# A Survey on Routing Protocols in Delay Tolerant Network

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Abstract—Delay tolerant network refers \*to a network where connectivity is opportunistic. Due to such intermittent connectivity traditional routing protocol fails. In order to efficiently route the information in such an environment researcher have proposed various classes of routing protocols: forwarding, replication, control replication etc. This technique uses local information available with node: Neighbourhood index, past contacts, contact duration, node mobility etc. to determine next hop or destination.

The work proposed in report evaluates Neighbourhood index, temporal distance, temporal diameter, and temporal centrality as time varying properties and using such characteristics benchmarking the existing routing protocol. First, temporal metrics are evaluated for synthetic and real trace data. Based on synthetic data characterization, Forwarding and Replication routing module evaluated. It is observed that due to the lower contact duration and contact edges, resulting in poor information dissemination. Second, extractions of temporal metrics along with contact history from real traces are used to design, develop and evaluate

contact history based routing protocol. Third, the Binary Spray and Wait protocol is flooding based routing scheme. As compare to Epidemic routing and other flooding based routing schemes it performs well. Finding the value of N at which particular destination will receive the message copy, we can consider that how many nodes are required for the network, which will be helpful to improve the network performance and also reduce the transmission which is cause of contention.

Keywords-Delay Tolerant Routing Protocol, Spray and wait, Epidemic Routing

# I. INTRODUCTION

Delay tolerant network [1] operates with intermittent and highly delayed connections and low degree of interactivity, but the flexibility of the Network architecture allows them to be connected to each other. In the past few years, delay tolerant networking is a very challenging research area, which can shape future technological applications.

Internet is interconnection of communication devices around the world. To provide communication between different types of devices several homogeneous sets of communication protocols used like TCP/IP protocol suite. The task of such protocol suite is: routing data and ensuring reliability of message exchange. Connectivity on the internet relies on wired links (wired telephone network) as well as wireless technology (short range mobile links, satellite links).

A delay tolerant network is a network of regional networks shown in Fig. 1.1 [1] which shows interplanetary internet. Nowadays communication devices are rapidly growing and operate on limited power. This is applicable to interplanetary space and common to all mobile communication wireless devices on earth.

Network partition/intermittent connectivity causes loss of data on the internet. In this case if packet is not immediately forwarded then packet drop occurs of packet discards. In case of TCP, it transmits packets in slower transmission rate. And if the packet dropping situation continues for a long time then TCP ends the session. This can fail the application.

Here for above scenario delay/disruption tolerant network support communication between intermittentlyconnected nodes by isolating delay with store and forward technique.



# A. WHY DTN?

The Evolving Interplanetary Internet basically a delay tolerant network concept came from interplanetary internet. The existing TCP/IP-based internet, while there

Fabulously successful in many environments, does not suit all environments.

The ability of TCP/IP depends on number of ability.

- An end-to-end path between source and destination exists for the duration of the communication session; (For reliable communication) the maximum round-trip
- time over that path is not excessive and not highly variable from packet to packet;
- The end-to-end loss is relatively small.

These networks typically serve environments in which it is impractical or impossible to configure either а communication environment that supports the assumptions on which the TCP/IP suite depends. Some of the constraints posed by extreme environments that may result in 'challenged networks" and considers the problems that these environments might cause for common Internet protocols and applications. Finally, we derive some "principles of design" for the DTN.

## II. ROUTING PROCESS IN DELAY TOLERANT **NETWORKS**

Delay Tolerant Network is vast area of research. In beginning, there are many routing protocol are developed

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First of all, developers have developed the Epidemic routing technique for the DTN. Epidemic routing the flooding based routing scheme. In epidemic routing, when other nodes come into contact with the source node, then both nodes exchange the data which they don't have. Follow this way and all the nodes of the network exchange the message copies. The disadvantage of this routing scheme is it generates too much transmission which is not good for the network.

# III. EXISTING ROUTING PROTOCOL IN DTN

While there are many kind of routing protocols, one of the most instant ways to create a classification is based on whether or not the protocol create replicas of messages. Routing protocols that never duplicate a message are careful forwarding-based, whereas protocols that do replicate messages are measured replication-based.

There are both advantages and disadvantage to each move towards, and the suitable loom to use is most likely dependent on the state at hand.

## A. REPLICATION BASED ROUTING

Replication-based protocols have just obtained much attention in the technical neighbourhood, as they can allow for considerably improved message delivery ratios than in forwarding-based protocols [6]. These types of routing protocols allow for a message to be simulated; each of the replicas, as well as the original message itself, are usually referred to as message copies or message replicas. Possible issues with replication-based routing include:

- 1) congestion in clustered areas,
- 2) being lavish with network possessions
- 3) Network scalability.

# B. EPIDEMIC ROUTING

Epidemic routing technique for the DTN. Epidemic routing the flooding based routing scheme. In epidemic routing, when other nodes come into contact with the source node, then both nodes exchange the data which they don't have. Follow this way and all the nodes of the network exchange the message copies. The disadvantage of this routing scheme is it generates too much transmission which is not good for the network [13].

### C. SPRAY AND WAIT

Another approach of routing in DTN is Spray and Wait. It mainly works into two phase: Spray Phase and Wait Phase [15]. In spray phase, when source node comes into contact with the other node it gives only one copy of message to contacted node. When destination is not found during spraying phase, all the nodes of the network switches to direct transmission.

# D. BINARY SPRAY AND WAIT

Then after the new technique of Spray and Wait is introduced and it is Binary Spray and Wait Protocol. When other node of the network comes into contact with the source node then source node gives n/2 copies to the contacted node and keeps n/2 copies for itself. When source node left with only one copy, it proceeds to direct transmission [15].

## IV. GENERAL STUDY

As explain in [15] To deal with DTN, generally flooding based routing scheme is used. When flooding based scheme is used in this type of intermittent network with high delivery, it suffers with waste of lot of energy and suffer with sever contention. Epidemic routing was the first routing scheme in DTN. In Epidemic routing, each node has number of message copies and when it comes into contact with another node then they both node exchange the message copies which they don't have. This way, all the nodes in network delivered the message copies including its destination. But epidemic routing generates too much transmission and waste lot of resources. Because of that the network the network performance will degrade. To overcome above problem, the new routing strategy has been introduced and it is called Spray and Wait, that sprays number of copies across the network and wait until one of them meet to the destination.

Using simulation engine "ONE" Spray and Wait protocol performs very well as compare to other flooding based routing schemes. Its overall performance close to optimal. Spray and Wait protocol is highly scalable and easy to implement. It generates low contention and performs fewer transmissions as compare to the other flooding based routing schemes [15].

In this paper, the new routing scheme was introduced which overcomes the short comes of the epidemic routing. Spray and Wait protocol is simple and performs well in terms of transmission and also achieve comparable delay. In future, new techniques can be developing which will be helpful to improve the performance of the DTN.

As per research paper [28], Delay Tolerant Network has the capabilities to interconnect devices in those region in which the existing technology cannot reach. In DTN, the idea of the end to end connectivity does not exist and both nodes and links are unreliable. The nodes are intermittently connected. DTN has introduced various routing strategies.

There are many routing schemes are used in DTN. Routing schemes are generally divided in to two families : 1) Flooding families and 2) Forwarding families

Flooding families includes following routing techniques :

- 1) Direct Hope Routing
- 2) Two Hope Routing
- 3) Tree Base Routing
- 4) Epidemic Routing
- 5) Prioritized Epidemic Routing

Forwarding families includes following routing techniques [28]:

- 1) Location Base Routing
- 2) Source Base Routing

- 3) Per Hope Routing
- 4) Hierarchical Routing
- 5) Single Hope Routing

This paper gives the basic idea of each routing strategies. After comparison, the epidemic routing technique was proved best.

Delay Tolerant Network is the new research area in the network. Many routing problems can arise during the packet transmission, especially in terms of delivery delay and resource consumption. This paper inspires to developers to develop such routing techniques which overcomes the problems of the existing routing schemes in DTN and satisfy the above condition. [28].

This paper [29] introduced new routing concept for DTN which is Epidemic routing. In Epidemic routing, each node has number of message copies and when it comes into contact with another node then they both node exchange the message copies which they don't have. This way, all the nodes in network delivered the message copies including its destination In Epidemic routing the network topology is minimal but it generates too much transmissions. It uses too many resources. This paper basically gives the idea of the military network.

According to this paper, the existing routing scheme "Epidemic Routing" has some drawback as below : [29]

- Overhead
- Limited replication
- Evaluation

This paper gives some unanswered questions for the future of the DTN, which can help to improve the performance of the existing routing schemes in DTN [29].

- 1) Given a network size and mobility, how can we conclude the number of nodes in the network?
- 2) How much replication, much or little?

3) How can we decide the accurate mobility model?

How can we handle the buffer management? This paper classifies the DTN routing algorithm based on the mobility model and topology knowledge. Epidemic routing requires no or little knowledge about the network. Many of the DTN applications do not involved into epidemic routing. The existing routing algorithm required better environment for routing in DTN.

Explained in Research paper [6], In Delay Tolerant Network the message are exchanges over end to end connectivity. This paper gives the basic idea of the various routing strategies in DTN. This is the first paper which has attempted to investigate different routing strategies in DTN. This paper gives the basic idea of the routing in DTN. It describes DTN network model using DTN Graph. DTN graph includes as below:

- Contact
- Message
- Storage
- Routing

It also describes the DTN routing issues like,

- Proactive Routing vs. Reactive Routing

- Source Routing vs. Per Hope Routing

DTN routing is the very challenging problem. DTN routing requires the techniques for the below,

- Select Paths
- Schedule transmissions

- Estimate delivery performance
- Manage buffers

As per paper [30], Delay and Disruption are new emerging techniques in the network. Since many years, many implementations and applications has been developed in towards DTN. This paper is the survey in this developed area and gives the idea of real time applications of the DTN. In Delay Tolerant Network, the nodes are intermittent, so it is sometimes referred to as Intermittent Network. TCP/IP protocol suite performs well in internet today. But some of the applications of the TCP/IP perform poorly because of node movement and intermittent nodes. A DTN approach can offer very reliable alternatives for communications in such type of network. As compare to other survey, this describes only DTN routing implementations and DTN routing issues. It also gives the basic understanding the DTN architecture. Real time application of the DTN are as below [30]:

- Space communication
- Military Network
- Under Water Network
- Urban Network
- Vehicular Network
- Sensor Network

This paper gives the idea of the DTN software, application and services. It inspires to developers to develop new techniques for DTN routing using various simulator tools which are easily available today [30].

## V. CONCLUSION

Delay-tolerant networks are a gifted new development in network research, that offer the trust of linking people and devices that hitherto were either unable to communicate, or could do so only at great cost. In this paper we have surveyed offered technique for routing in such networks. While we exposed a broad diversity of method that addresses the routing problem, we were able to organize them according to two key property: replication and knowledge. Our survey and Classification enable us to make the following explanation. First, to attain a high delivery ratio with low resource consumption, hybrid techniques that rely on both knowledge about the topology and replication will be required. This has been implicitly noted by several of the researchers in the field, though the dare is to verify the correct equilibrium between redundancy and resource consumption, and to find convenient solution for using network topology information. Second, in cases where message volume is low, straightforward epidemic routing works extremely well. This suggests that small investigational deployments could be quickly developed based on epidemic routing, allowing researchers to have real network topology and traffic data, which could be used to design new routing strategy.

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