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Enhanced Multicast routing for QoS in delay tolerant networks

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Abstract— *The Delay Tolerant Network is the network that establishes connection in network in dynamic environment and bundle of messages are sending by sender to more than one destination. A store and forward mechanism is commonly used to transfer data in a DTN. Nodes in network are decentralized and continuously move in limited area. Every node can store and carry data in its own buffer, and forward this data to other nearby nodes when they are available or in radio range. In this type of network intermediate nodes are playing the important role in communication. DTN routing should naturally support unicast and multicast routing strategies but in this research we actually focus on multicast routing performance. A network node can register itself to any receiver group by setting the corresponding destination. In this research we proposed the novel approach of multicast routing with MAODV protocol and compare this performance with QBMR (Quality Based Multicasting Routing) and DTN-DM (DTN-Delegation Multicasting) protocol. The QBMR and DTN-DM are also uses the multicast method for communication but the proposed MAODV is better. The performance of proposed protocol is improves the storing and forwarding capability of mobile nodes and as well improves the bundle message communication for multiple destination. In this research, performance of proposed protocol with other two existing is measure through performance metrics like throughput, routing load and PDF.*

Keywords: *DTN-DM, QBMT, MAODV, Multicasting, Routing, Performance.*

1.INTRODUCTION

Due to the rigorous operation condition and therefore the lack of continuous network property, there's an oversized spectrum of application that prioritizes ultimate message delivery over the message delay. Network serving these kind of application are generalized as Delay Tolerant Network (DTN).Introduced the Delay Tolerant network in [1] that they supply specification associated an application interface to synchronize forwarding of messages among a partition based mostly network within which topology changes endlessly and provides long delays. it's associate infrastructure less wireless network. It conjointly experiences frequent and better length partitions owing to nodes in DTN are measure intermittently connected. DTN network provides no guarantee that a path from supply to destination can stay same at when instance by that we are able to finish that two nodes will ne'er exist during a one connected portion of the network.

As compared to ancient web TCP/IP protocol that is employed to line up associate finish to finish communication path between supply to destination and that assumes low error rates, low propagation delays, the most trip time between any node try within the network isn't excessive and Packet drop likelihood is little. Unfortunately, this communication commonplace isn't appropriate in challenged or timeserving surroundings like underdeveloped region, part and heavenly body network within which communications are measure space below discussion to delays and disruption, such networks typically familiarity from frequent conditional partition and are measure referred to as intermittently connected networks (ICNs). well-liked samples of such intermittently connected networks (ICNs) situations are measure satellites, part probes, Mobile Ad-Hoc Networks (MANETs) usually consisting of nodes (e.g. GPSs, PDAs, Cellular Phones, pursuit devices, Laptops, etc). Delay tolerant networking analysis cluster (DTNRG) [2] studies the DTN connected standards. Whereas communication the packet transmission would possibly consequence the intense delays within the delay tolerant network. Conjointly the node has further limitation of prohibit buffer and there's no guarantee that a path from supply to destination can stay same at when. The surpassing circumstances construct the problem [3] for example finish to finish disconnection, Long queuing message Times, High latency, tiny rate and restricted resources in terms of partial memory.

Store carry and forward conception accustomed provides the communication among nodes within the delay tolerant network. By this, a node within the network transfer information from one node to a

different. By this, any node within the network needs to send information it's to accumulate and buffered the info within the sort of package. After that it carry the data until it deliver to other 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.

1.Literature Survey

The section describe about previous related work under the field of delay tolerant network, various security issues and prevention in MANET.

Shou-Chih Lo · Nai-Wun Luo · Jhih-Siao Gao · Chih-Cheng Tseng [1]"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.

Samuel C. Nelson, Mehedi Bakht, and Robin Kravets[4], proposed Encounter-Based Routing (EBR), to maximize delivery ratios while minimizing overhead and delay. EBR only considers the current rate of encounters and averages this rate using an exponentially weighted average to account for both older and newer data. EBR achieves up to a 40% improvement in message delivery over the current state-of-the-art, as well as achieving up to a 145% increase in good put.

Xiang FaGuo,MunChoonChan[5], present an efficient routing algorithm, Plankton, for Delay/Disruptive Tolerant Network (DTN).Plankton utilizes replica control to reduce overhead and contact probability estimates to improve performance. Plankton's evaluation shows that substantial overhead reduction can be achieved without loss in delivery ratios and latencies. Our work provides a technique that integrates highly reliable contact predictions and replica controls.

SaeidIranmanesh, RaadRaad, Kwan-Wu Chin [6], presents an algorithm to achieve high delivery ratio of packets/bundles at the lowest possible bandwidth cost, buffer space and energy. There is need of protocol which uses less resource to achieve high delivery ratio and low latency is an open . This title proposes a quota-based protocol which confines the number of replicas and forwards them based on the meeting history of nodes.

Mohammad,Boudguig,bdelmounaimAbdali[7], this title present a new algorithm based on the predictability concept since it introduces better resources management in terms of bandwidth, messages delivery compared to other routing algorithms for DTN. It is prove by large-scale simulations, the effectiveness of our algorithm in terms of eventually delivered messages, failed transmissions, dropped messages between nodes, buffer time and hop count enhancement. Title focused on the improvement of the prophet routing protocol through a new approach by implementing the predictability improved factor. Its approach has proved a clear improvement of the predictability concept.

Mohammad,Rahmatullah,Dr.PriyankaTripathi[8], this title have proposed a new buffer management policy based on message forwarding and message replication on the network. It introduced two utility functions. These functions are to find which message will be dropped when buffer overflow occurs. is a special protocol named Bundle Protocol (BP) that is not in TCP/IP. Bundle protocol (BP) provides store-carry forward mechanism that means when node is not in then message is hold by the node and when node comes in range then message will be forwarded. This policy utilize the properties of each message such as number of replicas of particular message , remaining time-to-live and the age to calculate the utility value of each message. With this utility value node decides which message is to be deleted from buffer whenever the buffer overflows.

***Pan Hui, Jon Crowcroft, EikoYoneki[9*]**, this title seek to improve our understanding of human mobility in terms of social structures, and to use these structures in the design of forwarding algorithms for Pocket Switched Networks(PSNs).It propose a social based forwarding algorithm, BUBBLE, which is shown empirically to improve the forwarding efficiency significantly compared to oblivious forwarding schemes and to PROPHET algorithm. It also show how this algorithm can be implemented in a distributed way, which demonstrates that it is applicable in the decentralised environment of PSNs

Vasco N.G.J. Soares, Joel J.P.C. Rodrigues, FaridFarahmand[10], purposed Vehicular delay-tolerant network (VDTN) which assumes asynchronous, bundle-oriented communication, and a store-carry-and-forward routing paradigm It proposes a VDTN routing protocol, called , which takes routing decisions based on geographical location data, and combines a hybrid approach between multiple-copy and single copy schemes.

Y. Xi, M. Chuah[11], this title explore an encounter-based multicast routing (EBMR) scheme for DTNs. Scheme uses fewer hops for message delivery. It present an analytical framework for estimating the delivery performance of the EBMR scheme, and present some analytical and simulation results to show that the EBMR scheme can achieve higher delivery ratio while maintaining high data transmission efficiency compared to other multicast strategies. It has presented an encounter-based multicast routing scheme for

DTNs. EBMR scheme allows nodes to cache the data until a good next-hop node can be found to relay the messages destinations. EBMR scheme takes fewer number of hops to delivery multicast packets. It demonstrated that this scheme can achieve high delivery ratio with reasonable data efficiency.

Eyuphan Bulut and Boleslaw K. Szymanski [12], this title considers DTNs in which malicious nodes are present, to which we refer to as compromised DTNs. It discusses and analyse the effects of presence of malicious nodes in the compromised DTN on routing of messages. It propose a two period routing approach which aims to achieve desired delivery ratio by a given delivery deadline in presence of malicious nodes. Results show that, with proper parameter setting, the desired delivery ratio by a given delivery deadline can be achieved most of the time by the proposed method. It focused on the problem of routing in compromised delay tolerant networks in presence of malicious nodes. Assuming that, with certain probability, the nodes in the network are open to coalition with these malicious nodes, it discussed and analyzed several message distribution schemes in terms of secure delivery of messages.

Long Vu, Quang Do, KlaraNahrstedt[13], this title present 3R routing protocol, which leverages the regularity of fine-grained encounter pattern among mobile nodes to maximize message delivery probability while preserving message delivery deadline. It evaluates and compares 3R with Prophet and Epidemic routing protocols over the collected trace. Evaluation results show that3R outperforms other alternatives considerably by improving message delivery while reducing message overhead. It shows that the fine-grained encounter pattern of people is regular. 3R exploits the regularity of fine-grained encounter pattern and provides a totally distributed routing solution to expedite message routing in Delay Tolerant Networks.

Sapna Grover, Aditya Pancholi, SonikaArora [14], this title uses ferry-based mechanism for providing security and maintaining consistency throughout the network. Security issues have thus become more challenging in these networks due to its dynamic nature. Thus these networks are vulnerable to different kinds of attacks because of which security has always been a major concern. This title presented a ferry-based secure algorithm for routing in DTNs. The algorithm effectively finds the shortest available path to the destination with the help of a centralized mechanism. The algorithm also provides security against malicious node in the network with the help of certain certified ferry nodes.

Daru Pan, Mu Lin, Liangjie Chen and JiapingSun [15], this title proposes the Spray and Wait with Probability Choice (SWPC) routing, where continuous encounter time is used to describe the encounter opportunity; a delivery probability function is set up to direct the different number of copies to the destination during the spray phase; and a forwarding scheme is implemented in the wait phase. In this title, it proposes the Spray and Wait routing with Probability Choice (SWPC) for opportunistic networks. In SWPC, encounter time is used to describe the encounter opportunity, a delivery probability function is set up to direct the different number of copies to the destination during the spray phase; and the last one copy is directly delivered to the node with higher delivery probability to destination in the wait phase.

Ahmed Elwhishi, pin Han Ho , K. NaiK, and Basem Shihaday [16], this title introduces a novel multi-copy routing protocol, called Self Adaptive Utility-based Routing Protocol(SAURP), for Delay Tolerant Networks (DTNs) that are possibly composed of a vast number of miniature devices smart phones, hand-held devices, and sensors mounted in fixed or mobile objects. SAURP aims to explore the possibility of taking mobile nodes as message carriers in order for end-to-end delivery of the messages. The best carrier for a message is determined by the prediction result using a novel contact model, where the network status, including wireless link condition and nodal buffer availability, are jointly considered. The title argues and proves that the nodal movement and the predicted collocation with the message recipient can serve as meaningful information to achieve an intelligent message forwarding decision at each node. The title introduced a novel multi-copy routing scheme called SAUPR, for intermittently connected mobile networks.

John Burgess Brian Gallagher David Jensen Brian Neil Levine [17], this title proposes MaxProp, a protocol for effective routing of DTN messages. MaxProp is based on prioritizing both the schedule of packets transmitted to other peers and the schedule of packets to be dropped. These priorities are based on the path likelihoods to peers according to historical data and also on several complementary mechanisms, including acknowledgments, a head-start for new packets, and lists of previous intermediaries. It has proposed MaxProp as an effective protocol for DTN routing, particularly for the context of our real DTN deployment. MaxProp unifies the problem of scheduling packets for transmission to other peers and determining which packets should be deleted when buffers are low on space. Additionally, it has identified several complementary mechanisms for improving the performance of path-likelihood based routing.

Aruna Balasubramanian, Brian Neil Levine and ArunVenkataramani [18], 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.

1.Problem Statement

Delay Tolerant Network (DTN) is a wireless network that design to handle the technical problems in heterogeneous network (MANET) that will lack continuous network property. In multicasting the group communication is possible but this communication is possible not efficient for proper data delivery in network. The packet dropping and delay in network is enhancing, if the communication in network is affected. The more packet dropping also enhance the unnecessary delay in network. In DTN the multicasting approach is done multicasting. Because of dynamical changing topology, this research aim to enhanced the performance of multicast routing in DT-MANET(Delay tolerant mobile Ad-hoc network) using collision removal and node capacity base data sending mechanism without membership maintenance under delay tolerant MANET.

1.Proposed Work

In dynamic network the possibility of packet dropping is more due to that routing overhead in network is enhance and also the packet receiving is affected in network. The DTN is support both unicasting and multicasting. In DTN the sender is sending bundle of messages and these messages are better for deliver to multiple destinations. As compare to unicasting the DTN is provides better result in multicasting.

In this work we proposed the enhanced performance then existing QBMR (Quota-Based Multicast Routing) mechanism under MANET. Before that our proposal, number of various multicast routing are simulated under MANET, but some issue are not consider i.e. channel utilization minimization, collision resolution and drop minimization under multicasting etc. they only focus the member node handling and group leader selection mechanism. So our work includes the performance measurement parameter and its quality increasing method using node capacity identification as well as channel measurement base (ideal, busy) between communicator nodes and utilized the effectively network bandwidth from the network.

In this proposal we apply routing protocol of MAODV (multicast ad-hoc on demand distance vector routing) that helps the creation of group and group management function i.e. group joining, leaving related issues. Meanwhile that protocol work under the DTN (delay tolerant network) is a special type of network and subject to delay and disruption. DTN faces the number of challenges that is high latency, low data rate, frequent disconnection etc. so our proposed approach focus to minimization the problem of DTN using channel awareness and node mobility as well as capacity aware based technique. initially where any sender want to communicate any group member node or whole group member than the MAODV helps to provide better route between sender to all group member in efficient path with ideal channel because we modify the working of MAODV through integration of path information and channel awareness function. Than the group coordinator responsible to maintain the route based on channel capacity as well as intermediate node capacity. MAODV also suggest the minimum delay based route from source to destiny nodes. In our approach our group coordinator not only manage the group member (join, leave info) is also take decision about better and efficient route with minimum delay. DTN created the bundle and send data to the particular destination, that work also strengthen the group communication because its gives the maximum channel utilization through bundle based technique, because while any source node want to send data to group member than source create the bundle and inbuilt the group member identification number and common data send to all member (if common data needed to all), its increase the channel utilization of the network. Through our proposed approach we increases the network performance based on packet delivery ratio, throughput and minimized network offered load i.e. routing overhead.

In this section we proposed a prototype formal algorithm, which helps to design our proposed techniques in efficient way, in this algorithm very first we initialize the network parameter and then execute the group election message and identifies the coordinator node, while coordinator node are decided then send data packet based on DTN bundle creation message. Proposed algorithm gives the route information based on node capacity and channel capacity based mechanism and increases the network channel utilization as well as delay minimization of overall network.

Group communication and election algorithm

Step 1: No. of Mobile Node = NM

Step 2: Select random node RN ϵ NM for election message generation

Step3: Calculate $Speed_i = D/(t_2-t_1)$// t_1 initial time , t_2 Broadcast Time, D distance travel

Step 4: Broadcast-Elect-msg(ci, MNi, speedi)// **c_i node capacity of i^{th} node, $speed_i$ is speed of i^{th} node**

{

If (radio-range<=500 && neighbour == Available)

{

Record time at tn; // **tn time in second's**

Get neighbour Mi-1, Mi-1, Mi+1, Mi+2

Get info NM (j)(cj)(sj)(Chi)// **j pointer not equal I, j node number , c_j capacity, s_i speed of node**

Compare if (M(ci) < M(cj) && M(si)> M(sj) && M(Chj) is ideal)

{

NMi eliminate from competition

Set new NM i = NMj ;

New NMi generate election message for selection;

Goto step 4:

}

Else

{

NMi as a coordinator;

} }

// While Group Form than DTN based data sends to group members

//Manage and broadcast group message through coordinator under DTN-MANET

Mobile node = NM; // Total number of mobile node

Group coordinator = NMi ; // NMi € NM, NMi select on the bases of capacity and speed

Send group_join_msg (mn , NMi, GNo.) // group join message

{

if (Rr <=550 && NMi == "true")

{Join group member = {m1, m2…..mn} // mn € NMi, if mn is in radio zone}

Else

{

Out of range

}

Set sender node = T;

Set routing = MAODV; //Multicast Routing Protocol

Broadcast _RREQ(T, NMi, Rr)

{

if (Rr<= 550 && neighbour>=1)

{

forward RREQ and create Rtable with the help of coordinator node

If (NMi ==”true”)

{

accept route packet and send group info

}

Sender sends actual data to Mi nodes through bundle creation;

Call group-msg(T,mn, type);

}

}

Else {

Node out of range or unreachable;

}

Group-msg (T,mn,type) // type contain packet info

{

Search mn nodes in Radio range;

Broadcast actual data to all group member mn with bundle creation;

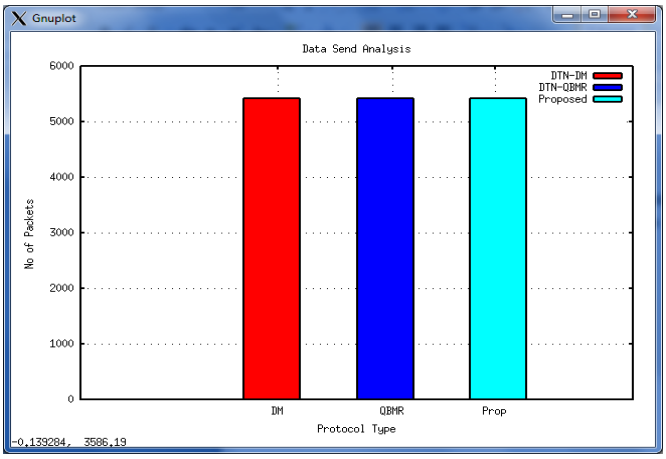
}

Performance of the proposed Scheme varies according to the variation in the network parameters, as we know that in ad-hoc network properties continuously vary. The mobility of the node of the network is high then the limited battery power i.e. energy of the node is our prime concern. So, we proposed a new routing scheme in such a way that performs best for that particular type of network.

1. RESULT

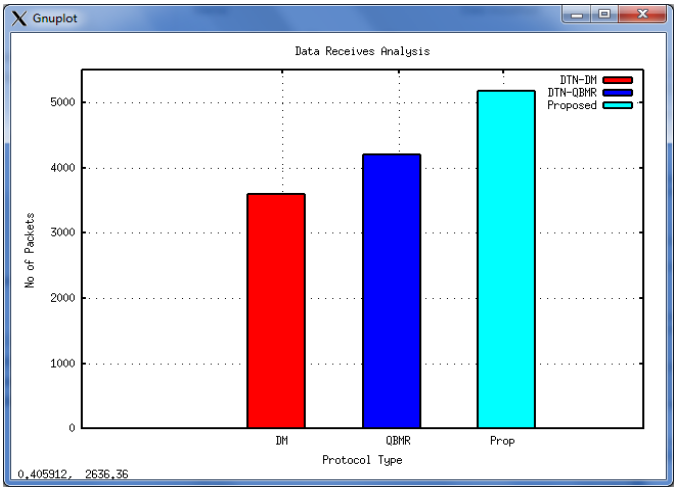
5.1. Data Send Performance

The number of data packets send by sender is calculated in given three scenarios. In these three scenarios the performance of individual protocol is measured and identified that the sending of packets in DTN is almost equal. In this scenario the first one is normal DTN routing (DTN-DM), second one is Quota-Based Multicast Routing (QBMRP) and proposed MAODV routing technique in DTN. In this graph the packet sending is all three protocols are equal and their performance is based on packets receiving.



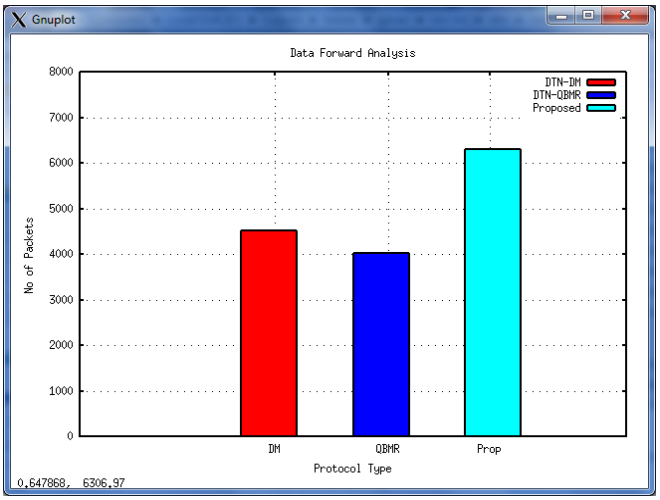
5.2. Data Receiving Analysis

The data sending by senders to destination in DTN is the bundle of messages. The proper data packets receiving in network are improves network and routing performance. The DM and QBMR protocol communication is not reliable because maximum 3800 and 4200 packets are received in network up to end of simulation time. The data receiving of proposed multicast routing is about more than 5000 packets. The receiving of successful data delivery is minimum in DTN network. This graph represents the packets receiving analysis in of DM, QBMR and MAODV multicast routing scheme and here we clearly notice that the performance of proposed multicast protocol is better for dynamic network.



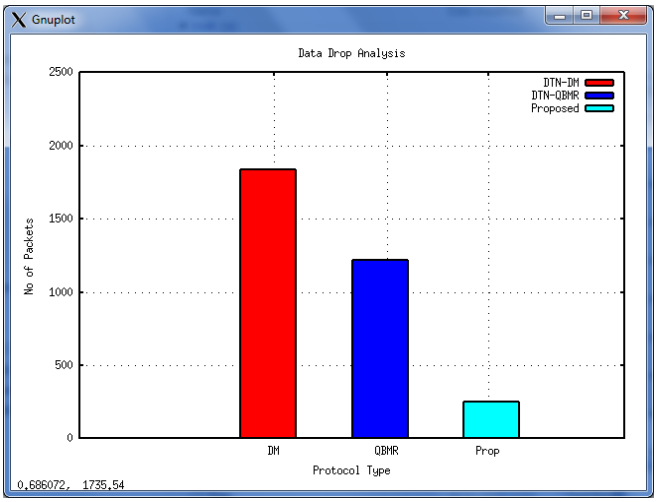
5.3. Data Forwarding Analysis

The senders are sends data in network and receiver are receive the data in dynamic multicast routing network. In multicasting the sender is sending data to multiple destinations and these destinations is not directly connected to sender. The intermediate nodes are collect data from sender and forwarded to destination or next intermediate nodes that are able to forward to destination. In this graph we compare the performance of three multicast routing but the data forwarding is proper in proposed multicasting routing in dynamic network. In proposed routing about more than 6000 packets are forwarded in network and rest of them two performance is not more than 4500 packets.



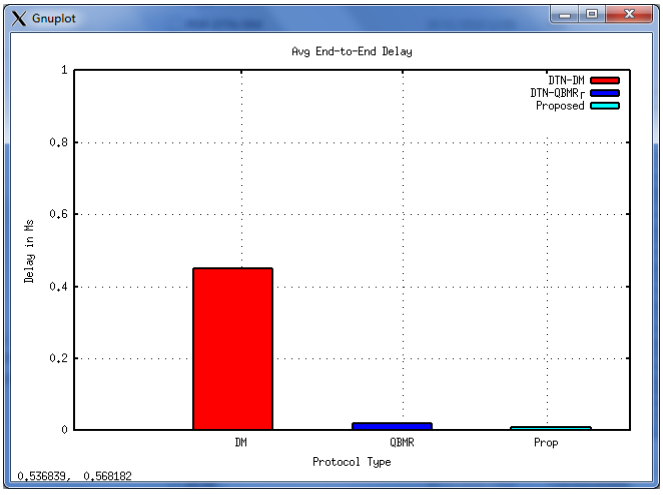
5.4. Data Drop Analysis

The proper data receiving in network is improves the routing and network performance in DTN. The lesser amount of packet receiving is shows the degradation in performance of network. If packets receiving is minimizes in network that means packet dropping in network is increasing. In this graph the packet dropping performance of three protocols are calculated and examine that the performance of proposed protocol is better because in this protocol the packet dropping is minimum. The highest packet dropping is examine in normal DTN network, it is about 1800 packets and minimum is about 200 is examine in proposed MAODV routing.



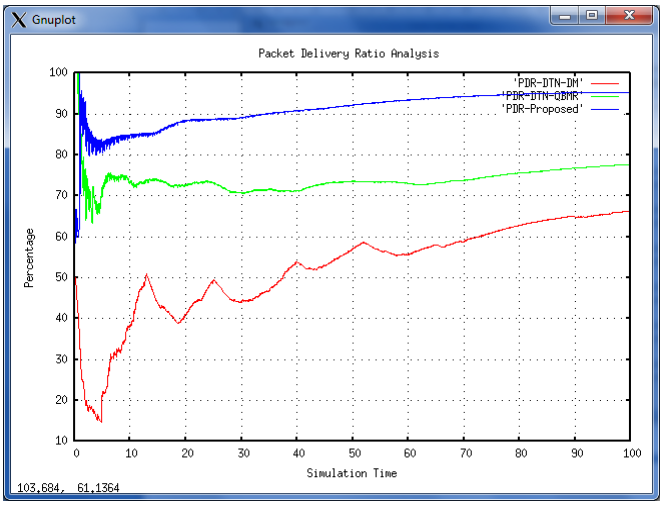
5.5. Average End to End Delay Analysis

The heavy dropping in network is also maximizes the delay in network because due to dropping of data packets senders are retransmit the data in network. The packet dropping in DTN is more that's why the delay in network is also more. In this graph the end to end delay analysis of DTN-DM, QBMR and proposed MAODV is compare and examine, the delay count in proposed scheme is minimum that is the sign of better performance. The maximum delay count is in DTN and after that count in QBMR multicast routing in group communication.



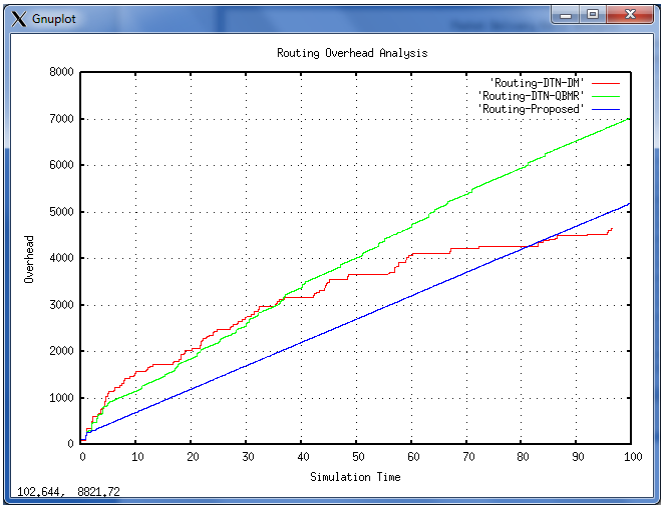
5.6. PDR Performance Analysis

The PDR (Packet Delivery Ratio) is calculated the percentage ratio of data receiving in network. In multicast communication single sender is bale to send the data to multiple destinations and these destinations position in dynamic network is continuously changes. In this graph the PDR analysis of DTN-DM, QMRP and proposed MAODV is calculated up to simulation time of 100 seconds. In DTN network the delay is overcome i.e. mainly occur due to mobility of mobile nodes. In this graph the PDR performance of proposed MAODV protocol for DTN network is enhanced and provides higher packets percentage about 95% successful data receiving but in case of QBMR it is 78% and DM is only 66%.



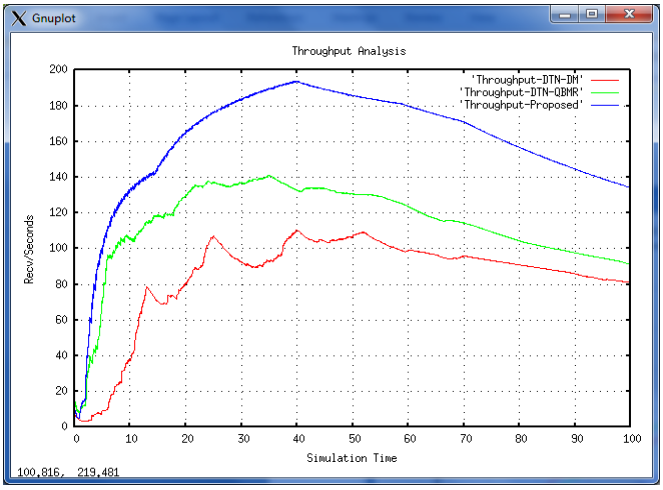
5.7. Routing Load Analysis

In multicast routing the sender is flooding the routing packets to finding the multiple destination in dynamic network. In DTN the bundle of messages are send by sender in network. In this graph the routing performance of normal multicasting DM, QMBR and proposed MAODV is evaluated and identified that the routing overhead in proposed is almost less than other protocols. Once the request reaches to the destination through intermediate nodes the response phase is entered and establishes the path. The number of routing packets in DTN network in proposed MAODV protocol is about 5000 up to end of simulation but in case of DM and QBMR it is much higher i.e. about 7000 and 4800 in network. The DM performance is slightly down up to end but it is not sure it maintain this value up to long time.



5.8. Throughput Performance Analysis

The number of packets sending and receiving is counted in network in per unit of time. This per unit of time calculation is called throughput. This throughput performance is measured in seconds in this research. The proposed MAODV protocol group communication is based on specific bundle based communication between the sender and receiver. The throughput performance of proposed MAODV is much better in DTN and QBMR network. Here the throughput is about 195 packs/seconds maximum and 138 minimum rest of the protocol performance of DM and QBMR is very less. The proposed scheme improves the multicast routing performance in DTN.



2.Conclusion

The multicast routing is used for group communication and multicasting is is provides the better results in group communication. The routing in DTN can be designed using different approaches like unicasting, broadcasting, and multicasting. These routing approaches are also further classified but routing strategy is same. That means multicast is classify in tree based and mesh based but do group communication. In multicast sender sends each copy of a multicast message to multiple receivers in the same multicast group. The control overhead problem in multicast DTN network is reduces by handling the communication properly but it is very difficult to send the data to multiple destinations in dynamic network. The proposed MAODV multicast routing protocol enhanced routing mechanism for handling the communication in a particular group in DTN network. In this technique the proposed protocol performance is provides the better results as compare to TDM-DM and QBRM multicast protocols. The bundle of messages is forwarded in network through intermediate node and each node is continuously moves in network with different speed. The proposed multicast scheme is provides the reduction in end to end delay, routing overhead and improves the throughput, PDR and packets receiving in network. The packet dropping in network is minimizes as compare to existing two approaches and because of that the end to end delay and routing overhead is also minimizes. The proposed approach is provides the better results in dynamic decentralized network.

In future we proposed the energy efficient cluster based multicast approach in which the low mobility node is selected the cluster head and rest of the nodes are the cluster members and perform routing on the basis of maximum remaining energy of mobile nodes. In this scheme we improve the performance by reduce energy consumption of MAODV and also calculate the life time of network on the basis of remaining energy of nodes in network.

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