

A Survey on Routing Protocols in Delay-Tolerant Networks

Nilam Chaudhary¹, Prof. Shakti Patel²

Computer Engineering, SPCE Visnagar^{1,2}

Email: nilamchaudhary115@gmail.com¹, svpatel.ce@spcevng.ac.in²

Abstract- Delay tolerant network refers to a network where connectivity is opportunistic. Due to such intermittent connectivity traditional routing protocol fails. In order to efficiently route the information in such an environment there have been proposed various classes of routing: Replication based, Knowledge based and Coding based etc. This technique uses local information available with node: Neighbourhood index, past contacts, contact duration, node mobility etc. to determine next hop or destination. This paper presents survey on a routing strategy of Flooding (Replication) based, Knowledge (Store and Forwarding) based and based on Coding in delay tolerant networks.

Index Terms: Delay tolerant networks, DTN, Routing protocols.

1. INTRODUCTION

A DTN is a Sparse Ad Hoc wireless network in which there is not always continuous path between source to destination. In TCP concept the link is disconnected or not perfect then data or information are losses. At that time DTN networks were introduced. ^[1] DTN is normally works with the opportunistic-connectivity networks that may tolerate the disruption or disconnection. The networks which has high delay and which are undergo with disruption or disconnection are comes under Delay Tolerant Network. ^[2]

DTN refer to a wide range of challenged networks, where 1) End-to-End connection cannot be assumed to exist. 2) Network partitioning is frequent. 3) Delay/Disruption/Disconnection can be tolerated. Inter-Planet satellite communication network, Military battlefield network, Wildlife tracking sensor network and underwater wireless sensor networks are the DTN examples. A new layer introduces in DTN Architecture named "bundle layer". Bundle layer establish between the transport layer and application layer. Bundle layer store the bundles/packets/messages and forward them.

2. DELAY-TOLERANT NETWORKS ARCHITECTURE

The Architecture of DTN based on the concept where the end-to-end connectivity is achievable only when the opportunity meets. The connectivity problems in some areas are, Inter-Planet satellite communication Network, Military battlefield Network, Wildlife tracking sensor Network and other different-different environments. The challenging areas in DTN are that how it should possible to communicate the end-to-end connectivity in heterogeneous environment.

Because of the DTN characteristics, it should make it to different approach from the other Internet architecture. Following are the characteristics of DTN:

2.1 Intermittent connectivity ^[2]

In DTN, it does not always possible end-to-end connected. Sometimes disconnection with the network and connect on sporadic occasions. Thus this type of opportunistic connectivity it is called intermittent connectivity.

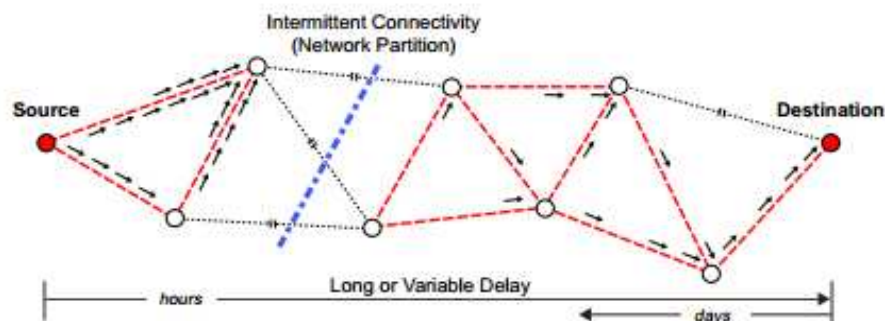


Figure 1: Intermittent connectivity ^[3]

2.2 Store and Carry approach ^[2]

In this approach an intermediate node becomes carrier and takes custody of the data in its buffer until the perfect path will be available and then forward the data to next node and continue the process. Due to the

Disruption, retransmission, delays, and flow control etc in the Network are using this technique in DTN.

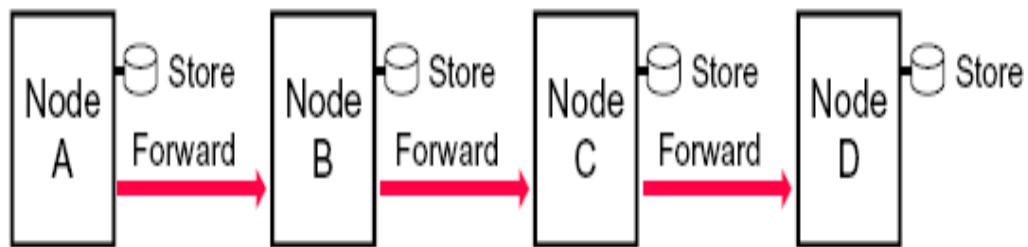
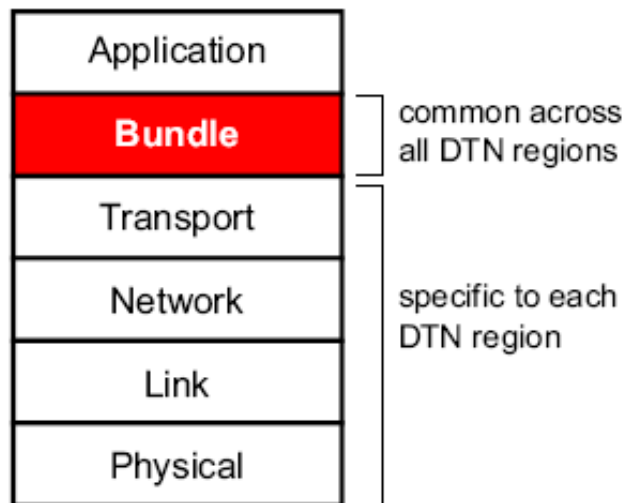


Figure 2: Store and Carry approach ^[3]

2.3 Bundle layer ^[2]

The store and forward mechanism in DTN architecture is implemented by new protocol layer called “Bundle layer”. Bundle layer stores the messages or bundles in

its buffer and forward them between nodes. It is below of the Application layer and above of the Transport layer.



DTN Layers

Figure 3: Bundle layer ^[3]

3. ROUTING PROTOCOL IN DTN

Because of the Opportunistic connectivity and lack of continuous path in DTN, it uses the routing protocols. DTN suffer from the lack of continuous path, at that time messages are store in buffer until the perfect path establish between nodes. Whenever node gets the opportunities to forward the messages then it spray the messages. Hence, DTN routing has several

methodologies that which is the best technique to successfully deliver the messages. Following are the basic DTN Routing Protocols:

- 1) Replication based (flooding) protocols
- 2) Knowledge based (store and forward) protocols
- 3) Coding based protocols

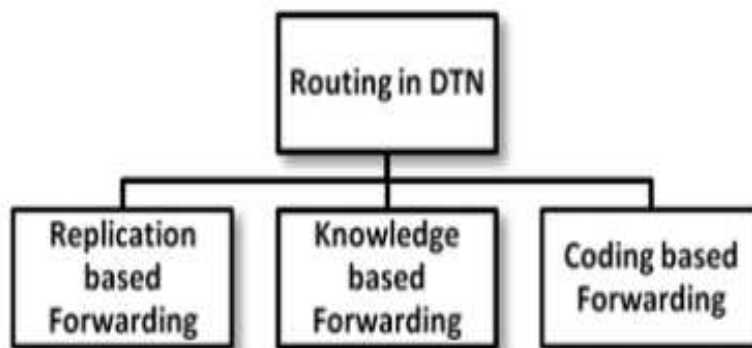


Figure 4: Routing in DTN Classification^[4]

3.1 Epidemic routing^[2]

In this schema the sender node flooding the bundles until the all nodes has the copy of the bundle. This process continues till the sender node has at least one copy. This scheme is useful when the network is partitioning and message size is small. Epidemic routing is simple routing strategy therefore it is used when not any better method is available. But the problem is that the node replicates the message even the message is successfully delivered to the destination.

3.2 Spray and Wait^[5]

Spray and Wait routing have two phases, Spray phase and Wait phase. In the spray phase, a sender node forwards the copy of message to its neighbour node until the destination encounter. The every node has at least one copy of message. If during this process destination is not encounter, this scheme switches to the wait phase. In this Wait phase, node keeps the copy of the message till the destination is encounter. Once the destination encounter then node directly delivered the copy of the message.

Binary Spray and Wait is the improve version of the conventional Spray and Wait. In this scheme a node forward the half of the copy of message to the entire node until destination encounter. If the destination does not encounter during this process then it switches to wait phase. In the Wait phase node keeps the copy of message till the destination encounter.

3.3 MaxProp^[5]

In MaxProp, this scheme related best suited example is city buses. In that the nodes are city buses which have maximum possibilities to meet often. For exchanging the messages this scheme use this concept of city buses. It measure the total cost to select the path to the destination. This scheme divides into two phases. In the First phase order stored messages based on hop count information of each message from low to high. Second phase is to order messages by cost from high to low.

3.4 Geographical Routing^[6]

In the wireless routing the node's coordinate is change in network topology then it changes the topology. So the topology changes in the network is often which

cause a large overhead in routing schemes. So that the position of the nodes is based on the routing. Thus, the routing strategy which is based on the information about the geographical position is called geographical routing.

3.5 Randomized routing

In this scheme, the node found the destination node to sending the bundle in random way. First, the node send the data to its nearest contact nodes, then the data reach at the destination node in few minutes and then after this sending process is stop. The data reach at destination in only one jump this is called one hop distance. But if it accesses the every node in network this arrives in worst case.

3.6 Location Service

It is a one kind of service or mechanism, in which it provide the destination's current location for data. Hence it is called Location service. It has dividing this mechanism into two parts:

3.6.1 Dream location service

The nodes exchange its position with nearest node. This is done by at first every node has defined value and exchanging them each other by lower rate, and so on. The value is defined based on the speed of node.

3.6.2 Simple location service

A node position is share with its nearest neighbour node. Thus location tables are exchanging between its neighbours, and also the Communication information is local while permitting the location data to globally be distributed in the system.

4. DTN ROUTING ISSUES ^{[2][7]}

4.1 Buffer space

Due to the opportunistic connectivity, messages are stored in buffer for large period of time. Until the perfect path is not available, the nodes require the large buffer size for storage of messages. Thus, the nodes buffer space is large enough require for storing the messages which is pending.

4.2 Security

Security is always an important issues for the network either a traditional or DTN. A message reaching at the final destination it should suffers from the many routers. Hence the users require secure transmission for message whether the message is securely delivered or not.

4.3 Disconnection/ Disruption

In Delay Tolerant Network partitioning disrupted is major issues. The design solution of this overall network takes mainly disruption is very big problem.

4.4 Low data rate, high latency

Due to the intermittent connectivity the message delay time is major challenges of the DTN, Because of this disconnection the node will store the messages in its buffer that time degrade the performance and it should in high latency and low data rate.

5. RELATED WORK

Epidemic Routing, in this scheme the sender node send a messages to every nodes which are in the network. All the node receive this message Hence, these becomes the carrier in the network. ^[4] The nodes exchange only those data which is different to those data in their memory buffer by using the contact with each other. Means that the node forward the data to its neighbour node which is not in their buffer. So it is strong to node, it gives the surety that if enough number of randomly exchanges of every nodes that will at last receive all messages in very few time. In this scheme it does not necessary to take the any kind of information about the network. Although it is necessary for large buffer space, power and bandwidth.

Spray and Wait gets the resource utilization by arranging a upper bound limits. The number of messages being forwarded by using its two distinct phase: the spray and the wait phase. ^[4] In the spray phase, one copy of the message is replicate to next node till the each node has at least one copy. If the destination is not encounter it reach at wait phase until it directly encounter the destination. The improve version of Spray and Wait is called Binary Spray and Wait, in that node deliver the half copies to its exactly nearest contact node and deliver the copy of message to that node. This process continue until the node has only one copy of message. Binary Spray and Wait is more suitable for faster message delivery than conventional Spray and Wait.

By comparing the existing schemes results it shows that the Spray and Wait performs per message how

much the number of transmissions delivered and delivery delay of average message.

MaxProp protocol is based on priority of packets in the queue. By using the priority queue, the node decide that if the Packets that should be dropped or transmitted.^[4] This scheme improves the delivery ratio of message. It manages an ordered queue where the ordering is require.

“A Mobility Vector Based Routing Algorithm for Delay Tolerant Networks Using History Geographic Information.”^[6] Geographic routing scheme is use for getting the real time location of destination by overcoming the challenges of DTN. In this paper the

movement range proximity is first calculate by author. It decides the destination it consider the mobility vector of node. In this paper author propose two types of algorithm, namely: The Reach Phase and The Meet Phase. For sake of the fast message delivery it replicates the message by using these two algorithms. It uses the Meet phase, if the message is the maximum amount of movement range. Furthermore, author proposes to calculate anti diffusion function for decreasing the redundancy. For improving the routing performance, it uses the scheduling scheme between Reach Phase and Meet Phase for replicated messages are under prioritized transmission.

6. COMPARISON ^[5]

Table:1 Comparison between based Routing Protocols

SR NO	Routing Protocol	#Copy	Strategy	Mobility Model
1	Direct delivery	Single	Source waits until it comes into contact	Mobility not evolved.
2	First contact	Single	Use any available contact.	Remote village , city bus network scenario
3	Spray and Wait	Multiple	Take advantage of limited number of nodes to flood message	Random waypoint model and Community based Mobility
4	MaxProp	Multiple	Forward the message to any device in the network having maximum probability of delivering the message to destination	Map based mobility
5	Epidemic	Multiple	Flood message	Random waypoint model
6	PROPHET	Multiple	Select the relay nodes by Predicting the delivery Probability	Random Waypoint model and Community model

7. CONCLUSION

Delay Tolerant Network is opportunistic connected mobile wireless network. Such a network is use in heterogeneous environments where the end-to-end connection is not always possible and also it tolerates the delay. In this survey paper we focus on routing strategies of DTN into three categories: Replication

(Flooding) based, Knowledge (Store and Forwarding) based, Coding based. Our survey is making us to help while designing routing protocol in DTN. This survey describe the routing strategies that improve the performance in delivery ratio, scalable, reliable, robust and decrease the overhead , large delay of routing protocols.

REFERENCE

- [1] Boudguig, Mohammad, and Abdelmounaïm Abdali."NewDTNrouting lgorithm." *International Journal of Computer Science* 10, no. 3 (2013): 82-87.
- [2] Puri, Paritosh, and Mrigendra Pratap Singh. "A survey paper on routing in delay-tolerant networks." In *Information Systems and Computer Networks (ISCON), 2013 International Conference on*, pp. 215-220. IEEE, 2013.
- [3] F. Warthman, "Delay Tolerant Networks (DTN)," *prius.ist.osaka-u.ac.jp*, no. March, 2003.
- [4] Salman Ali, Junaid Qadir, Adeel Baig, "Routing ProtocolsIn Delay Tolerant Networks :A Survey", IEEE-2010,page- 70-75,
- [5] R. S. Mangrulkar, Dr. Mohammad Atique." Routing protocol for Delay Tolerant Network: A SurveyandComparison",IEEE-2010, page-201-215
- [6] Yue Cao, Zhili Sun, Naveed Ahmad, Haitham Cruickshank"A Mobility Vector Based Routing AlgorithmforDelayTolerant Networks Using HistoryGeographicInformation",IEEE-2012, Page-2757-2762.
- [7] Mehta, Namita, and Mehul Shah. "Performance of Efficient Routing Protocol in Delay Tolerant Network: A Comparative Survey." *International Journal of Future Generation Communication and Networking* 7, no. 1 (2014): 151-158.