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Study and implementation of Ad-hoc ROUTING PROTOCOLS

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ABSTRACT

Ad-hoc networks are characterized by a lack of infrastructure, and by a random and quickly changing network topology; thus the need for a robust dynamic routing protocol that can accommodate such an environment. Consequently, many routing algorithms have come in to existence to satisfy the needs of communications in such networks. This project work presents a performance comparison between two categories of routing protocols, table-driven (Proactive) and on-demand (Reactive) routing protocols, this two categories were illustrated by using two different examples of routing protocols, first example is DSDV (Destination Sequenced Distance-Vector) from the Proactive family and the second example is AODV (Ad Hoc On-Demand Distance Vector) from the Reactive family. Both protocols were simulated by using NS-2 (network simulator-2) package. Both routing protocols were compared in terms of average throughput (packets delivery ratio) and packet loss ratio, while varying number of nodes and by using the Trace file. Although DSDV perfectly scales to small networks with low node speeds, AODV is preferred due to its more efficient use of bandwidth.

1. INTRODUCTION

Mobile Ad Hoc Network (MANET) is a collection of communication devices or nodes that wish to communicate without any fixed infrastructure and pre-determined organization of available links. The nodes in MANET themselves are responsible for dynamically discovering other nodes to communicate. It is a self-configuring network of mobile nodes connected by wireless links the union of which forms an arbitrary topology. The nodes are free to move randomly and organize themselves arbitrarily; thus, the network's wireless topology may change rapidly and unpredictably. MANETs are usually set up in situations of emergency for temporary operations or simply if there are no resources to set up elaborate networks. These types of networks operate in the absence of any fixed infrastructure, which makes them easy to deploy, at the same time however, due to the absence of any fixed infrastructure, it becomes difficult to make use of the existing routing techniques for network services, and this poses a number of challenges in ensuring the security of the communication, something that is not easily done as many of the demands of network security conflict with the demands of mobile networks, mainly due to the nature of the mobile devices (e.g. low power consumption, low processing load).

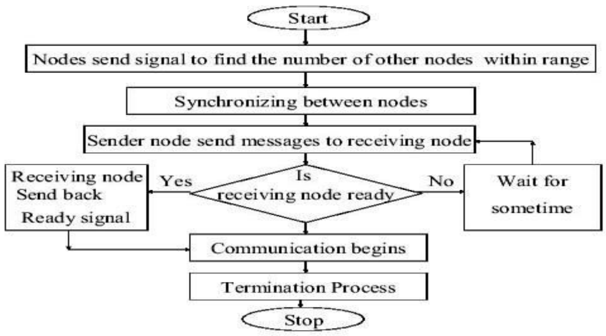

Figure 1. working of a general ad-hoc network

The OSI Layer

An **open system interconnection (OSI) model** is a set of protocols that allows any two different systems to communicate regardless of their underlying architecture. The purpose of the OSI model is to show how to facilitate communication between different systems without requiring changes to the logic of the underlying hardware and software.

The OSI model is not a protocol; it is a model for understanding and designing a network architecture that is flexible, robust and interoperable.

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The OSI model is layered framework for the design of network systems that allows communication between all types of computer systems. If consists of seven separate but related layers, each of which defines a part of the process of moving information across a network (see figure 2.). Understanding the fundamentals of the OSI model provides a solid basis for exploring data communications

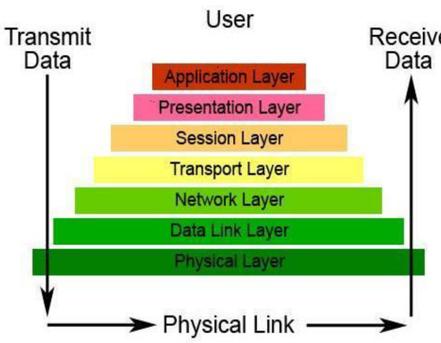

Figure 2 the seven layers of OSI

Proactive Routing Protocol

These protocols are also referred to as Table Driven Routing Protocols. These protocols are extensions of the wired network routing protocols. They maintain the global topology information in the form of tables at every node. These tables are updated frequently in order to maintain consistent and accurate network state information. In proactive routing protocols, nodes continuously search for routing information with in a network, so that when a route is needed, the route is already known. Periodically floods the network to reconstruct the routing table E.g. DSDV (Destination Sequenced Distance Vector) routing protocol. The Destination Sequenced Distance-Vector (DSDV) routing protocol, is example for the protocols that belong to this category.

Destination Sequenced Distance Vector (DSDV) Routing Protocol

The Destination Sequenced Distance Vector Routing protocol (DSDV) is a table-driven algorithm based on the classical Bellman-Ford routing mechanism. The improvements made to the Bellman-Ford algorithm include freedom from loops in routing tables.

Every mobile node in the network maintains a routing table in which all of the possible destinations within the network and the number of hops to each destination are recorded. Each entry is marked with a sequence number assigned by the destination node.

Ad-hoc On-Demand Distance Vector (AODV) Routing Protocol

The Ad-hoc On-Demand Distance Vector (AODV) routing protocol builds on the DSDV algorithm previously described. AODV is an improvement on DSDV because it typically minimizes the number of required broadcasts by creating routes on a demand basis, as opposed to maintaining a complete list of routes as in the DSDV algorithm. The authors of AODV classify it as a pure on-demand route acquisition system, since nodes that are not on a selected path do not maintain routing information or participate in routing table exchanges.

When a source node desires to send a message to some destination node and does not already have a valid route to that destination, it initiates a path discovery process to locate the other node.

It broadcasts a route request (RREQ) packet to its neighbors, which then forward the request to their neighbors, and so on, until either the destination or an intermediate node with a “fresh enough” route to the destination is located. (Figure 3.1 a) illustrates the propagation of the broadcast RREQs across the network. AODV utilizes destination sequence numbers to ensure all routes are loop-free and contain the most recent route information. Each node maintains its own sequence number, as well as a broadcast ID. The broadcast ID is incremented for every RREQ the node initiates, and together with the node’s IP address, uniquely identifies an RREQ. Along with its own sequence number and the broadcast ID, the source node includes in the RREQ the most recent sequence number it has for the destination. Intermediate nodes can reply to the RREQ only if they have a route to the destination whose corresponding destination sequence number is greater than or equal to that contained in the RREQ.

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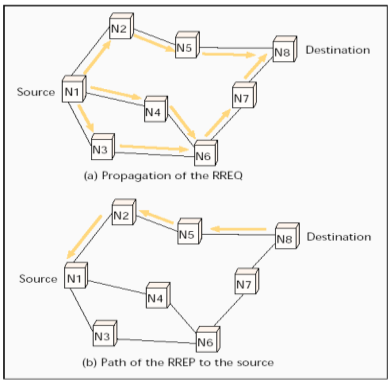

Figure 3 AODV route discoveries

Network Simulator Introduction

Network simulator 2 (NS-2) is an open source discrete event simulation tool used for simulating Internet protocol (IP) networks. It was developed by UC Berkeley and widely used worldwide for network simulation purposes. The NS-2 software uses TCL as a front-end interpreter and C++ as the back end network simulation engine. Network simulation scripts in TCL are used to create the network scenarios and upon the completion of the simulation, trace files that capture events occurring in the network are produced. The trace files would capture information that could be used in performance study, e.g. the amount of packets transferred from source to destination, the delay in packets, packet loss etc. However, the trace file is just a block of ASCII data in a file and quite cumbersome to access using some form of post processing technique.

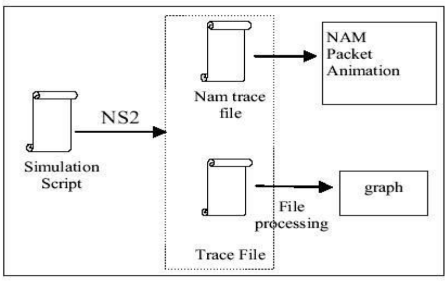

Figure 4.1 Ns-2 Simulation Process Flow

Simulation Scenario for DSDV Routing Protocol

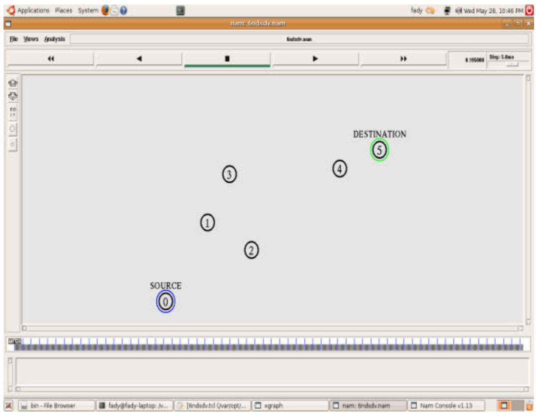

Figure 5 topology of a six nodes ad-hoc network

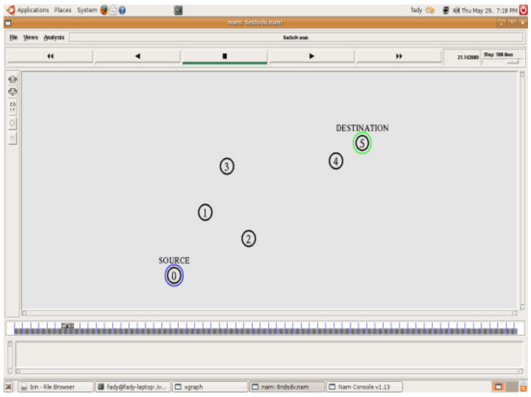

Figure 6 DSDV routing protocol

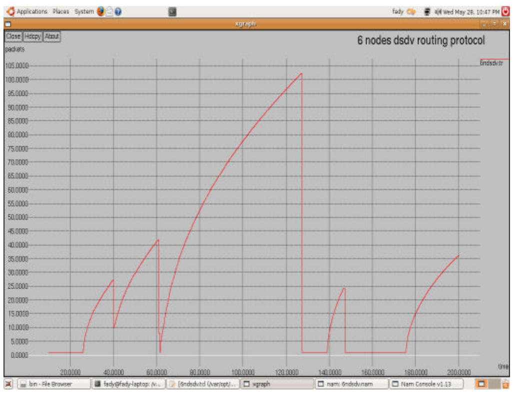

Figure 7. TCP window size in a six node scenario with DSDV routing protocol

Conclusion

We have compared the performance of DSDV (Destination Sequenced Distance-Vector) from the Proactive family with the second type is AODV (Ad-hoc On-Demand Distance Vector) from the Reactive family. We used a detailed simulation model to demonstrate the performance characteristics of these protocols. By simulating we can argue that if delay is our main criteria than DSDV can be our best choice but if reliability and throughput are our main parameters for selection then AODV gives better results compare to others because its throughput and packet delivery ratio is best among others. While there are many other issues that need to be considered in analyzing the performance of ad-hoc networks, we believe that our work could provide intuition for future protocol selection and analysis in ad-hoc networks. While we focus only on the network throughput, reliability and the delay, it would be interesting to consider other metrics like power consumption, the number of hops to route the packet, fault tolerance, minimizing the number of control packets etc.

In the future, extensive complex simulations could be carried out to gain a more in depth performance analysis of the ad-hoc wireless networks and enhancing the performance and also for proposing new protocols and new algorithms to solve some of ad-hoc routing protocol problems.

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