

Optimization of Epidemic router by new forwarding queue mode TSMF

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ABSTRACT

In most of dynamic Ad hoc sensor wireless applications (e.g. military networks, vehicular ad hoc networks, wild life tracking sensor network), it is not possible to sustain an uninterrupted path from source to destination. Hence the traditional routing strategies (TCP/IP) cannot be deployed as they have to establish complete path before transmission.

DTN (disruption-tolerant network) has emerged as technology which enables the communication by intermittently connected nodes. A node in DTN may not able to transmit all messages from its forwarding queue due to limited transmission duration, dynamic topology changes and network partitioning. Therefore, the order in which the messages are forwarded becomes very important.

In this paper we propose a new message forwarding queue mode to optimize the performance of Epidemic router in terms of delivery probability. This technique is called as Transmit smallest message first (TSMF). Through simulations we prove that proposed queue mode (TSMF) out performs well as compared to existing FIFO and RANDOM.

General Terms

Algorithm, Routing.

Keywords

Disruption Tolerant Networks, Epidemic router, Forwarding queue mode.

1. INTRODUCTION

The conventional networking architecture (TCP/IP, DNS, etc. [1], [2]) work with assumption that end to end path exist from source to destination and is not able to cope with modern networking applications such as deep space communication[8],digital content delivery in rural areas with under-development architecture[7, 3] and wild life and habit monitoring [12, 13].

To enable the communication in such environments Delay Tolerance Network DTN [9], Haggel[10] architecture proposed which works under store-carry-forward paradigm where each node in the network stores the message forwarded by other nodes, carries the message while moving and then forwarded/delivered it to node(s) it encounter.

DTN routing strategies can be divided into two categories, single copy and multi copy. In single copy scheme [14, 15] there is only one copy of message in the whole network which is forwarded to a single path, whereas in multi copy scheme multiple copies of each message are forwarded to multiple paths which increase the probability of message delivery. One example of multi copy is epidemic routing [11], where a node floods the message to entire network to increase delivery probability. Many variation of epidemic routing schemes have been proposed such as spray&wait , K-copy, Multi-copy [4,5,6] and Probabilistic forwarding[16].In Contrast to single copy schemes ,multi copy schemes gain more benefit from delivery performance ,(lower latency average) at the cost of more transmission over head and buffer occupancy.

Due to finite bandwidth and sudden intermission, DTN node with Epidemic may not be able to transmit all messages from its forwarding queue. In such circumstances, the order how the message is forwarded to next encounter node become extremely important [17].

In this paper we studied the impact of packet forwarding order with Epidemic routing protocol and optimize its performance in terms of delivery probability by introducing a new message forwarding queue mode TSMF as compared to FIFO and RANDOM.

The rest of paper is arranged as follows, Section 2 present router under observation. Section 3 discusses existing queuing forwarding policies, Section 4 depicts TSMF algorithm, and section 5 is about simulation setup and results with conclusion in section 6.

2. PROTOCOL UNDER OBSERVATION

2.1 Epidemic Router

In Epidemic routing [11] each node maintains a summery vector of its buffered messages. A summery vector is an index of messages keep by nodes.

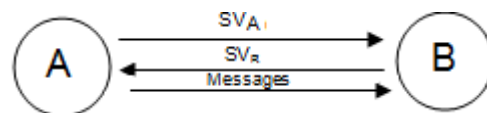


Figure 1

When two nodes A, B comes in transmission range of each other they exchange summery vectors (SV_A). After this exchange each

node can determine if other node has any message not previously received by it, in that case the node request the messages from other nodes.

3. QUEUING MANAGEMENT POLICIES

3.1 First in First out (FIFO)

In FIFO queue mode all messages are arranged according to arrival time and the message which has oldest arrival time will be transmitted first.

3.2 Random Queue Mode (RND)

The message is randomly selected for the transmission.

3.3 GRTR

“Assume A, B are nodes that meet while the destination is D, $P_{(X, Y)}$ denote the delivery predictability that a node X has for Destination Y. GRTR forward the message to node only if $P_{(B-D)} > P_{(A-D)}$ ” [17].

3.4 GRTRSort

“GRTRSort looks at difference $P_{(B-D)} - P_{(A-D)}$ values for each message between the nodes and forward the message only if $P_{(B-D)} > P_{(A-D)}$.” [17]

3.5 GRTRMax

“Select messages in descending order of $P_{(B-D)}$ forward the message only if $P_{(B-D)} > P_{(A-D)}$.” [17]

4. ALGORITHM

Figure 2, 3 depicts snapshot of message forwarding order with FIFO queue mode. When node-A comes in contact with node-B, A transmit its summary vector SV_A to B, B performs a logical and

Node-A					Node-B				
Mid	MS	AT	TT	ATT	Mid	MS	AT	TT	ATT
M1	800KB	50s	8s	8s	M5	800KB	90s	8s	8s
M2	200KB	100s	2s		M9	100KB	120s	1s	
M3	100KB	150s	1s		M21	200KB	150s	2s	
M4	500KB	200s	5s		M8	300KB	200s	3s	

Figure 2

operation between SV_A and negation of its summary vector (SV_B) to find out the messages SV_R which it needs from A.

$$SV_R = SV_A + \neg SV_B \Rightarrow (M1, M2, M3, M4).$$

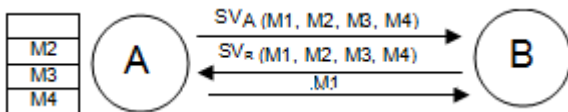


Figure 3

Node-B then transmits SV_R to SV_A for required message transmission. As available Transmission time is (8s) only M1 (Transmission time 8s) can be transmitted (Figure 3).

Figure 4 shows the message forwarding order with queue mode TSMF where small size messages are popped up.

Node-A					Node-B				
Mid	MS	AT	TT	ATT	Mid	MS	AT	TT	ATT
M3	100KB	150s	1	8s	M9	100KB	120s	1	8s
M2	200KB	100s	2		M21	200KB	150s	2	
M4	500KB	200s	5		M8	300KB	200s	3	
M1	800KB	50s	8		M5	800KB	90s	8	

Figure 4

By available Transmission time (M3, M2, and M4) will be transmitted. Rises in message transmission increase the delivery probability (Figure 5).

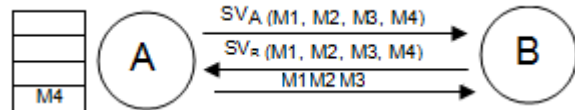


Figure 5

Algorithm

- Get Messages from Router
For each Message IN RouterMessageList
ADD (MessageLIST, message)
End loop
- Sort the MessageLIST according to size in Ascending order (TSMF)
SortedMessageList=SORT (MessageLIST)
- Transmit Message
For each Messages m: SortedMessageList
Send (Message)
End loop

5. SIMULATION AND RESULTS

In following sections we evaluate the performance of TSMF queue mode as compared to First in First out (FIFO) and Random by using DTN ONE simulator. The ONE [6] is a discrete event simulator written in Java. The main objective of simulator is to implement DTN store-carry-forward paradigm where the probability of disconnections and failures is high.

Table 1. Simulation parameters

Number of Nodes	126
Movement model 1	Random way point
Movement model 2	Map Route movement
Router	Epidemic
Number of groups	06

Message size	500KB to 1MB
Transmission range	10M
Transmission speed	250 Kbps
Message TTL	Infinite
Simulation area	4500m × 3400m

5.1 Delivery probability w.r.t Time

From Figure 6 we observe that the delivery probability of FIFO, RANDOM and TSMF queue modes. It can be seen that by increasing simulation time, TSMF has performed well in all cases due to reason of transmitting the smallest message first, while in FIFO large size message are selected and take more transmission time thus resulting in lower delivery probability.

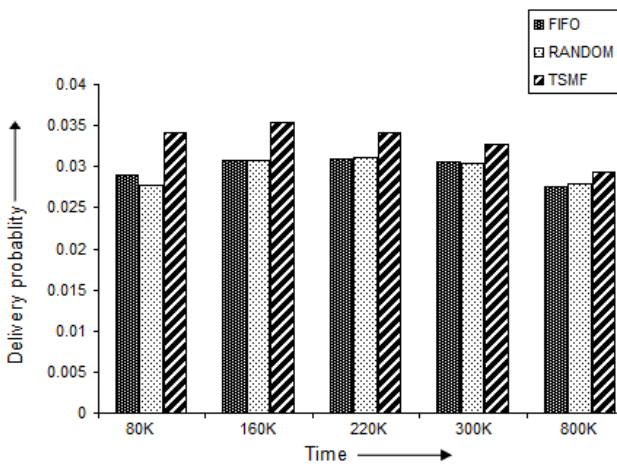


Figure 6

5.2 Delivery probability w.r.t Buffer Sizes

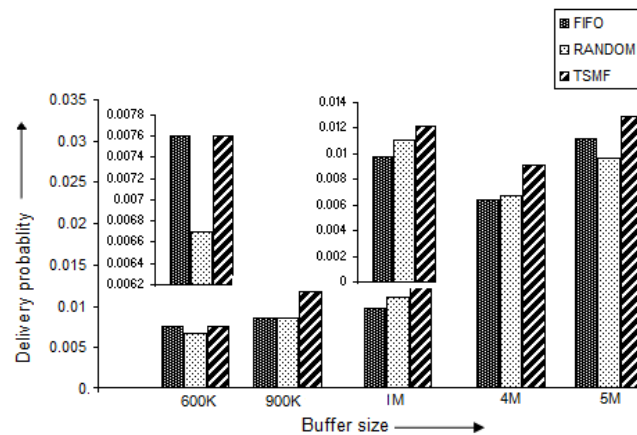


Figure 7

Figure 7 depicts the performance of FIFO, RANDOM and TSMF queue mode by shifting the buffer sizes. We can observe that by increasing buffer sizes TSMF persistently raise the delivery

probability; further TSMF has also stimulated the delivery probability on small buffer size (900K, 1M).

5.3 Delivery probability w.r.t Message Creation interval

Figure 8 simulated the activity of FIFO, RANDOM and TSMF queue mode by varying the message creation interval in seconds. Graph has depicted that TSMF has sustained the delivery probability for all ranges compared to FIFO and RANDOM.

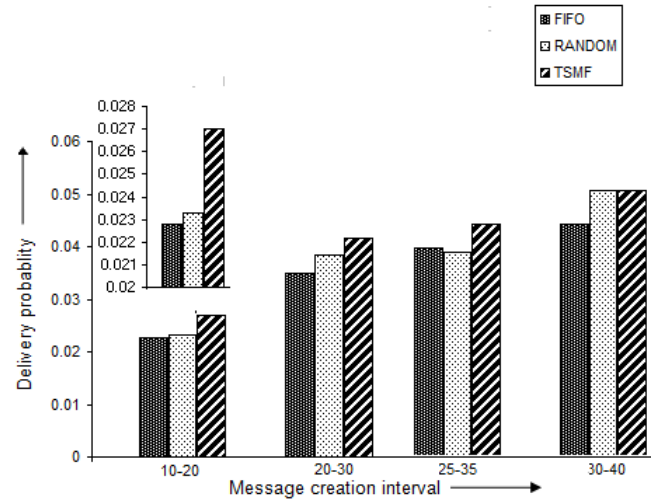


Figure 8

5.4 Delivery probability w.r.t Group Nodes Speed

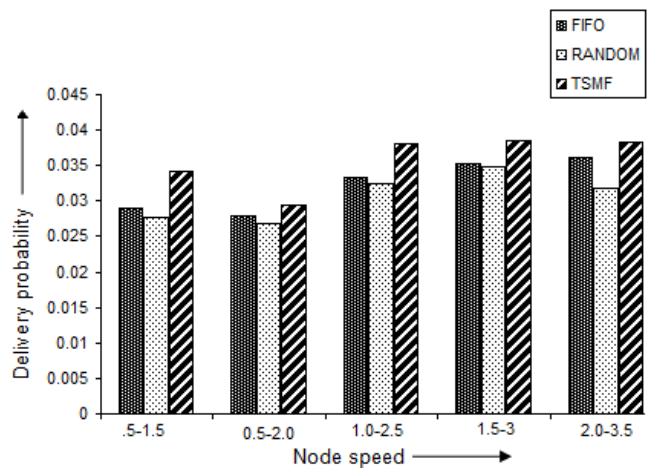


Figure 9

In figure 9 we find out the act of FIFO, RANDOM and TSMF queue mode in terms of node speed. When nodes are moving with high speed, they have limited time to communicate with each other so in that situations forwarding mechanism becomes very important. It can be clearly seen that TSMF with transmitting smallest message first out perform well with all ranges of node speed.

6. CONCLUSION

In this paper we propose a new message forwarding queue mode to optimize the performance of Epidemic router in terms of delivery probability. This technique is called as Transmit smallest message first (TSMF).

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