A Human Opinion Dynamics Based Trust Calculation And Communication In Delay Tolerant Network

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***Abstract* - Data routing in a delay tolerant network is an area of concern in recent years and many researchers have proposed many techniques for routing. In delay tolerant sparse network number of nodes in the network is very fewer and probability of losing the data is very high. Many approaches have been proposed in recent past but most of them failed to perform significantly. An opinion dynamics based approach is proposed in this work which calculates the trust value of a node based on the opinion of other nodes in the network. An opinion is calculated on the basis of parameters like packet delivery delay, number of packets lost and residual energy. The result also shows the improvement in various performance parameters in the network.**

***Keywords* - Delay Tolerant Network, Data Routing**

I. INTRODUCTION

Mobile Ad Hoc Network (MANET) is a collection of mobile nodes that communicate with each other without any fixed predefined infrastructure and communication links. MANET is a self-configuring network of mobile nodes connected by wireless links with an arbitrary topology [1]. A mobile ad hoc network provides network connectivity between mobile nodes over potentially multi-hop [2]. The main network-layer operations in MANETs are ad hoc routing and data packet forwarding, which interact with each other and fulfill the functionality of delivering packets from the source to the destination. The ad hoc routing protocols exchange routing messages between nodes and maintain routing states a teach node accordingly [3]. In recent years mobile ad hoc networks (MANETs) have received tremendous attention because of their self-configuration and self-maintenance capabilities.

Delay-tolerant networks (DTNs) have attracted lots of attention in last decades [4]. In a DTN, most of the time there are no end-to-end paths from communication sources to destinations due to node mobility, wireless propagation effects, sparse node density, and other adverse factors. For this kind of network, traditional ad hoc routing protocols, which rely on end-to-end paths, fail to work. The DTN architecture was designed to operate as an intermediate layer, called the bundle layer, between the application and the transport layers of the networks it interconnects. It provides services such as in-network data storage and retransmission, interoperable naming, authenticated forwarding, and coarse-grained classes of service [5]. The DTN architecture also specifies the bundle protocol which controls the exchange of bundles, i.e., application- layer messages. The Bundle Protocol can operate either atop transport protocols (e.g., TCP, UDP, etc), or atop lower layer protocols (e.g., Bluetooth, Ethernet, etc). The term ‘‘bundle’’ was chosen to connote the self-sufficiency of the messages: application-layer messages are expected to contain sufficient metadata to enable processing by the recipient without negotiation, as if all relevant metadata query and response messages have been anticipated by the sender and ‘‘bundled’’ into a single application data unit [6]. When operating atop the transport layer, the bundle protocol receives messages from the application.

II. LITERATURE SURVEY

Gao, Wei, Qinghua Li, et al [1] Presented multicast in DTNs from the social network. In this paper, multicast in DTNs with single and multiple data items has been shown which finds the necessary difference between multicast and unicast in DTNs, and formulate relay selections for multicast as a unified knapsack problem. The results indicates that data forwarding cost reduced effectively by number of relay used.

Liu, Yue, David R. Bild et al. [2] in this paper performance of delay tolerant network has been proposed. This paper utilizes the flooding protocol and it can be found that the network delivery rate and delay are robust to denial-of service and censorship attacks eliminating more than half of the participants.

Costa, Paolo et al. [3] SocialCast has been presented in this paper, it is depending on a routing framework for publish-subscribe which develops predictions based on metrics of social interaction to find the best information carriers. The evaluation results have indicate that that prediction of colocation and node mobility allow for maintaining a very high and steady event delivery with low overhead and latency

Dang, Ha, and Hongyi Wu. Et al. [4] in this paper an approach has been presented which is used for delay tolerant mobile networks. The main goal in this paper is to attain stability which becomes the main challenges in distributed clustering approach. Final simulation is being carried out in order to evaluate the effectiveness and efficiency of the cluster based routing. The performance indicates that the proposed scheme attained higher delivery ratio, end to end delay and lower overhead.

Lo, Shou-Chih et al. [5] this paper proposes a dynamic quota-control mechanism in delay tolerant networks. This mechanism permit routing to operate with different traffic loads. In order to eliminate the useless message copies from the network, a low-

cost probability-based method has been proposed in this paper. Research result indicates that per-hop forwarding of multiple copies of the same message to the destination can produce satisfactory routing performance in DTNs.

Daly, Elizabeth M et al. [6] in this paper a a novel algorithm for routing has been proposed which is depends on disconnected delay-tolerant MANETs in social network.the simulation uses the real trace data that SimBet Routing achieves delivery performance comparable to Epidemic Routing, without the additional overhead.

Chen, Ing-Ray, Anh Phan Speer et al. [7] Propose adaptive fault-tolerant quality of service (QoS) control algorithms based on hop-by-hop data delivery utilizing "source" and "path" redundancy. The main aim is to satisfy the application QoS requirements. Numerical data are presented and validated through extensive simulation, with physical interpretations given, to demonstrate the feasibility of our algorithm design.

III. PROPOSED TECHNIQUE

The problem of data transfer in sparse delay tolerant network can be evaluated using the values of Similarity, betweenness and trust value of the node based on the social influence factor. The values of these functions can be given as:

Similarity Calculation: Similarity is the numerical count value of the common neighbors between the source node and the destination node. The Similarity utility value of the source node with respect to the destination node is given by the ratio of the number of common neighbors to the total number of neighbors of the destination node.

$$SimU_i = \frac{Sim_i}{Sim_i + Sim_j}$$

Betweenness Calculation: Betweenness between the two nodes is calculated using the ego network of the node. Ego network of a node is simply formed by the number of neighbors of the node considered. The ego network plays an important role in calculating the betweenness of two nodes and can be calculated using the adjacency matrix. An adjacency matrix 'A' can be maintained by updating '1' if there is a direct link between the two nodes else '0'. Betweenness value of the source node is simply the reciprocal of the value calculated using $A^2[1-A]$. The product of the A^2 and $[1-A]$ is taken as the scalar product and the value is simply the reciprocal of the numerical value. Then the betweenness utility function is calculated using the formula:

$$BetU_i = \frac{Bet_i}{Bet_i + Bet_j}$$

Trust of a node: Trust of a node is calculated using the opinion of the neighboring nodes of a node whose value is based on the number of previous interactions of the source node with the destination node. It is simply given as the ratio of the numerical count value of the number of previous interactions between the nodes and the total number of interactions I of the destination node.

$$TrstU_i = \frac{I_{i,j}}{I_j}$$

So, the objective SimBeT utility function is a multi-objective constraint optimization function which is given by the equation:

$$SimBeTU_i = \alpha SimU_i + \beta BetU_i + \gamma TrstU_i$$

Where $\alpha, \beta \; and \; \gamma$ are the weights given to the equation and their value is:

$$\alpha + \beta + \gamma = 1$$

Results and Discussions

The proposed technique is implemented using the Network Simulator ns-2.35. The network is designed using the 20 nodes which are placed in the network. Their performance is evaluated on the basis of various performance parameters which are:

Energy Consumption: The total energy consumed in the network while transmitting or receiving the data from source to destination in the network. Figure 1 shows the comparison of SimBet approach and our proposed trust based approach. It is clear from the graph that the energy consumed in the proposed approach is less as compared to the basic approach.

Packet Delivery Ratio: It is defined as follows:

$$Packet\ delivery\ ratio = \frac{total\ packets\ received}{total\ packets\ generated}$$

Figure 2 shows the comparison of Simbet approach with the proposed approach. The packet delivery ratio for the proposed approach is better compared to the basic approach because the packet lost in the network reduces.

End to End Delay: it is given by:

$$Delay = (Packet\ received\ by\ receiver\ time - generated\ time)$$

Figure 3 shows the comparison between the SimBet function and the proposed trust approach with respect to time. The delay in the proposed approach reduces because of the reduction in number of retransmissions.

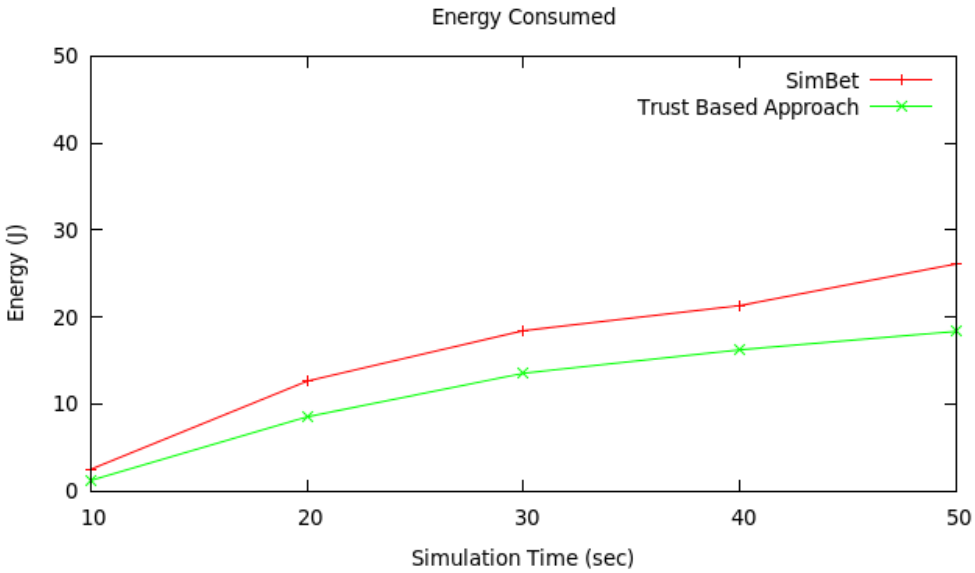

Fig 1: Energy Consumed in the network

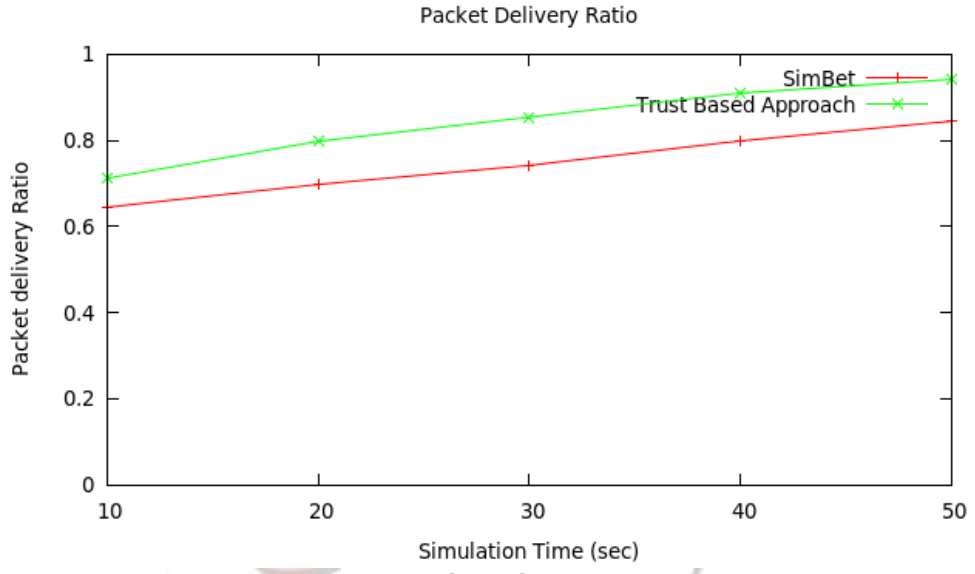

Fig 2: Packet Delivery Ratio

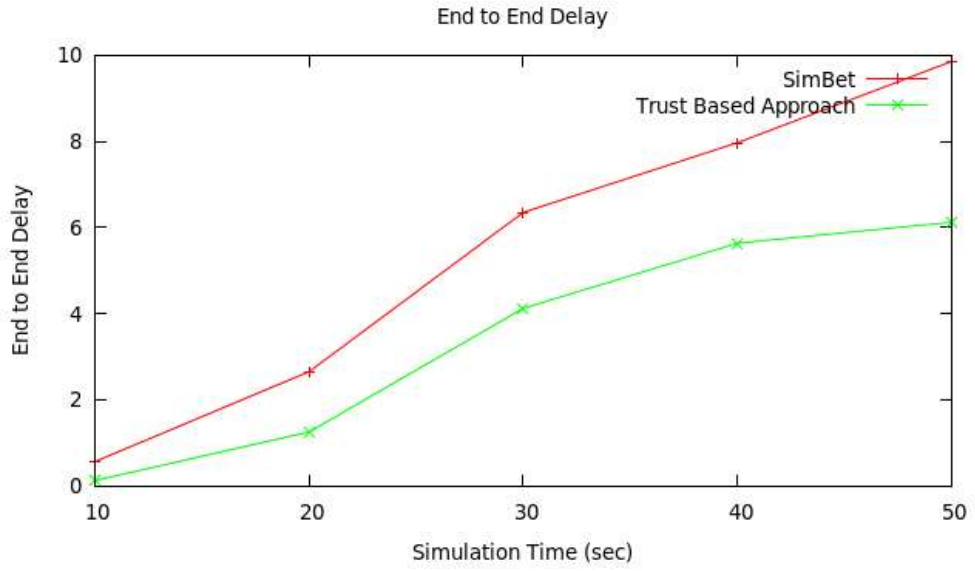

Fig 3: Packet Delivery Delay

IV. CONCLUSION

Delay tolerant sparse network is a network having very fewer nodes available for communication. There are many approaches proposed in the recent past but still routing is a major concern in these types of networks. A novel opinion based approach is proposed and the trust of each node is computed based on the opinion of the other nodes. So in this network the routing and route selection decisions are based on the trust value of the node. The result also verifies the proposed technique. In future other machine learning algorithms must be implemented and their results must be compared with the present work.

V. REFERENCES

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