Scheduling and Dropping Policies in Delay Tolerant Network

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Abstract— **Delay tolerant network is network where delay or disruption is taking into consideration where current networking technology is not going to reach in that region(space communication, under water communication),but network has potential to interconnect devices in that particular region. Delay tolerant network contain mobile nodes where we can't define end to end connectivity between the node, so network use one mechanism as Store-Carry-Forward mechanism: Where, A node may store a message in its buffer and carry it along for long period of times, until an appropriate forwarding opportunity arises. Scheduling and dropping policies are used to send messages between the nodes in efficient manner, which gives better result than randomly sending messages from buffer. Dropping policies are used to drop the messages from buffer in case of buffer overflowing. Currently, there are several scheduling and dropping algorithms namely FIFO, Random, Time Threshold (TT), Priority Greedy, Remaining Lifetime scheduling algorithm for scheduling and Head Drop, Random, Remaining Lifetime dropping algorithm for dropping. To maintain better performance and delivery ratio copy of every message is maintained at each forwarding node before message reaches its destination.**

Keywords-Delay Tolerant Network, Scheduling Policies, dropping policies,

I. INTRODUCTION

A wireless network where nodes are mobile but there is no end-to-end connectivity between nodes, this type of communication environments subject to delay and disruptions is called Delay tolerant network [1][3].. At each node in delay tolerant network we use "**store-carry-forward**" mechanism: where source node is in contact with any intermediate node (the node which is close to destination node) then message(s) stored at source node is forwarded to that node and carry along it till it reaches to the destination node. This process is continued until it reaches to the destination node hop by hop. The architecture of this network is shown in Fig.1 and called as Delay Tolerant Network Architecture. In order to increase delivery probability we propagated multiple replicas of messages [2].

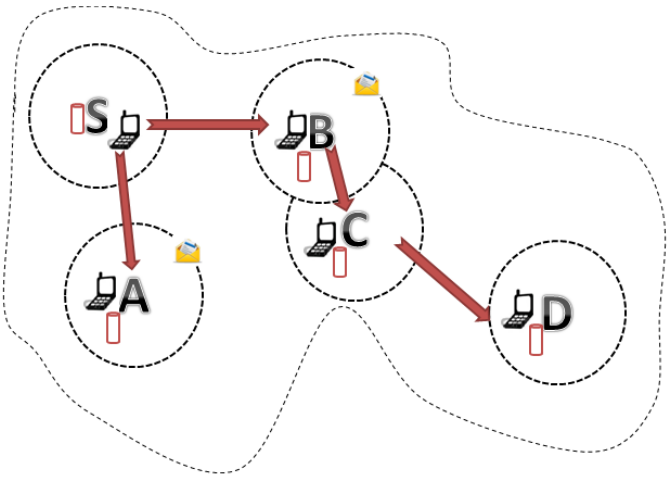

Fig 1: General DTN Store-Carry-Forward Mechanism

II. BUFFER MANAGEMNT TECHNIQUE

For understanding DTN related standards Delay Tolerant Networking Research group (DTNRG) [4] is very useful. In DTN architecture we have a layer name as bundle layer. Bundle contains messages or collection of messages. This bundle layer is present in between transport layer and application layer. To store a bundle, we require buffer at each node with efficient management technique. As shown in fig 2 buffer management techniques having scheduling policies and dropping policies. Scheduling of messages done by scheduling policies where as discarding of messages (in case of buffer overflow) is done by dropping policies.

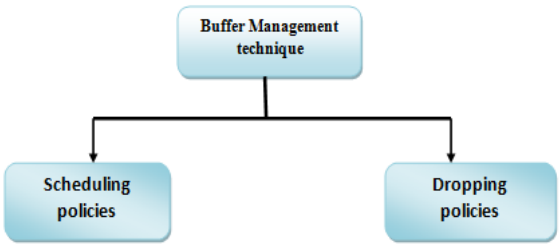

Fig 2: Buffer Management Technique

III. EXAMPLE OF BUFFER MANAGEMENT TECHNIQUE

➢ *Scheduling policies*

- FIFO
- Random
- Time Threshold (TT)
- Priority Greedy
- Remaining Lifetime scheduling algorithm

➢ *Dropping policies*

- Head Drop
- Random
- Remaining Lifetime dropping algorithm

Some scheduling and dropping policies are depend on limited bandwidth, limited contact duration, one of them is optimal joint scheduling.

IV. LITRATURE SURVEY

According to survey, FIFO from scheduling policies used to schedule the messages in order, which based on their received time. Random policy is used to send any messages randomly from the buffer. RL-DESC(Remaining Lifetime Descending order) is used to arrange messages in descending order of their TTL value and message which have highest TTL value should be sent first because message which have highest TTL value means that message have maximum probability to reach its destination. Dropping policies are Head drop, Random, RL-ASC [10]. Head Drop will drop first message from buffer to store new message. Random will discard any random message from buffer and RL-ASC (Remaining Lifetime Ascending order) will discard messages which having a small TTL value from the buffer list [5].

In addition with this, some more policies are available in which Priority Greedy (PG) is used to schedule the messages according to their priority. This policy contains three types of priority modes: bulk (low priority), Normal (medium priority) and expedited (high priority).The messages having expedited priority should be sent first and message having low priority should be discard first in case of buffer overflow. Round Robin (RR) scheduling policy traces message priority by placing them in circular order, and schedules each message from every class that has non-empty index [6].

Refer fig.3 to know more about aforesaid policies.

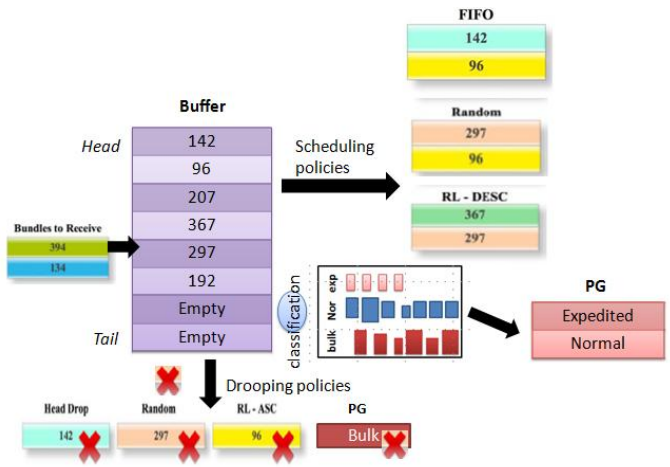

Fig 3: Scheduling and dropping policy

Next policy is Optimal-joint policy which is build on global knowledge base policy which maximizes and minimizes average delivery rate and average delivery delay respectively [8][9]. Consider a scenario where two nodes *I* and *J* have their respective buffers (local and global). Node *I* have X messages in its buffer which will be sent to node *J*. So to maximize global delivery rate optimal joint policy is used to decide which message should be sent first among the all messages which are present in buffer. Also the dropping policy maximizes the average delivery rate in case of buffer overflow. So by using the optimal joint policy, node J comes in contact with node I, who send messages in decreasing order depending on their utilities. Here highest utility message will send first and discard low utility messages in dropping policy [7].

V. COMAPRISION AND ANAYSIS

Here we are comparing scheduling policies and dropping policies and their mechanism, which are given in the discussed paper [6] [7] [9]. In scheduling policy mechanism, messages schedule in the buffer according with their criteria and dropping policy mechanism discard the message according to current state of buffer. Overview of all the policy comparison is shown in following table.

A. *Based on Scheduling*

Scheduling policies define some mechanism to schedule message in head first i.e. sent first message from the buffer, which is used in FIFO (First In First Out) scheduling policy Scheduling. Also schedules any message from buffer which comes under Random scheduling policies. There are some mechanism which is based on TTL (Time To Leave) for that particular message. RL-ASC will work on mechanism where highest TTL value sent first and exact opposite in case of RL-DESC. In case of PG the messages having Expedited (high) priority first. And in case of optimal joint, high utility messages sent first. Utility of that messages are calculated based on some message indexing system (hop count, number of copies, message size, Delivery cost, etc). Template is designed so that author affiliations are not repeated each time for

multiple authors of the same affiliation. Please keep your affiliations as succinct as possible (for example, do not differentiate among departments of the same organization). This template was designed for two affiliations.

TABLE 1:(COMPARISION BETWEEN MECHNISM)[5][6][7]

Policy	Scheduling Mechanism	Dropping Mechanism
FIFO	Head	Head
RANDOM	Random	Random
RL-ASC	High TTL	Low TTL
RL-DESC	Low TTL	High TTL
Priority Greedy	Expedited	Bulk
Optimal joint	High utility	Low utility

B. *Based on Dropping*

Dropping policies define some mechanism to drop message in head first i.e. drop first message from the buffer, which is used in FIFO (First In First Out) dropping policy. Also drop any message from buffer which comes under Random dropping policies. There are some mechanism which is based on TTL (Time to Leave) for that particular message. RL-ASC will work on mechanism where lowest TTL value message sent first and exact opposite in case of RL-DESC. In case of PG the messages having Bulk (low) priority first. And in case of optimal joint, lowest utility messages sent first.

VI. PROPOSED IDEA

For Efficient buffer management technique we are going to introduce a new scheduling and dropping policy called as hybrid scheduling (Priority and round-robin scheduling policy) and hybrid dropping policy (Priority and Remaining Lifetime dropping policy)

Hybrid scheduling policy contain a buffer which having three different type of messages at each node which classified as High priority, Medium priority and Low priority. Whenever messages will receive at a particular node, it will check the priority of that message and then store that message at respective priority state. Then assign a particular time to each priority state. Now for the given time we are able to send messages from corresponding buffer, depending on the each priority state of that message. The fig.4 shows the exact architecture of Hybrid scheduling policy.

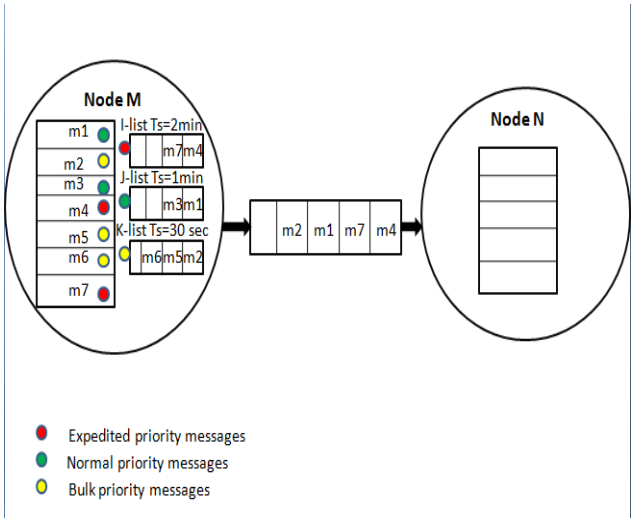

Fig 4: Hybrid scheduling policy

Hybrid dropping policy take into consideration both TTL and priority of that particular message. If TTL value of message is low as compare to other messages then it will drop messages from the buffer. If we have two messages having same TTL value then it will check the priority of that messages, so the message which having low TTL value and low Priority state will drop first. As shown in fig.5 first it will arrange messages from the buffer based on their TTL value. Now the message having TTL value 99 and low priority with yellow color dot get discarded from the corresponding buffer.

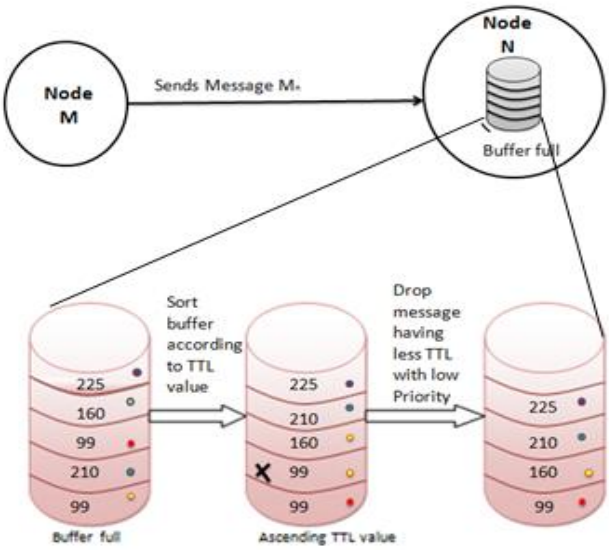

Fig 5: Hybrid dropping policy

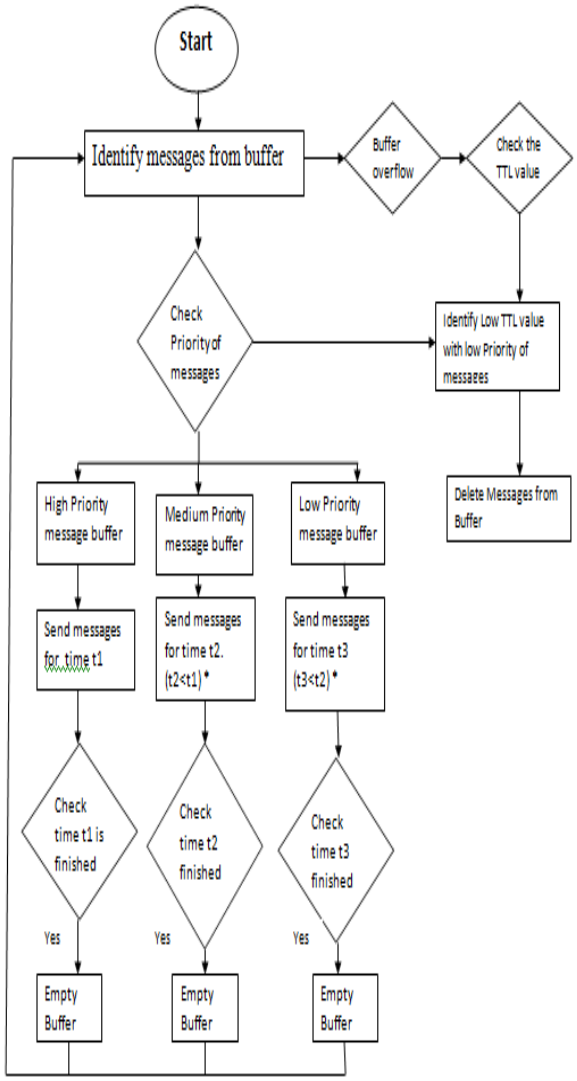

Fig 6: Flow of hybrid scheduling and dropping policy

VII. CONCULSION AND FUTURE WORK

In networking environment there is one field, name as Delay Tolerant Network Where there is no end to end connectivity between nodes. So it is a challenging job to send and receive messages over the network.

In this paper, the main goal of the study is the evaluation of different scheduling and dropping policies like FIFO, Round-robin, priority, RL-DESC, optimal joint. These policies are used for message transmission to find the best as well as improved delivery ratio and decrease average delivery latency as well as overhead ratio. This work is providing initial phase to study on scheduling, dropping and buffer management. There are some constraints which will be used for future work. In case of priority greedy we are assuming that duration of contact node is previously get determined [6]. And in case of optimal joint we considered the messages having same size [9].

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