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Delay Tolerance in Wireless Networks through Optimal Path Routing Algorithm

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Abstract

A Delay Tolerant Network (DTN) is a mesh network designed to operate effectively over great distances. DTNs have not custom to vindicate complete track from source to destination most of the time during communication. Existing data routing approaches used in DTNs were based on multi-copy routing. However, these existing methods incur overhead due to exorbitant transmissions and increases seer side processing. Hence there is a necessity to propose an optimal path routing algorithm to overcome the above issues. The optimal path routing reduces the proposition of message dropping and wax the throughput. The design approximate also uses random path generation that can reveal the path that affirms active connection for a longer duration to achieve a desired routing delay. In addition, this system has an effective buffer management mechanism to increase throughput and decrease routing delay. The analysis and as well as the simulation results clearly shows that the optimal path routing algorithm, provides high throughput and low routing delay compared to existing routing approaches.

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1. Introduction

A wireless network is a computer network that does not require wired connection for data transmission. Wireless networking is a tactic by which homes, telecommunications networks and venture (business) installations avoid the costly process of introducing cables into the building or as a connection between different locations. Wireless is generally implemented and administered using radio communication. The implementation of proposed system is carried out at the physical layer of the OSI model network structure.

This research work focuses on Delay Tolerant Networks for nodes that are at a distance between 100 and 300m, which are known as intermittently connected networks. The intermittent connection may result from [10] network dynamism, [3] power management of mobile nodes and [7] node scarcity. Routing methods specifically meant for DTNs have been widely studied in recent years. One of the major works is grouping of routing methods that uses multi-copy routing scheme named SEDUM with Optimal Tree Replication algorithm was introduced by Ze Li et al. that enable messages to meet its destination node with high probability but does not reduce the problem of message dropping. This paper focuses on introducing Optimal Path Routing Algorithm for DTNs which provides high throughput as well as reduces the problem of message dropping compared to existing routing approaches. In this estimated approach, initially it uses use random based routing technique through which it finds the Optimal Path, that are considered to be the path to maintain active connection for longer duration. By implementing the optimal path routing algorithm, the problem of message dropping is reduced using Path Trace Algorithm. In addition, this approach maintains effective buffer management in which the time duration for each transaction is updated.

1.1. Literature Survey

Costa et al. [1] proposed a Social Cast. It is a routing framework for publish-subscribe model, which exploit the predictions based on metrics of social interaction (e.g. patterns of movements among communities) to identify the best information carriers. The principles underlying in this protocol, its operation illustration and performance evaluation using a mobility model is based on a social network that has been validated with real human traces of mobility. The evaluation clearly shows the prediction of co location and node mobility leads to maintain a very high and steady delivery of event with low latency and overhead, despite the variation in number of replicas per message.

In [2], Ze Li et al. introduced intermittently connected mobile networks. Recent approaches which were used for transmission in such networks were primarily based on multi-copy scheme for flooding and single-copy scheme for flooding. However, they incur either high overheads due to excessive transmissions or long delay due to possible incorrect choices while message forwarding. In this paper, a utility based distributed routing algorithm with multi copies was proposed, where a packet was replicated to a certain number of its nodes that are neighbor, which packets are forwarded sequentially to the destination node based on a probabilistic routing scheme. Some methods for buffer management are also proposed to further improve its performance. In [3], Henri Dubois-Ferriere et al. introduced Fresher Encounter Search for efficient route detection in mobile ad-hoc networks. Here the source searches for intermediate node and the intermediate node then searches for the node that encountered the destination more recently and the procedure iterates until the end communicating partner is reached. Therefore, the single network wider search is replaced by FRESH into the succession of smaller searches resulting in cheaper route discovery. In [5], Levine B N et al. presented an intentional DTN routing protocol that can optimize a specific routing metric such as the worst-case delivery delay or the fraction of packets that are delivered within a border. The key imminent is to treat DTN routing as a resource allocation problem that translates the routing metric into per-packet utilities which determine how packets should be replicated in the system.

In [8], Anders Lindgren et al. introduced Problem of routing in intermittently connected networks. In such networks there is not at all a guarantee that a fully connected path between source and destination exists at any time, rendering routing protocols which are traditional unable to deliver messages between hosts. Thus, there is a need for a route path through such networks. A protocol for probabilistic routing named PROPHET is introduced that can deliver more messages with lower communication overhead.

In the existing system, a scheme named SEDUM with optimal tree replication algorithm is used in Delay Tolerant Networks. This routing process is achieved by the creation of multi copies. Therefore, if there is any message dropping, the copy of the original message can be sent to the destination and thus leading to successful transmission. On the other hand this routing process cause message dropping as well as it increases the receiver side processing and also the bandwidth is increased due to the creation of multi copies.

2. Proposed System

Based on the above survey held, it is necessary to propose an Optimal Path Routing Algorithm in order to improve the network efficiency. The three main steps involved in achieving the proposed system are, (1) initially, message is transferred in five random paths. (2) The path that maintains active connection for longer duration is found and (3) finally the message is transferred using the identified optimal (longer duration) path. Through this successful transmission is achieved and the receiver side processing is reduced and also the creation of multi copies can be avoided. The message dropping is reduced by implementing path trace algorithm.

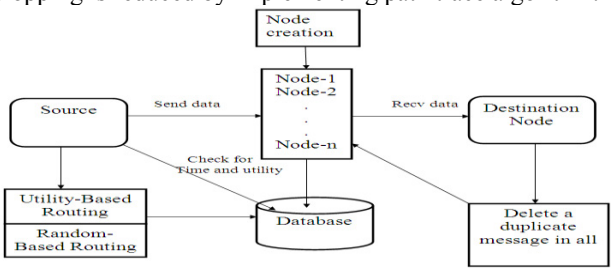


Fig. 1. Functional architecture for proposed system

The figure 1 clearly shows the functional architecture of proposed system. From the figure it is clearly understood that the source node sends its data to the destination via the number of intermediate nodes. The source node has to check the database for the accountability of inter mediate node's time and utility. This information can be gathered in the database based on random based routing and utility based routing. Prior to data reaches the destination, all the duplicate and redundant messages that are to the destination will be removed.

2.1. Module Description

2.1.1. Random Path Generation:

The nodes are created to form the network. The created network has sender node, receiver node and intermediate nodes. In this module, initially the routing table is checked to find whether any message transfer is made between the source and destination before. If there is no such transaction, then the Random routing is chosen. In this random path generation, five different transactions are made between the source and destination.

Input: Message from Source to Destination address.
Output: Acknowledgement from destination.
Algorithm:
Step 1: The nodes are created.
Step 2: The routing table is analyzed to identify if any transactions made between source and destination.
Step 3: The message will be sent from the source along with the destination address.
Step 4: Five message transactions are made from source to destination.
Step 5: The duration for each transaction is noted in the routing table.

2.1.2. Utility Based Routing:

The utility based routing process is chosen if the source and destination completes five random transactions. This is the routing process in which the path maintaining active connection for longer period is chosen and the further transactions are made through this path.

Input: Message from source, destination address and utility for each router.
Output: Transfer message to high utility router.
Algorithm:
Step 1: The utility table is analyzed and the path having the higher utility is identified
Step 2: The best path is chosen and the message is transferred through that path
Step 3: The source transfers the message to the high utility path along with the destination address

2.1.3. Optimal Path Routing:

In optimal path routing, the path that maintains active connection for more duration is identified and further transactions to the destination are made through this path. Also message dropping that occurs due to selfish nodes are reduced using the path trace algorithm.

Input: Message to destination through optimal path.
Output: Acknowledgement from destination.
Algorithm:
Step 1: The message from the source is send via the identified optimal path to the destination
Step 2: The selfish nodes are present in the optimal path are detected and these nodes are rectified
Step 3: Path Trace Algorithm is used in order to identify selfish nodes and reduce message dropping

2.1.4. Path Trace Algorithm

The major steps in Path Trace Algorithm are:

- Per - Hop distance estimation
- Link frequent appearance count

First, the Per-Hop distance estimation is where the distance between the nodes in the optimal path are determined.
And then the Link frequent appearance count is the selfish node which is identified based on the frequent occurrence of the node in a single path

2.1.5. Data Transfer:

In data transfer module, the transaction of message from source to destination is considered. If there is any delay while message transfer via the optimal path then the next path with high duration utility is chosen.

Input: Message from source.
Output: Acknowledgement from destination.

Algorithm:
Step 1: The source send message via optimal path.
Step 2: If a delay occurs then the next path with higher utility is chosen.
Step 3: Step 2 is repeated until message reaches destination.
Step 4: The acknowledgement which will be received from the destination if the message reaches destination.

2.2. Implementation of Proposed System

The wireless network is implemented using TCL, C++ language and programming is done using Network Simulator 2.35. The input to the network is data from the sender and the output is the data to the receiver. Each transaction is stored in the routing table.

3. Result Analysis

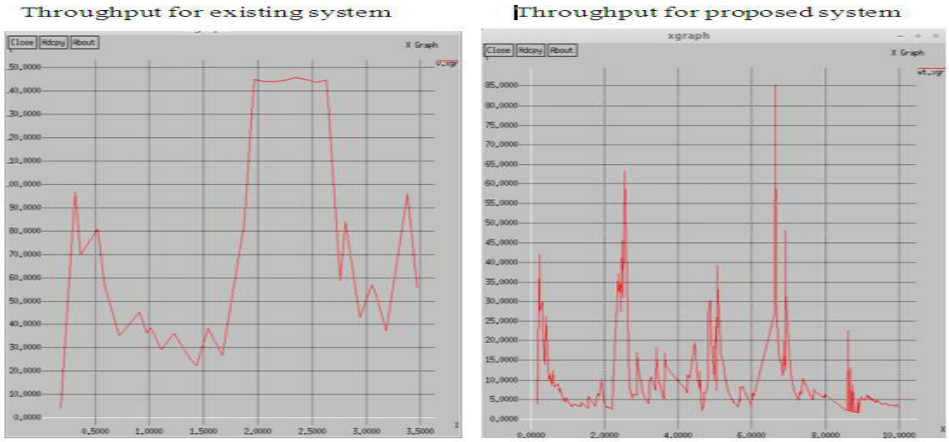
The performance analysis has been done on the following metrics. They are:

- Throughput.
- Average delay and
- Packet Delivery ratio.

3.1. Throughput

The throughput is defined here in terms of duration and energy consumption. It is defined as the ratio between the duration and the amount of energy consumed in that duration.

The duration and the energy consumption taken by the nodes to transfer message is determined in the throughput graph. The proposed system shows that the consumption of energy has been reduced when compared to the existing system. The X- axis represents duration and Y-axis represents the energy consumption.



X - axis : Duration; Y - axis : Energy Consumption

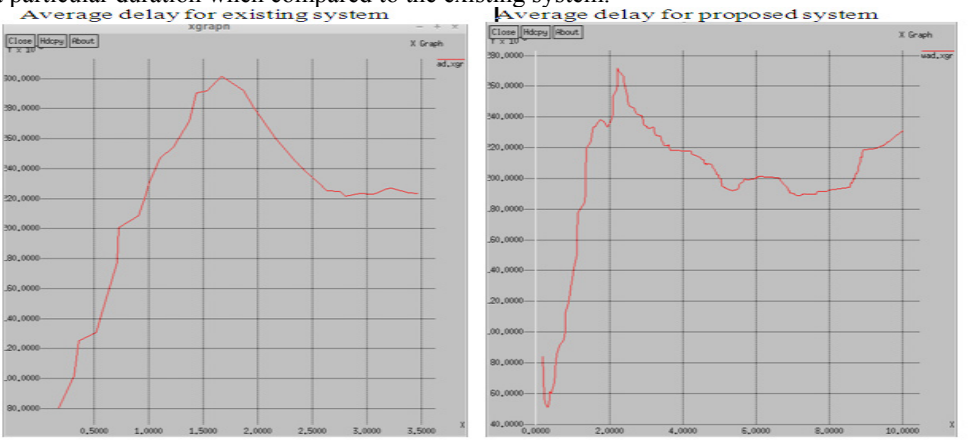
Fig. 2. Comparison of throughput between Existing and Proposed System

3.2. Average Delay

The average delay is defined as the ratio between the duration and the overall average delay taken place in that particular duration.

The duration and the average delay for a message is determined in average delay graph. The X-axis represents

the duration and Y-axis represents the average delay. The proposed system proves that the average delay has been reduced in a particular duration when compared to the existing system.



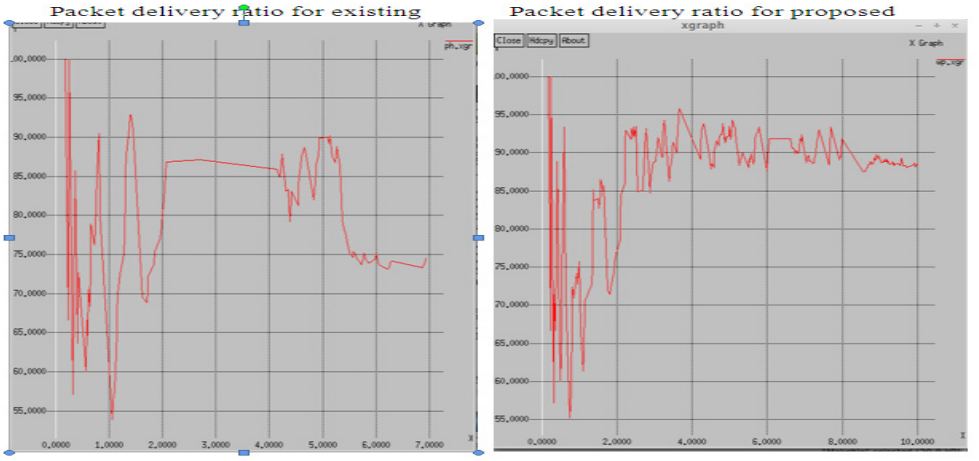
X – axis : Duration, Y – axis : Average Delay

Fig. 3. Comparison of Average delay between Existing and Proposed System

3.3. Packet delivery ratio

The packet delivery ratio is defined as the number of delivered data packets received to the total number of packets sent.

The X-axis represents the duration and Y-axis determines the Packet delivery ratio. The figure 4 clearly shows that with the help of proposed system the packet delivery ration has been increased when compared to the existing system.



X- axis : Duration, Y - axis : Packet Delivery ratio

Fig. 4. Comparison of packet delivery ratio between Existing and Proposed System

4. Conclusion

The proposed system has provided a Optimal path routing methodology to transfer message using an optimal path so the creation of multi copies can be reduced. The Utility based algorithm helps in identifying the path which

has been active for a longer period where that path has said to be as optimal path which has achieved the reliable and robust message transmission. The proposed system also uses path trace algorithm which determines per hop distance estimation and link frequent appearance count which has reduced the message dropping. In Delay Tolerant Networks, the existing routing processes were used and it has generated multi copies in order to achieve higher probability of successful message transmission. But it resulted in the increase of complexion at the receiver side. In the existing approach, message dropping was also not focused. All the issues have been clearly addressed in the proposed system. The implementation of optimal path routing and Path trace algorithm leads to the reduction of energy consumption, average delay and increase in packet delivery ratio.

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