [9]
- Hybrid Protocols: mixes are proactive and reactive protocols. (ZRP) [10]

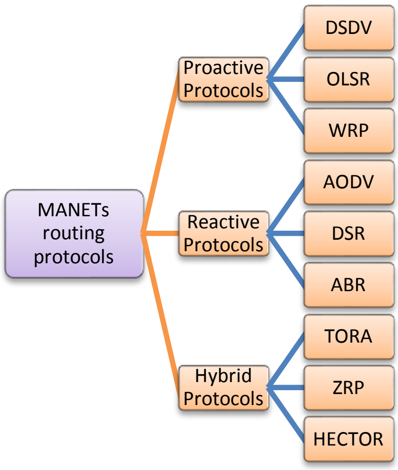

Fig 1. Routing protocols type

The characteristics of each class of protocols are shown in the table below:

Protocol	Reactivity	information exchange strategy	Advantages	Limits
DSDV	Reactive	Distance Vector	required	Non
OLSR	Reactive	Link state	selected	Relative
DSR	Proactive	Link state	Not required	Non
AODV	Proactive	Distance Vector	Required	Non
ZPR	Hybrid	undefined	undefined	Relative

Table 1. MANET routing protocols comparison

In this section, we summarize the routing protocols for mobile ad hoc networks that will evaluate later through implementation in NS2.

A. DSDV

The DSDV protocol (Dynamic Destination - Sequenced Distance -Vector Routing Protocol) [11] is one of the first protocols have been designed for ad hoc networks. DSDV is based on the algorithm Billman -Ford (DBF: Distributed Bellman- Ford) to calculate the paths. Each node informs its neighbors all destinations that can be reached by using a metric which is the number of jumps. It includes a sequence number (SN) that will make the difference between an old and new roads. The update of the routing table can be either full receipt of each table neighbors (which requires sending multiple data packets per table) or limited to entries that have been changed (in provided they are not too many). The DSDV eliminates two problems of routing loops and counting to infinity. Dissemination of an update, however, remains quite slow. Mobility for high losses are mainly due to the use of outdated table entries.

B. AODV

The Ad hoc On-Demand Distance Vector (AODV) algorithm enables dynamic, self-starting, multihop routing between participating mobile nodes wishing to establish and maintain an ad hoc network. AODV allows mobile nodes to obtain routes quickly for new destinations, and does not require nodes to maintain routes to destinations that are not in active communication. AODV allows mobile nodes to respond to link breakages and changes in network topology in a timely manner [8].

The operation of AODV is loop-free, and by avoiding the Bellman-Ford "counting to infinity" problem offers quick convergence when the adhoc network topology changes (typically, when a node moves in the network). When links break, AODV causes the affected set of nodes to be notified so that they are able to invalidate the routes using the lost link. Route Requests (RREQs), Route Replies (RREPs), and Route Errors (RERRs) are the message types defined by AODV. These message types are received via UDP, and normal IP header processing applies. So,for instance, the requesting node is expected to use its IP address as the Originator IP address for the messages. For broadcast messages, the IP limited broadcast address (255.255.255.255) is used. This means that such messages are not blindly forwarded [12].

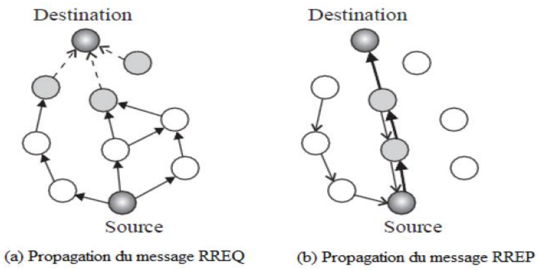

Fig 2. AODV, Discovery path

Route Error (RERR) is used to report the loss of a road, and includes a list of destinations become inaccessible after the break. The RERR message is propagated to the source, which restarts upon receiving a discovery path.

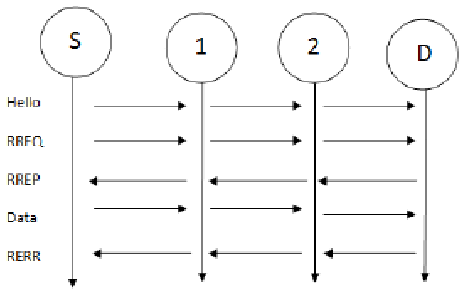

Figure 3. AODV messages

AODV uses the principles of sequence numbers to avoid the problem of counting to infinity (Bellmand-Ford). To maintain consistent routes, periodic transmission of the message "HELLO" (which is an RREP with a TTL of 1) is performed. If after a certain time no "HELLO" message is received from a neighbor node, the link in question is considered to be faulty.

C. DSR

The Dynamic Source Routing protocol (DSR) is a simple and efficient routing protocol designed specifically for use in multi-hop wireless ad hoc networks of mobile nodes. Using DSR,the network is completely self-organizing and self-configuring, requiring no existing network infrastructure or administration. Network nodes cooperate to forward packets for each other to allow communication over multiple "hops" between nodes not directly within wireless transmission range of one another. As nodes in the network move about or join or leave the network, and as wireless transmission conditions such as sources of interference change, all routing is automatically determined and maintained by the DSR routing protocol. The DSR protocol is composed of two main mechanisms that work together to allow the discovery and maintenance of source routes in the ad hoc network: [13][14]

- Route Discovery is the mechanism by which a node S wishing to send a packet to a destination node D obtains a source route to D. Route Discovery is used only when S attempts to send a packet to D and does not already know a route to D.
- Route Maintenance is the mechanism by which node S is able to detect, while using a source route to D, if the network topology has changed such that it can no longer use its route to D because a link along the route no longer works. When Route Maintenance indicates a source route is broken, S can attempt to use any other route it happens to know to D, or it can invoke Route Discovery again to find a new route for subsequent packets to D. Route Maintenance for this route is used only when S is actually sending packets to D.

D. OLSR

OLSR is a proactive routing protocol for mobile ad hoc networks. The protocol inherits the stability of a link state algorithm and has the advantage of having routes immediately available when needed due to its proactive nature. OLSR is an optimization over the classical link state protocol, tailored for mobile ad hoc networks.

OLSR minimizes the overhead from flooding of control traffic by using only selected nodes, called MPRs, to retransmit control messages. This technique significantly reduces the number of retransmissions required to flood a message to all nodes in the network. Secondly, OLSR requires only partial link state to be flooded in order to provide shortest path routes. The minimal set of link state information required is that all nodes, selected as MPRs, MUST declare the links to their MPR selectors. Additional topological information, if present, MAY be utilized e.g., for redundancy purposes. Each node selects a set of its neighbors as multipoint relay (MPR). [4] In OLSR only selected as MPR nodes are only allowed to carry the information. Neighbors who are not receiving MPR and also process information but does not retransmit. The choice of MPR must ensure that all neighbors of order 2 V are achievable by one of its relays. [15[16]

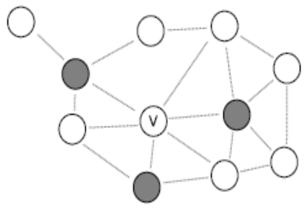

Fig 4. MPR node v (gray)

Basically, OLSR uses HELLO messages not forwarded to periodically update the list of its neighbors, and a restricted flood control messages called TC messages (Topology Contol messages) A TC message is sent by a node in the network to declare a set of links, called advertised link set which MUST include at least the links to all nodes of its MPR Selector set, i.e., the neighbors which have selected the sender node as a MPR.

III. PERFORMANCE ANALYSIS

NS2 (Network Simulator) is the most common network simulator. It has the ability to simulate a range of networks, including wired and wireless networks. In this section we evaluated the performance of AODV, DSDV and DSR protocols in NS2.

A. Simulation Environment

Network Simulator (Version 2), widely known as NS2, is simply an event driven simulation tool that has proved useful in studying the dynamic nature of communication networks. Simulation of wired as well as wireless network functions and protocols (e.g., routing algorithms, TCP, UDP) can be done using NS2. In general, NS2 provides users with a way of specifying such network protocols and simulating their corresponding behaviors.

NS2 consists of two key languages: C++ and Object-oriented Tool Command Language (OTcl). While the C++ defines the internal mechanism (i.e., a backend) of the simulation objects, the OTcl sets up simulation by assembling and configuring the objects as well as scheduling discrete events (i.e., a frontend). The C++ and the OTcl are linked together using TclCL. Mapped to a C++ object, variables in the OTcl domains are sometimes referred to as handles [17].

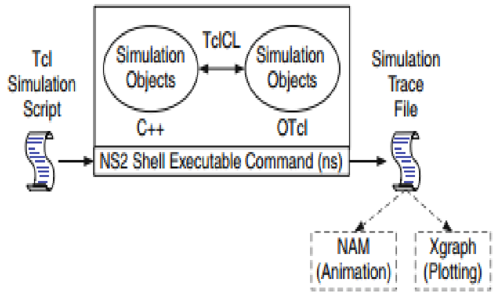

Fig 5. NS Architecture

After simulation, NS2 outputs either text-based or animation-based simulation results. To interpret these results graphically and interactively, tools such as NAM (Network AniMator) and XGraph are used. To analyze a particular behavior of the network, users can extract a relevant subset of text-based data and transform it to a more conceivable presentation.

In addition, the simulator already has a range of transmission systems (layer 1 of the TCP / IP architecture), schedulers and management policies queues for congestion control studies. The list of major components currently available in NS by category:

Application	Web, ftp, telnet, CBR, ...)
Transport	TCP, UDP, RTP, SRM
Routing	Static, dynamic (Vector distance) routing and Multipoint (DVMRP, PIM)
Queue management	RED, DropTail, Token bucket
Service discipline	CBQ, SFQ, DRR, Fair queueing
Transmission system	CSMA/CD, CSMA/CA, Point to point link

B. Methodology

The simulation is to evaluate the performance of routing protocols for mobile ad hoc networks under different conditions. To evaluate the performance of ad hoc routing protocols. Each source is a CBR source over UDP, varying the number of connections between 10 and 50 to describe the impact of the load on the performance of ad hoc routing protocols. Traffic between nodes is produced using a traffic generator which creates randomly CBR type connections that start at times evenly distributed between 0 and 100 seconds. The data packet size is 512 bytes. Transmission rate of a node is 600 Kbps. We assumed that the nodes are in transmission range at a constant distance of 195 m. The simulation time lasted for 80 sec.

Criteria	***Valeur***
Number of nodes	8, 20, 50
Simulation Area	600*600
Traffic Model	CBR/UDP
Size of Payload	512 bytes
Reflection model	Two-ray ground
Simulation Time	90 secondes
Mobility Model	random waypoint
Medium access protocol	IEEE 802.11

Table 2. Simulation parameters

Performance indicators for the evaluation of MANET protocols (AODV, DSDV) are:

- Throughput ;
- Packet Drop Rate;
- Average Packets End to End Delay;

C. Simulation Results and discussion

Given the large number of results found, we present in this section, only the results of the study of impact load.

1) AODV

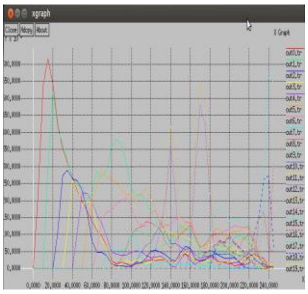

Fig 6. Throughput

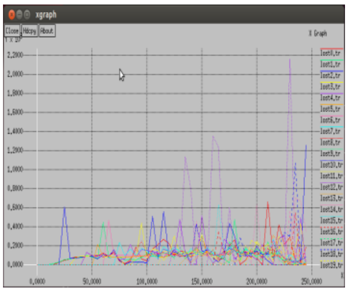

Fig 7. Packet Drop Rate

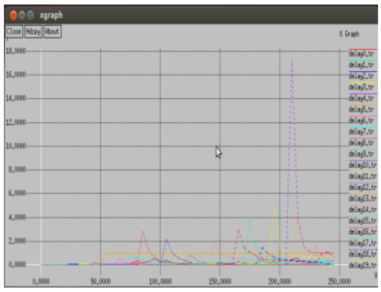

Fig 8. Average Packets End to End Delay

2) DSDV

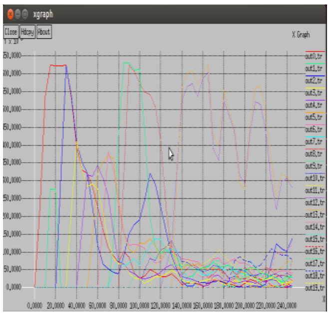

Fig 9. Throughput

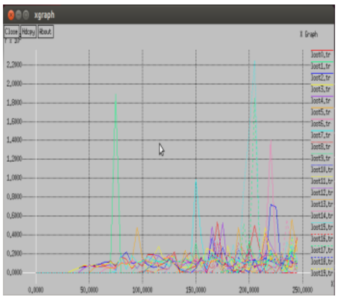

Fig 10. Packet Drop Rate

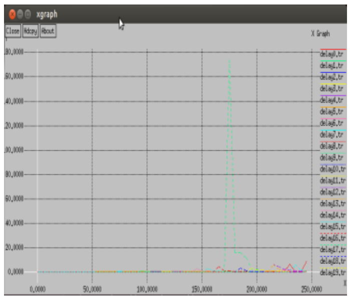

Fig 11. Average Packets End to End Delay

3) DSR

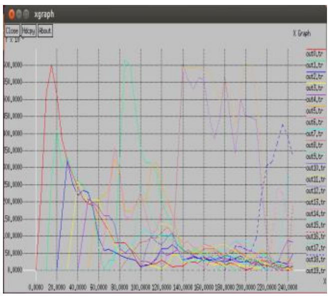

Fig 12. Throughput

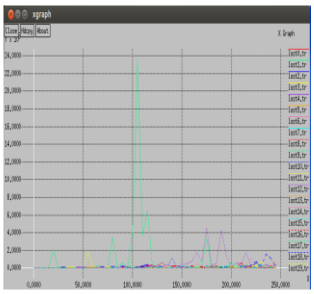

Fig 13. Packet Drop Rate

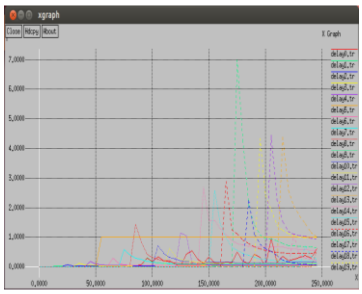

Fig 13. Average Packets End to End Delay

DSDV and DSR perform better in terms of bandwidth compared to AODV. However DSDV and AODV have better performance in terms of rate of packets delivered when comparing with DSR, it uses the cache for the route discovery; this mechanism degrades the performance of DSR in particular in terms of delay. The loss rate is higher by implementing a DSDV or AODV routing, unlike DSR.

IV. CONCLUSION

It allowed us to conclude that the choice of routing algorithm depends on several constraints and it is interesting to consider and combine the maximum of protocols to get the best profits. In future studies we will try to evaluate the performance of Ad hoc routing protocols with different mobility patterns and different types of traffic including the TCP traffic.

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