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Comparison of Movement Model in DTN using routing algorithm by varying the Nodes

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Abstract: Delay Tolerant Networks (DTNs) represent a class of wireless networks that experience frequent and long lasting partitions due to dense distribution of nodes in the network topology. In DTN the routing of packets is made using store-carry-forward method. In this paper, three popular routing protocols in DTN namely; Epidemic , Direct Delivery and First Contact have been measured for performance evaluation. The performance of these routing protocols has been evaluated using three movement models namely Cluster Movement Model and Map Based Movement Model, shortest path map based movement model.

Keywords: Delay Tolerant Network (DTN), The ONE (Opportunistic Network) simulator, Movement Models, Routing protocols, TTL (time to live).

I. INTRODUCTION

A DTN is a network designed to operate effectively in highly-challenged environments. The "D" part in DTN stands both for Delay and for Disruption. By delay we mean the end-to-end latency of data transmission. The network is partitioned into numerous sub-networks in DTN.

Message transmission between different source-destination pair is done using different intermediate nodes and each intermediate node having its own buffer space temporarily store message in it till it comes in the neighborhood of other intermediate node**.** DTNs **is** a class of infrastructure-less wireless systems that maintain the functionality of networks experiencing frequent and long lasting partitions. A challenge for Delay Tolerant Networks is to control the routes through the network without having an end to end connection at any given abrupt of time. In DTN the routing of packets is done using store-carry-forward mechanism [2, 3]. And when encounter occurs the packet is provided to next intermediate node. This procedure is followed until the destination is reached [4, 5]. Routing and forwarding of data packets in DTN is a challenging task because of the uncertainty of mobility and alternating behavior of the nodes [6]. There are several issues in Delay Tolerant Networks that needs to be addressed. The most essential factor is encounter schedule, network capacity, storage capacity, energy etc [7]. DTNs may be characterized by combination of any of the following:

- *A.* Intermittent Connectivity: There is no consistent end-to-end path between the source and destination.
- *B.* Asymmetric data rates: The Internet does support some forms of asymmetric both directional data, as in cable TV or asymmetric DSL access.
- *C.* High error rates: In DTN the link error rates is quite high.
- *D.* Indefinite mobility designs: Unlike the case with public bus services that maintain fixed routes or planetary trajectories, upcoming behavior of a node is not fully recognized for many DTN applications.

The remainder of this paper is organized as follows. Section II represents the background and related work that are important for the understanding of DTN. In Section III, the simulation setup and different assumptions used to simulate different routing protocols of DTN are described. Section IV is devoted to the simulation results. Section V concludes the work and provides some insights on future work.

II. BACKGROUND AND RELATED WORK

In this Section, an overview of three routing protocols for DTN Epidemic[8],Direct Delivery and first contact[10],along with the irrelative pros and cons have been described.

A. Epidemic

Vahdat & Becker[8] proposed one of the simplest and earliest routing schemes for DTN. It is a flooding-based scheme. This routing scheme results in incompetent use of the network resources such as power, Bandwidth, and buffer at each node. Davis et al.[15]improved the basic epidemic scheme with the introduction of adaptive dropping policies. Harras etal.[16]further introduced

Time-To-Live (TTL)as well as an expiry time associated with every message for controlled flooding in DTNs.

B. First contact

This is simplest strategy to transmit the data from source to destination in DTN. This convey message immediately as soon as the source and destination come in contact with each other directly. This is likely when the source and destination are one hop apart or immediately neighbor of each other.

C. Direct Delivery Routing

This data delivery scheme is one of the simplest possible where a source transports a packet to a destination when it comes in direct-contact. In other words, the source waits till it comes in radio range of the destination and then straight delivers the packet to the same. This scheme does not consume any supplementary resources and makes no further copies of the data. However, the major limitation is that the delivery delay can be enormously big and in many cases the source and the destination may never come in direct-contact of each other.

III. SIMULATION SETUP

In this work, ONE simulator [12] is used for the simulation. Three different types of movement models present in ONE simulator, namely Cluster movement [13], Map Based Movement [14], Shortest Path Map Based Movement [14], have been used for simulation. In this work, the nodes are assumed mobile in nature. The different simulation parameters taken in this work are given as per below table:

TABLE1: Simulation Parameters

Sim_time	30000 sec
Sim_area	(4500*3400m)Helsinki down town area
Bt_interface-transmit_speed	250kbps
Bt_interface_transmit_range	10kbps
Number of groups	4
Buffer_size	5 MB
TTL	100 sec
Cell_size	5 m
Reports	1
Messagesize	500KB–1MB

The setting and configurations used for varying the fields are as follows:

A. Varying the number of nodes

The nodes are increased as: 80->120->160->200->240, with an increment of 10 nodes in each group in each simulation. The time to live field is set to 200 seconds and all nodes moves according to their respective group speeds.

B. Varying the Message TTL

The TTL is varied from50->100->150->200->250seconds.The total numbers of nodes are kept fixed at160 and the speed of all group nodes is kept between 2.5-5.0m/s.

The following performance metrics are considered for comparative analysis of the routing protocols:

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1) *Throughput:* Ratio of number of messages delivered to destination and number of messages produced by source node.
2) Message delivery probability: It is the probability of the messages that are correctly acknowledged by the destination within a given time period.
3) Overhead ratio: It is defined as:

$$\frac{\text{(No. of Relayed Messages–No. of Delivered Messages)}}{\text{No of Delivered Messages}}$$

4) Average buffer time: It is the average time for which messages stayed in the buffer at each node.

IV. SIMULATION RESULTS

The results for the proposed work are calculated by varying two fields:

A. *Varying the number of nodes*

When the number of nodes is varied, the graphs obtained for various performance matrices are given as per below:

1) *Delivery Probability:* The figure 4.6 shows how the delivery probability of the messages varies when the number of nodes is varied for cluster movement model and the proposed movement model. It is clear from the figure that the delivery probability of the packets is higher in proposed movement model.

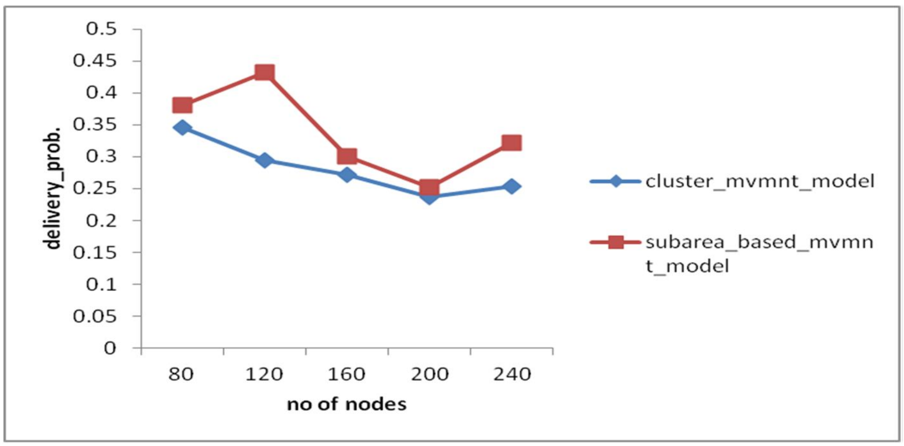

Figure 4.6: Number of nodes v/s delivery probability

2) *Drop Rate of messages:* The figure 4.7 shows the graph between drop rate of messages and number of nodes for the cluster movement model and proposed movement model. The figure shows that the drop rate is higher in case of previous movement model and lesser in the proposed work.

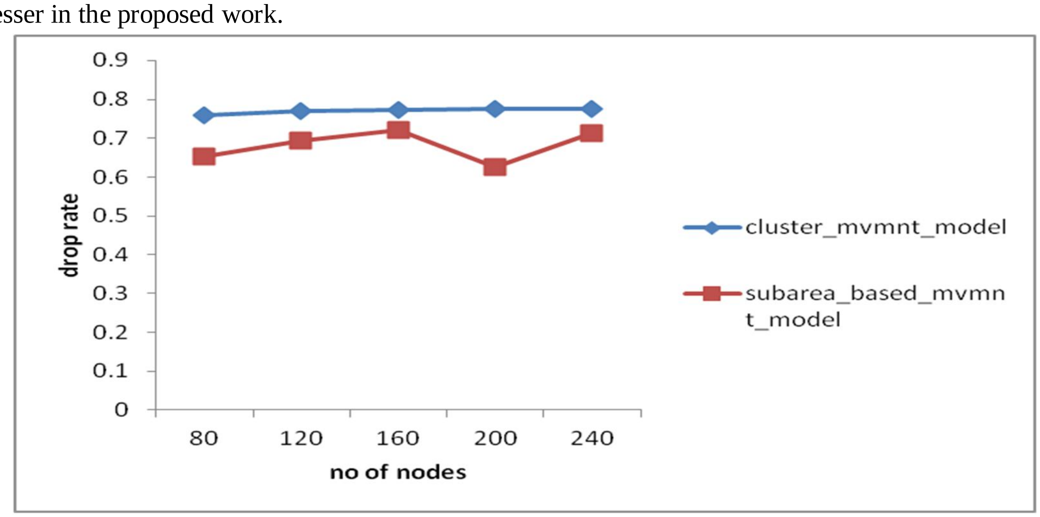

Figure 4.7: Number of nodes v/s drop rate

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3) *Throughput:* The figure 4.8 shows the graph between throughput and number of nodes. The graph depicts that the throughput is higher in case of the proposed movement model.

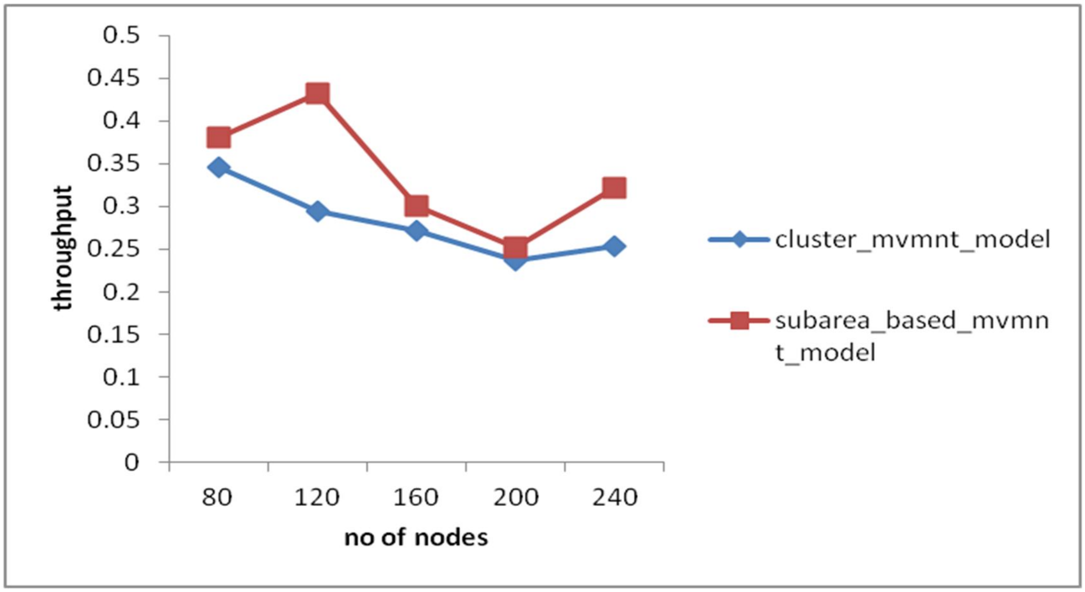

Figure 4.8: Number of nodes v/s throughput

4) *Overhead ratio*

The figure 4.9 shows the graph between the number of nodes and the overhead ratio. The graph shows that the overhead ratio for the proposed subarea based movement model is lesser then the previous cluster movement model.

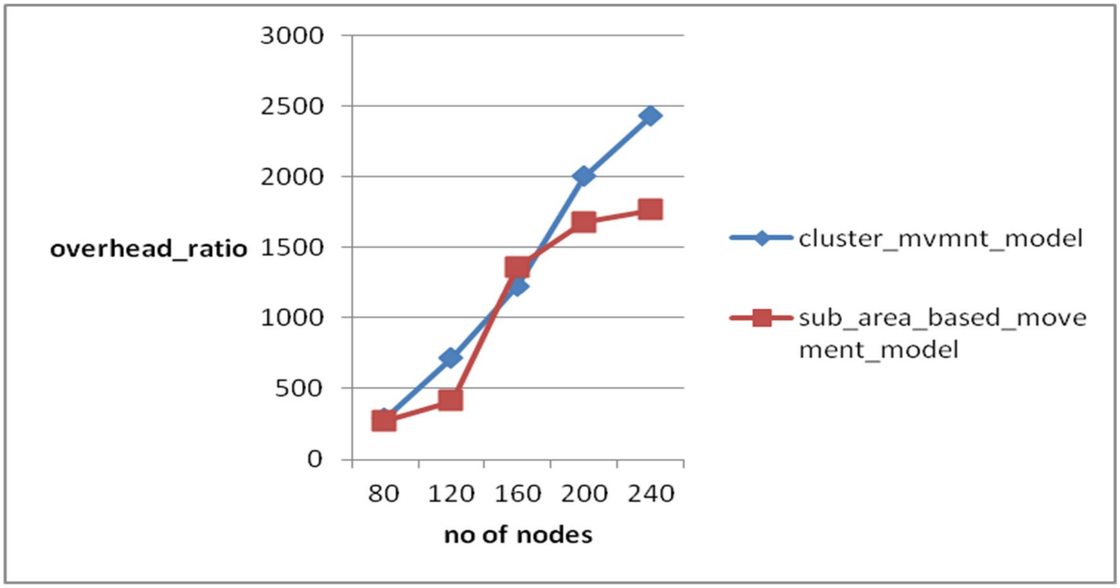

Figure 4.9: Number of nodes v/s overhead ratio.

V. CONCLUSION AND FUTURE WORK

The presented work is about to define a subarea based movement that is based on splitting of the network simulation area. When the proposed subarea based movement model is compared with the previous cluster movement model, it shows that the delivery probability of the packets and the throughput is higher in the proposed movement model. And the drop rate of messages and the overhead ratio in case of the proposed subarea movement model is lesser as compared to the cluster movement model. Thus the simulation results show that the proposed subarea based movement model is better than the previous cluster movement model.

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