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PERFORMANCE EVALUATION OF ROUTING POLICY IN DELAY TOLERANCE NETWORK WITH VARIOUS MOBILITY MODELS

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ABSTRACT

DTN is a wireless network. A Wireless Network is computer network that uses wireless connection for connecting nodes in network. DTN follow "store carry forward" mechanism for transferring data. DTN routing protocols instead take advantage of temporal paths created in the network as nodes encounter their neighbors and exchange messages they have been asked to forward. DTN has different routing protocols for transferring data. Here, performance of four routing protocols Epidemic, First contact, Direct delivery, and Prophet is evaluated with Random way Point Model, Shortest Path Map-Based Movement Model, Map Route Movement Model under two different scenarios and show best routing protocols among them. It is implemented in ONE simulator.

Keywords Delay Tolerance Network, Models, ONE, Routing Protocols, Scenario.

I. INTRODUCTION

Delay Tolerance Network is less infrastructure wireless system with long lasting partition. DTN does not have end to end path connectivity between nodes. It is an intermittently connected network. When a node has a packet for transfer, it store and carry the packet until it does not find any node connection. When two nodes come in contact, they exchange the packet according to requirement, this is forwarding process. So, DTN work on store carry forward mechanism. Routing and forwarding of data packets in DTN is a challenging task because of the uncertainty of mobility and intermittent behavior of the nodes. DTN has many issues in routing and for these issues best routing protocol should be known. One of the current research aspects in DTN is evaluating the best routing strategies. Many researchers have worked on different routing strategies to evaluate their performance based on different performance metrics. Performance of routing strategies can also evaluate using mobility models present in DTN. Here, analysis is done on routing strategies Epidemic, Prophet, First Contact and Direct Delivery through mobility models Shortest path map based, Map route movement, Random way model using ONE simulator. The study of different types of routing protocols will help in better

understanding of the basic characteristics and functioning of the protocols. By using these results researchers can further study by choosing the best routing strategies.

II. ROUTING PROTOCOL

A Routing protocol specifies how routers select routes between two nodes on computer network and communicate with each other. A routing protocol shares information first among immediate neighbors and then throughout the network. There are many protocols in Delay Tolerance Network. Here, following four protocols are studied:

2.1 Prophet

Prophet stands for Probability Routing Protocol using History of Encounters and Transitivity. Prophet does not send bundles of messages in network. It is a prediction based scheme. It is based on delivery predictability, transitivity and aging. If a node visited a location many times than there is a possibility to visit that location again. There are three parts of the delivery predictability calculation. First, the delivery predictability metric is updated whenever nodes encounters, so that nodes that are often encountered have high delivery predictability. The delivery predictability must age since a pair of nodes does not encounter each other for a moment of time. Transitivity is also applied in PROPHET. Based on the observation that if node A frequently encounters node B, and node B frequently encounters node C, hence node C probably is a good node to forward messages destined for node A.

2.2 Epidemic

Epidemic is easiest routing protocols in delay tolerance network. When a node receives a message, it spread a copy of message to all other nodes. This approach is less effort approach but there is no delivery guaranty. When a node receives a message its buffer will update with message and its unique identifier, this is called summary vector. When two nodes come in contact they exchange and compare their summary vectors to identify which message they do not have and subsequently request them.

2.3 First Contact

First contact is simplest routing protocol for sending data from source to destination in delay tolerance network. It is single copy scheme. When anode receive a message it check for connection if any connection is available then message will send otherwise node will wait for connection. Only one copy of message will forward to available node and message will delete from buffer after forwarding message. In this protocol source node and intermediate node forward message to nearby node which encounter first until message deliver to destination. If any intermediate node fails to carry message then message will lost.

2.4 Direct Delivery

In direct delivery routing source node send message directly to destination node. In this protocol source node carry message until it does not directly come in connection with destination node. This scheme has less

overhead and long waits time. Message will never deliver if source and destination does not come in range. This scheme is best when nodes have full knowledge of network.

3. Models

Models are used to achieve realism based on practical traces and synthetic theories. There are many mobility models in DTN. Here, following three mobility models are used in evaluation:

3.1 Random way point model

In this model, each node move towards a randomly chosen location. It includes a random pause time after each movement for selecting new location. Uniform distribution is used to sampling the direction, angles, speed and pause time in this model.

3.2 Shortest Path Map-Based Movement Model

Shortest path model used Dijkstra's shortest path algorithm to discover the shortest path to the destination. A map of network is used for data transfer. Each node has knowledge of map and chooses route according to map. Node calculate shortest path from map and choose this path to reach the destination.

3.3 Map Route Movement Model

In this model, some nodes are assigned predetermined routes that they must travel on the map. Routes within the map contain many points and these points are termed as stops on the routes. Nodes wait on every stop for some time before traveling to the next stop. Nodes follow the shortest path approach to reach the destination.

IV. SCENARIO

In this, simulation is done on tram group t on node speed. Scenario is done with different routing policy and different models.

Scenario Speed of nodes

Node speed=10, 20, 30, 40, 50, 60, 70, 80

No. of Tram Node fix=5

In this scenario, Node speed is changed and nodes remained fix. All routing policies are also evaluated with all models for performance comparison.

V. METHODOLOGY

Performance of different routing policy is evaluated with mobility models on the basis of different performance metrics using ONE simulator. The simulator is used to simulate the mobility environment and the open system interconnection layers utilized in wireless simulation. The Opportunistic Networking Environment simulator is a Java program which makes complex DTN simulations more realistic.

5.1 Simulation Parameters

Parameter Description	Value
Simulator	One
Protocol Studied	Epidemic, Prophet, Direct Delivery and First Contact
Simulation Time	35000
Buffer Size	5m
Waiting Time	0,120
No. Of interface	1
Speed	0.5,1.5
TTL	300min
No. of Groups	6
btInterface.transmitSpeed	250k
btInterface.transmitRange	10
Mobility Models used	Shortest path model, Map Route Movement model and Random Way Point Model

Table 1

5.1 Performance metrics

5.2.1 Delivery Ratio

It is defined as the ratio of the number of messages actually delivered to the destination and the number of messages sent by the sender.

$$\text{Delivery Ratio} = \frac{\text{Total Delivered Message}}{\text{Total Generated Message}}$$

5.2.2 Buffer Time Average

This is the average time that messages spend during its transit in the buffer nodes. This is not a metric of time spent in the buffer by the messages delivered, but it is the average of the time spent by all messages delivered and abandoned or stranded in the buffers of intermediate nodes.

5.2.3 Average Latency

The latency measured here is the time that elapses between the creation of a message and its delivery at its destination.

VI. SIMULATION RESULTS AND DISCUSSION

6.1 Delivery Ratio

Delivery ratio of all routing policies with three models is:

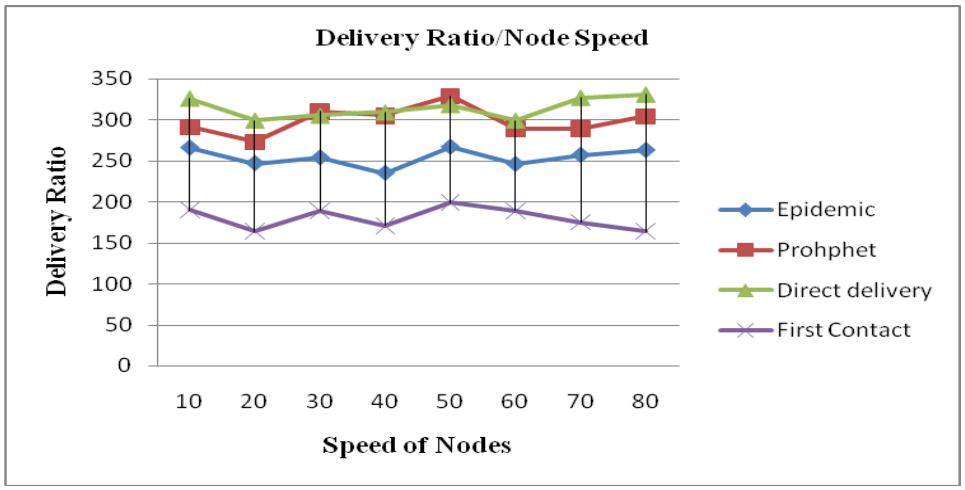

Fig 1

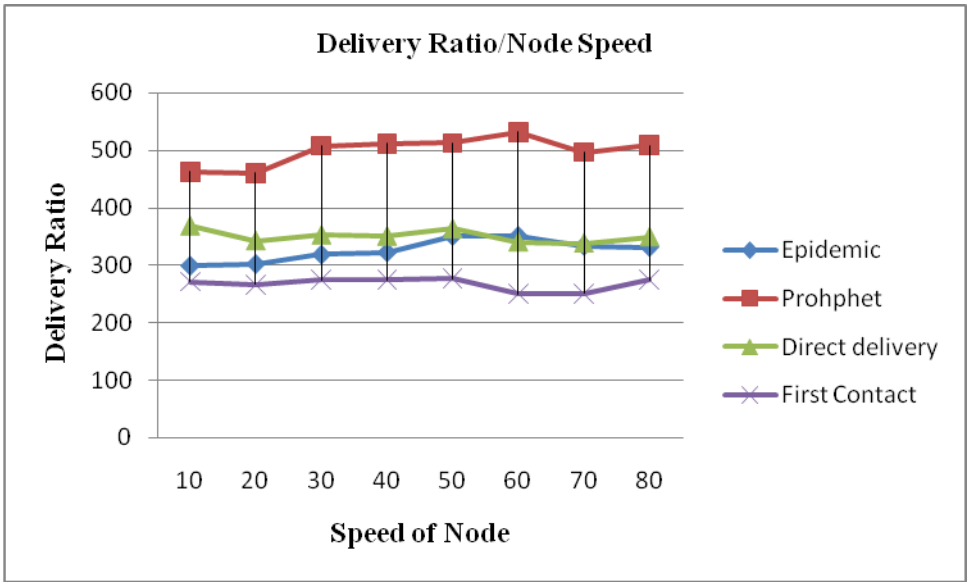

Fig 2

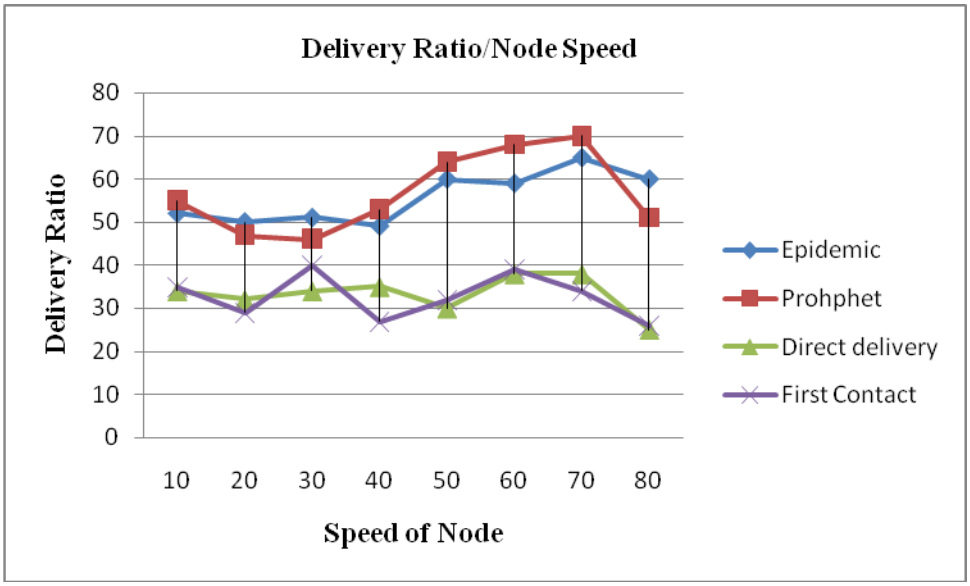

Fig 3

Delivery ratio obtained of all different routing policy with different models is shown from "Fig 1" to "Fig 3". Delivery ratio of all policy increased with increment in speed of nodes. Prophet gives overall best performance with all three models.

6.2 Buffer Time Average

Buffer Time Average of all routing policy with all models is:

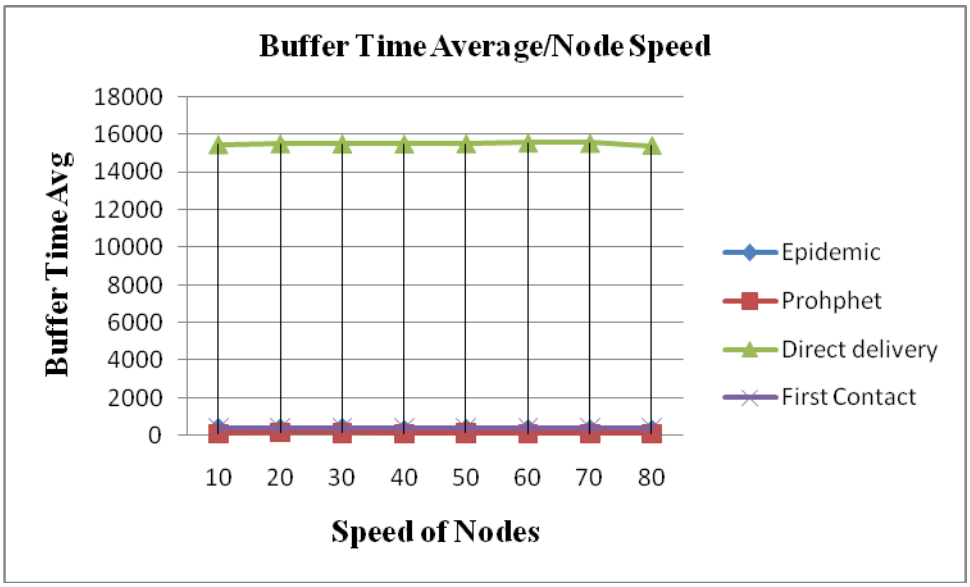

Fig 4

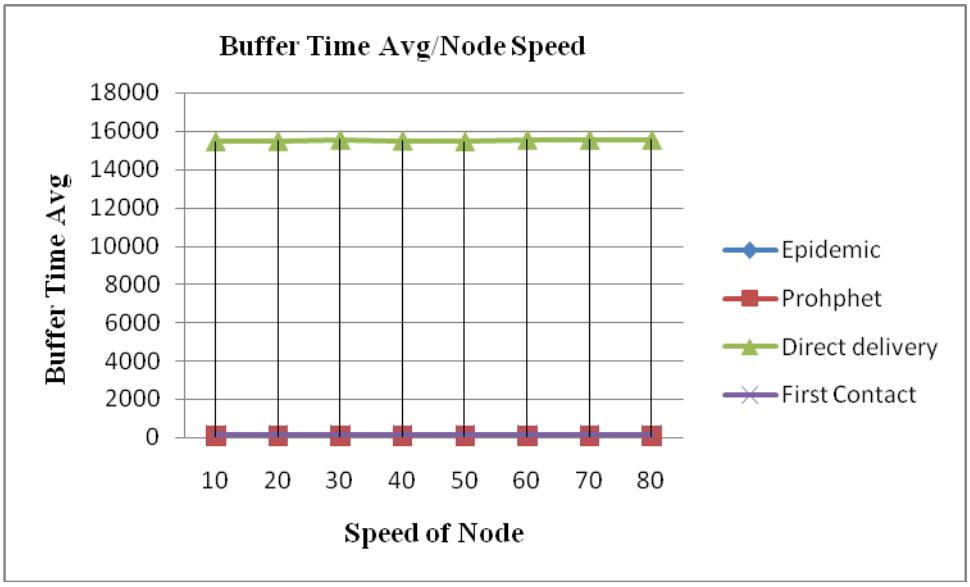

Fig 5

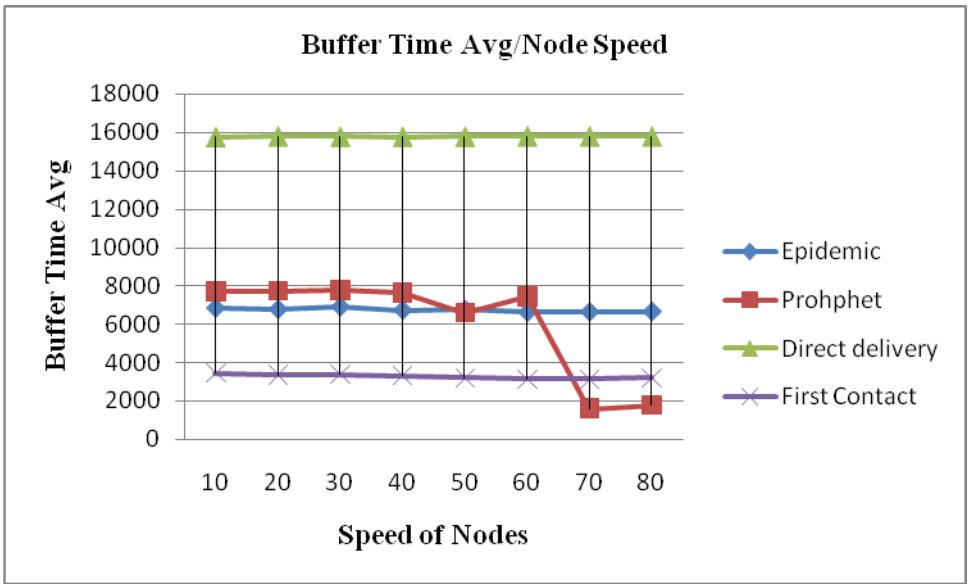

Fig 6

Buffer Time average obtained of all different routing policy with different models is shown from “Fig 4” to “Fig 6”. Buffer time average decreased with increment in node speed. Prophet gives overall best performance with all three models.

6.3 Average Latency

Average Latency of all routing policy with all models is:

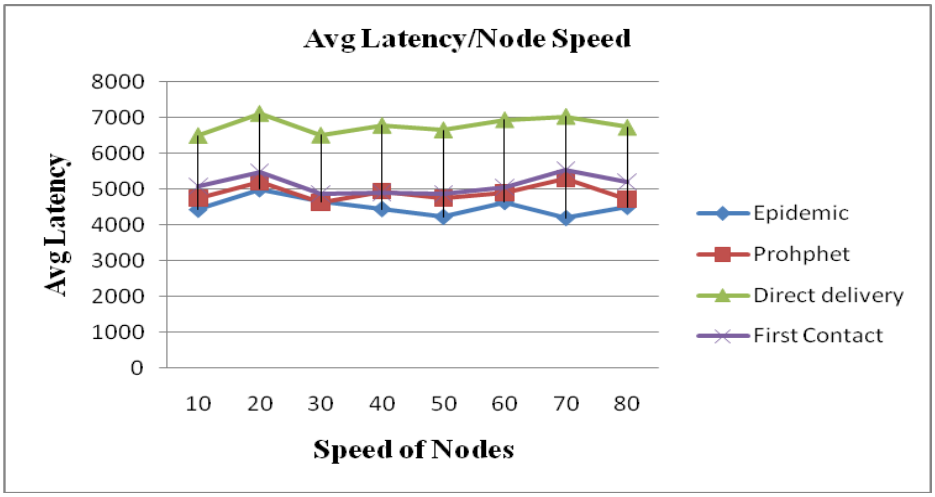

Fig 7

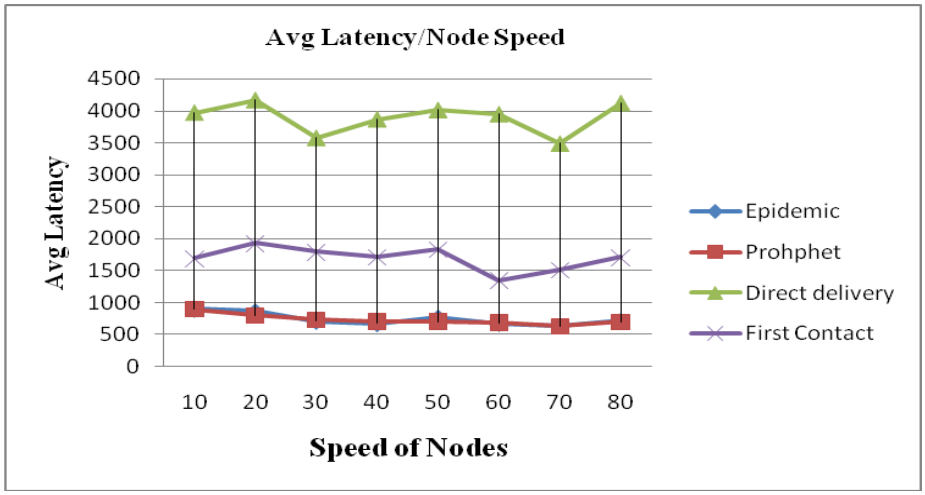

Fig 8

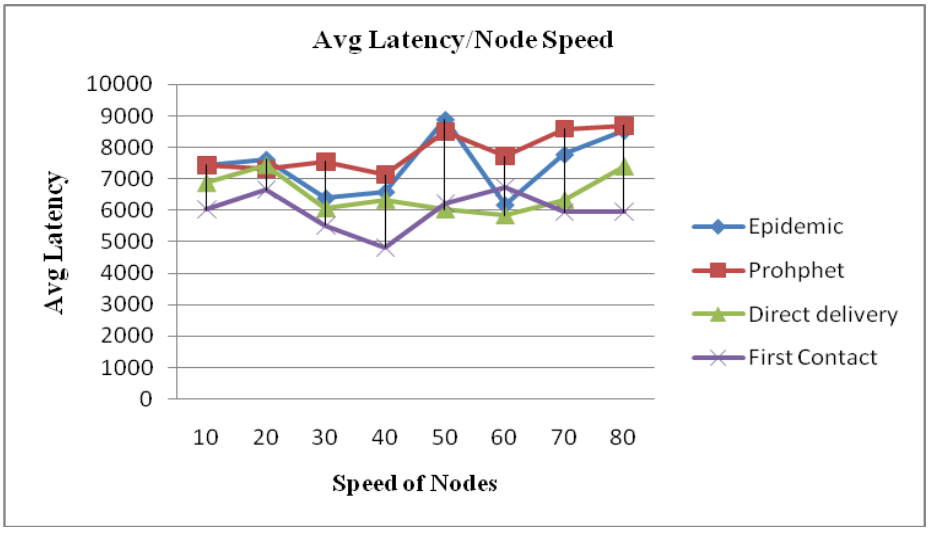

Fig 9

Average Latency obtained of all different routing policy with different models is shown from "Fig 7" to "Fig 9". Average Latency decreased with increment in node speed. In "Fig 7" and "Fig 8" Prophet and Epidemic less average latency but in "Fig 9" First contact less average latency.

VII. CONCLUSION

Empirical results illustrate that the performance of a routing protocol varies widely with different models by varying node speed. From this entire evaluation final conclusion is that Prophet is best among all other routing strategies under this scenario. Epidemic is on second place after Prophet but overall performance of Prophet is best. On other hand Map route movement model is better than other used models. All routing strategies gave good result using it. Prophet also gave best result using Map route movement model. By using these results researchers can further study the performance of other routing protocols of DTN or can choose the best routing strategies for future works in DTN.

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