



## An Optimized Routing Protocol to Increase Message Delivery Ratio and Reduce Message Replication in Opportunistic Networks

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**Abstract:** Opportunistic Networks (ONs) are designed for providing routing in sparse areas. Various standard routing algorithms are available in ON to provide routing of messages out of these algorithms Epidemic routing is one of the most used routing algorithm that provides high delivery ratio but at same time drawback of this algorithm is that in this algorithm large number of replication of messages are available that may cause high overhead ratio. In this paper we proposed an optimized routing algorithm to reduce replication of messages and increase message delivery ratio with less overhead ratio. To implement proposed strategy Opportunistic Network Environment (ONE) simulator is used i.e. specially designed for ON networks. Simulation results shows that proposed strategy has high delivery ratio less overhead ratio and less number of replication of messages.

**Keywords:** ON, Recognition, Epidemic routing, Replication and ONE

### I. Introduction

Opportunistic networks (ON) are designed for the challenging environment like infrastructure less scenarios, village networks forest networks etc. To transmit messages ON provides various routing protocols like direct delivery, first contact, epidemic and spray and wait routing. Each routing protocol has its own advantages and drawbacks. In Epidemic routing it uses the flooding method to accomplish maximum delivery ratio and low delay. In flooding method large numbers of duplicate messages are transmitted between networks. Epidemic routing injects unnecessary message copies into the network, which drain network assets and thus decline network performance [1]. Most of the copy-limited routing algorithms focused on how to allocate the current number of message copies between two encountered nodes. But they did not consider the efficiency of message distribution. These routing algorithms provide less delivery as compare to epidemic routing [2]. The basic concepts find their application in sensor networks, interpersonal communication (people or "pocket-switched" networks), and in mobile Internet access [3].

- Exchange of Bundles hop-by-hop via Bundle Protocol Agents.
- Bundle Protocol across different internetworks.
- Convergence layer provides mapping to lower layer.
- Custody transfer for reliability.
- Support for end-to-end semantics at the application layer [4].

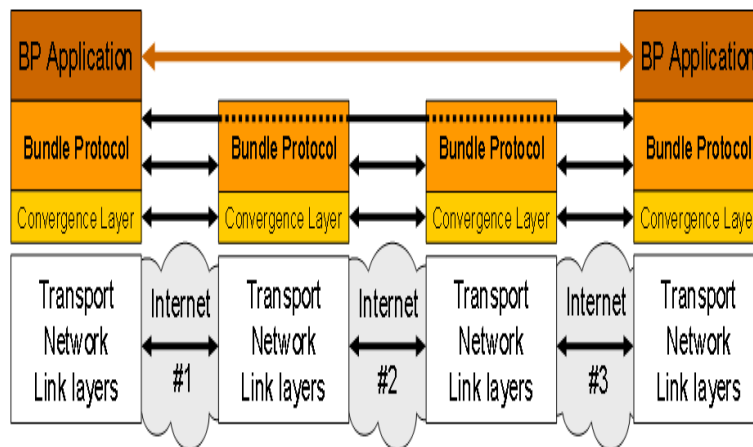


Figure 1: OPPNET Architecture [3]

## II. Related work

Khalil *et al.* [5] categorized the opportunistic network protocols, according to their use of three main techniques: queue management, forwarding and replication. Queue management orders and manages the messages in the node's buffer, forwarding selects the messages to be delivered when there is a contact and finally replication bounds the number of replicas in the network.

Anitha, Micheal *et al.* [6] “represented how to route a packet from one node to another, in such a network”. This problem becomes more complex, when the node mobility also is considered. The researchers have attempted to address this issue for over a decade. They have found that communication is possible in such a challenged network. The design of routing protocol for such networks is an important issue. The researchers have focused on various issues like reducing the delivery delay or increasing the delivery ratio. Optimizing resource usage, providing scalability etc. are also issues explored by various algorithms.

T. Camp, J. Boleng and V. Davies *et al.* [7] “proposed the Spray and Wait with Probability Choice (SWPC) routing”, where continuous encounter time is used to describe the encounter opportunity; a delivery probability function is set up to direct the different number of copies to the destination during the spray phase; and a forwarding scheme is implemented in the wait phase. Simulation results show that proposed SWPC shows prominent superiority in the delivery rate, the average delay and the communication overhead, and adapted for the frequently disconnected the opportunistic network.

Ning Li *et al.*[8] investigated the problems of epidemic routing algorithm, and proposed a novel and simple scheme based on pure epidemic routing called MPOER, which manages to modify ED algorithm by employing a HL estimation method to limit the number of replicate so as to control congest and save resource as much as possible. In this paper, we put emphasis on the network where nodes with limited caches and intend to control the quantity of replicates and save energy.

## III. Proposed Work

**Proposed algorithm:** In this section proposed algorithm and its description with flow chart has been presented.

1. Initialize all nodes with a temporary memory buffer to store routing information.
2. for  $i = 1 ; i \leq n ; i++$ 
  - {
  - Compute node having high recognition value.
  - 3. Use that node (chosen node having high recognition value for further transmission.
  - 4. This will overcome the drawbacks of replication, overhead ratio.
  - 5. }
  - 6. End.

*Recognition: Acknowledgments of message delivery.*

### A. Description of algorithm

In this algorithm proposed routing principle is discussed. This routing principle works in the environment of store carry and forward. This algorithm describes message transmission from source node to destination node using intermediate nodes at different time interval. We recognize next node by assuming that node which successfully delivers packets from one place to another. This can be checked by receiving the acknowledgement of message from destination node. This acknowledgement can be stored in the buffer of node. Using this we recognize the node having successful packet delivered from one place to another.

M-Message  
R-Receiver  
S-Sender  
 $N_i$ -Next Hop  
TTL-Time to Live  
 $R_i$ -Recognition of node

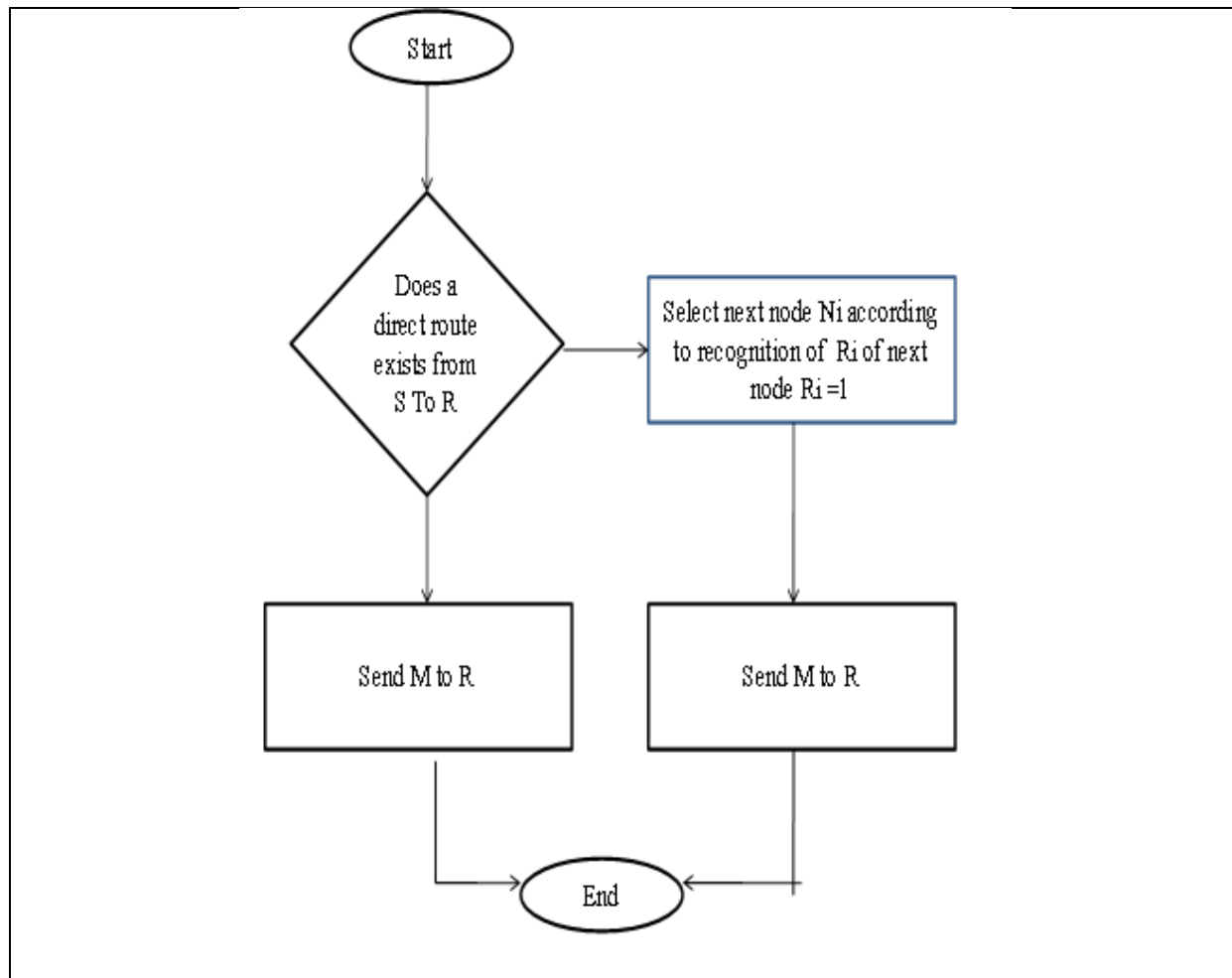


**Figure 2: Flow chart of proposed work**

Flow chart described pictorial representation of proposed algorithm. If the source node  $s$  carrying the message  $m$  finds a direct route to destination  $r$  then message is transmitted directly otherwise the message copy is forwarded to an intermediate node  $n_i$  selected on the basis of its recognition  $R_i$ . The next node  $n_i$  chosen successfully delivers the message to destination.

#### IV. Results and Analysis

Tool Used: ONE simulator is an open source freely available tool that can run on any platform. It is an java based tool.

##### i) Metrics used for analysis

The following performance metrics have been considered for simulation:

- Replication: It is defined as total number of message replicas created by source.
- Delivered Packets: It defines total Number of delivered packets.
- Overhead Ratio: It is defined as: (Number of Relayed Messages – Number of Delivered Messages)/Number of Delivered Messages.
- Throughput: It is defined as the ratio of number of messages delivered to destination to number of messages created by source node.

##### ii) Performance Parameters used for analysis

- Message TTL: TTL Time to live is defined as life time of the packet. Packet becomes invalid after expiration of TTL. TTL is measured in seconds. TTL has been varied as 50 -100> 150 -> 200 seconds.

##### iii) Results

In this section results of our proposed mechanism are presented. Proposed mechanism has been compared with epidemic routing scheme.

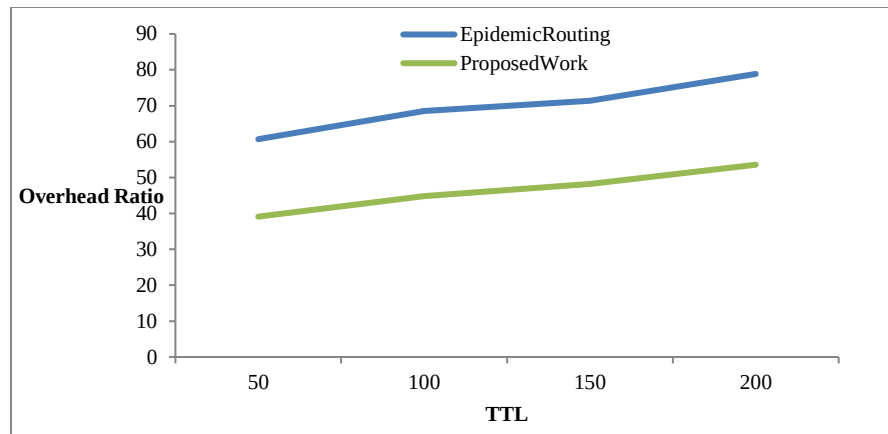


**Figure 3: Overhead ratio v/s TTL**

Figure 3 shows overhead ratio between epidemic routing and proposed mechanism. Overhead occurs due to high replication of messages. In proposed mechanism overhead ratio is low as compare to epidemic routing.

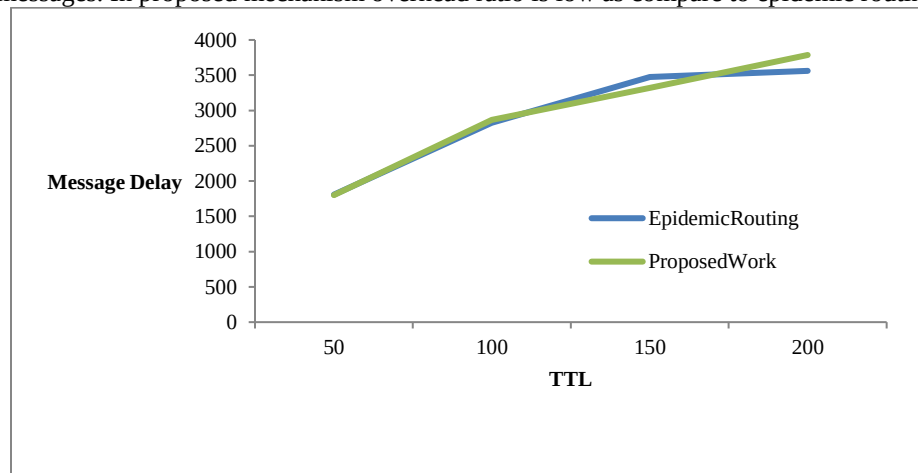


**Figure 4: Message Delay v/s TTL**

Figure 4 shows average message delay occurred during message transmission. For evaluation Time to Leave is varied from 50 to 100 in the interval of 50. As TTL increases delay also increases, in our proposed work delay is slightly higher than epidemic routing.

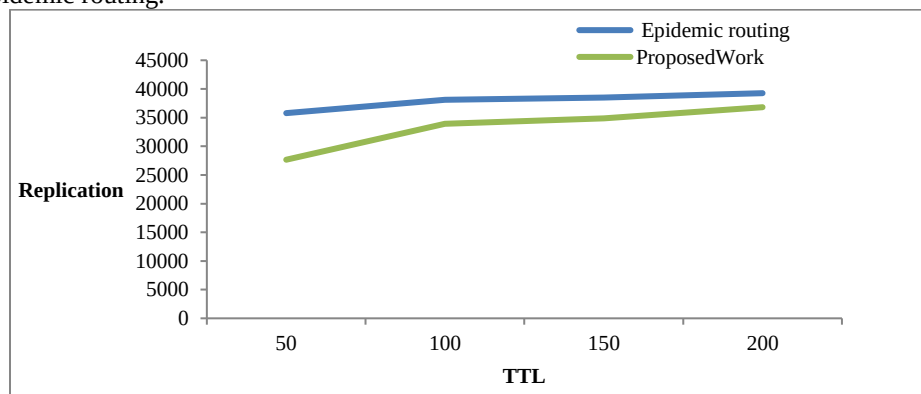


**Figure 5: Replication v/s TTL**

In Figure 5 replication of messages is measure in perspective of TTL. In proposed mechanism Replication is low as compare to epidemic routing.

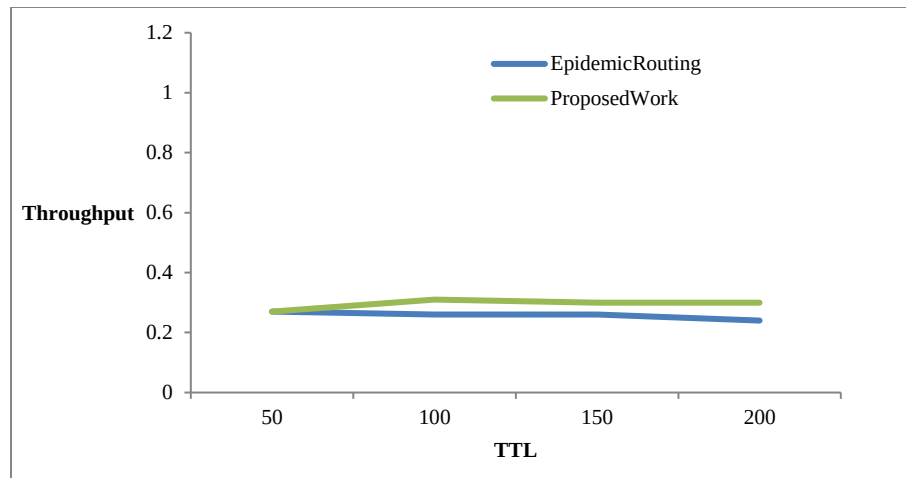


**Figure 6: Throughput v/s TTL**

In figure 6 throughput is evaluated and analyzed between epidemic routing and proposed mechanism. Throughput is high in proposed mechanism in perspective of epidemic routing. In epidemic routing due to high replicas of messages throughput is low.

#### IV. Conclusion

In this dissertation an optimized routing scheme to improve message delivery, reduce replication of messages and low overhead ratio in Opportunistic Networks has been proposed. For successful delivery of message to destination, message copy is forwarded to the node chosen on the basis of recognition of that node. The next node is recognized by assuming that node which successfully delivers packets from one place to another. This can be checked by receiving the acknowledgement of message from destination node. This acknowledgement can be stored in the buffer of node. Simulation results show that proposed scheme accounts for higher throughput and less overhead ratio than existing epidemic routing. On the other hand, replication of messages leads to high overhead for improving the performance of protocol. The performance of proposed routing is satisfactory and better than existing schemes. In future it is intended to continue working on it and propose new routing scheme which provides better throughput and less message delay.

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