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A Quality Hybrid Service Discovery Protocol

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----------**ABSTRACT**----------

Hybrid protocol combines the advantages of proactive and reactive routing in adhoc network. The routing is initially established with some proactively prospected routes and then serves the demand from additionally activated nodes through reactive flooding. In this paper we propose A Quality Hybrid Service Discovery Protocol (QHSDP) for discovering services. A broadcast mechanism is used to get the service and routing information of the nodes present inside the zone. The routing and service information reduces the packet flooding in the network hence reducing collision and increasing packet delivery efficiency. Reduced control packets in turn reduces the battery power consumption. A query message is bordercasted through the peripheral nodes to the nodes outside the zone. This makes the discovery procedure more sclable, hence increasing the node's coverage and reducing the latency in the proposed technology compared to the existing technology.

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I. INTRODUCTION

An Ad-Hoc Network is an infrastructure less, self organized and dynamic topology network. Mobility associated with the nodes is one of the important property of Ad Hoc wireless network. The nodes present in an Ad-Hoc Network are free to move and can organize themselves in an arbitrary manner. Therefore, an intelligent and efficient routing protocol is required to meet the requirements of the user. Nodes in Ad Hoc network are randomly mobile, topology cannot be predicted as it frequently changes so quick route reconfiguration is required to overcome path breaks.Nodes in the network should identify the services that is provided by other nodes. As the network is dynamic, locating the actual Service Provider is a challenge. So ideal routing protocol to locate and provide services is necessary. Management of energy is also crucial part of the Ad Hoc network. The network life depends on managing the sources and consumption of energy by the nodes in the network. Therefore an efficient routing protocol is needed to avoid packet collisions, transient loops, stale routing information, frequent path breaks. Routing protocols are classified into Proactive and Reactive. In the former an up to date routing information is maintained by all the nodes in the Mobile Ad-Hoc Networks (MANETs) by exchanging their routing tables and evaluating the routes to all reachable nodes, hence the name Table Driven. Whereas the latter is known as On Demand because routing path is searched only when a request is made. A Hybrid Routing Protocol is formed by combining the merits of both the proactive and reactive routing protocols. One such Hybrid routing protocol is Zone Routing Protocol (ZRP) maintains an up to date topological map of the zone for each of the nodes and are node centric. ZRP searches the destination path proactively within the zone and uses reactive scheme for route discovery outside the zone. Discovery is a mechanism for spontaneously referencing a resource on the network. A client seeking a service uses these references to get the requested service. The services offered by different servers in an Ad-Hoc Network are automatically detected with the help of any one of the various Service Discovery Protocols. In MANETs the centralized points grant gateway service to the members in the network and acquire the service through these points. Service discovery enables service advertising, list of services provided by other nodes, and choosing the required service.

In a network scenario multiple nodes can provide software application and hardware requirements to other nodes. Likewise, in a University the students in campus can access the information on college events, library brochures and other departmental information. In a hospital environment, service discovery can help patients

in locating specialized doctors suiting their needs, pharmaceuticals, laboratories, blood banks, etc. In shopping malls customers are assisted from parking to purchase of goods. Service discovery is especially useful in a network comprised of heterogeneous nodes where in each node is capable of providing specific function hence a network comprised of these nodes can execute the operation as a team, for example Military operations, Disaster management, by Mountaineers and Explorers, and so on. In this paper we have proposed QHSDP for discovering services for a low mobility environment. A broadcast mechanism is used to get the service and routing information of the nodes present inside the zone. Combining the routing and service information reduces the packet flooding in the network hence reducing collision and increasing packet delivery efficiency. Reduced control packet in turn reduces the battery power consumption. A query message is bordercasted through the peripheral nodes to the nodes outside the zone. This makes the discovery procedure more scalable hence increasing the node's coverage and reducing the latency.

Contribution: In this paper QHSDP technique is proposed. The enhanced AODV protocol is used to obtain routing information of the nodes present within the zone and uses Bordercasting when required to access nodes outside the zone. The service information of neighboring nodes is obtained in addition to routing information at the same time.

Organisation: The paper is organized as follows; survey of related work is mentioned in Section II. The proposed model QHSDP is explained in Section III. Algorithm is described in section IV, Simulation results and Performance analysis in Section V. Finally Section VI concludes the paper.

II. LITERATURE SURVEY

Hua-wen Tsai et al., [1] proposed service discovery protocol in adhoc network based on grid architecture to register and discover services. A service provider that provides service to the mobile nodes registers the service along a register trajectory. Askari Parichehreh et al., [2] proposed multi level hybrid service discovery protocol that provides to increase larger zone with less network traffic overload. Modifies service lookup table and advertise message structure of the node. Zone type field is added to identify the type of server base whether external or internal zone. Christopher Ververidis et al., [3] proposed service information which is piggybacking in routing messages, that saves battery power due to the decrease in communication overhead. Fatma Outay et al., [4] presented a service discovery method with the combination of bloom filters and the extensibility feature of ZRP. Proves the Bloom Filter-Service Discovery-Zone Routing Protocol is better than other cross layer proposals. Jawandhiya et al., [5] Proposed Hybrid Routing Protocol with Broadcast Reply (HRP-BR) takes the advantage of both proactive and reactive routing protocol, destination node broadcast the RREP packet to its neighboring nodes which are within its transmission range. These nodes, update their routing table by making an entry for the source and forwarding node of RREP packet. Node which is on the active path of the RREP packet rebroadcast it to its neighboring nodes where as other node simply drops the received reply packet(REEP) after making necessary entries in corresponding routing table.

Subramanya Bhat. et al., [6] focus is given on studying the performance evaluation of various routing protocols using Qualnet simulator 5.0.2. The performance of the proactive, reactive and hybrid protocols are analyzed with different node densities for mobile and stationary nodes. The metrics used for the performance evaluation include average jitter, throughput, packet delivery ratio and average end to end delay.

Pariza Kamboj and Ashok Sharma [7] Proposed a hybrid routing protocol that provides a hybrid solution of topological and geographic routing. The protocol is a flat routing protocol in spite of using the partitions. Incorporation of long hop routing (smaller number of longer hops) reduces the number of nodes on the route and hence also the overhead involved. It employs swarm intelligence location service to find out the location of a destination instead of exploiting the flooding, thus overcome from a number of related problems like low scalability, more overheads, energy and bandwidth usage, single point failure and network congestion. With the help of location information it forwards the packet directionally towards the destination. Zhang Liet et al., [8] proposed service discovery architecture based on anycast network. This scheme reduces the number of repeat service requests received by nodes and also keep the service protocol performance better. Kyong-Tak Cho and saewoong Bahk [9] numerically analyzed the average packet latency of multihop transmission scheme named Routing Enhanced Duty Cycle MAC Protocol and RMAC in probalistic manner. C Christopher N Ververidis and George C Polyzos [10] presented a survey on research service discovery approaches for MANETS. Described the basic service discovery architectures, presented the possible modes for service discovery as service selection mechanisms and service state maintenance techniques. Sreedevi et al., [11] introduced a new term called Partial Authority Node (PAN) which shares the load form cluster head and thereby performs intra-cluster routing efficiently. Also a gateway node or a border node (BN) is available for inter-cluster routing to trace the destination easily. So, most of the load is shared by PAN and BN. The algorithm is evaluated using Zone Routing Protocol by making simulations in ns2 and the results shows the performance in terms of throughput, packet delivery ratio, and lowered delay and hence it provides a better quality of service. Askari Parichechrah et al., [12] introduced query control mechanisms to avoid frequent forwarding of same query request messages. This helps to improve efficiency of hybrid protocol. Ashish Maurya, et al., [13] Protocols in

manet evaluated performance of proactive routing protocol and reactive routing protocol in variable pause time and variable number of nodes. they have used optimized link state routing (olsr) protocol as proactive routing protocol and location-aided routing scheme 1 (lar1) protocol as reactive routing protocol. RWP (random waypoint) mobility model is been used and performed simulations by using qualnet version 5.0 simulator from scalable networks. Performance of OLSR and LAR1 is evaluated based on average end to end delay, packet delivery ratio, throughput and average jitter. Prasad Patil and Rinku Shah [14] Cluster based routing protocol (CBRP) is hybrid routing protocol designed for MANET. By clustering nodes into groups, the protocol efficiently minimizes flooding, traffic during route discovery. However it has been realized that mobility of the nodes is not considered in route reply process of the protocol. There is no mechanism defined for mobility of cluster head in route reply process. It has been existing routing strategies in MANET are studied and proposed a solution to the drawback that is found in CBRP. Performance of CBRP will be enhanced using proposed solution. Kaouther Abrougui et al., [17] A QoS aware location-based service discovery protocol for vehicular networks is presented. This protocol guarantees load balancing on service providers, and routing paths between service providers and service requesters. It permits also to choose service providers and routing paths between service providers and service requesters that satisfy some performance attributes specified by service requesters. This QoS aware protocol, prove its correctness, report on its performance evaluation, and experimental results are discussed and have obtained using realistic scenarios.

Tamilarasan and Sivaram [18] Present a logical survey on routing protocols and compare the performance of AODV, DSR and TORA. On the basis of end-to-end delay, packet delivery ratio, media access delay, path optimality, routing overhead performance metrics. AODV has the efficient performance in all rounds of metrics. DSR is suitable for networks with moderate mobility rate. It has low overhead that makes it suitable for low bandwidth and low power networks. TORA is suitable for operation in large mobile networks. This networks having dense population of nodes. The major benefit is its excellent support for multiple routes and multicasting. Marzieh Ilka et al., [19] A method context aware service discovery with use of context source in the form of an advertisement board for service is presented. In a Pervasive Computing Environment Context, information plays an important role for providing more suitable services to the client. A context source with an information register of new entry services and, in addition, forwarding packets, acts like a billboard advertising service. In this context source method, it provides help in registering and advertising services but is not a directory and, if the context source fails, our method can undertake service discovery with other nodes in environment. To evaluate this method a simulation has been carried out. Its statistics and outputs show the suggested method, with its dynamic environment, client movement, directory less, and use of a context source is a suitable method for service discovery which has better results and costs less money and time. Faiyaz Ahmad and Saba Khalid [20] The proposed scheme uses the mesh backbone approach and selects a set of nodes on the basis of stability constraints to coordinate the network. The nodes which have minimal mobility are elected as mesh backbone and gateways or routers. These nodes function as service caches. Proposes the design of an efficient and scalable service discovery scheme that optimizes discovery overhead by integrating discovery information in routing demon. Also implemented the functionality of Optimised Fisheye Link State Routing Protocol OFLSR routing protocol in the network layer this reduces the routing update overhead by using different exchange period for different entries in routing table. The advantage of this scheme is that it reduces message overhead, battery power consumption and maintenance messages for Service Caches.

III. MODEL DESCRIPTION

In this paper the whole topography is divided into several grids where each node defines its zone on the basis of the number of hops required to reach its neighboring nodes. The number of hops is called the Zone Radius of the node. The network area around the node can be divided into two parts namely the Inner Zone for the nodes present within and equal to the zone radius, and Outer Zone for the nodes outside the zone radius. Every node maintains a Routing Table (RT) containing the routing and service information of the nodes present in its innerzone. A broadcast mechanism is used for creating the routing table.

A. Broadcast Mechasnism

The control messages are broadcast by every node to their respective neighbor nodes within their zone radius seeking route and service information is shown in the Figure 1. The query control messages are broadcast over a random interval of time to avoid packet collision which could occur due to simultaneous transmission of Broadcast Query Messages (BQM). The receiving node checks for the Source node ID and the Packet ID to avoid multiple receptions of the same packets. Otherwise the route and service information is put together in a single packet and then send back to the source node by the receiving node. Previously received packets are dropped. The hop-count, representing the number of nodes transverse by the BQM packet, is incremented by one. If the hop-count is greater than the zone radius the packet is dropped. To avoid unnecessary transmission of delayed packets, every packet is running in the node requests for a service by providing the required Service ID to the network layer.

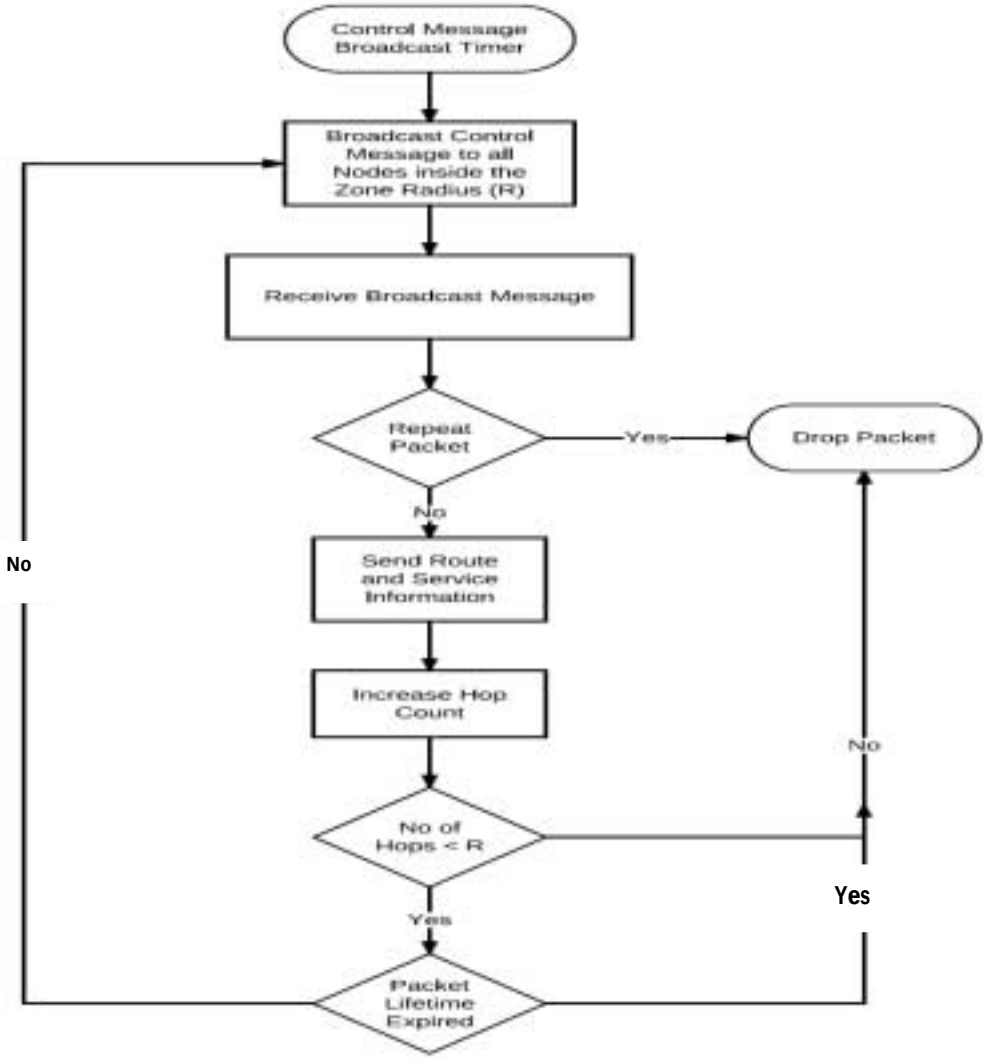

Fig1. Broadcast Mechanism

assigned a Time To Live (TTL). If the current time is greater than the TTL then the packet is dropped otherwise the packet is again broadcasted. Upon receiving the BAM message the source node updates its Routing Table (RT) with the routing and service information of the neighboring node.

B. Service Discovery Mechanism

The Service in the network is identified by an integer constant called Service ID. The application The node found the Service ReQuest Message (SRQM) is sent to the respective node. If the service is not available, the Service Query Message (SQM) is constituted and bordercasted to the peripheral nodes of the zone. The destination nodes check their respective RT for the respective sevice. If the service found the Service checks its RT for the available services in the intra zone. If the requested service is RePly Message (SRPM) packet is unicated to the reuesting source node, otherwise the node again bordercasts SRQM packet to its peripheral nodes. This process continues until the service is discovered or the packet expries its TTL. Upon receiving the SRPM packet the source node initiates the service data transfer that is shown in Figure2.

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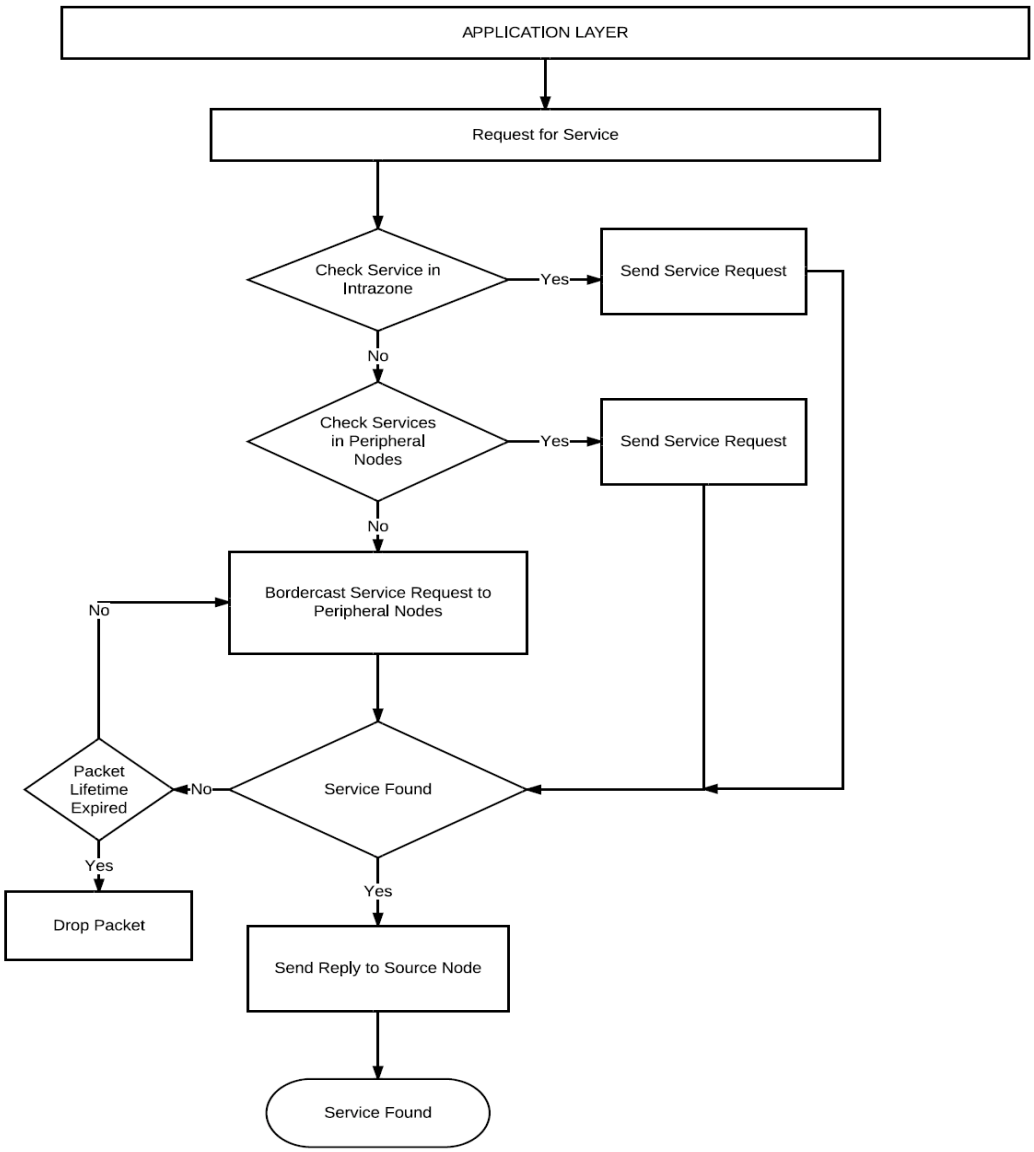

Fig.2. Service Discovery Mechanism

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IV. ALGORITHM

Problem Definition: To provide a light-weight service discovery for a low mobility Ad-Hoc network.

Objectives:
(i) To provide scalable service discovery for a large network area.
(ii)To reduce the control traffic and in turn increase the battery area.
(iii)To reduce the latency in service discovery procedure.

The steps involved in implementing a proposed algorithm are:

1. A Broadcast Timer randomly initiates the sending of BQM packets by every node active in the network.
2. BQM packets are transmitted periodically to every node within the Zone Radius. The packets are sent by all nodes randomly during an interval of time. The interval of time can be varied depending upon the mobility of nodes in network.
3. The receiving node checks for reception of repeated packets by comparing the Source Node ID and Packet ID of already received packets and arrived packet. Repeated packets are dropped.
4. The receiving node acknowledges the reception of BQM packet by sending a BAM packet containing its route and service information.
5. The node then forwards the BQM packet if the number of Hops is less than the Zone Radius and the packet has not expired its TTL.
6. The Sources Node updates its Routing Table with the route and service information of neighboring nodes. This route entry is automatically deleted if it is not updated in the next cycle of BQM packet broadcast.
7. Nodes at a distance equal to Zone Radius are specially marked as Peripheral Nodes in the Routing Table.
8. Whenever a service is requested, following steps are performed for Service Discovery:
   - The node checks its Routing Table for the services available within its Zone. If service is found, request for service is made by sending SRM packet. Else a SRQM packet is constituted and Bordercasted to Peripheral nodes of the zone.
   - The Peripheral Node checks for availability of service inside its Zone. If service is found, then a SRPM packet is sent back to requesting node. Else the peripheral node again Bordercasts the SRQM packet to its own Peripheral Node. This procedure continues till either Service is found or the packet expires its TTL. Packet is dropped when it expires its TTL.
9. The requesting node starts the data transfer on reception of SRPM packet.

V. PERFORMANCE ANALYSIS

The performance parameters like control messages, latency and Reply to Request ratio are estimated using ns2 [15] simulator. For simulation we considered 100 and 250 mobile nodes that move with a speed of 0-3m/s. The simulation network coverage area is of 2000m X 2000m with Zone radius ranging from 1-5 for each node. The simulation run time is 500 sec. The network parameter with symbol and values are given in the Table1.

TABLE I

NETWORK PARAMETERS

Parameter	Symbol	Value
Number of Nodes	N	100-250
Network Coverage Area	A	2000m X 2000m
Node Speed	V	0 – 3 m/s
Zone Radius	R	1 - 5
Time of Simulation	T	500 sec

The Control Message is the total number of packet transmitted between the nodes during the broadcast and the service discovery mechanism. The difference between the transmission of SRQM packets and the reception of SRPM packet is called the latency. The ratio of the total service messages sent to the messages received is called Reply To Request (RTR) ratio. The control messages, latency and RTR ratio for 100 and 250 nodes with zone radius from 1 to 5 for the proposed QHSDP is given in the Table 2.

It is observed that as zone radius increases, control messages and latency increases where as RTR ratio decreases with increase in zone radius value. The comparision of control messages for 100 and 250 nodes with zone radius of 1 to 5 for existing method Traffic Reduction in Hybrid Service Discovery Protocol in mobile AdhocGrid (MHP) [16] and proposed QHSDP is given in the Table 3. As the transmission of BQM packets have been randomized over an interval of time hence the collision rate of the packet decreased in turn reducing the traffic. Hence the number of control messages are less in the case of proposed protocol compared to the existing protocol. The

latency of various protocol are compared in the Figure 3. Pull-based and Push based Service Discovery Protocol (SDP) has higher value of latency compared to hybrid ZRP-SDP and SPIZ protocol since hybrid algorithm provide a combination of low latency for the services inside the zone and minimal invocation for the services outside the zone. The proposed QHSDP has less latency compared to existing Push and Pull and hybrid protocols since a light weight protocol not having Acknowledge and Retransmission packets for control traffic.

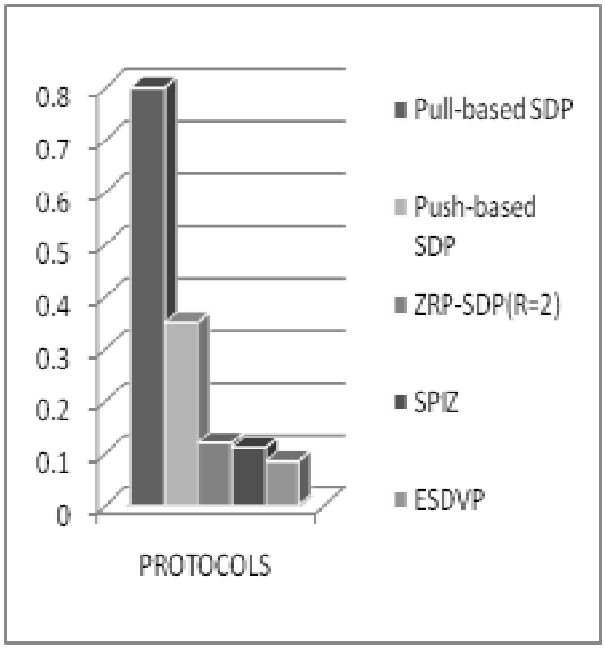

Fig 3. Latency comparison of proposed QHSDP with existing protocols

Zone Radius	Control Messages (x 10^2)			
	100 Nodes		250 Nodes	
	Askari et.al., [16]	Proposed QHSDP	Askari et.al., [16]	Proposed QHSDP
1	8	6	40	14.8
2	16	13.5	70	40.7
3	40	23	225	75
4	80	32.8	550	108.6
5	150	41.7	800	135.2

TABLE III
CONTROL MESSAGES OF EXISTING AND PROPOSED PROTOCOL

Zone Radius	100 Nodes			250 Nodes		
	Control Messages (×10²)	Latency (sec)	Reply To Request Ratio	Control Messages (×10²)	Latency (sec)	Reply To Request Ratio
1	6	0.075	0.923	14.8	0.061	1.117
2	13.5	0.085	0.912	40.7	0.073	1.083
3	23	0.095	0.885	75	0.087	1.072
4	32.8	0.108	0.863	108.6	0.098	1.032
5	41.7	0.118	0.83	135.2	0.110	1.023

TABLE II
PERFORMANCE PARAMETER OF PROPOSED QHSDP

VI. CONCLUSION

In this paper QHSDP protocol is proposed, the service discovery and routing is combined to efficiently utilize the resource available in the network. The transmission of BQM packets are randomozied over an interval of time, hence the collision rate decreases that reduces traffic. The Acknowledgement and retransmission of packets for control traffic is not considered results in small latency. In future the protocol can be improved for high mobility of nodes. Also scheduling algorithms can be included to improve the service selectivity of the network.

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