Rate base Congestion Control in Multipath Routing Strategies under MANET

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ABSTRACT
In mobile ad hoc network (MANET), congestion is one of the most important constraint that deteriorate the performance of the whole network and routing capability of AOMDV protocol. Multipath routing allows the establishment of multiple paths between a single source and single destination node. The multipath route establishment uses the method that discerns multiple multi hops communication between source and destination. Multipath routing can balance the load better than the single path routing in ad hoc networks, thereby reducing the congestion by dividing the traffic in more than two paths. This research presents a new approach of rate control based buffer enhancement congestion control mechanism for avoiding congestion in network communication flows. In this scheme the store and forwarding capability of nodes are enhanced by varying the packet capacity according to incoming data. The AOMDV protocol performance is also enhanced and the packet loss due to higher data rate and respective storing capacity. The performance of normal AOMDV is measured on the basis of load handling capability of nodes in network and through performance matrices. The performance of original AOMDV and proposed scheme with AOMDV or proposed AOMDV is considered. The proposed AOMDV is showing the better performance that has measured through performance matrices.

General Terms
Multipath AODV Routing, Load Balanceing.

Keywords
Congestion, AOMDV, Buffer, Multipath, Load balancing, Routing

1. INTRODUCTION
Mobile Ad Hoc Network (MANET) is a volatile temporary network contains a group of nodes that communicate with each other without any fixed infrastructure. It has no doubt, there are many restrictions that make Mobile Ad hoc network with complicated topology, especially the bandwidth, memory, and energy constrained. The main vital characteristics in MANET are that each node in the network will have two rules at the same time i.e. role of host and role of router. Mobile Ad hoc networks are widely used in the automated battlefields, search and rescue, crowd control, and disaster relief operation [1, 2].

All nodes in network are capable of movement and can be connected dynamically in random manner. The responsibilities for systematizing and controlling the network are distributed among the all nodes in network themselves. The entire network is mobile, and the individual node is allowed to move freely. In this kind of networks, some pairs of nodes may not be able to communicate directly with each other and have to required intermediate nodes within the sender and receiver so that the messages are delivered to their destinations. Such networks are often referred to as multi-hop or store-and forward networks. The nodes may be placed in or on airplanes, ships, trucks, cars, perhaps even on people or very small devices. MANET routing is considered as one of the most essential issues that need a scalable method because the network topology and transmitting data may become a requirement according to time. Routing is classified into two main categories: proactive routing and on-demand or single-path routing and multi-path routing [3]. Load balanced routing [1] aims to move traffic from the areas that are above the optimal load to less loaded areas, so that the entire network achieves better performance. The nodes in the network having a limited buffer space that causes the problem to handled heavy load in network. If the traffic is not distributed evenly, then some areas in a network are under heavy load while some are lightly loaded or idle.

2. AOMDV ROUTING PROCEDURE
The multipath routing protocol AOMDV (Ad hoc On Demand Multipath Routing) [4] that extends the single path AODV protocol to compute multiple path routing. The different routing mechanism of AOMDV is to establish multiple paths during route discovery procedure for contending link failure of existing pre-established path. In has no doubt the main goal of this protocol is to search multiple routes during the same route discovery procedure by same sender, but only the best path based on some metric (number of hop count) is chosen confirm by receiver and is used for data transmission between source and destination. The other paths are also used but the condition is the primary path fails.

This protocol is deliberate for Mobile Ad hoc Network because of the mobility of nodes is very important and consequently the route breaks are frequently that required retransmissions. AOMDV use the information same as available through AODV, but to compute multiple paths it adds additional number of control packet "overhead". AOMDV is based on two essential mechanisms:

• A route update is call to establish and maintain multiple loop-free paths at each node.

• A distributed protocol to find link-disjoint paths.

AOMDV allows building multiple link disjoint paths. It ensures multiple paths without common link between routes from source to destination. Additional modifications are made in the route discovery process to allow formation of node-disjoint paths from intermediate nodes to the source and destination.

3. CONGESTION ISSUE IN MANET
When the requirements become greater than maximum capability of the communication link particularly during multiple hosts attempting to access a shared media,

congestion occurs in the network. Congestion may also be caused during the following conditions.

- When the load in the link goes beyond the carrying capacity.
- When the broadcasting packets are surplus in nature.
- When more number of packets field has becomes time out and retransmitted.
- When the number of node increases.
- During standard deviation of the packet delay [5].

The congestion detected in the network can rigorously worsen network throughput [6]. It results in the packet losses, bandwidth degradation and energy expenditure [7]. When the congested network is left unattended i.e., when suitable congestion control technique is not executed, it results in congestion collapse of the network. So the data will not deliver to destined node in effective manner. When the routing protocols in MANET are not conscious about the congestion, it results in the following issues.

- Extended delay in Network**:** When the congestion is more rigorous, it is better to select an alternate new path by that the delay is enhanced. But the prevailing on-demand routing protocol delays the route searching process.
- High overhead for connection establishment: The control overhead in network is increase due to rapidly connection loss because of heavy load. The multipath routing is developed, its needs additional endeavor for upholding the multi The nodes in the network having a limited buffer space that causes the problem to handled heavy load in network.paths despite the existence of alternate route.
- Numerous loss of packet: The proposed congestion control load balancing technique attempts to minimize the overload in the network by either reducing the sending rate at the sender side or by enhance the buffer capacity of nodes or by executing both the process.

4. LITERATURE SURVEY

In this section we discuss about the previous work that has been done in the field of load balancing to reduce the loss by congestion and limited buffering capacity of nodes.

M. Ali, B. G Stewart, A. Sahrawi, A Vallavaraj in [1] proposed a new approach based on multipath routing backbones for enhanced load balancing in MANET. Nodes in MANET greatly differ with each other in terms of communication and processing capabilities. This approach work on multiple routing backbones are recognized from source to destination using intermediate nodes that have better communication and processing capabilities to take part in the mobile routing backbones and efficiently participate in the routing process. This work use multipath technique but not execute multipath simultaneously that case use alternative base load balancing technique.

Soundararajan et. al. in his titled "Adaptive Multi-Path Routing for Load Balancing in Mobile Ad Hoc Networks" [8] they propose congestion controlled adaptive multi-path routing protocol to achieve load balancing and avoid congestion in MANETs. The algorithm for finding multi-path routes computes fail-safe multiple paths, which provide all the intermediate nodes on the primary path with multiple routes to destination. The fail-safe multiple paths include the nodes with least load and more battery power and residual energy. When the average load of a node along the route increases beyond a threshold, it distributes the traffic over disjoint multi-path routes to reduce the traffic load on a congested link.

Amjad Ali, Wang Huiqiang "Node Centric Load Balancing Routing Protocol for Mobile Ad Hoc Networks" [9], suggested that each node avoid the congestion in greedy fashion. This algorithm uses the alternative route towards the destination to avoid new routes forming through congested node. Each node finds the current status of interface queue size, where node considers 60 as maximum queue size. Queue size 50 is considered as congestion threshold. When a node notices that the congestion threshold has been reached, it automatically starts ignoring new RREQ packets so as to not allow any new routes passing through it.

Sivakumar and Duraiswamy [10] have proposed a new distributed load based routing algorithm intended for a variety of traffic classes to establish the best routing paths. This approach calculates the cost metric based on the link loads. Here multimedia traffic is considered as high priority traffic and its routing is carried out over the lightly loaded links such that the links at the lighter loads are selected as an alternative to links holding heavier loads. Also the resources are shared among the high and low (normal traffic) priority traffic. The lightly loaded path is used by normal traffic in the lack of multimedia traffic.

Jingyuan Wang, Jiangtao Wen et. al. in his work titled "An Improved TCP Congestion Control Algorithm and its Performance" [11] In this paper, they propose a novel congestion control algorithm, named TCP-FIT, which could perform gracefully in both wireless and high BDP networks. The algorithm was inspired by parallel TCP, but with the important distinctions that only one TCP connection with one congestion window is established for each TCP session, and that no modifications to other layers (e.g. the application layer) of the end-to-end system need to be made. This work done only transport layer congestion control via TCP improvement method but congestion also occurs in routing time so that work enhance through routing base congestion control technique.

S.Karunakaran et al [12] proposed a "cluster based congestion control (CBCC) protocol that consists of scalable and distributed cluster-based mechanisms for supporting congestion control in ad hoc networks". The clusters autonomously and proactively monitor congestion within its localized scope. The present approach improves the responsiveness of the system when compared to end-to-end techniques. After estimating the traffic rate along a path, the sending rate of the source nodes is adjusted accordingly. Thus this protocol look forward the injection of dynamic flows in the network and proactively adjusts the rate while waiting for congestion feedback.

Kazi Chandrima Rahman et al [13] proposed "explicit rate based congestion control (XRCC) for multimedia streaming over mobile ad hoc networks". XRCC addresses the problems that TCP faces when deployed over ad-hoc networks, and thus shows considerable performance improvement over TCP. Although XRCC minimizes packet drops caused by network congestion as compared to TCP congestion control mechanism, it still suffers from packet drops.

Hongqiang Zhai et al [14] proposed "a novel rate based end-to-end Congestion Control scheme (RBCC)". Based on the novel use of channel busyness ratio, which is an accurate sign of the network utilization and congestion status, a new rate control scheme has been proposed to efficiently and reliably support the transport service in MANET. In RBCC, a sub layer consisting of a leaky bucket is added under TCP to control the sending rate based on the network layer feedback at the bottleneck node.

Emmanuel Lochin et al [15] proposed "a complete reliable rate-based protocol based on TCP-Friendly Rate Control (TFRC) and selective acknowledgement (SACK) mechanisms". This design also introduces a flow control variable, which regulates the sender to avoid packet loss at the receiver due to a slow receiver. In this mechanism, there is no packet loss due to flow control, at the receiver, and applies a smoothness criterion to demonstrate that the introduction of the flow control inside TFRC does not alter the smoothness property of this mechanism.

5. PROPOSED WORK

Congestion control is associated to controlling traffic incoming in Mobile Ad hoc Network. . To avoid congestive crumple or link capabilities of the intermediate nodes and networks and to reduce the rate of sending packets congestion control is used extensively. Congestion control and dependability mechanisms are combined with buffer enhancement and AOMDV to observe the congestion control without explicit feedback about the congestion status and without the intermediate nodes being directly intermittent. The congestion control status is required to identify the congested link and the number of relay nodes that deliver the data in same rate in network by that the congestion is heavily deployed.

This proposed scheme the main point is to observe the load in each node. Here the multipath means to execute route meaning to select the multiple path in between sender to destination and how many number of nodes in them. The buffer capacity of each node is evaluated through queue length (the capacity of nodes in network to hold the data packets temporary) in a single path from multiple paths and how many numbers of nodes in single path and calculates the capacity of all nodes which are the part of multiple routes in network. The rate controlling is required to not enhance the buffer capacity to much. If the sender controls the data rate the in that case the stored packets in buffer too much reduced.

Step 1: Set Initial Parameter

Set node = m; // m number of mobile node

Set Sender = s; // s € m s sender that belong into m node

Set receiver = r; // r € m s receiver that belong into m node

Set protocol = AOMDV; // Routing protocol

Set rr = 550m // maximum radio range of node

Step 2: Broadcast Routing Packet for Searching Destination

Route_Rreq(s, r, rr) // broadcast route request packet

If (rr<= 550 && nexthop==”true” && nexthop != r)

{

Record incoming and outing connection in each node's

next hop find ;

r-table = create route table;

Work until destination search;

}

Else if (nexthop = r)

{

If Find (number of paths from s to r) // all path are shortest base

{

Select only three paths for communication

}

}

Else {

Receiver out of range;

}

Step 3: Send Data ()

Step4: Check each path and node load through trace file

If (any path or node drops the packets)

{

Set queue for minimizing drop;

If (drop data)

{

Minimize load from sender using rate control base;

}

}

Else {

Normal flow of data through all paths

}

6. PROPOSED ARCHITECTURE

Congestion problem in network is challenging issue that arises from limited wireless channel availability. In this architecture we design various numbers of modules and its connectivity, that architecture defines internal, middle and outer view of the proposed work. In internal module we update the queue module as well as AOMDV protocol and generate object files, that object file provides the interlink between ns-2 with TCL (tool command language) and after that we generate output file name as network animator, trace file and udp, tcp file. NAM file use as animation purpose and trace file pass to the AWK script and retrieve the information like load of each node, packet delivery ratio etc.

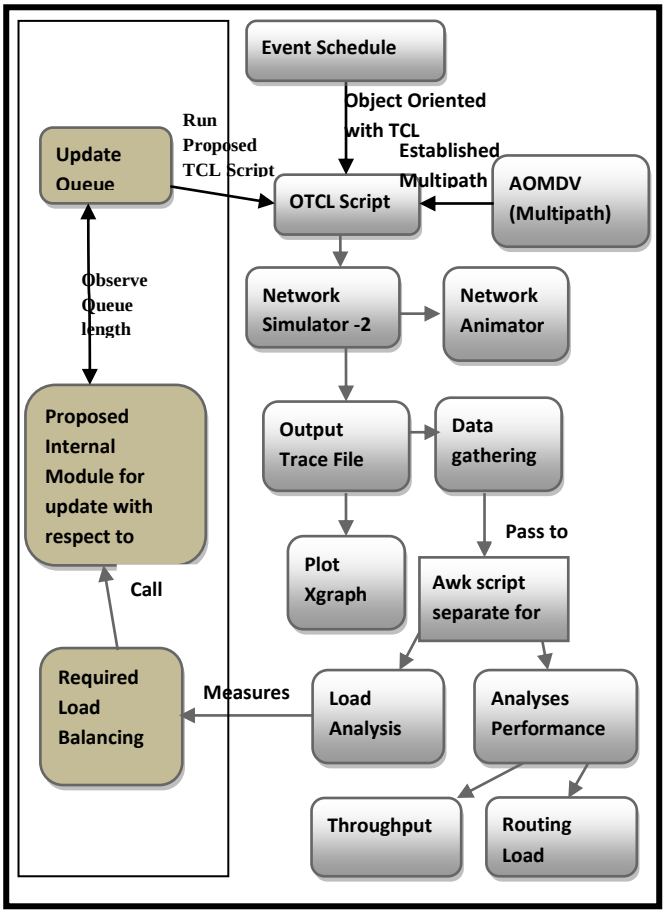

Figure 1: Proposed Architecture

7. SIMULATION TOOL

The proposed method SAODV was simulated in NS 2.31 (Network Simulator). NS2 is discrete event simulator developed by the University of California in Berkeley. The random mobility waypoint model [16, 17] is used to generate a random waypoint for every intermediate node between the source node and the destination node. . At network layer routing protocol used for simulation is AOMDV. Nodes send constant bit rate (CBR) traffic at varying rates over UDP connections. Each packet is of size 512 bytes. The simulation is done for the duration of 200 seconds. NS is written not only in Otcl but in C++ also. For efficiency reason, NS separates the data path implementation from control path implementations. In order to reduce packet and event processing time (not simulation time), the event scheduler and the basic network component objects in the data path are written and compiled using C++.

7.1 Performance Metrices

The performance matrices are required to measure the performance of proposed and other simulated schemes. Those matrices are cleared that the network performance of proposed scheme and normal routing scheme. There are following different performance metrics have showed the results on the basis of following:

7.1.1 Routing overhead:

This metric describes how many routing packets for route discovery and route maintenance need to be sent so as to propagate the data packets

7.1.2 Throughput:

It is defined as the total amount of data a receiver actually receives from sender divided by the time taken by the receiver to obtain the last packet.

7.1.3 Packet Delivery Ratio:

The proportion between the amount data packets actually received and incoming data packets. It is actually a percentage of data received in network evaluated.

7.1.4 UDP Packets Received Analysis

In this UDP performance evaluated the number of data packets are received at destination. ratio

8. SIMULATION RESULT

The simulation results are represents the performance of original AOMDV and proposed rate based buffer enhancement scheme with AOMDV routing protocol.

8.1 PDR Packet Delivery Analysis

PDR (Packet Delivery Ratio) is deliberated to observe the percentage of data is delivered in network. The PDR is the percentage ratio of number of packets is received from sending in network. In this graph the PDR analyses of original AOMDV and proposed rate control storing and forward enhancement technique with AOMDV is observed.

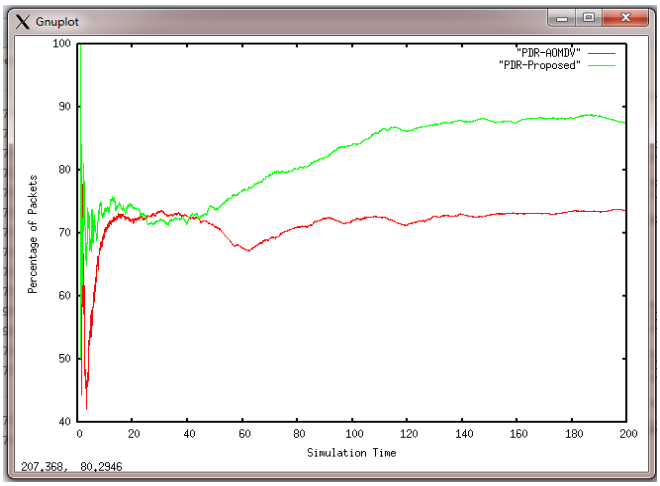

Figure2: PDR Analysis

In original AOMDV if the existing path is not able to forward the data then in that case the alternative path is select to deliver the data in network for balancing the load but not control the data rate of sender and not enhance the buffer capacity of nodes that deliver or forward the data to next neighbor or destination in network. In this graph, in case of AOMDV the PDF is about 73% but in case of proposed AOMDV the PDF is about 86 %. It means the proposed scheme is balance the load properly in network and improves the network performance.

8.2 Routing Packets Analysis

Routing packets are delivering in network to established connection in between sender and receiver. It the destination is confirmed then the destination has send the connection confirmation packet to receiver then the data delivery is started in network through sender. The routing packets are playing the important role to deliver the data in network but if the more number of routing packers are deliver in network showing the poor performance because it indicates that due heavy load in network the strong link is not established in

network. In this graph the routing load in case of AOMDV routing protocol is high, about 7500 packets but in case of proposed scheme the routing load is low about, 6750 packets. The proposed rate control and node buffer string capacity enhancement technique balance the load properly by that the possibility of retransmission is reduces and routing performance are increases. The original AOMDV protocol are able to control the overhead properly.

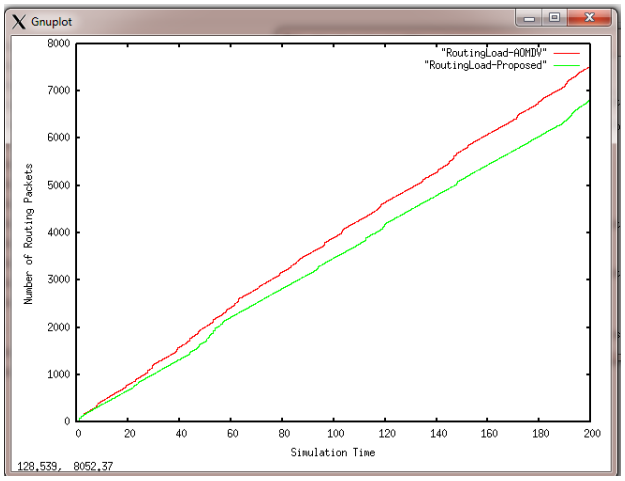

Figure 3:Routing Packets Analysis

8.3 Throughput Proposed

Throughput is the deliberate through number of dat packets are received at destination in per unit of time in network. It means the higher receiving of packets are showing the better throughput but also enhance the load in network. In this graph the performance analysis of original AOMDV and proposed AOMDV are considered. The throughput performance of proposed AOMDV is much better improves the receiving at destination. The throughput in case of proposed AOMDV routing is about 1200 packets/seconds but in case of original AOMDV is about only 830 packets / second. This result shows that in time between 10 to 50 seconds the path is lightly loaded then in original AOMDV the data is deliver and performance is better than proposed but in proposed identified the data rate then measure the buffer capacity then data is deliver by that the throughput degrades. Now after the 50 seconds the load in network increases then the original AOMDV performance is degrades but the proposed AOMDV performance is improves at the end of simulation.

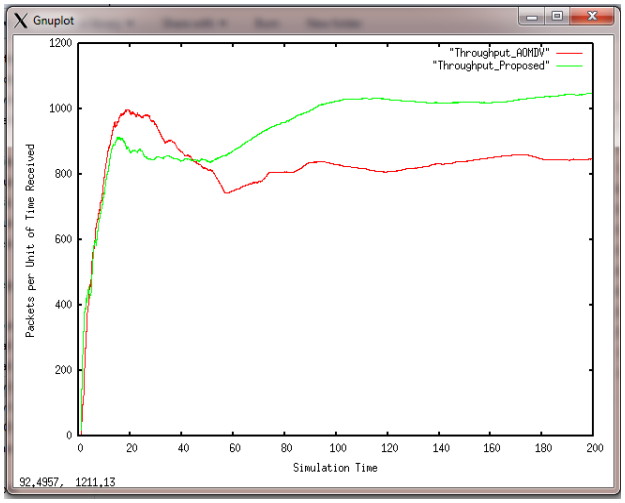

Figure4:Throughput Analysis

8.4 UDP Packet Receiving Analysis

User Datagram Protocol (UDP) is the transport layer end to end connection less protocol. in this protocol the sender is not confirm about the receiver it will ready for data receiving or not and start data delivery in network. Due to that the possibility of packet dropping in network is more and also because of that the UDP communication also unreliable communication. It means the performance of UPD protocol is completely depends on the load on network.

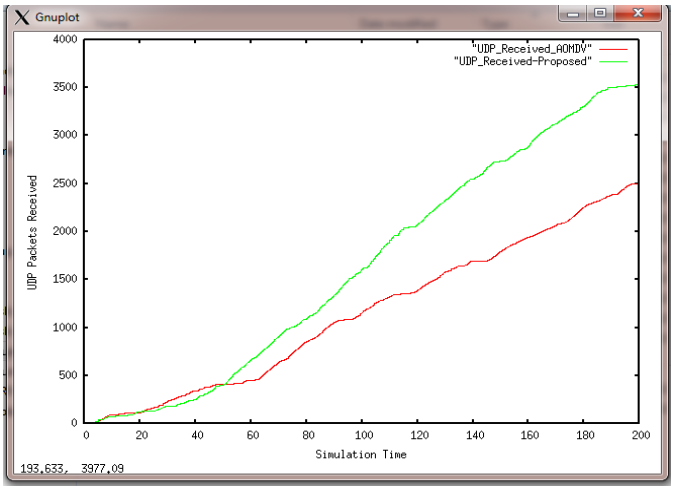

Figure5: UDP Receiving Analysis

This graph illustrates the UDP packer receiving analysis of original AOMDV and proposed scheme with AOMDV. In original AOMDV about 2500 packets are received in network but in case of proposed rate control and buffer storing improvement scheme about 3500 packets are received in network. This is shows that the performance of proposed scheme is much better and provides reliable communication from unreliable protocol.

8.5 Packet Dropping Reasons Analysis

Packets drooping in network are degrades the network performance and also degrades the routing capability of routing protocol mentioned in table 1. Heavy packet drooping enhance the possibility of retransmission. In this table the different packet packets dropping reasons are mentioned in case of original AOMDV and proposed AOMDV network. The proposed scheme is clearly show that it minimizes the packets drooping in network and enhance the routing performance of AOMDV routing protocol.

Table 1 Packet Dropping Reason

Drop Reasons	AOMDV		Proposed AOMDV	
Drop from ARP	85	0.28%	123	0.38%
Drop from IFQ	2284	7.41%	0	0.00%
Drop from CBK	459	1.49%	412	1.26%
Drop from NRT	125	0.41%	319	0.98%
Total Drop Via Congestion	2769	8.98%	1614	4.94%
Total Drop	5722	18.56%	2468	7.56%

9. CONCLUSION

Mobile nodes in a MANET acts as a both host and router relaying traffic on behalf of other nodes in the network, which characterize MANET by simple of exploitation in ay where. On the other hand, mobile node has restricted computational capacities like bandwidth and buffer suspect. Additionally, mobile nodes join and leave the network dynamically that leads to topological changes. The demands for quality based multipath routing have resulted in considerable attention by researchers in the area of load balancing in MANET. There is a tendency in traditional Mobile ad hoc routing protocols to use intermediate nodes for large number of routes. This route selection is based on the routing protocol connection establishment procedure. The new routing approach we proposed with AOMDV routing protocol between a pair of source and destination nodes using intermediate nodes which are rich in resources like bandwidth and having a capability to handle the heavy load in network that reduces the possibility of congestion. The proposed scheme is maximized mobile nodes packet delivery ratio, throughput lifetime and load unbalanced as a result the packet drop because of different reasons is minimized. After the entire packet dropping due to buffer space is zero in network and rest drop matrices is also improved.

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