# Comparison of DTN – FLOW Routing Techniques in Delay Tolerant Network

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**Abstract -** Delay Tolerant Network (DTN) is a network designed to operate effectively over extreme distances such as those encountered in space communication. In such environment, long latencies are sometimes measured in hours or days. DTN nodes are capable of storing packets in intermediate node until such time as an end – to – end route can be established. In store - carry - forward strategy transit messages can be sent over an existing link and buffered at the next hop until the next link in path appears. A different routing paradigm exploit node mobility to deliver messages by overlapping many snapshots over time and end – to – end path will be formed eventually.

**Index Terms -** Delay Tolerant Network, robustness, throughput, routers, overhead.

## 1. INTRODUCTION

A collection of computing devices connected in order to communicate and share resources. A computer network is a telecommunication network that allows computer to exchange data. In the network computing devices pass data to each other along data connections. Data is transformed in the form of packets. The connection between nodes is established using either cable media or wireless media. Computer devices that originate route and terminate the data are the network nodes [16]. Two such devices are said to be networked together when one device is able to exchange information with the other device, whether they have a direct connection to each other. Scope of the network is determined by the size of the organization or distance between users on the network [6]. Computer networks differ in the physical media used to transmit their signals where the communication protocols organize network traffic, network size, topology and organizational intent.

A Delay Tolerant Network is a network supports interoperability across radically heterogeneous networks. DTN is a multi hop packet based wireless network composed to a set of mobile nodes that can communicate and move at the same time. DTN is self organizing and adaptive networks that can be formed and deformed on-the-fly without the need of any centralized administration [8]. A DTN is a type of ad hoc network that can change locations and configure itself on the fly. Routing is the act of moving information across an inter network from source to destination. DTN consist of mobile agents that contact intermittently. However, the intermittently connectivity rate between different pairs of nodes in a network may be different due to the heterogeneity in real networks. The routing algorithm is a part of the network layer software responsible for a deciding which output line an incoming packet should be transmitted on the next intermediate node for the packet. Metrics use routing protocol to evaluate path which will be the best for a packet to travel. The mobility of many real objects are non – deterministic but periodic. Routing is a process of selecting network paths to carry network traffic. General purpose computers can also forward packets and perform routing though they are not specialized network and may suffer from limited performance. Routing process usually directs forwarding on the basis of routing tables which maintains a record of the routes to various network destinations [15]. Thus, constructing routing tables which are held in the router’s memory is very important for efficient routing. Most routing algorithm uses only one network path at a time.. Instantaneous end – to – end paths are difficult to establish routing protocols must take to a store and forward approach where data is incrementally moved and stored to the throughput of the network in hopes that will eventually reach its destination. To maximize the probability of a message common technique is being successfully transferred to replicate many copies of the message in the hope that will succeed in reaching its destination.

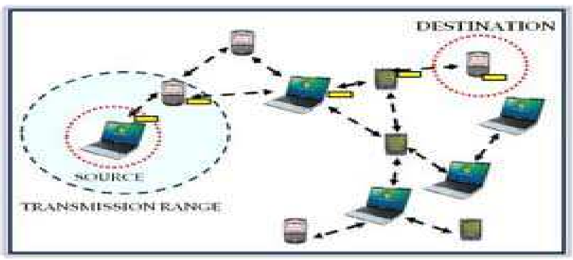


Fig 1. Structure of DTN

## 2. TYPES OF ROUTING PROTOCOL

Routing protocol is the set of rules used by the routers to communicate between source and destination. They do not move the information to source to destination only update the routing table. Each protocol has its own algorithm to choose the best path. Routing protocols store the result of their metrics in routing table. Administrator updates all routes on large networks as it is time intensive. When the administrator add routes there is no bandwidth usage between links

### *2.1. Destination Sequenced Distance Vector Routing (DSDV)*

Destination sequenced distance vector routing protocol is a pro – active, table – driven routing protocol. Each entry in the routing table contains a sequence number. The destination is generated by the number and the emitter needs to send out the next update with this number. In routing the information is distributed between nodes by sending full dumps infrequently and smaller incremental updates more frequently [1].DSDV uses the hop count as metric in route section. Every node will maintain a table listing all the other nodes routing table has known either directly or through some neighbours. Every node has a single entry in the routing table. The destination node keeps track of the next hop neighbour in which the timestamp of the last update is received.

### *2.2. Cluster head Gateway Switch Routing(CGSR)*

Cluster head gateway switch routing is a clustered multi – hop mobile wireless network with several heuristic routing schemes [11]. A distributed cluster head selection algorithm is used to elect a node as the cluster head which modifies DSDV by using a hierarchical cluster head to route traffic. Gateway nodes serve as bridge nodes between two or more clusters [3]. A packet sent by a node is first routed to its cluster head and then the packet is routed from the cluster head to a gateway of another cluster and then to the cluster head and so on, until the destination cluster head is reached. Frequent changes in the cluster - head may affect the performance of the routing protocol.

### *2.3 Dynamic Source Routing (DSR)*

Dynamic source routing is a self – maintaining routing protocol for wireless networks. The protocol functions with cellular telephone systems and mobile networks with up to about 200 nodes. A dynamic source routing network configures and organizes itself independently of oversight by human administrators. When a mobile node has a packet to send to some destination dynamic source routing first consults its route cache to check whether it has a route to that destination. If the node does not have a route which initiates the route discovery by broadcasting a route request packet [4]. This Route Request contains the address of the destination, along with the source address. Each node receiving the packet checks to see whether it has a route to the destination. A route reply is generated when the request reaches either the destination itself or an intermediate node that contains in its route cache an un-expired route to that destination [13]. If the node generating the route reply is the destination, dynamic source routing places the route record contained in the route request into the route reply.

### *2.4. Temporally Ordered Routing Algorithm (TORA)*

Temporally ordered routing algorithm is a highly adaptive loop-free distributed routing algorithm based on the concept of link reversal. The height metric is used to model the routing state of the network. During the route creation and maintenance phases nodes use a height metric to establish a directed acyclic graph rooted at the destination [19]. Links are assigned to a direction based on the relative heights which decouples the generation of potentially far-reaching control messages from the rate of topological changes [10]. A node which requires a link to a destination because it has no downstream neighbours for it sends a query packet and sets its route-required flag. A query packet contains the destination id of the node a route is sought to. The reply to a query contains the height of the neighbour node answering a query to the destination field.

### *2.5. Associativity Based Routing (ASR)*

In associativity based routing a route is selected based on the degree of stability associated with mobile nodes. Associativity based routing is defined by connection stability of one node with respect to another node over time and space [2]. The route discovery is accomplished by a broadcast query reply cycle. When a discovered route is no longer desired, the source node sends a route delete broadcast so that all the nodes along the route update their routing tables.

### *2.6. Wireless Routing Protocol (WRP)*

Wirless routing protocol message retransmission routing protolol contains the sequence number of the update message and a list of updates sent in the update message. Nodes inform each other of link changes using update messages. Nodes send update messages after processing updates from their neighbors or after detecting a change in the link [14]. If a node is not sending messages, it must sends the message within a specified time to ensure connectivity. If the node receives the message from a new node, that node is added to the table avoids the count to infinity problem.

| Routing Protocol | Route Acquisition | Flood to route discovery | Delay for route discovery | Multipath capability | Effects of route failure |
|---|---|---|---|---|---|
| DSDV | Computed a priori | No | No | No | Updates the routing table of all nodes |
| DSR | On – demand, only when needed | Yes, Aggressive use of caching reduce flood | Yes | This technique quickly restores route. | Route errors propagated up to the source to erase invalid path |
| TORA | On – demand, only when needed | Basically one for initial route discovery | Yes, once the DAG is constructed multiple paths are found | Yes | Error is recovered locally |
| WRP | Computed a priori | No | No | No | Updates the routing table of all nodes by exchanging the MRL of all neighbors |

Table 1. Routing Protocols

## 3. PERFORMANCE EVALUATION

### *3.1. Packet Delivery Ratio (PDR)*

Packet Delivery Ratio (PDR) is the proportion to the total amount of packets reached the receiver and the amount of packet sent by source. The amount of malicious node increases, packet delivery ratio decreases. The higher mobility of nodes causes packet delivery ratio to decrease. Packet delivery ratio is the ratio of the number of delivered data packet to the destination which illustrates the level of delivered data to the destination. The ratio of packets that are successfully delivered to a destination compared to the number of packets sent out by the sender [11]. The calculation of packet delivery ratio is based on the received and generated packets as recorded in the trace file. Packet delivery ratio defines the ratio between the received packets by the destination and the generated packets at the source.

$$\text{PDR (\%)} = \frac{\text{Number of packers successfully delivered to destination}}{\text{Number of packets generated by source node}}$$

### *3.2. Throughput Consumption*

Throughput consumption is the amount of the throughput consumed by the sensors for the data transmission over the network. Throughput is the amount of packets that can be routed between two areas within their time – to – live specification in a unit time period. Throughput of a network is measured using various tools available on different platforms. Measuring the throughput in network is concerned about measuring the maximum data throughput in bits per second of a communication link or network access. Response time is the amount of time between a single interactive user requests are entered and received the application response [7]. The application level throughput is the number of useful bits per unit of time forwarded by the network from a certain source address to a destination in which the protocol overhead and data packets are retransmitted. Throughput consumption is dependent on each bit carrying the same amount of information. The communication is mediated by several links with different bit rates and the maximum throughput of the overall link is lower than or equal to the lowest bit rate.

Throughput Consumption = Sum of throughput consumed by each sensor

### *3.3. Overhead*

Overhead is the number of routing packets required for network communication. Overhead node often changes their location within the network where the routes are generated in the routing table which leads to unnecessary routing overhead. Overhead refers to metadata and network routing information sent by an application uses a portion of available bandwidth of a communication protocol. Overhead is the extra data making up the protocol headers and application specific information does not contribute to the content of the message [17]. The percentage of non – application bytes is divided by the total number of bytes in the message. Resources consumed or lost in completing a process that does not contribute directly to the packet. Data bits are added to user transmitted data for carrying routing information and error correcting through operational instruction.

A source creates the limit of # message relays for known regions. Overhead ratio controls the # of message relays with the region and node information. All the nodes are having the handover acknowledgement. Only half of the acknowledgement is contacted to intra region node for current region id [9].The acknowledgement for other region is contacted to the first node which goes for that region where it creates the acknowledgement for newly found region.

Overhead ratio is allocated to the units produced in the period in which the overhead cost is incurred. If the overhead is associated w then the packet is delivered with greater bandwidth. Routing overhead is the number of routing bytes required by the routing protocols to construct and maintain routes. The packet delay is the average end – to – end transmission delay taking into account the only correctly received packets.

Overhead = Number of messages involved in beacon update process

From the trace obtained from the data transmission from source to destination, performance metrics such as throughput consumption, overhead, and packet delivery ratio are obtained using the awk script. Awk script processes the trace file and produces the result. The awk script graph is plotted for performance metrics using x graph tool available in ns-2.

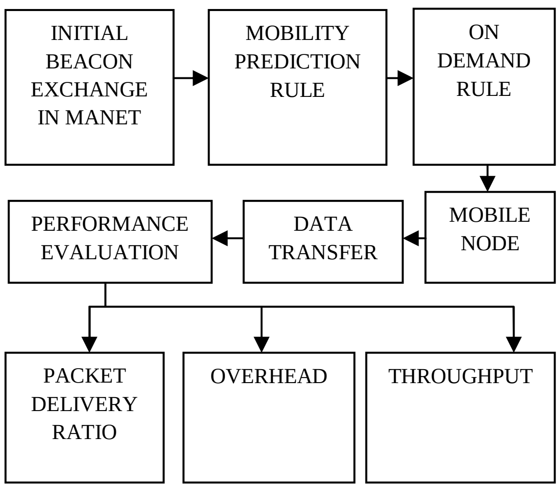


Fig. 2. Structure of Packet delivery ratio, throughput consumption and overhead

## 4. METHODOLOGY

### *4.1. Network Creation*

Network creation creates the network environment for adaptive position update for geographic routing system. Network creation performs adaptive position update technique. In the route node, network creation designs the network node which performs the operations of beaconing information, mobility prediction rule and on - demand learning rule [5]. The Source node perform the operation of triggering router node by sending the data using socket technique by giving the internet protocol address from one node to another node.

### *4.2. Beaconing Information*

Beaconing information triggers the router node so the node initialization process is carried out. Then, the beacon packets are transmitted to all the nodes in the network. Beaconing information checks the nodes distance between previous position and current position. The node distance is greater than acceptable threshold which updates their position to its neighbours through beacon packets.

### *4.3. On – Demand Learning Rule*

On demand learning rule suggests a node broadcasts beacons on-demand which is in response to data forwarding activities that occur in the vicinity of that node. During data transmission whenever a node overhears from a new neighbour, on demand learning rule broadcasts a beacon as a response [18]. A node waits for a small random time interval before responding with the beacon to prevent collisions with other beacons. The location updates are on the data packets and that all nodes operate in the promiscuous mode which allows them to overhear all data packets transmitted in their vicinity [20]. The data packet contains the location of the final destination that overhears a data packet also checks its current location and determines the destination is within its transmission range. The destination node is added to the list of neighbouring nodes which is not already present.

### *4.4. Graph Analysis*

Graph analysis analyzes and evaluates the impact of varying the mobility dynamics and traffic load on the performance of accelerated processing unit by comparing it with periodic beaconing. The simulation results show that accelerated processing unit can adapt to mobility and traffic load well [5]. For each dynamic case, accelerated processing unit generates less similar amount of beacon overhead.

## 5. CONCLUSION

In this paper, state of art technique is not efficient in throughput ratio of a DTN. By comparing all the routing techniques, DTN has formed a route acquisition which quickly restores the route through multipath. Ad hoc On Demand Distance Vector (AODV) technique makes the better shortest path with high reliability inter – landmark by maximizing the throughput where the node to node communication makes stronger and better DTN Network.

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