

A Review Paper on Routing Protocols in DTNs

Ms. Gulnaz Malled¹, Mr. Logesh K.²

^{1,2}Department of Computer Science,

Kuppam Engineering College, Kuppam,(AP), (India)

ABSTRACT

There are number of protocols, some proposed, some in already in use which deal with Mobile ad hoc networks limitations and extensions. Delay Tolerance Networking is the key technology used in MANETs. As we know, there does not exist a full-fledged network infrastructure in MANETs, therefore communication relies on the mobility of nodes. Nodes help each other by participating in message forwarding as they move along freely. But since nodes have limited resources in terms of power, storage and bandwidth, message forwarding should not drain them. In the view of these limitations and extensions several protocols try to overcome these problems. In this paper strategy of few algorithms will be reviewed theoretically.

Keywords–*Node, Network, Routing information, Delay tolerant networks (DTNs), Spray and Wait Algorithm, Epidemic Algorithm, Incentive Compatible routing algorithm (ICRP), optimal sequential stopping rule, VCG based auction Algorithm, Wireless Sensor Network(WSN).*

I. INTRODUCTION

A common analogy from real world makes it clear why we require different protocols for communication in different types of networks. Let us take the example of transport, land transport, water transport and air transport although exist to facilitate people in reaching different places but they all follow different routes and protocols catering to the fields at their disposal. Similarly communication in different networks requires different protocols. Case in study is about MANETs. Already popular routing protocols either from TCP/IP suite or from Ad hoc routing schemes DSR or AODV [1] do not suit as they assume end to end connectivity between nodes. MANETs can be seen in Military operations, Disaster management, in Space study. And apart from these areas epidemic growth of smart phones and voice over data applications have opened up a new area of regulating data traffic independently to offload exiting network infrastructure.

MANETs by nature are sparsely or intermittently connected, and have mobile nodes. This makes it both simple and difficult to route messages from a source to destination. Difficult in the sense, traditional routing assumes complete connectivity between a source and destination and does not care about resources, which are limited in MANETs and easy because each packet can be independently routed without caring about network topology. Nodes require to store-carry-forward the messages till they meet the destination node, this technology is known as DTN [2]. We will consider three different strategies in following sections to see how they try to overcome the limitations posed by MANETs.

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II. RELATED WORK

Along the way following literature work were seen apart from closely looking into three algorithms.

S. Burleigh et.al [3] say that increasingly, network applications must communicate with counterparts across disparate networking environments characterized by significantly different sets of physical and operational constraints; wide variations in transmission latency are particularly troublesome. The proposed Interplanetary Internet, which must encompass both terrestrial and interplanetary links, is an extreme case. An architecture based on a "least common denominator" protocol that can operate successfully and (where required) reliably in multiple disparate environments would simplify the development and deployment of such applications. The Internet protocols are ill suited for this purpose. The Authors identify three fundamental principles that would underlie a delay-tolerant networking (DTN) architecture and describe the main structural elements of that architecture, centered on a new end-to-end overlay network protocol called Bundling. The Authors also examine Internet infrastructure adaptations that might yield comparable performance but conclude that the simplicity of the DTN architecture promises easier deployment and extension.

Thrasyvoulos Spyropoulos et.al [4] describe that intermittently connected mobile networks are wireless networks where most of the time there does not exist a complete path from the source to the destination. There are many real networks that follow this model, for example, wildlife tracking sensor networks, military networks, vehicular ad hoc networks (VANETs), etc. To deal with such networks researchers have suggested to use flooding-based routing schemes. While flooding-based schemes have a high probability of delivery, they waste a lot of energy and suffer from severe contention which can significantly degrade their performance. With this in mind, the Authors look into a number of single-copy routing schemes that use only one copy per message, and hence significantly reduce the resource requirements of flooding-based algorithms.

Zhenseng Zhang [5] the author describes that introduction of intelligent devices with short range wireless communication techniques has motivated the development of Mobile Ad hoc Networks (MANETs) during the last few years. Such challenged networks, also known as Intermittently Connected Networks (ICNs) adopt the Store-Carry-Forward (SCF) behavior arising from the mobility of mobile nodes for message relaying. In this article, the Authors consider the term ICNs as Delay/Disruption Tolerant Networks (DTNs) for the purpose of generalization, since DTNs have been envisioned for different applications with a large number of proposed routing algorithms. Motivated by the great interest from the research community, the Authors firstly review the existing unicasting issue of DTNs because of its extensive research stage.

Quan Yuan et.al [6] describe that Routing is one of the most challenging open problems in disruption-tolerant networks (DTNs) because of the short lived wireless connectivity environment. To deal with this issue, researchers have investigated routing based on the prediction of future contacts, taking advantage of nodes' mobility history. However, most of the previous work focused on the prediction of whether two nodes would have a contact, without considering the time of the contact. This paper proposes predict and relay (PER), an efficient routing algorithm for DTNs, where nodes determine the probability distribution of future contact times and choose a proper next hop in order to improve the end-to-end delivery probability. The algorithm is based on

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two observations: one is that nodes usually move around a set of well visited landmark points instead of moving randomly; the other is that node mobility behavior is semi-deterministic and could be predicted once there is sufficient mobility history information. Specifically, our approach employs a time homogeneous semi-marked process model that describes node mobility as transitions between landmarks. Landmark transition and sojourn time probability distributions are determined from nodes' mobility history

III. DIFFERENT STRATEGIES OF ROUTING

A. Flood-based routing

Epidemic routing algorithm [7] is considered as an example of flood-based routing. The authors develop an algorithm which depends upon the transitive distribution of messages through MANETs, where messages reach eventually to their destination.

A FIFO buffer is maintained by each host to hold their own messages and messages of other hosts which they are forwarding. And also hash tables and summary vectors are used for efficiency. When two hosts come in transmission range of each other, they intelligently exchange messages avoiding redundancy. And also gives freedom to receiving host to accept or reject a message based on its size of message or to the host it is destined. The authors also suggest associating Epidemic Routing with a unique *message identifier*, a *hop count*, and an optional *ack request* with each message. This is similar to IP packets, where message identifier is 32-bit number a concatenation of the host's ID and a locally-generated message ID (16 bits each). Hop count is like TTL in IP and Ack is optional sent upon request and can be piggy backed.

In the paper it is shown that implementing the protocol results in very high delivery ratio. But because of multiple hops overall energy consumption is a bit more.

B. Multi-copy routing

In order to save limited resources of MANETs, different strategies have been proposed like one here [8] a routing protocol with multiple copies. It performs significantly fewer transmissions than flooding based routing schemes, under all conditions. It uses "spray and wait strategy, the authors show that implanting it delivers a message faster than existing single and multi-copy schemes, and exhibit close to optimal delays. It is simple, and require as little knowledge about the network as possible, in order to facilitate its implementation. The algorithm employs following steps

- *spray phase*: for every message originating at a source node, L message copies are initially spread—forwarded by the source and possibly other nodes receiving a copy—to distinct relays.
- *wait phase*: if the destination is not found in the spraying phase, each of the nodes carrying a message copy performs "Direct Transmission" (i.e., will forward the message only to its destination).

The above algorithm reduces number of hops and helps in maintaining energy utilization. A variant of this is also proposed by the authors with "spray and focus" name, which can be used in university campuses, where

hosts have a particular moving pattern. The paper has elaborate discussion and implementation data which shows that the suggested algorithm is works well in terms of number of transmissions and delivery delays.

C. Probabilistic Relay node selection routing

Incentive compatible routing protocol [9] is considered in the section. Authors describe that in MANETs some hosts do not participate in message forwarding to save their limited resources and depend on others to forward their own messages. This kind of selfish behavior beats the purpose of network's basic idea of communication. ICRP proposes a way of rewarding those hosts who participate in routing thus stimulating them to co-operate with other.

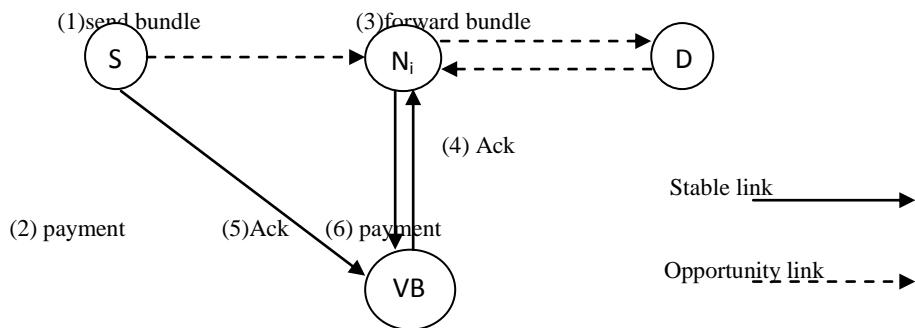


Fig 1: ICRP Process

Fig 1 shows source host S needs to send a bundle, it chooses node N_i as relay node. And then deposits virtual currency into virtual bank (VB) as a fees for forwarding node. Node N_i forwards the bundle to destination host D. Node D acknowledges by sending an Ack which in turn it sends to virtual bank (VB).

VB duly rewards the co-operating node by sending payment. These points or virtual currency would be used by the node N_i to pay to forwarding nodes for its messages.

Following are the steps to select a relay node.

- In incentive-compatible protocol, relaying nodes are chosen based on the optimal sequential stopping rule.
 - Find the optimal stopping time threshold adaptively based on realistic probability model and propose an algorithm to calculate the threshold.
 - Based on this threshold, a new method to select relay nodes for multi-copy transmissions is devised.
 - To defend against forgery attacks in DTNs, a new payment method by the use of virtual currency and bilinear pairing is discussed in ICRP.

In the paper the authors show that ICRP has high delivery ratio, low overhead and low energy consumption when compared with “spray and wait” and epidemic algorithms.

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IV CONCLUSION

It is clear that routing strategy has direct impact on the resources of individual hosts in MANETs. In order to save limited resources, routing algorithm should be chosen carefully which not only has high delivery rate and low end to end delay, but also maintains overall energy levels of network. Flood based routing has high delivery ratio but consumes lots of energy by distributing message to every host in its neighborhood. Spray and wait saves energy by sending few copies only but has multiple hops before the message reaches the destination. ICRP protocol carefully selects relay node so that the message reaches in just two-hops to destination. Thus saves lots of energy at same time with better delivery ratio. Further study can be done to simulate few protocols in order to see the performances actually.

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