Co-operative analysis of Proactive and Reactive Protocols Using Dijkstra's Algorithm

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ABSTRACT: - Ad hoc networking provides movable devices to establish communication independent of a main infrastructure. However, the fact that there is no main infrastructure and that the devices can move randomly gives rise to various kind of problems, such as routing and security. In this system, path routing and protocol selection are the primary strategies to design any wireless network. In mobile Adhoc network (MANET) the selected protocol should have best in terms data delivery and data integrity. Hence, the performance analysis of the protocols is the main step before selecting a particular protocol. Selection of the protocols and path routing are the most common strategies that are to be focused while designing any kind of wireless networks such as MANETs, WSNs, WMNs and VANETs. MANETs A lot of challenges which are facing wireless MANETs like network stability, security, and energy. In this paper, using Dijkstra's Algorithm and to find shortest path, and hence to carrying out the performance analysis on Adhoc On-demand Distance Vector (AODV), Dynamic Source Routing (DSR), Optimized Link State Routing (OLSR) and Destination Sequenced Distance Vector (DSDV) protocols using NS2 simulator. The end-to-end delay, throughput and packet delivery ratio are the three parameters we are using for the comparison of performance of routing protocols.

Keywords: - MANET, Routing Protocols, Dijkstra's Algorithm.

1 Introduction

Now a day's mobile ad-hoc protocol acting an essential part in a wireless atmospheres. Today mobile network has become a primary element of recent communication infrastructure for its applications in mobile and personal communications. The strength of mobile ad-hoc technologys is that the mobile devices can be used anywhere and at any time. In mobile ad-hoc network, all devices work as a router or end node, which participate an significant function during safeguarding and searching of routes. The breakdown of a mobile device can critically modify the performance of an ad - hoc network. each node maintain one or more tables to store routing information, whenever any changes in network topology then they respond by propagating updates messages throughout the network in order to maintain consistent network view. The process is completed when a route is found or all possible routes have been examined. Once the route has been established, some form of route maintenance procedure maintains it until the routes is no longer desired.

MANET is a collection of wireless devices that set up the relationship between wireless nodes exclusive of centralized management and infrastructure [1, 18, 20]. The wireless nodes are proficient of shifting their location and connect each other randomly in a wireless network. The whole procedure replicates, during finding the whole route, the destination mobile device sends route reply message to the source mobile device for successful route making and searching procedure [2, 16]. The arrangement of route detection and preservation is the important process functioning in DSR [3]. The proactive routing protocol Bellman-Ford method working in DSDV [6, 21]. The protection and marking of routes ought to be finished below some limitations for example utilization of bandwidth and minimum quantity of overhead [4, 10, 15, and 16].

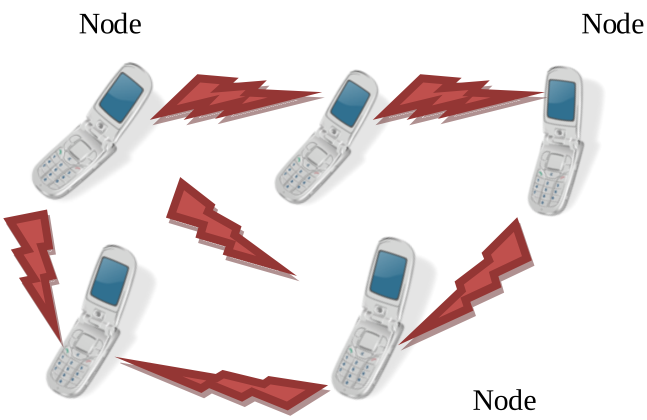

Fig.1. A Mobile Adhoc Networks.

The main goal of a routing protocol is to set up a accurate and competent route linking two mobile nodes that can be sent or received in time. Traditional routing protocols for ad hoc network select the routes under the metric of the minimum hop count. Such min-hop routing protocols can use energy unevenly among the nodes and thus it can cause some nodes to spend their whole energy earlier and make a network partition as a degradation in network performance. On demand protocols flooding the route request packets throughout the network does the route discovery. Our main aim is to make the routing protocol more energy efficient and ultimately to perform load balancing of the node in the ad hoc network.

2 Routing Protocol

2.1) AODV: Ad hoc On Demand Distance Vector (AODV)[2,13,17], routing algorithm comes under the category of On- demand routing protocol means that it creates routes between nodes only as needed by source nodes, designed for ad hoc mobile networks. It is capable of both unicast and multicast routing. AODV has sequence numbers, which ensure the freshness of routes. It provides loop-free routing using broadcast ID. When an originator node wants a route to a destination node for which it does not have a route, it broadcasts a route request (RREQ) packet throughout the network. A node receiving the RREQ may send a route reply (RREP) if it is either the destination node or if it has a route to the destination node with corresponding sequence number greater than or equal to that enclosed in the RREQ. If a link break occurs while the route is active, the node upstream of the break propagates a route error (RERR) message to the originator node to inform it of the now unreachable destination(s). After receiving the RERR, if the originator node still desires the route, it can reinitiate route discovery.

2.2) DSR (Dynamic Source Routing): The Dynamic Source Routing protocol is composed of two main mechanisms to allow the discovery and maintenance of source routes in the ad hoc networks. *Route Discovery* The mechanism by which a Source node wishing to send a packet to a destination node, obtains a source route to the destination. Route Discovery is used only when the source node attempts to send a packet to a destination and does not already know a route to that destination.

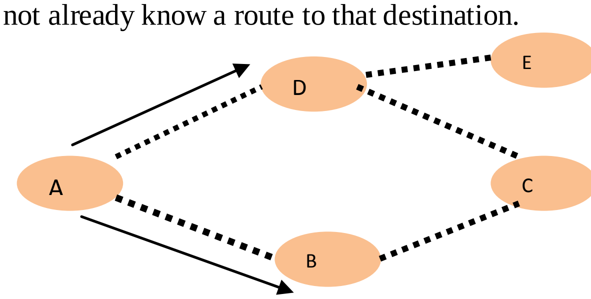

Fig.2.Route Discovery

Route Maintenance: The mechanism by which a node wishing to send a packet to a destination is able to detect, while using a source route to the destination, if the network topology has changed [9,12].

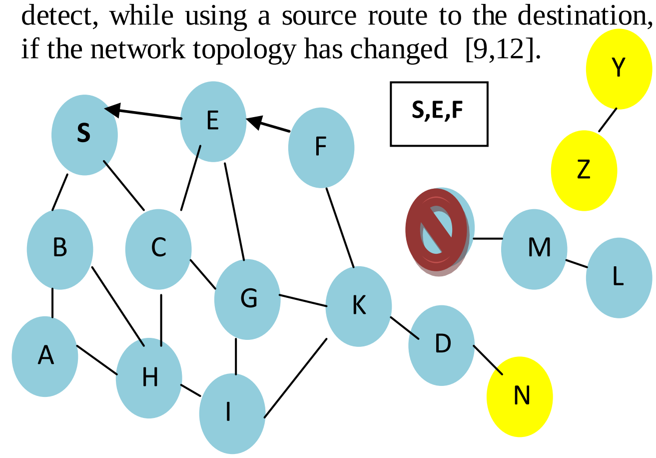

Fig.3. Route Maintenance

Route Maintenance for this route is used only when the source node is actually sending packets to the destination. We provide the basic characteristics of the Dynamic Source Routing (DSR) as a) Uses source routing b) Provides loop-free routes c) Supports Unidirectional links d) asymmetric routes with the optimizations available it is a good choice for an ad hoc network.

2.3) OLSR: Optimized Link State Routing (OLSR) [5,6,8] protocol is a table-driven proactive routing protocol for wireless mobile ad hoc networks. This protocol optimizes the flooding process and reduces the control message overheads by marking subset of neighbors as multi-point relays (MPRs). In OLSR, each node periodically broadcasts two types of messages: HELLO messages and Topology Control (TC) messages. A HELLO message contains two lists in which one list includes the addresses of the neighbors to which there exists a valid bi-directional link and the other list includes the addresses of the neighbors from which control traffic has been heard but bidirectional links are not confirmed.. Based on the information contained in the neighbor table and the TC message, each node maintains a routing table which includes destination address, next-hop address, and number of hops to the destination [7,11].

2.4) DSDV: The Destination-Sequenced Distance-Vector (DSDV) Routing Algorithm [14,19] based on the idea of the classical Bellman-Ford Routing Algorithm with certain improvements. Every mobile station maintains a routing table that lists all available destinations, the number of hops to reach the destination and the sequence number assigned by the destination node. The sequence number is used to distinguish stale routes from new ones and thus avoid the formation of loops. When the network is relatively stable, incremental updates are sent to avoid extra traffic and full dump are relatively infrequent. Based on the past history, the stations estimate the settling time of routes. he stations delay the transmission of a routing update by settling time so as to eliminate those updates that would occur if a better route were found very soon.

3 Problem Descriptions

A mobility model which represents movement behavior of considered application scenarios should incorporate and is an important feature that may change characteristics of mobile nodes. It describes how speed, acceleration and direction of the node changes over time. In order to check the performance of various mobility model the result of a protocol for an ad hoc network, the protocol should be tested under realistic conditions such as the transmission of the packets in sensible transmission range, limited buffer space for storage of messages with various data traffic models, and realistic movement of mobile nodes using Dijkstra's Algorithm.

In the MANET there are various mobility models such as Random Walk Mobility Model, Random Waypoint Mobility Model, Reference Point Group mobility Model, Boundless Simulation Area Mobility Model, Gauss-Markov Mobility Model, Probe Walk Mobility Model, Column Mobility Model and City Section Mobility Model.

3.1 RPGM (Reference Point Group mobility Model)

RPGM is a mobility model with spatial dependency to simulate group behavior where each node belongs to a group where every node follows a logical center (group leader) that determines the group's motion behavior. The different nodes use their own mobility model and are then added to the reference point which drives them in the direction of the group.

3.2 CMM (Column Mobility Model)

CMM is a mobility model with spatial dependency also and this model is derived from RPGM. It is a set of mobile nodes that move around a given line or column, which is moving in a forward direction or row. The new reference point for a new mobile node is calculated by the following:

New_reference_point = Old_reference_point + Advance_ vector

3.3 RWP (Random Waypoint Model)

The Random Waypoint Model was first proposed by Johnson and Maltz. Soon, it became a 'benchmark' mobility model to evaluate the MANET routing protocols, because of its simplicity and wide availability. The Random waypoint model is a random model for the movement of mobile users, and how their location, velocity and acceleration change over time. RWP mobility model is the most common mobility model used in research community.

4 Implementation

Dijkstra's Algorithm works by keeping the shortest distance of vertex v from the source in an array, sDist. The shortest distance of the source to itself is zero. sDist for all other vertices is set to infinity to indicate that those vertices are not yet processed. After the algorithm finishes the processing of the vertices sDist will have the shortest distance of vertex w to s two sets are maintained Frontier and New Frontier which helps in the processing of the algorithm. Frontier has k vertices which are closest to the source, will have already computed shortest distances to these vertices, for paths restricted up to k vertices. The vertex that resides outside of Frontier is put in a set called New Frontier. The following pseudo-code gives a brief description of the working of the Dijkstra's algorithm.

Procedure

Dijsktra (V: set of vertices 1... n {Vertex 1 is the source}
Adj[1…n] of adjacency lists;
EdgeCost(u, w): edge – cost functions;)
Var: sDist[1…n] of path costs from source (vertex 1);
{sDist[j] will be equal to the length of
the shortest path to j}
Begin:
Initialize

{Create a virtual set Frontier to store i where sDist[i] is already fully solved}
Create empty Priority Queue New Frontier;
sDist[1]←0;
{The distance to the source is zero}
forall vertices w in V – {1} do
{no edges have been explored yet}
sDist[w]←∞
end for;
Fill New Frontier with vertices w in V organized by priorities sDist[w];
endInitialize;
repeat
v←DeleteMin{New Frontier};
{v is the new closest; sDist[v] is already correct}
forall of the neighbors w in Adj[v] do
if sDist[w]>sDist[v] +EdgeCost(v, w) then
sDist[w]←sDist[v] +EdgeCost(v, w)
update w in New Frontier
{with new priority sDist[w]}
endif
endfor
until New Frontier is empty
endDijkstra;

The algorithm illustrates Best-First-Breadth-First-Search. It is the Best-First because the best vertex is New Frontier is selected to be processed next.

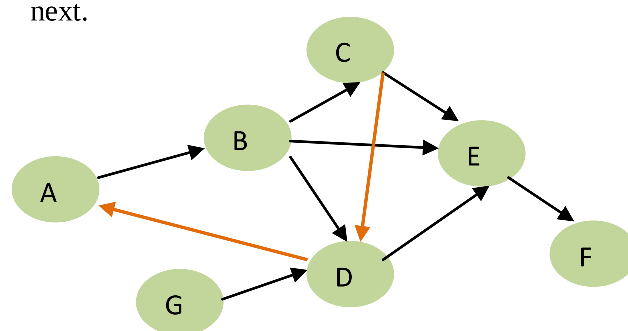

Fig.4. Dijkstra's algorithm

The search used is Breadth-First, since New Frontier consists of vertices that can be tried next and these vertices are one edge away from the explored vertices.

5 Results and Discussion

5.1 Average Delay

As the graph depicts, X-axis = no. of nodes and Y-axis = delay in mille seconds AODV (red) shows the minimum average delay compared to other protocols and its delay rate is kept constant as it is increasing with number of nodes. DSR (blue) shows mixed delay rates as it shows maximum delay for initial nodes as it searches for alternate path from there on delay rate keeps rising and falling at some distant intervals during its search for best routing paths. OLSR (yellow) and DSDV (green) have higher rate of delay rate in comparison to the above mentioned protocols in which OLSR outperforms DSDV having lower delay rate because of its constant radiating ability it can find a node at regular intervals. DSDV is supposed to have the highest initial delay rate which reduces with the increase in nodes i.e. in case of high density the performance with respect to delay is best shown by DSDV.

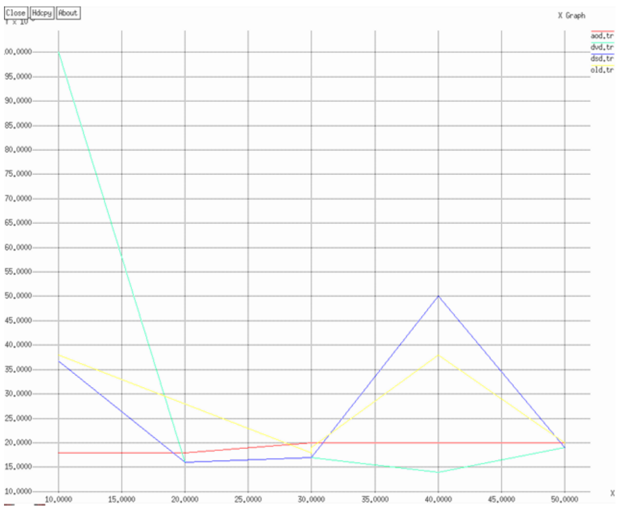

Fig.5. Comparative Average Delay Graph

5.2 Packet Delivery Ratio

As we can observe the above graph which represents X-axis= no. of nodes and Y-axis = Packet delivery ratio in mille units. AODV (red) has the highest packet delivery ratio and it shows the best performance among all the protocols proving to be the most reliable protocol. DSR (blue) shows the second best performance as it is on demand protocol which sends packet only when required. Hence, it shows good performance as its packet delivery ratio is very close to AODV and it outperforms OLSR and DSDV routing protocols.

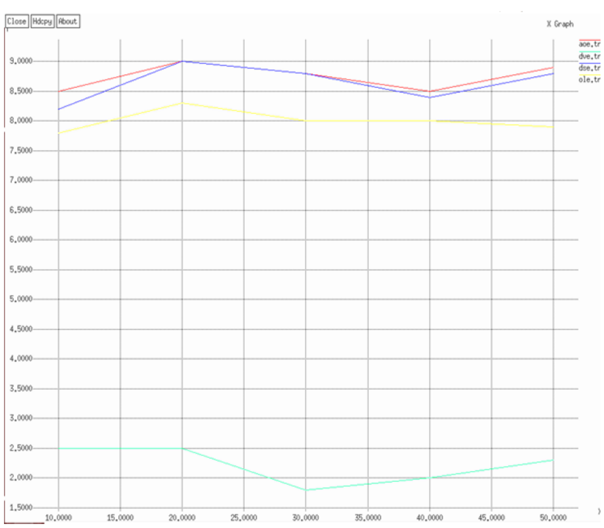

Fig.6.Comparative Packet Delivery Ratio Graph

OLSR (yellow) being a proactive protocol has more packet loss so it has comparatively third best packet delivery ratio rate and it outperforms DSDV (green) which has lowest packet delivery ratio.

5.3 Throughput

Formula: PDR= (Packets Received / Packets Sent)*100 as the graph suggests, X-axis = no. of nodes and Y-axis = throughput in kilobytes. In comparing all the protocols for the throughput we find that AODV (red) shows the best throughput among all the existing protocols. Whereas, DSR (blue) has throughput closer to OLSR (yellow) but it outperforms OLSR in case of throughput on maximum occasions both in case of fewer and higher number of nodes. DSDV (green) shows the least throughput as it undergoes very high packet loss during the transmission process. Although it carries out constant transmission but due to packet loss its throughput property is compensated.
Throughput= (number of delivered packet * packet size)/total duration of simulation.

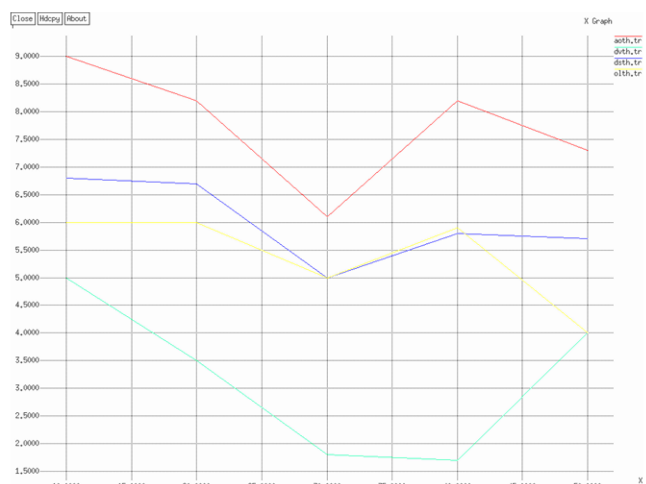

Fig.7 Comparative Throughput Graph

As the graph suggests, X-axis = no. of nodes and Y-axis = throughput in kilobytes. In comparing all the protocols for the throughput we find that AODV (red) shows the best throughput among all the existing protocols. Whereas, DSR (blue) has throughput closer to OLSR (yellow) but it outperforms OLSR in case of throughput on maximum occasions both in case of fewer and higher number of nodes. DSDV (green) shows the least throughput as it undergoes very high packet loss during the transmission process. Although it carries out constant transmission but due to packet loss its throughput property is compensated. Throughput= (number of delivered packet * packet size)/total duration of simulation

6 Conclusion & Future Work

In this paper, we conclude that AODV is by far the best protocol among all the four considered protocols since it out performs all the other protocols in all three parameters discussed above but lags behind in average delay case as it uses concept of Route Request and Route Reply. The DSR protocol has property very close to AODV but it falls short in performance by not much margin and can be considered as a good routing protocol. OLSR and DSDV being the proactive protocols are comparatively less effective in routing, even though they show better performance in delay but are less reliable protocols as packet loss is quite prominent factor in these two protocols.

As a result of which reactive protocols are more in existence since they use lesser amount of energy to create the routing path and AODV is most widely used of all the existing protocols nowadays. Hence the future work is to increase in packet delivery ratio, throughput, decrease in delay, routing overhead using different algorithms.

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