A Survey on DTN Routing Protocols

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Abstract - Delay Tolerant Network (DTN)[1] is special type of wireless Mobile Ad-hoc Network characterized by intermittent connectivity, long or variable delay, asymmetric data rate, higher error rates. This paper represents various routing techniques which are based on strategy. This paper also describes the classification based on routing protocol. This all routing protocols compared based on delivery ratio, delays, overhead ratio and resource consumption. The routing based on different parameters like delivery predictability, transitivity, hop count. DTN protocols improve the delivery ratio to route the message from source to destination.

Key words – **Delay tolerant network, Routing protocol**

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I. INTRODUCTION

Delay tolerant network is a networking architecture that is designed to provide communications in heterogeneous environments, where the network would be frequent and long lasting disruptions and high bit error rates that could often degrade the performance. Disruption tolerant network is evolved from Mobile Adhoc Network (MANET).It is sparse and intermittent connected network where reliable communication end to end connectivity is not available for message transmission. DTN is designed to operate effectively over farthest distances such as in space communication and interplanetary scale. In such an environment long latency is measured in hours and days is an unavoidable. Sensor based networks, Wireless networks, Terrestrial wireless networks, under water acoustic networks with delays are the examples of DTN.

New layer introduced named 'Bundle layer' in the architecture of DTN, is above the transport layer and below of application layer used for store and forward of messages. This architecture has many different challenges like lack of infrastructure, disconnection, disruption, lack of resources. In these "Store and Forward" mechanism each node[3] in DTN stores incoming messages in the buffer and forwards it when it comes to the destination node or nearer of these desired destination among nodes. Intermediate node copies incoming messages and passes it to the other nodes based on the probability of message delivery. DTN is called opportunistic network because the intermediate node always searches opportunity to relay messages from source to destination.
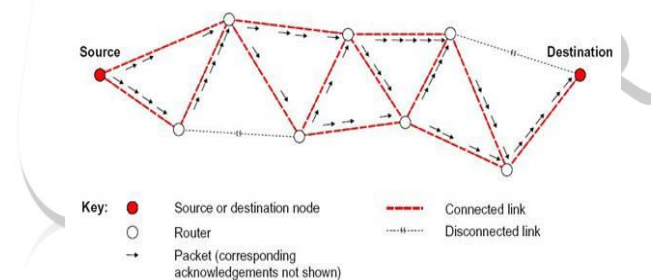

Figure:1packet forwarding strategy in dtn[2]

Goals [4] of Delay Tolerant Network
– Support interoperability throughout heterogeneous networks
– Efficient performance in disconnected environments
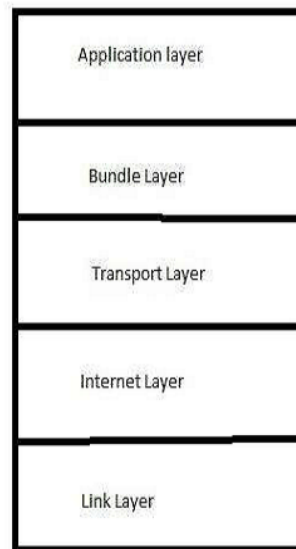– Significant performance for low delay

fig 2 layers of DTN[4]

Features [5] of Delay Tolerant Network
- Intermittent connection
- High delay, low efficiency, high queue delay
- Limited resource
- Limited life time of node
- Dynamic topology
- Poor Security
- Heterogeneous interconnection

Classification of Routing Protocol
Routing protocol is to selecting and searching paths in the network from source to destination. Routing protocols are different in wireless network rather than wired network and all affected by various factors. There are two types of routing protocols which are,

A. *Pro-active routing*
   In this type of routing, the routing information and position of nodes are predefined and which are stored in the table. The best route can be found with minimum delay and need less no of resources to maintain the table. This is called table driven routing.

B. *Reactive routing*
   In this approach, there is no need to keep information predefined. This type of technique is to finds a path on demand to route request packets by flooding the network but it encounter high latency time to find paths. This is called on demand routing.

II. ROUTING PROTOCOLS IN DTN

Based on the strategies, there are main two categories of routing in DTN, Flooding strategy and Forwarding strategy. Flooding strategy is to make no of copies and spread it to other nodes so the message is reach to its destination which is based on different parameters. Forwarding strategy uses the single message to reach to its destination via intermediate nodes.

Flooding Strategy
In this strategy, there are no of copies will be created and send it to the other nodes to reach to its destination. The nodes stores the messages in the buffer until it reach to its destination called relay nodes. Message replication is used to increase the probability of message is successfully delivered to the node. These protocols do not need of any knowledge about the network.

Forwarding strategy
In these forwarding strategy, knowledge about the network is used to find out the best route to transmit data from source to destination. There is no replication of data in the network.

A. *Single Hop Transmission*
   In this routing protocol, data can be transmitted from source to destination in only one hop. Source node can directly transmit data to the destination node. There are no relay nodes. The advantage of this routing protocol is no need of more resources to transmit data. Large delays and low probability are the main disadvantages of single hop transmission. It increases the mobility of nodes and throughput and decreases the cost.

B. *Two hop Relay*
   There are two hops between source and destination. If there are n nodes connected in the network, n no of copies will be generated to transmit data from source to destination and send it to the other nodes to transmit data. Two hop[3] relay increases the message delivery probability. It also increases the bandwidth and storage consumption.

C. *Tree based Flooding*

In this tree based flooding routing protocol, to produce copies and send it to the other nodes[3] which come in contact with the nodes. It also maintains information about no of copies of message which relay node created and forwarded to it other nodes. Relay nodes create tree structure which is from source node.

D. *Epidemic Routing*

Epidemic routing protocol is the first introduced routing protocol in the history of DTN. In this flooding based forwarding mechanism, Each and every node receives a message, replicate it and send it to the other nodes which encounter in the network. Messages are stored in the buffer with its unique identifier called summary vector. When two nodes are communicates with each other in the network, they exchange and compare their summary vector and transmit the messages which they don't. This protocol finds optimal path to reach the message to its destination. The disadvantage of these protocol is waste of resources such as buffer, bandwidth.

E. *Spray and Wait*

Spray and wait routing protocol consists of two phases, spray phase and wait phase. In spray phase, Source node transmits L no of copies of the message[5] to the nodes which it encounters and goes to the waiting phase for the delivery confirmation. In the wait phase, nodes are waiting for the delivery confirmation. Message is delivered to its destination by spraying L copies of messages to the relay nodes. Relay node transmit message during contact phase. Limited no of messages reduce resource consumption. Spray and wait protocol gives better performance rather than the epidemic routing protocol.

F. *Binary spray and wait*

In binary spray and wait, the source node creates L no of copies and when they meet the node it transmit half no of copies and keep the remaining copies. This method continues till the single copy of message remaining with itself. In this transmission source node wants to direct transmission with destination node.

G. *MaxProp*

MaxProp is probability based forwarding routing protocol. Each node set the probability of nodes to reach the destination node with hop count. Nodes exchange values with their neighbour nodes. The probability value is used to calculate the destination path cost. When the buffer is full, MaxProp selects the higher priority value of the message and transmit with low hop count. MaxProp gives poor performance when nodes have small buffer space because of threshold value.

H. *Location based routing strategy*

In location based routing requires knowledge about the location of nodes in the network. The distance formula is used to estimate the cost of delivering messages from one node to other. There is no need to store information in routing tables. Best path[3] estimation is based on the source, destination and intermediate nodes. It suffers from obstacles even the path is shortest. It gives poor performance when nodes are moving.

I. *Label based forwarding strategy*

In this strategy, to create groups and assign label to these groups called labelled groups. These groups are chosen as the next node to transmit data and then forward it. The results improves when label nodes works in groups. It utilizes bandwidth and consumption.

J. *PROPHET (Probability ROuting Protocol using History of Encounters and Transitivity)*

PRoPHET works 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. In this method, to estimate the probabilistic metric called delivery predictability. This metric estimates the probability of node to transfer the message to another node. Higher delivery predictability means node visited many times. It has transitive property, if node A meets node B, and node B meets node C frequently then, node A comes to contact with node C. PRoPHET has low overhead ratio and high average delay rather than epidemic routing.

III. CONCLUSION

This paper represents various routing protocols. The routing have common objective to increase delivery ratio and decrease resources and latency. The advantages and disadvantages are discussed. Each protocol works on different parameter.

IV. REFERENCES

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