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Survey on Probabilistic Routing Schemes in DTNs (Delay Tolerant Networks)

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Abstract

Delay-tolerant networks called DTNs have tendency to interconnect devices in areas where existing networking technology cannot approach. To examine the Delay Tolerant Network, path should be defined over multiple unreliable, intermittently-connected components. This document, will took into consideration the problem of probabilistic routing in networks. These networks cannot ensure that at any time a fully connected path can exist between source and destination, proclaiming conventional routing technologies not able to provide/aim information in the form of messages among hosts. Hence, a way to route through such networks is required. Schemes have been nominated which focus on PRoPHET, a probabilistic routing protocol for such networks and estimating with traditional routing protocol named Epidemic Protocol through simulations. Therefore, we propose an algorithm called PROPHET through which the messages are disseminated faster into the network with lesser number of replication of individual message.

Keywords *:* Delay Tolerant Networks, Routing Techniques, Network Protocols- Routing Protocols.

1.INTRODUCTION

DELAY-TOLERANT networks (DTNs) have the ability to connect the nodes/devices and have the potential to serve areas of the world that are being serviced by traditional networks. DTNs provide communication by taking benefit of temporary connections to broadcast data in a similar fashion as per the postal networks [1], instead of having an end-to-end network connected path to be accessible. Such networks are being probed for education services [2], telecommunication services [3], government relevance [4], environmental monitoring [5], and vehicular elucidation [6]. The point that hinders in implementing such networks is that it is onerous to determine how to get bring information from the source to the destination. Simple sophisticated DTN-like networks were constructed using static routing [2], which gives competent approach for smaller networks. However, it will cause benefit if such networks can be enlarged to service larger areas. To accomplish this goal of scaling smaller networks to bigger ones, routing protocols must need to automate the configuration and try to confront with changes and failures. DTN networks provide communication in those environments which are challenging in themselves and in sparse mobile ad-hoc networks where conventional networking fails and new routing and application protocols required Delay-tolerant networks. A crucial challenge for Delay Tolerant Networks is to determine without knowing which routers will help in connecting end to end path at any given instant of time. The problem defines additional constraint of limited sized buffers at each node. Routing approaches were introduced which target either on replication of epidemic messages or on previously known information about the connectivity schedule. The epidemic approach which comes under flooding based technique, of replicating messages to all other nodes has a very high overhead, and it is unable to perform well with rising load. Through this documentary, efforts are carried out to maximize the message delivery rate without compromising on the amount of message discarded. The number of messages which are discarded has a direct relation with the bandwidth used and the battery consumed. The more the bandwidth used as more message discarded and battery utilized by each and every node in transferring the message. At the same time, nodes are adversely affected with the increase in number of messages discarded. Therefore, better algorithmic approach has been proposed through which the messages can be circulated faster into the network with lesser number of duplicate copies of individual messages.

2.RELATED WORK

Because the routing problem must be solved in order to use a new network, there has been extensive research on routing in delay-tolerant networks. The previous work can be divided into two broad categories: Flooding protocols and forwarding protocols.

2.1 Flooding Protocols

Flooding protocols focus on nodes which continuously replicate and deliver the data to newly discovered hops that do not possess a copy of the message. These types of protocols create multiple replica of the message and forward these to a large

number of nodes carrying the hope that one of these intermediate nodes will reach the final destination resulting in acknowledgement in return. The currently representative flooding protocol is Epidemic Routing Protocol [10] which aims to provide all the existing nodes a copy of every message through random interchange between the nodes. Due to above factor this approach can achieve high delivery ratios which helps in delivering all the messages to the nodes present in the network in minimum possible span of time. The major disadvantage of this protocol is that it is costlier in terms of number of transmissions and buffer space. Therefore, it cannot be considered as an efficient protocol, as this approach is unable to enlarge sufficient amount of nodes and number of messages in the network which is not acceptable as per the requirement.

Multiple surveys have been studied ways to make epidemic routing more efficient like in [11], [12], [13], [14], [15], [16]. Buffer and bandwidth are the critical resources for epidemic routing. Over the simple FIFO called First In First Out scheme [11] an influential buffer management scheme can help in improving the delivery ratio. It offers an effective buffer policy which transfers packets that are least likely to be delivered. Taking an example, If node P met with node Q frequently, and P met R frequently, then P is likely to deliver messages to R through Q. Similar metrics can be used in a number of epidemic protocol variants [11], [12], [13], [15], [16]. Physical locality and non-random movements are the advantages offered. The proposed protocols provide efficient efforts than the conventional epidemic routing protocols, ensuring of transmitting multiple copies of each message.

2.2 Forwarding Protocols

In conventional routing protocol schemes, it was quiet simple to choose and decide where to forward message; the message is delivered to the neighbor with the shortest path to destination. Since the reliability of paths is relatively high, so the message can be forward to only single node.It should be kept in mind while deploying forwarding approach that path selection should be done carefully to forward a single replica of each message. Selection of routing path can be done in various ways. Forwarding –based routing protocols are those who never replicate messages. These protocols are generally useful in network resources, as there is only a single replica of a message in storage in the network at any given time. Furthermore, at the receiver end while receiving the message, no other host can have a copy of that message. This helps in eliminating the need for the destination to receive the message; so that no other node can have a copy. Thus there is no need to provide feedback to the destination network, to indicate that the outstanding copies can be deleted. The major cause of forward-based approaches is that these do not allow sufficient message delivery rates. One interesting approach can be used that is location-based routing, where nodes pass the message on the next hop that is closest enough to the destination. “Closeness” can be measured in terms of physical distance. The measure of “closeness” shows the probability that how nodes can come into contact with each other.

In the next section, we try to reframe DTN Network model we develop a set of definitions and a framework for evaluating DTN routing algorithms. We then propose several of our own routing algorithms and use the framework in conjunction with simulations to evaluate their performances.

3.DTN NETWORK PROTOCOL AND OVERLAY ARCHITECTURE

3.1 Bundle Layer

Kevin fall proposed the bundle layered architecture, before it was developed by DTN Research Group into RFC 4838. As shown in figure 1, there is a bundle layer which links application and the transport layer and all other lower layers into region specific layers. Although each regional layer if of different network type, but the bundle layer enables them to communicate by transmitting bundles using store and forward mechanism.

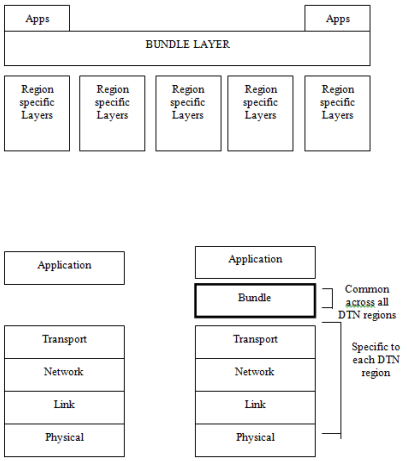

Figure1: The bundle layer

The bundle layer approach allows communication across multiple regions without causing any adverse effect on upper-layer applications.
The following are the services performed by the bundle layer.

- *Custody Transfer*- referred as custodial acceptance from a node to its previous custodian. The implementation of retransmission responsibility delegation is necessary, so that the sender node can comfortably send the retransmission responsibilities to other nodes; this provides the resources which can use for another bundle.
- *Return receipt*- It is the confirmation to the source node that the destination node has received the bundle.
- *Custody-Transfer Notification*- is the notification to the source node whenever a node acquires a bundle's custody transfer.
- *Bundle-forwarding Notification*- It is the notification to Source whenever a bundle is passed to the adjacent node.
- *Priority of Delivery*
- *Authentication*- Authentication refers to the method which helps in verifying the sender's and receiver's integrity.

3.2 Nodes and Edges

Delay tolerant network architecture contain a directed multi-graph called DTN graph, in which more than one edge (also called link/channel) may exist between a pair of peers (see figure 2). The reason for using a multi-graph is that if we wish to pass data between similar pair of nodes then there must exist a physical channel between peers. Moreover, a lesser extent, propagation delay are said to be time-dependent where capacity is zero at times whenever the link becomes unavailable. Hence, it is necessary to have both of the propagation delay and the time varying capacity to be captured by set of multiple parallel edges. Real life example would be a bus carrying a wireless access point passing by a village.
When communication is not possible, the edge is assigned zero capacity.

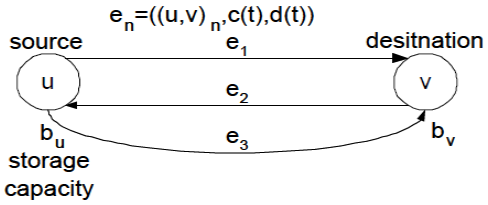

Figure 2: Edges in a DTN graph. Nodes may be connected by multiple edges, representing different physical links. Each node j performs store-and-forward routing, and has finite storage capacity (bj). An edge is parameterized by its source and destination nodes plus a capacity (c(t)) and delay function (d(t)).

3.3 Contact

A contact is a procedure to send data information over an edge. In precise words, edge is more specific and the time interval during which the edge capacity is measured results positively.

3.4 Messages

Messages are the ways to communicate between the peers in the network. A message van be defined as a tupple having parameters (u,v,t,m), where u indicates source of the message, v is the destination, and t is the time interval at which the message is delivered into the system and m corresponds its size. The set of all messages is called the traffic demand.

3.5 Storage

Storage refers to buffering, it is said that the nodes present in Delay Tolerant Network have finite long term fashion storage. These buffers can be used for carrying transitional data. Destination nodes are assumed to have sufficient capacity for holding data to be consumed by an application.

3.6 Routing

Routing offers passing of messages in a store and forward fashion. The routing algorithm is responsible for determining the next edge(s) upon which the message should be forward. Messages not immediately forwarded but they are assigned to peers by the routing algorithm.

4.ROUTING APPROACHES

4.1 Epidemic Routing

One of the routing approaches is Epidemic Routing which is flooding-based in nature, as in this approach node and the nodes/components continuously duplicate and deliver informational messages to newly discovered contacts that do not carry a copy of the similar message. In more simple terms, epidemic routing is always said to be flooding; however, more practical techniques can be applied to limit the number of messages transfer. Epidemic routing assures distributed databases which remain synchronized, where many other techniques, such as rumor mongering, can be applied directly to routing.

This protocol relies on the basic theory of epidemic routing algorithms by passing pair-wise information of messages between nodes in the network as the nodes comes in contact with each other to deliver messages corresponding to their destination nodes. To identify whether the message been previously seen it is necessary that each message should contain a globally unique message. Messages to be delivered from source address to destination address should also contain a hop count field which is an obvious. This field performs actions which is same as that of TTL field in IP packets and helps in determining the maximum number of hops a message can be sent, and also used to restrict the resource utilization of the protocol. The messages with hop count associated with them can only be delivered to final destination.

4.2 Prophet Routing

Prophet routing protocol called as Probabilistic routing protocol provides parameters based on non-randomness of mobility which gives advantage in mobile applications to improve routing performance. Instead of delivering blind epidemic replicas of messages in the form of bundles in the network, it applies "probabilistic routing".

To improve the routing performance it is required to adopt probabilistic routing scheme that will result in intercommunication between the nodes. This protocol wishes to use a bi-directional route for the exchange of information; this allows communication in both the directions in avoidance of establishing a second route for information exchange in reverse direction. Prophet is currently defined to run over TCP, because TCP provides reliable bi-directional network channel between two peers. It focuses on the investigation of limited buffer size and the usage of acknowledgment of messages to enhance its performance. To overcome the limitations of Epidemic routing protocol, spray and wait routing scheme can be considered. Thus, PROPHET Routing Protocol with simple forward strategy have worked fairly well and outperformed Epidemic Routing. However, it is still interesting to investigate other forwarding technologies to see if performance can be enhanced further.

5. CONCLUSION

This paper distinguished between flooding routing protocols and forwarding routing protocols in Delay Tolerant Networks. The main objective of writing this paper is to represent overlay architecture of DTN which enables interoperability between different network types. And to assure that Prophet routing protocol is better in all respects than epidemic routing.

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