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NOVEL CONGESTION CONTROL MECHANISM TO IMPROVE PERFORMANCE OF MOBILE ADHOC NETWORK WITH QUEUE MODEL

DR. S. HEMALATHA[1*], **KOMALA C R[2], A. AJINA[3], SURESH BALAKRISHNAN THANGASAMY[4], G. VIKRAM[5], RAMU KUCHIPUDI[6], PRAMODKUMAR H KULKARNI[7] DR. HARIKUMAR PALLATHADKA[8]**

[1]Professor, Department of Computer Science and Business System, Panimalar Engineering College, Chennai (Tamil Nadu), India. Post Doctorial Research Fellow, Manipur International University, Imphal, Manipur, India.

[2] Department of Information Science and Engineering, HKBK College of Engineering, Bengaluru, Karnataka 560045, India.

[3] Department of Artificial Intelligence and Machine Learning, M S Ramaiah Institute of Technology, Bengaluru, Karnataka 560054, India.

[4] Department of Computer science and Engineering, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences, Thandalam, Chennai, Tamil Nadu 602105, India.

[5] Karunya school of Management, Karunya Institute of Technology and Sciences, Coimbatore, Tamil Nadu 641114, India.

[6] Department of Information Technology, Chaitanya Bharathi Institute of Technology, Hyderabad, Telangana 500075, India.

[7] Department of Electronics and Telecommunications, Dr. D Y Patil Institute of Technology, Pune, Maharashtra 411018, India.

[8]Vice Chancellor and Professor, Manipur International University, Imphal, Manipur, India.

E-mail: pithemalatha@gmail.com, komala.satisha@gmail.com, ajinajaya@gmail.com, sbalakrishna30@gmail.com, vikram@karunya.edu, kramupro@gmail.com, pramod75kulkarni@gmail.com, harikumar@miu.edu.in

ABSTRACT

Self organized communication network without relay on any infrastructure is named MANET. Transmission of packet in reliable communication will be done with the help of the transport layer which is having the responsibility of flow control, congestion control etc. If the packet transmission is fails and not reaching to the destination node says that the entire network forming is vain. This article proposed the novel algorithm and better buffer management technique to resolve the Congestion problem in MANET .The novel algorithm does the role of congestion avoidance technique eliminating unwanted packets, avoid multiple flooding, detecting the attackers and dropout the packet. Buffer management technique support for maintain the buffer in a threshold level , if reaches the threshold level and refine the buffer space by keeping only data packets and removing remaining all other packets .This buffer management and novel congestion algorithm help to the MANET to improve the performance of the communication network with the support of queue model .

Keywords: *MANET, Congestion Control, Routing Protocol, Queue Management, NBM Algorithm*

1. INTRODUCTION

Each and every player In the MANET protocol stack is responsible for manipulating of the data to transfer to the next hope. In the MANET, functionality of the every layers functionality is determined by the performance factors. The major performance factor of the MANET [1] [2] [6] [11] is relies on the transport layer which perform the flow control, congestion control, delivery of the packets.

The performance of this layer is computed with the support of the performance factors of delay, packet delivery ratio, packet loss, end to end delay. All these factors will be computed with the background support of buffer or queue management

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in the node. Well buffer management technique is needed for achieving good network performance.

All of the packets to be transported are queued in the source node. The queue will operate on a first come, first served basis, which means that the packets that arrive first in the node queue will be forwarded to the next hope. Queue management in MANET is one of the most difficult tasks in the network in terms of improving Quality of service (QoS), which also helps with congestion control and avoidance. Figure 1 depicts three distinct queue management schemes: passive management, active management, and proactive queue management.

The most straightforward management buffer implementation option is passive management, in which the buffer queue is relayed on losing the packet whenever the buffer is full and there is no preventive technique for packet loss. The best example is drop tail, in which the buffer dumps packets as it becomes full. The Proactive Queue Management technique use TCP congestion management knowledge to selectively delete buffer packets.

The third category active management strategy is a preventive technique, in which the sender node is notified when the buffer level of the nearby node gets full, and the sender automatically stops delivering the packet to the next node. RED (Random Early Detection), REM (Random Exponential Marking), SFQ [22] [25] (Stochastic Fair Queuing), FRED (Flow Random Early Drop), RED-PD: Random Early Detection with Preferential Dropping, SRED: Stabilised Random Early Detection, BLUE, and AVQ: Adaptive Virtual Queue is the best examples of this type of technique.

RED operates on the basis of buffer capacity; when a buffer is empty, the complete receiving packet is accepted; otherwise, the receiving packets are rejected. REM is an active queue management system that measures congestion rather than queue metrics. Stochastic Fair Queuing allows for numerous packet queues as opposed to a single queue that supports the FIFO technique.

Flow Random Early Drop and Random Early Detection with Preferential Dropping is a modified variant of RED that uses varying bandwidth active flow accounting for buffer maintenance and drop.

In contrast to RED, Stabilised Random Early Detection focuses on active packet flow rather than available queue capacity. The BLUE active management technique includes a congestion notification alert.

The Adaptive Virtual Queue maintains queue length stability, resulting in minimal delay and packet loss in queue management. Using the divide and conquer technique, this research work offered a new way of queue management and support for collecting lost packets from the intermediate node.

. Quality of Service (QoS) is an important parameter for making the network in to the wide usage ***B.Purushotham, Dr.Ch.D.V Subba Rao (2019)*** *[26].* To achieve the best QoS, the major concentration is required in managing the internal buffer of the nodes since the packet delivery achieved gives excellent QoS. Every node in the MANET having the internal buffer for receive the packet and forward to the next hop, this procedure achieved the packet reach to the destination.

Three category of buffer management are in MANET called active, passive and proactive buffer management. All depends on the managing the internal buffer from overflow. Managing the internal packet whenever the buffer is fill names as passive, drop tail is the best example of this category. Selectively dropping the packet when the buffer gets full named as proactive Queue management. third category is preventive technique of buffer management , alert the neighbour about the buffer status and makes the neighbor node not to send any packets , the best example of this category are Random Early Detection ,Random Exponential Marking and etc .

Research survey made from the year 2013 to 2021 and the impact of the research survey states that One of the major challenges in MANET nodes are providing QoS **Prachi Goyal** et al [8] and more research need for this aspect .Especially in the smart mobile devices when making the communication on short range **Shahriar Kaisar, et al** [22] required additional research to provide QoS. Research carried out in VANET **Banoth Ravi et al** [7] to concentrates on supporting QoS using the stochastic model that predicts traffic on the VANET in order to improve QoS. Separate vision examined to provide a quality of service in the wireless devices to improving the buffer management strategies.

Set of research work were done related to the buffer management with the support of routing protocols such as QRBP is a quota-based routing method with finite buffer management **Mohd Yaseen Mir and Chih-Lin Hu** [24] suggested using heuristic algorithms which based on more numerous measurements , Routing protocol for Throw-Box-based network topology that combines the stored and forward routing protocols **S. Pirzadi, et al** [19] method used the pick the parameter value in advance, even if done in advance, the mobility value would not be used when needed. Effective Network Behaviour Analyse (ENBA) for route sections to control congestion in MANETs **Kankane et al** [15] but in this method the high data rate could not be achieved. Enhanced path routing with buffer allocation (IPBA) technique **Rajendra Kumar et al** [14] for preserving packets from packet loss utilising the coupling node selection algorithm but connecting the nodes by using coupling is practically impossible. Finally MANET-DTN routing protocols with the annealing process to optimise MANET delay **Pirzadi et al (2022)** [10] parameters such as current node speed changes, node movement direction, vacant space, delay, forwarding message previous but the parameter values collected and estimated in advance

Set of research group were focusing on buffer management strategy to provide better buffer management in MANET. First priority-based buffer management approach (PBMT) with a threshold for managing **Srivastav, S.K., Tripathi, M.M.** [20] but This work does not address dropping packet selection if the highest priority packet is in the queue. Second buffer aware route finding system with residual buffer size and knapsack algorithm support **Sanjay** [18] but this system could only be employed in reliable communication locations. Third Buffer monitoring-based TCP/IP management method **K Abdul Rasak** et al [17] will have an impact on how the TCP/IP protocol functions and is not ideal for high traffic flows between MANET nodes. Fourth HDELL-MCT method **Mangasuli et al** [12] for transferring multimedia material in crisis situations, however, this comparison was done in a non adaptive propagation mode. Finally Reactive buffer management scheme known as the Buffer Occupancy Estimation Model given in **J. Singh** [4] However, when the nodes cause buffer congestion, this paradigm reduces the overall quality of the messages.

The author of Khan et al [16] drives an analysis on MANET in terms of internal and external security threats and justifies the analysis when the network nodes' packets from the buffer were misrouted. Mechanism for detecting packet dropper attackers in the network layer **Venkat Reddy et al** [21] using packet processing capabilities, these parameters, however, support packet dropper attackers but will not fully help detecting the packet dropper attacker due to MANET node characteristics. The Active queue Management technique for NB-IoT to control packet dropping **Jafri et al** [9] using Aggressive Random Early Detection which is neither desirable nor adequate for successful communication. Congestion control strategies and presented centralized congestion control methods utilizing Novel Rate Aware-Neuro-Fuzzy based Congestion Controlling strategy **Mohan and Vimala** [13] this strategy will not accomplish the required PDR if the congestion window is expanded, as planned as a feature work of this study. Adaptive active queue management (AAQM) approach **A. Alshahrani et al** [3] to manage the queue in a buffer to avoid congestion and packet drop. This AAQM algorithm makes a choice on the buffer packet based on the Dp (Dropping Probability) values. However, this strategy is entirely dependent on the Dp value and cannot guarantee that the dropped packets are not data packets. Group of research carried out the cross layer approaches **Mohana Priya** [23] using bottom three layers of the MANET, but it takes more parameters to estimate to get successful value. **Jinbin et al** [5] introduce the forward degree concept and forward degree strategy to measure the node's ability to transmit messages and enhance delivery rate However, this result was only accomplished by keeping the hop count under 5.

Section 2 covers the related survey-based buffer management, followed by the novel queue management proposal, problem identification in section 3, algorithm proposal in section 4, simulation in session 5, and conclusion regarding the proposed work implementation in section 6.

2. RELATED SURVEY ON QUEUE MANAGEMENT SCHEME AND CONGESTION CONTROL SCHEMES

To improve the performance of the Transport layer, congestion control must be improved, as well as a better queue management method implemented. This section describes the various research projects linked to the congestion control technologies employed in the MANET.

[27] S. MOHAN, P. VIMALA, 2023, authors suggest that standard MAC protocol for congestion control and improving QoS. Fuzzy based congestion control mechanism was used to detection congestion. AIACOAR protocol and ECC encryption used for finding out optimal path and enhance the secured multi hop scheduling .Initially congestion was defined to overcome the delay, data

rate, overhead and throughput also concentrated the PDR, END. Proposed work implemented using MAT Lab and compared with compared to the existing AIFSORP and LF-SSO, PDR value reaches 99% PDR and low delay, transmission time 0.24s. However it require to maintain the higher transmission rate to maintain the threshold balancing which make more pressure to congestion control , system performance need to improve to minimize the latency and queue delay.

[28] Arnas Sofyan, Vera Suryani, Hilal H. Nuha 2023 , authors made IEEE wireless network 802.11 performance comparison between the TCP AFW and TCP FeW. The Research comparison reveals that TCP Few performs good than TCP New Reno, but the TCP AFW outperforms 1.12% higher throughput than TCP Few when make simulation in NS2 with limited , random, minimum modification of the scenario. After the simulation the research finds implement TCP AFW does not require more changes in Traditional TCP , window growth rate is $(0 < \alpha < 1)$ even in congestion .Finally for handling packet loss new algorithm suggested to address congestion control in TCP AFW.

[29] Ganesha M and Dr Sarvottam Dixit 2020 , authors finds that network gets congestion due to excessive amount of traffic and link failure , and planned to balance the nodes load to achieve the better packet delivery thus proposed the load balancing network congestion control among the nodes which supports for nodes running beyond the congestion . The proposed work shift the traffic from the crowed path to the less congestion route path even the route has more hop count , and simulated protocol TALB-AODV compared with AOMDV which increases the life time , energy and balancing the traffic and congestion as well packet loss.

[30] Seyed Salar Sefati, and Roya Zareh Farkhady 2023, Authors invented Ant Colony optimization algorithm for giving solution to the congestion in wireless network. The research work formed a cluster head, ACO Algorithm send the packet to the cluster head which find out the route analysis using Tabu Search a forward the packet to the route. The proposed work is simulated and compared with the same data set to other algorithm ACSRO algorithm, FCOABC algorithm, and Flock-CC algorithm and set the congestion route when the path has more than 70% threshold value. The simulation results achieved the less packet loss, better node life time, energy optimized but finding the route based on the traffic threshold value and making alternative route path is a cluster head node overhead.

. [31] Nibedita Jagadev,Binod Kumar Pattanayak,Ahmadkhader habboush, Bassam Mohammad Elzaghmouri, Mahmoud Ali Al Shugran 2023 , authors proposed the ABMM which uses the FBRA band with sharing concept to prevent the congestion in MANET. The algorithm uses the channel utilization of each node and queue length to decide the congestion status. The sender nodes check the channel utilization for sending the packet received node verify the essential files and band width of the route then send ACK to the sender. comparing with the traditional congestion control FBRA achieves better END, Higher PDR, less Error rate but computing the parameter value of the channel utilization and queue length will be done by the control signal is cumbersome .

[32] Liu, X.; Amour, B.S.; Jackal, A. 2023, Authors proposed the Markov decision process using reinforcement learning algorithm to address the congestion control in VANET dynamic condition . The RL algorithm uses the current channel conditions of packet delivery and channel congestion to decide the traffic. The proposed QBACC approach model beats another two dynamic model comparison but this work requires maintaining the congestion work in less critical level.

[33] M.M.Karthikeyan, M.A.Christy 2023, in this article, authors invented hybrid congestion control mechanism with the support of optimal data handling and the value of time taken for transmission. this hybrid congestion algorithm minimize the delay, and improves the throughput but the calculation of time taken for transmission and optimal data handling are create additional overload to the algorithm.

[34] Ouladdjedid, L.K.; Calafate, C.T.; Kerrache, C.A.; Guellouma, Y. 2023 , authors introduced the 5G communication technology in VANET to build heterogeneous IoV, to solve the MAC layers ratio channel congestion problem while vehicle density increases. DCC congestion mechanism and ETSI mitigate channel congestion achieves the better parameter improvement , simulation results produced error margin 5% and decrease the latency but this research work produce the low performance while the VANET channel load increasing .

[35] N Thrimoorthy Somashekhara Reddy D Chandramma R Soumya Unnikrishnan Vanitha K 2023 authors invented Ornstein–Uhlenbeck Transition and Cache Obliviousness Neural Adaptive (OUT-CONA) congestion control model

with adaptive reinforcement learning algorithm for IoT enabled wireless mesh network .First design uses Gauss and Markov Processes to scheduling which achieves energy reduction. LTSM with cache congestion formed the Cache obliviousness based congestion method, simulation evaluation proved good throughput with conventional mesh network. But the stage by stage of processing of the congestion work is lead to time variant in packet flow.

[36] Augustine Chidiebere Onuora, Eyo Edmund Essien, Felix Ukpai Ogban 2023 In this article the authors proposed the Hybrid protocol which combines the features of AODV, OSLR also named as Responsive Hybrid Routing .Simulation work implemented with NS 3 along 20 to 200 nodes and compared with OSLR and AODV, the results proved that better PDR, END, Jitter and throughput but this work consumes some mitigate delay while transferring the packets in MANET.

From the introduction and Literature survey different congestion control mechanisms were proposed by different authors but all the method could not prevent the congestion control as well as could not improve the all factors of performance metric in MANET. Some mechanisms achieve end to end delay, remaining achieves individually the packet loss congestion, packet loss throughput, packet delivery ratio in MANET. Still the research is needed to provide a new method to overcome all the congestion control mechanism and improve the performance of the MANET. This article proposed a method for overcome congestion control in the MANET with the support of better buffer management and Novel message passing mechanism.

3. PROBLEM IDENTIFICATION

Finally, a literature review of all three categories of buffer management approaches will be conducted in passive, active, and proactive buffer management; however, further research is required before suggesting a novel strategy to combat packet drop in MANET. Passive buffer management is used when the buffer is full, active buffer management is used before the buffer is full, and proactive buffer management relies on TCP congestion control. All of the categories do not provide a dependable strategy for successfully controlling the buffer. Congestion control mechanisms are proposed in the literature survey section; each mechanism must apply a unique technique to attain the desired MANET performance.

4. PROPOSED ACTIVE BUFFER MANAGEMENT ALGORITHM

According to the literature review, all three categories of buffer management strategies will be done in passive, active, and proactive buffer management, however further research is required before presenting a novel method to combat packet drop in MANET. Passive buffer management is used when the buffer is full, active buffer management is used before the buffer is full, and proactive buffer management relies on TCP congestion control. All of the categories do not provide a dependable strategy for successfully controlling the buffer.

In this article, a novel algorithm is proposed that monitors buffer capacity and applies the strategy to the buffer when it is half full. This proposed algorithm always maintains the buffer capacity between 50% and 90%. The reason for retaining the buffer size range is to control the congestion control in the MANET.

Novel Buffer Management (NBM) is the name given to the proposed MANET active buffer management technique. Receiving buffer information could be classified as actual packets, router requests, router responses, synchronization, Ack, and so on. This algorithm keeps track of the buffer size information, and when the buffer size reaches half, the algorithm will automatically invoke the controlling the packet. This algorithm begins verifying the buffering information, except for dependable data packets, and the remaining categories of packets are eliminated from the buffer. The detailed work flow is given in the visual depiction in Figure 2, and the NBM algorithm stages are shown in Algorithm 1. This is accomplished by estimating the Sample Interval queue size (SIQS) and the estimated Queue threshold level (EQTL) per second by dividing the overall queue size by two. When a packet arrives in the buffer queue, the current queue length (cql) is compared to the predicted Queue threshold level (eqtll); if (cql) (eqtll), the full incoming packet is allowed into the queue for forwarding; otherwise, the NBM algorithm is executed to drop the non-data packets in the queue. The targeted queue delay Qd in each node is calculated as Qd = targetDelay * ptc, where ptc = linkBandwidth (bits)/ (8 meanPktSize).

Algorithm 1 Novel Buffer Management Algorithm for each buffer

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Algorithm 4.1 NBM for each node

1. *Calculate total buffer space occupied by the each node*
2. *Check whether it reached to the threshold let say Half of the buffer size*
3. *If reached threshold limit call NBM4. NBM*
   a) *Accept all the Data Packets*
   b) *Reject Other packets*
5. *Update the buffer space to NBM*

5. SIMULATION SETUP

The suggested Novel Buffer Management technique is tested using the Network simulator (NS2) with flow arrival rates of packets ranging from 20Mbps to 25Mbps, 30Mbps to 40Mbps, and a total of 100 nodes. Drop Tail, RED, and TCP congestion are contrasted to the NBM's active, passive, and proactive buffer management techniques.

When the flow arrival rate is initially set at 20Mbps and subsequently increases, the more packet flow and packet transmission produces congestion in the MANET. Two simulation testing scenarios are defined: a. packet arrival rate without congestion and b. packet arrival rate with congestion. Tables 1 and 2 summarise the Packet Loss Ratio NBM technique when compared to other methods of Drop Tail, RED, and TCP congestion, respectively.

The Pictorial Comparison provided in Figure 3 and Figure 4 shows that NBM algorithm packet loss is reduced and RED follows preventive strategies that indicate packet loss is less in both conditions when compared to active buffering techniques Drop Tal and TCP Congestion.

6. CONCLUSION

This study proposed the Novel Buffer management approach to overcome packet losing due to buffer overflow. This is done with the help of a network simulator, and the simulation results are compared to active buffer management, proactive buffer management, and passive buffer management. The results reveal that the proposed technique is supported for congestion control and can also be improved to overcome buffer overflow attacks in MANET.

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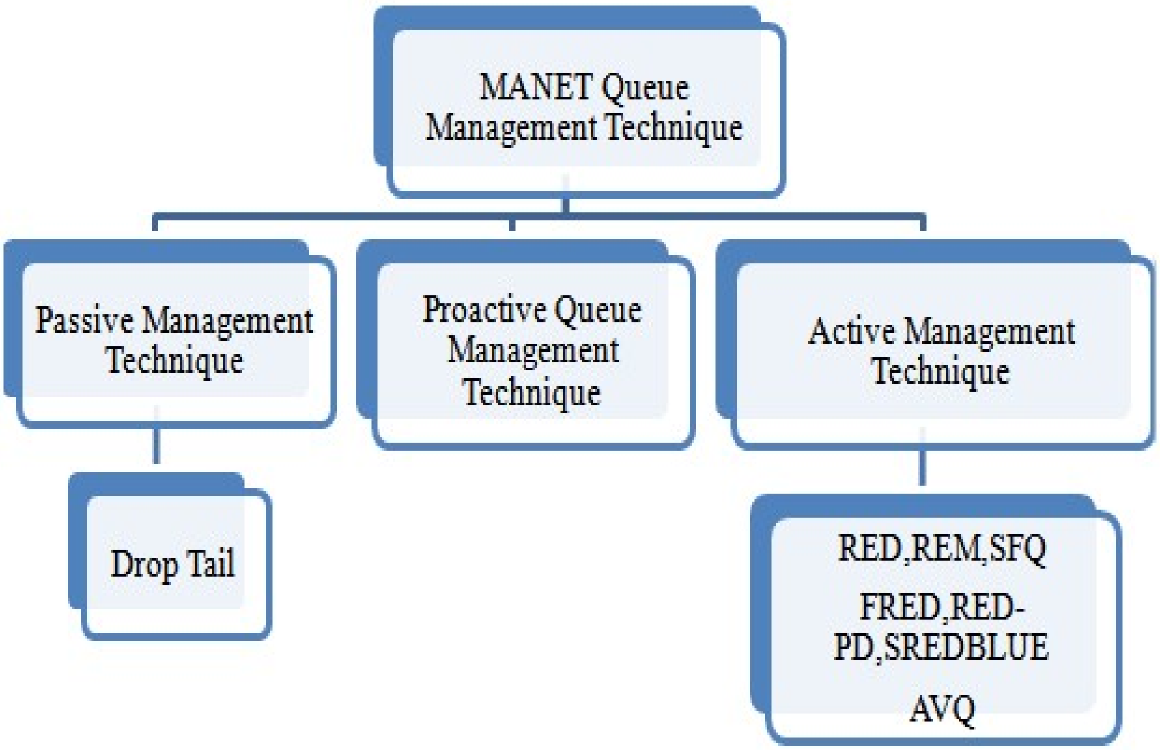

Figure 1 Classifications of Queue Management

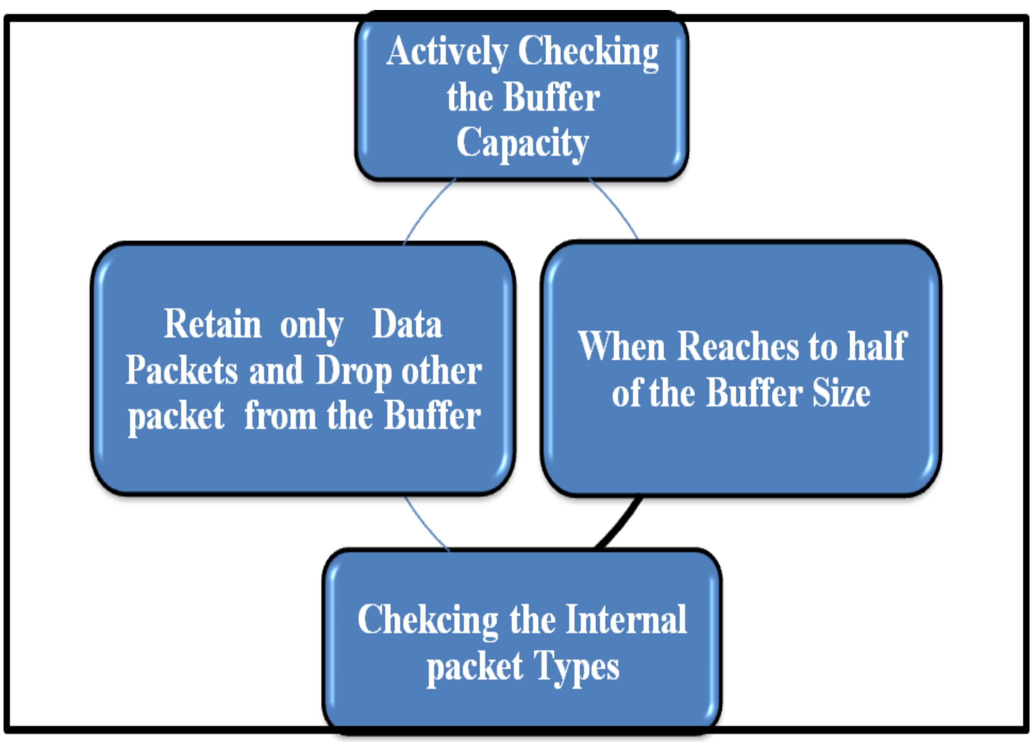

Figure 2 Work Flow of NBM algorithms

Table 1 Packet Loss Ratio without congestion

Packet Flow Rate	Novel Buffer Management Algorithm	Random Early Detection	TCP	Drop Tail
20	0.04	0.06	0.09	0.08
25	0.06	0.11	0.12	0.13
30	0.07	0.12	0.13	0.15
35	0.08	0.14	0.12	0.17
40	0.09	0.16	0.15	0.18

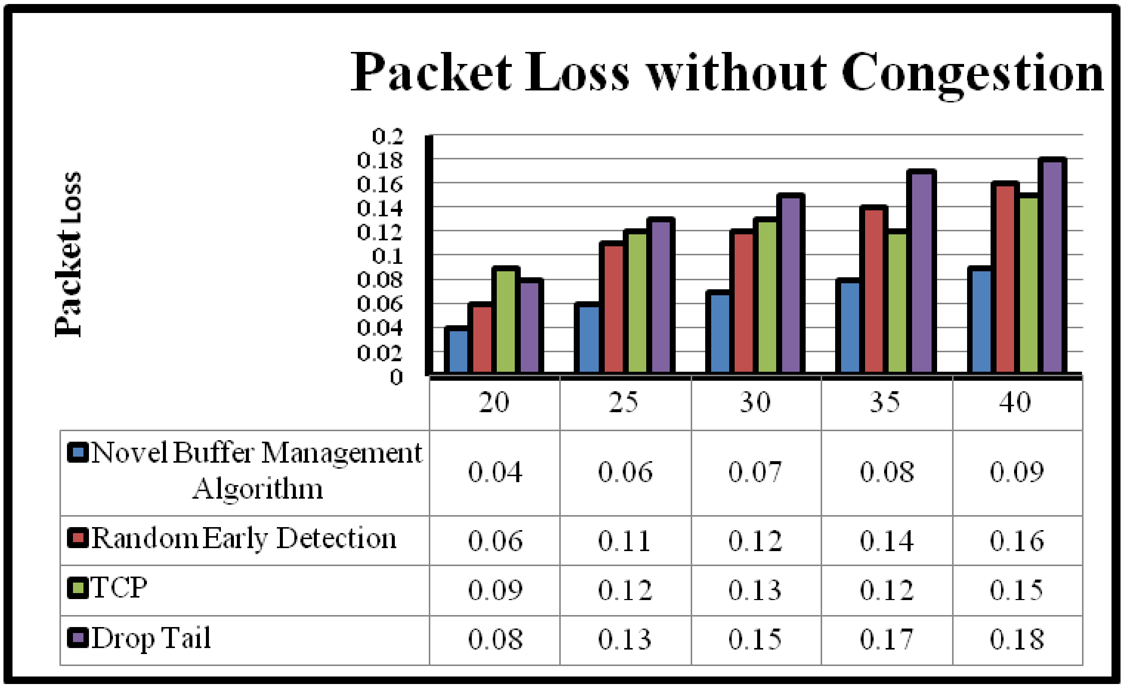

Figure 3 Packet Loss without congestion

Packet Arrival (Mbps)	Novel Buffer Management Algorithm	Random Early Detection	TCP Congestion	Drop Tail
20	0.06	0.08	0.06	0.11
25	0.08	0.11	0.13	0.13
30	0.08	0.12	0.15	0.15
35	0.09	0.14	0.12	0.18
40	0.11	0.16	0.17	0.2

Table 2 Packet Loss Ratio with congestion

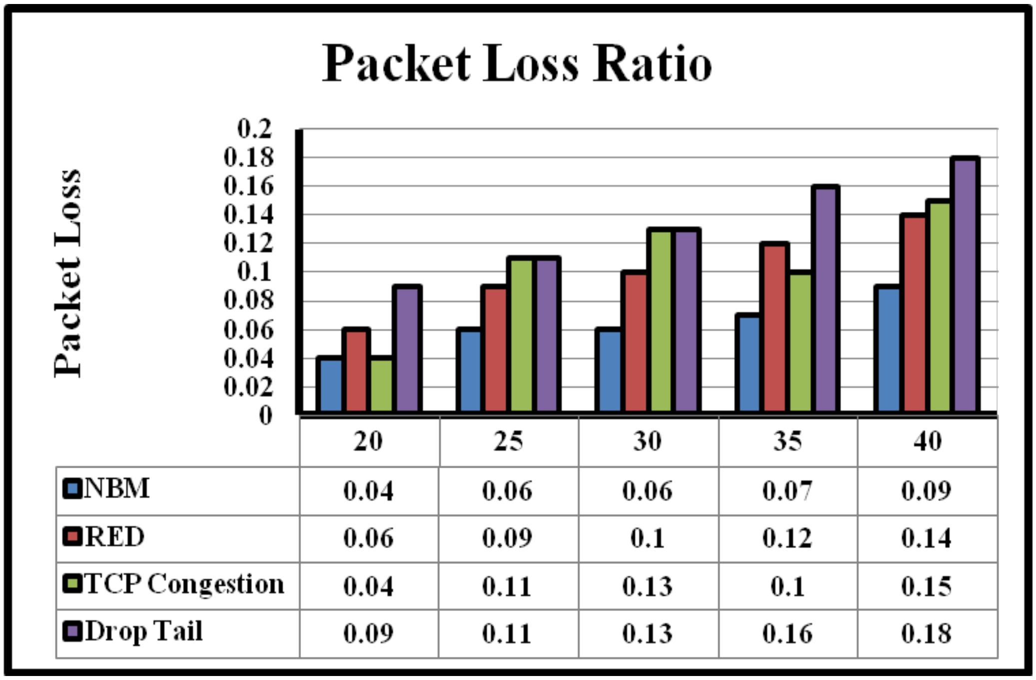

Figure 2 Packet Loss with congestion