An Overview of Routing Protocols in Manet

M.Rufiya Banu, S.Sugantha Priya MCA.,
II MSc Computer Science, Assistant Professor,
Dr.SNS Rajalakshmi college, SNS Rajalakshmi college Of Arts and Science,Coimbatore. of Arts and Science,Coimbatore.

Abstract

As a new generation of wireless communication system, mobile ad-hoc network has developed greatly during the past ten years. Endowed by great mobility, dynamic topology, self-organizing and other unique features, it is commonly used in emergency operations, disaster relief efforts and military networks. However, this new wireless network has lots of technical challenges and potential benefits need to be discovered and conquered. Without a doubt, we will soon be able to see ad-hoc network deployment everywhere in the near future. This thesis first introduces the concept of mobile ad-hoc network including its main features, network structure and applications. Then, it focuses on one of the key issues of the ad-hoc network---routing. Finally, on-demand routing protocol (AODV, DSR, TORA) is selected andcompared in simulated small-scale networks by using the software OPNET Modeler, aiming tofind differences in their performances.

Keywords:
Ad-hoc network, dynamic topology, AODV, network simulation

Introduction

Mobile Ad Hoc Networking is a technology under development for the last 20 years principally through research funding sponsored by the U.S Government. It is somewhat synonymous with Mobile Packet Radio Networking (a term coined via during early military research in the 70's and 80's), Mobile Mesh Networking (a term that appeared in an article in The Economist regarding the structure of future military networks) and Mobile, Multihop,Wireless, Networking (perhaps the most accurate term, although a bit. 19 concept of commercial ad-hoc networks arrived with notebook computers and other viable communications equipment. At the same time, the idea of a collection of mobile nodes was proposed at several research Conferences.

The IEEE 802.11 subcommittee had adopted the term "ad-hoc networks" and the research community had started to look into the possibility of deploying ad-hoc networks in other areas of application. Meanwhile, work was going on to advance the previously built ad-hoc networks. GloMo (Global Mobile Information Systems) and the NTDR (Near-term Digital Radio) are some of the results of these efforts. [1][2] GloMo was designed to provide an office environment with Ethernet-type multimedia connectivity anywhere and anytime in handheld devices.

Later on in mid-1990s, within the Internet Engineering Task Force (IETF), the Mobile Ad-Hoc Networking working group was formed to standardize routing protocols for ad-hoc networks. [3]The development of routing within the working group and the larger community resulted in the invention of reactive and proactive routing protocols.

Soon after, the IEEE 802.11 subcommittee standardized a medium access protocol that was based on collision avoidance and tolerated hidden terminals, making it usable for building mobile ad hoc networks prototypes out of notebooks and 802.11 PCMCIA cards.

HyperLAN and Bluetooth were some other ad-hoc network standards that addressed and benefited ad-hoc networking.

As a new technology for information acquisition, the mobile ad-hoc network is of high research value and wide application prospects. It has become hot off the press in the last ten years in the globe. Routing is one of the core issues in mobile ad-hoc network. An effective routing mechanism will be helpful to extend the successful deployment of mobile ad-hoc network. In this thesis, a brief introduction of the mobile ad-hoc network definition, main features, network structure and applications will be given in the first place. Then, three existing pro-active routing protocols (AODV, DSR, and TORA) will be presented including their algorithms, terminology, and message format and operation process. The main content of this paper is

Trying to compare these three protocols' performance in emulated small-scale networks based on the software OPNET Model.

Mobile Ad Hoc Network and its Routing Protocols.

Ad hoc is a Latin phrase which means "for this purpose". It generally signifies a solution designed for a specific problem or task. Mobile ad hoc network, known as MANET by IETF, is an autonomous collection of mobile users that communicate over relatively bandwidth constrained wireless links.

Since the nodes are mobile, the network topology may change rapidly and unpredictably over time. The network is decentralized, where all network activity including discovering the topology and delivering messages must be

Executed by the nodes they, i.e. routing functionality will be incorporated into mobile nodes.

Features

A MANET consists of multiple free nodes which can move about arbitrarily. The Nodes maybe located in or on transportations including aeroplanes, ships,Trucks, cars, perhaps even on people or very small devices, and there may be multile hosts per router. A MANET is an autonomous system of mobile nodes which may operate in isolation, or may have gateways to and interface with a fixed network.

Characteristics of MANETs

(1) Dynamic topologies: Nodes are free to move randomly; thus the networktopology which is typically multihop, may change randomly and rapidly at unpredictable times, and may consist of both bidirectional and unidirectional links.

(2) Energy-constrained operation: Some or all of the nodes in a MANET may rely on batteries or other exhaustible means for their energy. For these nodes, the most important system design criteria for optimization may be energy conservation.

(3)Bandwidth-constrain invariable capacity links: Wireless links will have significantly lower capacity than their hardwired counterparts. Furthermore, after accounting for the effects of multiple access, fading, noise, and interference conditions, the realized throughput of wireless communications is often much less than a radio's maximum transmission rate.

(4) Limited physical security: Mobile wireless networks are generally more prone to physical security threats than fixed-cable nets. The increased possibility of eavesdropping, spoofing, and denial-of-service attacks needs to be carefully considered. Existing link security techniques are often applied within wireless networks to reduce security threats.

These characteristics create a set of underlying assumptions and performance concerns for protocol design which are distinguished from those guiding the design of routing within the higher-speed, semi-static topology of the fixed Internet.

Application

Ad-hoc networks are suited for use in situations where an infrastructure is unavailable or to deploy one is not cost-effective. One of many possible uses of mobile ad-hoc networks is in some business environments, where the need for collaborative computing might be more important outside the office environment than inside, such as in a business meeting outside the office to brief clients on a given assignment.
A mobile ad-hoc network can also be used to provide crisis management services applications, such as in disaster recovery, where the entire communication infrastructure is destroyed and recovering communication quickly is crucial. By using a mobile ad-hoc network, an infrastructure could be set up in hours instead of weeks, as is required in the case of wired line communication. Another application example of a mobile ad-hoc network is Bluetooth, which is designed to support a personal area network by eliminating the need of wires between various devices, such as printers and personal digital assistants. The famous IEEE 802.11 or Wi-Fi protocol also supports an ad-hoc network system in the absence of a wireless access point .

Routing protocol performance issues

The routing protocols of MANET have to meet certain QoS requirements. The following is a list of desirable qualitative properties of MANET routing protocols:

(1) Loop-freedom: It is not required in light of certain quantitative measures but it is generally desirable to avoid problems such as worst-case phenomena.

(2) Distributed operation: This is an essential property of MANET that the protocol has to own.

(3) Proactive operation: This is the flip-side of demand-based operation. In certain contexts, the additional latency demand-based operation incurs may be unacceptable. If bandwidth and energy resources permit, proactive operation is desirable in these contexts.

(4) Demand-based operation: Instead of assuming a uniform traffic distribution within the network (and maintaining routing between all nodes at all times), the
Routing algorithm adapts to the traffic pattern on a demand or need basis. If this is done intelligently, it can utilize network energy and bandwidth resources more efficiently, at the cost of increased route discovery delay.

(5) Unidirectional link support: Bidirectional links are typically assumed in the design of routing algorithms, and many algorithms are incapable of functioning properly over unidirectional links. Nevertheless, unidirectional links can and do occur in wireless networks. Often, a sufficient number of duplex links exist so
That usage of unidirectional links is of limited added value. However, in situations where a pair of unidirectional links (in opposite directions) form the only bidirectional connection between two ad hoc regions, the ability to make use of them is valuable.

(6) Security: Without some form of network-level or link-layer security, a MANET routing protocol is vulnerable to many forms of attack. It may be relatively simple to snoop network traffic replay transmissions, manipulate packet headers, and redirect routing messages within a wireless network without appropriate security provisions. While these concerns exist within wired infrastructures and routing protocols as well, maintaining the "physical" security of the transmission media is harder in practice with MANETs. Sufficient security protection to prohibit disruption of modification of protocol operation is desired. This may be somewhat orthogonal to any particular routing protocol approach, e.g. through the application of IP Security techniques.

(7) "Sleep" period operation: As a result of energy conservation, or some other need to be inactive, nodes of a MANET may stop transmitting and/or receiving (even receiving requires power) for arbitrary time periods. A routing protocol should be able to accommodate such sleep periods without overly adverse consequences. This property may require close coupling with the link-layer protocol through a standardized interface.

The following is a list of quantitative metrics that can be used to assess the performance of any routing protocol.

(1) Route Acquisition Time: It is the time required to establish route when requested and it is usually being used for on-demand routing protocols.

(2) End-to-end data throughput and delay: Statistical measures of data routing performance (e.g., means, variances, distributions) are important as they can be used as measures of a routing policy's effectiveness

(3) Efficiency: To achieve a given level of data routing performance, two different policies can expend differing amounts of overhead, depending on their internal efficiency. Protocol efficiency may or may not directly affect data routing performance. If control and data traffic must share the same channel, and the channel's capacity is limited, then excessive control traffic often impacts data routing performance.

(4) Percentage Out-of-Order Delivery: An external measure of connectionless routing performance of particular interest to transport layer protocols such as TCP which prefer in-order delivery.

Route maintenance

When originating or forwarding a packet using a source route, each node transmitting the packet is responsible for confirming the data can flow over the link from that node to the next hop. An acknowledgement can provide confirmation that a link is capable of carrying data, and in wireless networks, acknowledgements are often provided at no cost, either as an existing standard part of the MAC protocol in use, or by a “pass acknowledgement”.

This means that if the existing acknowledgement mechanism is not available, the node transmitting the packet can explicitly request that a DSR-specific software acknowledgement be returned by the next node along the route. This software acknowledgement will normally be transmitted directly to the sending node, but if the link between these two nodes is unidirectional, this software acknowledgement could travel over a different, multi-hop path.

Conclusion

In conclusion, although the three protocols have their own merits and drawbacks, from comparison in the figures above, it is obvious that AODV is a more efficient protocol which is best suited for general mobile ad-hoc networks as it consumes less bandwidth and lower overhead when compared to other two protocols.

Due to limited time and complexity in network simulation process, only three protocols are presented in this article. While it is not clear that any particular algorithm or class of algorithm is the best for all scenarios, each protocol has definite advantages and disadvantages, and is well suited for certain situations.

References

[1].Alex Hinds, Michael Ngulube, Shaoying Zhu and Hussain Al- Aqrabi, "A REVIEW OF ROUTING PROTOCOLS FOR MOBILE AD-HOC NETWORKS (MANET)".

[2].Mansi Sharma and Dr. Sanjay Kumar Dubey, "ANALYTICAL STUDY OF CLUSTER BASED ROUTING PROTOCOLS IN MANET"

[3].K.Maheswari and M.Sahaya Agnel Rigana, "ROUTING PROTOCOLS IN MANET".

[4].Deeptanoy Ghosh and Poonam Thakar, "A SURVEY ON – DEMAND ROUTING TECHNIQUES IN MANET".

[5].M.Vigneshwaran, P.Chandrasekar, and S.Kalaivani, "A SURVEY OF ENERGY EFFICIENT ROUTING PROTOCOLS IN MANET".