A Survey: Various Congestion Control Strategies for Routing in Delay Tolerant Networks

Jinkal G. Patel[1], Mala H. Mehta[2]

[1] *P.G Student, Information Technology Department, SVIT Engineering Collage, Vasad, Gujrat, India.*
[2] *Assistant Professor, Information Technology Department, SVIT Engineering Collage, Vasad, Gujrat, India.*

ABSTRACT

Delay-Tolerant Networks are characterized by lack of continuous end-to-end path connections between source and destination due to - node's mobility, limited power sources and data storage space. DTN use store-carry and forward mechanism, which givers high performance with respect to delivery ratio but there is a fair chance of a communicating node being congested and high packet overheads. Existing Routing Techniques which focus either on Flooding based routing techniques or Forwarding based Routing Techniques, in which all intermediate nodes and high probable nodes are being congested respectively. In Social Routing, packets are only passes through nodes which are having high social contact strength and high popularity. So there will be congestion at popular nodes. So there is a need to reduce congestion at popular nodes to improve performance of social routing, reduce overheads and efficient movement of signal message. This paper describes survey of various strategies of congestion control and avoidance. Which can lead to precious resources such as buffer and battery life of nodes will be saved and overall performance of social routing can be increased in terms of traffic load in network and total message overhead .

Keyword: - *Delay Tolerant Networks, Congestion Control, Congestion Avoidance, Node Popularity, Bloom Filters*

1. INTRODUCTION

In MANET there is an existence of an end-to-end network connection between source and destination. So packets can easily moves from source to destination. But in some situation network get partitioned due to lack of network connection, limited resources, storage space etc. To cope with such situations Delay Tolerant Networks[1] has been introduced in which there is no existence of end-to-end network connection between source and destination due to - node's mobility, limited power sources and data storage space. This type of network has found its applications in many challenging environments such as providing delay-tolerant Internet services to suburban and rural areas [2], and to vehicles [3], Military purpose. In addition, DTNs have promising applications in monitoring and tracking wildfire animals and whales in oceans [4], environmental monitoring such as lake water quality monitoring [5]. Moreover, they are used in space networking such as the interplanetary network [6] which was historically the first application of DTN.

For overcoming the problem with the DTN it uses Store and Carry approach in which the DTN router needs persistent storage for their queues. Disconnection, delay, flow control and retransmission etc. are the reasons for applying this approach in DTN. In this approach node or custodian keep the data till the right communication opportunity will be available and then passes data to next node and so on. For using Store-carry and DTN works with bundle layer between Application layer and Transport layer. It groups incoming data blocks from Application layer into bundles and transmits them using a store-and-forward technique to transport layer whenever network is available.

In delay tolerant networks, flooding based routing algorithms such as epidemic routing which allow node to transmit packets to nodes which it encounters. A receiving node, if it is not the destination of the message, stores the message and transmits a copy of the message to nodes it encounters. The process continues until the message reaches its destination or its life time expires. So that Epidemic quickly drains the resources of the network. In forwarding based techniques sending node will make forwarding decision(based on node's movement, probability of neighbor node to reach destination etc.) for deciding to transfer messages so it will reduce unnecessary transmission. Forwarding based scheme such as PROPHET routing which causes the unbalanced traffic load distribution between the high probable nodes. Existing Routing Techniques which focus either on Flooding based routing techniques or Forwarding based Routing Techniques, in which all intermediate nodes and high probable nodes are being congested respectively.

DTN must rely on the perfect congestion control mechanism to ensure reliability, stability, and extensiveness of the network. Therefore congestion control plays an important role in Delay tolerant network.

2. SOCIAL ROUTING IN DTN

In Social Routing[7], packets are only passes through nodes which are having high social contact strength and high popularity. Social contact strength can be calculated as, how many times two nodes were meet with each other in past. Each node has its own social status that indicates the level of popularity of that node. Based on these two values sending node will make forwarding decision whether to transfer message to encountered node or not. If social contact strength between encountered node and destination node is higher than that of sending node, and if sending node is high popular than that of encountered node, then and then sending node will transfer that message to encountered node.

When the TTL of a message is expired, it can be legally removed from the network. To reduce the number of messages dropped before reaching the destination, threshold is used for the TTL. When a message whose TTL reaches the threshold, it is flooded into the network to get a last chance to be delivered.

But in all above conditions there will be congestion at popular nodes or high connected nodes. So there is a need to reduce congestion at popular nodes to improve performance of social routing, reduce overheads and to save precious resources such as battery life of node and buffer. In social routing, a simple message called signal message is used which travels through the network to remove old copies of same messages which have already reached the destinations. Signal message can move efficiently by reducing congestion at intermediate nodes. So that traffic management plays an important role in Delay Tolerant Networks.

3. RELATED WORK

For Congestion Control strategies are discussed follows:
1)Bloom Filter [8]: In this author has proposed Counting Bloom Filter in which, encountered nodes periodically exchange constant-size Counting Bloom filters assigned to every node in the network. Filter contains topological information collected by particular node, summary vector of a node, requested message by particular node, and set of data packets. The proposed protocol is based on two novel operations defined over the Bloom filters, namely, the unary degradation operation that models the loss of topological in formation as it gets stale or as it is propagated away from the place where it was generated; and the binary addition operation that is used to acquire topological information from other nodes. These two operations are used to assign probability to every node to reaching any destination. These probabilities reflect the amount of information nodes have regarding the different destinations.
By using this protocol total overhead is reduced by reducing traffic in network.

2) SACC algorithm [9]: To control congestion author has proposed Social Aware Congestion Control(SACC) Algorithm In this algorithm, the social features and the congestion level of the node are utilized to construct a Social Congestion Metric (SCM) SCM is calculated to indicate the forwarding ability of the node. In the forwarding process, messages are forwarded to the nodes with higher SCM. When the congestion occurs, the node calculates the social links of itself with every message's destination node, and then drops the message with minimum social link rather than random dropping. For dropping of messages Message Dropping Mechanism is proposed.

3) CASE Routing algorithm [10]: To avoid and control congestion, Congestion Avoiding Strategic Epidemic routing protocol is proposed in which a node receives incoming message(s) and check congestion in its buffer. If receiving node is congested and not able to store any of received message and if any of one received message is High Priority message, then for storing received message and to avoid congestion it will drop no longer needed messages from buffer and create space for all High Priority messages or at least one High Priority message. By this way congestion will be controlled and avoided.

4) Congestion Control in Social Opportunistic Networks(SON) [11]: Author has investigated traffic congestion distribution in real life SON when social-aware routing protocol is applied in the network. They identified that traffic congestion is not randomly distributed in the network, but is most likely to occur in a few most popular nodes. So author has proposed a new protocol design of congestion control in a SON node that considers node's popularity in the algorithm's forwarding decision.

Proposed algorithm architecture consists of two components: routing and congestion control modules. The routing module consists of a social aware routing algorithm, which is responsible to select relay nodes that are able to deliver messages to destinations in short delays. The congestion control module in other hand consists of congestion control algorithm that controls the node's buffer congestion. During a node contact, each module separately exchange its information with its peer's module. The routing modules exchange routing metrics, such as node's popularity and social community, and the congestion control module requires information of both node's buffer statistics such as queue length and total drop messages as well as node's popularities(from routing module). Then forwarding decision is eventually made by considering both the routing and the congestion control calculations.

5) Buffer Space Advertisements to Avoid Congestion [12]: Author has proposed a mechanism that advertises buffer occupancy information to adjacent nodes and avoids forwarding through nodes with high buffer occupancy. A message can be transferred only to such intermediate nodes who advertise sufficient available buffer capacity at the time of message forwarding. For advertising buffer occupancy information in *Hello* packets that nodes periodically broadcast to each other. The nodes then achieve global congestion avoidance simply based on locally available information. The proposed mechanism works independent of the routing protocol and is thus applicable to wide array of scenarios.

6) DCM Mechanism [13]: Author has proposed the DCM mechanism that migrates partial bundles of congestion node to its adjacent nodes, which makes full use of adjacent distributed storage to reserve bundle and optimizes the valuable storage resource. If neighbour can find new forwarding path for migrated bundles, then these bundles will be forwarded to its destination rather than migrating to original node of bundles. At the same time a feedback should be sent to original node of bundles to notify the new forwarding. If not, the neighbour will have to wait until the original node of bundles resolves congestion. When the original node has solved the congestion problem, the migrated bundles are retrieved back again.

4. CONCLUSIONS

Delay-Tolerant Networks are characterized by lack of continuous end-to-end path connections between source and destination due to - node's mobility, limited power sources and data storage space. DTN use store-carry and forward mechanism, which givers high performance with respect to delivery ratio but there is a fair chance of a communicating node being congested and high packet overheads. In flooding based routing scheme of DTN congestion will be at all the intermediate nodes and in forwarding based routing scheme of DTN congestion will be at high probable intermediate nodes. Social Routing is forwarding based routing scheme in which packets are only passes through nodes which are having high social contact strength and high popularity. So high popular nodes will being congested. DTN must rely on the perfect congestion control mechanism to ensure reliability, stability, and extensiveness of the network. Therefore congestion control plays an important role in Delay tolerant network.

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