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Simulation of Epidemic, Spray and Wait and First Contact Routing Protocols in Delay Tolerant Network

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Abstract−*Delay Tolerant Networks (DTNs) are the networks that are operated in challenged and extreme environment. These networks have long transmission delay, having high path errors and limited resources. The aim of this paper is to discuss the various routing schemes currently presented in DTN and simulate them using ONE Simulator with the help of these matrices delivery probability, overhead ratio, storage capacity and average delay and find the best routing among these routing schemes.*
Keywords−*DTN (Delay Tolerant Network), ONE (Opportunistic Network Environment), Routing protocols.*

I. INTRODUCTION

Delay Tolerant Networks (DTNs) are a new development in network research field. DTNs are the networks where no end-to-end paths are present between nodes for a long period of time.Delay Tolerant Networks are wireless networks where disconnections and delays are high.

DTN works on the principle of store, carry and forward mechanism. A store, carry, forward mechanism is a mechanism in which when a node receives a packet then it stores in its buffers, and when next intermediate node come in range of network then it forward the packet to that node .This is known as store, carry, forward mechanism [1,2,8].

Delay tolerant networks (DTNs) correspond to a class of infrastructure-less wireless systems that carry the functionality of networks experiencing frequent and long lasting partitions. DTNs are planned to deal with scenarios concerning lack of *contemporaneous* end-to-end links, *intermittent* connectivity between adjacent nodes, *heterogeneity* of standard, and exceptionally *high delays* and error-rates. Likewise, nodes working in challenged environments are extremely restricted in their resources; such as CPU processing power, memory and network capacity. A DTN setting has to account for all or some of these factors.

DTN protocols and architectures are planned to achieve interoperability and final connectivity to a range of complex applications that include:

-Wireless Sensor Networks (WSNs): WSNs are deployed in wildlife tracking or in severe regions (e.g. volcanic and underwater areas).

-Mobile Ad-Hoc Networks (MANETs): MANETs connecting remote and rural communities via GPSs, cellular devices and portable storages.

-Exotic Media Networks (EMNs): EMNs interconnecting extra-terrestrial nodes such as satellites and deep space probes in Inter-Planetary Networks (IPNs).

1.1 Characteristics

Disconnection – No connection is present between numbers of nodes.

High Latency-Latency is defined as end to end delay between nodes. Latency is high due to number of disconnection between nodes.

Low Data Rate – Data rate is a rate which describes number of message delivered under given time period. Data rate is low due to long delays between transmissions.

High error rates- If bit errors occur on links, then they require error correction. For this so many approaches are there. And result of applying these approaches is usage of more bandwidth. Even retransmitting the entire packet, leads to more network traffic.

Ambiguous mobility patterns- In the case of public bus services, the fixed routes or planetary trajectories are maintained. But in case of DTN applications, future behavior of a node is not fully known. It is generally assumed, however, that node mobility patterns (while random) are generally recurrent.

Variable and uncertain connection duration- The packets in DTN are considered as bundles. Routing protocols require making a decision whether to transmit all or a subset of bundles when nodes meet each other. For example, as zebras in ZebraNet gather for a limited time period, the routing protocol has to decide which data to forward in order to maximize delivery probability.

Limited resources- DTNs have the resources constraints. It requires protocol designs to be efficient. In other words, nodes must consume their limited hardware resources such as CPU, memory and battery efficiently. For example, in WSNs, nodes can be placed in an open environment for years before data are collected, and hence requires nodes to cautiously manage their energy usage. In addition, a good routing protocol will influence the resources of multiple nodes. For example, nodes may select to shift some of their stored bundles to other nodes to free up memory or to reduce transmission cost.
Long Queuing Delay-Each node have its own buffer to store message, frequent disconnection may cause long queuing delay.
In this paper Section II presents the related work related with routing schemes. In Section III, the simulation setup and various assumptions used to simulate different routing protocols of DTN are described. Section IV presents the simulation results. In Section V conclusion and future scope are discussed

1.2 DTN Architecture

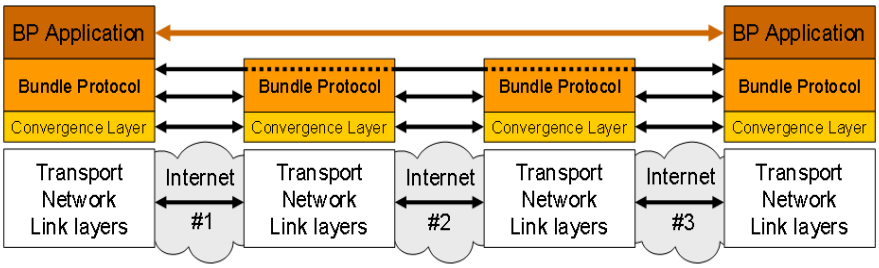

Fig.1. DTN Architecture

The DTNRG has developed architecture for Delay-tolerant networking that has emerged from the efforts on Interplanetary Internet (IPI). The basic concepts find their application in sensor networks, interpersonal communication (people or "pocket-switched" networks), and in mobile Internet access. Exchange of Bundles hop-by-hop via Bundle Protocol Agents Bundle Protocol across different internetworks Convergence layer provides mapping to lower layer.

1.2 Movement Models

Movement models govern the way nodes move in simulation. They provide coordinates, speeds and pause times for the nodes. There are various movement models presented in DTNs. Some of them are discussed here.

- Random Waypoint
- Shortest Path Movement
- Map Based Movement Model[7,11]

Random Waypoint- In random waypoint movement model, nodes moves randomly in arbitrary direction. There is no particular mechanism behind the node mobility. It includes pause times between changes in direction and/or speed. Mobile nodes start from one location and then travel randomly in any direction.

Shortest Path Movement-The more sophisticated version of the map-based movement model is shortest path map based movement. In this model, node use the shortest path from all available paths, shortest available path is chosen on the basis of Dijkastra algorithm that is applied as backend. Map data can also contains Points of Interest (POIs).

Map Based Movement Model- In this model, there is predefined map and node moves on the basis of that map.The ONE simulator release includes three map-based movement models. These are: random map based movement, shortest path map based movement and route map based movement.

1.3 Queuing Policies [1,5,8]

DTN protocol assumes that each node has a buffering queue. DTN networks have so many challenges, so to cope with them buffered nodes are used. It decides which message should be dropped in case of buffer is full. It is based on priority basis. Each node have its own buffer and when buffer gets full and new message wants to accommodate in a queue then on the basis of following queue management policies, it is decided that which packet is to be discarded:

1.FIFO (First In first out) - It is a way for organizing and manipulating an queue buffer where the message that was entered first in the queue that is processed first. In this message leave the queues in the order in which they arrive or the first entered message get dropped first.
2.MOFO(Evict Most Forwarded First) - This policy needs observance track of the number of times each message has been forwarded. The message that has been forwarded the most is the first to be dropped, thus giving messages that have not been forwarded fewer times a chance.
3.LEPR (Evict least probable first) - The node having least delivery probability value will be dropped first.

II RELATED WORK

In this Section, an overview of three routing protocols for DTN, namely Epidemic, First Contact and Spray & wait, along with the irrelative pros and cons have been described.[1,2,3,4]
1) Epidemic- It was proposed for the synchronization of replicated databases. Epidemic algorithms promise that provided a enough number of random exchanges of data, all nodes will finally receive all messages. In epidemic routing number of duplicate messages are transmitted in the hop that at least one will reach to destination. Epidemic Routing is comparatively simple because it requires no knowledge about the network. This provides a large amount of redundancy while all nodes receive every message, making this strategy tremendously robust to node and network failures. It tries every path and delivers each message in minimum amount of time. The disadvantage in epidemic routing is that it requires a large amount of buffer space, bandwidth and power is used to deliver multiple copies of message although delivery ratio is good but increases the overhead due to large consumption of bandwidth.

2) Spray and Wait- In spray and wait routing there are two phases.
First phase is Spray phase in which it limits the generation of duplicity of messages to minimize the use of network resources. Second phase is Wait phase in which sender wait for the response of sent messages which are sent in spray phase if there is no response of delivery of message then sender again send the messages to destination.
Spray and Wait routing overcomes the problem occurred in epidemic based routing.
In Spray and Wait routing, delicacy of message is less as compared to epidemic based routing. Also bandwidth consumption is less in Spray and Wait routing as compared to epidemic.

3) First Contact- In this routing, node send a message randomly using any available contact. If none of the path is available then the message waits for that particular path until become available and is assigned to first available contact.
This results in only a single copy of every message in the network. To prevent two nodes who stay in contact for a long time exchanging the same messages back and forth, the receiving node accepts a message only if the message has not passed through it before. Unluckily, there are no guarantees that the first node that is met is a better candidate than the previous node carrying the message, so First Contact is not likely to achieve very high delivery probabilities either.

III SIMULATION ENVIRONMENT

ONE (Opportunistic Network Environment)
Here in this paper simulation of various routing protocols are done on ONE Simulator. This simulator is open source and easy to use. It can be simulated in java and run on any platform that supports java[7].

Table 1. Simulation Parameter

Parameter Description	Value
Simulation Area	4500m*3400m
Simulation Time	20000s
Mobility Model	Shortest Path Map Based Movement Model
Routing	[Epidemic ;Spray and Wait ;First Contact]
Transmission Range	10m
TTL(Time To Live)	300s
Buffer Size	5m,10m,15m,20m,25m
Warm Up Period	1000seconds

Performance Matrices

1) Delivery probability - This is the ratio of total number of packets created to total number of packets delivered to destination.
2) Storage Capacity - It defines the ability of a node to store number of messages.
3) Overhead Ratio - The overhead ratio shows the amount of network resources needed to deliver a packet to its destination.
4) Average Delay - It is defined as the average value of the delays for each successful delivered packets.

Performance Parameter:

Buffer Space: A buffer is a place where nodes can temporary stores the data during data transmission. Here in this paper using buffer space compute above mentioned matrices in above mentioned routing protocols.

IV SIMULATION RESULTS

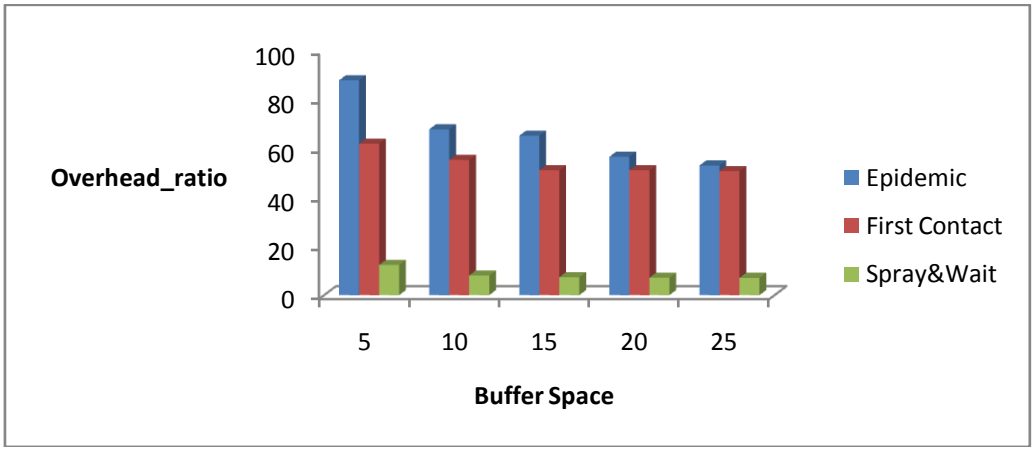

Fig.2. Overhead ratio v/s Buffer Space

The graph depicts the results for changing Overhead ratio while increasing Buffer space. Overall, it is estimated that when we increase the Buffer space then Overhead ratio will always decreases. But rate of decrease of Overhead ratio vary according to different routing schemes. In Epidemic routing scheme, initially Overhead ratio decreases sharply and then there is a constant decrease as buffer space increases. In First Contact and Spray and Wait, initially there is a slight decrease in Overhead ratio and then Overhead ratio remains constant as Buffer Space is increasing.

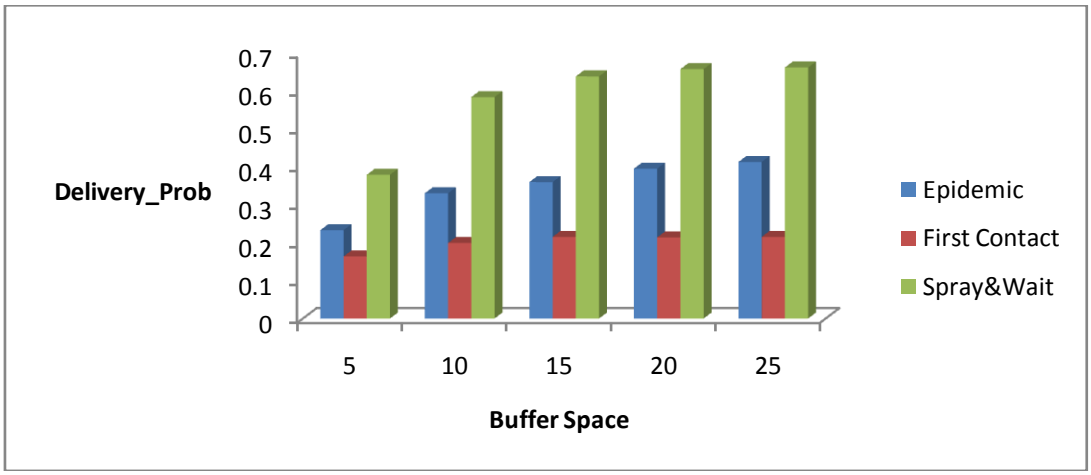

Fig.3. Delivery Probability v/s Buffer Space

It is to be concluded that from all routing schemes, Spray and Wait mechanism works best as delivery probability in this mechanism increases continuously as Buffer Space increases. Message delivery rate in First

Contact routing mechanism is very poor. In Epidemic Scheme, message delivery probability increases continuously as buffer space increases.

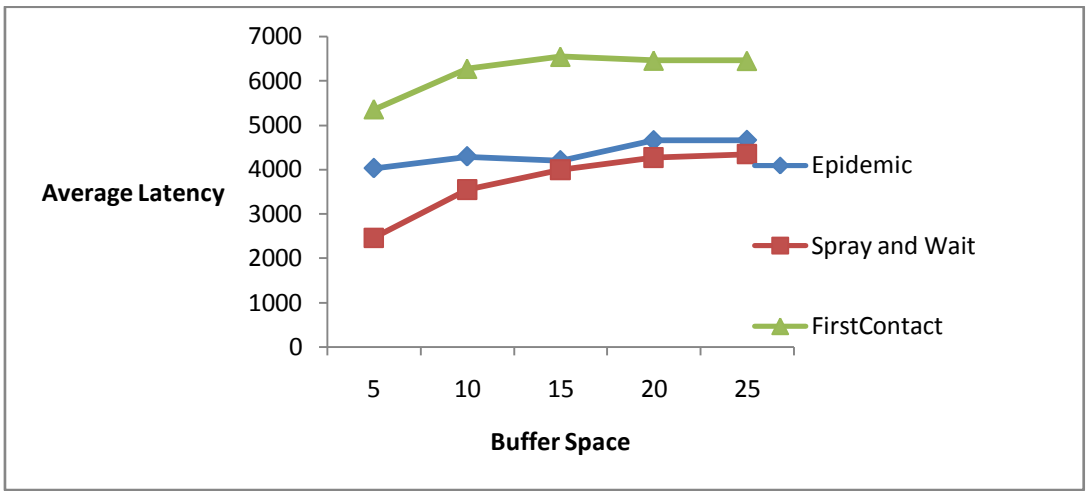

Fig. 4. Average Latency v/s Buffer Space

The graph shows the results of Average delay rate in contrast with Buffer space.
There are uncertain changes in results in Delay rate in both Epidemic and First Contact. As Delay rate first increases then decreases and then again increases but in case of Spray and Wait average Delay increases while increasing Buffer space.

V CONCLUSION AND FUTURE SCOPE

In this paper various existing routing schemes are discussed. These schemes are simulated on ONE simulator in fully distributed manner to thwart various attacks without relying on any tamperproof hardware and software platforms. Simulation results shows that Spray and Wait routing is best among the three mentioned routing in perspective of the Delivery Probability, Overhead ratio and Average delay. In future our aim is to propose a new routing scheme and compare it with spray and wait routing scheme.

REFERENCES

[1] http://www.topcoder.com/dtn
[2] Gao et al., "Multidimensional Routing Protocol in Human-Associated Delay-Tolerant Networks" ,*IEEE Transactions On Mobile Computing*,Vol. 12, No. 11, pp. 2132-2144, 2013
[3] A. Lindgren et al., " Probabilistic routing in intermittently connected Networks" , ACMSIGMOBILE CCR, 2003
[4] S. Jain, K. Fall, R. Patra., "Routing in a Delay Tolerant Network".*Proc. of ACM SIGCOMM, pp. 145–2008.*
[5] Y. Cao et al., "Approach-and-Roam (AaR): A Geographic Routing Scheme for Delay/Disruption Tolerant Networks*", IEEE Transactions On Vehicular Technology,* Vol. 63, No. 1, pp. 266-281, 2014
[6] Anders Lindgren, Avri Doria, and Olov Schelen, "Probabilistic routing in intermittently connected networks", *Proceeding of 1st International Workshop on Service Assurance with Partial and Intermittent Resources , 2004, 239-254.*
[7] Anju Rani , Atul Sharma, Dr. Dinesh Singh, Sanjeev Indora "Movement Models based Performance Comparison of Routing Protocols in DTN [d]Proceedings of 'Second International Conference on Emerging Research in Computing, Information, Communication and Applications'(ERCICA-14)2014.
[8] Dinesh Singh, SanjeevIndora, Anju Rani, Atul Sharma" Routing Policies & Strategies in Delay Tolerant Network"International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 National Conference on Advances in Engineering and Technology .
[9] Spyropoulos, T., Psounis, K. &Raghavendra, C. S., "Spray and wait: an efficient routing scheme for intermittently connected mobile networks", *Proceedings of ACM SIGCOMM workshop on Delay-tolerant networking, ACM, New York, NY, USA, 2005, 252–259.*
[10] Evan P.C. Jones and Paul A.S. Ward , "Routing Strategies for Delay TolerantNetworks", University of Waterloo, Ontario, Canada.
[11] A. Lindgren et al., " Probabilistic routing in intermittently connected Networks" , ACMSIGMOBILE CCR, 2003