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Survey of Routing Protocols under Realistic Mobility and Traffic

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Abstract:
Mobile ad hoc networks are a dynamic and unpredictable community topology. There are numerous routing protocols that have been proposed for MANETs. Maximum pervious research centered on improving the present routing protocols or designing new routing algorithms. In our work, we investigated and compared the effect of mobility models on routing protocols for various site visitors instructions in MANETs. There have been many factors that affected the overall performance of routing protocols which include mobility and visitors styles. We designed several simulation models that added these factors together and measured the software performance in terms of end -to-end throughput (bit rate), latency, and jitter. three instructions of MANET routing algorithms (Proactive, Reactive, and Hybrid), mobility models (Random Waypoint and group), and three instructions of visitors styles (constant bit rate, variable bit rate, and random) have been used.

Keywords: FSR, AODV, OLSR, DYMO, and ZRP

Introduction:

Main challenges in QoS provisioning in MANET include dynamic bandwidth management to guarantee the end-to-end delay and throughput performance to satisfy the requirements for diverse applications. There are several factors that affect the QoS including mobility, routing algorithms, and traffic patterns. Recently, many researchers have developed several theoretical models to describe mobility, traffic patterns, and routing algorithms. In this thesis, we intend to conduct a comparative analysis of several routing algorithms under a few popular mobility models and diverse traffic patterns. Specifically, we have developed simulation models that incorporate various mobility models, routing algorithms, and traffic sources to measure applications' performance in 1 terms of end-to-end throughput (bit rate), latency, and jitter. Three classes of MANET routing algorithms (Proactive, Reactive, and Hybrid), two mobility models (Random Waypoint and Group), and three classes of traffic patterns (constant bit rate, variable bit rate, and random) have been investigated. We have designed network topology based on randomly placed devices over a communication area. While we studied various simulation tools, we found that QualNet [1] offers many important analytical details to better assess the trade-offs across layers. This work provides network designers and network operators with significant insight about the relationship between mobility and routing, on one hand, and users and their applications, on the other hand, to effectively manage their network.

Issues in Mobile Ad hoc Networks (MANETs)

Generally, MANETs were first proposed for military battlefield and disaster recovery communications. However, recent evolution in several application areas such as remote sensing, smart highways, remote

environmental and animal movement outposts are based on ad hoc networks concepts. These applications require different QoS requirements. The bandwidth requirements vary from a few Kb/s to several Gb/s. Some are delay-sensitive, while others are loss-sensitive. Also, some are highly mobile and others may have limited mobility.There are several issues in MANETs that are very difficult to integrate with internet. We will address some of them below.

Security

Security is an important issue in MANETs. In wireless networks, the link is more vulnerable to nose, error, and eavesdropping than a wired link. Providing security in the presence of mobility and wireless links is more challenging. Therefore, security is often performed through encryption and/or physical layer spread spectrum modulation (direct sequence or frequency hopping). It is a difficult problem to find a trust channel.

Routing

Routing is one of the most difficult problems to implement in MANETs. Routing is the process of finding the best path to send data packets from a source to a destination. Since every device acts as a router, the network becomes more complicated to manage. This is because each node can move randomly in any direction within the network. When a node moves, new paths need to be discovered and selected, as the optimal route in specific time might not work after a few seconds. Also, the environment can be changed from indoor to outdoor scenarios that cause a path to fail.

Scalability

The operation of MANETs strongly depends on network size and packet size. Routing and finding feasible paths become more complicated with size. Similarly, packet size has major impact on forwarding. Scalability measures the ability of the network to provide an acceptable level of services as network grows in size and traffic. Routing protocols add more limitation for the scalability of MANETs. The dynamic topology of a MANET creates a big challenge to provide the huge amount of broadcast message in a dynamic environment.

Quality of Services

Quality of Services (QoS) is a very challenging issue for the developers. It is harder to achieve high performance in MANET due to highly dynamic topology. The network should be able to provide the required quality of service for user's demand. The performance can be characterized by delay, jitter, and bandwidth. It is difficult to maintain the quality of these parameters under mobility. In a MANET, cross-layer optimization is needed to achieve quality of service.

Other Issues Related to Quality of Service (QoS) in MANETs

Quality of services in MANET is limited due to the lack of resources and continuous topology changes, which make QoS provisioning a very complicated process. The QoS should be provided in all network layers such as application layer, transport layer, etc. There are other equally important issues that are briefly described below.

Unpredictable Link Properties

Wireless links are unpredictable and change their conditions with time. Signal quality fluctuates due to several factors such as fading, interference, and multipath cancellation. These properties will influence the bandwidth and delay measurements.

Node Mobility

Mobility of devices (nodes) changes the network topology frequently, which changes routes dynamically. Mobility affects the transmission range between two devices. When a device moves, it may cause link

failure that increases packet loss rate and retransmission. Mobility influences many factors including channel access, routing, and applications.

Hidden and Exposed Terminal Problems

Media access control (MAC) uses a traditional *Carrier Sense Multiple Access protocol* (CSMA), which introduces the hidden and exposed terminal problems. The hidden terminal problem happens when two nodes (A and B) are hidden from each other when they are colliding at receiver node C. An exposed terminal problem will result from a scenario where node B and C attempt to transmit data to node A and D respectively. Node B is exposed to the signal range of node C, which postpones its transmission. Nodes B and C hear each other; therefore, they will not transmit.

Limited Battery Life

Battery life is one of the important issues in MANETs. Mobile devices use batteries that have a limited capacity of power to supply devices. If the power of the device is consumed, it will affect itself and the entire network. QoS should be power aware and power efficient.

Route Maintenance

Given that the topology in MANET is a dynamic, this changes the behavior of communication medium making the accurate maintenance of network state information very difficult. Therefore, the routing algorithms in MANET must deal with inaccurate information. Nodes in a MANET can enter and leave an environment continuously, which may cause broken path during the data transfer. Thus, the need of a route withminimal delay and overhead emerges. end-to-end QoS requires a bandwidth reservation at intermediate nodes, which may become cumbersome due to dynamic topology.

Traffic Model

There are many types of traffic sources that can be generated as a stochastic model of traffic or data source. We can classify data traffic into four types:

Constant Bit Rate (CBR)

CBR generator generates a fixed data rate (deterministic rate) by transmitting packets of a fixed size at a fixed rate, which is used for measuring the data rate in the network. CBR is used to simulate applications between end systems, which require expected response time and fixed amount of bandwidth to be continuously available during the connection time. It is useful for streaming multimedia content including applications services such as video and voice services on a limited capacity channel because it uses maximum bit rate, not the average. Therefore, CBR is used to take advantage of all capacity. It is not the optimal choice for storage due to the fact that it does not allocate enough data for complex sections because it wastes data for simple sections.

To solve the problem of lack of enough data for complex sections, it can choose a high bit rate to guarantee that there will be enough for the whole encoding process [48]. It is difficult to achieve a perfect CBR that deals with other coding schemes such as Huffman coding or run length encoding to produce variable length codes. This problem can be partly solved by changing the quality or completely solved by padding. When the stream video uses a CBR, the sender could be under the CBR rate. Therefore, it is necessary to add stuffing packets in the stream to complete the data rate required. These packets do not have any effect on the stream.

Variable Bit Rate (VBR)

VBR is opposed to constant bit rate (CBR) where VBR files change the amount of output data per time segment. VBR allows a higher bit rate that requires more storage space to be allocated to the more

complex segments of media files, while less space is allocated to less complex segments. VBR uses an average bit rate, which calculates the average of these rates. This feature of VBR produces a better space management compared to a CBR file of the same data. It allows more flexibility to use bits available to encode the sound or video data more precisely. It uses fewer bits in small encode demand and more bits in high encode demand. There are several disadvantages that are shown on VBR, which may take additional time to encode data. Therefore, the process becomes more complex. VBR may show problems during streaming when the bit rate exceeds the data rate of the communication path. We can avoid this problem by limiting the bit rate during encoding through increasing the playout buffer.

Random Traffic

Random traffic is a stochastic model of the traffic flows (a random distribution based traffic generator) such as a cellular network and computer network. These random distributions are applicable to both session property and traffic property. A packet generation model is a traffic of packet flows such as web traffic, and the data of which can be sent and received by a user's web browser. It can generate different traffic models: Exponential, Pareto, and Uniform. Exponential is an ON/OFF mode that the holding time follows in an exponential distribution. During the ON period, packets are generated at a burst rate while the OFF period does not generate any traffic. Pareto is also ON/OFF traffic with burst times follows Pareto distribution. These models are used to analyze the performance of different protocols, algorithms, and network topologies.

File Transfer Protocol (FTP)

FTP is a standard network protocol used to transfer files from one device (client) to another (server) over TCP network. FTP uses a separate channel for control and data connections between client and server. It also uses an authentication system (username and password) to ensure that only authorized users are allowed to access a server, but, sometimes, anonymous users can connect to the server if it is set up to provide files to any user requesting them. FTP uses encryption content for secure transmission that keeps the username and password secure such as Secure Sockets Layer (SSL)/ Transport Layer Security (TLS), and Secure Shell (SSH) File Transfer Protocol (SFTP). When the connection is established and authentication is complete, there are two basic commands used to send or received files. The main goal of FTP is to make file transfer simple and easy. FTP can be used with other applications to move files from one place to another.

Conclusion:

There are several types of mobility models used in different studies. For example, random waypoint model is used more widely than other models. In this model, nodes move and select destination in a random way. After that, nodes pause for a period of time (nodes stop for some time after they reach the destination), then select the new destination randomly and move. A new speed and a new destination direction are chosen independently from the previous movement. Pause time is an important parameter in the Random Waypoint model that affect the behavior of mobile nodes. Random waypoint and group mobility models are used in our simulation.

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