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IMPROVING QUALITY OF SERVICE IN MOBILE ADHOC NETWORK BY DOING MISSING PACKET COLLECTION DUE TO BUFFER OVERFLOW WITH DIVIDE AND CONQUER STRATEGY

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ABSTRACT

One of the difficult problems in Mobile Adhoc Network is enhancing the Quality of Service which can be accomplished through effective packet delivery between source and destination nodes. An improved buffer management method that recovers packet loss due to buffer overflow results in a higher packet delivery ratio. Many research works were conducted to overcome packet loss, but all required some additional overload to the routing algorithm, transport layer, and could not achieve the expected results. Furthermore, existing researches could not concentrate a new vision about the collection of missing packets that could support QoS in the MANET. This research article goal was discovered to be achieving the QoS of the MANET by facilitating packet delivery to the destination. Furthermore, rather than resending all packets to the destination, the research concentrated on missing packets that were dropped due to congestion or buffer overflow in the node, as well as collecting those missing packets from the intermediate node in the route from the source to the destination. This article focuses on locating and forwarding lost packets utilizing the divide and conquer method of the route path. The proposed Divide and Conquer AODV (DVCAODV) buffer management was simulated with NS2.34 and compared with the available buffer management PBMTAODV, TCP/IPAODV, and HDELL-MCTOADV, with simulation values revealing that packet loss ratio and missing packet collection time of the proposed DVCAODV ranged from 0.04% to 0.09%.and 0.07ns to 0.12 ns respectively.

Keywords: *Buffer management, Congestion control, Divide and Conquer, Mobile Ad Hoc Networks (MANETs), Packet delivery, Quality of Service (QoS).*

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1. INTRODUCTION

In wireless communication, Mobile Adhoc Network (MANET) is distinguished as a network type that does not rely on any infrastructure-based network for communication. The critical aspect of obtaining widespread adoption is assuring Quality of Service (QoS) [1]. Effective management of internal node buffers is critical for achieving optimal QoS since it has a direct impact on packet delivery, hence improving overall QoS. Each node in the MANET has an internal buffer that receives and forwards packets to the next hop, ensuring that packets reach their intended destinations. Figure 1.1 depicts many sorts of buffer management strategies. MANET has three main methods of buffer management: active, passive, and proactive. The efficacy of each type is dependent on the prevention of internal buffer overflow. Within the active category, the drop tail mechanism stands out as a prime example, as it actively manages internal packets once the buffer is filled. When the buffer is nearly full, selective packet discarding is used for proactive queue management. The third category is preventive buffer management approaches, which include warning neighbouring nodes about buffer problems and blocking packet transmission. This category contains notable instances such as Random Early Detection and Random Exponential Marking.

The results of a research survey conducted between 2013 and 2021 highlight the considerable issue in Mobile Adhoc Network (MANET) nodes in terms of Quality of Service (QoS) delivery [2], highlighting the necessity for additional research in this area. There is a necessity for more research, particularly in the context of smart mobile devices communicating across short distances [3], to fulfil QoS requirements. Current MANET research [2] focuses on QoS support by using a stochastic model to forecast MANET traffic and improve QoS. In addition, a novel approach was investigated to improve buffer management tactics in order to optimize QoS providing in wireless devices. . QRBP, proposed as a quota-based routing solution with finite buffer management [4], takes a unique approach to routing. The Routing protocol for Throw-Box-based network topology, as defined in [5], mixes stored and forward routing algorithms to provide a novel solution to network topology difficulties. Effective Network Behaviour Analysis (ENBA) [6] targets congestion control in MANETs by segmenting routes and implementing a strategic intervention to successfully manage network

The Enhanced Path Routing with Buffer Allocation (IPBA) technique [7] optimizes routing paths by pre allocating buffer resources, which improves the efficiency of selected routes. A number of research initiatives have focused on improving buffer management mechanisms in MANETs. The endeavours began with the implementation of a priority-based buffer management method (PBMT) [8], which included a threshold mechanism for successful management. The focus then moved to developing a buffer-aware route finding system that took advantage of residual buffer size and knapsack algorithm support [9]. This was followed by the development of a TCP/IP management strategy based on buffer monitoring [10]. The fourth project includes the development of the HDELL-MCT method [11], which is designed for the transfer of multimedia material in crisis situations, hence improving buffer management skills in MANETs.
congestion.

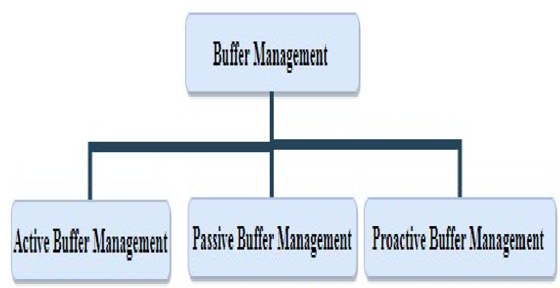

Figure 1.1 Types of Buffer Management

To summarize the succession of attempts, the Buffer Occupancy Estimation Model evolved as a reactive buffer management technique, as described in [12]. Furthermore, a group of researchers investigated cross-layer methodologies [13], which involved the lower three tiers of the MANET protocol stack, albeit with a more complete parameter estimation process to get optimal results. Furthermore, [14] established the forward degree concept and approach, which aimed to assess nodes' message transfer capabilities and improve delivery rates. Notably, these accomplishments were made while keeping a hop count under five.

All research effort related to providing QoS in MANET with respect to the accumulation of research work on buffer management. Both the

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routing-based protocol and the buffer management-based study were unable to achieve the required QoS; each method achieves some criteria while missing others. The study on MANET QoS is still ongoing. According to the poll, better QoS is obtained when all packets arrive at their destination without any gaps. According to the survey, no study has been conducted on how to collect missing packets; research on missing packets will help to improve QoS in MANET.

This Research article addresses the same issue. When a packet drops due to buffer overflow or congestion on the internal buffer, the missing packet is collected and forwarded to the destination, allowing the QoS to be achieved. Rather of collecting the missing packet from the source, it is preferable to collect it from the intermediate nodes. This article focuses on collecting missing packets in a MANET using the dive and conquers technique to achieve QoS. This article is organized as follows: Related research work was done on focusing on buffer management, which was discussed in Chapter 2, followed by the research methodology used to carry out the research in Chapter 3, simulation work set up for the proposed research explained in Chapter 4, result and discussion elaborated with the pictorial comparison in Chapter 5, and finally the conclusion and feature work of this research was highlighted in Chapter 6.

2. LITERATURE SURVEY

This article presents a detailed overview of current advances and problems in buffer management solutions for Mobile Ad Hoc Networks (MANETs). Using a variety of research projects, we investigate several strategies provided by academics to optimize packet delivery, minimize congestion, and improve Quality of Service (QoS) in MANETs. The article provides a thorough examination of each strategy, emphasizing its benefits and limits. The Table I shows the summary of the review finding with advantages and disadvantages.

Table I Summary of review

Authors	Methods	Advantages	Disadvantages
Prachi Goyal [2]	video transmission methods and QoS in H-MANET.	Studied impact of delay and routing strategies from 2013 to 2021.	Provided technical direction and future aspects of H-MANET research.
Mohd Yaseen Mir and Chih-Lin Hu [4]	QRBP	Quota-based routing with finite buffer management. - Outperforms Epidemic, Spray and Wait, Temporal Closeness and Centrality-Based (TCCB) routing schemes, and common buffer management policies. - Optimizes successful delivery rate using heuristic algorithms based on quota value, remaining time-to-live, and contact rate.	Practically impossible to connect nodes using coupling.
Kankane et al [6]	ENBA	Controls congestion in MANETs using Effective Network Behaviour Analysis. - Extends routing strategy and load management by controlling packets, links, and node pathways. - Achieves buffer capacity of nodes with higher TTL settings.	Unable to achieve high data rate.
Rajendra Kumar et al [7]	IPBA	Preserves packets from loss using enhanced path routing with buffer allocation. - Contributes to lower	Connecting nodes using coupling is impractical.

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		packet costs, END overhead, and increased network lifetime.	
Srivastav, S.K., and M.M. Tripathi [8]	PBMT	Priority-based buffer management approach for managing congestion and internal buffers. - Simulated results show higher delivery probability and lower average latency compared to existing methods.	Does not address dropping packet selection if the highest priority packet is in the queue.
Sanjay [9]	Buffer aware route finding system	Supports residual buffer size and knapsack algorithm for buffer overflow avoidance. - Improves packet loss and performance.	Limited to reliable communication locations.
K Abdul Rasak et al [10]	Congestion control system	Better buffer management strategy for MANET congestion control. - Real-time quality checking for buffer size and flow.	Impacts TCP/IP protocol functionality. - Not ideal for high traffic flows between MANET nodes.
Mangasuli et al [11]	HDELL-MCT	Method with buffer management for transferring multimedia material in crisis situations. - Performs well in terms of QoS metrics.	Comparison done in non-adaptive propagation model. - Several factors like video encoding, storage, bandwidth, and delay tolerance not addressed.
J. Singh et al.[12]	Buffer Occupancy Estimation Model	Reactive buffer management scheme for Oppnets. - Simulation shows it's a realistic and synthetic model.	Reduces overall message quality when nodes cause buffer congestion.
Mohana Priya [13]	Cross-layer methodologies	Integrates routing, physical, and MAC layers for MANET node management. - Simulation results show superior PDR, END, and throughput.	Integrating individual layer attributes challenging.
Jinbin Tu et al [14]	Forward degree concept and strategy	Measures node's ability to transmit messages and enhances delivery rate. - Experimental results show improved PDR for various routing protocols.	Achieved results only with hop count under 5.
Ahmad Karami and Nahideh Derakhshanfard [15]	RPRTD routing protocol	Overcomes buffer management problems in Delay Tolerant Networks. - Minimizes delay and requires extra storage.	Impact on TCP/IP protocol functionality.
A. Alshahrani et al [16]	Adaptive active queue management (AAQM)	Manages queue to avoid congestion and packet drop. - Achieves zero packet loss in high traffic scenarios.	- Entirely dependent on Dropping Probability (Dp) value. - Cannot guarantee dropped packets are not data packets.
Bagade et al [17]	Optimized resource framework for 5G networks	Utilizes compressed data and single buffer strategy for packet transmission. - Improves accuracy compared to existing systems.	Does not address all issues related to latency, circuit complexity, and buffer enhancement.
Banoth Ravi et al [18]	Stochastic model for QoS in VANET	Predicts traffic in VANET to improve QoS. - Utilizes stochastic model for service provision and	Challenges with service provision and scheduling despite flexible

		scheduling.	offloading mechanism.
Jafri et al [19]	Active Queue Management technique for NB-IoT	Controls packet dropping early in 5G network. - Improves END, PDR, and throughput.	- Combining RED and ERED may not be adequate for successful communication.
S. Pirzadi et al. [20]	Routing protocol for Throw-Box-based network topology	Combines stored and forward routing protocols. - Uses annealing technique to improve delay tolerance in MANETs.	Unable to collect and estimate delay, overhead, and packet loss values in advance. - Mobility value not used when needed.
MOHAN, DR. P. VIMALA, [21]	Centralised congestion control methods	Utilizes Novel Rate Aware-Neuro-Fuzzy based Congestion Controlling strategy for congestion improvement. - Achieves QoS in terms of delay, overhead, throughput, and data rate.	May not accomplish required PDR if congestion window is expanded.
Venkat Reddy et al. [22]	Mechanism for detecting packet dropper attackers	Detects packet dropper attackers in network layer. - Considers parameters like packet processing capabilities and node energy.	Parameters may not fully help detecting packet dropper attackers due to MANET node characteristics.

We conducted an extensive literature study to find relevant research articles on buffer management solutions for MANETs. A total of studies were chosen for examination, representing a diverse range of methodologies proposed by researchers. Each method was thoroughly studied, including the underlying ideas, implementation strategy, and experimental findings. Our investigation reveals a wide variety of buffer management approaches proposed for MANETs. These include quota-based routing, priority-based buffer management, congestion control systems, cross-layer techniques, and others. Each approach has distinct advantages, such as faster packet delivery, lower latency, and longer network lifetime. However, significant obstacles remain, including scalability issues, network dependencies, and restricted applicability in specific settings.

A separate category of work in buffer management was carried out based on the literature survey on buffer management. Some groups focused on buffer management through message scheduling and dropping, as well as adaptive active queue management. Another group works on the priority-based buffer management technique, a subset of research that employs the Gauss Markov model, internal parameters, and the coupling node selection algorithm. All of the categories were chosen for managing the buffer by dropping, but no technique was launched to gather the missing packets within the buffer. A new research vision is required to collect lost packets or packets that have dropped in the buffer. This research article is focusing on collecting the missing packet from the intermediate nodes in the route rather from the source using the divide and conquers strategy.

3. RESEARCH METHODOLOGY

The research objective was discovered from the literature review stated in chapter 2 that the QoS of the MANET [23] [24] [25] could be achieved by enabling packet delivery to the destination. Furthermore, rather than resending all packets to the destination, the research concentrated on missing packets that were dropped due to congestion or buffer overflow in the node, as well as collecting those missing packets from the intermediate node in the route from the source to the destination. This study article focuses on the same topic by employing the divide and conquers approach to locate the missing packet and deliver it to its destination. Assuming that this research work is correct, each node retains the delivered packet from the buffer until the transmission to live of the packet

The research methodology's design when a packet is dropped from the buffer, the details of

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the packet are sent to the intermediate nodes so that the packet can be resent to the destination. The request was sent to all intermediary nodes and may be collected from any individual node; the Divide and Conquer strategy was used to choose the target node.

Divide and Conquer Problem

The divide and conquer problem is mathematically computed for measuring complexity by dividing the problem n into a number of sub problems. Eq1 calculates the time complexity of each problem.

$$T(n) = aT\left(\frac{n}{b}\right) + g(n) \ldots\ldots\ldots Eq1$$

Where

N is the given problem
B is the number of division done on the problem which is b>1 always
The total number of subdivided problems from n and b is given by a.

T [n/b] is the time for each divided sub problem
G (n) is a time taken to combine the sub problem a in to n.

From the theorem, Let F be the non decreasing function which satisfying the eq2.

$$F(n) = aT\left(\frac{n}{b}\right) + C \ldots\ldots\ldots Eq\,2$$

Where n is divisible by b and a>=1, b>1 and c is a positive integer which state the time taken for combining the problem in to single as given in Eq 3 and eq4.

$$F(n) = aT\left(\frac{n}{b}\right) + g(n) \ldots\ldots\ldots Eq3$$

$$F(n) = \begin{cases} O(n^{\log_b(a)}), & a > 1 \\ O(\log_b(n)), & a = 1 \end{cases} \ldots\ldots\ldots Eq4$$

Algorithm 3.1 for defining the divide and Conquer in Buffer Management

Step1: Select the route from the source S node to the Destination node D

Path selected from S to D are *{I_1, I_2, I_3, in, D)*

Where I_1, I_2, I_3 ...In are odes next hop intermediate node of S and D.

Step 2: Every node maintains a focus on the internal buffer.

Case 1: any congestion occurs in the buffer send the signal to the node about the congestion and reduces the packet forwarding

Case 2: Any packet drop due to the buffer overflow

Call Divide and Conquer to collect the Mussing packet by sending the missing packet details

Step 3: Forward the packet to the destination node D by following the same selected route

Step 4: Whether the full packet is forwarded and the path is disconnected

Divide and Conquer (Intermediate node, missing packet details)

{
Let the Intermediates node be the link between the source and the missing packet node *{I_1, I_2, I_3 ...I_{im}}*
Find mid node from Intermediate nodes = *I_1, I_2, I_3 ...Iim /2*
// Take the number of nodes from = *I_1, I_2, I_3...I_{im}.*
Send the packet request to the mid node (Mid node, Packet information)
If packet received from the mid node forward to the next hop
Break;

Label: otherwise send packet send to the new mid calculated from the source to the mid
If packet received forwarded to the Destination node D

Break;

Else if go to label

Else

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Send packet request to the source node S
If packet received forwarded to the Destination node D
Break;

}

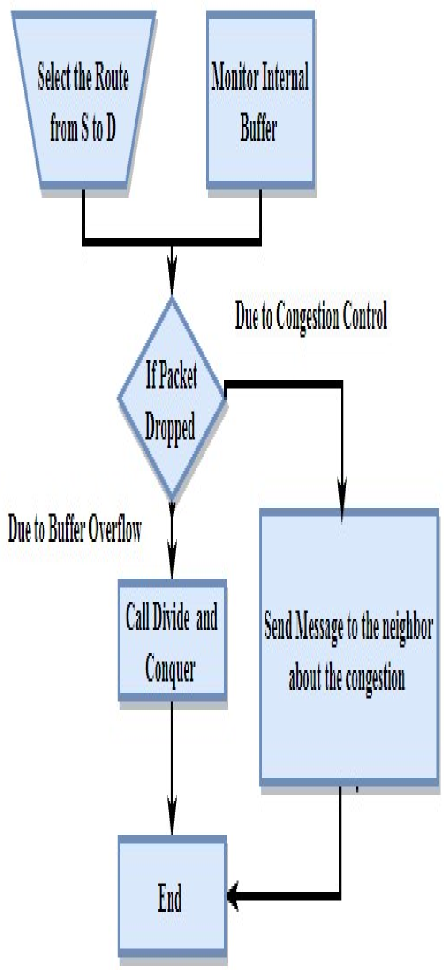

Figure 3.1 Algorithm of Buffer Management

The buffer management algorithm is explained in Algorithm 3.1, and the algorithm's operation is shown in the flowcharts in Figures 3.2 and 3.2. Because it is an on-demand route strategy, the route from the Source node to the Destination node D was chosen using the AODV routing approach during stage one. The buffer management Algorithm will monitor the internal buffer condition in the second stage. While monitoring any packet loss caused by congestion, the node sends a congestion message to its neighbor to control the congestion; otherwise, if the packet loss is caused by internal buffer overflow, the divide and conquer mechanism is used.

When the divide and conquer method is started, it looks for a mid node between the source and current nodes, sends the missing packet request to the mid nodes, and then forwards the packet to the destination node D if it is received. Otherwise, identify a new midpoint between the source and the existing midpoint and repeat the request. Finally, if the missing packet node cannot locate the middle, the missing packet request signal is sent to the source, which collects the packet and sends it to the destination node.

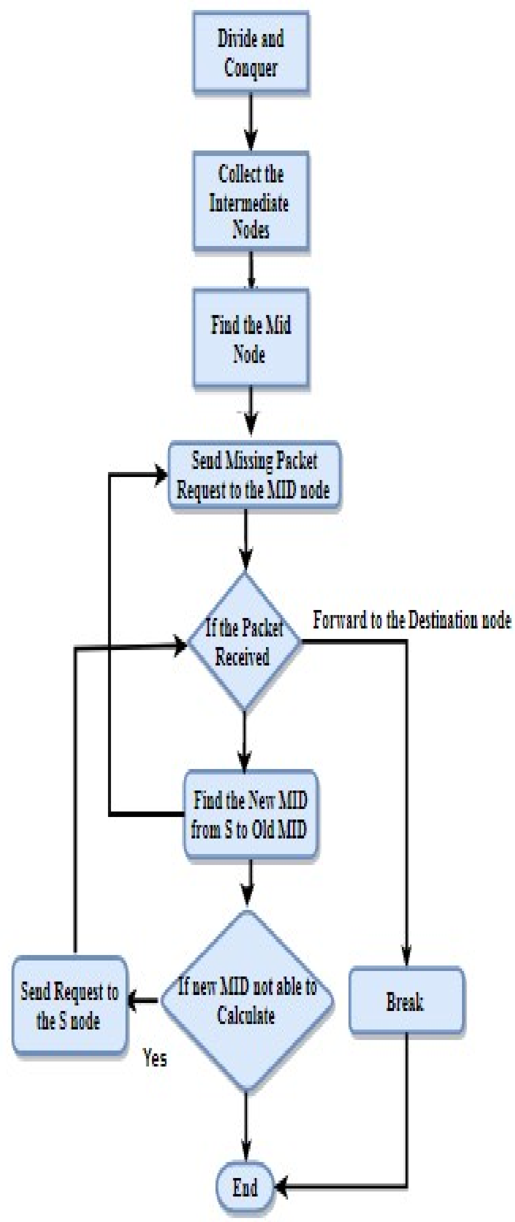

Figure 3.2 Divide and Conquer

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4. SIMULATION PARAMETERS

The proposed divide and conquer technique specified in the research methodology for collecting missing packets is implemented using the Network simulator NS2.34. Table II lists the parameters that have been defined for the simulation setup [26]. Initially, 25 nodes are defined to communicate, and the node count is gradually increased by 25 every 20ns until it reaches 150 nodes. The packet arrival rate was set to examine the buffer, initially at 20Mbps and 25 nodes, and no congestion or buffer overflow was seen in the experiment.

When the packet arrival rate was increased to 25Mpbs and 50 nodes, there was moderate congestion, which was controlled by the node by sending messages to the neighbor. When the packet arrival rate is set to 30Mbps with 100 nodes, the buffer overflow occurs, and the divide and conquer algorithm is initiated to collect the missing packets. When the packet arrival rate is set to 35Mbps with 125 nodes, the divide and conquer algorithm performs well in collecting the missing packets. Finally, when the packet arrival rate is set to 40Mbps with 150 nodes, the buffer overflow occurs, and packets begin dropping more.

. . ***Table II Simulation Parameter***

Parameter	***Value***
Network simulator	*NS 2.34*
Physical Layer	*IEEE 802.11a*
Time defined for simulation	*1000s*
Transport Layer Protocol	*TCP*
Size of the network	*500*500m*
Total nodes	*150*
Node speed limit	*2.5ms*
Routing protocol	*AODV*
Packet size	*512 bytes*
Queue	*FIFO*
Queue buffer size	*2000*
Packet Arrival Rate	*20,25,30 and 40 Mpbs*

5. RESULTS AND COMPARISON

The simulated setup was defined, and the results of the disclosed simulation were compared to the newest research work on buffers conducted by various writers. 1) Priority-based buffer management strategy (PBMT) [8] buffer monitoring-based TCP/IP management approach [10], HDELL-MCT method [11] and the reactive buffer management technique Buffer Occupancy Estimation Model published in [12]. To compare buffer management, all of the approaches are simulated using the AODV protocol and have been described as DVCAODV (Divide and Conquer AODV), PBMTAODV [8], TCP/IPAODV [10], and HDELL-MCTOADV [11]. To make the comparison, two scenarios were defined: a packet loss due to buffer overflow and a missing packet collection using the divide and conquer technique. The Packet Loss Ratio of DVCAODV and missing packet collection time with various buffer management methods PBMTAODV, TCP/IPAODV, and HDELL-MCTOADV are summarised in Tables 5.1 and 5.2.

The simulation reveals the outcome of the first scenario comparison. Figure 5.1 depicts the packet loss ratio in comparison to various existing buffer management approaches such as PBMTAODV, TCP/IPAOD, and HDELL-MCTOADV. When the packet flow is 20 Mpbs with 25 nodes, the suggested DVCAODV packet loss is 0.04%, compared to PBMTAODV, TCP/IPAODV, and HDELL-MCTOADV packet losses of 0.07%, 0.08%, and 0.07%, respectively. When the packet flow is extended to 25 Mpbs and 50 nodes, the suggested DVCAODV packet loss is 0.05%, and the PBMTAODV, TCP/IPAODV, and HDELL-MCTOADV packet losses are 0.12%, 0.13%, and 0.12%, respectively. The PBMTAODV and HDELL-MCTOADV packet losses stay the same.

When the packet flow is extended to 30 Mbps and 100 nodes, the projected DVCAODV packet loss is 0.08%, while the PBMTAODV, TCP/IPAODV, and HDELL-MCTOADV packet losses are 0.13%, 0.14%, and 0.14%, respectively. When the packet flow is raised to 35Mbps with 125 nodes, the projected DVCAODV packet loss is 0.08%, whereas PBMTAODV, TCP/IPAODV, and HDELL-MCTOADV are 0.15%, 0.13%, and 0.16%, respectively. When the packet flow is extended to 40Mbps with 150 nodes, the projected DVCAODV packet loss is 0.09%, while the PBMTAODV, TCP/IPAODV, and HDELL-MCTOADV packet losses are 0.17%, 0.16%, and 0.17%, respectively. The simulation graph reveals that the proposed DVCAODV buffer management

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packet loss ranges from 0.04% to 0.09% depending on the packet flow and number of nodes.

Table 5.1 Packet Loss Ratio

Packet Flow arrival rate (Mbps)	Packet Loss Ratio			
	DVCAODV	PBMTAODV	TCP/IPAODV	HDELL-MCTOADV
20	0.04	0.07	0.08	0.07
25	0.05	0.12	0.13	0.12
30	0.08	0.13	0.14	0.14
35	0.08	0.15	0.13	0.16
40	0.09	0.17	0.16	0.17

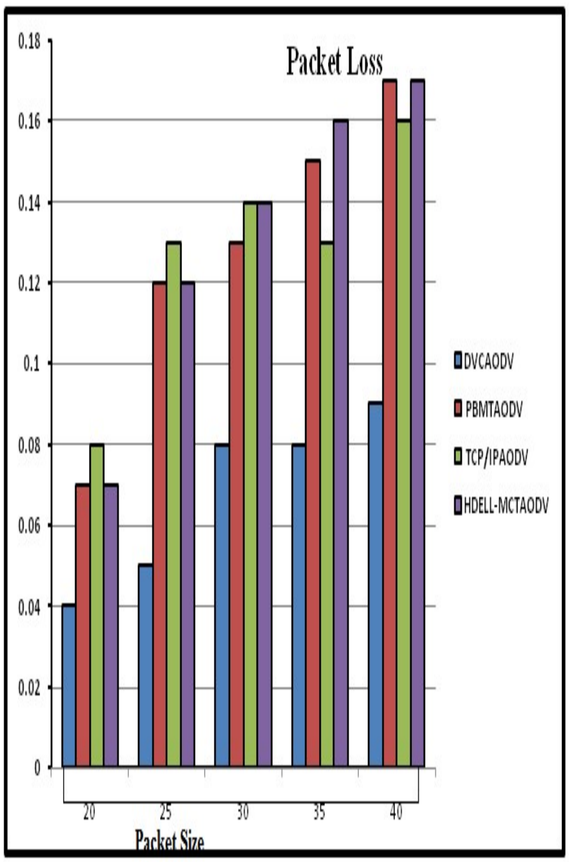

Figure 5.1 Packet Loss Ratio

The second case is compared. Figure 5.2 depicts the missing packet collection time based on the Simulation revels result of the proposed DVCAODV with other existing buffer management methods PBMTAODV, TCP/IPAOD, and HDELL-MCTOADV. When the packet flow is 20 Mpbs with 25 nodes, the proposed DVCAODV missing packet collection time is 0.07ns, compared to 0.12ns, 0.09ns, and 0.13ns for PBMTAODV, TCP/IPAODV, and HDELL-MCTOADV, respectively. When the packet flow is extended to 25 Mpbs and 50 nodes, the projected DVCAODV missing packet collection time is 0.09ns, whereas PBMTAODV, TCP/IPAODV, and HDELL-MCTOADV are 0.15ns, 0.16ns, and 0.15 ns, respectively.

. When the packet flow rate is increased to 30 Mbps and 100 nodes, the projected DVCAODV missing packet collection time is 0.09ns, while the PBMTAODV, TCP/IPAODV, and HDELL-MCTOADV are 0.16ns, 0.18ns, and 0.17 ns, respectively. When the packet flow rate is increased to 35Mbps with 125 nodes, the projected DVCAODV missing packet collection time is 0.01ns, while the PBMTAODV, TCP/IPAODV, and HDELL-MCTOADV times are 0.18ns, 0.15ns, and 0.17 ns, respectively. When the packet flow is raised to 40Mbps with 150 nodes, the projected DVCAODV missing packet collection time is 0.12ns, while PBMTAODV, TCP/IPAODV, and HDELL-MCTOADV are 0.2ns, 0.2s, and 0.22 ns, respectively. The simulation graph reveals that the proposed DVCAODV buffer management missed packet collecting time varies from 0.07ns to 0.12ns depending on the packet flow and number of nodes.

Table 5.2 Missing packet collection time

Packet Flow arrival rate (Mbps)	DVCAODV	PBMT AODV	TCP/IP AODV	HDELL-MCTAODV
20	0.07	0.12	0.09	0.13
25	0.09	0.15	0.16	0.15
30	0.09	0.16	0.18	0.17
35	0.1	0.18	0.15	0.2
40	0.12	0.2	0.2	0.22

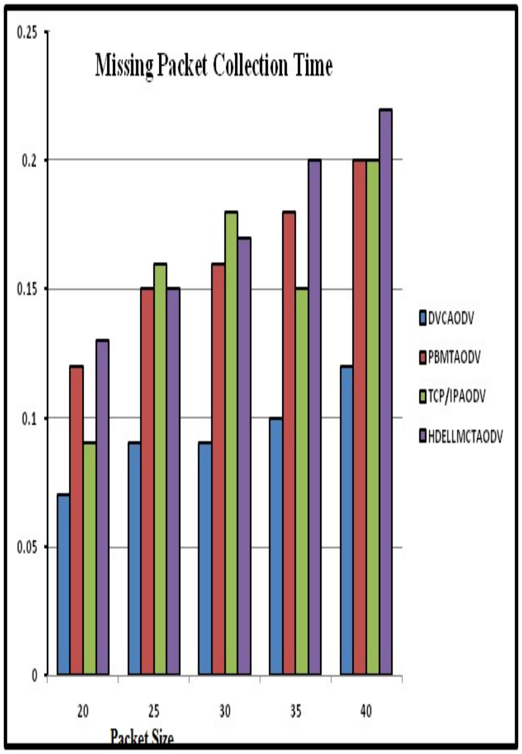

Figure 5.2 Missing packet collection time

6. CONCLUSION

This research article focuses on the providing solution to improve the QoS in MANET with the support of efficient buffer management strategy. The proposed work of DVCAODV buffer management uses the divide and conquers strategy to collect the missing packet from the route path rather from the source node which support for QoS in MANET. The proposed DVCAODV buffer management scheme was simulated using NS2.34 and results are compares with existing other buffer management schemes PBMTAODV, TCP/IPAODV and HDELL-MCTOADV, the result of simulation values reveal that packet loss ratio and Missing packet collection time of the proposed DVCAODV 0.04% to 0.09 %.and 0.07ns to 0.12 ns respectively .finally the proposed work improves QoS in the MANET. In feature this work could be enhanced to provide other missing messages like synchronization, control messages, Beacon signals due to buffer overflow. This work should be improved to include other missing messages such as synchronization, control messages, and beacon signals due to buffer overflow.

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