RESEARCH ARTICLE OPEN ACCESS

Routing Mechanism in Wireless Ad-hoc Network

Sunil Kumar
School of Electrical Engineering and Information Technology
Punjab Agricultural University, Ludhiana
Punjab - India

ABSTRACT
An ad hoc network is a collection of wireless mobile hosts forming a temporary network without the aid of any centralized administration or standard support services. In such an environment, it may be necessary for one mobile host to enlist the aid of others in forwarding a packet to its destination, due to the limited propagation range of each mobile host's wireless transmissions. Some previous attempts have been made to use conventional routing protocols for routing in ad hoc networks, treating each mobile host as a router. This paper points out a number of problems with this design and suggests a new approach based on separate route discovery and route maintenance protocols.

Keywords:- Ad-hoc, Routing, Packet

I. INTRODUCTION

A) Wireless Ad-hoc Network

Wireless networking is an emerging technology that allows users to access information and services electronically, regardless of their geographic position. Wireless networks [3] have become increasingly popular in the computing industry. Given the fact that Ad-hoc is infrastructure less, which means every node is a terminal node but also be responsible to packet forwarding task, traditional routing protocol is unsuitable for Ad-hoc networks. That shows the research of Ad-hoc routing protocol and its performance is becoming an important research direction [2]. Ad-hoc wireless networks are increasingly gaining importance due to their advantages such as low cost, ease of deployment and no need of pre-deployed infrastructure. An ad-hoc network is characterized by its self-organized behavior [1]. Much research has been done on routing in ad hoc network. The new generation wireless networks permit to have much higher transmission rate, e.g., IEEE 802.11b supports up to 11 Mbps transmission rate, IEEE 802.11a can support even up to 54 Mbps. There are two modes of wireless networks.

- Infrastructure
- Infrastructure less (Ad-hoc network)

In Infrastructure, there is use of fixed wired backbone. There are some semi mobiles nodes which are used as a access points to connect internet. When the node goes out of the range of a base station, it gets into the range of another base station.

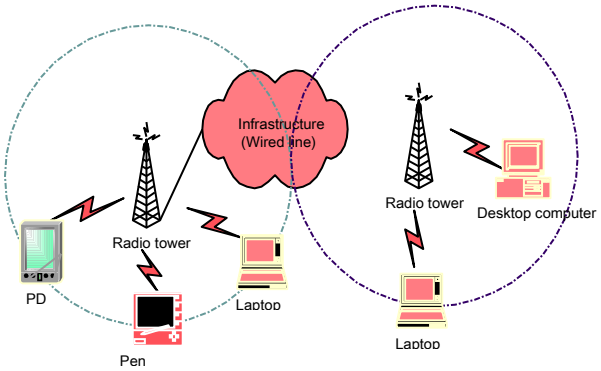


Fig 1 Infrastructure Mode[6]

In Infrastructure-less or ad-hoc mode, the nodes can move easily while they communicate with each other in the network. There is no use of fixed base station in the network and all the nodes in the network act as a router.

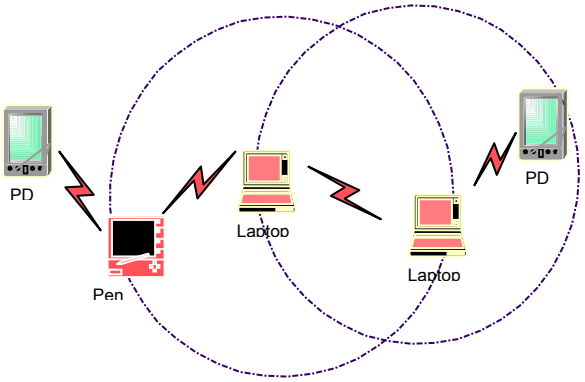


Fig 2 Infrastructure-Less or Ad-hoc Mode[6]

Some form of routing protocol is in general necessary in such an environment, since two hosts that may wish to exchange packets might not be able to communicate directly. The maximum number of network hops needed to reach another mobile host in any practical ad hoc network is likely to be small, but may often be greater than one as shown here. The routing problem in a real ad hoc network may be even more complicated than this example suggests, due to the inherent non uniform propagation characteristics of wireless transmissions and since any or all of the hosts involved may move at any time.

II. CONVENTIONAL ROUTING TECHNIQUES

Conventional routing protocols are based on either distance vector or link state algorithms [4].

A) Distance Vector:- In distance vector routing, each router maintains a table giving the distance from itself to all possible destinations. Each router periodically broadcasts this information to each of its neighbor routers, and uses the values received from its neighbors to compute updated values for its own table. By comparing the distances received for each destination from each of its neighbors, a router can determine which of its neighbors is the correct "next hop" on the shortest path toward each destination. When presented a packet for forwarding to some destination, each router simply forwards the packet to the correct next hop router. By transmitting routing table updates more frequently such as when any information in the table changes, the algorithm converges more quickly to the correct path (for example, when a link comes up or goes down), but the overhead in CPU time and network bandwidth for transmitting routing updates increases.

B) Link State: In link state routing, each router maintains a complete picture of the topology of the entire network. Each router monitors the cost of the link to each of its neighbor routers, and periodically broadcasts an update of this information to all other routers in the network. Given this information of the cost of each link in the network, each router computes the shortest path to each possible destination. When presented a packet for forwarding to some destination, each router forwards the packet to the next hop router based on its current best path to that destination. Link state routing protocols converge much more quickly as conditions in the network change, but generally require more CPU time (to compute the complete shortest path to each possible destination) and more network bandwidth (to broadcast the routing update from each router to all other routers in the entire network) than distance vector algorithms.

I) Problems

Although using either type of conventional routing protocol in an ad hoc network, treating each mobile host as a router, may often work, there are a number of problems with this approach :

- Transmission between two hosts over a wireless network does; not necessarily work equally well in both directions.
- Many ''links'' between routers seen by the routing algorithm may be redundant. Wired networks, on the other hand, are usually explicitly configured to have only one (or a small number) of routers connecting any two networks. The redundant paths in the wireless environment unnecessarily increases the size of routing updates that must be sent over the network, and increases the CPU overhead required to process each update and to compute new routes.
- Periodically sending routing updates wastes network bandwidth. Often, nothing will change from one routing update to the next, but each router (mobile host) must continue to send periodic updates so that other routers will continue to consider routes through that router as valid. Routing updates from mobile hosts outside each other's transmission range will not interfere with each other, but where many mobile hosts are within transmission range of each other, their routing updates will consume each other's network bandwidth.
- Periodically sending routing updates wastes battery power. Most mobile hosts in an ad hoc network will be operating on battery power, and transmitting each packet expends a significant amount of battery power (transmitting a packet, in effect, launches a portion of the host's battery power into the

air). Although receiving a packet generally requires less power than sending one, the need to receive these periodic routing updates effectively prevents a host from conserving its own battery power by putting itself into "sleep" or "standby" mode when not otherwise busy.

- Finally, conventional routing protocols are not designed for the type of dynamic topology changes that may be present in ad hoc networks. In conventional networks, links between routers occasionally go down or come up, and sometimes the cost of a link may change due to congestion, but routers do not generally move around dynamically, shifting major portions of the network topology back and forth. Mobile hosts, though, may be characterized by such dynamic movement, because they are, after all, mobile. Convergence to new, stable routes after such dynamic changes in topology may be quite slow, particularly with distance vector algorithms. The speed of convergence may be improved by sending routing updates more frequently, but such a shift only wastes more bandwidth and battery power when topology changes are less dramatic.

III. ROUTE DISCOVERY AND MAINTENANCE

The problem of routing can be divided into the two areas
of *route discovery* and *route maintenance.* In order for one host to communicate with another, it must initially discover a suitable route to use in sending packets to that destination. As long **as** conditions remain unchanged, this route should then continue to work for as long as it is needed. However, as the status of different links or routers used in this route change, changes in the route may be necessary, or a new route may need to be discovered.

A) Route Discovery

In an ad hoc network [7], if the source and target mobile hosts are both within transmission range of each other, a simple ARP query is all that is needed to find a "route" to the target host; the returned MAC address may be used directly to transmit packets to that host. In this case, no periodic routing updates are needed, providing substantial savings in network bandwidth and battery power requirements for all involved. What is needed to make this approach a general solution to route discovery in ad hoc networks is a technique for extending this to the case in which the source and target may not be within range of each other, while still preserving the simplicity and efficiency of the protocol as much as possible in the case in which they are.

One possible solution is to send a request packet (similar
to ARP) but to propagate the request using some form of flooding, in order to reach other mobile hosts beyond the sender's transmission range. As the request propagates, each host adds its own address to a route being recorded in the packet, before broadcasting the request on to its neighbors (any host within range of its wireless broadcast transmission).

Since many mobile hosts may be within transmission range of each other, though, there may be many duplicate copies of each request propagated. To largely eliminate these duplicates, each request should contain a unique ***request id*** from the original sender; each host keeps a cache giving the request id and sender address of recently forwarded requests, and discards a request rather than propagating it if it has already propagated an earlier copy of the same request id. Thus, each host will only propagate the first copy of each request that it receives. This will usually be the copy that came to it along the shortest path from the original sender (since it arrived first), and thus is most useful in finding the shortest path to the final target. This scheme could easily be extended, though, to include the length of the path in the request id cache and to propagate a later copy of the same request if it somehow arrived over a shorter path than the earlier copy.

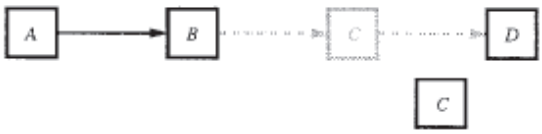
As mentioned previously, although more than one network hop may be needed to reach another mobile host in an ad hoc network, the maximum number of hops needed it is likely to be small. The number of duplicate requests propagated can thus be further reduced by limiting the maximum number of hops over which any route discovery packet can be propagated. When processing a received route discovery request, a mobile host should discard the request rather than forwarding it if it is not the target

of the request and if the route recorded in the packet has already reached the maximum length.

When the query packet ultimately reaches the target host,
the complete route from the original sender to this host will have been recorded in the packet. In order *to* be of use to the original sender, though, the route must then be returned to the sender. The target host may attempt to reverse the recorded route to reach the original sender, or may use the same route discovery procedure to find a route back to the original sender; the route from the original sender to this target should be returned to the sender in the new query packet used for its own route discovery.

This route discovery exchange between the two end mobile hosts could optionally be piggybacked on the first data packets sent between them. For example, when opening a TCP connection, separate packets are usually used to exchange SYN and ACTS control bits between the two end hosts of the connection; the route discovery information could easily be carried in these same packets. If the end mobile hosts use a flow setup protocol to reserve resources or bandwidth for a specified quality of service between them, this route discovery exchange could likewise be integrated with the flow setup exchange. Such a flow setup could also be used to establish state for the route in each of the mobile hosts along the path, so that the entire route need not be included on each packet sent along the path.

B) Route Maintenance



(a) Host *C* has moved, breaking the route at *B*

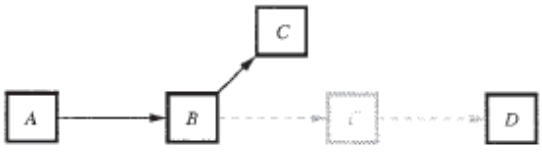


Fig 3. Route changes due to host movement

In an ad hoc network [7], a route may also stop working if one or more of the mobile hosts along the route simply move. For example, Figure 3 illustrates two possible scenarios in which the movement of a mobile host causes an existing route to stop working. Assume that mobile host ***A*** has been sending packets to mobile host D using a route through mobile hosts *B* and C. Figure 3 (a) shows the case in which C has moved out of range of ***B,*** breaking the route on to ***D.*** Figure 3 (b) shows a different scenario in which *C* has moved such that it is now out of range of its next hop on to *D;* in this case, C after moving is still within range of *B,* but it has led the route away from *D.*

In many wireless networks, route maintenance can be provided with very little overhead. Since wireless networks are inherently less reliable than wired networks, many wireless networks utilize a hop-by-hop acknowledgement at the data link level in order to provide early detection and retransmission of lost or corrupted packets. In these networks, the problem of route maintenance is quite simple, since at each hop, the sender can determine if that hop of the route is still working. If the data link level reports a transmission problem for which it cannot recover (for example, because the maximum number of retransmissions it is willing to attempt has been exceeded), all that is needed is to report this error back to the original sender to cause that host to re invoke the route discovery procedure to find a new route. It may also be possible for the intermediate host experiencing the error to instead use the route discovery procedure itself to extend the existing route (up to itself)' on to the correct target.

If the wireless network does not support such lower-level
Acknowledgements, an equivalent acknowledgement signal may be available in many environments. After sending a packet to the next hop mobile host, the sender may be able to hear that host transmitting the packet again, on its way further along the path.

IV. CONCLUSION

This paper has proposed a new method for routing in ad hoc networks based on separate *route discovery* and *route maintenance* protocols. The performance of this approach depends on a number of factors such as how often mobile hosts in such an environment attempt to communicate with other mobile host for which they have no cached route (when

route discovery is needed) and how often mobile hosts move enough for existing routes to stop working (when route maintenance is needed). Perhaps the most important factor in the protocol affecting performance is how well the propagation of redundant copies of a route discovery request by any mobile host can be reduced through methods such as discarding a request if this mobile host is already listed on the route in the request or if this mobile host has recently processed a request with this same request id, through limiting the maximum length of a route, and through aggressive route caching and full use of information in the cache. A number of options remain to be resolved in the design of the protocols described here. We are currently building a packet-level simulation with which to evaluate these options and to study the behavior and performance of the system. We are also exploring additional areas related to ad hoc networking, such as the routing between an ad hoc network and a wide-area network such as the Internet: if one or more of the mobile hosts in an ad hoc network are also connected to the Internet [5], it is possible for other mobile hosts in the ad hoc network to communicate with Internet hosts, but additional routing support is needed for them to learn an appropriate route to these Internet hosts and for Internet hosts to be able to route packets into the ad hoc network.

REFERENCES

[1] Md. Anisur Rahman, Alex Talevski " Performance Measurement of Various Routing Protocols in ad-Hoc Network", IMECS, March 18-20,2009, Hong Kong

[2] P.Chenna Reddy, P.Sekhar Reddy," Performance Analysis of Adhoc Routing Protocols", @IEEE 2006

[3] Lars Michael Kristensen, "An Introduction to Ad Hoc Networking" Department of Computer Science University of Aarhus.

[41 Radia Perlman. Interconnections: Bridges and Routers. Addison-Wesley, Reading, Massachusetts,1992.

[5] Charles Perkins, editor. IP mobility support. Internet Draft, IETF Mobile IP Working Group, 21 October 1994. Work in progress.

[6] Sunil Kumar, Jyotsna Sengupta , "AODV and OLSR Routing protocols for Wireless Mesh Network an Ad-hoc Networks" IEEE ICCCT Sept, 2010 at MNNIT Allahabad.

[7] Sunil Kumar, Jyotsna Sengupta, "Analysis and Simulation of Routing Protocols for Wireless Ad-hoc Network", PCTE Journal of Computer Science, Vol No- July-Dec 09, pp no.91-96

AUTHOR DETAILS

Sunil Kumar, received the M.Tech degree in Internet and Communication Technology (ICT) from Dept. of Computer Science, Punjabi University, Patiala, Punjab in 2010. Doing Ph.D (Computer Science) from Punjabi University, Patiala. He currently works for School of Electrical Engg & Information Technology, Punjab Agricultural University, Ludhiana, Punjab. His research interests include Wireless mesh networks and ad-hoc networks. He is the members of professional societies **IACSIT (**International Association of Computer Science and Information Technology), Singapore and **IEDRC** (International Economics Development Research Center) HongKong.