An Analysis Optimal Buffer Management Policy to Improve QOS in DTN Routing Protocol

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ABSTRACT
Existing Network Architectures like DSR and AODV cannot be performed in environments where end-to-end path is not stable due to network partitioned, intermittent connectivity and node mobility. A delay-tolerant network is a network designed so that temporary or intermittent communication problems and limitations have the least possible adverse impact. In Order to perform data delivery in such operational environment (e.g. deep space, under water) researchers have proposed *store-carry- and- forward* protocol: A node store message in its buffer and carry until a suitable transmission opportunity arises and whenever buffer overflow buffer management policy play a important role in Delay tolerant Network The function of buffer management policy is minimize the Drop and maximize the Delivery Rate. This paper provides a comparative review of different buffer management policy and proposed buffer management policy.

General Terms
Delay Tolerant Network; Buffer Management; Routing Protocol

Keywords
Store-Carry-forward; Buffer Management policies; Delay Tolerant Network

1. INTRODUCTION
A Delay-Tolerant Network (DTN) is defined as a network of regional networks, which requires a novel protocol layer to reside on top of existing networks such as the Internet and wireless cellular network.[8] The DTN can bear long or variable transmission delay from several hours to days. This insensitivity to delay opens new horizon for applications necessary for larger delay than the current network architecture limits This emerging technology transmits data by adopting store-carry-forward paradigm[4], where a node store the message in its buffer, carries it while moving and deliver or forward when encounter with other node(s).Because of limited bandwidth, limited resource, intermittent Connectivity[9], frequently changing behavior, Node mobility and long delay routing procedure in delay tolerant network become the most challenging issue[7][6] To improve the delivery of messages in such challenged network environments, we need to consider several research issue, one is routing in DTN and this is deal by two well known mechanisms one in simplest and other one in sophisticated [4], Epidemic routing is one of the simplest mechanism in which when a node encounters portion of network than it perform sharing of node information and prophet routing is sophisticated mechanism which uses special knowledge of the network i.e. delivery probability of each node. Another important issue that must be examined in DTN is influence of buffer management policy because in store-carry-and-forward paradigm there is high possibility of buffer overflow [15][16][17] Although a large amount of effort has been invested in the design of efficient routing algorithms for DTNs, there has not been a similar focus on buffer management policies A critical issue is to select which message(s) to be dropped upon a full buffer, therefore efficient drop policy is necessary to overcome congestion and to improve quality of service[12]. This paper gives a comparative review of various buffer management techniques.

2. EXISTING BUFFER MANAGEMENT POLICES
When a new message arrives at a node and its buffer is full, the node must drop the buffered message(s) to sustain this new arrival. The function of good buffer management policy is to minimize this drop [5]; following is the list of available buffer management technique in DTN

2.1 T-drop:
Drop the message having size lie between the threshold value

2.2 Mean drop:
Drop the message having size less than mean value of buffered message

2.3 Drop Random:
Drop the message in random manner

2.4 Drop –Least-Recently-Received:
The message with the long stay time in buffer will be dropped. The idea is that the Packet that has been in buffer for long time has less probability to be passed to other nodes

2.5 Drop Oldest:
The message with the shorted remaining life time (TTL) in network is dropped. The idea of dropping such a packet is that if packet TTL is small, it has been in the network for long time and thus has high probability to be already delivered.

2.6 Drop last:
Drop the newly received message, irrespective of whether it is new or old, that is why responsible for maximize drop ratio.

2.7 MOFO:
Evict most forwarded first: The message that has been forwarded to maximum number of times will be dropped first. Each node maintain information about no of forwarding of particular message in its queue

2.8 Optimal Buffer Management Policy:
Drop the message on the basis of global knowledge about the

network. Global knowledge means how many time a particular message stores in different nodes.

2.9 SHLI - Evict shortest life time first:

Drop the message having shorter lifetime. The idea behind this is that if a node having shortest life time the message will be automatically dropped after completion of TTL [10].

2.10 LEPR - Evict least probable first:

Drop the message on the basis of P-value, each node calculate the p-value on the basis of probability that a message will be delivered or not

2.11 N-Drop:

When node send message it increase the value of forwarding no and whenever this no reaches to N message gets deleted [11].

2.12 GBD (Global Knowledge based Drop):

GBD drop message according to global knowledge of network

2.13 E-Drop:

When a new message is come and buffer is full than that time this policy checks the size of any message which is equal or more than the incoming message and that message will be dropped to accommodate new one

2.14 HBD:

A deployable variant of GBD that uses the new utilities based on estimates of *m* and *n*, where *m* is the expected no of same message that stored in different *n* nodes.

3. AVAILABLE ROUTING PROTOCOL FOR EVALUATIONS

3.1 Epidemic:

In epidemic routing [1], application messages are diffused on relay nodes called carriers. When carrier node while moving comes in contact with other node it performs the pair-wise exchange of messages. This blind cyclic exchange of each message continues on all encountered nodes which increases the delivery of messages via multiple paths. The epidemic routing protocol is more robust but it consumes high volume of network resources such as buffer space, bandwidth and energy.

Fig 1 Epidemic router

3.2 Prophet Routing:

Epidemic replicates messages to all encounter nodes falling within the range but Prophet is a Probabilistic Routing Protocol [2] which forwards the message to a node by utilizing its encounter history and transitivity. Prophet router uses the metric called delivery predictability which is updated for each node on encounters. If node A wants to transmit the message to destination D then node A look in neighbors nodes and forward the message to node which has high encounters with D.

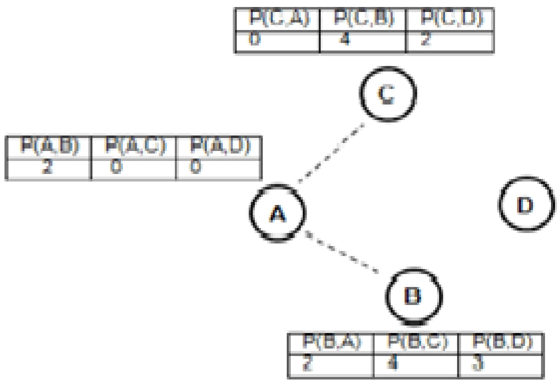

Fig 2 Prophet Router

In fig 2 when node A wants to transmit message to node D , node A looks for encounter probability of its neighbor B and C and observe that node B has high probability so it communicates with D via node B.

Table 1: Description of policy

Name of Policy	Message dropping Criterion	Advantage	Disadvantage
T-drop	Threshold value	-High delivery probability -Minimum hop count -Improved Buffer time average for short -message	-Decision of suitable threshold
Mean drop	Mean value of buffered message	-High delivery probability -drops the least amount of messages	-Perform well in congestion aware environment
Drop Random	Randomly	-Simple, perform best in continuous connectivity	-Continuous end to end connectivity is required -maximize the drop
Drop Oldest	Drop the message having shortest TTL	-Simple, perform best in continuous connectivity	-Continuous end to end connectivity is required -maximize the drop
Drop last	Drop the message having last position in buffer	-Simple, perform best in continuous connectivity	-Continuous end to end connectivity is required -maximize the drop
MOFO	Max no of Forwarding	-Improved Buffer time average	-Max no of hop
HBD	Historical analysis of message	-Suitable for large network	-Complex
SHLI	Shortest TTL	-Maximize delivery probability	-maximize the drop
LEPR	Message delivery probability	- Less message drop	-deciding P is complex task
N-Drop	Threshold N	-High delivery probability	-deciding N is complex task
GBD	Global knowledge about message	-Perform best in large area network with high delivery probability	-Require high knowledge of entire network
E-Drop	Equal or Greater size	-High delivery probability -Max buffer time average	-Having problem when a message got deleted will very close to its destination
Optimal Buffer Management Policy	Global Knowledge	-Perform best in large area network with high delivery probability	-Require high knowledge of entire network

4. ANALYSIS OF VARIOUS ALGORITHM

Traditional packet dropping policies are widely used in delay tolerant networks [10]. This paper provides complete review of above mentioned buffer management dropping policy.

In which some policy work well either with epidemic or prophet routing protocol. Policies such as **Drop Last**, **Drop Oldest** and **Random Drop** are sufficient in networks with continuous end-to-end paths because all the packets in the buffer can be transferred to the next-hop node for sure. But in DTN the end-to-end path between nodes don't exist for the most of time so these policies might not perform adequately in DTN always.

T-Drop policy [14] cut out the limitation of drop last, drop random, and drop oldest and perform well in disrupted network. In T-Drop a range is predefined and whenever buffer overflow are occurred so the message that fall within the threshold range. This technique give high buffer time to small messages result in less message drop, overhead, hop count with high delivery probability and buffer time average and hence QoS improved much better, but deciding appropriate threshold for particular situation is challenging task.

Mean Drop policy [8] perform well in congestion aware environment. One factor which can raise the network throughput is to control the redundant message drop, Mean Drop first computes the mean of all buffered messages and drops all those messages which are equal or greater than the Mean Size. This intuitive idea gives priority to relay messages and improves the average delivery probability**.** According to study Mean-Drop (MD) drops the least amount of messages and sustains more messages .Moreover against MD policy, ESTF produced higher number of drops as compared to MOFO. In epidemic routing policy the MD policy reduce message drop by an average 42.5% as compared to ESTF and 23.75% against MOFO. The reason is that, MD policy controls the unnecessary drop of messages using mean-size metric and bound the infection rate of epidemic in better way than ESTF and MOFO. However, in prophet due to predictability the prophet have better control on drop but still MD drop policy outperforms and also reduces the drop by average of 33.75% and 14% as contrast to ESTF and MOFO.

MOFO [10] is most forwarded first, in which most forwarded message gets deleted but In MOFO when ever congestion arises it continues to drops messages to free space for new messages resulting more relay and increase in hop so require some improvement

E-Drop [5**]**which is an enhancement of MOFO drop the message whose size is greater or equal to new message, E-DROP policy can be adjust to minimize the metrics of relayed, dropped , average latency overhead ratio ,hop count and to maximize the average delivery probability and buffer time. We examine the Overhead ratio with respect to router 50% less in E-Drop in epidemic and 20% less in prophet routing compare to MOFO, E-Drop perform much better in terms of hop count, buffer time average and average latency compare to MOFO

Optimal Buffer Management Policy and GBD (Global Knowledge based Drop) [13] are based on global knowledge of network provide good result but requires complex approach to acquire the knowledge of number of node that have a particular message in the whole network. All the buffer management policies discussed so far fail to consider network-wide information, such as the number of replicas of each message, the number of nodes, etc. Yet, optimality cannot be achieved without this information.

SHLI, LEPR, N-Drop having much better performance compare to classical buffer management policy but don't having special knowledge about network. This table illustrates the comparative performance metric of different management policy. **SHLI** purely works on shortest TTL so there is some possibility that a message is about to deliver gets deleted. **LEPR perform** well in terms of hop count, buffer time average but require complex knowledge to decide P-value. **N-Drop** also minimize no of drop and hop count but deciding the N for different-different node quite complex.

Table 2: Comparative review of different buffer management policy

Buffer Management Policy	Overhead ratio	Delivery probability	Drop message
Drop Last	-	.65(buffer size 300)	-
Drop Random	48(buffer size 40M)	.55(buffer size 40M)	-
Drop Oldest	290(83200s,Epidemic) 190(83200s,prophet)	.54(83200s,epidemic) .59(83200,prophet)	50000(83200s,epidemic) 38000(83200s,prophet)
Mean Drop	1000(200000s,epidemic) 510(200000s,prophet)	.031(200000s,epidemic) .06(200000s,prophet)	200000(200000s,epidemic) 200500(200000s,prophet)
E-Drop	147(200000s,epidemic) 97(200000s,prophet))	.049(200000s,epidemic) .051(200000s,prophet)	48000(200000s,epidemic) 41000(200000,prophet)
N-Drop		1(buffer size 300)	
T-Drop	65(83200s,epidemic) 50(83200s,prophet)	.55(83200s,epidemic) .68(83200s,prophet)	8000(83200s,epidemic) 10000(83200s,prophet)
Optimal buffer management policy	25(buffer size 40M)	.75(buffer size 40M)	-
GBD	400(no of resource 30)	.89(buffer size 30)	-
MOFO	2470(200000s,epidemic) 800(200000s,prophet)	.018(200000s,epidemic) .048(200000s,prophet)	280000(200000s,epidemic) 280000(200000s,prophet)
SHLI	2400(200000s,epidemic) 990(200000s,prophet)	.024(200000s,epidemic) .054(200000s,prophet)	390500(200000s,epidemic) 390000(200000s,prophet)
HBD	410(no of resorce 30)	.87(buffer size 35)	-

5. PROPOSED WORK

Traditional buffer management policy has many pros and cons i.e. some of the policies work well only in continuous environment and some not perform better in DTN limitation like limitation of buffer, connectivity and limitation of bandwidth. In order to provide better delivery rate and delay rate this proposed work suggests a buffer management policy and we assume that it improve the performance of DTN. Whenever drop occurred must check Age of message (TTL) and No of replica of that message

Proposed Algorithm

1. Begin
2. New Message M (new) Arrives at node N
3. Available Buffer Size will be checked
   (a) If BA >= M (new),
   Then put the M (new) in buffer
   (b) If Buffer Available (BA) < M (new)
   Than go to next step,
4. Find the two message that has highest & second highest replication at node N
5. Let the message be MH and MSH
6. Compare TTL
   (a) If TTL (MH) >= TTL (MSH)
   Than discard MH & add M (new) in buffer
   (b) Else discard MSH & add M (new)
7. END

6. CONCLUSION

DTN is expected to become increasingly important in next-generation Internet structures. One of the important research issues in DTN is buffer management. In this study, we proposed a buffer management policy and provided a comparative review of existing buffer management policy. It would be encouraging to inspect and explore this area and propose more polices with local knowledge and partial network knowledge based approaches that take into account of different message sizes and limited buffer sizes and can implemented in DTN real applications. In particular, buffer management optimization strategy considering delivery ratio, delay, and overhead simultaneously is presented to significantly improve the overall performance of routing algorithms in DTNs

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