Chapter 4

Model-1: ADWD-RED-IP

4.1 Introduction

Congestion control is a critical and demanding issue in a Mobile Ad-hoc Network (MANET). The conventional congestion management mechanism in MANET faces new challenges such as recurrent link failures, high packet drop ratio and throughput loss. It happens when the demand for network services is higher than the resources available because network speeds are increasingly mismatched.

There are various techniques to control congestion. One of the important techniques, which makes use of Active Queue Management (AQM) mechanism. Active Queue Management (AQM) establishes a methodology for mitigating congestion from individual flows.

A new algorithm, RED (Random Early Detection), has been introduced by Floyd and Jacobson [16]. The basic framework of this strategy is that by calculating the relative queue length, the router can feel the congestion. The router alerts the sender node until the network overload has happened. To encourage the source to change the packet transmission rate to prevent queue overload and network congestion. Two stages of the RED algorithm. The total queue length is calculated in the beginning step and the decrease likelihood is calculated in the next step. It is used to determine whether or not packets are lost, and is the signal of network congestion if packet drop occurs. Since the RED algorithm depends on queue lengths, evaluating the magnitude of network congestion is an intrinsic challenge.

The congestion control action in RED experiences with many questionings such as high packet drop ratio, low throughput and regular link failures. Due to these drawbacks the performance of RED is not satisfactory for present market demand. During over-crowding the transmission system's gateway modifies its window length depending on the size of bandwidth. The RED rule is developed to manage short type of bursts that might be delay sensitive but not allow the average queue length increase very much. Due to the delay between packet drop and notification received at the sender, a massive packet could born which may causes congestion.

In this model (**Model-1: Application of Dynamic Weight with Distance to Improve the Performance of RED (ADWD-RED-IP)**), we suggested a robust active queue management to regulate queue size to some extent.

4.2 Motivation and Objectives of Model-1: ADWD-RED-IP

The main motivation and objectives of this Model (ADWD-RED-IP) is to improve the performance of the existing RED algorithm by using dynamic weight with distance mechanism. For this purpose, a queue based algorithm congestion control has been developed, that can be able to control congestion. In this scheme, the original RED algorithm is improved by introducing a new range parameter. To achieve this objective, following points have been considered:

- The original RED algorithm is improved by introducing a new "range" parameter.
- A router is equipped with a stable range, and then only the nodes under that range can deliver information to that node.
- Including this factor into the original RED algorithm reduces the congestion in effective manner.
- Messages are arbitrarily discarded once the overall queue length reaches its minimum level, or the specific congestion warning bit is labelled.
- When the average queue reaches the maximum threshold, then all packets are discarded or labelled.

Two new parameters have been introduced here: MIN_q and MAX_q which are lower limit and upper limit of packets number those are assigned to buffer with existing RED parameters. The algorithm keeps a count the number of buffer data packets, LEN_q, and a estimate of times, AVG_q, when the flow is not sensitive ($LEN_q > MAX_q$).

4.3 Proposed Scheme: Model-1 ADWD-RED-IP

Congestion control in wireless sensor network is the major issue which needs to improve for smooth communication. Any router present in the network received packets from various nodes and maintain queue when deliver them. We have observed that if a characteristic of "range" is introduced then efficiency of RED algorithm can be enhanced. When a router provided a predefine range then the devices which will belongs to that ranges only will be able to send packets to that specific router. It has been observed that inclusion of such ”range” will reduce the congestion in the network which is more effective.One of the packets dropped with notification when the average queue length exceeds a minimum threshold (MIN^{th}) value, on the other hand,all packets will be dropped when the same exceeds maximum threshold (MAX^{th}) value.

In this Model (ADWD-RED-IP) where maximum threshold is considered as the maximum length of queue for better utilisation of queue space. Here, we have introduced two parameters in ADWD-RED-IP, MIN_q and MAX_q which are lower limit and upper limit of the numbers of data packets where each flowing is allowed to memory cache with present RED factors. This algorithm holds a count of buffer data packets, $qlen$ and number of times when the flow is not answering ($qlen > MAX_q$). It employs a global variable AVG_q to calculate the number of packet in average. It records the active flows counts and for each of them, this algorithm will penalize flows with high strike values. The algorithm of the proposed Model-1 (ADWD-RED-IP) is describe below:
If ($AVG_q \leq MIN^{th}$) then no Packet dropped.
If ($AVG_q \geq MAX^{th}$) then all Packet dropped.
If ($MIN_{th} \leq AVG_q \leq MAX^{th}$) then Packet dropped with probability P_b.

4.3.1 Algorithm of Model-1: ADWD-RED-IP

This algorithm is active queue based and it is able to control the congestion:

In this algorithm, we have initialize all the variable for router buffer. If the critical zone is greater than threshold value then the communication between nodes is not possible; otherwise it checks if Radio zone is less than the threshold value then the system allow to enter in network range.

The average queue size (AVG_q) is calculated by the system to determine whether or not to drop the packet. Then the router first checks whether a node is in range of the router. If the distance of the node from the router is less than the range then the source is allowed to send packet to the router; otherwise, it checks the distance of the node from the router. If it

Algorithm 4.1: Algorithm of ADWD-RED-IP

input : Initialize the nodes.

output: Congestion will be control with high throughput and lesser packet drop ratio and end to end delay.

```
Algorithm Transform():
    // Step 1:  Initialization of variable for Router buffer
    if ( critical zone > Threshold value) then
        Communication between nodes is not possible;
    else if ( Radio zone <= Threshold value) then
        Allow to enter in network range ;
    end
    // Step 2:  The average queue size (AVGq) is calculated to determine whether or not to drop the packet.
    // Step 3:  The router first checks whether a node is in range of the router
    if (distance of the node from the router <= range) then
        The source is allowed to send packet to the router;
    else if (distance of the node from the router > range) then
        The router is unreachable ;
    end
    // Step 4:  If the node comes under the range of the router:
    // Let AVG = 0 and COUNT = -1;
    if (the queue is not empty ) then
        AVG =(1-WeightParameter)AVG + WeightParameter * Current queue size ;
    else if (AVG>Maximum Threshold) then
        if (Maximum Threshold < Queue_Size) then
            Maximum Threshold = Maximum Threshold +1;
            Pa=Pb;
        else
            Pa=1;
        end
    end
    // Step5:
    else if (MinimumThreshold ≤ AVG < MaximumThreshold) then
        if  (ThresholdDifference >= 1 * Queue_Size) then
            Middle = (MinimumThreshold + MaximumThreshold)/2;
            if (AVG<Middle) then
                MaximumThreshold = MaximumThreshold -1 ;
                MinimumThreshold =MinimumThreshold +1;
                Pb=Pa;
                Increment count with probability Pa and mark the arriving packet;
                count =0;
            else if ( count= -1 ) then
                When queue become empty;
                start of the queue idle time = time;
            end
    end
    // Step6:
    else if  (AVG <= MinimumThreshold) then
        if (ThresholdDifference >= Queue_Size) then
            MaximumThreshold = MaximumThreshold -1;
            Pb=Pa;
        else
            Pa=0;
        end
    end
```

is greater than range then the router is unreachable. If the node comes under the range of the router then its check the queue size. If the queue is not empty then calculate $AVG = (1 - WeightParameter)AVG + WeightParameter * Currentqueuesize$; else if AVG is greater than $Maximum\ Threshold$ then update the $Maximum\ Threshold$ by depending on the Queue Size and update $Maximum\,Threshold = Maximum\,Threshold + 1$. Furthermore, if AVG value is belong to the range between $Minimum\,Threshold$ and $Maximum\,Threshold$ then check we have to calculate $Middle = (Minimum\,Threshold{+}Maximum\,Threshold)/2$; Again, if AVG is less than $Middle$ then update $Maximum\,Threshold = Maximum\,Threshold - 1$ else update $Minimum\ Threshold = Minimum\ Threshold + 1$;
After that increment count with probability Pa and mark the arriving packet. The other condition is mentioned in the Algorithm-1.

4.4 Results and Comparison of Model-1: ADWD-RED-IP

In this section, the results of simulation work have been presented to make comparison of the performance of Model-I: ADWD-RED-IP with that of existing RED based routing algorithm. It has been found that the proposed ADWD-RED-IP based routing algorithm is very effective in terms of performance metric: (i)throughput (ii)end to end delay (iii) packet delivery ratio and (iv) goodput.

The simulation has been performed with 100 nodes and the proposed path selection take random. The table 4.1 shows the performance measurement of the proposed ADWD-RED-IP scheme with various number of nodes from 2 to 100. In this experiment,End to End delay varies from 240 to 163, which depends on the number of input node. When number of node increases in the network then end to end delay decreases. Packet delivery ratio also decreases, but throughput and goodput increases depending on the increase of input node.

End to End Delay: The ratio of the packet received time to packet send time is termed as end to end delay. The end to end delay should be low in order to provide better performance. The Table 4.2 and graph fig. 4.1 show the performance of routing end to end delay in continuous traffic pattern for ADWD-RED-IP and RED.

Table 4.1: *Experimental results of ADWD-RED-IP*

Nodes	End-to-End Delay	Packet Delivery Ratio	Throughput	Goodput
2	340.235	92.67	710.23	388.76
10	312.674	90.43	715.54	408.32
25	208.443	93.56	728.25	431.45
50	184.385	92.29	750.67	455.39
75	180.438	93.97	752.45	462.68
100	163.275	90.35	753.45	478.49

In the proposed ADWD-RED-IP,packet moves smoothly with a little bit loss due to Active Queue Management. Here, congestion can be avoidable and packet can be delivered within time while increasing node. Thus, the proposed ADWD-RED-IP performed better with low end to end delay when compared with existing scheme.

In this approach, congestion can be avoided and packet can be delivered within time while increasing no of nodes.

Table 4.2: *End to End Delay of RED and ADWD-RED-IP*

Nodes	RED	ADWD-RED-IP
2	335.446	340.235
10	304.878	312.674
25	206.093	208.443
50	179.589	184.385
75	177.267	180.438
100	161.335	163.275

Packet Delivery Ratio: Packet delivery ratio is determined as the ratio of total numbers of data packet send to the total number of data packets accepted. The results are shown in Table 4.3 and the according to the graphical activity is shown in Fig. 4.2. The Fig. 4.2 represents the routing packet delivery ratio for existing RED and proposed ADWD-RED-IP algorithm with respect to number of nodes. Due to active queue management of ADWD-RED-IP, it

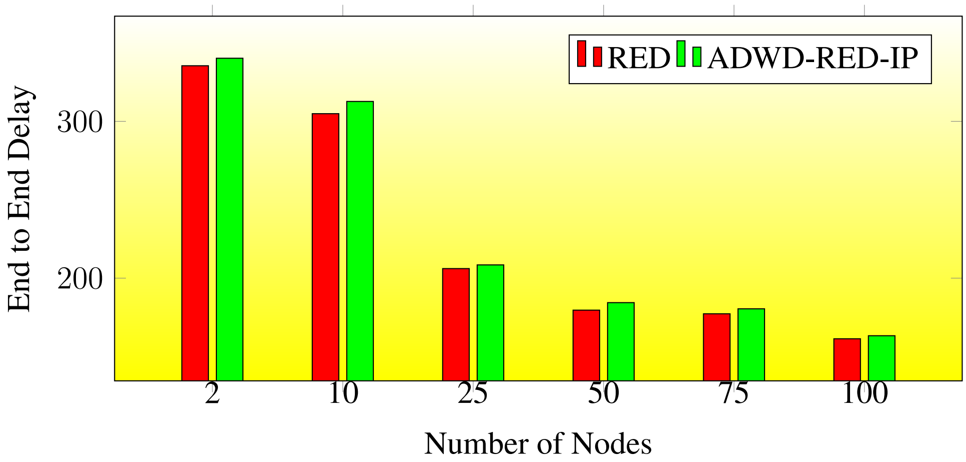

Figure 4.1: *Comparison of proposed schemes with respect to End to End Delay*

is possible to receive more data packet without any loss, and the proposed ADWD-RED-IP algorithm achieves high packet delivery ratio than RED and gives better result.

Table 4.3: *Packet Delivery Ratio of RED and Model-1: ADWD-RED-IP*

Nodes	Packet Delivery Ratio (RED)	Packet Delivery Ratio (ADWD-RED-IP)
2	91.21	92.67
10	86.86	90.43
25	92.77	93.56
50	91.64	92.29
75	90.22	93.97
100	88.63	91.35

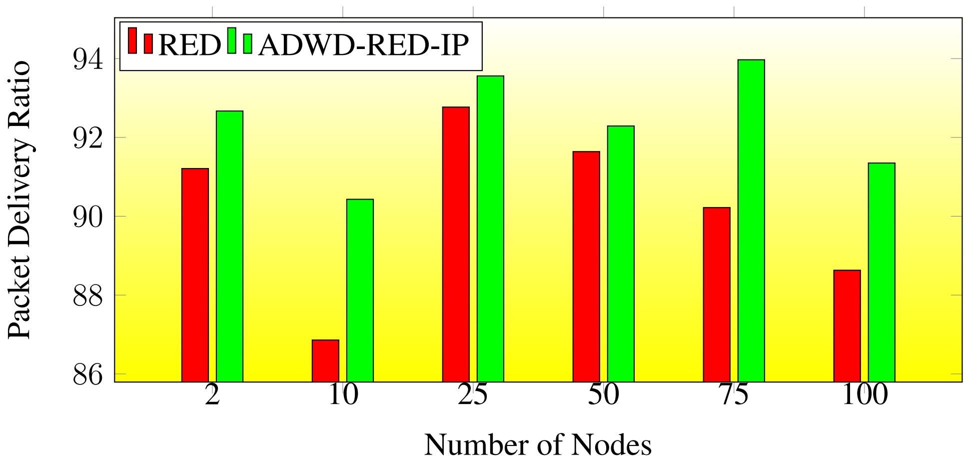

Figure 4.2: *Comparison of proposed schemes with respect to End to End Delay*

Throughput: Throughput is one of the important parameter for evaluating the performance of MANET. The throughput is calculated based on number of bits transmitted per second. In order to provided better performance of the network the system throughput must be high. The simulated results are shown in Table 4.4 and corresponding graph (Fig. 4.3) shows the performance comparison between RED and ADWD-RED-IP. It is analysed from the graph that, the throughput of the ADWD-RED-IP is gradually increasing more compared to the existing RED. Therefore, the proposed ADWD-RED-IP gives better throughput without data loss.

Table 4.4: *Throughput of RED and ADWD-RED-IP*

Nodes	RED	ADWD-RED-IP
2	709.48	710.23
10	712.79	715.54
25	726.55	728.25
50	748.08	750.67
75	746.54	752.45
100	745.26	753.45

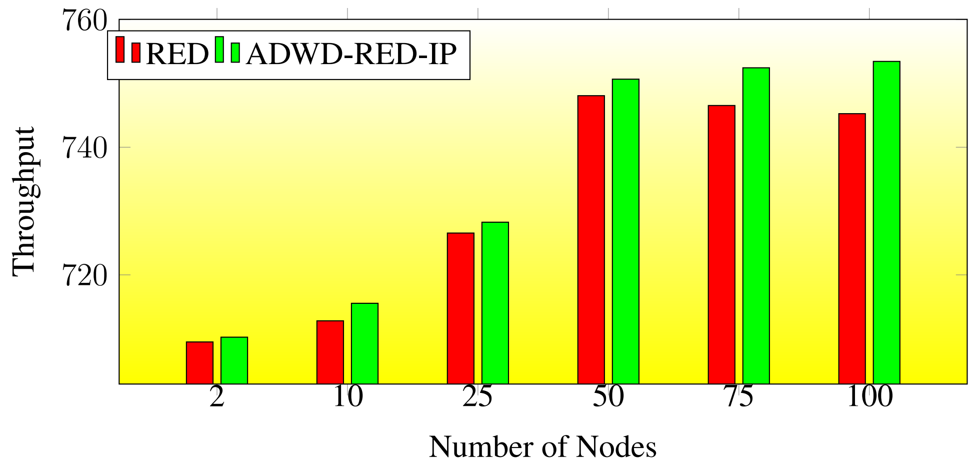

Figure 4.3: *Comparison of proposed schemes with respect to Throughput*

Goodput: In the computer network, goodput is the number of useful information delivered by the system to a certain node per unit of time. The goodput is always lower than the throughput due to overhead and lost or dropped packet for congestion. Table 4.5 shows the goodput comparison between RED and ADWD-RED-IP. In the proposed ADWD-RED-IP, the goodput is better than RED because the ”range” parameter is proposed to maintain the active queue management. The corresponding graph is presented in Fig. 4.4.

Table 4.5: *Goodput of RED and ADWD-RED-IP*

Nodes	RED	ADWD-RED-IP
2	337.85	388.76
10	355.04	408.32
25	367.21	431.45
50	374.04	455.39
75	377.04	462.68
100	382.18	478.49

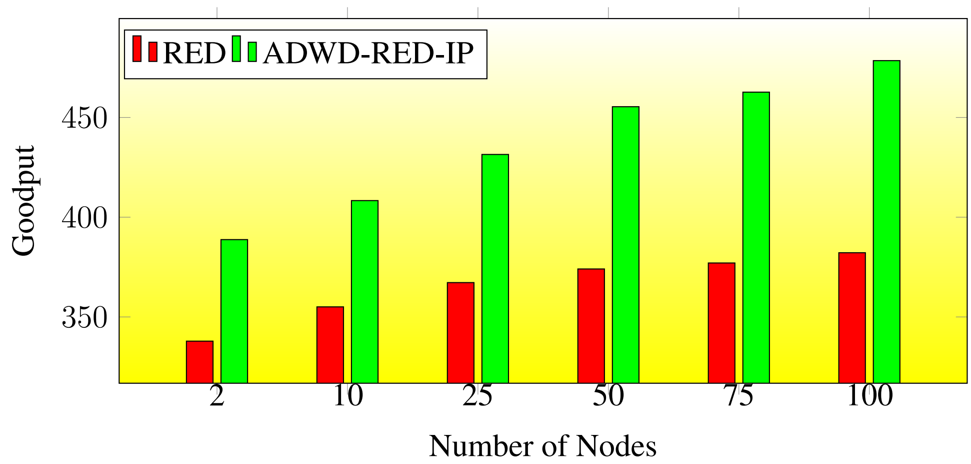

Figure 4.4: *Comparison of proposed schemes with respect to Goodput*

Table 4.6: *Analysis of the proposed scheme in terms of the number of packets received, forwarded, dropped, and packet loss rate for flows 20,40,60, ..., 200*

Algorithms	Packets received	Packets sent	Packets dropped	Packet Loss Rate	Throughput
RED	8487	8018.643	463.4286	0.0612	1.170581
MODEL-1:ADWD-RED-IP	8357.231	8565.617	208.386	0.0243	1.124935

Table 4.6 presents the comparison of RED and ADWD-RED-IP in terms of number of packet received, forwarded, dropped and loss rate for flows 20, 40, 60, ... 200 nodes. Here, packet loss rate is lower than RED due to active queue management with introducing MIN_q and MAX_q parameters. The corresponding graph indicates that the ADWD-RED-IP improves the performance of RED algorithm.

4.5 Summary of Model-1: ADWD-RED-IP

In this chapter:a priority queue-based AQM framework called Application of Dynamic Weight with Distance to Enhance Performance RED (ADWD-RED-IP), which uses the packet's arrival rate and queue size to estimate the number of drops and mark a packet to reduce the effect of network congestion, has been proposed. Comparative study with existing RED techniques reveals that our ADWD-RED-IP methodology not only outperforms compared to other techniques by securing a lower rate of packet loss and greater good positioning, but it is also more resilient to keeping a secure queue of complicated workloads. Queue consistency is an advantageous feature of an AQM policy because it helps to reduce the rate of data packet loss. By reducing the delay, the simulation results show the improved efficiency of the proposed model ADWD-RED-IP. In addition,high packet distribution ratio is achieved while not increasing the overhead substantially.