PRODUCTIVE ANALYSIS OF ROUTING PROTOCOLS IN MANETS: PROACTIVE VS REACTIVE CATEGORIES

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Abstract: The study of routing protocols in MANETs is one that requires a great deal of research due to the challenges it poses as a consequence of continuous mobility and lack of infrastructure. Several factors such as throughput, packet delivery ratio, end to end delay, overhead and so on need to be considered to decide upon the most suitable protocol for Adhoc communication. Basically, the routing protocols of MANETs can be categorized as proactive and reactive. In this paper, our main focus has been to select a category of protocol out of two (i.e. proactive & reactive). For this we have selected, implemented and analyzed the best protocols of these categories and compared the results, using NS2, NAM and AWK. The protocols that we have selected are OLSR and AODV from proactive and reactive categories respectively, based on their relative advantages and disadvantages in comparison to the other protocols of their category.

Keywords: AODV, AWK, OLSR, MANET,NS2

I. INTRODUCTION

MANET is the acronym for Mobile Adhoc Networks. It can be defined as an autonomous system of mobile devices connected by wireless links. It is characterized by a lack of fixed infrastructure, dynamically changing topology, unexpected and unrestricted entry, exit and movement of the devices, energy and bandwidth constraints and an interoperation with the internet. Each device in a MANET acts as both a node and a router and carries routing information. They relay data packets from source to destination by communicating with their neighbors.

It has wide applications in the areas like military, civilian applications (such as in taxis, meeting rooms, sports stadiums, boats and chartered planes etc.) and Personalized area networks (such as in small movable devices like cell phones, laptops, headsets, wrist watches etc.).

Though MANETs have a large number of applications, their efficiency in them is affected by a few issues. These issues or drawbacks include wireless communication – makes the transmission unreliable and bandwidth constrained, mobility – involves partitioning of a network that constantly changes, which is a highly tedious task and portable equipment – due to small size and light weight such equipment often suffers from lack of resources like sufficient memory and power backup or battery life [1].

II. ROUTING CATEGORIES

Since the advent of Defense Advanced Research Projects Agency (DARPA) packet radio networks in the early 1970s, numerous protocols have been developed for ad hoc mobile networks. Such protocols must deal with the typical limitations of these networks, which include high power consumption, low bandwidth, and high error rates [2].

Routing as such involves two basic steps. Firstly, finding the most appropriate path between the source and destination via certain intermediate nodes and secondly, the transfer of data packets using this path. Depending on the manner in which these two steps are contemplated, as mention earlier, routing has been classified as

A. *Proactive routing*

In proactive routing fresh lists of destinations and their routes are maintained by periodically distributing routing tables throughout the network [3]. Here routing information is computed and shared and the path is set prior to the actual transfer of data packets between the source and destination.

In the proactive routing scheme we are able to conveniently send the data packets across as everything is planned before hand. But, it requires that each and every node in the network have the capacity to store all the routing information. Also, if the network changes its topology very rapidly our planning may fail. Examples of these kind protocols are OLSR, DSDV, and CGSR etc.

B. *Reactive routing*

In reactive routing routes are found on demand by flooding the network with route request packets. Here the source initiates the data transfer process by issuing a route request, the most relevant immediate neighbor issues a route reply to this request and takes forward the data transfer process. This happens till the destination is reached and the data packet received [3].

In the reactive routing scheme we are able to overcome all shortcomings of the proactive routing scheme. But, this scheme may suffer from high latency time for finding routes. Also, excessive flooding may lead to network clogging. Examples of these kind protocols are AODV, AOMDV, DSR, TORA and CBRP etc.

III. ROUTING PROTOCOLS

A routing protocol is a set of rules guiding how routers communicate with each other. As mentioned earlier our work includes the thorough study of two protocols which have been discussed in details below.

A. *Optimal Link State Routing protocol*

OLSR routing protocol has the following properties:

It is a proactive routing protocol. It is a flat routing technique. Both proactive and reactive routing schemes can be sub categorized by flat and hierarchal routing techniques. Flat routing technique is the one in which every node is treated equally whereas, hierarchal routing technique is one in which the more robust nodes act as supervisory nodes and the less robust nodes as mere transmitters.

It begins by the periodic broadcast of routing tables thereby building a global view of the network topology. Due to this periodicity, lot of unnecessary repetition is seen that adds to overhead. To remove this overhead OLSR makes use of Multi Point Relays (MPRs).

The network is modified by removing cycles with the use of MPRs that forward control traffic with control messages that have a relatively reduced size. A group of MPRs is selected from one hop neighbors and each two hop neighbor is reached through an MPR. Apart from the above the MPRs perform the functions of advertising link state information and route calculation and formulation. It is the best routing protocol of the proactive category.

B. *Adhoc On demand Distance Vector routing protocol*

AODV is a packet routing protocol designed for use in mobile ad hoc networks. It is intended for networks that may contain thousands of nodes. It is one of a class of demand-driven protocols. The route discovery mechanism is invoked only if a route to a destination is not known. Source, destination and next hop are addressed using IP addressing. Each node maintains a routing table that contains information about reaching destination nodes. Each entry is keyed to a destination node. Routing table size is minimized by only including next hop information, not the entire route to a destination node. Sequence numbers for both destination and source are used. Managing the sequence number is the key to efficient routing and route maintenance. Sequence numbers are used to indicate the relative freshness of routing information.

Updated by an originating node, e.g., at initiation of route discovery or a route reply. It is observed by other nodes to determine freshness [4][13].

AODV is an on-demand protocol, which initiate route request only when needed. When a source node needs a route to certain destination, it broadcasts a route request packet (RREQ) to its neighbors. Each receiving neighbor checks its routing table to see if it has a route to the destination. If it doesn't have a route to this destination, it will re-broadcast the RREQ packet and let it propagate to other neighbors. If the receiving node is the destination or has the route to the destination, a route reply (RREP) packet will be sent back to the source node. Routing entries for the destination node are created in each intermediate node on the way RREP packet propagates back. A hello message is a local advertisement for the continued presence of the node.

Neighbors that are using routes through the broadcasting node will continue to mark the routes as valid. If hello messages from a particular node stop coming, the neighbor can assume that the node has moved away. When that happens, the neighbor will mark the link to the node as broken and may trigger a notification to some of its neighbors telling that the link is broken [9]. In AODV, each router maintains route table entries with the destination IP address, destination sequence number, hop count, next hop ID and lifetime. Data traffic is then routed according to the information provided by these entries [5][6].

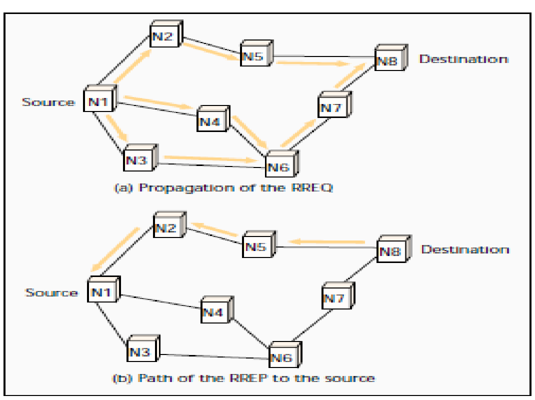

Fig 1: AODV route discovery

IV. SIMULATION SETUP

The protocols to be implemented and analyzed and the tools to be used for this implementation and analysis have been selected by a thorough study of the reference papers mentioned in the later portions of this text. We have discussed pervasively about the protocols and now we will be discussing the tools in the same way.

We begin with simulation for which we use the second version of Network Simulator (NS2) [15]. The simulation process involves the creation of a Tool Command Language (TCL) [18] file that makes a setup of the scenario, meaning to say it specifies in it the required features of the network such as number of nodes, kind of agents working on the nodes and so on. After creating such a file, it needs to be run. This marks the generation of the desired network. NS2 is an open source software and extremely user friendly and so the most appropriate tool in our context.

Simulation is followed by a display of the working of the network with the protocols. This is done by using Network Animator (NAM). NAM is a TCL/TK based animation tool for viewing network simulation traces and real world packet traces. It supports topology layout, packet level animation and various other data inspection tools [12].

Finally for analysis we need to run some AWK (Aho Weinberger Kernighan – family names of its authors) scripts that lead to xgraphs. The AWK utility is a data extraction and reporting tool that uses a data-driven scripting language consisting of a set of actions to be taken against textual data (either in files or data streams) for the purpose of producing formatted reports. The language used by awk extensively uses the string data type, associative arrays (that is, arrays indexed by key strings), and regular expressions. The xgraphs so produced for the performance parameters for the two protocols are compared and conclusions are made.

These simulations are using AODV, OLSR that will be tested on Random Waypoint Mobility Model scheme. The simulation periods for each scenario are conduct in 10 seconds and the simulated mobility network area is 800 m x 800 m rectangle with 250m transmission range.

Parameter Type	**Parameter Value**

Protocols	AODV ,OLSR
Simulation Time	10s
Number of Nodes	50
Network Load	4 Packets / sec
Pause Time	0
Environment Size	800m x 800 m
Traffic Type	Constant Bit Rate
Maximum Speed	10 m / s
Mobility Model	Random Waypoint
Network Simulator	NS 2.34
Platform	Linux Fedora

Table 1: Simulation Setup

V. Performance Metrics

The conclusions have been made by taking into consideration the following performance parameters [20].

A. *End-To-End Delay (Delay)*

It refers to the time taken for a packet to be transmitted across a network from source to destination.

$$\text{Delay} = \frac{\sum i\ [\text{time when packet(i)received} - \text{time when packet(i)sent}]}{\sum i\ \text{count packet(i)}}$$

B. *Throughput (t)*

It is the average rate of successful message delivery over a communication channel. This data may be delivered over a physical or logical link, or pass through a certain network node. The throughput is usually measured in bits per second (bit/s or bps), and sometimes in data packets per second or data packets per time slot. The system throughput or aggregate throughput is the sum of the data rates that are delivered to all terminals in a network.

$$t = \frac{\sum i\ \text{Size of Packet(i) received}}{\text{simulation time}}$$

C. *Packet Delivery Ratio (PDR)*

It is the ratio of the number of delivered packets to the destinations by the total number of packets actually sent.

$$\text{PDR} = \frac{\sum i\ \text{packet(i)received}}{\sum i\ \text{packet(i)sent}}$$

The greater the value of the packet delivery ratio, the better is the performance of the protocol.

D. *Overhead (v)*

The additional costs incurred during the data packet delivery process.

$$V = \frac{\sum i\ \text{Data packet(i)received}}{\sum i\ \text{Routing packet(i)sent}}$$

VI. Performance Evaluation

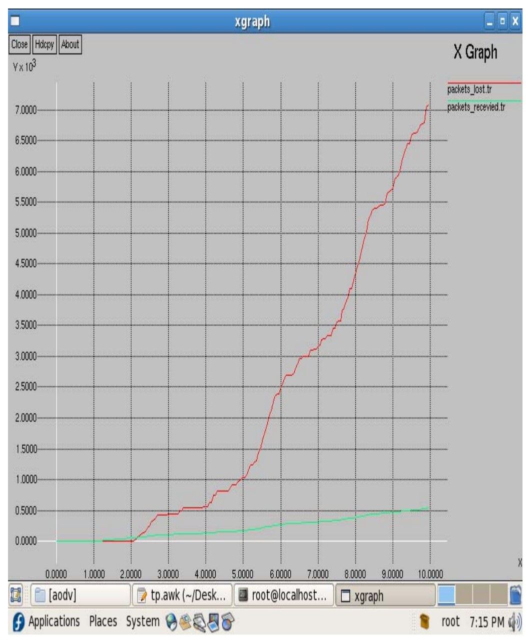

Fig 2: AODV graph comparing packets lost and packets received

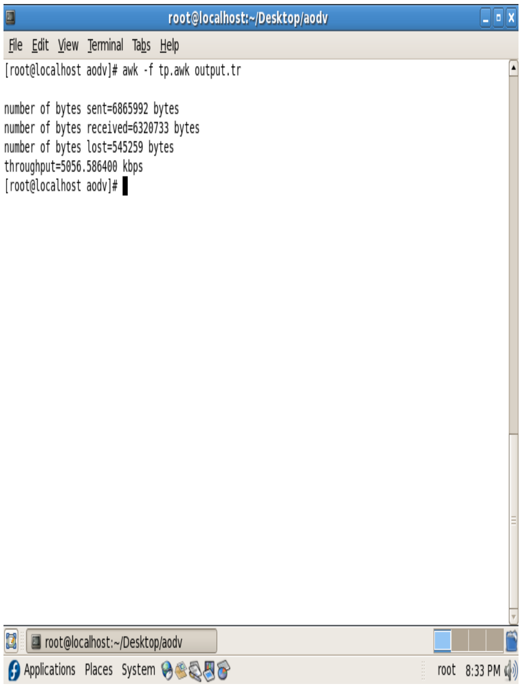

Fig 3: Throughput output of AODV

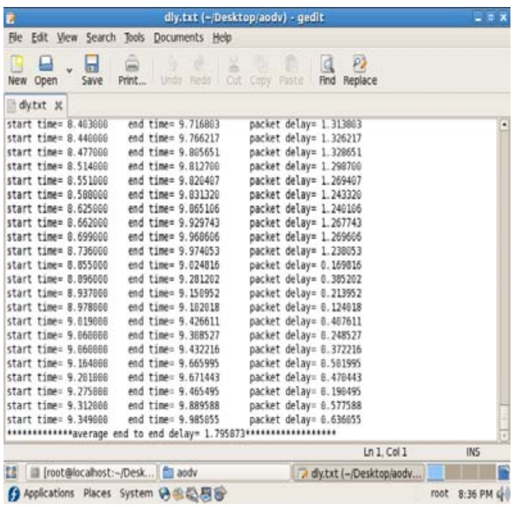

Fig 4: Delay output of AODV

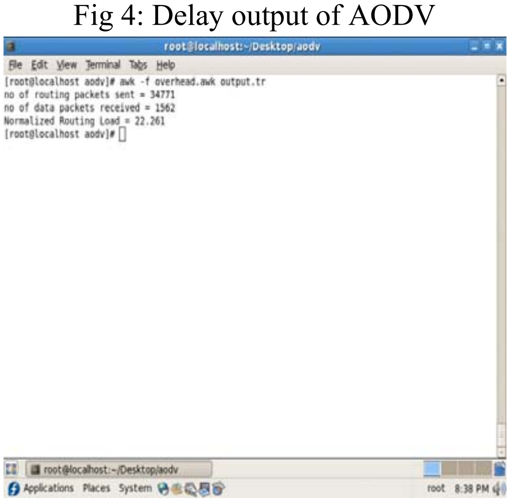

Fig 5: Overhead output of AODV

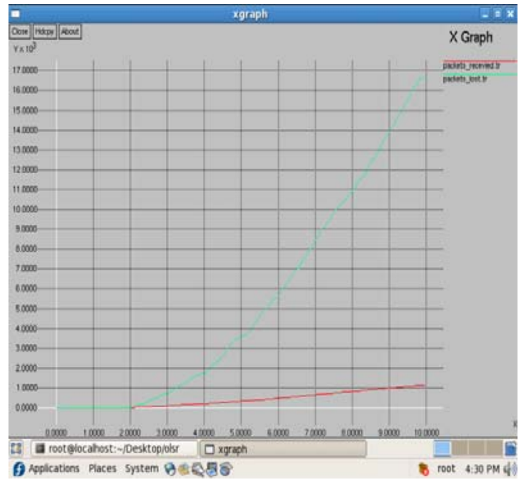

Fig 6: OLSR graph comparing packets lost and packets received

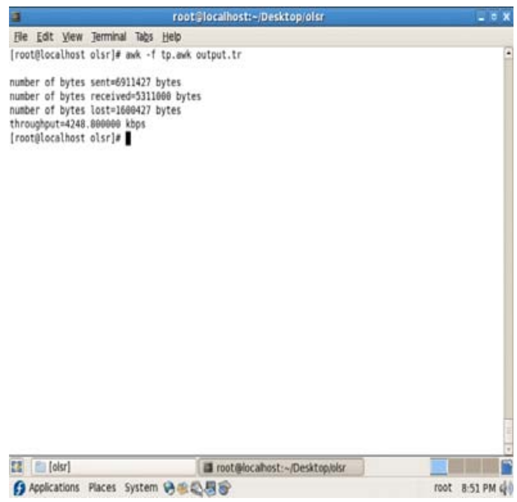

Fig 7: Throughput output of OLSR

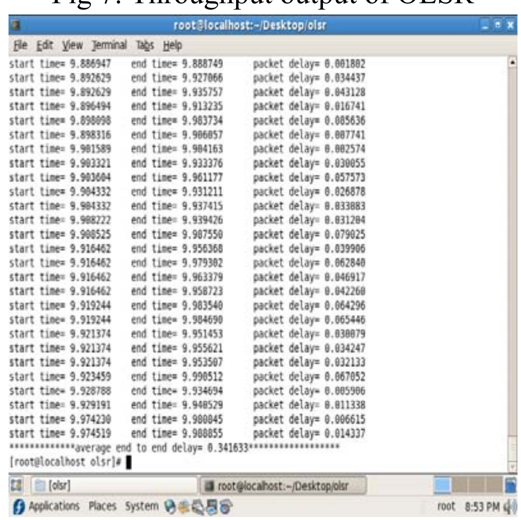

Fig 8: Delay output of OLSR

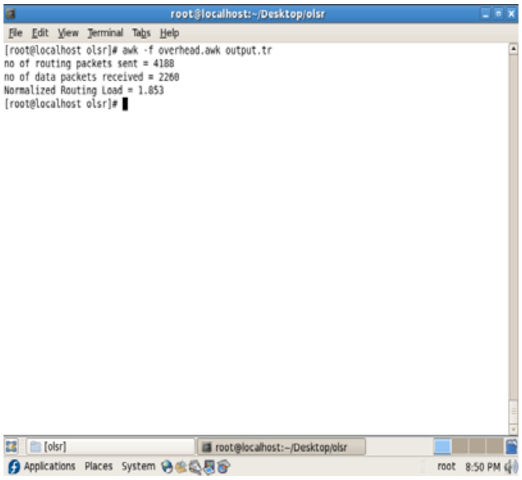

Fig 9: Overhead output of OLSR

Fig 10: Comparing lost packets of AODV and OLSR

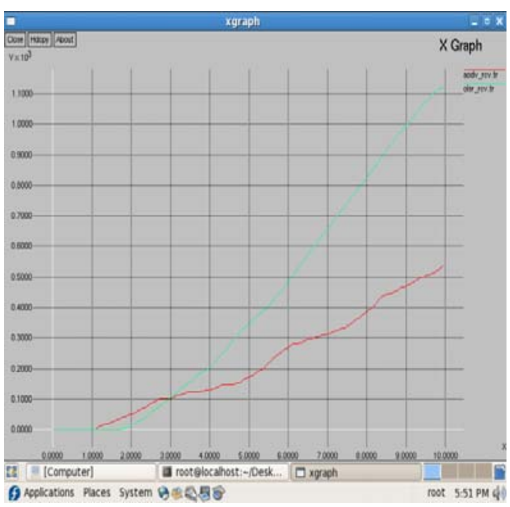

Fig 11: Comparing received packets of AODV and OLSR

VII. Observations

From the given xgraphs the performance parameters computed are as recorded in the table that follows:

	OLSR	AODV
throughput	120packets/sec	60packets/sec
End to end delay	10ms	9ms
Packet delivery ratio	0.067	0.075
Overhead	1.83	22.26

Table 2: Comparisons between OLSR and AODV.

From these statistics we can note that

- OLSR has a significantly better throughput than AODV.
- End to end delay and packet delivery ratio of AODV are better than OLSR but, the difference is not very significant.
- The overhead of OLSR is also better than AODV.

VIII. Conclusion And Future Work

Therefore, the overall performance of OLSR is better than that of AODV which indicates proactive routing protocols are more preferable than reactive routing protocols. (Yet, according to traffic patterns this may vary). And also overhead of OLSR is less compared to AODV.

As of now we have considered only fixed number of nodes, Also there has been no emphasis on mobility. Even pause time has been neglected. The future scope is to find out what factors are responsible for these simulation results, as performance of AODV in various situations as compared to OLSR are not as expected. Further simulation needs to be carried out for the performance evaluation with not only increased number of nodes but also varying other related parameters like Pause Time, Network load, Speed, Mobility modes etc. Various parameters such as jitter, energy can also be analyzed.

IX. References

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