Analysis and Impact of Trust and Recommendation in Social Network based Algorithm for Delay Tolerant Network

A Project Report submitted in fulfillment of the requirement for the award of the degree of

Master of Technology

in

Computer Science & Engineering

Under the Supervision of

Dr. Shailendra Shukla

By

AbhilashaRangra

Enrollment No: 142211

Jaypee University of Information Technology,Waknaghat, Solan, Himachal Pradesh-India 173234

Certificate

This is to certify that synopsis report entitled "Analysis and Impact of Trust and Recommendation in Social Network based Algorithm for Delay Tolerant Network", submitted by "Abhilasha Rangra" in partial fulfillment for the award of degree of Master of Technology in Computer Science & Engineering to Jaypee University of Information Technology, Waknaghat, Solan has been made under my supervision.

This report has not been submitted partially or fully to any other University or Institute for the award of this or any other degree or diploma.

Date: 04/06/16

Supervisor's Name & Signature

Designation

Acknowledgement

I would like to thank all the persons in my life for their support and encouragement for my research. First of all, I would like to thank my advisor Dr Shailendra Shukla for constant guidance, encouragement and support. Without guidance and motivation from his, my research would not have been possible. His deep knowledge of routing protocols or other subjects has always helped me, not only towards my research but also in other domains of life. His dedication towards her subjects and work has inspired me to remain dedicated towards the goals for life. I would also thank to my family members mom Mrs Anita Rangra, dad Mr. Shakti Rangra, brother Mr Abhilaksh Singh Rangra, all my BTech friends Atul, Jatin, Aatisha, all my JUIT members Ishani, Ashima and my classmates, and my relatives for continuous support.

Date: 4/06/2015

Signature: Abhilasha

Abhilasha (142211)

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Abhilasha (142211)

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Abstract

Message delivery in sparse Mobile Ad hoc Networks (MANETs) is difficult because of the network is not connected properly. To provide path for message in a delay tolerant network is an area of concern in last few years and many researchers have introduced so 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. Social studies are a successful approach for information propagation in wireless networks. Bridge nodes are identified on their centrality i.e., to broker information exchange among other disconnected nodes. Because of complexity in centrality metrics the concept of ego networks is developed in which nodes are not required to exchange information about the entire network, but only locally available information is given. Then SimBet Routing proposed the exchange of pre-estimated 'betweenness' centrality metrics and locally determined social 'similarity' to the destination node with combination with the human opinion as a recommendation. 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. SimBet Routing outperforms PRoPHET Routing, particularly when the sending and receiving nodes have low connectivity. The influence of social network analysis or impact of social network analysis is very high while packet dissemination in delay tolerant network but none of the reported work shows any study of security. So we are focusing on trust area to develop a fast scalar method to overcome the malicious attacks in nodes for security through which we can deliver more messages from source to destination without any loss in packets or data and increase the delivery rate. The result also shows the improvement in various performance parameters in the network.

CHAPTER 1: INTRODUCTION

1.1 What is delay tolerant network?

Delay-tolerant networking (DTN) [1] is a methodology for computer networks that attempt to address the technical difficulties in heterogeneous networks that is diverse in nature due to which there may be less continuous network connectivity. This movable networks consists of many attributes such as an intermittent connectivity, large transferring data delay, node movement, and so on. In this author [2] proposed this network with another name which is also known as the disruption tolerant networks (DTNs). There are various kinds of network in which there is no end-to-end link in between the nodes that is from source to the destination there is no connection. Even, in these criteria, the traditional routing protocols are not applied directly for transferring the message. If there is no connectivity in the network, then also there is a chance to transfer the information from a source to a destination. The main idea behind in these networks is to retrieve the data from a source to the destination; the main purpose of this networks that it can have higher delay. It is used in many real world areas such as Hsu & Helmy [3] students roaming in a college premises, or Burgess et al.[4], buses is travelling in limited metropolitan area or Shah et al.[5] in wireless in which is no connectivity in a sensor network which contains some movable nodes, etc.

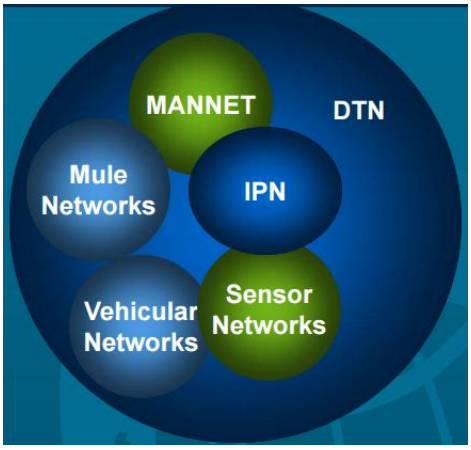

FIGURE 1.1: DELAY TOLERANT NETWORK [6]

1.2 Basic Features of Delay Tolerant Network

- **Intermittent Connection:** Nodes are free to move anywhere within the network because of which there energy are less, in DTN network disconnects frequently, and due to this reason there is continue change in DTN topology. Network has all the status of its track of intermittent connection and partial connection because of which there is no guarantee in the network to achieve end-to-end path.
- **High delay, low efficiency, and high queue delay:** It gives us the entire sum up of delays of every hop on the path. Delay consists of waiting time, queuing time, and transmission time. Every hop delay can be very large because of which DTN occurring at irregular intervals connection which keeps unreachable and because of which it have a very large time and due to this there is a lower information rate and displaying the asymmetric characteristics in up-down link information rate. Queuing delay is one of the important roles in end-to-end delay and frequent divisions in DTN make queuing delay growing gradually.
- **Limited resource:** Node's calculating and performing the series of methods ability, communication ability and storage space is less than the function of a computer because of the limitation of cost, volume and power. The constraints for the storage space resulted in more packet loss rate.
- **Limited Life time of node:** In constraints in the network, the node is common to use the battery power for the most difficult times, because of which the life time of node reduces. If the power is switched off, then there is no guarantee for node that they will work normally. There are also other criteria which can happen that the data also be transferred if the power is switched off.
- **Dynamic topology:** As DTN topology is not work properly because of its dynamic nature which means they are not fixed, they are changing because of reasons such as environmental changes, energy depletion, due to which there is loss of network.

- **Poor Security:** DTN is visible to-- danger of wireless communication network-- message modification, routing spoofing, Denial of Service (DoS), and other security threats, etc, because of which there is the lack of maintenance in real-world.
- **Heterogeneous interconnection:** DTN is a type of network for transferring an asynchronous data. Proposed the bundle layer, in DTN it can run on dissimilar heterogeneous network protocol stacks and DTN gateway ensures the reliable transfer of interconnection data.

1.3 Challenges for DTN[1]

In Delay-tolerant networks, not any particular time period, the network can be connected. Message is going to transfer in a DTN with the help of store-carry-forward methodology. Nodes in the network receive the message from the starting point of node to the final location of the node, from which the already existing nodes in the network receive the message from source to destination, in more than one hop, due to which every node with the path relay the message from the past encountered node and put it into local space. Then this node takes the message for a short period of time, and encountered with another node, transfers the message. Due to this, the message is transferred to the final location. When any two nodes put into a particular space with another node, they even can interchange their message; this is called as encounter. The link generated in this durable of time is time-sensitive which is only applicable for the time when the nodes are in limit of one another. When two nodes change their position, the link will break. Even, with time, there is multiple links at a pair of nodes. The connectivity in DTN can be shape as a time-varying multigraph. We will see some of the challenges of DTN which are as follows:

1.3.1 Encounter Schedule

Jain et al. [7]; Ghandeharizadeh et al. [8] introduced that for transferring the message from source to the destination, the source node from which the data is going to send can stay till it meet with the destination node and after that while transferring the message directly to it. It will take a long time. It had data about the meet with every

pair of nodes, then it calculate and check the best route for nodes to transfer the data for reaching the destination node. After knowing the schedules, because of which the errors will take place, but routing should be able to take place and then also it transfer the data to the destination. Movement of the nodes is random because of which there is a memory less meet schedules, assumptions can't takes about the node interaction pattern. Mobility is used to check how the nodes will meet with one another.

1.3.2Network capacity

The time of a meet as well as the connection of nodes of bandwidth is the sum of message which can be changed between a pair of nodes. Contention is the cause due to the existence of many nodes trying to send message at the interval of meeting with each other. According to this a data from a source to a destination want to be divided.

1.3.3 Storage

At the interval of meeting, nodes can think to change all their data. But is the nodes are storage-restricted, and then the node size will be high which will result in message loss. The naive method of changing all the messages on meeting may not check or verify in all application settings. There should be limit to the copies for the information in the DTN should be done to efficiently node storage. If the network is heterogeneous form and few nodes are very strong and less resource-restricted from others then it is better for transferring information strategy for DTN.

1.3.4 Energy

Delivering of message is a sum up of the power. Battery operated wireless sensor networks, the resources is huge restricted into the account the residual power of a node while checking whether to change the information when it meets. In vehicular networks, the restriction on power not severe. Message transferring methodology for DTNs should be capable of a huge limit of scenarios.

1.4 Network Examples of DTN

a) Vehicular Networks [9]

– Message ferry [10]

– Village network [11]

b) Mule Networks [12]

– Zebra net (The goal is tracking of zebras in wildlife)[13]

c) Inter Planetary Networks [16]

d) Sensor Networks [15]

–Acoustic underwater networks [15]

e) Ad hoc Networks (MANET) [16]

–Military tactical networks [10]

Figure 1.2. Zebra Net [13]

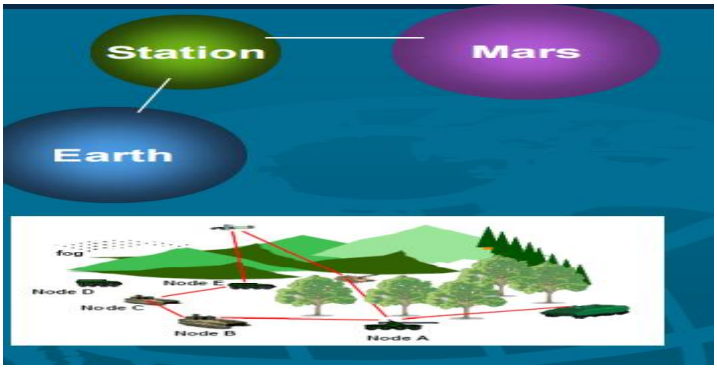

Figure 1.3. Inter Planetary Network[14]

1.5Metrics of interest

Several of majority of the routing schemes is used for the delay tolerant networks which indicate the aim for methodology very less parameters that has impact on the system performance which are as follows:

1.5.1 Message delivery ratio

This parameter seizes the total number of successful rate of transferring the message in DTN. Another definition is how many messages produced by sources which were transferred to their given destinations location in the network setting under consideration. Data is linked with a transfer deadline. If the data is not transferred within a specified time by the range then it is taken as a failed delivery. A updating in a definition for transferring ratio is the fraction of the data properly transferred to their destinations location within a specified period of time.

1.5.2 Delay

When applications are capable to liberal huge amount of delays in a DTN, it till messages are transferred to their desired destinations, it should be optimized. Its aim is to optimize both the transferring ratio and the delay. For example in a college where the professor wants to send the message to everyone for changing in the time table of lecture to all students trying to exchange the information during the change in time of an upcoming meeting. The data is applicable if exchange of data took place before the initial of the event. The delay in DTNs does not need to be spontaneous; the main idea is short as possible subject to resource restriction.

1.5.3 Number of replicas

The effectiveness of a message transferring methodology increases as sum of the copies of a message are produced and transferred by main relays. However, the enlarge in the probability of message transferring comes at the price of growth in the storage purpose at the individual nodes of a DTN. The number of duplicate is a supplementary metric that skilled the delay and data transferring ratio to give an all-round implies of the performance of a given message transfer methodology in a DTN.

1.5.4 Energy/Power

The energy dole out to achieve a message transfer ratio and average delay is a function of the number of transferring incurred by all the nodes. This includes the energy spread due to Free State and due to addition. The number of message transfer as an indicator of the parameters. This parameter is not easy to quantify where nodes have not similar resources. Energy is not a big idea in some applications such as in vehicular networks.

1.6 Advantages of ad hoc networks in delay tolerant network

Now a day there is various growths in ad hoc network technology which is using very commonly in movable computing system such as laptops, mobile phones, etc. In this it is used an opportunity to approach the web services, like such as the telephone calls when the user is in travelling. The occurrence of intellect-organizing network gives the edge of reducing the exchange of information price.

The edge of an ad hoc network contains:

- In this there is no central network administration.
- Nodes which are one own-configuring are also known as routers.
- Self-healing takes place through the continuous re-configuration.
- Scalability consolidates the inserting of more number of nodes.
- Mobility provides ad hoc networks to build a fly in any of the situation in which there are many of the wireless devices.
- Ductile ad hoc cannot be permanent setup at any of the time and in any of the places.
- The initial price gets reduced because of the decentralized administration.
- The nodes present in the ad hoc network want not to depend on any of the hardware and the software. So, it can be linked properly and exchange of the information takes place very quickly.

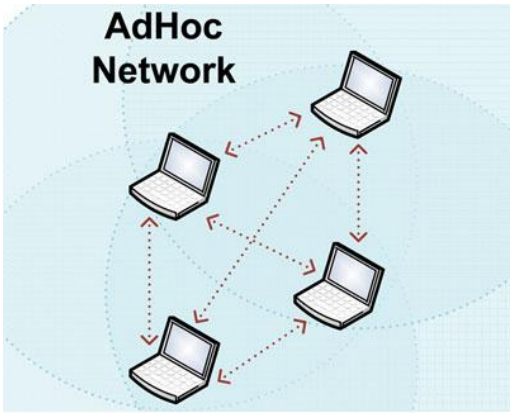

Figure 1.4. Ad-hoc Network [17]

1.7 Open Issues

1.7.1 Energy Efficiency

It is one of the important key problems in wireless ad hoc networks. The existing routing method for delay tolerant networks is taken as the energy consumptions of the nodes, reducing the network life time. In radio frequency structure of nodes has to do its job every time for end the possible opportunistic connectivity to its neighbours. The nodes end their battery quickly and it only gathers the data. The routing protocol should create tradeoffs between the energy consumption and message transferring ratio. In DTMNs with less connectivity. Radio frequency structure saves energy but it tends to less connectivity. To maintain the connectivity while keeping the energy consumption less is a challenging issue for DTMNs.

1.7.2 Security Routing

Routing protocols for DTMNs only used for increasing the data transferring ratio and decreasing the data transferring, but does not see any security issue. In DTMNs with not fully connectivity, so the problem of security is important. DTMNs see all the security threats in a traditional network faces. The nodes in DTMNs are controlled by people. Some nodes are malicious attackers using the nodes to transfer modified message in the network. So, security routing is a hot problem for DTMNs now days.

1.7.3 Selfish Routing

There is a common key point to remember that every node in the network is not selfish and coordinated properly. Every node receives the data sent by other nodes. There are some malicious nodes, which want to modify and keep their own resources with the services of others and take the resources of other nodes, especially in social network. Most people are socially selfish, that, they forward messages to nodes with they have social connection with but not others, and such condition change with how strong the social tie. Social selfishness will cause node behaviours. A node will not transfer data if it has no social ties with that, and it gives first priority to message received from nodes with high social ties especially when the resources are less. Because of this social selfishness took into consideration.

1.7.4 Social Routing

Taking the social behaviour and relationship of humans is very important. Knowledge of the social model of people can enable the devices like mobile which is use to provide the bridge between the disconnectedness and to forward message more efficiently.

1.7.5 Cross-Layer Design

Cross-layer design indicates to protocol design done by actively which make full use of dependence in protocol layers to get the performance gains. It is different from the protocols in different layers are designed separately. Knowledge is shared between layers to obtain the highest possible adaptively. To use the data of other layers to assist in routing decision and optimizing forwarding.

1.8 Comparison of DTN characteristics and Internet environment

– Internet environment[18]

- End-to-end RTT is not large.
- Some path exists between endpoints.
- E2E reliability using ARQ works well.
- Packet-switching is the right abstraction.

– DTN characteristics

- Very large delays.
- Intermittent and scheduled links.
- Different network architectures.
- Conversational protocols fail.
- No ARQ.

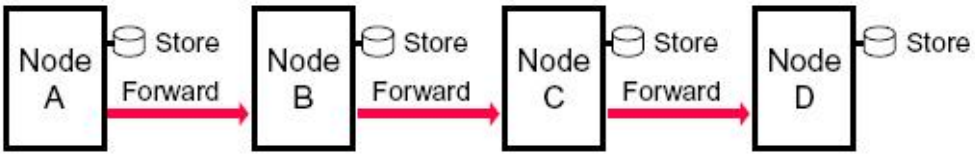

Figure 1.5. Method of DTN[19]

1.9 How Delay tolerant Network exist in MANETs (Mobile ad-hoc Networks)?

This is a dynamic wireless network that is not stable or fixed in nature, in this there is no infrastructure present as we can see from the following figure 6. In this nodes are movable in nature that means nodes can move freely not fixed and they properly manage themselves. Sparse Networks in which nodes are very limited and they are a class of Ad hoc networks in which node density is less, and link in between the nodes in the network do not take place very frequently. Ad-hoc network is an independent system in which nodes are linked with a wireless connection .The node present in this network exchange information with another node without any connection in between them. The nodes present in the ad hoc network directly connect the network when the communication link is once created in the network. Every node present in the network exchange information with one another with the help of the radio waves. The whole network is divided and nodes are combined with every other node with no fixed station or base. It is a local area network that constructs an automatic link to the nodes in network [16]. The network is hardly, linked and data transfers must be delay-tolerant. Due to the drawback takes place in traditional MANET routing protocols which is unsuccessful to path the data if there is no full path is present from source to destination during sending the data. Because of this reason traditional MANET routing protocols is not proposed to be used in sparse MANETs. Nodes are free to move because of which nodes take data between not connected parts of the network. This mobility assisted routing which uses the store-carry-and-forward model. Every node in this is independent in nature and they are creating the forwarding decisions that happen when any 2 nodes meet. Data is transferred through one node to another till it meets with the final destination. Social network analysis techniques are used for forwarding the message in not linked delay-tolerant MANET. It works same in VANET (Vehicle Ad-Hoc Network) and WSN (Wireless Sensor Network).

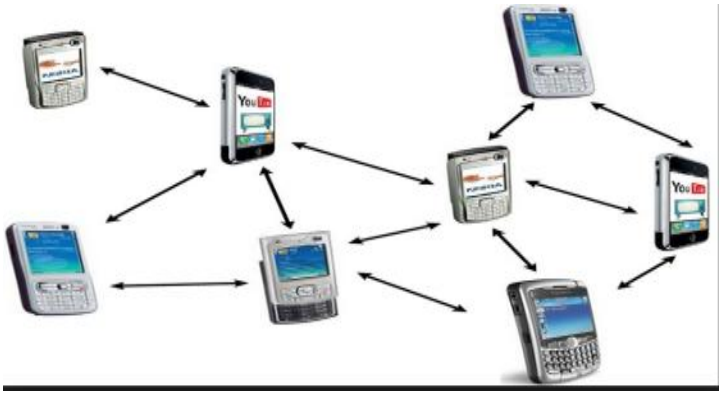

Figure 1.6. Mobile MANET Example[20]

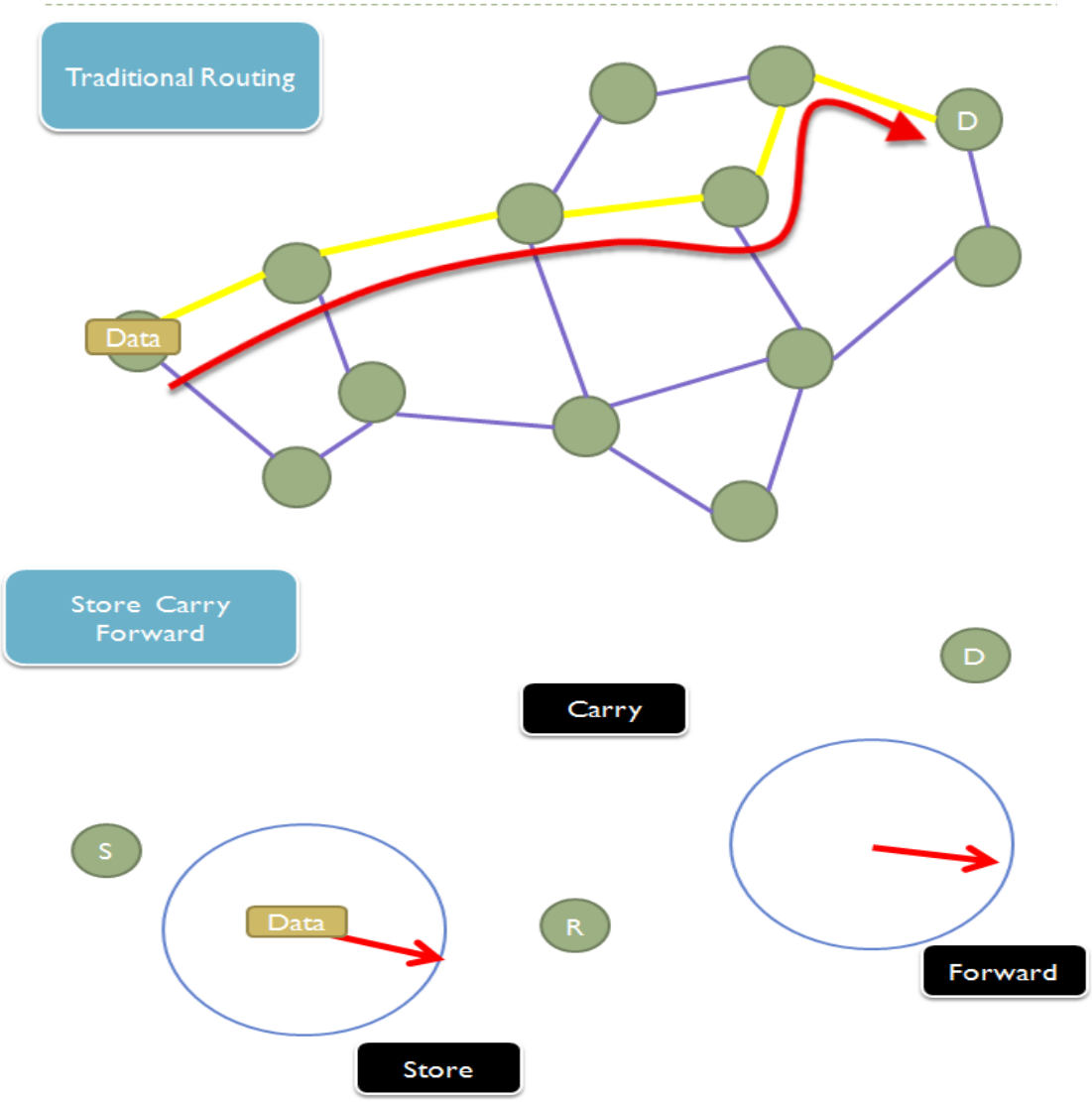

Figure 1.7. Delay Tolerant Network [16]

1.10 Data delivery mechanisms

We categorised routing schemes for DTNs into a small number of division based on their properties which are as follows:

1.10.1 Epidemic routing schemes [10]

S.No	Topic	Idea	Advantage	Disadvantage	Application	Security
1.	Epidemic routing for partially connected ad hoc networks [2]	whenever 2 nodes encounter they will exchange all the messages they currently carry with each other. Both will possess the same set of messages. Every node will be able to send information to every other node. So the packets are basically flooded through the network much like the spread of a viral epidemic.	fastest way in which information can be disseminated in a network with unlimited storage and unlimited bandwidth constraints. This requires no knowledge about the network or the nodes.	inefficient use of the network resources such as power, bandwidth, and buffer at each node. Moreover, messages may continue to exist in the network even after they have been delivered to the destination.	Mobile Sensor Networks Smart Dust Disaster Recovery/ Military Deployment	No

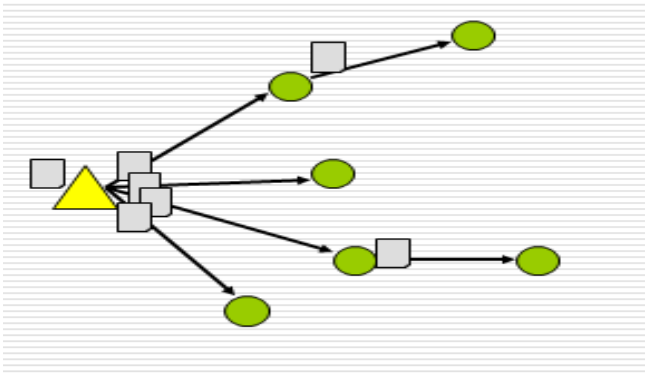

Figure 1.8. Epidemic Routing Technique[10]

1.10.2 One-hop relay schemes [12]

2.	Data MULEs: modelling a three-tier architecture for sparse sensor networks [3]	Special node in the system is called MULEs. MULEs are mobile nodes and move around the sensor area randomly. MULES try to collect data from the static sensor nodes and carry data back to the base station.	Advantage of our approach is the potential of large power savings that can occur at the sensors because communic ation now takes place over a short-range.	Disadvantage of this approach, however, is increased latency because sensors have to wait for a MULE to approach before the transfer can occur.	internet connectivity to remote villages	No

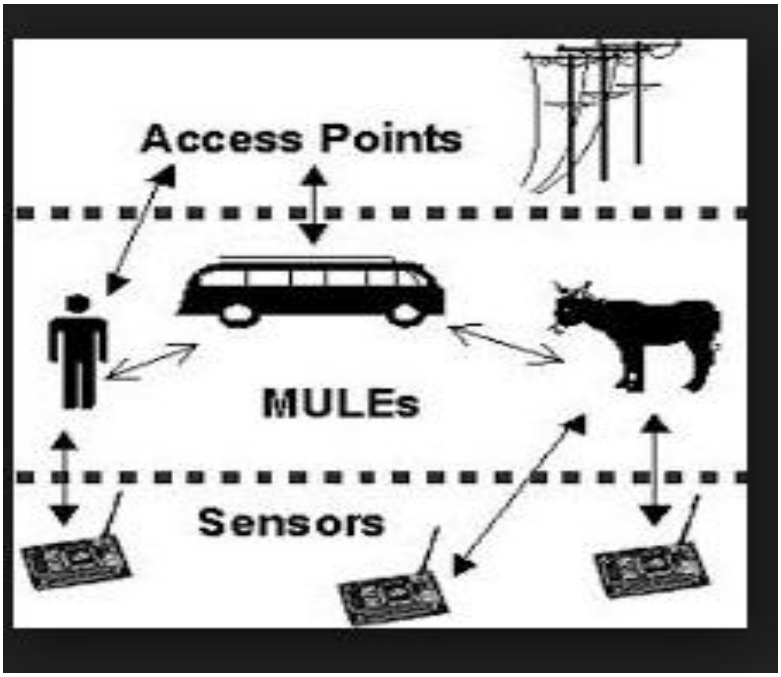

Figure 1.9. Data Mule[12]

1.10.3 Message Ferrying [21]

3-	A Message Ferrying Approach for Data Delivery in Sparse Mobile Ad Hoc Networks [1]	MF approach utilizes a set of special mobile nodes called *message Ferries*. Idea behind the MF approach is to introduce *non-randomness in the movement of* nodes and exploit such non-randomness to help deliver data.	*provide communication service* for nodes in the deployment area. Exploits mobility to improve data delivery performance and reduce energy consumption in nodes.	low throughput and large delay as compared to connected networks, are acceptable because the alternative is no communication.	Crisis-driven Geography-driven Cost-driven Service-driven	No

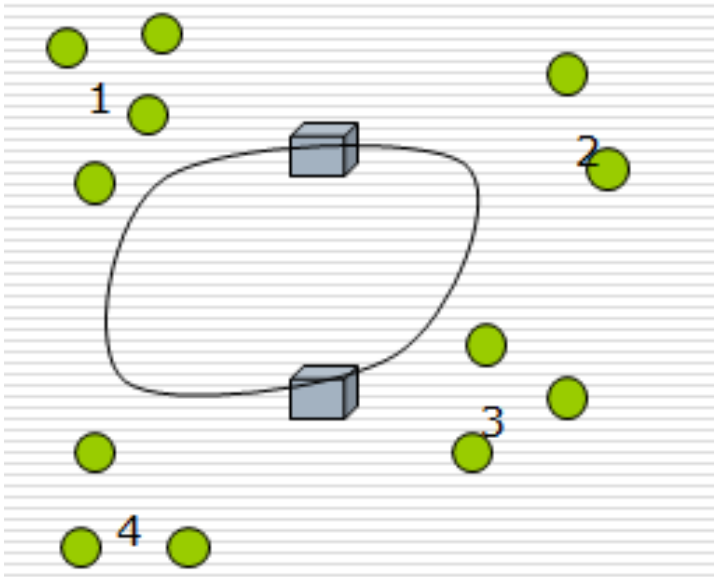

Figure 1.10. Message Ferrying[21]

1.10.4 Controlled replication schemes [22]

4-	Spray and Wait: An Efficient Routing Scheme for Intermittently Connected Mobile Networks[5]	While flooding-based schemes have a high probability of delivery, they waste a lot of energy and suffer from severe contention, which can significantly degrade their performance. introduce a new routing scheme, called Spray and Wait, that "sprays" a number of copies into the network, and then "waits" till one of these nodes meets the destination.	Reduce the transmission overhead of flooding-based schemes *and have better performance with respect to delivery delay.* It does not require the use of any network information, not even that of past encounters.	Power consumed Security Constrained Mobility of Nodes	Internet Mobile Ad hoc Network	No

Figure 1.11. Spray and Wait[22]

1.10.5 Network coding based schemes[23]

5.	Network Coded Routing in Delay Tolerant Networks: An Experience Report [8]	Intermediate nodes not only forward incoming packets toward their destinations, but also "mix" packets from multiple sources to increase information content in forwarded packets. Useful in DTNs, where opportunities to exchange data are intermittent and unpredictable.	Network coding can reduce both routing overhead and delivery latencies compared to probabilistic routing without coding	Not work properly if there are link failures or topology changes in the network. Improve the scalability and robustness	Global Routing	No

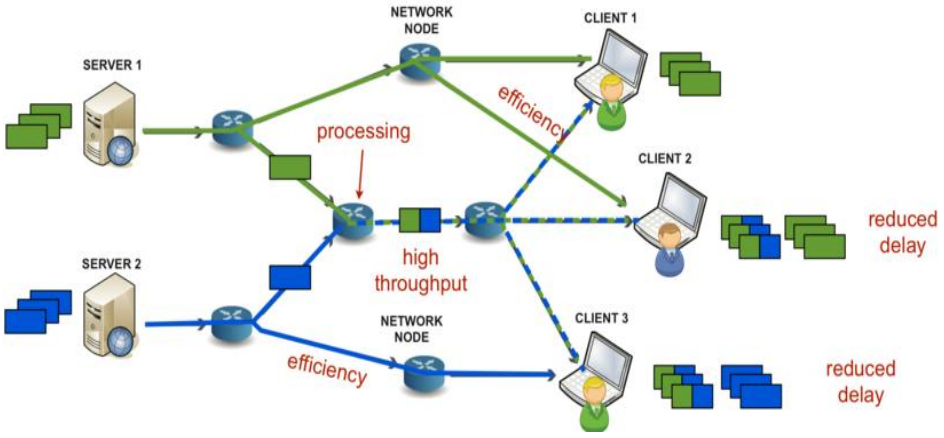

Figure 1.12. Network Coding[23]

CHAPTER 2: RELATED WORK

DALY TOLERANT NETWORK

P.Tennent et.al [24] proposed the FarCry as a supporting structure for the applications in wireless networks for transferring the data. Due to this concept the movement of the persons are considered as the transferring the data in the different areas of network. As there is no fixed structure for ad-hoc or wireless network for transferring the data so due to which the movement of the person is directly proportional to the sending the data from source to destination by mobility. In this paper the author proposed the three applications of mobile by using FarCry as an essential structure in the entire three applications epidemic routing algorithm. The three applications used in this paper by author are as follows: MediaNet, MeetingNet and last but not the least NewsNet. All of these three applications are based on the interactions between the users through which the message is going to collection according to the encounters between them. MediaNet is transferring the sounds files between relatives and buddies. This application is especially used in the sending the data for example itunes for iphone we need to attach the phone with our laptop to send the data from laptop to phone or vice-versa. MeetingNet is sending the data in meeting regarding the any agenda. For example in meeting there is a presentation so to share with all the members in the meeting they email the agenda of the meeting. NewsNet is based on the collaborating the message not with itself but with the other sources. For example in the news bulletin the highlights are gives according to the particular period of time to catch the data. All these applications are totally dependent upon the number of interactions between the users that how much it will interact with each other.

In this paper the FarCry is used for all the entire three applications as provides the transferring the message in a proper baseline system. Because of social togetherness there is no drawback in the overhead and no fault in the limited range of bandwidth as the user can go as whereas so due to this there is no certain range for transferring the message. This contains the plus point over others as it can send the message only when it comes in front with each other not like others to reduce the distance between two nodes for sending the data. Even it provides the sum up of the social group. So in

this author took care of the range more on focus so that data can travels to the wider range.

There are many fields of Mobile epidemic algorithm where routing the data is the only purpose. Suet al. [25] illustrated an opportunistic approach for the Bluetooth ad-hoc networking algorithm where sending the data from the area of the range of networks. S. Goel et.al [26] and A. Khelil et.al [27] gives a proper significant algorithms for transferring the message in comparison with the mobile ad hoc networks, with the help of the tornado coding and epidemic algorithms. Beaufour et al. proposed a structure for transferring the message in not movable but fixed sensor networks which is applied on the Bluetooth of smart tags [28]. The area of the applications is applied on the number of user enter in the national park sending the data in one particular of an environmental sensors. Esbjörnsson et al.'s Hocman [29] shows that how can URLs with the human profiles can be intermixed with each other by taking an ad hoc networking in the motorcyclists. But none of the applications cannot applied in the epidemic, as the data can only transferred in between the nodes, even it takes the message in many nodes. Sandler et al. [30] illustrated that, the purpose of the link-to-link based systems is used to decrease the bandwidth range of an overhead which is made by RSS feeds. It depends on the work of 'retrieve and store' model which is used to access the web information, with the help of the peerto-peer algorithm for setting the few similarities in the mobile area of the context.

R. C. Shah et.al[12] proposed and examine the structure for gathering the sensor information in a sparse sensor networks which is very limited in range . It takes the mobile entities which are known as the MULES and these are present within the environment. It take the information from the sensors when it is near within the limit, it collect, and deliver the message to the access points. Without any interruption because of human it should gather the message very frequently from the sensors for a longer amount of time. The cost of sensors must be less and it should work in a particular range. The achievement of the network longer duration depends upon the power management. Sensors may spread in huge area which is resulting in a sparse network. It can be homogeneous that is it is uniform in nature spread in a particular range and even it can be heterogeneous in nature in which it can spread as far as possible and it is not uniform in nature. Due to this there is a saving of power and this

can transfer over a limited range. In this author presents a very easy analytical model with the help of which the performance of the system is evaluated. In this model author take the assumption that it is a two-dimensional random area of walk for the movement or it includes the structure variables such as number of MULEs, sensors and access points. The evaluation is given on the basis of how much data is transferred successfully.

The main idea to used data MULEs is that the latency of this is very high as compared to ad-hoc and base station, even its sensor power and infrastructure cost of implementation is very low as compared to other two approaches, or transferring the data successfully is medium as compared to other approaches but we can conclude from this is that it is overall a good approach for routing the data in delay tolerant network where network connectivity is present partially. Even the system is more robust as compared with others as sensors depend upon the MULEs, and, if fault arise in any MULEs so it is not called as a connectivity failure. The flexibility of the system provides to transport the data through the medium which is going too used with other applications.

A.Vahdat et.al [10] proposed in this paper that nodes are allowed to communicate or transfers the data with one another, with or without any network structure existed. Ad hoc routing protocols which is already existed, and due to robust reason there is a frequently change in network topology; even there is an assumption that the path is fully linked between the source and the destination. Due to the power limitations, the limited range in a wireless networks, and the huge amount of the physical conditions over which ad hoc networks bring into an effective action, in some areas the assumption is invalid. In mobile sensor networks and disaster recovery area, nodes should spread very large geographical in distances. It is impossible to virtually achieve the data transferring with the help of current ad hoc routing protocols. In this the author proposed the techniques to send the data in which there is no connection between the source to destination or even there is a network partition presents with the time when the message is generated. It introduces Epidemic Routing, in which there are exchanges of information with mobile hosts which guarantee the data delivery. The main idea behind the Epidemic Routing is to provide the large amount of message delivery rate, less amount of message latency, and lesser the sum up of all

the resources consumed in transferring the data. In this author illustrated that the Epidemic routing which delivers 100% of message with some collaboration of the resource consumption whereas ad hoc routing protocols which is already present is not able to transfer any message due to the reason that there is no end-to-end routes are available.

Davis et al. [31] in this there is an addition with the epidemic scheme with adaptive dropping policies. In this there is a restriction in the size of buffer with every node which can save the upper K packets that can be adjusted with a dropping policy. It is categorized in four ways: Drop-Random (DRA), Drop-Least-Recently-Received (DLR), Drop-Oldest (DOA) and Drop-Least-Encountered (DLE). The results give us the idea that DLE and DOA are having the best performance. DLE attempt to drop packets on the basis of data regarding nodes location and mobility whereas DOA drops packets which is present in the network the longer that are present globally having long lived once which are already transferred to the desired locations. Harras et al. [32] introduced methods for controlled flooding in DTNs. It contains the idea in which there is a Time-To-Live (TTL) addition with an expiry time combining with each information. When the data is transferred to the required location, the process healing is started to 'save' the network from the duplicate copies of the data. This is same kind of the idea of"death certificates" introduced previously in duplicate database maintenance. This entire update version decreases the resource requirement of epidemic routing which has a less impact on the average delivery delay. In this aggressive death certification scheme it shows to decrease the storage for every node but in this it will require huge transmissions but it gives the reliable data transfer in DTNs.

It is one of the easy ways to transfer the data from source to destination in direct-contact. The source can wait when it comes to the radio range of destination and after which there is a transfer of the data similarly in direct contact. It does not require any more resources and no further duplicate messages. The drawback can be the delivery delay which can be very huge and source and the destination will not come under the direct-contact with everyone. In ZebraNet [13] information perceive by sensors which is connected with the zebras which is retrieved by humans. In vehicular networks, Kapadia et al. [33] proposed the direct-contact with the data delivery. They give us

the evaluation of the performance of a of duplication methodologies that can check the number of duplicates copies for a message on the basis of its popularity priority.

Goodman et al. [34] illustrated the Infostation architecture which is present in the wireless ports which is known as the Infostations which is geographically distributed and is used to give the high bit-rate links. Infostations can be placed in very easily accessible areas for example in a airport and entrances of the buildings, and it does not guarantee any continuous coverage. So the Infostation architecture provides "no matter how many-time and no matter how many-where" communication between the nodes is required. Small and Haas [35] represents the SWIM, which is a network architecture that is the combination of the Infostation architecture and the ad hoc networking model. Basically by duplicating and by transferring the data throughout the movable nodes present in the network decrease the delay till the duplicate data do not reach the destination in Infostation.

M,Gerla et.al[36], P.Sinha et.al[37], in this paper author illustrated many experiments to investigate the multicast to give assistance in ad hoc routing protocols. All the techniques are right in which the network is not partially linked it is fully connected. The network is not fully connected it is partially connected in Epidemic Routing. In real-time there are no guarantees provided for delivering the message in appropriate timing, but transferring the information to a pack of receivers is very beneficial for many of the applications.

A. Demers et.al [38] proposed that in Epidemic algorithms the information is based on the distribution protocol. This algorithm was created to give the consistency for duplicated databases without having any of the particular duplicate copy which is available to a particular time. The update with the pairs of duplicate copy is done randomly with the pair-wise propagation; and eventually the new version which is updated is then delivered to every duplicate. In this it is using the total contexts, adding the total number of receiver in group and partially connected just like in mobile.

R. A. Golding, K. Petersen et.al, D. B. Terry et.al, [39,40,41] illustrated through their work that there is a various type of theories for the epidemic algorithms which is having the advantage over the application domain. All the information is given and provided by all the duplicate copies, all is having their own information in their individual hosts.

S. Basagni et.al, Y. BaeKo et.al [42, 43] introduced the global positioning system (GPS) to decrease the area for the search space combining with ad hoc routing algorithm. In this author evaluated the need of prioritizing the message to combine the restricted resource consumption with the Epidemic Routing. In anti-entropy, nodes can change their present speed and direction to check and evaluate the potential carrier which is going in a roundabout area to handle the receiver. Due to this, the carrier is checked according to the degree due to which the information is dispatched.

R. Castaneda et.al [44] proposed the Query localization which used the criteria of spatial locality to decrease the network by ad hoc routing protocols. When there is a break in a given route because of the mobility in the nodes, new paths are requested and it is diverted by k hops from the past encountered path. In this they used a spatial locality to excel the work of Epidemic Routing. In some circumstances the locality is used according to the mobility of nodes. Due to this period of time there is exchange of list of data with the last n nodes meets by a host during anti-entropy. This data is used for verifying the principal that in particular the host is seen most recently, and there is even one more scenario that it will be seen even in the future.

D. Chakraborty[9] proposed in this paper that the Inter-vehicular communication(IVC) is used in many research areas from the previous few years. As comparison with the Traditional Mobile-adhoc-network (MANET) protocols Vehicular-adhoc-network (VANET) are more powerful protocol. Even the protocols are not valid for the dense area where network is not fully connected. In this author illustrated that a Distance Node Based Multicast Routing (DBMR) protocol is used for sparse areas in which there is a small overhead in multicast group selection in which there is a little changing takes place in the Border node Based Routing (BBR) protocol. It is proved that the position based routing protocols is considered in rural areas due to the cause of terrain effects. The performance of DBMR is checked with

comparison in VanetMobiSim based mobility model and there is no position data overhead. It verifies that the multicast behaviour of the given DBMR ruined the distinct range of utilization as comparison with the flooding behaviour of BBR.

W. Zhao et.al [21], studied the difficulties of data delivery in sparse MANETs where network division is stays for a longer period of time. For long range communication, past methodologies are used due to which there is a rapid loss of nodes' limited batteries, or due to mobility in the nodes in which there is a low data delivery rates and huge delays in transferring the data. Author illustrated in this paper the Message Ferrying (MF) method to point the difficulties. MF is not a stationary approach it is movable in nature in which there is a number of special kind of mobile nodes which is known as message ferries which is available for the communication service for nodes where network is not properly fully connected. MF approach was proposed because of the non-randomness mobility of nodes and make use of this non-randomness to deliver data due to which there is decrease in the energy consumption in nodes. The MF approach is effective in data transferring and there is a energy consumption in various network conditions.

T. Spyropoulos et.al [22] in this paper author proposed a new routing scheme, which is known as Spray and Wait, the "sprays" stands for the total number of duplicates present in the network, and then "waits" stands for the period in which one of these duplicate nodes meets with the destination. Intermittently connection with the mobile networks present is the sparse wireless networks in which mostly there is no complete path exists in between the source and the destination. These all kind of networks comes under Delay Tolerant Networks. Due to this difficulties with such kind of the networks author introduced the use of flooding-based routing schemes. In flooding-based schemes there is a high probability of delivery, a lot of energy waste and even it has severe contention problem, due to which it reduces the performance, and even it decreases the overhead in flooding-based schemes due to which there is a huge amount of delays. Spray and Wait overcome with all the existing schemes with the average data transferring delay and total of transferring per information delivered as its performance is better in scalability and robust. In this implementation is very easy and simple.

T. Spyropoulos et.al [45], presents a new “oracle-based” algorithm. In this algorithm they are already now the future mobility, and combines the result that is then is used for the forwarding decisions according to which it transfers the information to its end within less amount of time. The algorithm is not practically implemented, but then also it is to comparable with the other proposed implemented algorithm.

A. Petz et.al [23], tells us that the in delay-tolerant networks, there is no end-to-end routes which are available, and the routing protocols should have advantage for an opportunistic interactions in between the nodes for transferring the information. But, for making effective routing protocols it is difficult to reduce the latency due to which duplication of data will grow, due to which there is growing in routing overhead. In Network coding, it is a way to grow the throughput in DTNs due to which there is no such effect relevant effect in overhead, and this routing approaches gives us the promising answer. In this there is an implementation for the coded routing for DTNs and it gives us the methodology for creating and putting the new router into the DTN2 Implementation in the bundle protocol.

Pentland et al. [46], introduced in DakNet vehicles there is a Mobile Access Points (MAPs) which is used to transport message in village kiosks and with the centralized internet hubs. It is one of the oldest applications for wireless technology, for IEEE 802.11, used first in the national e-governance used in India with the computerizing land records data in rural areas.

It is one of the oldest transferring algorithms introduced, for the transfer of data in vehicular networks by the Zebroids [8] study. The main purpose is source contains the information regarding the contacts between the vehicles for particular time duration, it estimates the transferring of data through the route by many carrier vehicles. The vehicles itself have restriction in the storage capacity. Because of accepting a message from its previous, if the buffer of vehicles is full, it determines which packet must be replaced with the new one. In this author checks a wide variety of replacement policies and it tells in the conclusion that policy which chose the eviction of the candidates randomly which provides the competent performance. It validates the

performance that was introduced on the basis on real-world which they get the information from a small bus network all around a college campus Burgess et al[4].

Leguay et al. [47,48] introduced a structure for routing in DTNs, called MobySpace, in which every node is shown through a point in a form of multi-dimensional Euclidean virtual space. Routing takes place by sending the messages forward towards nodes which is having mobility patterns which is same to the movement of the pattern of the destination. The authors describe the feasibility of the structure with the help of an example in which every dimension shows the probability of a node to find in a location.

A gradient-based routing, the data goes to gradient of increasing the utility functions towards the final location by transferring the data with less delay and with a less system resources. Lindgren et al. [49] introduced the PROPHET in probabilistic routing taking all the previous encounters of the nodes. This methodology was introduced to have advantage on the non-random movement behaviour of the nodes in real-world. The purpose of every node is combined with a metric that shows its delivery for the destination. When a node is taking the information encounters with other node having good metric for destination, it transfers the data to it. The parameters are updated on the basis on most recent node meeting and parameters for sparsely meeting the nodes are aged. The data is exchanged with the time between the nodes due to which the nodes maintain the important and useful parameters in between them. As nodes has less storage memory, the eviction node as a candidate is chose basis of a FIFO methodology with more smart eviction methodologies is studied. The PROPHET methodology shows the superior performance with compare with the epidemic routing with respect to the community mobility model.

In a Tree-based flooding method [50] in this author introduced the improvement in two-hop relay by giving it by share the job of creating the copies for other nodes. When the information copy is delivered to the node, it will show the node with the total number of copies it will create. Due to the nodes it will create a tree rooted at the source, the method is known as the tree-based routing. A lot of method to describe the copies with the node will create. An easy way for allowing every node for creating the unlimited copies, but to limit the data for passing a maximum of nn hops from the

source. This algorithm can transfer the data to the final location which are many hops away, unlike wise direct contact or the two-hop relay. However, changing the metrics is a difficult problem.

Gossip [51] called with another name called as the non knowledge-based routing technique. As compare with the flooding algorithm, Gossip decrease the network resources requirement randomly picking the node as compare to transfer the data to every node it contacts with. Total number of data copies is managed and the resource requirement decreases. But, randomly selection to the next hop is suitable node and will have negative impact on the performance.

In this SimBet introduced [16] creating routing decisions through the betweenness and similarity of the nodes. Betweenness refers to the popularity as in BUBBLE. The centrality tells how many times a node linked a nodes which are not directly connected. Similarity is evaluated on the basis of the number of similar neighbours with every node. SimBet routing exchanges the assign the centrality and locally evaluates the similarity with every node for creating a forwarding decision. A forwarding decision sum of the combination decision on the similarity utility function and betweenness utility function. When the nodes meet with another node, the node selects the node which is having the highest SimBet utility for the final location

OPINION BASED MODEL

X.S. Yang[52] in this paper author categorised an optimisation algorithms into two: deterministic and stochastic. Deterministic algorithms will create the same set of a cycle that initially starts with similar start guess. While in stochastic algorithms it generates a bit kind of different answer even with similar starting point. But the end results, is different, usually tend to meet the similar optimal results within a given appropriate time. Deterministic algorithms are similar with all search algorithms, and it is appropriate in finding local optima. In this there is a risk for algorithms which gets restrict under the local optima, whereas the global optima are not in a range. In this author has used the Firefly Algorithm to find out nonlinear design optimisation. The algorithms are using some parameters to test functions. After implementing a new test functions with respect to singularity and stochastic components, they take the

FA for solving the unconstrained stochastic functions. Firefly Algorithm is more useful as compared with other algorithm for example particle swarm optimisation.

Yang 2010[52] proposed that a design optimization produce an effective part of any design issues in engineering and industry areas. In this structural design optimization pin point for finding the appropriate result for difficult framework design issues under dynamic difficult loading system with difficult nonlinear restriction. These restrictions indulge many number of members with limitations on stress, moreover a service requirements. The main idea behind is not for reducing the price and resources usage, whereas it is also used for increasing the performance and the long life services. All the issues are importance. Many framework implementation optimization issues are highly nonlinear with noise, and they are often NP-hard. Finding an appropriate algorithms are not easy. An algorithm needs an extensive experience and information of the difficulties of interest. After that also there is no assurance that we get an appropriate solution.

Gandomi 2011[53] Both the Metaheuristic algorithms and swarm intelligence algorithms is growing more useful methods for solving many difficulties and in real-world engineering difficulties. Many of these metaheuristic algorithms are derived with study of behavior biological systems. (Kaveh 2010) Like in, particle swarm optimization which was introduced on the basis on the swarm behaviour of birds and fish or charged system search inspired from physical processes.

X.S. Yang[54] introduced a new metaheuristic method, which is called as, the Bat Algorithm (BA), on the basis of an echolocation behaviour of bats, and the study tells it is a very good algorithm. The ability of echo sound of microbats is mesmerising as bats can see their food and evaluate how unique kind of insects even found in total darkness. BA shows it is more powerful algorithm used to solve the difficulties. The sound author assume as Ai=0 and pulse rate as ri= 1, BA decrease to the metrics particle swarm optimization and if set Ai=ri =0.7 to 0.9, BA it frequency change with respect to the pitch adjustment.

M. Dorigo[55] introduced Ant Colony Optimization meta-heuristic which is used to solve the optimization difficulties by graph representation. In this author combine this algorithm with travelling salesman problem for transferring the data in the network which is very useful to solve the optimizing problem. It is used to reduce the price paths with all the restriction in TSP. Sum of all the data collect by ants is put in pheromone trails which will considered as a long-term memory such as search engine. The ant can go back in similar route and update it and it is known as an online delayed pheromone update. Any ant dies, then it is like freeing from all the resources. ACO refers to route in network for communication as ACO which has routing table with respect to which it evaluate the traffic over network and which the help of which it calculate the performance, network type and service provided is increase.

A. Gionis et.al[56] introduced opinions of person as single in a social network with the processes under social dynamics, as a Nash equilibrium. With some standard of parameters in social system model such as a dynamics the question arises: in social network there is everyone with their internal opinions regarding message, in which individuals require to take a positive opinion because of which in the equilibrium state, the network has the increasing positive opinion. The algorithm implemented on the basis on link between opinion dynamics and random walks with thinking states. The framework main point is under social networks for their end result.

R. Kaur et.al[57],introduced that human opinion and their communication is dynamics and it is used for resolving difficult mathematical issues. With the social perspective the opinion dynamics system models are less in nature but to know the real world difficulties resolved by human beings. After that it is analysed by small world, random graphs etc. The effect of change in network with respect to the time can be studied. In this paper author introduced the adaptive noise algorithm and evaluated the performance with respect to the PSO. Since the algorithm very easy and do not do its job well under of highly multimodal issues, but it can increase its performance by evaluating the methodology dynamically and then update metrics to get the desired the search.

TRUST BASED MODEL

M.J. Chang et.al[58] assumes that , a DTN with some not trustable nodes it illustrate a methodology to take a trustable data to take with main idea behind to increase data transferring rate without affecting the data delay or data overhead with respect to DTN routing. DTN routing protocols are basically based on how much the nodes meet. The issues is how to evaluate an encounter between nodes takes place or not, due to this drawback takes place due to which the data is lost for single-copy routing, or flooded for multi-copy routing. For malicious nodes, there is no trustable message delivery. Many solutions take place but with that there are many drawbacks comes under like such as data travelling among encountered nodes and behaviours taking as credit incentives. But in a centralized management system if there is a single point of fault is done, it will be very difficult to transfer credit management in a DTN with some not trustable nodes. Many approaches are used in this which is taking under consideration as a social relationship and social networking as one of the parameter to choose the data transfer in DTNs. In this author combines the social trust and Quality of Service (QoS) trust divided into the trust metric for evaluating the best data path against new encounters for transferring the data. In this author introduced the implementation of trust thresholds for evaluating whether the node is trustable or not and it is acting as a recommender, and evaluate among the best thresholds under the trust-threshold based routing (TTBR) in DTNs. In this the method is distributed in nature and does not need a complex credit management system. Every node will check TTBR to check whether the node is trust to its peers using the similar trust threshold depending upon application characteristics, and with which it choose the best trustable nodes as transferring for data routing. There should be no loss of data; for that author take healthiness and cooperativeness used for social trust to check the node's is not malicious in nature for data delivery, and connectivity and energy for QoS trust to check for every node's QoS abilities to transfer the data to the final location. It analysis the TTBR with epidemic routing, social-trust-based routing and QoS-trust-based routing with which they check the circumstances the best trust thresholds checked under which trust-threshold based routing perform better than the baseline routing algorithms for DTN with heterogeneous mobile nodes.

Y. Sun et.al [59] proposed the trust methodology, which is based on fuzzy logic in terms of 0 and 1, discrete or continuous number which is given to check the trust such as a continuous value is assigned in the form [0*;* 1]. In this they present in the form of belief, disbelief, and uncertainty, respectively. Integer values are taken in discrete. The main purpose in trust model produces to check the trust with respect to its neighbouring nodes. Every node has its own a trust value for every neighbour, which shows how trustworthy every neighbour is. In the past trust in ad hoc networks only concentrate on trust checking method after establishing the trust relationship. There is not clearly defined the method of trust to evaluate. In this paper author introduced that data is theoretic structure of trust method and process. In this structure, trust is checked by the uncertainty and even by the entropy. Author point the main rules for creating trust with the help of third party and with the recommendations from many sources.

I.R. Chen et.al, Lo et.al[60,66] proposed a trust management protocol which is valid for DTNs and it is used for secure routing to evaluate its utility. In this trust management protocol is an integration of QoS trust with respect to the social trust to retrieve a composite trust parameters. It has the best trust for trust aggregation to be checked due to which the subjective trust is near to the objective trust for every individual node trust property for decreasing the trust. It is used for best trust formation and application-level trust settings to be checked the increase the performance of the application. In this it used a trust management protocol with respect to the Bayesian trust-based routing and non-trust-based routing protocols which is the PROPHET and epidemic in DTNs. It is proved that the trust-based secure routing protocol performs better than the Bayesian trust-based routing and PROPHET. The performance of epidemic routing with respect to the delivery ratio and data delay with no high data or protocol maintenance overhead. It is used by malicious nodes to increase their own payoffs while giving their contribution to DTN routing performance.

I.R. Chen et.al [61,67] introduced the trust management protocols for an encounter-based routing in DTNs. The feature of this paper protocol is not only connectivity of a QoS trust but also honesty properties into composite trust parameters for making decision in DTN routing dynamically. Results shows the proper selecting weights

combined with QoS and social trust parameters for trust, in this trust management protocols can get the ideal performance level with respect to the delivery ratio and delay by epidemic routing, because of not trustable and selfish nodes increases. In this author are thinking to check other forms of data transferring as more than one copy of data to transferring and other attacks by selfish nodes for example jamming, forgery, self-promoting and slandering attacks.

A.Verma et.al [62], proposed a Trust Security structure for Ad hoc Network and in this the trust structure considered as the trust service. The services under this are for checking the trust, trust updating and trust propagation. The trust structure is considered in the following ways – Trust Configuration, Trust Assessment and Trust Appliance. The trust configuration engrosses-- consists of trust relationships, a limit of trust categories, probable trust values. The trust evaluation steps is responsible for the checking the trust. The trust appliance is for the trust values for calling module. A trust is calculated by a single unit to its confidence in the trust value of given point. The trust signifies the successful interaction, with the help of which some result can be retrieve.

I.R. Chen et.al[63] proposed this comparison table 2.1

Management Scheme	**Trust Model**	**Trust Protocol Design**	**Trust Metrics Considered**	**Direct / Indirect Trust**	**Trust Attacks Considered**	**Trust Protocol Validation**	**DTN Routing Performance Optimization**
1	Iterative Reputation	Trust aggregation	Delivery reception and feedback consistency	Both	Bad-mouthing, ballot-stuffing, and whitewashing	Based on mobility models	No

2	Weighted Summation	Trust composition, trust aggregation, and trust formation	Honesty, cooperativeness, and connectivity	Both	Bad-mouthing, ballot-stuffing, and whitewashing	Based on random mobility models	No
3	Weighted Summation	Trust aggregation	Delivered and forwarded messages	Direct trust only	No	Based on mobility models	No
4	Bayesian Model	Trust aggregation	Positive feedback	Both	False recommendations	Based on mobility models	No
5	Weighted Summation	Trust aggregation	cryptographic operation, and node behaviour	Both	No	Based on random mobility in a city area	No
6	Weighted Summation	Trust composition, trust aggregation, and trust formation	Healthiness, unselfishness, energy, and connectivity	Both	Bad-mouthing, ballot-stuffing, and self-promoting	Based on both mobility models and real traces	Yes

CHAPTER 3: PROPOSED WORK

3.1Preliminaries

The research on ad hoc networks was introduced in the year 1972 which was sponsored by DoD - PRNET, which was developed gradually into the Survivable Adaptive Radio Networks (SURAN) program. This network is a combination of exchange of information nodes that want to communicate with every node in the network, but there is no fixed structure present. Every node is accountable for dynamically find all the nodes which they can communicate straight. In this the assumption is that not every nodes can straight exchange the information with every other nodes, and nodes spread message from other nodes to deliver message across the network.

One of the main characteristic of ad hoc networks is that it changes quickly and due to this character in this network the link characteristics was proposed because of the node movable and power control such as power consumption, throughput, routing, and connectivity. The existence security model deal with protecting resources from unauthenticated access, but are not able to save the network from those who offer resources. Combining trust to the security model would increase the security of the environments. In the proposed model, the trust value can be evaluated to make decisions which depend on the communication between the nodes with every node other about granting or rejecting the messages.

This model are not only useful in checking and evaluating attacking node, but also increase the network performance as trustable nodes can reject job with malicious nodes. The main aim of our work is to create a structure that describe trust metrics and create models of trust propagation in ad hoc networks. The introduced structure are then apply to increase the performance of ad hoc network routing and to check the not the trustable node detection. The difficulties of describing trust parameters and trust relationship has been studied for public key authentication, e-commerce and in P2P networks. Thus trust can be evaluated in many different ways.

3.2 Assumptions

- Let G (V) = N where 'N' represents the number of nodes in the network. G(S) is the source and G(D) is the destination node. The source wants to send data from source to destination G(S)->G(D) but the network is disconnected and the nodes are movable in nature not static in nature.
- The data is transferring from nodes.
- Some nodes are malicious nodes.

3.3 Problem Description

Delay Tolerant Network exhibits partially or no end-to-end connectivity. Hence, routing protocol is an open issue in Delay Tolerant Network. One of the existing solutions is the use of Social Network analysis algorithm in creation of routing protocol for Delay Tolerant Network. Most recent paper for Delay Tolerant Network routing uses social network analysis for routing [16] but they assume that their network is secure. Although one of the key parameter of social network analysis is trust but paper [57] ignores this factor while deriving algorithm for DTN. So, in this work we have studied and analysed the impact of trust factor in social network analysis based communication protocols for Delay Tolerant Network using human opinion dynamics.

3.4 Why do we need trust in Social network for DTN?

3.4.1 Methodology on the project

Trust management in ad hoc networks main idea is on trustworthiness checking the method after starting the trust relationship has been established. However, direct how to get the starting trust relationship partially due to the meaning of the trust parameters is not properly described [59]. This network is at great failure as its environment and much vulnerability that lie in the networks are:

- **Channel vulnerability**: Broadcasting with the help of wireless channels can create the data eavesdropping and injection.
- **Node vulnerability**: Nodes is not protected, due to which they are easy to attacks.
- **Absence of infrastructure:** in this certification and authentication authorities are not present.
- Not fixed it is dynamically changing network topology because of which the security of routing protocols is not secure it is under threat.
- Combining the trust factor to the existing security model will increase the security of the environments. Under this there are two methods of evaluating trust in networks:

  (a) Trust propagation which is use to predict the trust of nonadjacent nodes by adding the trust values with different indirect paths.

  (b) Trust - based recommendation which is used to check trust on the recommendations given by the neighbouring nodes in the network.

3.4.2 Objective and scope

The project explores the area of computer networks with the aim of creating a system which is able to send message to a reliable node. By evaluating the trust factor we can suggest the nodes which are reliable in mobile networks or not.

- To analyze trust method in ad-hoc networks during sending the message in the nodes.
- To implement a real time system for mobility of nodes.
- **Performance Requirements**: computationally inexpensive, adaptability, on self initializing and it needs the knowledge of environment.
- The system will check the mobility of message and evaluate the trust factor of every node and it provides the trust value as output.

3.4.3 Contribution

- We introduced the security features in social routing protocol for increasing the transmission rate for delivering the data from source to the destination.
- We even add the opinions of the human with the simbet routing and with the help of opinion recommendation is created from which we evaluate the trust value from which we can check whether the node is malicious or not.
- Implementation is a combination of simbet routing addition with the human opinion as recommendation through this we evaluated the trust for security in the network.

3.5 PROPOSED SOLUTION

In this methodology we focus on employing SimBet routing mechanism with human opinion dynamics as a recommendation with which we add the trust factor for checking whether the node present in the network is malicious or not. In these schemes, the source node tries to select the node to broadcasting the message and assign the duty of forwarding the message to the destination node. However, these approaches may not select the best candidate that can forward the message to other nodes fastest. In this approach, we develop a prediction and selective forwarding based broadcasting algorithm. In this algorithm, each node calculates the similarity of the nodes and the betweenness centrality of the node and after this we calculate the weight age of the node which is recommended by neighbouring elements with the help of which we check which whether the node is trustable to send the data from source to destination or if the node is not trustable. In the broadcasting process, the sender disseminates a message to all its neighbours in the broadcasting direction. Hence, it selects the candidate based on considering its neighbours according to its higher betweenness and similarity combining with the social rank higher with the priority of nodes addition with the trust factor too. Moreover, because each node only needs to maintain parameters, the overhead is very low. Our simulation results indicate that our approach can significantly decrease the end-to-end delay and improve the message delivery ratio, compared with existing approaches.

3.6 First Module – SimBet and Betweenness utility

The problem for selecting the appropriate node for transferring the data from source to destination is resolved by using a SimBet and betweenness utility. The procedure for this algorithm evaluates the similarity and the betweenness of centrality of nodes. On the basis of the predicted values the right decision is made from which they check whether to select a node or not for exchanging the message. Because of this SimBet routing is proposed which can handle the delivering the data from source to destination with the help of in between nodes in less delay. In this work we have tried to build a SimBet routing algorithm using ns2.3.5.

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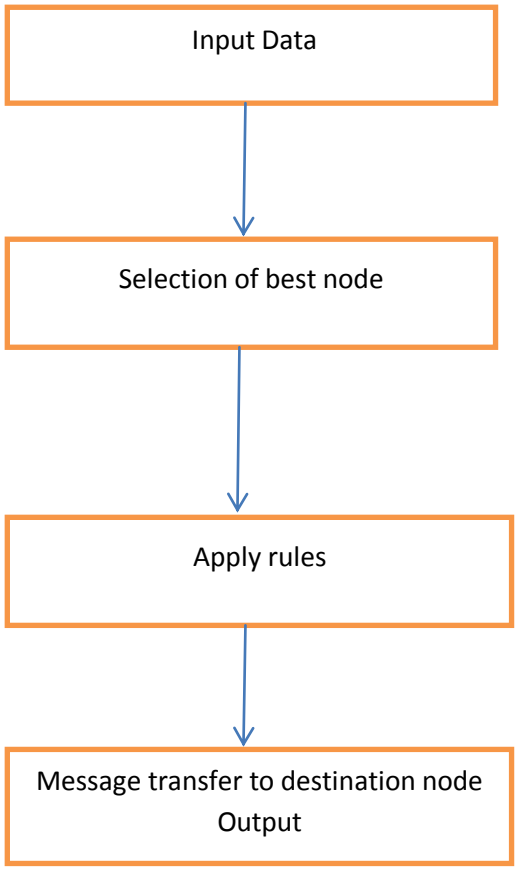


Figure 3.1: Architecture of the Simbet and Betweenness Routing[16]

3.6.1 SIMBET ROUTING

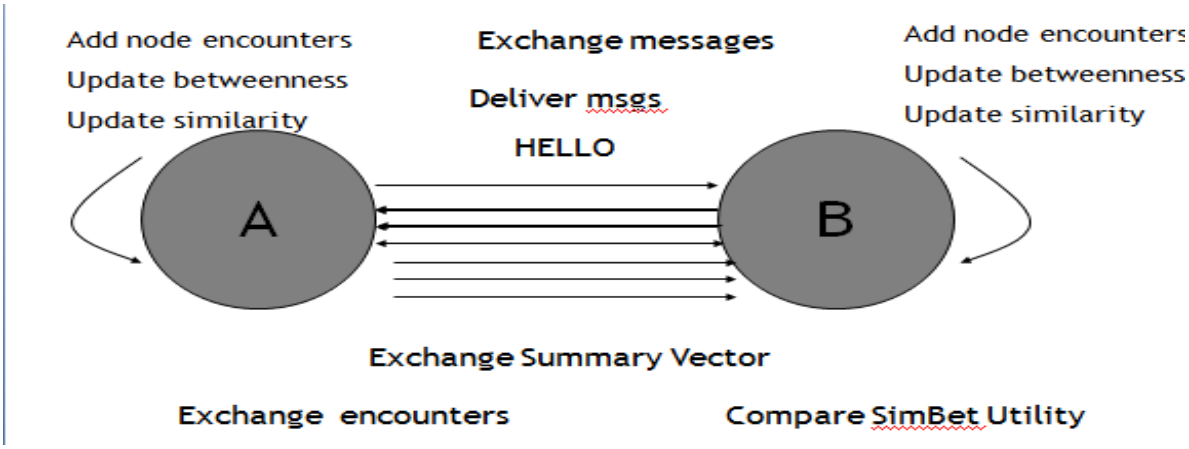


Figure 3.2. SimBet Routing[16]

3.6.2 SIMBET UTILITY CALCULATION [16]

Similarity Calculation: It is the total count value of the similar neighbours in the source node and the destination node. A^2 is the multiplication of two adjacent matrixes.

$$P(x,y) = |N(x) \cap N(y)|$$

The utility value of the source node with the destination node is the ratio of the number of similar neighbours to the total number of neighbours of the destination node.

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

Betweenness Calculation: in this two nodes is evaluated using the ego network of the node. This network of a node is easily created by the number of neighbours of the node considered. The ego network main idea is calculating the betweenness of two nodes and can be checking using the adjacency matrix. This matrix 'A' is carried by updating '1' with direct link in two nodes else '0'. Its value of the initial node is easily reciprocal of the value evaluating by$A^2[1-A]$. The multiplication of the $A^2[1-A]$ is scalar product and the value is easily reciprocal of the numerical value. This function is evaluated by using formula:

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

The main idea of SimBeT utility function is a multi-objective constraint optimization function given by the equation:

$$\mathrm{SimBeTU_i} = \alpha \mathrm{SimU_i} + \beta \mathrm{BetU_i}$$

Where α, β is a weight considered in the equation and they represented by:

$$\alpha+\beta=1$$

If the weight is not given to us then we take it as random value 0.5. Each weight is given equal weight age.

3.7 Second Module – Opinion based model

In this we add the human opinion with SimBet routing for resolving the difficulties of the optimal selection of the node for the delivering the data. The algorithm evaluates the similarity and the betweenness of centrality of nodes and after whole evaluation the utility of the nodes we take that values as fitness value to evaluate the weight age of the nodes on the basis of the predicted values the decision whether to select a node or not for exchanging the data is considered. Because of this human opinion was introduced to handle the delivering the data from source to destination with the help of in between nodes in less delay. In this work we have tried to build a SimBet routing algorithm with human opinion using ns2.3.5.

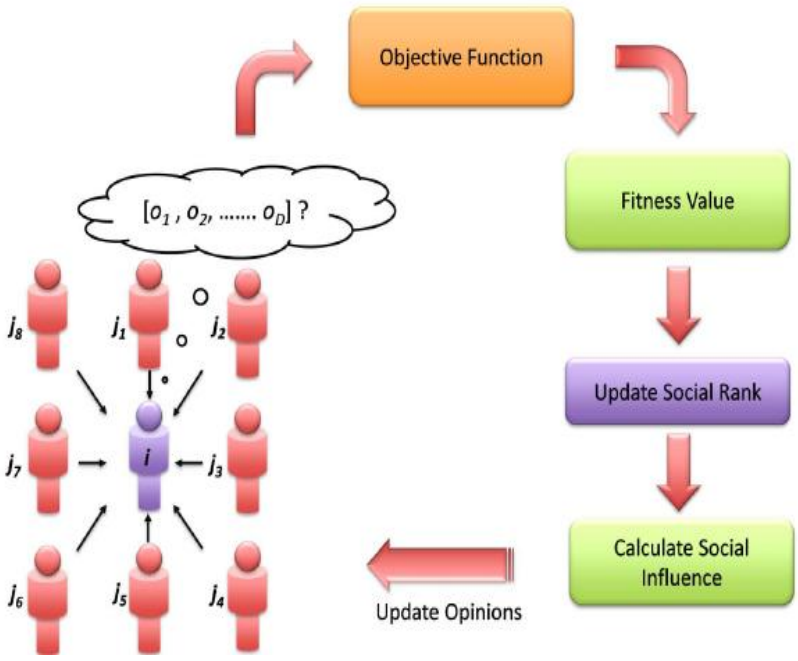


Figure 3.3: Architecture of the Human Opinion Dynamics [57]

3.7.1 OPINION MODEL [57]

The social influence $w_{i,j}(t)$ of individual j on individual i is given by equation(1)

$$w_{ij} = \frac{SR_j(t)}{d_{ij}(t)}.$$

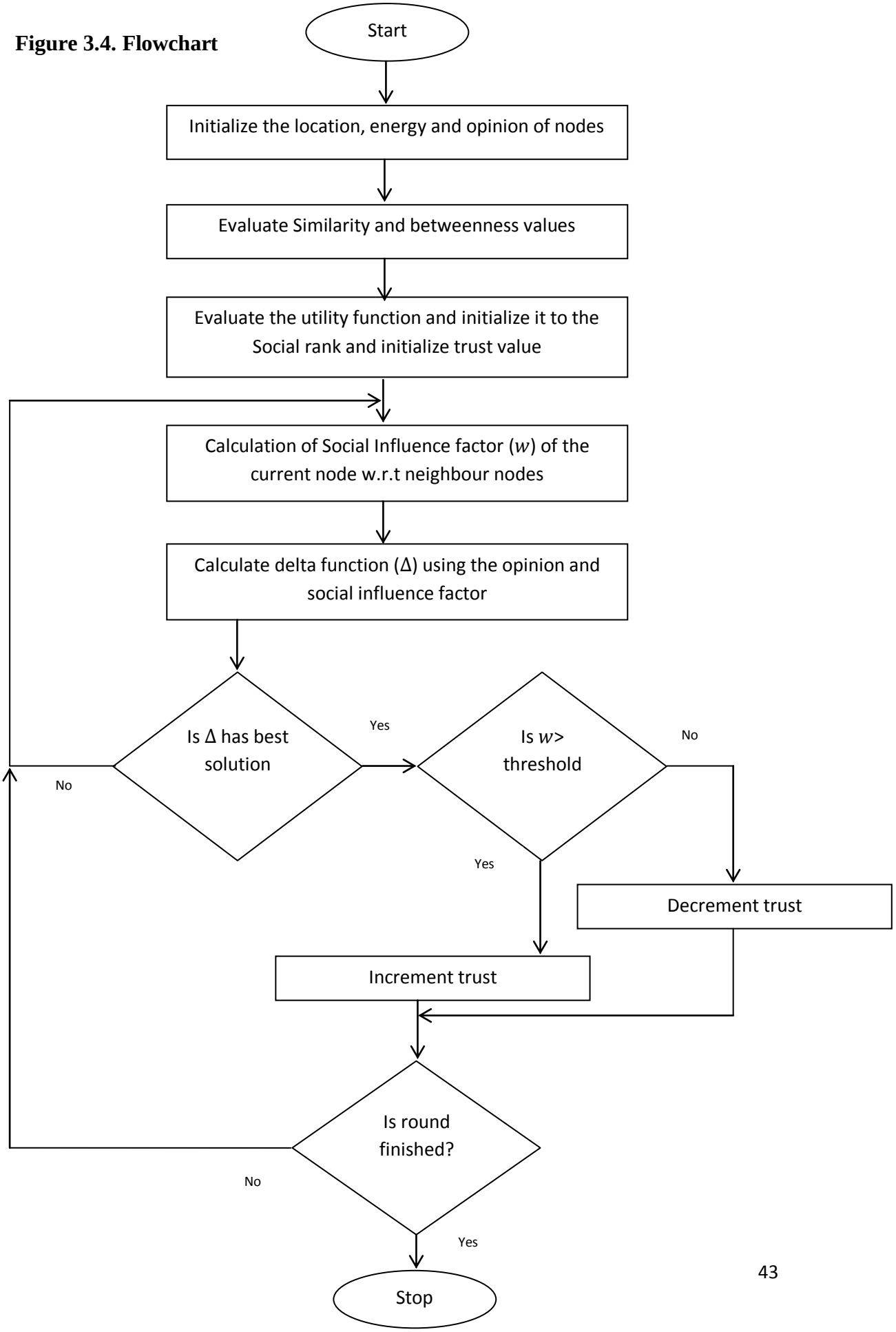
where $d_{ij}(t)$ is the Euclidean distance between individual i and j

in the above equation SR is the fitness value of an individual, in which fitness value represents the error which required to be optimized. In this *i* indictes the node and *j* represents the neighbouring node. Every node opinion is updated as:

$$\Delta o_i = \frac{\sum_{j=1}^{N} (o_j(t) - o_i(t)) w_{ij}(t)}{\sum_{j=1}^{N} w_{ij}(t)} + \eta_i(t), j \neq i,$$

$o_j(t)$ is the opinion of neighbours of every nodes l *i*, w_{ij} represents social influence factor, and η is the adaptive noise for individualization in society when some limit is reached.

Figure 3.4. Flowchart



3.7.2 Algorithm: HOD based Routing in Sparse Delay Tolerant Network

Begin

Initialize opinions for nodes

Allocate current node and neighbour node to opinion1 and opinion2

n: number of nodes in the network

l: number of neighbour nodes

lp: number of loops

np: number of opinions d: the domain space

f(x):objective function as a function of similarity and betweenness

Define the objective function of f(x), where $x=(x_1,.....,x_d)$

Generate the initial population of opinions or x_i (i=1,2 ,..., n)

While (i<lp)

For j=1 to np (all opinions)

Allocate current node and neighbour nodes

End for

Store best individual to bfn

For j=1 to np (all opinions)

For k=1 to np (for all opinions)

If k not equal to j

Calculate social influence w_{jk}

End if

End for

Calculate η standard deviation

If j not equal to bfn

Update opinions using discussed equation

End if

End while

End procedure

3.8 Third Module – Trust Based Model

Trust-oriented security structure is used to secure the network from selfish nodes, which are used in making decisions for the following perspectives point of view which are as follows

Application execution

There are various ad hoc network operations, such as email, instant messaging, ftp and many others. As all of the nodes present in the ad hoc network which guarantee the durability of the target node before initialization with any type of application execution as an communication with the target node.

Routing Environment

There are many message transfers over the network. The data consider the route as per the routing protocol defined from node to node. Before delivering the message from the source first and then gets the trust value of the receiver and then allowed to transfers only if the trust value is higher than the threshold specified. Trust value also the combination of past interactions as recommendation so any misbehaving with nodes can be eliminated on the basis of trust.

Authentication

For accepting and rejecting a public key certificate it all depends on the trust value of starting node. So the nodes present in decision making is the value of trust that node has on the original.

Selection process

There are various possibilities of nodes in network which means that there are many nodes in the network for communicating or getting services. For selection purpose, one of the methodologies is to take the node for which the starting with the highest trust value. So it leads to choosing the best among the available choices which will enhance the security of the network.

Trust of a node: It is calculated [58] with the opinion of the neighbouring nodes whose value is on the number of past interactions of the source node with the destination node. The ratio of the count value of the number of past communication between the nodes and the total number of interactions I of the destination node.

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

CHAPTER 4: SIMULATION AND RESULTS

4.1 NS2 simulator

NS is a separate affair simulator under the attack at networking research. It provides strength for simulation of TCP, routing, and multicast protocols over wired and wireless networks. It starts as a variant of the REAL network simulator since in 1989 and has evolved over the previous few years. It simulates both wired and wireless networks. It is first introduced in UNIX based. TCL, scripting language is used. Ns-2 is a standard experiment environment.

The ns-2 wireless simulation model energizing nodes in motion an unobstructed plane. Motion follows the random waypoint model [7], a node pick a destination uniformly at random in the simulated region, pick a velocity uniformly at random from a configurable range, and then goes to that destination at the chosen velocity. At the chosen waypoint, the node stops for a configurable period before repeating the similar method. In this structure, the stop time represents as a substitute for the degree of movable in a simulation; high stop time amounts to many nodes being fixed for many of the simulation.

The two languages used in ns2 are:

C++: It requires systems programming language. Byte manipulation, packet processing, algorithm implementation are using this language. Run time speed is important. Turnaround time is less.

Tcl(Tool Command Language): Simulation of a few unstable metrics or configurations. It is important for high exploring a number. The number of cycle time is important.

Network Animator:

It is on animation tool which is for seeing network simulation traces and real world data traces. It help topology layout, data level animation, and many message inspection tools. It has a graphical interface, which gives information like number of data fails at every link. NAM introduced in 1990 as an easy tool for animating data trace data. Nam starts at LBL. It is development effort combing with the VINT project. It is for showing easy simulation of the ad-hoc network. It start NAM with the command 'nam<nam - file>' where '<nam - file>' is the name of a NAM trace file that was introduced by NS or one can run it directly out of the Tcl simulation script.

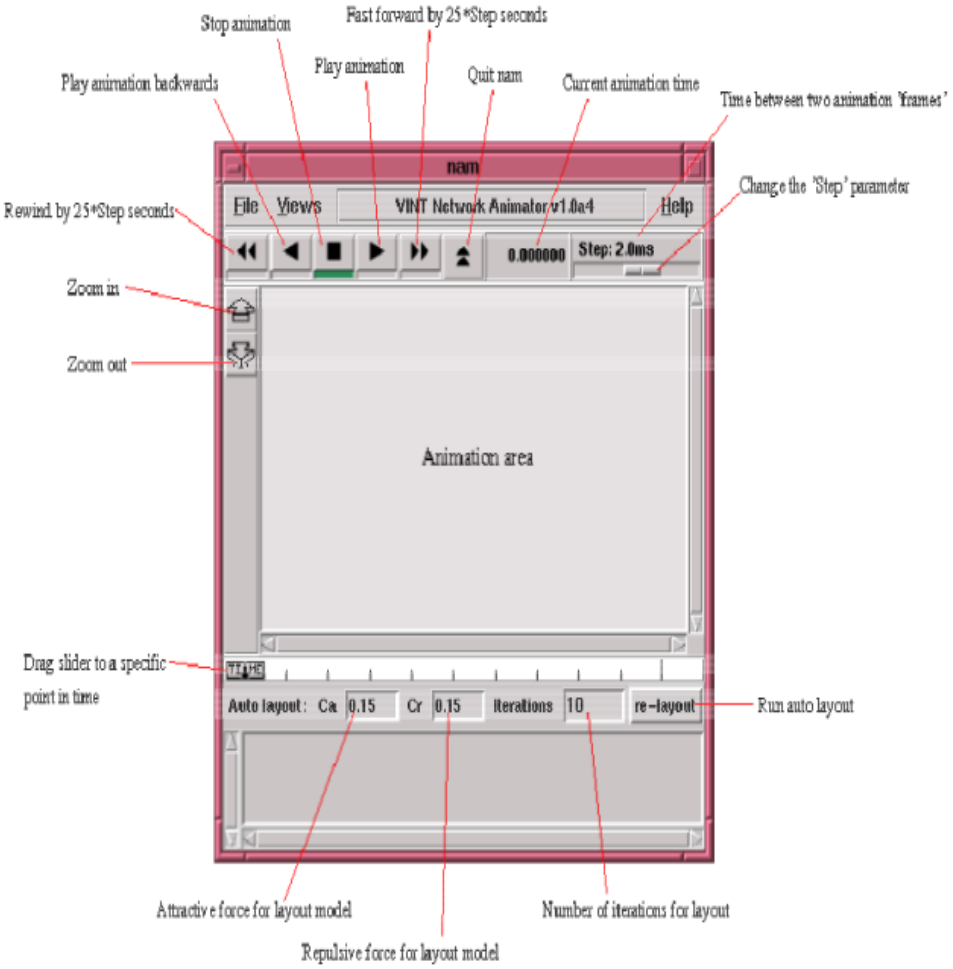


Fig 4.1: Network Animator[64]

X-graph

It is one part ns-allinone simulator is 'xgraph', used for plotting purpose used to generate graphic representations of simulation results of the nodes. It is one of the types of gnuplot.

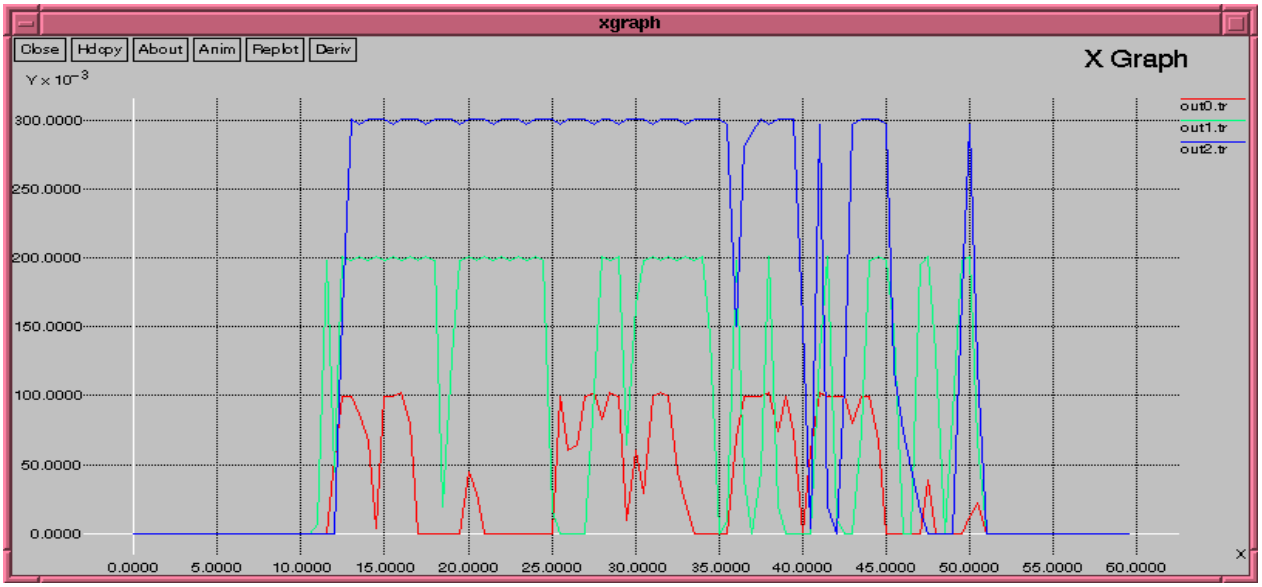


Fig 4.2: Xgraph[65]

AODV Routing Protocol:

Ad hoc On-Demand Distance Vector (AODV) Routing is a protocol used for mobile ad hoc networks (MANETs) and also used for wireless networks. This algorithm enables dynamic, self-starting, multihop routing for dividing the movable nodes used for establish and maintain a network which is not fixed in nature. Another characteristic is the usage of a destination sequence number for every path entry. The destination sequence number is established by the destination to indulge with path information is sends to destination nodes. Route Requests (RREQs), Route Replies (RREPs), and Route Errors (RERRs) are the message types defined by AODV. These message received by UDP, and normal IP header processing applies.

DSDV Routing Protocol:

Destination-Sequenced Distance-Vector Routing (DSDV) is a table-driven routing protocol used for ad hoc mobile networks which is on the Bellman–Ford algorithm. Each node control a table of list of all nodes it has known either directly or through some of its neighbours. Each node has one entry in the routing table. The entry table will contain data about the node's IP address, last known sequence number and the hop count to reach that node. It keep the track of the nexthop neighbor to reach the destination node, the timestamp of the last update received for that node.The DSDV message consists of three fields, Destination Address, Sequence Number and Hop Count.

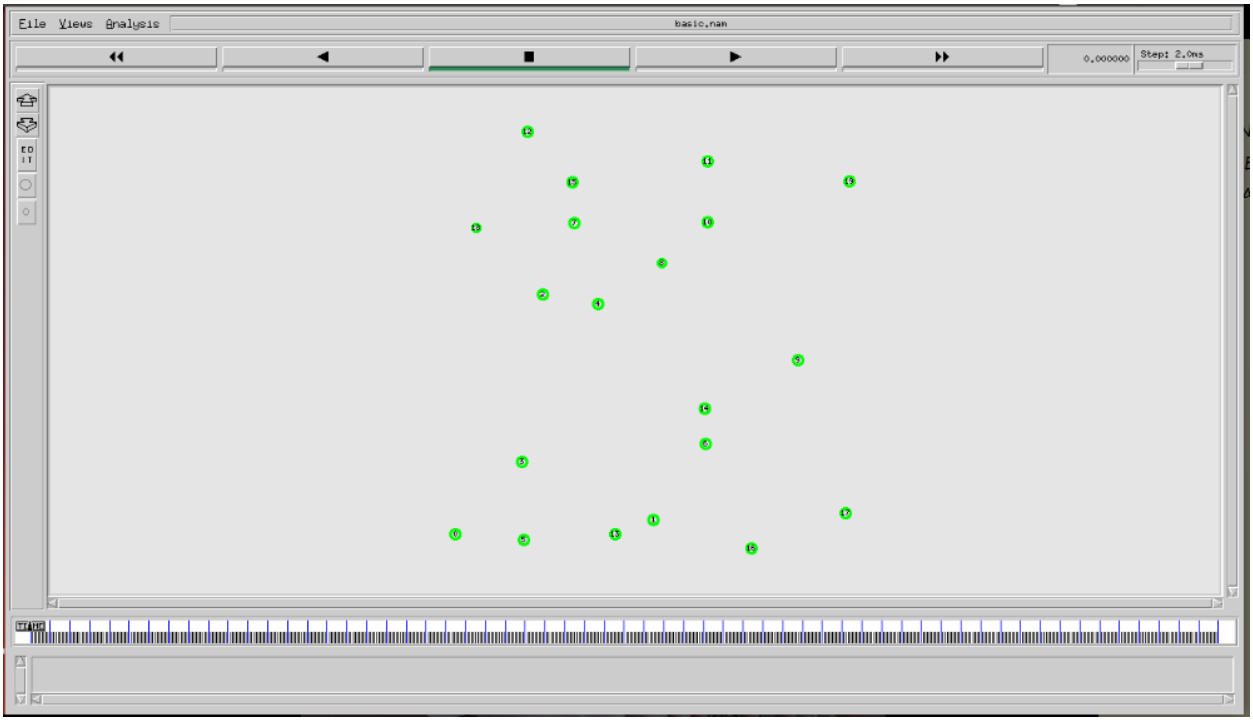
4.2 Implementation and Experiment

We conduct simulations using ns2 simulator. The radio propagation model is used to generate the nodes distributed in transferring the data from source to destination. The size of the environment is 1000x1000 m^2. The maximum packet in interface queue is 100. The number of mobile nodes is 20. The time to end simulation is 60 s. The MAC protocol is 802.11.

Many broadcasting protocols are based on the idea that the current sender selects the node that is well connected to others nodes so that it take less time to transfer data from source to destination . The performance is analyzed on the basis of Packet Delivery Ratio and End to End Delay. The rest one is the packet delivery ratio, which is the ratio of the number of packets transfers from source to destination and residual energy. The second metric is the end-to-end delay. It is the time elapsed from the packet generated until the packet reaches the receiver in the desired area.

Table 4.1: NETWORK PARAMETERS VALUE

NETWORKS PARAMETERS	**VALUES**
Number of Nodes	20
Transmission Energy	Dynamic (depend on distance) but initial 100
Packet generation Rate	1 packet per second
Network Area	1000 x 1000 m^2
Maximum packet in interface queue	50
Simulation time	50 seconds
MAC Protocol	802.11
Routing Protocol	AODV protocol
Antenna Model	Omni Antenna




```
0015703470588145339 0.0016549333621284322 0.0015406520618016491 0.00042839407924
819651 0.00017962058467502727 0.00081577958836249684 0.00015971743135 2865 0.0019
011655036440343 0.0017742361210434936}
op(9)  = fitness 0.83699235452198995 opin 0.33050245108571952 trust 0.7856594652
103539 soc_inf {5.4284257333734905e-05 0.00042773442332580646 0.0005063404160212
1832 0.00099771086587546244 0.0012277734818469698 0.00065786920175517339 0.00179
42227190675816 0.00076536195549217496 0.00017945701483414582 0.00210601826083832
26 0.00080452610666216409 0.00087798881162609187 0.0016767906285411573 0.0006191
1824991075235 7.5428439942131943e-05 0.0012569458880113769 0.000308767604782368 9
8 0.0010322962792347445 0.0019554556802468181}
utility function ------0.18535265556455455--------
utility function ------0.48581585630159163--------
utility function ------0.21142613207928382--------
channel.cc:sendUp - Calc highestAntennaZ_ and distCST_
highestAntennaZ_ = 1.5,  distCST_ = 550.0
SORTING LISTS ...DONE!
utility function ------0.13215287456937208--------
utility function ------0.8511137866162759--------
utility function ------0.50266863940495243--------
utility function ------0.50948233561481548--------
utility function ------0.39860529442279186--------
utility function ------0.61492151132112938--------
utility function ------0.39027538779311055--------
```

4.3 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.

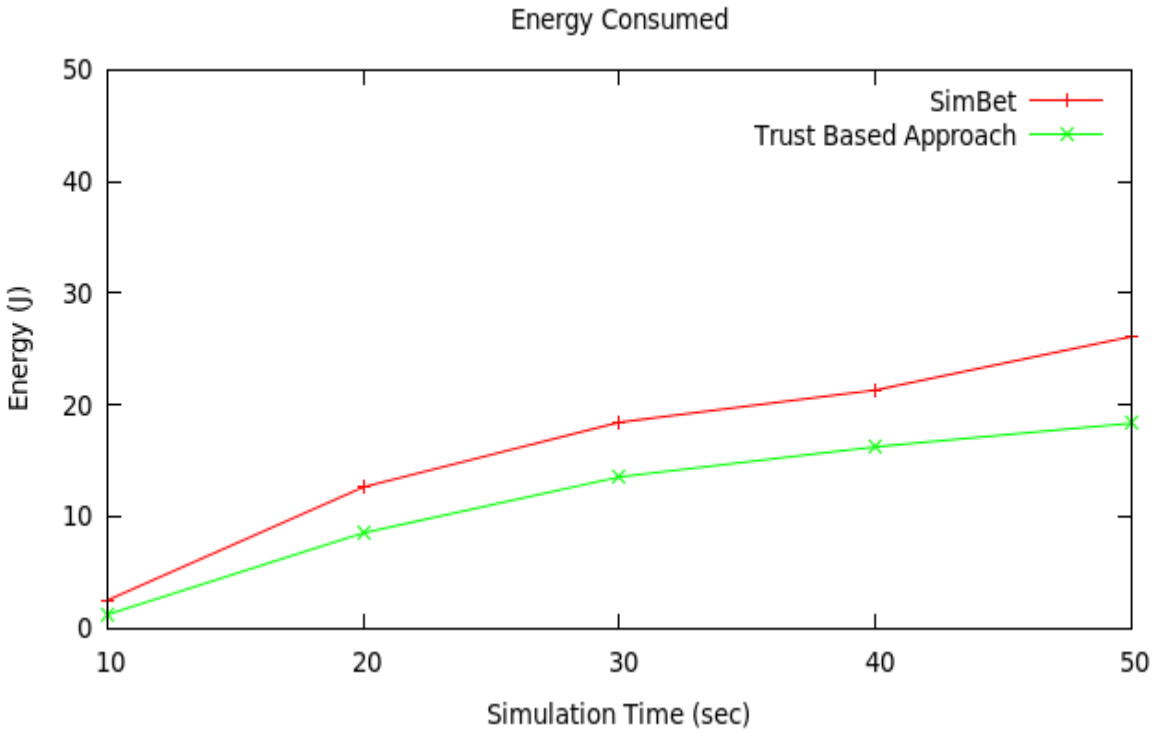


Fig 4.3: Energy Consumed in the network

Packet Delivery Ratio: It is defined as follows:

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

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 thepacket lost in the network reduces.

Fig 4.4: Packet Delivery Ratio

End to End Delay: it is given by:

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

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 4.5: Packet Delivery Delay

CHAPTER 5: SUMMARY

5.1 CONCLUSION

Delay tolerant is a sparse network having very less nodes for exchanging the message. There are so many methodologies proposed in the recent previous year but still routing is a main difficulty in these networks. In this, we presented a new message transmitting algorithm for transferring the message from source to destination. It is observed that the influence of social network analysis or impact of social network analysis is very high while packet dissemination in delay tolerant network. In this algorithm, a message sender can select the best node among its neighbours with the help of Simet routing and human opinion dynamics so that it can send the message fastest to other nodes through using similarity utility and betweenness utility and with opinion of humans as recommendation. An opinion based approach is introduced and the trust of every node is calculated on the opinion of the nodes. So in this network the routing and path selection decisions are on the basis of the trust value of the node. The result also verifies the proposed technique. The simulations demonstrate that our approach shows the packet delivery ratio which should be more and the end-to-end delay should be less so that packets or message can be send with less time and more information should be provided.

5.2 FUTURE SCOPE

In this work, we have only focused on exploring features for delay tolerant network in Social Network Analysis adding the opinion as recommendation with calculated value of trust. We focused on the algorithm and feature that could be used to resolve the transferring the data from source to destination in less delay time in low connectivity with security featuring adding with it In future other machine learning algorithms must be implemented and their results must be compared with the present work. We took an example in which we are transferring the data using similarity and betweenness utility from source to destination. We also use trust factor to know the node from which we are transferring the data is secure or not using trust algorithm. However, the results show that there is further scope for performance improvement of this approach with additional features and world-knowledge which we aim to explore in future.

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