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SURVEY ARTICLE

A Survey on Scheduling and Dropping Policies in DTN's

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Abstract— Delay-Tolerant Networks (DTNs) work in the region where current technology cannot reach, but it has potential to interconnect devices. DTN is such kind of n/w, where an end-to-end connection may never be present. As end-to-end route can't establish, it requires buffer at each node to store packets in intermediate nodes. DTNs use store-and-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 policies are used to select the order by which bundles are sent between the networks when they have an opportunity for data exchange. 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, Dropping Policies, Buffer Management, Scheduling Policies

I. INTRODUCTION

Delay tolerant network is a wireless network where nodes are mobile but there is no end-to-end connectivity between nodes [1] [3]. This type of communication environments subject to delay and disruptions. When 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. This mechanism is called "**store-carry-forward"** mechanism. This type of architecture is called as Delay Tolerant Network Architecture, shown in Fig.1. In order to increase delivery probability we propagated multiple replicas of messages [2].

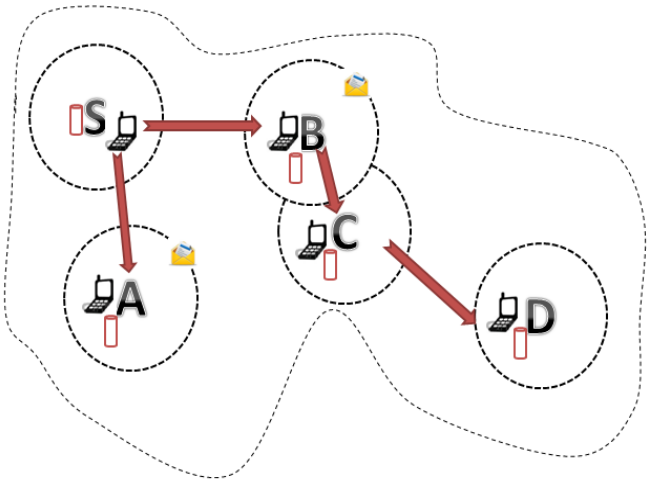

Fig 1: General DTN architecture

Delay Tolerant Networking Research group (DTNRG) [4] is very useful while understanding DTN related standards. In DTN architecture we have a bundle layer. Bundle layer is between transport layer and application layer. Bundle is nothing but messages or we can say that collection of messages. For keeping collection at each node we require buffer with efficient management technique which are scheduling policies and dropping policies shown in fig.2. Efficient scheduling decides which messages should be sent first and efficient drop policies will decide which message should be discarded first.

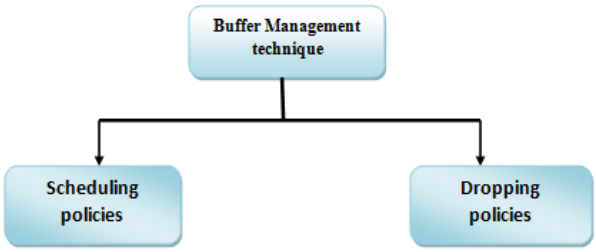

Fig.2.Buffer Management Technique.

In this paper we are going to study for some scheduling and dropping policies, which are FIFO, Random, Time Threshold (TT), Priority Greedy, Remaining Lifetime scheduling algorithm for scheduling and Head Drop, Random, Remaining Lifetime dropping algorithm for dropping. Some scheduling and dropping policies are depend on limited bandwidth, limited contact duration, one of them is optimal joint scheduling.

II. LITERATURE SURVEY

Here we are discussing three papers which are 1) Impact of Scheduling and Dropping Policies on the Performance of Vehicular Delay-Tolerant Networks. 2) Scheduling and Drop Policies for Traffic Differentiation on Vehicular Delay-Tolerant Networks. 3) Message Drop and Scheduling in DTNs: Theory and Practice.

Here we are using scheduling policies like FIFO where scheduling is done in the order where messages are received at a node, Random where bundles are sort randomly and schedule it, RL-DESC(Remaining Lifetime Descending order) where each message has TTL value according to which we have to sort messages in descending order of TTL 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. And the dropping policies are Head drop, Random, RL-ASC [10]. In Head Drop, drops first message from buffer. In Random, any message from buffer can be dropped. In RL-ASC (Remaining Lifetime Ascending order), drops messages which have small TTL value [5].

Also we have some more scheduling policies Priority Greedy(PG), this type of scheduling policies are work on the basis of priority of messages like bulk(low priority), Normal(medium priority), expedited(high

priority) ,the messages having expedited priority should be sent first, And message having low priority should be dropped first in case buffer overhead. 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].

All the above scheduling and dropping policies are shown in the fig.3 for better understanding.

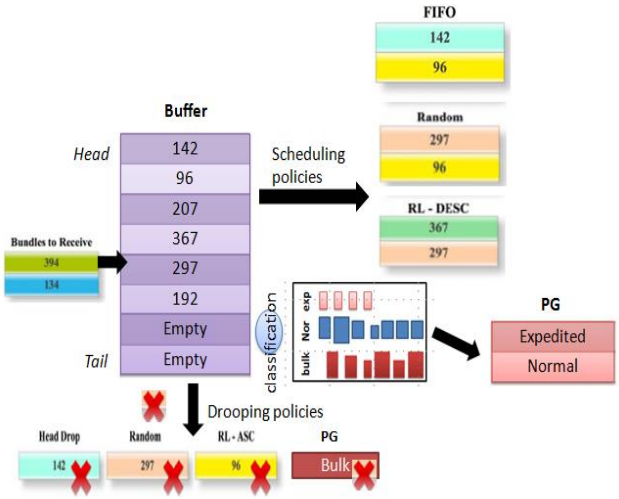

Fig 3: Scheduling and Dropping policies

Now we are going to study optimal joint scheduling & dropping algorithm which is based on global knowledge based scheduling and dropping which maximizes average delivery rate and minimizes average delivery delay. 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 which message should be sent first to maximize the global delivery rate for all messages currently in network is decided by optimal joint policy. Also the dropping policy maximizes the average delivery rate in case of buffer overhead. That is decided by optimal joint scheduling-dropping policy [9]. Which explains scheduling as, when node J comes contact with node I, node I replicates messages in decreasing order of their utilities, followed by sending the message of highest utility first. Where as in case of dropping, the message having least utility drop first among the all [7].

III. COMPARISON AND ANALYSIS

Here we are comparing scheduling policies and dropping policies with their mechanism, which are given in the discussed paper [6] [7] [9].

Scheduling policies gives the mechanism of message schedule first and dropping policies gives the mechanism of which message should drop. Overview of all the policy comparison is shown in following table.

1. 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).

TABLE I

Policy name	**Scheduling**	**Dropping**
FIFO	Head	Head
Random	Random	Random
RL-ASC	High TTL	Low TTL
RL-DEC	Low TTL	High TTL
Priority Greedy(PG)	Expedited	Bulk
Optimal joint	High utility	Low utility

2. 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.

IV. OPEN ISSUE

In delay tolerant networking environment, buffer management is an important issue, to decide which scheduling policies are better for the respective environment. To maintain the delivery probability and overhead ratio in any kind of environment, this is a difficult task. To maintain efficient scheduling and dropping policies.

V. CONCLUSION AND FUTURE WORK

In networking environment there is one field name is Delay Tolerant Network where there is no end to end connectivity between nodes, So it is a challenging job to send messages and receive at nodes over the network .In this paper, the main goal of the study is the evaluation of different scheduling polices and dropping policies.

These policies are used for message transmission to find the best that would improve the delivery ratio and decrease average delivery latency and decrease overhead ratio.

We studied scheduling policies and dropping policies (FIFO, Round-robin, priority, RL-DESC, optimal joint).

This work is provide a 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 will be previously determined [6]. And In case of optimal joint we considered the messages having same size [9].

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