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ENHANCING DATA AVAILABILITY THROUGH REPLICATION IN MOBILE AD-HOC NETWORKS

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ABSTRACT

A Mobile Ad-hoc Network (MANET) is a self-configured infrastructure-less network. It consists of autonomous mobile nodes that communicate over bandwidth-constrained wireless links. Nodes in a MANET are free to move randomly and organize themselves arbitrarily. They can join the network or quit the network in an unpredictable way, such rapid and untimely disconnections may cause network partitioning. In such a case, the network faces multiple difficulties, which in turn can dramatically impact the applications deployed on top of it. One major problem is data availability. Replicating data on multiple nodes can improve availability and response time. Determining "when" and "where" to replicate data in order to meet performance goals with many users and files, and dynamic network characteristics are difficult. We identify the issue of power consumption and propose an efficient method to replicate data in appropriate nodes in the network.

KEYWORDS: Data Replication, mobile ad hoc network databases, AODV, OPNET.

INTRODUCTION

In the recent years communication technology and services have experienced an unprecedented development. Mobility has become very important, as people want to communicate anytime and from anywhere. In the areas where there is little or no infrastructure is available or the existing wireless infrastructure is expensive and inconvenient to use, Mobile Ad hoc Networks, called MANETs, are becoming useful. A mobile ad hoc network (MANET) is a type of wireless ad hoc network, and is a Self-configuring network of mobile devices connected by any number of wireless links. Every device in a MANET is also a router because it is required to forward traffic unrelated to its own use. The primary challenge for building a MANET is for each device is to continuously maintain the information required to properly route the traffic.

ISSUES IN DATA REPLICATION

Replica relocation

This issue is related to where the data must be replicated or in other words which node must have the data replica.

Consistency management

This issue is related to making sure that the data present in the node is consistent.

Power Consumption

The power available in a particular node must also be taken into account while transferring data as there is a chance of data being dropped by a node of low power as it does not have enough power to send or receive the data.

Mobility Prediction

In mobile networks a frequent problem that occurs is that of mobility prediction. Only if a particular node within the range of the network can it send or receive data from other nodes.

ABOUT OPNET

OPNET is a comprehensive software environment for modelling, simulating, and analyzing the performance of communications networks, computer systems and applications, and distributed systems. Is provides the user with a well built and detailed graphical user interface giving him the advantage to create difficult network topologies with different node characteristics and apply various simulations on it. OPNET is also used as a decision support tool to provide insight into the performance and behaviour of existing or proposed networks, systems, and processes. Specific tools are included with each OPNET license that assist users through the following phases of the modelling and simulation cycle:

Figure: Phases of the modelling and simulation cycle

THE SCENARIO OF THE PROPOSED SYSTEM

Our model basically consists of three kinds of nodes which can operate in four different types of modes. The 3 types of nodes are as follows.
1. Primary node: This node should maintain the id and power availability of all nodes.
2. Secondary node: This node should contain the replica of the data. So whenever a request is made it should respond to client node by providing the data.
3. Client node: This node should send requests for data to the primary server and contact the suitable secondary server for the data by the id sent by primary server.

PACKET FORMATS

Primary node sends the Hello packet to all the available nodes in the network and each node responds to the hello packet by giving their power availability value. The primary node maintains these values in a log.

Node ID	Remaining Power

Figure: Hello packet

Client node sends the Request packet to the primary node. The packet format for the request packet is shown below.

Client ID	File Name

Figure: Request Packet

The format of the Response packet from the primary node is shown below.

| Secondary Server ID |
|---------------------|

Figure: Response Packet (Primary Server)

The secondary node also sends the proper data or file requested by the client through a response packet.The format of this packet is shown below.

Secondary Server ID	File

Figure:.Response Packet (Secondary Server)

METHODOLOGY USED
The flowchart below will represent the cycle of events taking place in sequence.
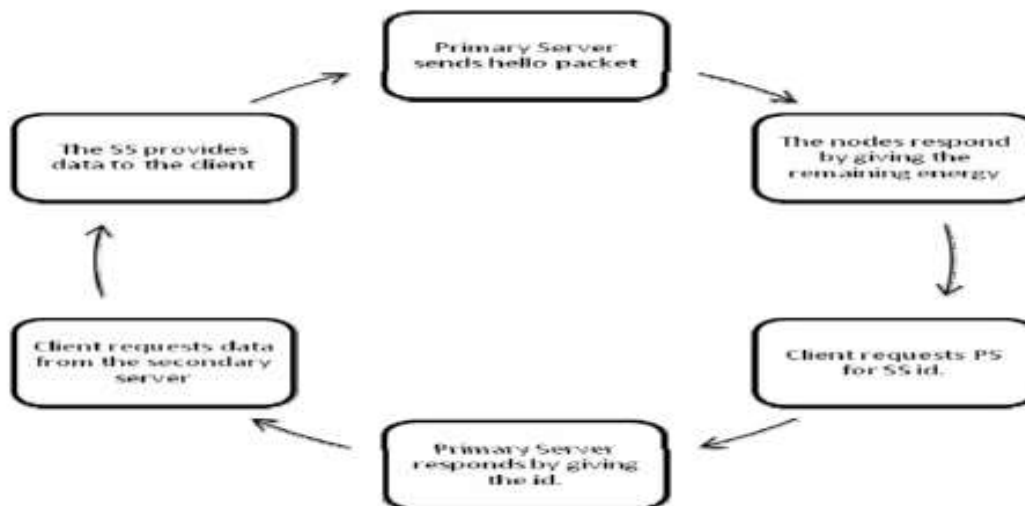
Figure: Methodology

Power-aware routing in mobile wireless ad hoc networks has been investigated extensively in the framework of reactive routing in the recent years. We propose a power calculation formula in which a certain threshold value of power is needed for the node to function. According to this formulae,
If Power Available <= Threshold value then,
i. if the node is a primary server then choose a neighbouring node with maximum power and make it the primary server.
ii. If the node is a secondary server then, choose a neighbouring node with maximum Power and make it the secondary server. Else
i) No action is taken.

Selection of an appropriate path
Remaining power is calculated in each and every node periodically and are maintained in a variable. In any path of transmission from the source node to the destination node, the cumulative remaining power is calculated from all the nodes in the path. Which is done using the below formula.
Cumulative remaining power = Sum of the remaining powers of all the nodes in the path.
The number of hops is also maintained in a variable. Using the cumulative remaining power and the number of hop counts, we obtain the average cumulative remaining power by the formula,
Average cumulative remaining power = (Cumulative remaining power/No. of hops)
The path which is having the higher average cumulative remaining power is considered highly reliable and it is chosen for the data transmission.

AN OVERVIEW OF AODV PROTOCOL
Since the issue we are dealing with is power, our protocol aims to reduce the power consumed and it also aims to reduce the loss of data due to low energy available. So we calculate the consumed energy for each transaction i.e. sending and receiving data, we also update the remaining energy after every transaction so that we have the up to date values for remaining energy in each node. We also calculate the cumulative remaining energy and maintain the hop count for each route. We also calculate the average remaining energy for each route. By doing so, we get to know the route which is more reliable or efficient for sending or receiving the data. The main steps involved are the route request and the route reply.

The following diagram shows the protocol scenario:

Figure: Protocol Scenario

From the above diagram we can see that there are 2 routes from source to destination. The first route can be from the source to the destination via the low energy node-1(LE-1), while the other route can be from source to destination via the high energy nodes (HE-1, HE-2, HE-3, HE-4). Since the route request arrives earlier via the low energy node (LE-1) the reply is sent via that node in any normal protocol. But according to our protocol the source gets the route reply from both the routes and we maintain a variable which regularly updates the route which has the maximum average remaining energy. This is done using the formulae explained in the previous chapter. So in the next transaction the source uses the high energy nodes to communicate with the destination. We update the variable by comparing the existing route average remaining energy with the incoming route average remaining energy. If the incoming route average remaining energy is greater than that of the existing route's then we update the route else no change is made. This is explained in the code which is provided in the next section. All calculations pertaining to finding the consumed energy, the remaining energy, the cumulative remaining energy and the average remaining energy are found out or updated at every transaction. So all the values are up to date and the route found out for transaction is the best possible route at that instant of time.

CONCLUSION
Thus we created a power aware protocol which can be used to replicate the data, by which the availability of data and the response time of the network increases .The power aware custom protocol reduces the power consumption in the network, and improves the reliability of data transmission in the network thus increasing the network lifetime.

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