Analysis of Prophet DTN Routing Protocol under various Mobility Models

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Abstract

This paper presents the performance analysis of Prophet DTN routing protocol under cluster movement, map based movement and map route movement models. So as to assess the presentation of Prophet routing protocol, delivery probability, overhead ratio, average latency, average hop count and average buffer occupancy metrics are utilized.

Keywords: DTN, prophet, mobility models, routing, ONE

I. Introduction

So as to deal with disengagements and long delays in sparse network scenarios, DTN utilizes store-carry-and-forward approach [1, 2]. A network node stores a bundle and hangs tight for a future opportunistic connection. At the point the connection is built up, the bundle is sent to an intermediate node, as indicated by a hop-by-hop forwarding/routing scheme. This procedure is repeated and the bundle will be handed-off hop-by-hop until arriving the destination node. In this context, various diverse routing protocols have been offered for DTNs.

This paper presents the relative analysis of different DTN (Delay Tolerant Networks) routing protocols (direct delivery, epidemic, prophet, max-prop and spray and wait routing protocols) under cluster movement, map based movement, map route movement, random direction, random waypoint and shortest path map based movement models. So as to assess the presentation of these routing protocols, delivery probability, overhead ratio, average latency, average hop count and average buffer occupancy metrics are utilized.

The rest of the paper is sorted out as follows. Section II presents past work done in the field of mobility models in DTN environment. Section III presents the simulation set up and our comparative analysis of Prophet DTN routing protocol under various mobility models. Last section concludes the paper.

II. Literature Review

Various study works have also been completed in the past that analyze different DTN routing protocols for their performance investigation. The work done in [4] shows a relative investigation of numerous DTN routing methodologies for their performance over a cluster-based mobility model. In this research paper, the authors have discovered that MaxProp and Prophet routing protocols are performing better than the other existing routing protocols when a cluster mobility model is in thought. However, it has restricted opportunity of application as disaster relief work may not generally be constrained to cluster-based mobility, where other models may likely be followed. The authors in [5] have proposed few of the DTN routing protocols that are reasonable to work in a post-disaster scenario yet no normalized correlation has been analyzed to recommend better or good protocols. The DTN routing comparison works done in [6, 7] depends on a single mobility model and distinctive routing methods have been assessed over it. The idea of performance comparison over different mobility patterns is novel and presents an extent of genuine usage if there should be an occurrence of any large scale disaster.

Mobility models are separated into broad classifications—specifically Entity-Based model and the other one as the Group-based mobility model [8]. Nodes move exclusively with no impact by other nodes in an entity-based model, whereas in Group-based model the node's movement within groups is influenced by other member nodes. In the Random Waypoint [8] model, which is an Entity-Based mobility model, mobile nodes select destination points haphazardly and travel there with constant speed and some pauses at destinations. Random Walk [8] is again an Entity-Based mobility model which is similar to a Random Waypoint model however having zero pause time. The Shortest Path Map Based mobility model [8] is an Entity-based and map based model which exploits algorithms, for example, the Dijkstra's to compute shortest paths between any two points on the map. Working day mobility model [8] is a Group-based model that models an overall result of numerous sub-models of node mobility during a whole day. It considers day to day common activities of various kinds of people. Cluster Mobility Model [8, 9] is a group-based model that partitions the whole network in a specific number of clusters. Nodes that convey information starting with one cluster then onto the next are Carrier nodes. The other nodes present in each cluster are known as internal nodes. An internal node's movement gets characterized around a Cluster Center. Cluster Mobility Model is most appropriate as a group-based mobility model to emulate a post-disaster scenario.

Uddin et al. [10] have proposed a post-disaster mobility model for a DTN that helps in giving communication in such contexts where it is infeasible and hard to think about an ensured end-to-end connectivity. The mobility model proposed by them uses numerous actors in post-disaster including relief workers of different classifications, transportation network, population movement and relief vehicle movement, and so on.

III. Performance Analysis Using ONE Simulator

There are two notable simulators broadly utilized in DTN environment, the Network Simulator 2 (NS-2) and the Opportunistic Network Environment simulator (ONE). NS-2 is an event driven test system, created through extensive coordinated effort between numerous firms. It is an open source venture which incorporates an assortment of user-developed extensions, protocols, and customizations. On the other hand, the ONE Simulator is additionally an event based simulator created at the Helsinki University of Technology explicitly for simulating DTN routing protocols. The detail of different simulation boundaries is recorded in Table 1 given beneath.

TABLE I. Simulation Setup

Parameters	**Their Values**
Routing Protocol	Prophet DTN Routing Protocol
Simulation Run	3600 s
Node Transmission Speed	2 – 10 Mbps
Node Transmission Range	10 m
Node Buffer Size	5 – 50 MB
Wait Time	0 – 120 s
Node Speed	0.5 – 13.9 m/s
Message TTL	300 minutes
No. of Nodes	100
World Size	4500 m*3400 m
Warm Up	1000 s
Message Size	500 KB – 1 MB
Simulation Duration	14400 s
Message Creation Interval	25 – 35 s
Mobility Model	Cluster Movement (MM1), Map Based Movement (MM2), Map Route Movement (MM3)

A. Delivery Probability

$$Delivery\ Ratio = \frac{\text{Number of delivered messages}}{\text{Number of created messages}}$$

TABLE II. Analysis in terms of Delivery Probability

Mobility Model	**Delivery Probability**
Cluster Movement	0.3333
Map Based Movement	0.3333
Map Route Movement	0.1417

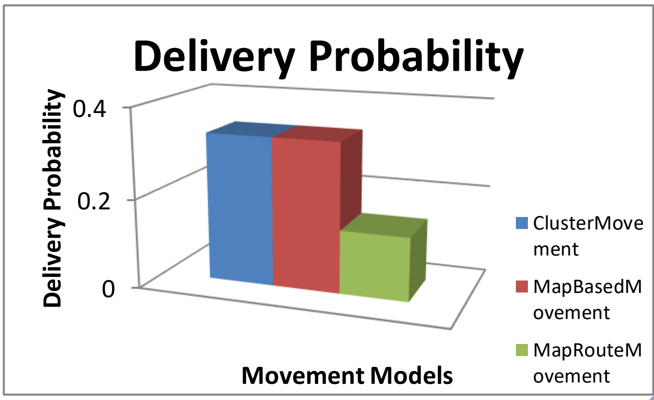

Fig. 1. Analysis in terms of delivery probability

B. Overhead Ratio

$$Overhead\ Ratio = \frac{\text{Number of relayed messages} - \text{Number of delivered messages}}{\text{Number of delivered messages}}$$

TABLE III. ANALYSIS IN TERMS OF OVERHEAD RATIO

Mobility Model	Overhead Ratio
Cluster Movement	2755.775
Map Based Movement	2755.775
Map Route Movement	509.4706

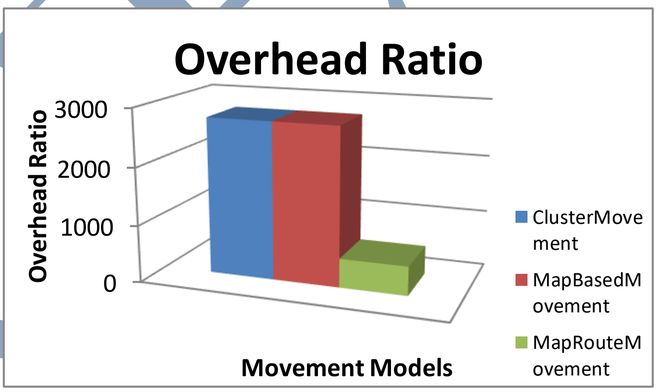

Fig. 2. Analysis in terms of overhead ratio

C. Avg. Latency

$$Average\ Latency = \frac{\text{Sum of delivered message's delay}}{\text{Number of delivered messages}}$$

TABLE IV. ANALYSIS IN TERMS OF AVG. LATENCY

Mobility Model	Ang. Latency
Cluster Movement	261.7425

Map Based Movement	261.7425
Map Route Movement	653.1294

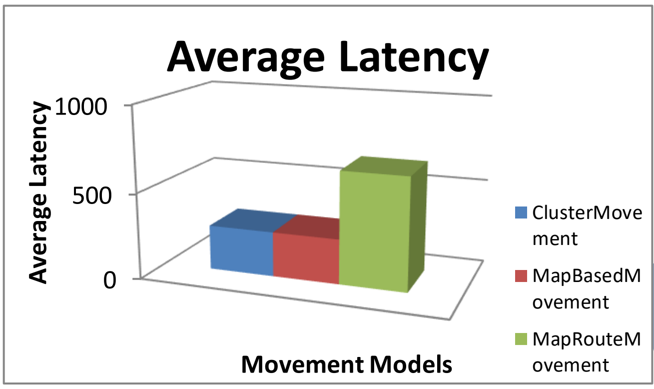

Fig. 3. Analysis in terms of avg. latency

D. Avg. Hop Count

$$Average\ Hop\ Count = Average\ number\ of\ hops\ between\ source\ \&\ destination\ nodes$$

TABLE V. ANALYSIS IN TERMS OF AVG. HOP COUNT

Mobility Model	**Avg. Hop Count**
Cluster Movement	6.375
Map Based Movement	6.375
Map Route Movement	3.8824

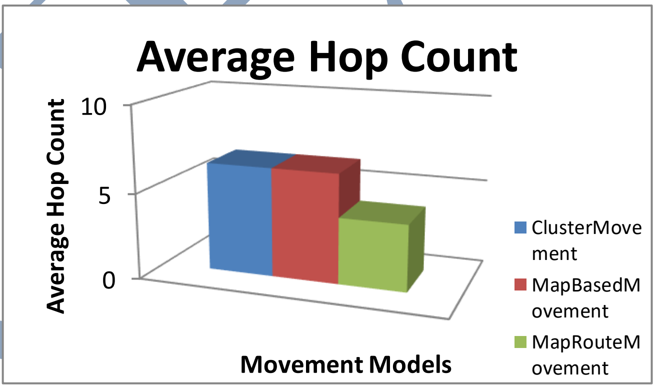

Fig. 4. Analysis in terms of avg. hop count

E. Avg. Buffer Time

$$Average\ Buffer\ Time = \text{Average time for which message stayed in buffer at each node}$$

TABLE VI. ANALYSIS IN TERMS OF AVG. BUFFER TIME

Mobility Model	**Avg. Buffer Time**
Cluster Movement	54.8942
Map Based Movement	54.8942
Map Route Movement	149.2027

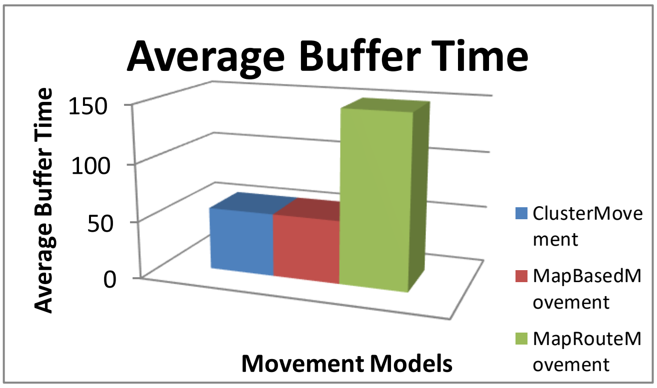

Fig. 5. Analysis in terms of avg. buffer time

IV. Conclusion

This paper assesses the presentation of Prophet DTN routing protocol underneath several node mobility models like cluster movement, map based movement and map route movement models. It is obvious from the outcomes shown by our paper that no one model is adequate for all the circumstances and diverse situation.

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