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NETWORK CONGESTION DETECTION AND PREVENTION USING DEPENDENCY MEASURE IN DTN

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Abstract- Delay Tolerant Network (DTN) supports the concepts of uni-casting and multicasting both but the multicasting approach is better and advanced than the uni-casting approach while group communication needed. The network is dynamic and the sender first creates the bundle of same messages for different destination nodes in network. Multicast senders should be aware of their multicast recipients ahead of time. In ad hoc based delay tolerant (DTN) communication whiles multiple node use bundle-based communication which increases the network congestion so in proposed approach fuzzy logic concept is helpful for detecting the congestion in network. The congestion status information actually shows the status of network. In fuzzy logic approach measures the channel capacity, buffer space and delay and decides the level of congestion i.e. acceptable or not. The status of congestion divided into more than one level or set the different threshold for different level of congestion. When transferring data in a DTN, it is standard practice to utilize a store and forward technique. In addition, a node can store and transfer data from its own buffer, and this data can be sent to other nodes as they become available. A network node can register itself with any receiver group by specifying the destination for the group to which it wishes to be registered. These researches demonstrate that upgrading the group communication mechanism of the ODMRP protocol may significantly improve the routing performance of the protocol. In this technique, the number of participants for group communication in the DTN network is taken into consideration. The proposed NCDP performance is compared to the performance of the CASPeR. The proposed protocol's performance increases the storing and forwarding capabilities of mobile nodes, as well as the capacity to communicate in a bundled manner to many destinations. The simulation results demonstrate that the performance of the proposed multicast routing scheme is assessed using performance measures such as latency, overhead, and throughput, among others.

Keywords: DTN, Fuzzy Logic, Multicasting, Congestion, Routing, ODMRP.

I. INTRODUCTION

Due to the rigorous operation condition and the lack of continuous network connectivity, there is a large spectrum of application which prioritizes eventual message delivery over the message delay. Network serving this kind of application are generalized as Delay Tolerant Network (DTN). Introduced the Delay Tolerant network in [2] which they provide network architecture and an application interface to synchronize forwarding of messages within a partition-based network in which topology changes continuously and provides long delays. It is an infrastructure less wireless network. It also experiences frequent and higher duration partitions due to nodes in DTN are intermittently connected. DTN network provides no guarantee that a path from source to destination will remain same at every time instance by which we can end that two nodes will never exist in a one connected portion of the network [7-8].

As compared to Traditional Internet TCP/IP protocol which is used to set up an end-to-end communication path between source to destination and which assumes low error rates, low propagation delays, the maximum round trip time between any node pair in the network is not excessive and Packet drop probability is small [9]. Unfortunately, this communication standard is not suitable in challenged or opportunistic environment such as underdeveloped region, deep space and interplanetary network in which communications are area under discussion to delays and disruption, such networks generally familiarity from frequent conditional partition and are known as intermittently connected networks (ICNs). Popular examples of such intermittently connected networks (ICNs) scenarios are satellites, deep space probes, Mobile Ad-Hoc Networks (MANETs) typically consisting of nodes (e.g. GPSs, PDAs, Cellular Phones, Tracking devices, Laptops, etc). Delay tolerant networking Research Group (DTNRG) [2] studies the DTN connected standards. While communication the packet transmission might consequence the extreme delays in the delay tolerant network. Also, the

node has extra limitation of restrict buffer and there is no guarantee that a path from source to destination will remain same at every time. The exceeding circumstances construct the difficulty [14] for instance end to end disconnection, long queuing message Times, High latency, small data rate and restricted resources in terms of partial memory.

Store carry and forward conception used to provide the communication among nodes in the delay tolerant network. By this, a node in the network transfer data from one node to another. By this, any node in the network wants to send data it has to accumulate and buffered the data in the form of package [10]. After that it carry the data until it delivers to another node successfully when they are available. For the period of the communication in DTN the reliability is accomplished by using the conception of Custody transfer mechanism. In the recent years researchers have been focused on routing problem of DTN. We have tried to categorize the different routing protocol with its advantage and drawbacks [11-13].

II. RELATED WORK

To minimization the network congestion and resolve the problem of network reliability numerous researches done in the field of DTN.

Michael Stewart, *et. al.* has been proposed [1] CASPaR: Congestion avoidance shortest path routing for delay tolerant networks" CASPaR is a single-copy routing protocol with two primary objectives: (1) identify shortest path routes between source and destination and (2) avoid congested regions of the network. Its ultimate goal is to minimize packet latency and maximize total network buffer space. The CASPaR algorithm attempts to route packets over connected paths by exchanging network information with neighboring nodes in order to determine optimal routes. The algorithm is defined by

A routing-protocol-dependent, proactive congestion avoidance mechanism18 that uses an open-loop congestion control scheme based on buffer availability and historical connectivity data. This allows for alternate route discovery and avoids packet pileup. Congestion avoidance takes precedence over routing forcing a direct-delivery-like mode of operation during times of heavy traffic. Except for their one-hop neighbors, nodes have no knowledge of other nodes in the network.

Shou-Chih Lo, *et. al.* [2] "Quota-Based Multicast Routing in Delay-Tolerant Networks" In this title, we propose a new multicast routing approach which can not only achieve a high delivery rate but also adapt to network conditions. Most importantly, our proposed approach need not maintain group membership. In other words, any interested users can freely join and leave any multicast groups, and this feature suitably fits into DTN environments.

Aruna Balasubramanian, *et. al.* [3], this title present rapid, an intentional DTN routing protocol that can optimize a specific routing metric such as worst-case delivery delay or the fraction of packets that are delivered within a deadline. It evaluate rapid rigorously through a prototype deployed over a vehicular DTN test bed of 40 buses and simulations based on real traces we have proposed a routing protocol for DTNs that intentionally maximizes the performance of a specific routing metric. This protocol, rapid, treats DTN routing as a resource allocation problem, making use of an in-band control channel to propagated metadata.

Savita Lobiyal, *et. al.* [4] "A Delay Tolerant Networks Location Information and Inter-Contact Based Routing Approach" Delay tolerant networks (DTNs) are frequently susceptible to the problem of high delay, as discussed in this title. Quite often, the lack of a complete path from source to destination is the primary cause of network latency. One of the most difficult challenges DTN faces is enabling end-to-end communication in a heterogeneous environment with severe performance issues. The DTN routing problem is a constrained optimization problem in which edges may be unavailable for long periods of time and each node has storage constraints. By reducing several overheads, the proposed protocol aims to reduce the amount of energy required for communication. It calculates the probability of delivery via each of its neighbours and sends out copies of the message accordingly.

Seung Deok Han and Yun Won Chung [5] "In a Delay Tolerant Network, An Improved PRoPHET Routing Protocol" If the forwarding counter and hop counter values are smaller than or equal to the threshold values, we can improve the PRoPHET (probability routing protocol using history of encounters and transitivity) protocol's dissemination speed by using epidemic protocol for disseminating message m. The proposed protocol's performance was evaluated in terms of delivery probability, average delay, and overhead ratio. By appropriately selecting the threshold forwarding counter and threshold hop counter values, numerical results show that the proposed protocol can improve the delivery probability, average delay, and overhead ratio of the PRoPHET Protocol.

Chenqian Zhou, *et.al.* [6]. "An Optimized Probabilistic Delay Tolerant Network (DTN) Routing Protocol Based on

Scheduling Mechanism for Internet of Things (IoT)" We propose the Scheduling-Probabilistic Routing Protocol using History of Encounters and Transitivity as a new routing protocol (PROPHET). We compute the delivery predictability in this protocol based on node encountering frequency. Two scheduling methods are suggested to enhance performance in both storage and transmission in DTN by extending the conventional PROPHET protocol. We use an Opportunistic Network Environment (ONE) simulator to simulate the proposed routing protocol and compare it to existing routing protocols.

III. PROPOSED RESEARCH WORK

Delay tolerant network is a kind of network where delay is important factor for real time data delivery. DTN deploy in remote area or military services where crucial data retrieve in real time, in the DTN network node are semi-ad-hoc nature which means some node are movable (dynamic) and some are static which treated as router to send the data to the destination node. In DTN network congestion comes due to many reasons such factors are low bandwidth, low power, light weight processor in device, limited queue, shared resources. In the proposed approach we detect and prevent the network congestion using the fuzzy logic rule-based system. In fuzzy logic system take the input data from network and send to fuzzification system which classify data based on define rules after that inference are retrieve and defuzzification done at the end conclude the outcome. In the proposed NCDP mechanism three input data are measured such are channel utilization, buffer utilization and delay. Initially all the data filter based on their nature and quantify in between range [0 to 1] which pass to respective module and separate into the three classes low, medium and high. In the table 1 contain the rules for inference identification.

Table 1: Fuzzy Rule for Inference Identification

Rules	Channel Utilization	Buffer Utilization	Delay	Level
Rule1	MEDIUM	HIGH	LOW	Good
Rule2	HIGH	MEDIUM	LOW	Good
Rule3	MEDIUM	HIGH	MEDIUM	Good
Rule4	MEDIUM	LOW	LOW	Perfect
Rule5	HIGH	HIGH	LOW	Acceptable
Rule6	HIGH	HIGH	HIGH	Not Acceptable
Rule7	LOW	MEDIUM	LOW	Perfect
Rule8	LOW	HIGH	HIGH	Not Acceptable

With the help of rule detect the congestion of the network, as per define rule while channel utilization Medium, buffer utilization Low and Delay is Low which is prefect and congestion free network. Other rest of rules is not acceptable, acceptable or good condition which need to modification of algorithm for congestion minimization. In proposed NCDP method, we modify the routing protocol based on congestion status identification. In the NCDP approach during the route discovery process aware the channel capacity, size of queue and their current utilization, expected delay. The route packet comes into the destination node which create separate route table for each path and select out of all path based on higher channel available, higher buffer space and low delay. With the selected path, source are transmit the data to destination node, but the time of data transmission network in congestion mode (real time communication) than intermediate (congested) router send the control message to source node to minimizing the data rate and also intermediate router dynamically increases the buffer size to store incoming packet which minimize the data drop and increase reliability.

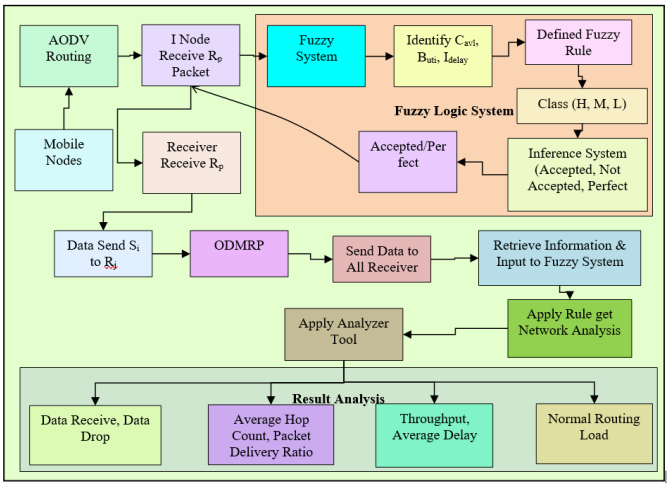

Figure 1: Proposed Network Congestion Detection and Prevention (NCDP)

Proposed NCDP mechanism adopt in DTN communication where delay is measure factor for real time data communication. In the NCDP approach we achieve better reliability in the terms of delay, packet delivery ratio, throughput and low overhead. The proposed NCDP method simulate with the help of network simulator-2 and analyze the impact based on fuzzy ruled mechanism and detect as well as prevent the network from the congestion. In the next section describe research design which is interface with the network simulator-2.

IV. PROPOSED NETWORK CONGESTION DETECTION AND

PREVENTION (NCDP) ARCHITECTURE

In the proposed network congestion detection and prevention (NCDP) architecture deploy in figure 1 that shows interface between different modules and their interface to resolve the problem of congestion and recover from that, the proposed system implement and simulate by network simulator-2 and analyze network impact.

V. SIMULATION PARAMETER

Based on the simulation settings listed in Table 2, both routing methods are simulated using the same set of variables. Based on the current CASPeR and NCDP communication schemes, as well as the proposed bundle-based multicast communication strategy, a simulation of a DTN network using the same parameters for both the protocols.

Table 2: Simulation Parameter

Network	Considered Parameters
Simulation Environment	1000m*1000m
Types of Antenna	Omni-Direction
Propagation Type	Free Space, Two Way Ground
No. of Nodes	Hundred
Energy Model	Initial 50 Joule
Network Protocol	AODV, ODMRP
Transport Layer	TCP, UDP
Transport Layer	TCP, UDP
Application Data	CBR
Message length	1024bit
Queue Size	25,50, 75, 100 MB
Mobility	Random
Random Waypoint parameters	Node speed= 0.5 m/s
Simulation Time	100 Seconds

VI. SIMULATION RESULTS

The simulation results demonstrate the performance of CASPe, and the NCDP suggested bundle-based multicast routing in a DTN network, as well as differences performance. The suggested NCDP approach improves sending and receiving of data by preserving accurate channel information throughout transmission.

A. Data Receive Vs Buffer Size [MB]

The packets received are assessed at the network layer in the network for the purpose of establishing a connection in the network. The suggested NCDP protocol is showing better communication, since the number of successful data deliveries received in the DTN network is at its highest level. This graph depicts the data reception analysis in the case of the proposed NCDP routing scheme, and CASPeR in different node density scenarios. There are maximum 5499 packets are received in the network that indicating that the protocol's performance is superior in a dynamic network. The analysis in tabular form also mentioned in table 3.

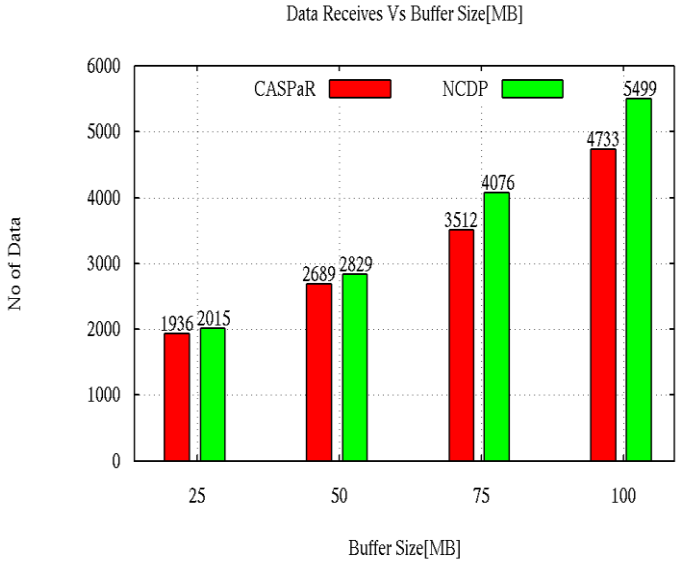

Figure 2: Data Receiving Analysis

Table 3: Receiving Analysis

Buffer Size [MB]	CASPaR	NCDP
25	1936	2015
50	2689	2829
75	3512	4076
100	4733	5499

B. Data Drop Vs Buffer Size [MB]

Number of packets lost in a network owing to a variety of factors such as collisions, congestion etc.

Table 4 shows the results of the packet dropping analysis of CASPeR and proposed NCDP. The NCDP reduces link breaking due congestion, which reduces needless delay, but the suggested scheme reduces the load on paths of network. In addition to improving network performance by reducing

inference from other nodes, the NCDP routing also reduces the chance of data loss by ensuring that nodes have sufficient processing ability. The analysis in tabular form mentioned in figure 3.

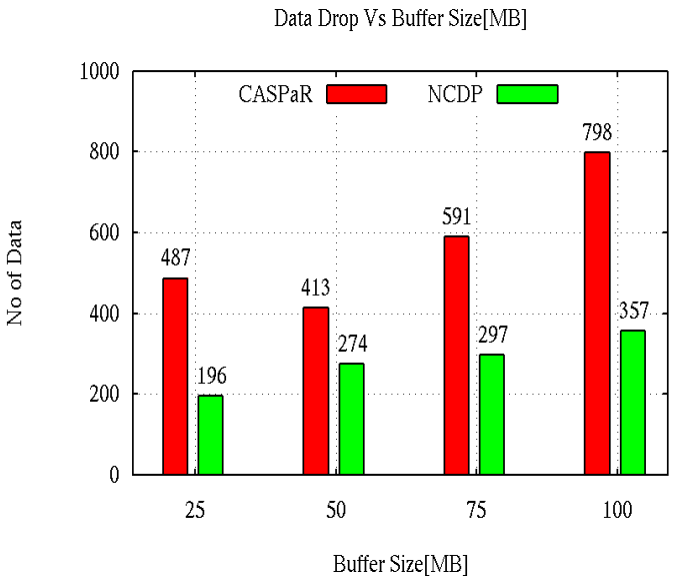

Figure 3: Data Drop Analysis

Table 4: Drop Analysis

Buffer Size [MB]	CASPaR	NCDP
25	487	196
50	413	274
75	591	297
100	798	357

C. Average Hop Count Vs Buffer Size [MB]

The DTN supports multicast routing approach for forwarding data bundles of messages. The dynamic nature of DTN also enhances the chances of congestion in network. If the information transferred from minimum hops it means less delay possibility in network but the chances of load increase on a particular link is more. As a result of this aspect, the NCDP approach, as for reduces the bandwidth consumption by applying fuzzy logic based approach. NCDP approach enhances the routing performance and reduces the loss of packets. The analysis also mentioned in a tabular form.

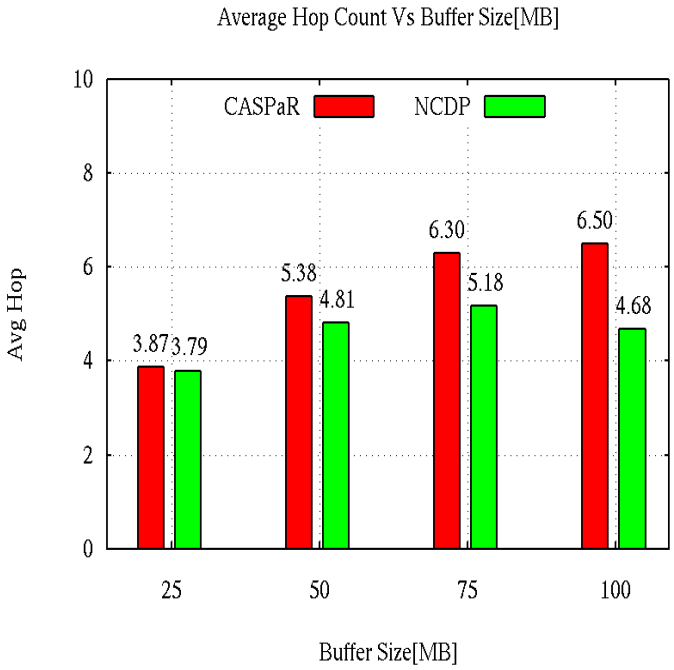

Figure 4: Hop Count Analysis

Table 5: Hop Count Analysis

Buffer Size [MB]	CASPaR	NCDP
25	3.87	3.79
50	5.38	4.81
75	6.3	5.18
100	6.5	4.68

VII. CONCLUSION

The bundle of messages of different destinations is successful delivered under the Delay Tolerant Network. In this network, the single sender sends the data to multiple receives or different groups. Multicasting is a method of sending multiple copies of data to many recipients within the same multicast group by utilizing the underlying uni-cast routing capabilities of a network. The broadcast method distributes the copies of messages over the whole network, whereas DTN transfer the data to a selected receiver, receivers and groups. When nodes exchange global or local routing information with one another, multicast routing path information is gained, resulting in an increase in network control traffic. The multicast approach also suffers from the problem of congestion but the proposed solution is capable to resolve it. It is possible to decrease the control overhead problem in a multicast DTN network by correctly managing the communication. Specifically, the proposed NCDP multicast routing protocol improved the routing method for dealing

with communication inside a certain group/s in the DTN network. In this approach, the suggested protocol performance outperforms the CASPeR multicast protocols of the DTN, yielding significantly superior results overall.

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