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Network Routing Without Delay Using Message Scheduling

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ABSTRACT— Multi-copy routing method have considered the most applicable way to deliver the message in Delay Tolerant Networks. They allow multiple message copies to be sent in order to increase the message delivery ratio or reduce its delay. The efficient message scheduling method to determine which messages should be dropped and which should be forwarded if buffer is full. In this paper examine a novel message scheduling framework for two-hop forwarding and epidemic routing in delay tolerant networks , such that node can take the dropping and forwarding decision during each contact for either optimal message delivery ratio or message delivery delay. The proposed scheduling framework can achieve superb performance against its counterparts in terms of delivery delay.

KEYWORDS: DTN, Epidemic And Two-Hop Forwarding Routing, Message Scheduling.

I. INTRODUCTION

Delay Tolerant Networks (DTN), are characterized by the lack of continuous end-to-end connections, and the limitedness of power sources and data storage space. This type of networks has found its applications in many challenging environments such as providing delay-tolerant Internet services to suburban and rural areas and vehicles. In addition, DTN have its promising applications in monitoring and tracking wildlife and whales in oceans , environmental monitoring such as lake water quality monitoring , and many others. Traditional routing protocols for wired and wireless networks failed to work in this environment because the assumed the existence of continuous end-to-end connection between sources and destinations.

In multiple-copy routing, earlier work has proposed using motor buses as auxiliary network nodes to form a DTN with heterogeneous node types. These nodes move in a faster speed which gives them the superior message relaying capability to improve delivery delay. However, the superior relaying capability also requires higher operating cost for node motorization. This kind of superior nodes is referred as *super nodes*. They are commonly constituted as a subset of relay nodes in DTNs with heterogeneous node types. Adopting higher cost super nodes in a DTN introduces a novel way to improve delivery delay. A super node can be a motor bus which needs higher energy than a pedestrian for its physical movement. However, its higher mobility makes it a superior node that can better improve the delivery delay.

A mathematical formulation of optimal routing is developed, assuming the availability of present and future nodes contact and buffer information. A heuristic routing protocol is proposed. The protocol exploits the social relationships between network nodes to increase the chance of reaching the destination, without flooding the network with too many copies.

Using simulations, we compare the proposed protocol with a full flooding protocol (Epidemic), a

limited flooding protocol (Binary Spray-And-Wait (SnW)) and a guided routing protocol (PROPHET) in addition to the optimal protocol in terms of their delivery ratio, number of transmissions, and average packet delay. The comparison is conducted under different conditions: the number of nodes in the network, their buffer capacities, the traffic load (number of packets generated), and their
Time-to-live (TTL) values.

Results show that our proposed protocol efficiently spread packets over the network achieving higher delivery ratio with minimal energy consumption than other protocols.

II. RELATED WORK

A number of routing techniques have been introduced to handle routing issues in DTNs environment Yet, the impact of buffer management and scheduling policies on the performance of the system has not been largely considered by the DTN community. Only a few studies have examined the impact of buffer management and scheduling
policies on the performance of DTN routing. The epidemic routing by evaluating simple drop policies such as drop-front and drop-tail, and analyzed the situation where the buffer at anode has a capacity limit. The paper concluded that the drop-front policy outperforms the drop-tail. A set of heuristic buffer management policies based on locally available nodal parameters and applied them to a number of DTN routing protocols. Buffer management scheme which divides the main buffer is full. Some of the messages in the lowest priority queue are dropped to give for new message.

Buffer management policy based on using two types of queues for two types of data traffic; a low-delay traffic (LDT) queue and high-delay traffic (HDT).

In DTNs, when two nodes encounter each other, they exchange summary vector which contains an index of all messages carried by a node. Based on some specific information, a routing strategy is then applied in order to decide which message to forward. The fastest way to deliver messages is to spread the messages to all hosts, thus forming a type of persistent flooding, which is known as epidemic routing. In this scheme, all the messages are eventually spread to all nodes in the entire network. Although considered to be very robust against node failure and to provide the fastest message delivery, the scheme is very resource consuming in terms of the number of transmissions and number of message copies stored in each node; and such resource consumption increases exponentially as the number of nodes and the traffic load increases. Clearly, epidemic routing is impractical in most real application scenarios in which bandwidth, buffer space and energy are scarce resources due to the possible large queuing delay, and a significant number of retransmissions and message drops at each node.

To improve the performance of epidemic routing by reducing the resources consumption. These schemes are known as multicopy (controlled flooding) schemes. Spray routing is a family of multicopy schemes that was developed to achieve fast message delivery and less transmission by limiting the number of message copies possibly launched in the network. The schemes under Spray routing generate only a small number of copies to ensure not overloading the network with launched messages. Nonetheless, the performance of these schemes degrades when the traffic demand is higher than the available network resources.

Other schemes are based on social networks analysis called social network based forwarding with these schemes, the variation in node popularity, and the detect ability of communities are employed as main factors in forwarding decisions.

A. Vector Exchange Module:

During each contact, the network information summarized as a “summary vector,” is exchanged between the two nodes, which includes

TABLE I
NOTATION

Variables	Description
$Sr(t)$	The source of message i
$Dst(t)$	The destination of message i
T_i	Elapsed time since the creation of the message
Tx	Time-to-live of message i
R_i	Remaining lifetime of the message $(R_i = Tx_i - T_i)$
$n_i(t)$	Number of copies of message i
$m_i(t)$	Number of nodes who have "seen" message i
$s_i(t)$	Number of nodes who have seen message i and their buffers were not full
P_{f_i}	Probability of forwarding message i to very encountered node

III. PROPOSED ALGORITHM

The DTN message scheduling framework, which illustrates the functional modules and their relations. The SVEM is implemented at a node during a contact; then the NSEM is used to measure the values of $m_i(T_i)$,$n_i(T_i)$,and $s_i(T_i)$ according to the most updated network information. The two parameters are further taken as inputs in the calculation of the proposed per-message utility

function in the UCM. The decision of forwarding or dropping the buffered messages is made based on the buffer occupancy status and the utility value of the messages.

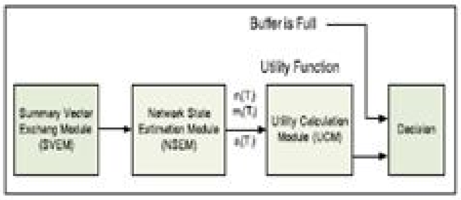

Fig.1. The Message scheduling Framework

A.Summary Vector Exchange Module:

1) Statistics of intercounter time of every node pair maintained by the nodes.

2)Statistics regarding the buffered messages, including their IDs, remaining time to live (Ri), destinations, the stored ni(Ti), mi(Ti), and si(Ti) values for each message that were estimated in the previous contact.

The SVEM ensures the above information exchange process, and activates NSEM for the parameter estimation based on the newly obtained network statistics right after each contact.

B.Network State Estimation Module:

The NSEM is used to obtain the estimated mi(Ti), ni(Ti),and si(Ti) such that the UCM can make decision in the buffer management process. Since acquiring global information about a specific message may take a long time to propagate and hence might be obsolete when we calculate the utility function of the message, we come up with a time-window-based estimation approach. Rather than using the current value of mi(Ti) and ni(Ti) for a specific message i at an elapsed time Ti, we use the measure of the two parameters over the messages that node a is aware of(has “seen”) during an elapsed time Ti. These estimations are then used in the evaluation of the per-message utility. For this purpose, we propose a novel estimation approach called Global History-Based Prediction (GHP), which estimates the parameters by considering their statistics since the corresponding message was created. Let mi(Ti), ni(Ti), and si(Ti) denote random variables that fully describe the parameters mi(Ti), ni(Ti), and si(Ti) at elapsed time Ti, respectively. We have:

$$E[Mi(Ti)]=\frac{\sum_{i=1}^{i} m_i(T_i)}{j}$$

$$E[N_i] =\frac{\sum_{i=1}^{i} n_i(T_i)}{j}$$

and

$$E[S_i]=\frac{\sum_{i=1}^{i} s_i(T_i)}{j}$$

where j is the total number of messages that have been seen by node a. These messages include the messages stored in the buffer that are considered more senior than message i.

C. Utility Calculation:

Based on the problem settings and estimated parameters, the following question should be answered at a node during each nodal contact: Given $n_i(T_i)$, $m_i(T_i)$,$s_i(T_i)$ and limited buffer space for supporting epidemic or two-hop forwarding

routing , what is an appropriate decision on whether the node should drop any message in its buffer or reject any incoming message from the other node during the contact, such that either the average delivery ratio or delivery delay can be optimized?

D.Forwarding and Dropping Policy:

The per-message utility, the node first sorts the buffered messages in a descending manner. The messages with smaller utility values have higher priorities to be dropped when the node’s buffer is full, while the messages with higher utility values have higher priorities to be forwarded to a encountered node. Fig. 2 illustrates the forwarding and dropping actions: if the utility Uj of message j (the message with the highest utility value) buffered in a is higher than UB of message i (the message with the lowest utility value) at node b, then message i is dropped and replaced by a copy of message j if the buffer of b is full during the contact of the two nodes.

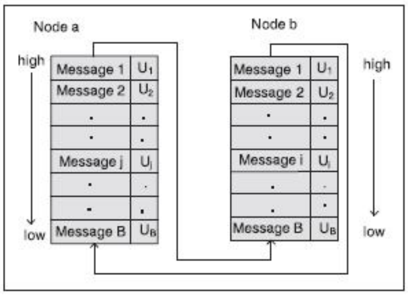

Fig. 2. The forwarding and dropping at a node.

IV. SYSTEM DESIGN

A.System Architecture

The architecture design describes the overall flow of the system. It explains all the main process such as the adaptive opportunistic routing allows a receiver to disengage from an ongoing reception, and engage onto a stronger incoming signal to avoid loss of packets.

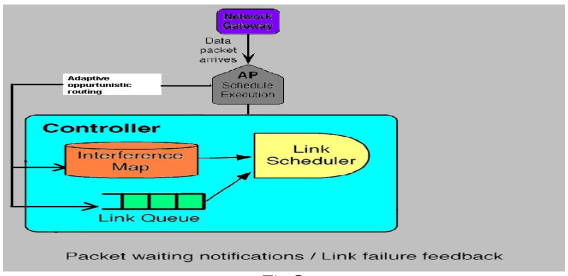

Fig.3

B.Module Designs

The figure 4 gives overall description of all modules. It includes client and router designing, selection of two nearby nodes and selection of congestion-free nearby nodes.

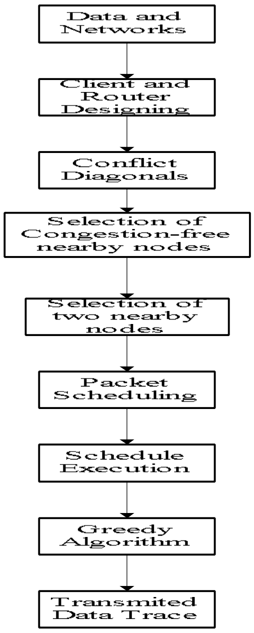

Figure 4.dataflow diagram

C.Client and Router Designing:

In this project the client and router design is used to arrange the users and the routers.MIM is used to avoid the traffic in networks and the packets are sent and receive using the signal strength, in this there are multiple node is available and if the first node strength is low means it will be automatically switched to the other node, during the packets switching at the time it is possible to hack the packets so we have to use adaptive opportunistic routing and to avoid the intruder and packet loss. And in this module arranging the client and the routers for transmit the packets between the one source and destination. MIM is empowering because it enables a receiver to decode an SoI, even if the SoI arrives after the receiver has already locked on to the interference. Of course, the required signal-to-interference-plus-noise ratio (SINR) is higher for relocking onto the new signal. Conversely, if the SoI arrives earlier than the interference, the reception with MIM-capable hardware is same as traditional reception.

D.Selection of two nearby nodes:

In this module the selection of two nearby nodes is used to sent and receive the packets between the sender and receiver using the signal strength.MIM technique analyze the signal strength and transmit the packets between the source and destination. And the nodes will be automatically assigning depends the signal strength using the MIM technique. The packets will be sent to the newly assigning nodes depending upon the signal strength and the packets will be able to loss when the node will be switching and we using the adaptive opportunistic routing for avoiding the packet loss and to increase the security.

E.Selection of Congestion-free nearby nodes:

Congestion in a network may occur at interval time when the incoming traffic is larger than the capacity of the network. This network congestion can several increase delay and packet loss and cut the network throughput. Congestion control refers to techniques that can keep away from congestion before it happens or recovery after it happens. The main aim of congestion control is to lower the End to End delay and reduced packet lost caused by network congestion and offer better performance of the network. In wire line networks, congestion control is employed at the transport layer and it is independent from the functionality of other layers However, these congestion control techniques do not apply directly to ad hoc networks, because the ad hoc network is challenged by a limited wireless bandwidth, power constraints and route failures, due to node mobility and limited buffer size. The final result is a high packet-loss rate, re-routing instability, loss of energy, bandwidth and retransmission of lost packets, which implies that more packets are transmitted in the network. These delays and packet losses are not originated by network congestion, but this can be misinterpreted as congestion losses.

V. DISCUSSION

The buffering and forwarding unlimited number of messages may also cause intolerable resources and nodal energy consumption; and it is imperative to set up buffer limitations at the DTN nodes to better account for the fact that each node could be a hand-held and battery-powered device with stringent limitations on buffer space and power consumption. With such buffer limitations at the DTN nodes, message drop/ loss could happen due to buffer overflow. This leads to a big challenge in the implementation of most previously reported DTN routing scheme.

With the per-message utility, the node first sorts the buffered messages in a descending manner. The messages with smaller utility values have higher priorities to be dropped when the node's buffer is full, while the messages with higher utility values have higher priorities to be forwarded to a encountered node. With such buffer limitations at the DTN nodes, message drop/ loss could happen due to buffer overflow. This leads to a big challenge in the implementation of most previously reported DTN routing scheme.

VI. RESULT

Our results suggest that, with a carefully designed statistics collection strategy, the proposed GHP scheme can be manipulated to achieve a graceful tradeoff among the computation time (which is directly related to nodal power consumption) and performance according to any desired target function. In addition, we have seen that GHP only takes a small fraction of computation time compared to the case by maintaining a complete view on all the messages older than message i, while without significantly affecting the performance.

VII. CONCLUSION

We propose a adaptive opportunistic routing allows a receiver to disengage from an ongoing reception and engage onto a stronger incoming signal to avoid loss of packets. In homogeneous DTNs the scheduling framework for two-hop forwarding and epidemic routing , aiming to optimize either the message delivery ratio or message delivery delay. The proposed framework incorporates a suite of novel mechanisms for network state estimation and utility derivation, such that a node can obtain the priority for dropping each message in case of full buffer. Using simulations based on two mobility models; a synthetic (Random Way Point) and areal trace-model (Zebra Net), the simulation results show that the proposed buffer management policies, named GHP, can significantly improve the routing performance in terms of the performance metrics of interest under limited network information.

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