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Design and Implementation of Context-Aware Adaptive Routing for Delay-Tolerant Mobile Networks

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ABSTRACT: Research on mobile ad hoc networks often operates under the constant assumption that a direct connection exists between any two nodes in the network. For many decentralized mobile networks uses, such as vehicle networks, sensor networks for wildlife monitoring, communication systems in space, and emergency operations networks, this assumption is totally unrealistic. Delay tolerant networking (DTN) has recently attracted a lot of attention from researchers looking for a solution to the issue of message routing in partitioned networks. For mobile networks that are intermittently linked, this article details the process of creating and implementing the Context-aware Adaptive Routing (CAR) protocol, which allows for delay-tolerant unicast communication. The protocol is based on the idea that nodes might act as messengers between different parts of the network.

KEYWORDS: Delay Tolerant Network (DTN), Context-aware Adaptive Routing (CAR), Destination Sequence Distance Vector (DSDV).Transmission Control Protocol/Internet Protocol (TCP/IP)

I. INTRODUCTION

The field of delay-tolerant networking, or DTN, has recently attracted a lot of attention from researchers [1]. Progress in wireless and mobile technology has facilitated the development of network systems in which occasional disconnections are not uncommon. Current TCP/IP network models, which allow end-to-end communication, do not operate in these types of networks. Assuming a direct path between the sender and receiver is not always viable in these systems.

Therefore, any synchronous communication approach is likely to exhibit significant performance issues. Existing models of TCP/IP networks, which enable end-to-end communication, are incompatible with these networks. In certain systems, it is unrealistic to expect a direct path from the transmitter to the receiver.

To function, synchronous protocols require an always-on connection between the message's originator and its recipient. If this connection is not present, the originating host will receive a failure indicator at best. In contrast, asynchronous communication does not require the persons engaged to be in the same connected segment of the system. Depending on whether the nodes are in motion or separated by large physical distances, wireless ad hoc networks can be categorized into different segments. These networks utilize specialized nodes to implement a store-and-forward mechanism for the purpose of gathering and transmitting data to mobile sinks.

Much of the prior literature on mobile ad hoc networks has presupposed a direct link between the 2 nodes. Hence, it is necessary to develop novel communication paradigms and strategies that enable communication even in situations where networks are temporarily divided, such as when hosts are in motion. This paper especially focuses on the challenges within this particular application domain. One simple way is to use a constant flooding mechanism to spread the messages to all hosts. As part of the epidemic routing approach, a host will flood all of the hosts in its linked segment of the network with the message it plans to send. Every carrier host stores the message in a buffer. If the host moves and encounters other hosts that do not have a copy of the message, it transfers the message to them, turning them into new carriers [2]. Epidemic routing is a viable strategy in situations when there is a lack of knowledge on the probable movement patterns of nodes inside the system. In the field of mobile ad hoc networks, there have been

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numerous basic methodologies proposed for asynchronous communication.

Finding the best carrier or carriers for each message is a relatively simple operation, but it's also the most difficult part of developing an algorithm to deliver asynchronous messages. Also, it's possible that the sender and receiver will never meet, so leaving the message with them might not be the best choice. The routing protocol described in this study is a component of this endeavor.

Organization

The parts that follow provide the framework of this study. In Section 2, the current study's goal and scope are described. The system flow diagram and an analysis of the system design are presented in Section 3. Section 4 displays illustrations of the asynchronous delivery of messages. Section 5 provides the final outcome or result of the current research or project. Section 6 provides a comprehensive list of references.

II. OBJECTIVE AND SCOPE OF THE PRESENT WORK

In this research, we look at how to make one-to-one communication possible in mobile networks that can tolerate delays, even in the face of random drops in connection. The Context-aware Adaptive Routing protocol is suggested as a routing mechanism that relies on predictions.

By leveraging mobile nodes that move between discrete groupings of nodes (called clouds) to send messages between clouds, this technology enables message exchange. Even if two nodes are never physically connected in the same network, they can nonetheless share delayed information with each other.

Think about the situation where two sets of nodes are linked as shown in Figure 2.1(a) to get a feel for how this protocol works.

Fig. 2.1 (a) Two network clouds, showing delivery probabilities for message transmission between N1 and N6

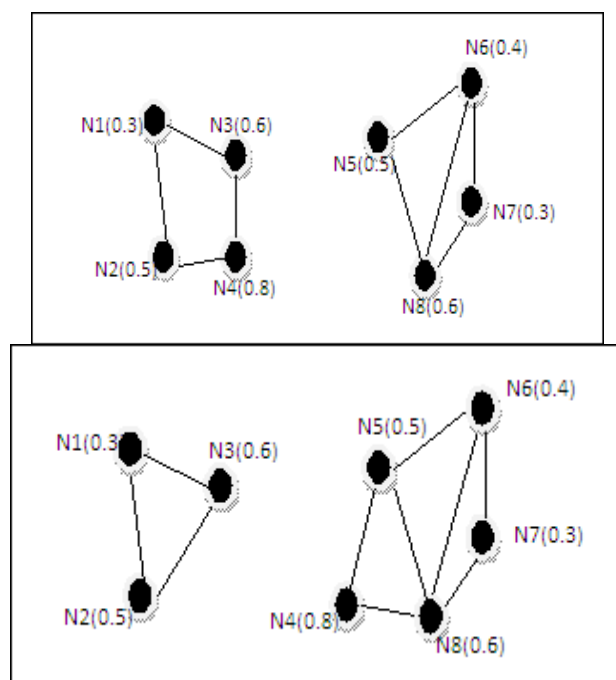


Fig. 2.2 (b) Next, N4 flies into the second cloud with the message.

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We take it for granted that the DSDV protocol [8] is used for synchronous routing in this specific implementation. Host N1 desires to transmit a communication to N6. Synchronous execution is not possible due to the absence of a connected pathway between the two. Assume that the chances of delivery for N6 are depicted in Figure 2.2 (a). In this scenario, the host with the highest likelihood of successfully delivering to host N6 is N4. As a result, the message is transmitted to N4 and thereafter stored there. N4 moves to the opposite cloud when a certain amount of time has passed, as shown in Figure 2.2(b). The message has been transmitted to its intended destination successfully since a continuous path has been established between N4 and N6. With the DSDV protocol, it is important to mention that N4 can promptly deliver the message after entering the cloud because it will obtain the routing information about N6 at that time.

Delivery probabilities are determined based on local synthesis of context information, including how quickly a host's connections are changing (used to assess the possibility of encountering other hosts) and its proximity to the message receivers. In this example, "context" means the set of characteristics that describe the various parts of the system that can be used to send messages. A change in connectivity, more especially the number of connections and disconnections that a host has faced within the last T seconds, is an example of context information. This metric quantifies the degree of mobility and, as a result, the likelihood of a host coming into contact with other hosts.

Given our proactive routing protocol, each host regularly transmits two sets of information. Included in the first set are synchronous routing specifics, such as distance-based routing tables and next-hop host identities. For the remaining hosts, the second set contains delivery probabilities [2]. The host then updates its routing tables after receiving this information. With respect to the asynchronous routing table, each host maintains a record of entries, where each entry is a tuple containing the fields. We choose to look into the case where each message is given to a single carrier rather than a group, meaning that there is only one entry for each destination in the list. The message is buffered by the host when it is selected as a carrier and received.

After solving the routing problem, the algorithm was considered a success. The routing table has a sequence number for each entry. The sequence number is usually even if there is a relationship, and odd if there isn't. The receiver is responsible for generating the number, and the transmitter is obligated to use it to give the future update. Routing information is disseminated among nodes by transmitting routing-table data to the interconnected nodes.

III. SYSTEM DESIGN

Modules:

- Network construction
- Route calculation
- Deliverable probability calculation
- Network reconfiguration

Network construction:

Building a network topology is the main topic of this course. A mobile network consists of interconnected nodes that share information in two ways: directly and indirectly. Each node may or may not be directly connected to other nodes.

Route calculation:

This module provides information about the path that is now accessible. Data transmission from the source node to the receiver node has started when paths are available. Use the quickest path to send data to the receiving node out of all the possible paths. Alternatively, the process has commenced to locate whether the recipient node is accessible within any other network.

Deliverable probability calculation:

Within this module, we determine the node with the highest likelihood of successful delivery among all the nodes. A "most deliverable node" refers to a node in a network that has the highest number of connections. The connection might be either unidirectional or bidirectional with other nodes. This node is only

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appropriate for transitioning from one network to another network. It possesses the majority of pathways inside the network.

Network reconfiguration:

In this module, the node is transferred from Network1 to Network2. Simply said, Network2 is a network of nodes that receive data and send it on to other nodes in the network. The node that can be delivered connects to one node in Network2, which just so happens to be the node with the highest delivery rate in Network2. Network1 and Network2 have been successfully reconfigured and retain the previous connection history of nodes.

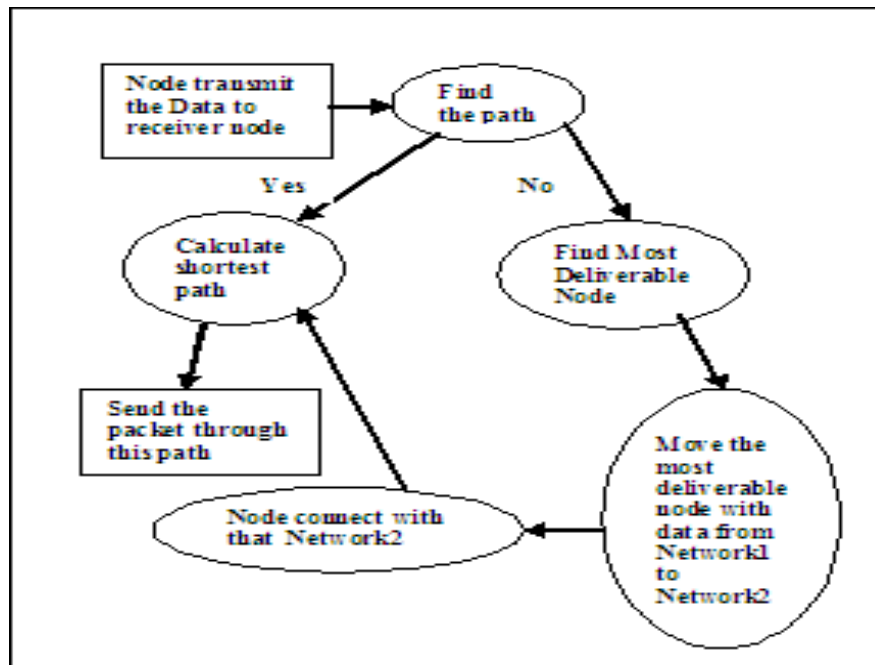


Fig 3.1 System flow-chart

Fig 3.1 shows the system flow diagram for finding the route for message delivery for both synchronous and asynchronous communication.

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IV. RESULTS

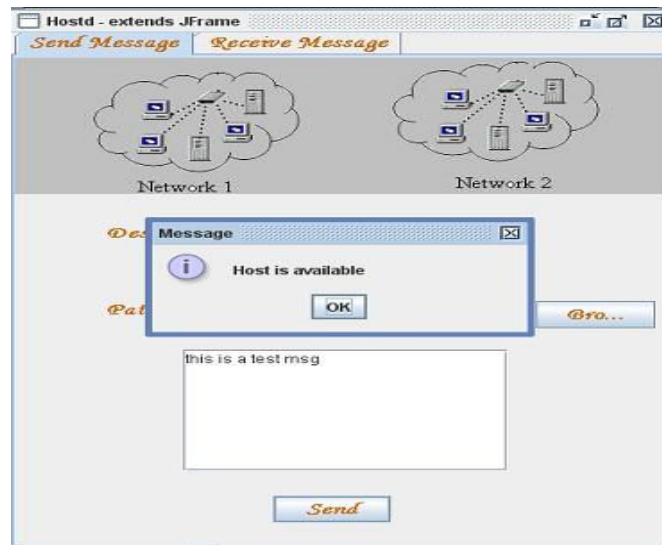


Fig.4.1 Snapshot showing availability of destination node

Figure 4.1 illustrates the accessibility of the destination host for the delivery of messages. The procedure checks if the destination host is reachable, whether it's on the same network or a separate one, whenever a message needs to be sent.



Fig. 4.2 Snapshot showing asynchronous delivery

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Fig 4.2 shows the asynchronous delivery of message. It means that the destination is present in the other network.



Fig. 4.3 Snapshot showing message sent

Fig 4.3 shows the message has been sent to the specified destination using asynchronous message delivery.

V. CONCLUSION

The CAR protocol, which allows for communication in mobile ad hoc networks that cannot tolerate delays, has its design and implementation detailed here. Even in the absence of a continuous path between the sender and receiver, our research shows that prediction methodologies can be used to build store-and-forward mechanisms for message delivery in mobile ad hoc networks with intermittent links.

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