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RESEARCH OF ROUTING PROTOCOLS IN MOBILE AD-HOC NETWORKS

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Many Routing protocols have been developed for MANETs to function properly. In this paper MANETs routing protocols has been considered and evaluated.

Introduction

Ad-hoc networks are wireless networks where nodes communicate with each other using multi-hop links. There is no stationary infrastructure or base station for communication. Each node itself acts as a router for forwarding and receiving packets to and from other nodes. Routing in ad-networks has been a challenging task ever since the wireless networks came into existence. The major reason for this is the constant change in network topology because of high degree of node mobility. A number of protocols have been developed to accomplish this task.

Major Aims of this work

Wireless ad-hoc networks have gained a lot of importance in wireless communications. Wireless communication is established by nodes acting as routers and transferring packets from one to another in ad-hoc networks. Routing in these networks is highly complex due to moving nodes and hence many protocols have been developed. This article concentrate mainly on routing protocols and their functionality in Ad-hoc networks their merits and demerits with a discussion being made on two selected protocols DSDV (Destination-Sequenced Distance Vector) and AODV (Ad hoc On-Demand Distance Vector), ending with their comparison.

Mobile Ad-hoc Networks

Mobile Ad-hoc networks are self-organizing and self configuring multi-hop wireless networks where, the structure of the network changes dynamically without the aid of any stand-alone infrastructure or centralized administration. This is mainly due to the mobility of the nodes. Nodes in these networks utilize the same random access wireless channel, cooperating in a friendly manner to engaging themselves in multi hop forwarding. The nodes in the network not only act as hosts but also as routers that route data to and from other nodes in network.

In mobile ad-hoc networks where there is no infrastructure support as is the case with wireless networks, and since a destination node might be out of range of a source node transmitting packets; a routing procedure is always needed to find a path so as to forward the packets appropriately between the source and the destination. Within a cell, a base station can reach all mobile nodes without routing via broadcast in common wireless networks. In the case of ad-hoc networks, each node must be able to forward data for other nodes. This creates additional problems along with the problems of dynamic topology which is unpredictable connectivity changes.

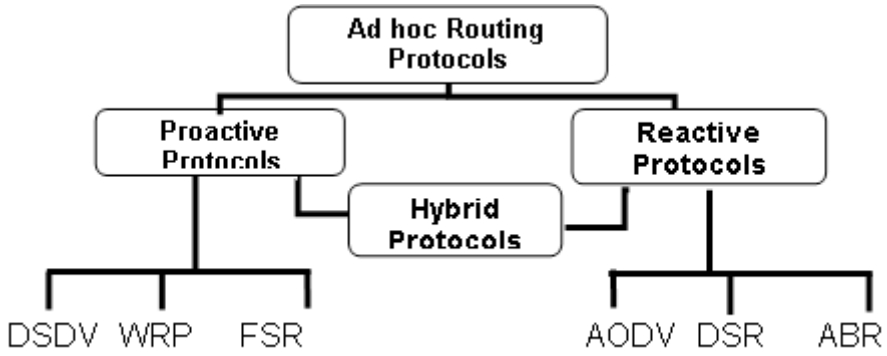
Routing

Routing is the act of moving information from a source to a destination in an internetwork. During this process, at least one intermediate node within the internetwork is encountered. Routing was used in the networks in early 1970's. But this concept has achieved popularity from the mid 1980's. The major reason for this is because the earlier networks were very simple and homogeneous environments; but, now high end and large scale internetworking has become popular with the latest advancements in the networks and telecommunication technology.

The routing concept basically involves, two activities: firstly, determining optimal routing paths and secondly, transferring the information groups (packets) through an internetwork. The later concept is called as packet switching which is straight forward, and the path determination could be very complex.

Routing protocols use several metrics to calculate the best path for routing the packets to its destination. These metrics are a standard measurement that could be number of hops, which is used by the routing algorithm to determine the optimal path for the packet to its destination. The process of path determination is that, routing algorithms initialize and maintain routing tables, which contain the total route information for the packet. This route information varies from one routing algorithm to another.

Classification of routing Protocols in MANET's



Picture 1. Classification of routing Protocols in MANET's

According to the different sources [2, 5] there are different criteria for designing and classifying routing protocols for wireless ad hoc networks. For example, what kind of routing information is exchanged; when and how the routing information is exchanged, when and how routes are computed and so on. Classification criteria will be discussed bellow.

Proactive vs. Reactive Routing

Proactive Schemes presume the route is already present whenever needed. Route Discovery overheads are large in such schemes as one has to discover all the routes. To keep routes up-to-date they consume bandwidth. Due the fact that route is already present packet forwarding is faster in these schemes. Examples of such schemes are the conventional routing schemes, Destination Sequenced Distance Vector (DSDV).

Reactive Schemes determine the route only when needed. Therefore they have smaller

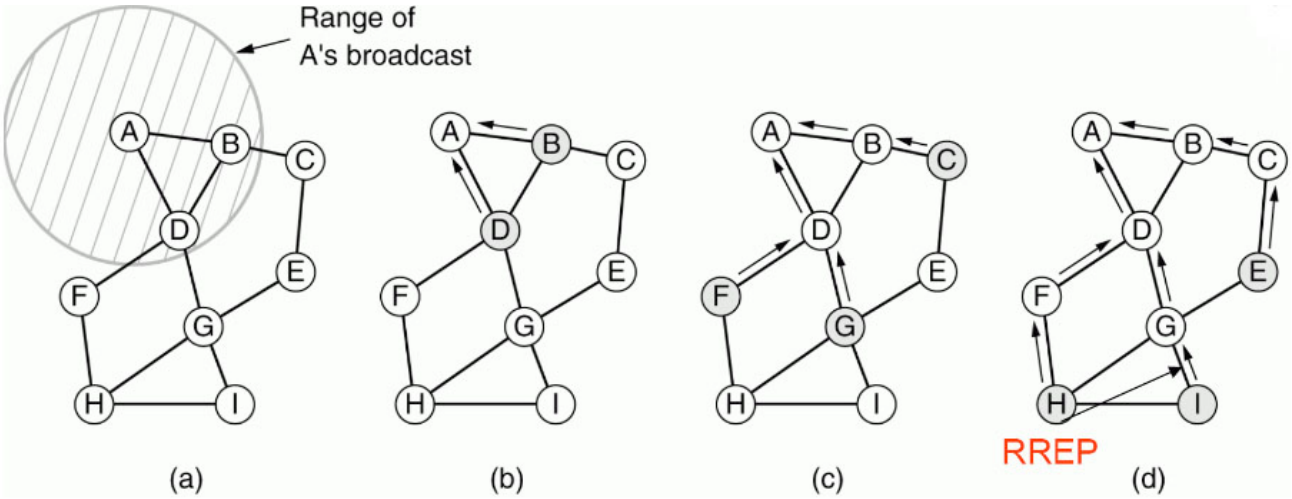
Route Discovery overheads. A flooding (global search) mechanism is involved. The drawback is a node trying to transmit a packet may have to wait for route discovery. Examples of such schemes are Dynamic Source Routing (DSR), Ad-Hoc On Demand Distance Vector Routing (AODV) etc.

Apart from proactive and reactive there is another (the easiest routing method) called Flooding where no route is computed or discovered. Every packet is broadcasted to all the nodes in the network. But flooding generates heavy traffic. Apart from proactive and reactive there is hybrid (reactive as well as proactive) schemes e.g. Zone Routing Protocol (ZRP).

Reactive Routing

– Only the routing information for the routes currently in use is maintained in tables.
– Routing process consists of two steps: 1) Route discovery, 2) Route maintenance.

Route discovery



Picture 2. Route Discovery from node A to node I (a – d – steps of route discovery)

Every host floods the network with Route Requests (RREQ), initiated by the source. Broadcast sequence number and source address is used to detect duplicate RREQ that have been received before. Broadcast sequence number incremented whenever the node initiates a route discovery. RREP is unicast replay from destination node along reverse route. Nods on discovery route automatically learn route to destination via RREP.

To decide Route Discovery task every node maintains: routing table, Broadcast ID: incremented for each new RREP, Node sequence number (RRP is broadcast to immediate neighbor only).

Route Maintenance

Link layer or periodic hello messages used to detect link failures:

– upstream neighbour sends RREP with next destination sequence and ∞ metric to active neighbors;
– ensures that routing tables entries for this route is overwritten when RREP is propagated backwards.

Rediscovery of route:

– by source node or another (earlier) upstream neighbour;

– uses a larger destination sequence number than received in the RREP;
– ensures that a new route is created or a newer route is reused.

Advantages of reactive routing:

– control overhead will be less as compared to purely table based protocols as routes are created only on demand;
– routes are guaranteed to be loop-free and valid;
– well suited for large networks.

Disadvantages of reactive routing:

– requirement of symmetric routes;
– use of periodic hello messages;
– route caching can reduce latency.

Proactive routing

Proactive (table-driven) protocol more similar to conventional routing.

Advantages of proactive routing

– Low route latency.
– State information.
– DSDV protocol guarantees loop free paths.
– Count to infinity problem is reduced in DSDV.
– We can avoid extra traffic incremental updates instead of full dump updates.
– Path Selection: DSDV maintains only the best path instead of maintaining multiple paths to every destination. With this, the amount of space in routing table is reduced.

Disadvantages of proactive routing

– Wastage of bandwidth due to unnecessary advertising of routing information even if there is no change in the network topology.
– DSDV doesn't support Multi path Routing.
– It is difficult to determine a time delay for the advertisement of routes.
– It is difficult to maintain the routing table's advertisement for larger network. Each and every host in the network should maintain a routing table for advertising. But for larger network this would lead to overhead, which consumes more bandwidth.
– High overhead (periodic table updates).
– Route repair depends on update frequency.

Conclusion and further plans

The study reveals that, DSDV routing protocol consumes more bandwidth, because of the frequent broadcasting of routing updates. While the AODV is better than DSDV as it doesn't maintain any routing tables at nodes which results in less overhead and more bandwidth. MANET simulation-based research is an involved process with plenty of opportunities to compromise the credibility of the study. In this paper we did not identify the simulation lifecycle. In perspective authors plan to simulate several Ad-hoc configurations and test routing algorithms. Beyond experimentation, we plan to investigate techniques for analyzing stability and correctness of the composed protocols under a deferent network dynamics and tra□c patterns.

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