Available Online at www.ijcsmc.com

International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320–088X

IJCSMC, Vol. 2, Issue. 7, July 2013, pg.317 – 321

RESEARCH ARTICLE

ON-DEMAND ROUTING IN MULTI-HOP WIRELESS MOBILE AD HOC NETWORKS

P. Umamaheswari[1], K. Ranjith singh[2]
[1]Periyar University, TamilNadu, India
[2]Professor of PGP College, TamilNadu, India

[1] umamrk1986@gmail.com; [2] kranjithsingh@yahoo.com

Abstract— An ad hoc network is a collection of wireless mobile nodes dynamically forming a temporary network without the use of any preexisting network infrastructure or centralized administration. Routing protocols used in ad hoc networks must automatically adjust to environments that can vary between the extremes of high mobility with low bandwidth, and low mobility with high bandwidth. This thesis argues that such protocols must operate in an on-demand fashion and that they must carefully limit the number of nodes required to react to a given topology change in the network. I have embodied these two principles in a routing protocol called Dynamic Source Routing (DSR). As a result of its unique design, the protocol adapts quickly to routing changes when node movement is frequent, yet requires little or no overhead during periods in which nodes move less frequently. By presenting a detailed analysis of DSR's behavior in a variety of situations, this thesis generalizes the lessons learned from DSR so that they can be applied to the many other new routing protocols that have adopted the basic DSR framework. The thesis proves the practicality of the DSR protocol through performance results collected from a full-scale 8 node tested, and it demonstrates several methodologies for experimenting with protocols and applications in an ad hoc network environment, including the emulation of ad hoc networks.

I. INTRODUCTION

The need to exchange digital information outside the typical wired office environment is growing. For example, a class of students may need to interact during a lecture; business associates serendipitously meeting in an airport may wish to share files; or disaster recovery personnel may need to coordinate relief information after a hurricane or flood. Each of the devices used by these information producers and consumers can be considered a node in an ad hoc network. In a typical ad hoc network, mobile nodes come together for a period of time to exchange information. While exchanging information, the nodes may continue to move, and so the network must be prepared to adapt continually. In the applications we are interested in, networking infrastructure such as repeaters or base stations will frequently be either undesirable or not directly reachable, so the nodes must be prepared to organize themselves into a network and establish routes among themselves without any outside support. The idea of ad hoc networking is sometimes also called infrastructure less networking since the mobile nodes in the network dynamically establish routing among themselves to form their own network "on the fly."

1.1 ROUTING IN AD HOC NETWORKS

The basic routing problem is that of finding an ordered series of intermediate nodes that can transport a packet across a network from its source to its destination by forwarding the packet along this series of intermediate nodes. In traditional hop-by-hop solutions to the routing problem, each node in the network maintains a routing table: for each known destination, the routing table lists the next node to which a packet for that destination should be sent. The routing table at each node can be thought of as a view into part of a distributed data structure that, when taken together, describes the topology of the network. The goal of the routing protocol is to ensure that the overall data structure contains a consistent and correct view of the actual network topology. If the routing tables at some nodes were to become inconsistent, then packets can loop in the network. If the routing tables were to contain incorrect information, then packets can be dropped. The problem of maintaining a consistent and correct view becomes harder as there is an increase in the number of nodes whose information must be consistent, and as the rate of change in the actual topology increases. The challenge in creating a routing protocol for ad hoc networks is to design a single protocol that can adapt to the wide variety of conditions that can be present in any ad hoc network over time. For example, the bandwidth available between two nodes in the network may vary from more than 10 Mbps to 10 Kbps or less. The highest speeds are achieved when using high-speed network interfaces with little interference, and the extremely low speeds may arise when using low-speed network interfaces or when there is significant interference from outside sources or other nodes' transmitters. Similar to the potential variability in bandwidth, nodes in an ad hoc network may alternate between periods during which they are stationary with respect to each other and periods during which they change topology rapidly. Conditions across a single network may also vary, so while some nodes are slow moving, others change location rapidly. The routing protocol must perform efficiently in environments in which nodes are stationary and bandwidth is not a limiting factor. Yet, the same protocol must still function efficiently when the bandwidth available between nodes is low and the level of mobility and topology change is high. Because it is often impossible to know *a* priori what environment the protocol will find itself in, and because the environment can change unpredictably, the routing protocol must be able to adapt automatically. Most routing protocols include at least some periodic behaviors, meaning that there are protocol operations that are performed regularly at some interval regardless of outside events. These periodic behaviors typically limit the ability of the protocols to adapt to changing environments. If the periodic interval is set too short, the protocol will be inefficient as it performs its activities more often than required to react to changes in the network topology. If the periodic interval is set too long, the protocol will not react sufficiently quickly to changes in the network topology, and packets will be lost. Periodic protocols can be designed to adjust their periodic interval to try to match the rate of change in the network, but this approach will suffer from the overhead associated with the tuning mechanism and the lag between a change in conditions and the selection of a new periodic interval. In the worst case, which consists of bursts of topology change followed by stable periods, adapting the periodic interval could result in the protocol using a long interval during the burst periods and a short interval in the stable periods. This worst case may be fairly common, for example, as when a group of people enter a room for a meeting, are seated for the course of the meeting, and then stand up to leave at the end. The alternative to a periodic routing protocol is one that operates in an on-demand fashion. On-demand protocols are based on the premise that if a problem or inconsistent state can be detected before it causes permanent harm, then all work to correct a problem or maintain consistent state can be delayed until it is known to be needed. They operate using the same "lazy" philosophy as optimistic algorithms. The Dynamic Source Routing protocol (DSR) completely avoids periodic behavior, and uses source routing to solve the routing information consistency problem. First, DSR is completely on-demand, which allows the overhead of the protocol to automatically scale directly with the need for reaction to topology change. This scalability dramatically lowers the overhead of the protocol by eliminating the need for any periodic activities, such as the route advertisement and neighbor detection packets that are present in other protocols. Second, DSR uses source routes to control the forwarding of packets through the network. The key advantage of a source routing design is that intermediate nodes do not need to maintain consistent global routing information, since the packets themselves already contain all the routing decisions. Beyond this, every packet that carries a source route carries a description of a path through the network. Therefore, with a cost of no additional packets, every node overhearing a source route learns a way to reach all nodes listed on the route. While the on-demand mechanisms built into DSR are intended to improve the network's performance, they also have potentially significant liabilities. For example, by deferring work until it must be performed in order to complete some desired action, the time taken to complete the desired action will increase as none of the work has been precompiled. In the network, this means that packets may be delayed or lost while the network performs the tasks needed to deliver them. Chapter 4 looks at a number of these issues in detail and shows how the DSR mechanisms are able to mitigate the liabilities. This thesis concentrates on achieving high-performance unicast routing in multi-hop wireless ad hoc networks. There are two related problems that this thesis will not directly address: quality of service (QoS) routing and multicast routing. Time-sensitive and multi-media data traffic, such as voice and video, will typically not function properly unless the senders and receivers of the data are provided with promises that the quality of service supplied by the network will fall within some prearranged bounds, or, at the very least, are provide with information about the quality of service that traffic across the network can expect. Providing this quality of service information requires the involvement of the routing protocol, since no other layer of the network stack has a view of the multiple paths available across the network. While multicast routing can be achieved at layers above the routing layer, it too benefits from access to the information.

Available at the routing layer and it deserves support from the routing protocol. More extensive comments on these subjects can be found in on related work.

II. PACKET RADIO NETWORKS

The first packet radio networks date from the very earliest days of the wireless radio, when radio station operators would manually forward telegram-like messages between stations in order to further the distance over which messages could be carried. These networks, like the Marconi Short Beam network, used "manually configured" routes and the intuition of the human operators to route messages through the network. This solution worked well, as the topology was very static and the links very reliable. The first development of packet radio for computer communications was in 1970 as part of the ALOHANET project operated by the University of Hawaii. ALOHANET consisted of a radio network used to connect together university computers on each of the major Hawaiian Islands. The network was single-hop however, meaning that only nodes directly in reach of each other could communicate. From the ALOHANET project, packet radio grew in two main directions, non-military amateur radio networks.

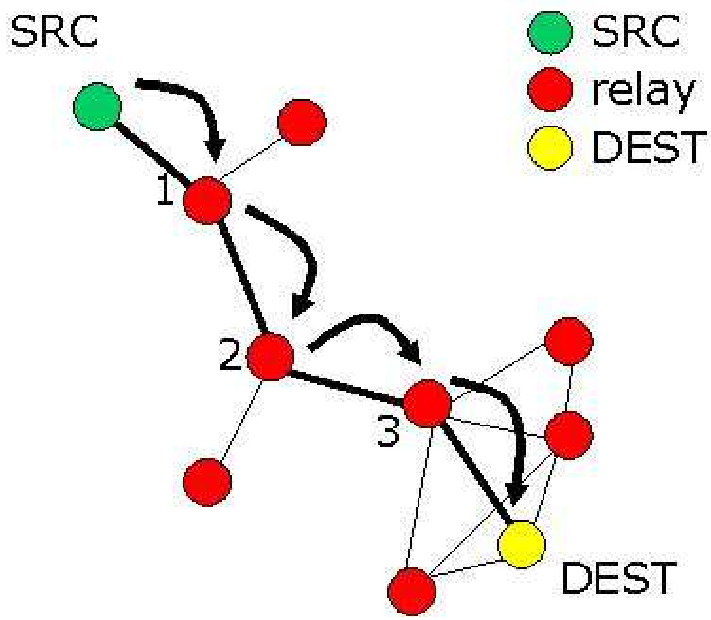

Fig1 .The multihop ad hoc network model

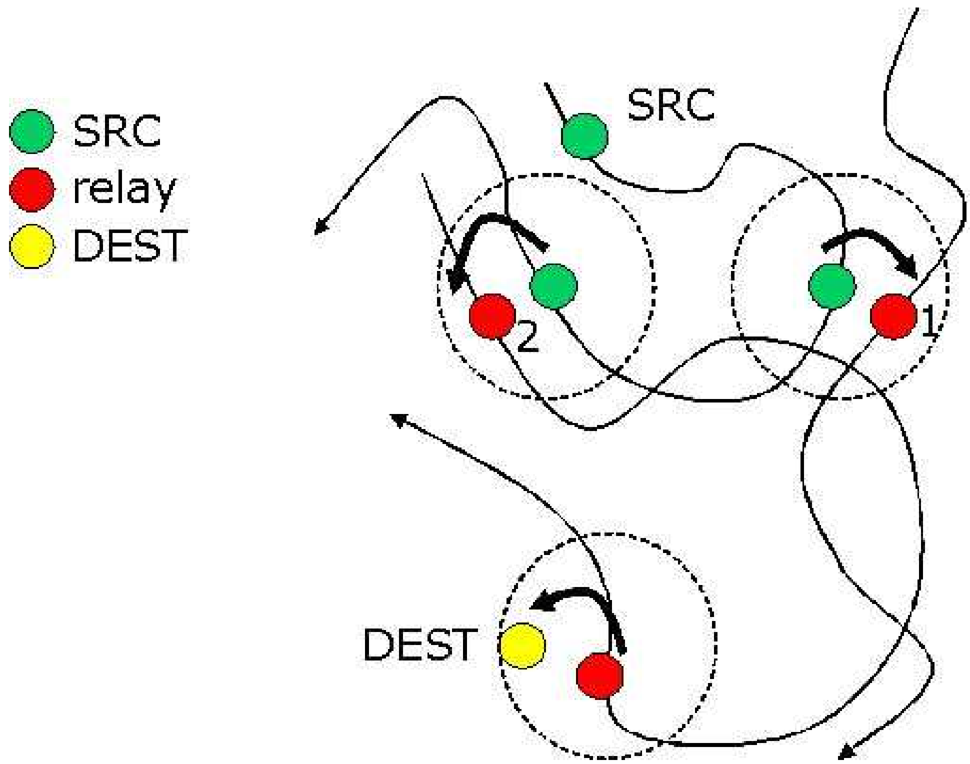

Fig 2. The Mobile Infostation Network Model

III. AMATEUR PACKET RADIO NETWORKS

Towards the end of the 1970s, Amateur radio operators became interested in packet radio as a means to achieve three goals: to exchange messages with other operators outside their radio horizon, to achieve better message delivery in the presence of radio interference that made voice communication impossible, and to offer new services to other amateur operators (e.g., BBS bulletin-board service). Nodes in the amateur radio network are known as Terminal Node Controllers (TNCs), and the first TNCs were built in 1978 in Montreal, Canada [56]. The Vancouver Amateur Digital Communication Group followed this with a TNC kit available in 1980. The most widely used TNC was developed by the Tucson Amateur Packet Radio Corp in 1982, which claims over 100,000 TNCs have been sold .The amateur packet radio network today still uses a variety of different protocols. Examples include _ The NET/ROM protocol that originally allowed a user to remotely log into a directly reachable TNC and, from there, access the TNC's neighbor list and recursively log into TNC's further and further away. This ability is roughly equivalent to remote-shell or telnet today, but limited to the abilities to only log into a directly connected machine and to only execute commands supported by the TNC. Later versions of NET/ROM [32] supported automatic routing using a variation of a distance vector protocol. _ A variant of the X.25 network protocol called AX.25. AX.25 is a true packet-based protocol that has been modified to use radio call signs as source and destination addresses, which added routing tables to the AX.25 network, but required all routes to be manually configured into the route tables and updated by hand as new nodes come on-line or drop off-line. The TCP/IP protocols as used on wired networks. Of these protocols used in amateur packet radio networks, only theNET/ROMand TCP/IP suites provide the functionality of DSR and the other protocols described in this thesis. The remainders of the protocols require direct human intervention to deal with any change in routing, be it caused by a new node appearing, a node disappearing, or a node moving.

3.1 MILITARY PACKET RADIO NETWORKS

In contrast to the amateur packet radio networks, which often focused on the hardware, military packet radio networks from their very beginning developed hardware, software, and protocols that could adapt to the changing topologies and environments that were expected on a battlefield. Freeversyser and Leniner provide a good overview of the United States' military packet radio efforts. Growing out of ALOHANET, the DARPA-sponsored Packet Radio Network (PRNET) project extended the single hop packet radio into a multi-hop packet radio network in a series of development efforts stretching from 1972 to 1983. Unlike most amateur packet radio networks, the PRNET project designed and tested protocols in environments where the nodes were expected to be mounted on mobile platforms, such as trucks. As a result, the protocols had to adapt automatically to changes in topology, although routes were expected to remain stable for “at least a few minutes, if not longer” As of 1987, PRNET supported 138 nodes, either packet radios or attached hosts, and it used a flat distance vector protocol for routing conducts a comparison of the performance of a distance vector protocol with that of DSR. PRNET used its own non-IP routing header on packets, but could encapsulate IP data packets and connect to the Internet via gateways. PRNET did not address scalability to large numbers of node, high rates of mobility, quality of service, or multicast, When the PRNET project ended, the Survivable Adaptive Networks (SURAN) project began, and ran from 1983 to 1992. SURAN was followed by the Global Mobile Information Systems project that ran from 1995 to 2000. Contemporaneously with the work on DSR described in this thesis, the United States Army began the Near Term Digital Radio project (NTDR) to develop a tactical packet radio for deployment in battlefield settings. The goal was to support 400 nodes in a metropolitan sized area. NTDR uses a two-level routing hierarchy. Nodes are first organized into clusters by an elected cluster head. The cluster head then participates in a link-state routing protocol with other cluster heads to form the network backbone.

IV. CONCLUSION

The use of clustering reduces the amount of information that must be propagated by the link-state protocol. NTDR also provided multicast and limited support for quality of service, in the form of header bits that indicate handling precedence [110]. Published data on the performance of NTDR is not available, and this thesis did not evaluate a similar enough protocol to enable a comparison between DSR and NTDR. As an example of the importance of multi-hop ad hoc wireless networks, however, NTDR equipped radios have been a part of the US Army’s First Digital Division’s “go-to-war” equipment since 1998, and they are used by the armed forces of a number of other countries as well.

REFERENCES

[1] http://www.isi.edu/nsnam/ns/. Network Simulator Notes and Documentation, the VINT Project, UC Berkeley, LBL, USC/ISI and Xerox PARC.
[2] http://www.monarch.cs.rice.edu/. Rice University Monarch Project, Mobility and Wireless Extensions tons.
[3] http://www.agorics.com/new.html.
[4] http://robotics/eecs.berkeley.edu/˜pister/SmartDust/. Smart Dust project page.
[5] http://www.xbow.com/. Crossbow Technology Inc.
[6] S. Agarwal, S. Krishnamurthy, R.H. Katz, and S.K. Dao. Distributed power control in ad-hoc wireless networks. In Proc. IEEE PIMRC ’01, 2001.
[7] D.P. Bertsekas. Dynamic Programming: Deterministic and Stochastic Models. Prentice-Hall, Englewood Cliffs, N.J., 1987.
[8] J. Broch, D.A. Maltz, D.B. Johnson, Y.C. Hu, and J. Jetcheva. A performance comparison of multi-hop wireless ad hoc network routing protocols. In Proc Mobicom, pages 85–97, 1998.
[9] S.M. Cherry. Wi-fi takes new turn with ”wireless-g”. IEEE Spectrum Magazine, pages 12–13, August 2003.
[10] K.P. Chong and H.Z. Stanislaw. An Introduction to Optimization. Wiley, New York, 1996.

