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P2P Topological Ad-hoc Routing Protocol (P2P-ARP)

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***Abstract*- Routing packets in wireless ad-hoc networks have always been a challenge to overcome such power consumption, route discovery and efficiency hindrances amongst many more. An attempt to study and understand P2P Topological Routing lays foundation for faster packet delivery and route acquisition time to certain extent. Ad-hoc hybrid protocols are interleaved between proactive and reactive routing mechanisms.**

***Keywords*-- Routing Protocol, Ad-hoc, P2P, Topological.**

I. INTRODUCTION

Routing of a packet from source to destination occupies considerable need and importance in the field of mobile ad-hoc networks. Ad-hoc networks are prone to greater mobility, scalability and more importantly infrastructure less. Considerable amount of study over efficient and robust routing protocols are going on. Amongst all of them, few of those selected under review for this paper are DSDV, AODV and WRP.

P2P-ARP falls under this category of algorithms dealing with route search and implementation. Routing algorithms focus over selected the most efficient path of information transfer over the network from Sender S to Receiver R.

P2P-ARP is a topological based peer to peer ad-hoc routing protocol. As the name suggests the connections over the network of nodes are peer to peer. Thus P2P. The topological acronym was used keeping in mind the fact that topology of the network is determined by constraints laid down by the algorithm.

Assuming, maximum branches $\mu \leq \emptyset$. Thus, the power of the node determines the capacity of itself to serve to the bandwidth needs. Here, ø=4.

A. Routing:

When packets are needed to be transferred from a source to destination the route traversal mechanism is trivial. Many algorithms and protocols are found that solve and resolve this issue. Route packets in wireless ad-hoc networks often reply negative acknowledgements [1] due to high mobility of network nodes. Routes discovered sometimes lay burden on the network bandwidth and sometimes on the nodes' storage capacity.

B. *Analysis of The Protocol*:

The protocol based on P2P topological route have less burden on the overall network by reducing the connect request limiting up to the first found neighbour only. As is true with P2P networks. "*First Found First Connects*" adheres to quick connection and reconnection requests. Any incoming node $y_n \subseteq Ny$ if makes connection with the Network Nt, must identify at most one node $\mu \subseteq Nt$, such that satisfying the logical connectivity,

$$y_n \notin \mu$$

Emphasis is on reducing route request bandwidth consumption rather than searching and finding minimum hop counts [2] and minimum weight of link [3].

II. THE ALGORITHM

Sequences for messages and to connect establishment attempts:

1. ***[at New Node End]***

```
Begin
   ThisNode.searchNeighbour( );    /* Nearest neighbor */
   ConnectNeighbour(ThisNode);/*Connects neighbour*/
End
```

2. ***[Existing Neighbor End]***

```
Begin
   UpdateRouteTable(NewNode); /*New entry */
   ConfirmNeighbour(NewNode);/*Confirm Connection*/
End
```

3. ***[New Node End]***

```
Begin
    UpdateRouteTable(NewNode);
End
```

4. ***[Existing Neighbor End]***

```
Begin
   SendNeighbour(NewNode);/*Alert   neighbours*/
End
```

III. Schematic Representation Of The Algorithm

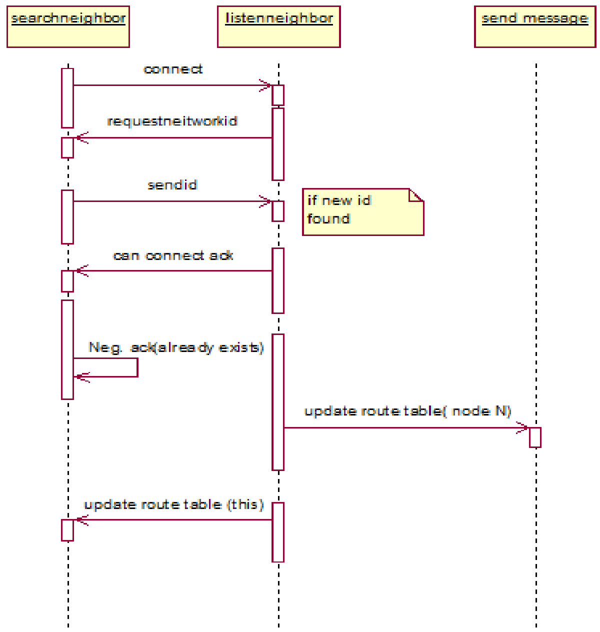

Fig. 1 Interaction diagram of active functions

There are shown the usage of three objects. The *searchneighbor* represents a new node and has three functions which are invoked time to time relevant to the operation. The *SelectNeighbor(),ConnectNeighbour() and UpdateRoutingTable(NewNode)* are its three functions. The *listenneighbor* object represents the node to which a new node connects. It too has some functions such as *UpdateRouteTable(NewNode) and ConnectNeighbour(this). listenneighbor* sends a broadcast to its neighbours using function *SendAllNeighbours(NewNode)* about the newly found node.

$$T_{conneciton}(P2P) = \sum_{c=1}^{\phi} \text{Time}_c \qquad (1)$$

Where, ϕ is number of messages for establishing a connection. It is a constant value for any size of network. Time_c is the time for each message.

$$T_{conneciton}(*) = \sum_{c=1}^{\phi} \text{Time}_c + \sum_{x=1}^{\varphi} \text{Time hop count}_x \qquad (2)$$

φ is the number of nodes of interest. Time hop count $_x$ is the time to compare the hop count from a sender node to the receiver node. From eq. (1) and (2),$T_{conneciton}(P2P) < T_{conneciton}(*)$. $T_{conneciton}(*)$ represents other algorithms which involve computation of minimum hop count in the derived route.

IV. Hybrid P2p Topological Ad-Hoc Routing Protocol

To start with the protocol let us view a set of wireless ad-hoc nodes that arrive near the connected network and gets sucked into the net provided it is a newly found node.

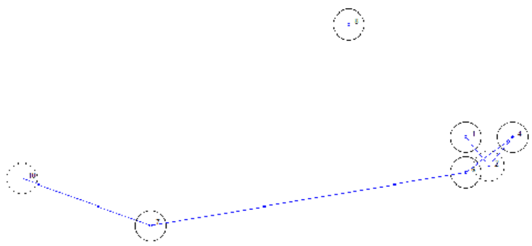

Fig. 2: connected nodes and outlier nodes

The figure 2 shows a connected graph depicting the networking model between various nodes in the Wireless Ad-hoc Networks which is a prerequisite for the protocol. The nodes links from peer to peer, Hence it is a topological route protocol. Every node must identify at least one connected neighbor. There cannot be cyclic paths in the graph.

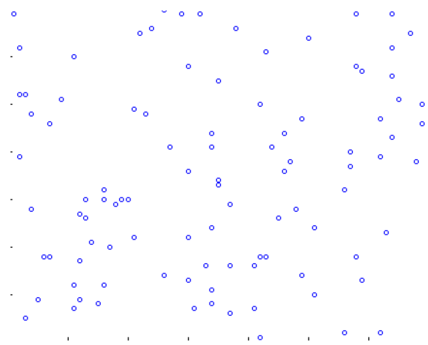

Fig. 3: Scattering of nodes

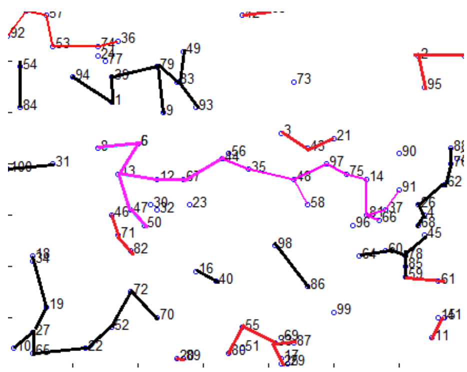

Fig. 4: sub-networks

V. Results And Discussion

In figure 4 there are 100 nodes that lie in close contact to one another. Encircling the nodes is the wireless range of each node as shown in figure 2. In this case neighborhood information sharing cost and overhead [12] is sufficiently high. P2P –ARP reduces this overhead of data transfer limiting information sharing up to one per connection only.

The p2p network detects any incoming node as a new path. The path attribute of a node determines its group. If two neighbor nodes belong to different path attribute they tends to connect themselves as a independent connected group otherwise adopting some common path attribute where all nodes are in a common group shown in figure 5.

Figure 6 assumes each node searches and finds its best neighbor and waits for discovery of new nodes and neighbors. If all the nodes are completely connected the color of path will be in same intensity.

A. *SOME INTERPRETATIONS*:

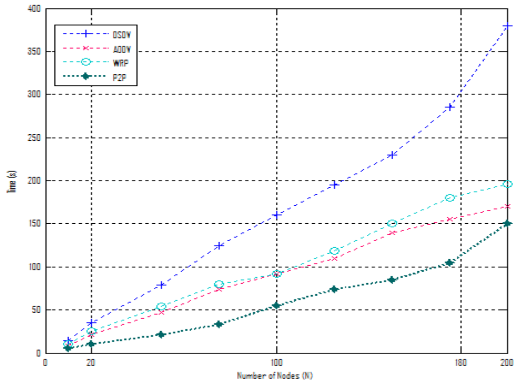

Fig. 5 Route Discovery Time in seconds

Figure 5 represents the route discovery time required by one source for one destination. The route discovery time in P2P-ARP as shown takes minimum time. The overhead of such mechanism is much less.

Overhead for other algorithms are:

$$\sum_R \sum_l \min\left(t_{taken}, t_{alloted}\right) \quad (3)$$

R is the number of discovered routes, l is the links in each routes. The network remains *idle*, and channel bandwidth allotted for connection establishment remains unused in P2P-ARP, that be shown by eq. 1. Efficient use of this much available channel can be utilized properly. The notion of "*plug and play*" nicely fits to the necessary functions that can be performed over P2P-ARP. Also, data packet size post connection establishment is proportional,

$$DataPacketSize_{TDMA} \propto \frac{1}{number\ of\ links\ at\ node\ p}$$

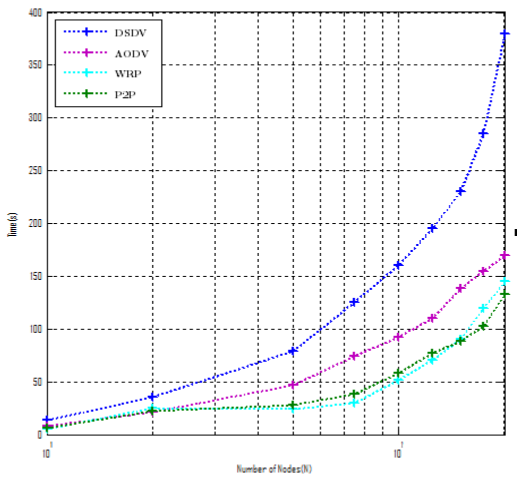

Fig. 6: Time by which Route Regains

Time of delivery is given by,

$$t_d = \sum link\ weight \times local\ delay \times \frac{message\ size}{size\ of\ local\ packet} \quad (4)$$

Figure 6 shows the route regain time if one node disconnects for a moment which always happens in adhoc network.

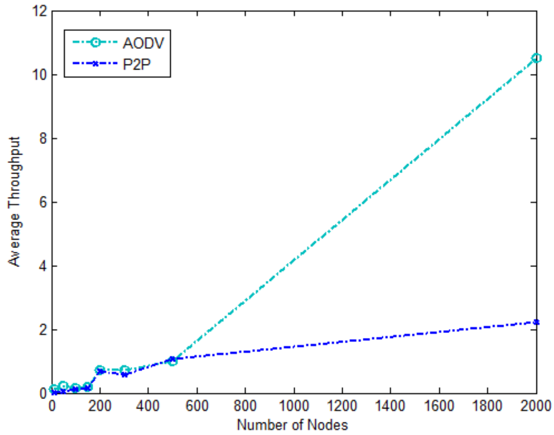

Fig. 7: shows the average throughput of the network where

$$throughput = \frac{Number\ of\ Messages}{time\ taken} \quad (5)$$

The calculation was based on controlled channellizaiton (TDMA) from source to destination. The sudden change of throughput at 500 nodes in x-axis is due to long routes through the links.

$$throughput \propto \frac{1}{congestion}$$

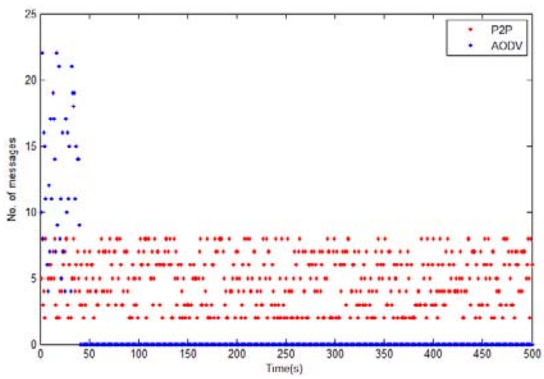

Fig. 8: Congestion at a random node no. 44
(Plotting time v/s number of messages)

Figure 8 shows the congestion over 500 seconds for 100 nodes through node number 44 when several nodes try to send at least one packet to all other nodes. From the figure it is clear that AODV requires higher band width and channel capacity which may not be available but the messages are delivered quickly. P2P-ARP takes time to send all the messages to its destination but is always in constant bandwidth.

Congestion in node is given by,

$$A = \sum_{i \in Links} Link_i \times \mu_{channel} \times packetsize_i \quad (6)$$

Where, µ is the rate of data transfer.

Figure 9 show that if some node is disconnected due to its mobility and requires some time in x seconds to reconnect, the time at various readings are as shown. The figure shows the time in seconds for which one node remains disconnected from the network in average time t.

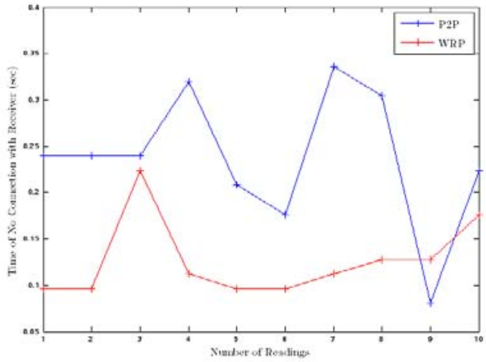

Fig. 9: Packet Loss Time

Let us say the packet loss time given by the following equation:

$$\textbf{packet losstime} = \textbf{Active time}_t - \textbf{Loss time}_t$$
$$= N_t \times t_t - N_i \times d_{ti} + N_j \times d_{tj} \qquad (7)$$

Where,

N_T : Number of active node at instant

t_t : Total active time of one node

N_i : Number of nodes traversed by new route

t_{di} : time of disconnection

N_j : Number of nodes traversed for routing information updation

t_{dj} : time to connection

Number of nodes traversed for the maximum path is given by,

$$N_{tv} = \sum_s^n adj(N_s, N_{s+1}) \qquad (8)$$

N_{tv} : Number of nodes traversed

adj (N_s, N_{s+1}) : adjacency matrix value (0 or 1)

s : Source Node

n : Destination

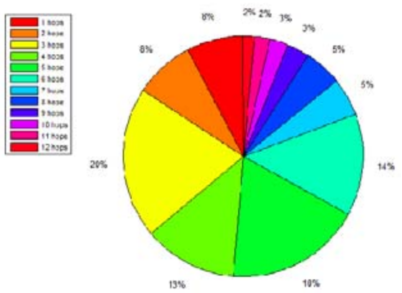

Fig. 10 percentage of average hop count in a network of 200 nodes in WRP/DSDV/AODV algorithm

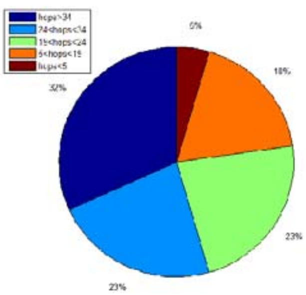

Fig. 11: percentage of average hop count in a network of 200 nodes in P2P algorithm

VI. Conclusion

.The theory involves minimum message passing for route information from neighbor nodes of the observed node of importance. New nodes can be added and removed easily from the network without many changes to the route table and also without much data transfer. No overhead of hop count is introduced which makes the node available for use instantly. Sometimes path followed can be longer than expected if compared with AODV and WRP.

The routing algorithm can suffice to minimize the end-to-end delay and path discovery time. *Problem of high packet delivery time and high congestion on intermediate nodes are getting addressed and is ongoing.*

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