

SOCIAL BASED ROUTING IN DELAY TOLERANT NETWORK

Chalikwar priti vijay
Information Technology,
MITCOE
Pune, India
E-mail: pritchalikwar@gmail.com

Milind R. Penurkar
Information Technology
MITCOE
Pune, India
E-mail: milindpenurkar@gmail.com

Abstract—This Delay tolerant networks (DTNs) are also called as sparse mobile ad hoc networks. Here, in this kind of network, there is no end to end path between source and destination. Delay Tolerant networks (DTNs) are intermittently connected mobile networks. Hence, routing in such kind of network is difficult and also message delivery in such a network is difficult. There are number of routing algorithms proposed such as probabilistic routing, epidemic routing etc. in probabilistic routing, there is only limited local view of the network. Probabilistic routing algorithm uses past history of node to select the forwarder. So, most of the time would select better forwarder in a network. Epidemic routing requires more network resources because it floods the packet in to the network. In social based routing algorithm, forwarder is selected based on the social map on each node. Social map contains surrounding social network. Community is group of nodes in a network. Community can be formed by location of the node. Here, in this paper our focus is on different routing algorithms based on social behavior of the network.

Keywords: *Network, DTN, epidemic routing, probabilistic routing, floods.*

I. Introduction

Communication network that may be wired or wireless has always been assumed that there is connection present at all the time. That is there is end to end path present between source and destination. But in DTN that is in delay tolerant network, there is no end to end path. Delay tolerant network is ad hoc kind of network where nodes are mobile in nature. In this kind of network, there is no fix location of the node. Hence, routing is difficult. There are very distinct characteristic of delay tolerant network such as intermittent connectivity, long or variable delay and low delivery ratio. Hence routing in such type of network is difficult [1].

Here, in sparse mobile ad hoc network, the network graph is rarely connected because mobile density is low and also the contact between the nodes in network doesn't occur frequently.

Message delivery in delay tolerant network must be delay tolerant. DTN architecture required to the store

messages in non-volatile memory when reliable delivery of message is required.

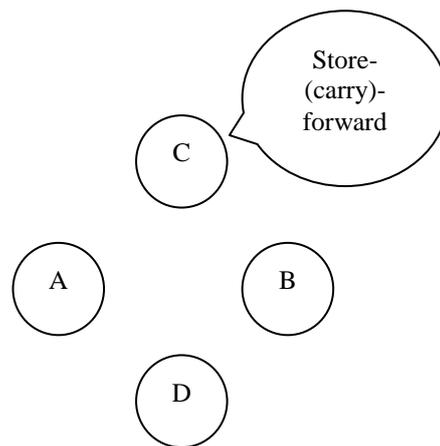


Fig 1: DTN data delivery [8]

In DTN, data delivery occurs through the physical movement of the node. If node A wants to send message to node B it may be possible that shortest path may be from node C, which moves towards the range of node B. In DTN, there is no end to end connection hence store and forward carry paradigm comes in picture [8].

A. DTN architecture

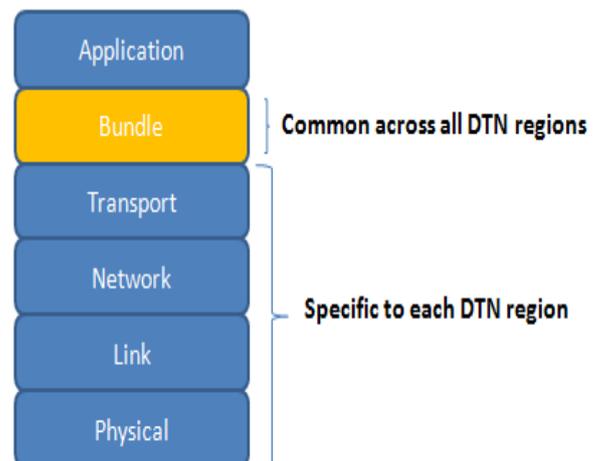


Fig 2: DTN architecture [2]

In this delay tolerant network architecture, source generates bundle that is no. of messages combined to form bundle and stores it until it doesn't find any relay node or destination node. If source doesn't find any relay node it stores that message and moves hence this DTN architecture is also called as store-carry-forward architecture. Relay node may store the bundle if it doesn't find any relay or destination node [2].

There are different types of contacts in DTN such as:

- Opportunistic.
- Scheduled.
- Predicated.

B. Applications of Delay tolerant network

- Vehicular Communication.
- Battlefield.
- Mobile military deployments across seas and deserts.
- Wildlife Tracking.
- Deep sea communication.
- Interplanetary Internet.

C. Routing in Delay tolerant network:

Mainly there are two types of routing algorithm as Deterministic and stochastic.

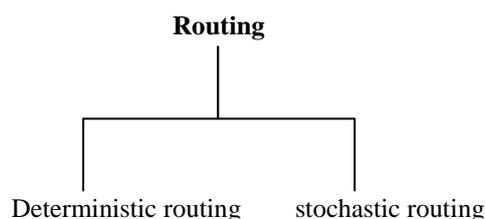


Fig 3: Types of routing[3]

In deterministic routing, future movement of the node is known by the network. Hence, path is selected based on available information about the hosts in the network. This type of routing is also called as forwarding. Due to only single copy present in a network for each packet, it requires less number of network resources [3]. Example of this type of routing is probabilistic routing. In probabilistic routing, nodes probability is used to select the forwarder. Messages are forwarded to the node which has higher delivery ability to meet the destination than the other. Probabilistic routing algorithm does not flood the message into the network [3].

In Utility base routing, forwarder is selected based on utility function. Utility matrix can be frequency of node encounters. In community based routing, nodes are grouped into communities. Nodes which are within the communities have strong connections and outside the community have weak connection.

In Stochastic routing, node movement is not known. This is also called as opportunistic routing. Here in this type of network, there is no information about connectivity and mobility of the nodes.

There are number of routing strategies proposed in such type of network such as Epidemic routing. This type of routing is replication based routing. In replication based routing there are number copies of message or message is present in the network and it has high delivery ratio. Replication based routing algorithm are Epidemic routing, prophet routing, Maxpro, bubble rap protocol etc. Epidemic routing is flooding type of routing protocol. Here when two nodes meet, they exchange their messages with each other and replicates message from the other node which is not on its memory. It requires high storage and transmission resources. As there is less no. storage space and resources in delay tolerant network hence. This epidemic routing algorithm is not efficient and practical.

II. Literature survey:

Epidemic routing requires more number of network resources. Hence it is not feasible in delay tolerant network environment where there is only limited no. of resources. In probabilistic routing, forwarder is selected based on probability of node to meet destination. This algorithm has very limited local view of the network. It cannot select the better forwarder.

Paolo Costa et al describes a routing algorithm based on publish/subscribe concept. Here, some nodes act as publisher and some are acts as subscriber.[4].

Elizabeth Daly and Mads Haahr et. al describes algorithm which select the node based on centrality and similarity. But by selecting the relay based on centrality and similarity will result in bottleneck [5].

Kang Chen, Haiying Shen et.al describes social based algorithm. Here, each node maintains social map to records it surrounding social network. When two nodes in the network meet, they exchange their social map. Based on this social map node selects the next node in a path. In this social map routing, when two nodes meet, they exchange their social map. Hence network view increases every time. Social map contains meeting frequency between the nodes. That is if any two nodes meets more number of times than the other then their frequency encounter increases.

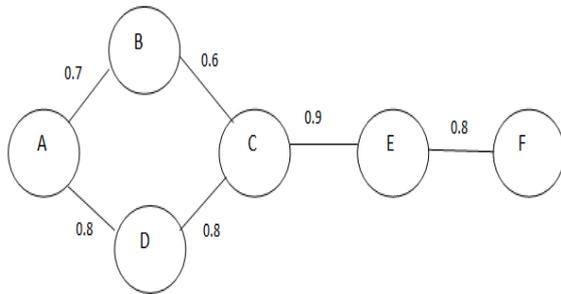


Fig 4: Social map of E [6]

Figure contains social map of node E. When node E meets C they both exchange their friends map. Then, after exchanging friend map E will get to know that messages for node B could be forwarded to node C. Each node maintains its top L friend list. Top L friend list contains the nodes whose meeting frequency is greater than the other. The stability of these top L friend list is calculated by MIT reality project and Huggler project.[6] Benefits of this social map are it provides much Browder view of the network and it finds the route of any length. Due to the stability of these top L friends it requires less frequent update of this social map. Social map can be constructed by assigning friendship rank to each top L friends of the node.

Konglin Zhu, Wenzhong Li, et.al. describes community based routing strategy. To form a community or to form a group of nodes, dynamic community partitioning process that is m-partition is applied. In a community, that is intra-community communication is based on utility function is used for data forwarding. But by using utility function blind spot and dead end problems arises. Hence, to find the next forwarder in a path social feature and decay function is used. Social centrality and social similarity are the two factors of social network. Social centrality is calculated as number of common friends between the pair of nodes and social centrality is calculated as structural importance of node in a network. In inter-community communication that is communication between the communities. Fringe node acts as agent. These fringe node acts as bridge nodes for inter-communities. Fringe node is capable of communicating between the communities [7].

III. Proposed idea

Consider there are number of nodes in a network and these nodes are grouped into communities. Each group is having one or more agents. Agents act as relay node between the communities.

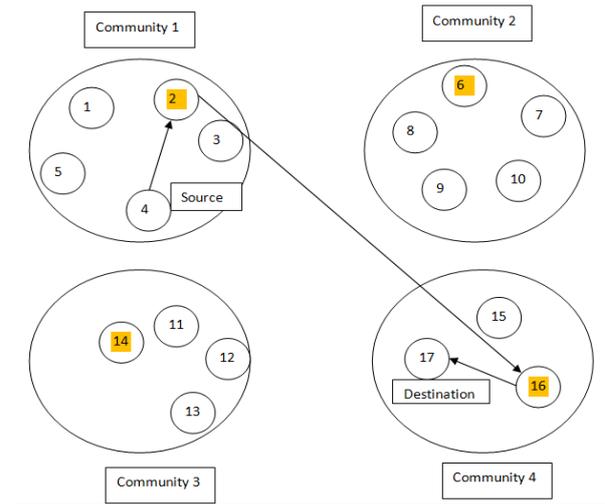


Fig 5: Social community based routing algorithm

Each community has unique communityID and each node in community has unique node number wrt community. Hence each node is uniquely identified using node id as below

Community id	Node number
--------------	-------------

Fig 6: Node id

Each node contains a list of top L friends that is social map. These top L friends mean frequency of meeting with other nodes. If node A meets more often with B then, node A is top friend of node B and vice versa. Each agent node contains two lists:

- Table of top L friends list.
- Table of top L agents list

In the figure, if node 4 wants to send the packet to node 17, then node will send the packet to the agent node. Agent node will check if the destination node's community is friend or not. If it is top L friend of source then it will send the packet to that agent of the destination community and agent from destination community will send the packet to the destination node. If agent node of source is not connected with destination community or destination community is not top L friend of source then agent node will select the node as agent which has higher meeting frequency with the destination agent.

IV. Conclusion

DTN that is delay tolerant network is a kind of network where there is no end to end path present at all the time. Nodes are mobile in nature hence route establishment is difficult. Social based routing algorithm is a type of routing algorithm which uses social map for route establishment. Social map is a map which contains surrounding social network. Social based routing algorithm selects better forwarder

V. REFERENCES

- [1] Namita Mehta¹ and Mehul Shah “**Performance of Efficient Routing Protocol in Delay Tolerant Network: A Comparative Survey**”, International Journal of Future Generation Communication and Networking Vol.7, No.1 (2014), pp.151-158.
- [2] SuvarnaPatil*,Geetha R. Chillerge, “**Delay Tolerant Networks**”, ISSN : 2248-9622, Vol. 4, Issue 2(Version 2), February 2014, pp.21-25.
- [3] S. Jain, K. R. Fall, and R. K. Patra, “**Routing in a delay tolerant network**,” in Proc. of SIGCOMM, 2004.
- [4] Paolo Costa, Cecilia Mascolo, Mirco Musolesi, and Gian Pietro Picco, “**Socially-Aware Routing for Publish-Subscribe in Delay-Tolerant Mobile Ad Hoc Networks**”, IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS, VOL. 26, NO. 5, JUNE 2008.
- [5] Elizabeth Daly and Mads Haahr, “**Social Network Analysis for Routing in Disconnected Delay-Tolerant MANETs**”, *Proceedings of the 8th ACM international symposium on Mobile ad hoc networking and computing*,2007
- [6] Kang Chen, Haiying Shen, “**SMART: Utilizing Distributed Social Map for Lightweight Routing in Delay-Tolerant Networks**”, *IEEE/ACM Transactions on networking*, 2013.
- [7] Zhu, K.; Li, W.; Fu, X., “**SMART: A Social and Mobile Aware Routing Strategy for Disruption Networks**,” *IEEE Transactions on, Vehicular Technology*, Volume : PP , Issue : 99, 2014.
- [8] Forrest Warthman, Warthman Associates, “**Delay- and Disruption-Tolerant Networks (DTNs) A tutorial**”