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A Modified CAR Routing Method for Delay Tolerant Mobile Ad Hoc Networks

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The vast majority of mobile ad hoc networking research makes a very large assumption, that communication can take place between nodes that are simultaneously accessible within the same connected cloud. In reality this assumption is likely to be poor one, particularly for sparsely or irregularly populated environment. Some ad hoc network scenarios are characterized by frequent partitions and intermittent connectivity. MANETs are challenging networks mainly because of node mobility. Indeed, node mobility causes fluctuations of the network topology. In particular, unless specific conditions are met the network is likely to be partitioned. When considering these challenges, mobile ad hoc networks can be referred to as Delay Tolerant Networks (DTN. The key distinguishing feature of a DTN from Mobile Ad Hoc Network (MANET) is that there may never be an end to end path. Hence, existing ad hoc routing schemes that assume that an end-to-end path exists from a source to a destination do not work in such challenging environment. The traditional approaches may fail to deliver a message when the link is highly unavailable. Disruption/Delay Tolerant Network (DTN) enables transfer of data when mobile nodes are connected only intermittently. The contribution of this paper is to modify the existing context aware protocol. the CAR assumes only one message carries for the entire data transmission. The drawback of the CAR is if the particular potential message carrier is unable to deliver the message, the entire message could be lost. In order to tackle the problem here we are introducing potential multiple receivers to avoid the packet loss and to ensure the reliable transmission the acknowledgment mechanism also useful. So the modified CAR protocol will work better than the existing one.
Keywords: Delay Tolerant Routing, Multicasting, Inter Region Communication, Disconnected Mobile Ad Hoc Networks

Introduction

In Recent years Delay-Tolerant Networking (DTN)[1] has emerged as a new area of research with many promising applications. DTNs are characterized by intermittent connectivity, network partitioning, long and variable delays, and high error rates. Such performance-challenging conditions can be found in many different environments such as vehicular networks, sparse sensor/actuator networks, in the field military or disaster-relief networks, satellite and deep-space interplanetary communications , and terrestrial networks serving remote or rural areas[14]. Interesting real-life experiments comprise "pocket-switched networks" based on human mobility, networks based on public transportation systems, wildlife tracking, and rural kiosks providing Internet access in developing nations. A typical DTN scenario consists of a sparse network of fixed or mobile devices, where most of the time there does not exists a complete path from a source to a destination, or such a path is highly unstable and may soon break. Over time, different links come up and down due to node mobility. Several architectures have been introduced in the literature [21] in order to cope up with delays.

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Delay Tolerant Mobile Ad Hoc Networks(DTNs) are fluctuating networks populated by a set of moving materials equipped with wireless communicating devices. These materials are called stations, nodes or devices. They can spontaneously interconnect each other without any pre-existing infrastructure. What makes the management of such network difficult is their nature. DTNs are mobile, ad hoc configuring, and frequently partitioned. At a given moment, two stations belonging to distinct partitions can neither communicate directly nor indirectly (using multi-hop communications). In these scenarios we envision a new network comprised of regions, and is defined as a cluster of nodes may or may not be having an end to end path between any two nodes in the clusters. Each region generates a large amount of data that can be grouped into bundles, which are then relayed to other destination region. The region could be either mobile, as in search and rescue groups or military battalions, or stationary, as in remote disconnected villages.

The contribution of this paper is to modify the existing CAR protocol we have used with delay tolerant networks. Our work is in two main areas. First, we consider environments where regions are mobile and dynamic in nature. Secondly, we introduce the idea of how these nodes are communicating with other nodes since the networks are disconnected.

2. Present Work

2.1. Manet Routing

Mobile ad-hoc routing is focused on situations where mobile nodes act as routers. MANET routing schemes fall broadly into the two major categories of proactive and reactive. Proactive protocols compute routes ahead of time; reactive protocols compute a route to a destination when traffic for the destination is ready to be sent. Reactive protocols save network resources by not advertising routes that are never used, but initial traffic for a new destination may be delayed as the route discovery process takes place on-demand. In each case, the goal of routing convergence is to determine an immediately available path from source to destination. In areas where node coverage is dense, this approach may be appropriate. For rural areas in developing regions, however, this is rarely the case. Moreover, while MANET routing tends to focus on selecting paths from many options, we are instead interested in being as efficient as possible with the few paths we have available.

2.2. DTN Routing

When an end-to-end path may fail to exist between a source and destination, both standard and MANET routing protocols no longer suffice. As a result, a number of proposals for disruption or delay tolerant (DTN) routing have recently surfaced. These schemes do not assume that an end-to-end network path necessarily exists, but rather than such paths(s) exist over time. In addition, routing information is not always assumed to be 100% accurate – a node may only have a probabilistic chance of successfully delivering a message. Thus, message replication is typically used to enhance delivery probability. Due to the richness and apparent novelty of the DTN routing problem, it has been a very active area of research.

The simplest DTN routing protocol is flooding or epidemic [6] flooding. In this scheme, messages are simply copied to any node that is reachable and does not already have a copy of the message. As new nodes become reachable due to mobility or other reasons, additional copies are made. The variations of epidemic routing have been found in [15]. Because of the overhead of these schemes, they are generally deemed to be too expensive for practical use, although they have been used for small networks (e.g. in Zebranet [19]). Examples of semi epidemic approaches are Spray and Wait [8],[3], based on the generation of a given number of copies sent to a random set of neighbors, and PRoPHET [7]. The Prophet routing protocol [7] bases the likelihood of a next hop being able to successfully deliver a packet on its previous behaviour, and only replicates a message if this probability exceeds a threshold.The publish subscribe routing[4] is a social aware routing , uses a different approach than epidemic routing. Another variation of routing method found in [5] uses time series information for message forwarding.

CAR [2] relies on a single copy of the message in the network, optimizing memory space and transmission overhead. For this reason, CAR is also suitable for scenarios composed of resource constrained devices, whereas epidemic and semi epidemic solutions are too expensive in terms of overhead. In [10],[12] the authors present a set of protocols for routing in ad hoc networks based on a partial or complete knowledge of the structure of the network using a time-varying network graph representation. The design of this protocol is based on a modified version of Djikstra's algorithm, minimizing the delivery delays and queuing times. In [9], the authors study the DTN routing problem from a resource allocation problem perspective. Zhao et al. in [20] discuss the so-called Message Ferrying approach for message delivery in mobile ad hoc networks. The authors propose a proactive solution based on the exploitation of highly mobile nodes called ferries. The routing problem is considered differently in [11],[13].

3. Proposed System Model

3.1. CAR Routing Method

Before describe the proposed system, first give a summary on how CAR [2] works. CAR is a unicast protocol designed for communication in delay tolerant networks that uses prediction to allow the efficient routing of messages to the recipient. CAR based on the idea of exploiting nodes as carriers of messages among network partitions to achieve delivery. A host willing to send a message to a recipient or any host in the multihop path to it uses a Kalman Filter prediction and Multicriteria decision Theory to choose the best next hop for the message. It supports synchronous and asynchronous message transfer. The delivery process depends on whether or not the recipient is present in the same connected cloud of the network as the sender. Each host calculates its delivery probabilities to all other nodes and sends to the connected cloud as a part of update of routing information. This metric indicates how likely it is that node will be able to deliver a message to that destination. So all the nodes are updates its routing table information within a fixed time period. The delivery process depends on whether or not the recipient is present in the same connected cloud of the network as the sender. If both are currently in the same connected portion of the network, the message is delivered using an underlying synchronous routing protocol to determine a forwarding path. If a message cannot be delivered synchronously; the best carriers for a message are those that have the highest chance of successful delivery, i.e., the highest delivery probabilities.

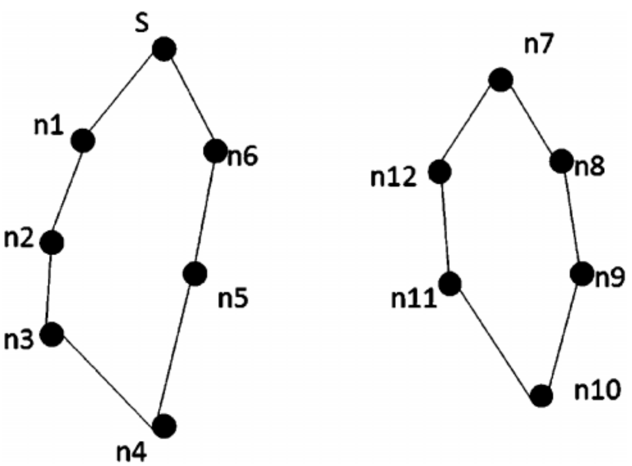
The message is sent to the host with the highest one using the underlying synchronous protocol. Delivery probabilities are synthesized locally from context information. We define context as the set of attributes that describe the aspects of the system that can be used to drive the process of message delivery.

3.2. Modified CAR Routing Method

The existing CAR protocol has several disadvantages. They used only one node as the message carrier. If the particular node fails to send the data to the destination the entire packet could be lost. In order to tackle this situation we are sending multiple copies for the message carriers. Also we are using multiple carrier nodes instead of single carrier. So it ensures message transmission reliability as comparing with CAR. The modified CAR will work more efficiently than the existing CAR protocol.

3.3. Example Scenario

This section describes how our modified CAR protocol works efficiently as comparing with other prediction based routing methods. The figure shows two disconnected mobile ad hoc network, S represents the source and n1, n1…represents intermediate nodes.



The nodes in the network may or may not be connected. Here we are using a parameter as a threshold probability and the NumCarriers. The threshold probability says if any particular node has to select as a carrier its probability should be above this threshold value. We select a number of nodes whose probability values are high as comparing with others. The NumCarriers specifies this particular number of carrier.

Initially the source S sends the packet to n8. It will check for the nodes having highest delivery probability say n4 and send the packet to it. Then it looks for the NumCarriers and send tha packet to all Numcarriers also. Initially n4 forwards the packet to the destination. If it's not reach the destination, checks for the other carriers to forward packets. In this way the modified context aware routing works well as comparing with older version.

4. PREDICTION AND EVALUATION OF CONTEXT INFORMATION

CAR uses predicted future values of the context attributes for making routing decision described in [2].The process of prediction and evaluation of context information as follows. Each host calculates its delivery probabilities for a given set of hosts. The calculated probabilities are sent to the other nodes within a connected region so that all other node updates its routing table. The delivery probabilities are calculated by evaluating the utility of each host as a potential carrier for a message. The context information related to a certain host can be defined using a set of attributes (X1, X2.. …Xn). CAR focus on two attributes, the change degree of connectivity and the future host colocation, because these are the attributes most relevant to the ad hoc scenario taken into consideration.

The change degree of connectivity of a host h is

$$U_{cdch} = \frac{|n(t-T)\cup n(t)| - |n(t-T)\cap n(t)|}{|n(t-T)\cup n(t)|}$$

Where n (t) is h's neighbor set at time t. The formula yields the number of host that became neighbors or disappeared in the interval [t – T, t] normalized by the total number of host met in the same time interval. A high value of means that h recently changed a large number of its neighbors.

The colocation of h with a host i is calculated as follows

$$U_{col_{n,i}} = \begin{cases} 1 & \text{If the host h is colocated with host i} \\ 0 & \text{otherwise} \end{cases} \qquad (2)$$

These values are fed into Kalman Filter Predictors $\hat{U}_{cdc_h}$ and $\hat{U}_{col_{h,i}}$ of these utilities at time t + T. These are then composed into a single utility value using theu multicriterian decision theory.

$$U_{h,i} = W_{cdc_h}\hat{U}_{col_{h,i}} + W_{col_{h,i}}\hat{U}_{col_{h,i}} \qquad (3)$$

Which represent how good of a node h is for delivering messages to i. The weight W indicates the relative importance of each attributes, these values depends on application scenarios, and these weights are same for every host. More explanation about how prediction is calculated can be found in [22].

5. RESULTS

In this section, we present several simulation results that describe the performance of the protocol. We have implemented a simulation scenario with 50 nodes and 1 km area.

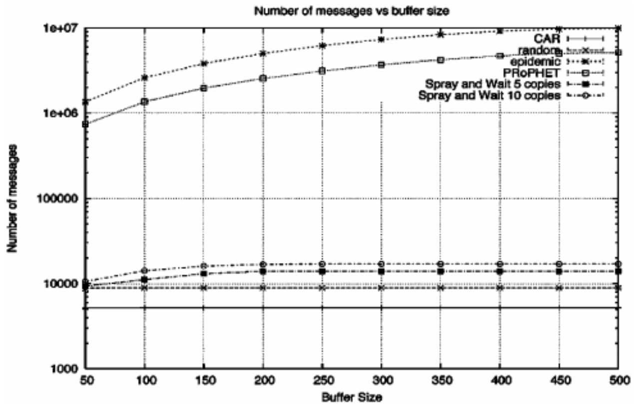


Fig. 1: Delivery Ration with Buffer Size with 50 Nodes.

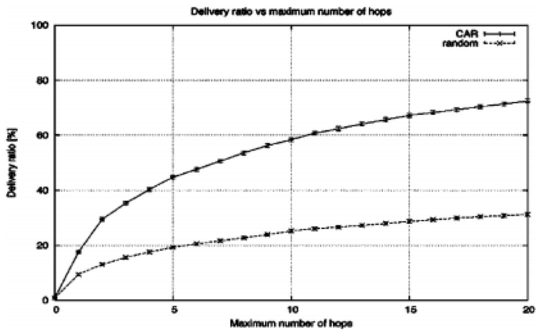


Fig. 2: Influence of the Number of Retransmissions on the Delivery Ratio.

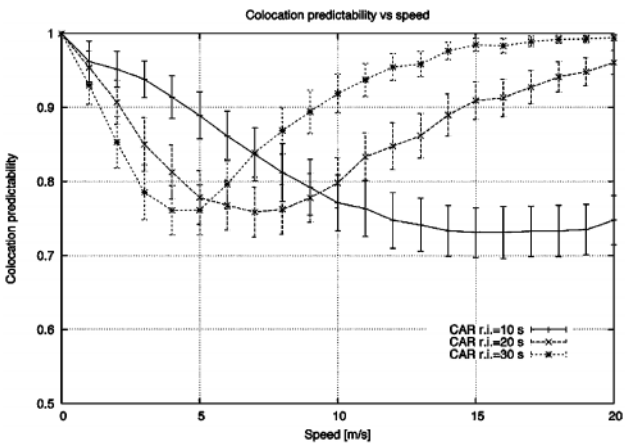


Fig. 3: Influence of the Host Speed on the Colocation Predictability

6. CONCLUSION AND FUTURE WORKS

In this paper we presented a modified context aware routing scheme designed for DTN. It has been proposed an efficient routing method for disconnected mobile ad hoc network, which works better than the existing context aware protocol. Our scheme allows node to cache the data until a good next hop node can be found to relay the messages to the destinations. The method uses more than one node as the message potential carries, so that it increases the probability to reach packets to the destination. We have shown that prediction technique can be used in store and forward method to deliver the messages in intermittently connected mobile ad hoc networks. Comparing with other routing methods our modified protocol works well since it overcomes all the pitfalls of others.

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