Mobile Wireless Enhanced Routing Protocol in Adhoc Networks

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Abstract:

Adhoc network consists of peer-to-peer communicating nodes that are highly mobile. As such, an ad-hoc network lacks infrastructure and the topology of the network changes dynamically. The task of routing data from a source to a destination in such a network is challenging. Both proactive and reactive routing protocols prove to be inefficient under these circumstances. Most of the ad-hoc protocols support presence of the bidirectional links but in reality the Adhoc network may consists of heterogeneous nodes with different transmission ranges. Thus, unidirectional links are formed. In this paper we consider a routing protocol called the Enhanced Zone Routing Protocol (ZRP) combines the advantages of the proactive (table driven) and reactive (demand driven) approaches to provide scalable routing and to create bidirectional links in the Adhoc networks. It is also proposed that, the stable routes and a query enhancement mechanism in enhanced Zone Routing Protocol to maximize the throughput and for effective utilization of bandwidth.

Keywords:* *MANET, AODV, ZRP, IARP, IERP, Query detection.

1. Introduction:

Ad-hoc networks are mobile wireless networks that have no fixed infrastructure. There are no fixed routers instead each node acts as a router and forwards traffic from other nodes. Adhoc networks consist of mobile nodes that communicate each other. The rate of change of the network topology depends upon the mobility of the nodes. Thus, routing in such a network is difficult and challenging. These protocols mainly classified as either proactive or reactive. Both proactive and reactive routing has specific advantages and disadvantages that make them suitable for certain type of scenarios. Since proactive routing maintains information that is minimal but the reactive protocols must first determine the route, which may result in considerable delay if information is not available in the table. Furthermore, the reactive route search procedure may involve significant control traffic due to global flooding. This, together with the long setup delay, may make pure reactive routing less suitable for real-time traffic. However, employing route maintenance can reduce the traffic. Purely proactive schemes use a large portion of the bandwidth to keep routing information up-to-date. Because of fast node mobility, the route updates may be more frequent than the route requests, and most of the routing information is never used. Hence the bandwidth is wasted.

2. Zone Routing Protocol:

As explained above, both a purely proactive and purely reactive approaches to implement a routing protocol for a MANET have their disadvantages. The Zone Routing Protocol or ZRP [1], as described in this paper combines the advantages of both into a hybrid scheme. The proactive routing uses excess bandwidth to maintain routing information, while reactive routing involves long route request delay and floods entire network for route domination.

In a MANET, it can safely be assumed that the most communication takes place between nodes close to each other [1]. Changing in the topology is most important in the vicinity of a node- the addition or the removal of anode on the other side of the network has only limited impact on the local neighborhood. It can be assumed that the largest part of the traffic is directed to nearby nodes. Therefore, ZRP reduces the proactive scope to a zone centered on each node. In a limited zone, the maintenance of routing information is easier. Further, the amount of routing information that is never used is minimized. Still, nodes farther away can be reached with reactive routing. Since all nodes proactively store local routing information, route request can be more efficiently performed without querying all the network nodes.

ZRP can be categorized as flat protocol because the zones overlap. Hence, optimal routes can be detected and network congestion can be avoided. Further, the behavior of ZRP is adaptive [2]. The behavior depends on the current configuration of the network and the behavior of the users.

The routing protocols AODV, SDDV, WRP, DSR, and TORA assumes that the links in the MANETs are bidirectional. However, wireless ad-hoc networks could consist of heterogeneous nodes with different power capabilities. The transmission range of node might be different from that of another. Thus, a node (say node X) whose transmission range is larger than that of another node (say node Y) will be able to transmit information to node Y, but will be unable to receive the data of node Y. This would result in the creation of unidirectional links in the networks.

ZRP architecture:

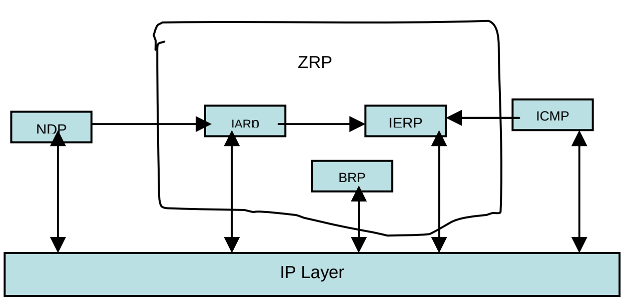

Figure 1: ZRP architecture

The Figure 1 depicts, the ZRP refer to the locally proactive routing component as the Intra-Zone Routing Protocol (IARP) [3] and globally reactive routing component is named IntEr-zone Routing Protocol (IERP)[4]. The topology of the local zone of each node is known can be used to reduce traffic when global route discovery is needed. Instead of broadcasting packets, ZRP uses a concept called border casting. Border casting utilizes the topology information provided by IARP to direct query request to the border of the zone. The Border cast Resolution Protocol (BRP) provides the border cast packet delivery service. In order to detect new neighbor nodes and link failures, the ZRP relies on a Neighbor Discovery Protocol (NDP) provided by the Media Access Control (MAC) layer. NDP transmits "HELLO", beacons at regular intervals. Upon receiving a beacon, the neighbor table is updated. The Route updates are triggered by NDP, which notifies IARP when the neighbor table is updated. IERP uses the routing table of IARP to respond to route queries. IERP forwards queries with BRP.

IntrA Zone Routing Protocol (IARP):

The goal of the IARP algorithm is to maintain an outbound tree to some nearby nodes. In case of networks with only bi-directional links, ZRP defines the zone as consisting of nodes which are within ZONE-RADIUS hops. In our protocol, zone membership is not determined by the number of hops to the node, but rather by the number of hops from the node. Thus, for a node (say j) to be in the zone of a node (say I), node I must be reachable from node j in ZONE_RADIUS hops or less. For computing the outbound tree, every node uses the units obtained from some nearby nodes. Every node prepares a packet that consists of the different parameters shown in Figure 2.

IN	ON	OT	SN	UF	UF offset	TTL	Pay load

Figure 2: IARP Packet

IN (Inbound Neighbors): the set of neighbors which have a link to the node X.

ON (Outbound Neighbors): The set of neighbors to which node X has a link.

OT (Outbound Tree Nodes): The nodes on the outbound tree of node X which is created from the packets obtained from other nodes.

SN (Sequence Number): To identify a packet and to avoid duplicate.

UF (Urgent Flag): if this flag is set, then the packet is to be forwarded as soon as possible.

TTL (Time to Live): Number of hops up to which the packet can be forwarded. The TTL is initialized to the ZONE_RADIUS and is decremented as the packet traverses a path.

2.2 Routing of Data Packets within a Zone:

Any routing protocol may be used for routing within a zone. A shortest path tree is computed from node X to other nodes within its zone. A shortest path algorithm (such as Dijkstra's algorithm) is then used to compute the shortest path tree from node X to other nodes. However, it is to be noted that the entire route might have to be included in the packet. Popular proactive routing protocols for Adhoc networks include the Destination Sequenced Distance Vector (DSDV) Protocol [6], the Wireless Routing protocol , and the Source Tree Adaptive Routing (STAR) Protocol are used for routing packets within its own zone.

2.3 IntEr Zone Routing Protocol (IERP):

The purpose of the IERP algorithm is to compute routes when the outbound tree computed by the IARP algorithm does not have a route to the destination. IERP [4] mainly relies on a mechanism called border casting, which stands for forwarding the route request to a subset of nodes (border nodes) using a tree, called the border cast tree.

3. Border-cast Tree:

The border cast tree is a tree used for sending a broadcast message to asset of nodes. When the destination is not reachable by using the outbound tree computed by IARP, this tree is used for forwarding the route query. As the border cast tree, preferably, is a shortest path it is a sub-graph of the outbound tree. The border nodes are supposed to lead to destinations that are being searched for. Hence, they must have links incident to odes outside the broadcast tree. The list of outbound neighbors is used to identify the nodes from which such links are incident. Such nodes are candidates for being chosen as border nodes. The inner nodes of the border cast tree should not be candidates for the border nodes.

4. Query Detection Mechanism:

The goal of the Query detection (QD) mechanism is to identify nodes that do not need to initiate border cast. Trivially, the nodes which have already initiated border cast (e.g., source node) or have been border nodes in some border cast of the same query need not perform subsequent bordercasts for the same query if there are no enhancements. To identify a query, the query identifier, which is a pair consisting of the source address and a unique query number assigned by the source, is used. Each border node keeps track of query identifiers seen in the recent past (based on the largest time taken by a query to transmit from one node to another). After a border node receives a query, if the query identifier matches an identifier stored in the hash table, then the node simply drops the query.

5. Stable route selection and elimination of route acquisition latency:

In the basic ZRP, a receiver selects routes based on the minimum delay. A different route selection method is applied when we use the mobility prediction. The idea is inspired by the Associatively-Based Routing (ABR) protocol which chooses associatively stable routes. In this algorithm, instead of using the minimum delay path, choose a route that is the most stable with this process maximum bandwidth could be achieved.
The major drawback of on-demand routing protocols is the delay required to obtain a route. This route acquisition latency makes on-demand protocols lees attractive in networks where real-time traffic is exchanged. To eliminate these problems, when a source has data to send but route is not known, it floods the data instead of requesting route. The periodic transmission of request query also eliminated. Thus, route acquisition latency is eliminated.

6. Simulation Result:

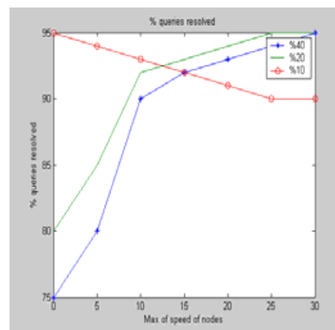

Figure 4(a): % of queries resolved

Figure 4(a) shows the percentage of queries that were resolved. Queries could be resolved if the IARP or IERP succeeds, or if the query is enhanced by some node that reports that there exist alternate destinations having paths to the original destination, resulting in a new query with an alternate set of destinations.

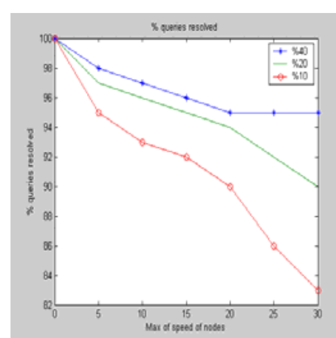

Figure 4(b): % of queries resolved correctly

Figure 4(b) shows the number of computed routes that physically exist after the route computation is over. We see that the accuracy of the computed routes decreases as the mobility increases; this is because the link-state information gets stale faster as the nodes move faster.

7. Conclusion:

The Zone Routing protocol provides a hybrid routing framework, in which each node maintains local routes within its zone in a pro-active manner, while interzone communication is performed in a reactive manner. Within the routing zone, the pro-active component IARP maintains up-to-date routing tables. Routes outside the routing zone are discovered with the reactive component IERP using route requests and replies. By combining bordercasting, query detection and early termination, it is possible to reduce the amount of route query traffic. We have applied a new route selection algorithm to choose routes that will stay valid for the longest duration of time. The usage of stable routes and elimination of the route acquisition latency further reduces the control overhead. Thus, maximum throughput achieved with high mobility.

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