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Efficient ZRP Routing Protocol

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Abstract
ZRP is a hybrid routing protocol that act as the reactive protocol in intra zone and as procreative for inter zone. The ZRP protocol is modified to increase the security. The existing secure ZRP routing uses the end 2 end digital signature authentication for the security. This paper decreases the routing overhead by using the trust based routing in the intra zone and authentication for the inter zone. The trust based routing is introduced by using a trust factor depending upon forwarding ratio while the authentication occurs by using the digital signature within the packet.
Keywords: *MANET, Routing, ZRP, trust, digital signature.*

I. Introduction

A Mobile ad hoc network is a group of wireless mobile computers (or nodes); in which nodes collaborate by forwarding packets for each other to allow them to communicate outside range of direct wireless transmission. Ad hoc networks require no centralized administration or fixed network infrastructure such as base stations or access points. A MANET is an autonomous group of mobile users that communicate over reasonably slow wireless links. The network topology may vary rapidly and unpredictably over time, because the nodes are mobile [1].

Nodes in a MANET act as both hosts and routers to forward packets to each other. [2] The nodes that are within the radio range of each other communicate directly while others use intermediate nodes as relay points. These networks have gained ample interest in recent times due to its various advantages as compared to the networks that require a basic infrastructure to work [2].

The promise held by the application of wireless ad hoc networks is immense. It ranges across the horizon and the number of real world problems that could be solved with the application of Mobile Ad hoc Networks is growing by the day. A network of this kind is well suited for highly critical applications like disaster management, emergency relief, military operations, mining activities and terrorism response where no pre deployed infrastructure for communication exists. [3] For example, in the case of an earthquake, ad hoc networks could be used for communication when conventional communication networks could be damaged. [4]

II. Routing Method in ADHOC Networks

The wide range of ad-hoc networks operating configurations poses a challenge for developing efficient routing protocols. On one hand, the effectiveness of a routing protocol increases as network topology information becomes more detailed and up-dated. On the other hand, in an ad-hoc network, the topology may change quite often, requiring large and frequent exchanges of data among network nodes. This is in contradiction with the fact that all updates in the wireless communication environment travel over the air are costly in resources. Existing ad-hoc routing protocols can be classified into two groups: proactive and reactive routing protocols [5].

The Proactive routing algorithms maintain up-to-date routing information between every pair of nodes in

the network by proactively propagating route updates at fixed time intervals [6]. When a request comes in before forwarding it this protocol learns the network topology. Since the proactive routing algorithms maintain up-to-date routing information for all nodes in the network, a route is found immediately it is requested. This protocol is having an advantage of low latency in discovering new routes and minimizes the end-to-end delay. Examples of proactive protocols are Destination-Sequenced Distance Vector (DSDV) Optimized Link-State Routing (OLSR) [7], Cluster- Head Gateway Switch Routing Protocol (CGSR), Wireless Routing Protocol(WRP) and Topology- Based Reverse Path Forwarding (TBRPF) [8] Protocols.

While on the other hand, the Reactive algorithms are also called on-demand routing algorithms establishing a route when a request comes by initiating a route discovery process. Once the path has been established the nodes keeps it until the destination is no longer accessible. When a node is willing to forward a request, the re-active routing protocol becomes active. The re- active protocols are having an advantages over pro- active .The reactive protocols are more efficient in terms of control overhead and power consumption because routes are created dynamically when required Some of the re-active routing protocols are Dynamic Source Routing Protocol (DSR) , Ad Hoc On- Demand Distance-Vector Routing Protocol (AODV), Temporally Ordered Routing Algorithm (TORA), Associatively-Based Routing (ABR) and Preferred Link-Based Routing Protocol (PLBR) [7].

Regardless a reactive protocol gives the low overhead of control messages, it has higher latency in discovering routes the routes are determined by using flooding route request packet in the network and builds the route on demand from the responses it receives. On the other hand, proactive protocols need periodic route updates to keep information updated and valid, also many available routes might never be needed all these increases the routing overhead and consume large amounts of bandwidth [6].

III. ZRP

As seen, to maintain routing information the proactive routing uses excess bandwidth, while reactive routing comprise long route request delays. Reactive routing also inadequately floods the entire network for route determination. The Zone Routing Protocol (ZRP) [5] aims to address the problems by combining the best properties of both approaches. ZRP can be classed as a hybrid reactive/proactive routing protocol.

ZRP (Zone Routing Protocol)[9,10] shown in Figure.1 uses the hybrid approach to routing. It is based on the merits of both proactive and reactive routing protocol. The nodes of a zone are divided into peripheral nodes and interior nodes [11]. Every node in the network has a zone associated to it. The zone of a node is defined as the collection of nodes whose minimum distance from the node is not greater than the radius of the node. The minimum distance is defined in terms of number of hops from that node.

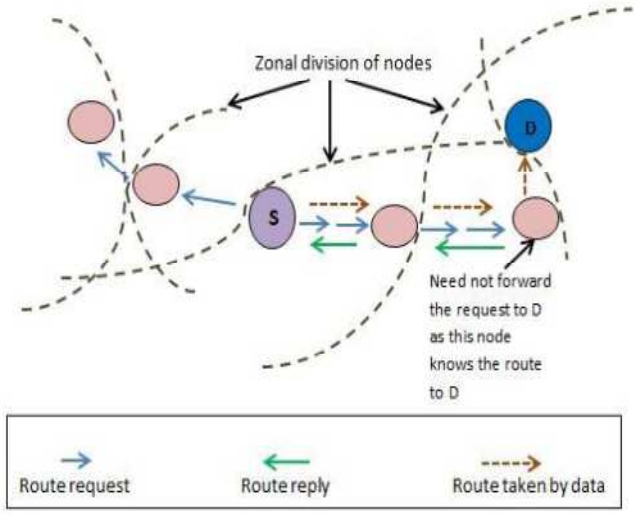

Figure 1: ZRP Protocol [9]

(i) Iarp (Intra Zone Routing Protocol)

The Intra zone Routing Protocol (IARP) [13] is a limited scope proactive routing protocol, which used to support a primary global routing protocol. The routing zone radius shows the scope of the proactive part, the distance in hops that IARP route updates relayed. lARP's proactive tracking of local network connectivity provides support for route acquiring and route maintenance. First, routes to local nodes are immediately available, avoiding the traffic overhead and latency of a route discovery. Traditional proactive link state protocols modified to serve as an IARP by limiting link state updates to the scope of the link source's routing zone [12].

(ii) Ierp (Inter Zone Routing Protocol)

The Interzone Routing Protocol (IERP) is the global reactive routing component of the Zone Routing Protocol (ZRP)[12]. IERP adapts existing reactive routing protocol implementations to take advantage of the known topology of each node's surrounding R-hop neighborhood (routing zone), provided by the Interzone outing Protocol (IARP) [13]. The availability of routing zone routes allows IERP to suppress route queries for local destinations. When a global route discovery is required, the routing zone based border cast service used for efficiently guide route queries outward, rather than blindly relaying queries from neighbor to neighbor. Once a route discovered, IERP can use routing zones automatically to redirect data around failed links similarly, suboptimal route segments identified and traffic re-routed along shorter paths.

Advantage [14]:

- ZRP is since uses both reactive and proactive schemes, it exhibits better performance.
- Since hierarchical routing is used, the path to a destination may be suboptimal.
- Since each node has higher level topological information, memory requirement is greater**.**

IV. Proposed Work

In the existing work ZRP is secured by authentication process. The end 2 end authentication occurs by using the digital signature. The digital signature filed is added to the ZRP data packet format. It means the intra as well as the inter zone communication using the authentication using the digital signature. The proposed method reduces the authentication overhead by using the trust based security. The trust value is assign to each node. The trust value depends upon the number of successful transmission done by the node. The trust value of a node increases with the successful transmission and decreases with the unsuccessful transmission. The trust based routing is used in the intra zone. While the inter zone routing uses the digital signature based end 2 end authentication. This process must reduce the end 2 end delay while maintaining the security. Moreover the routing overhead of this technique must be less than the existing technique. The proposed technique can be easily understood by the following algorithm:

1. Assign Initial random trust value to each node
2. Select The Source S and destination D.
3. If Zone(S) ~= Zone(D)
4. Add digital signature to Data Packet DP
5. Transmit the Data packet from S and follow ZRP routing
6. If signature matched at D
7. Then send reply
8. Else
9. Discard the packet.
10. End if
11. Else
12. Current=S
13. G=Select group of one hop neighbor
14. N=Select node with highest trust from G
15. If dist(N) > dist(current)
16. Discard the node
17. Go to step 14
18. else
19. Transmit the packet to N
20. Update trust value of current
21. Current=N
22. If current~=D
23. Go to step 13
24. Else
25. Exit
26. End if
27. End if

The above algorithm transmits the data securely from S to D using the proposed process explained above. The proposed algorithm is implemented using NS2. The simulation results are shown below graphically.

V. Results

The algorithm discussed in section 1v is implemented by using the NS2. The comparison of various scenarios is done by varying the radius of the zone and the mobility rate of the nodes. The comparison is done by analyzing the delay, throughput, PDR and the normalized routing load. The existing technique as well as the proposed technique to be compared is discussed in previous section.

Table 1: Parameter Analysis of Average Delay at Various speed

Mobility Rate	Average Delay							
	Radius =2		Radius =3		Radius =4		Radius =5	
	Existing ZRP	Proposed ZRP	Existing ZRP	Proposed ZRP	Existing ZRP	Proposed ZRP	Existing ZRP	Proposed ZRP
20 m/s	1.30077	0.95648	1.23247	0.928883	1.22673	0.917367	1.22673	0.917367
30 m/s	1.32153	0.987977	1.20442	0.901065	1.22149	0.917811	1.22149	0.917811
100 m/s	1.30591	0.965541	1.37824	1.04755	1.32983	1.01003	1.32983	1.01003
150 m/s	1.39545	1.0458	1.27824	0.961985	1.23605	0.936427	1.23605	0.936427
500 m/s	1.42561	1.08078	1.27285	0.958775	1.29048	0.972258	1.29048	0.972258

Table 2: Parameter Analysis of Packet Delivery Ratio at Various speed

Mobility Rate	Packet Delivery Ratio							
	Radius =2		Radius =3		Radius =4		Radius =5	
	Existing ZRP	Proposed ZRP	Existing ZRP	Proposed ZRP	Existing ZRP	Proposed ZRP	Existing ZRP	Proposed ZRP
20 m/s	48.3414	87.8705	51.7843	86.6746	51.9894	86.2708	51.9894	86.2708
30 m/s	47.4964	87.5474	50.8246	86.5354	51.0106	86.1158	51.0106	86.1158
100 m/s	46.6971	86.7198	48.6546	84.1307	48.7857	83.6901	48.7857	83.6901
150 m/s	45.7083	86.1078	48.5968	83.9527	48.7466	83.8904	48.7466	83.8904
500 m/s	45.5556	85.0587	48.0313	83.2549	48.2768	83.2252	48.2768	83.2252

Table 3: Parameter Analysis of throughput at various speed

Mobility Rate	Throughput							
	Radius =2		Radius =3		Radius =4		Radius =5	
	Existing ZRP	Proposed ZRP	Existing ZRP	Proposed ZRP	Existing ZRP	Proposed ZRP	Existing ZRP	Proposed ZRP
20 m/s	260.80	302.64	1253.08	1293.45	1332.50	1374.31	1332.50	1374.31
30 m/s	276.07	317.84	1260.64	1302.01	1412.31	1454.41	1412.31	1454.41
100 m/s	262.68	303.55	1216.88	1256.99	1340.46	1381.84	1340.46	1381.84
150 m/s	264.24	305.24	1306.36	1348.26	1395.07	1436.73	1395.07	1436.73
500 m/s	251.46	290.16	1176.83	1215.05	1243.23	1281.59	1243.23	1281.59

Table 4: Parameter Analysis of routing load at various speed

Mobility Rate	Load							
	Radius =2		Radius =3		Radius =4		Radius =5	
	Existing ZRP	Proposed ZRP	Existing ZRP	Proposed ZRP	Existing ZRP	Proposed ZRP	Existing ZRP	Proposed ZRP
20 m/s	2.0655	1.13976	1.92855	1.15526	1.92091	1.16069	1.92091	1.16069
30 m/s	2.10236	1.14391	1.96498	1.15711	1.95782	1.16274	1.95782	1.16274
100 m/s	2.13831	1.15484	2.05245	1.19028	2.0470	1.19648	2.04705	1.19648
150 m/s	2.1845	1.16308	2.05503	1.19273	2.04886	1.19353	2.04886	1.19353
500 m/s	2.19191	1.17738	2.07926	1.2027	2.06865	1.20315	2.06865	1.20315

The above tables show the values of the delay, PDR, throughput and the load by varying the mobility rate and the radius of the proposed algorithm. It can be compared with existing as shown in the below figures:

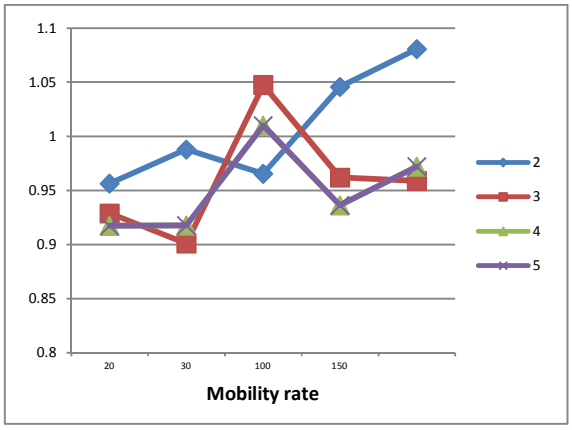

Figure 2: Comparison of Average Delay of Proposed

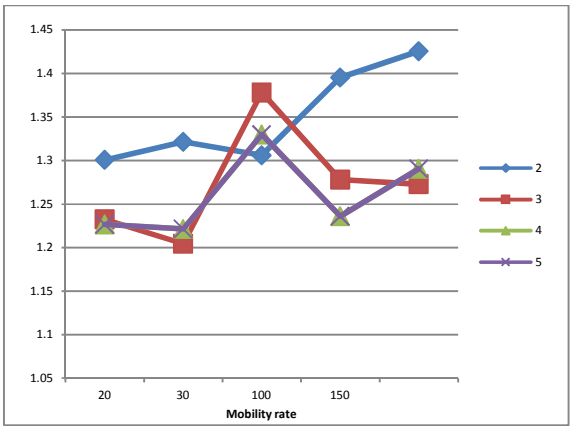

Figure 3: Comparison of Average Delay of Existing

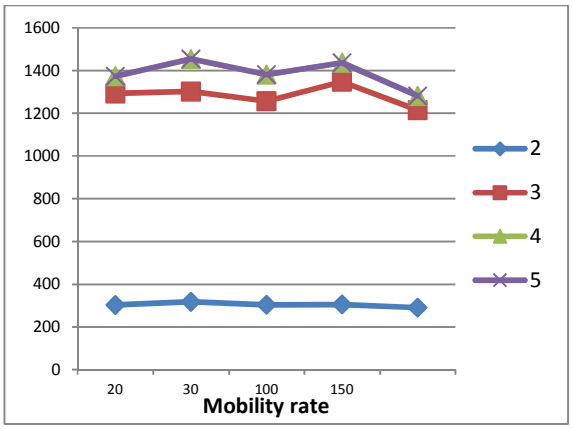

Figure 6: Comparison of Throughput of Proposed

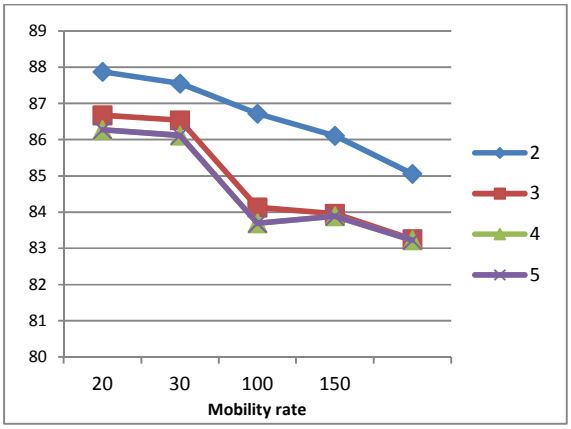

Figure 4: Comparison of PDR of Proposed

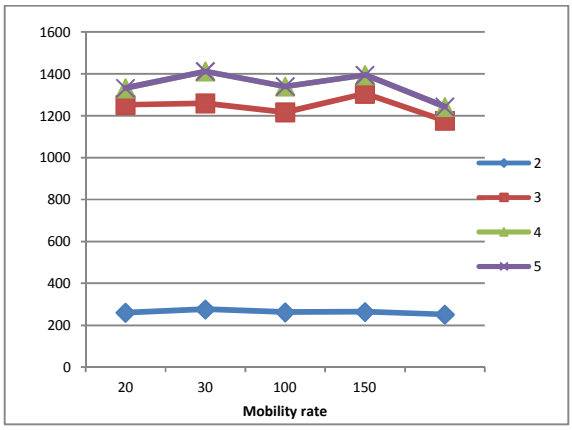

Figure 7: Comparison of Throughput of Existing

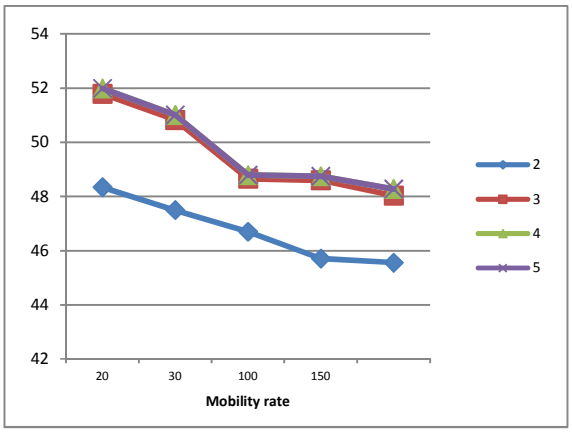

Figure 5: Comparison of PDR of Existing

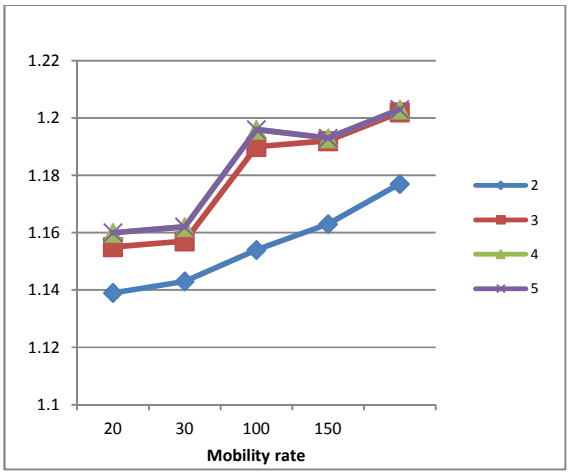

Figure 8: Comparison of Routing Load of Proposed

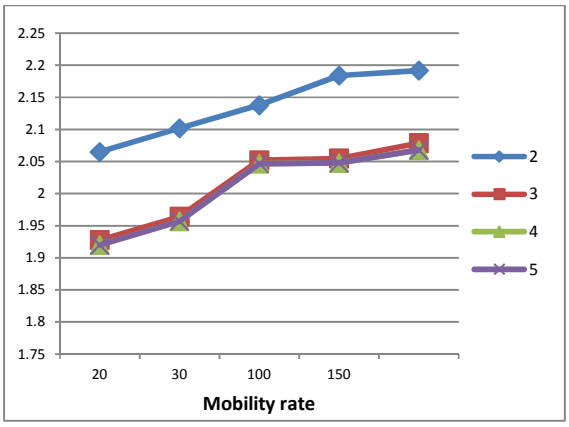

Figure 9: Comparison of Routing load of Existing

The comparison figure 2 to figure 13 shows the better performance of the modified ZRP as compared to the existing ZRP protocol. The comparison is done by increasing the zone radius. The zone radius increment results in better performance but after a certain value the performance gets constant. This is due to fact that all nodes already get covered within the zone. The performance of ZRP at radius 4 remains same as in radius 5. This is due to fact that all nodes get captured within zone in zone with radius 4. Moreover, in every case the performance of modified ZRP is better than the existing ZRP in terms of throughput, PDR etc.

VI. Conclusion

This paper modifies the existing ZRP protocol and enhance the performance of the ZRP routing . The modified protocol is implemented by using the NS2 and the results are compared by using e2edelay, throughput, pdr, routing overhead. The increase in PDR, throughput and decrease in e2edelay and routing overhead confirms the better performance of modified protocol. In future this protocol can be extended by using the artificial intelligence.

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