ID : 1805113

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NS2 Project Report

MAC-Address: Wireless 802.11(static) and Wireless 802.15.4(static)

Routing Protocol: DSDV

Agent type : TCP

Application : FTP

Flow : Random source destination

Modification in C++ code:

In my modification, I modified the congestion control algorithm of "Old Reno".In my modification,I changed the slow start phase,congestion avoidance phase and fast recovery phase such that the variation of congestion window size in minimized.

So to achieve this , I changed **tcp.cc** ,**tcp.h** and **tcpreno.cc.**

In my modification,

In the slow start phase,the congestion window is allowed to increase exponentially until the first packet drop is detected.When the first packet drop is detected, I stored the value of **cwnd_** at that time as the maximum allowable congestion window size(**max_allowed_cwnd**) as well as I changed the current window size to the **three fourth** of **max_allowed_cwnd.**

```
269     bool dupacks_occurs;
270     bool timeout_occurs;
271     bool first_packet_dropped;
272     double max_allowed_cwnd;
273
```

Figure 1:adding some variables in "tcp.h"

```
68  TcpAgent::TcpAgent()
69      : Agent(PT_TCP),
70        t_seqno_(0), dupacks_(0), curseq_(0), highest_ack_(0),
71            cwnd_(0), ssthresh_(0), maxseq_(0), count_(0),
72            rtt_active_(0), rtt_seq_(-1), rtt_ts_(0.0),
73            lastreset_(0.0), closed_(0),
74            dupacks_occurs(false),timeout_occurs(false),
75            first_packet_dropped(false),max_allowed_cwnd(0), t_rtt_(0), t_srtt_(0), t_rttvar
76        t_backoff_(0), ts_peer_(0), ts_echo_(0), tss(NULL), tss_size_(100),
77        rtx_timer_(this), delsnd_timer_(this), burstsnd_timer_(this),
78        first_decrease_(1), fcnt_(0), nrexmit_(0), restart_bugfix_(1),
79            cong_action_(0), ecn_burst_(0), ecn_backoff_(0), ect_(0),
80            use_rtt_(0), qs_requested_(0), qs_approved_(0),
81        qs_window_(0), qs_cwnd_(0), frto_(0)
```

Figure 2:Initalizing those variables in "tcp.cc"

```
1120  */
1121  void TcpAgent::opencwnd()
1122  {
1123      double increment;
1124      if (!first_packet_dropped) {
1125          /* slow-start (exponential) */
1126          cwnd_ += 1;
```

Figure 3:cwnd_ is increasing exponentially until first packet loss detected

After detecting the very first packet drop "**slow start phase**" stops permanently and "**congestion avoidance phase**" starts.From this point the congestion window size is allowed to increase linearly until it reach to the **max_allowed_cwnd** or a packet drop detected.Whenever the current window size(**cwnd_**) reach the **max_allowed_cwnd or** packet drop is detected,the current window size is reduced to the **three-fourth** of **max_allowed_cwnd** again.

```
212     last_cwnd_action_ = CWND_ACTION_DUPACK;
213     //printf("Packet Drop detected due to dupack\n");
214     //slowdown(CLOSE_SSTHRESH_HALF|CLOSE_CWND_HALF);
215     //dupacks_occurs=true;
216     //timeout_occurs=false;
217     if(first_packet_dropped == false)
218         {
219             first_packet_dropped = true;
220             max_allowed_cwnd = (double)cwnd_;
221         }
222
223     slowdown();
```

Figure 4:when a packet loss is detected via "duplicate acknowledgement" ,the function "dupack()" is called in tcp.cc.Reducing the "cwnd_" at this point

```
1138         case 1:
1139             /* This is the standard algorithm. */
1140             increment = increase_num_ / cwnd_;
1141             if ((last_cwnd_action_ == 0 ||
1142               last_cwnd_action_ == CWND_ACTION_TIMEOUT)
1143               && max_ssthresh_ > 0) {
1144                 increment = limited_slow_start(cwnd_,
1145                   max_ssthresh_, increment);
1146             }
1147             cwnd_ += increment;
1148
1149             if((double)cwnd_ >= max_allowed_cwnd)
1150                 slowdown();
```

Figure 5:in When the "cwnd_" reaches "max_allowed_cwnd",cwnd_ is reduced

```
1245
1246  void
1247  TcpAgent::slowdown()
1248  {
1249      cwnd_ = (double)(max_allowed_cwnd * 3.0/4);
1250      //printf("max allowable window size: %lf\n",max_allowed_cwnd);
1251  }
1252
```

Figure 6:overloading "slowdown()" function in "tcp.cc"

```
        ++nrexmit_;
        last_cwnd_action_ = CWND_ACTION_TIMEOUT;
        //slowdown(CLOSE_SSTHRESH_HALF|CLOSE_CWND_RESTART);
       // printf("Packet drop detected due to timeout\n");
       // dupacks_occurs=false;
        //timeout_occurs=true;
        if(first_packet_dropped == false)
        {
            first_packet_dropped = true;
            max_allowed_cwnd = (double)cwnd_;
        }
        slowdown();
```

Figure 7:when a packet loss is detected via "Retransmission timeout" ,the function "timeout()" is called in tcp.cc.Reducing the "cwnd_" at this point

In this way,I limited the variation of the "**cwnd_**" in between **max_allowed_cwnd** and three-fourth of **max_allowed_cwnd.**

Impact of My Modification:

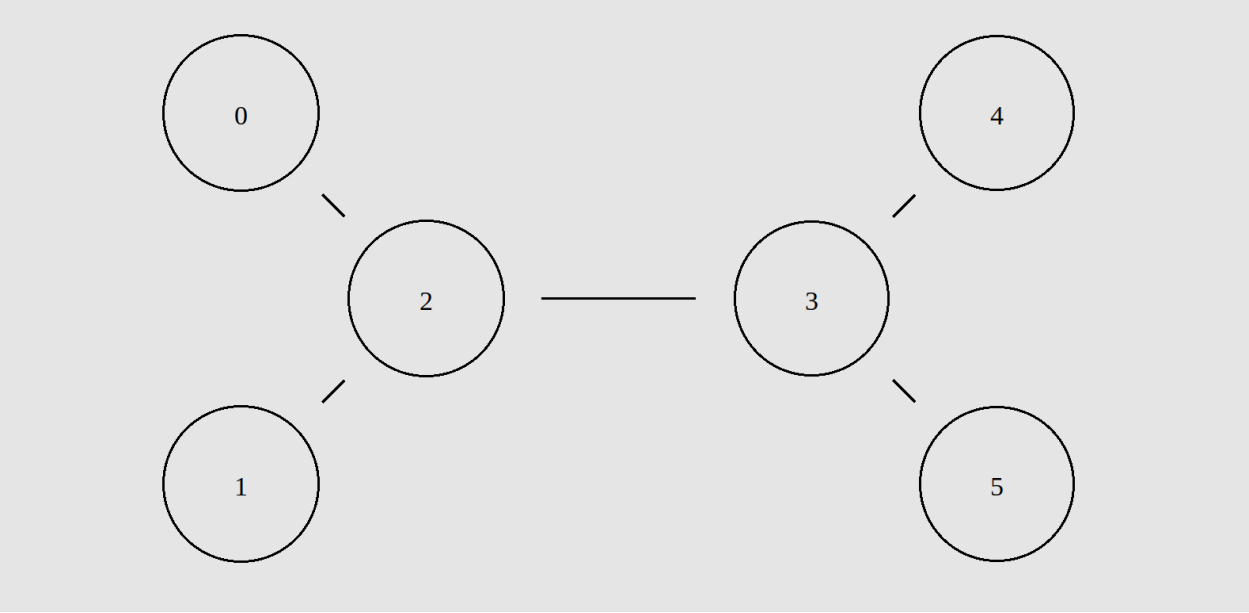
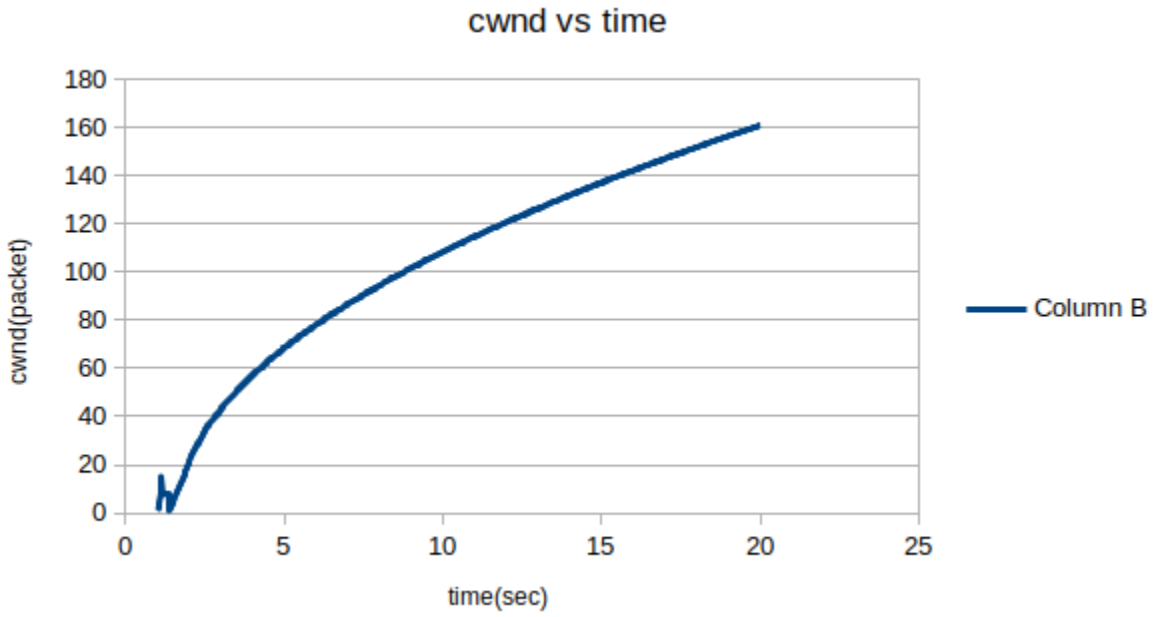
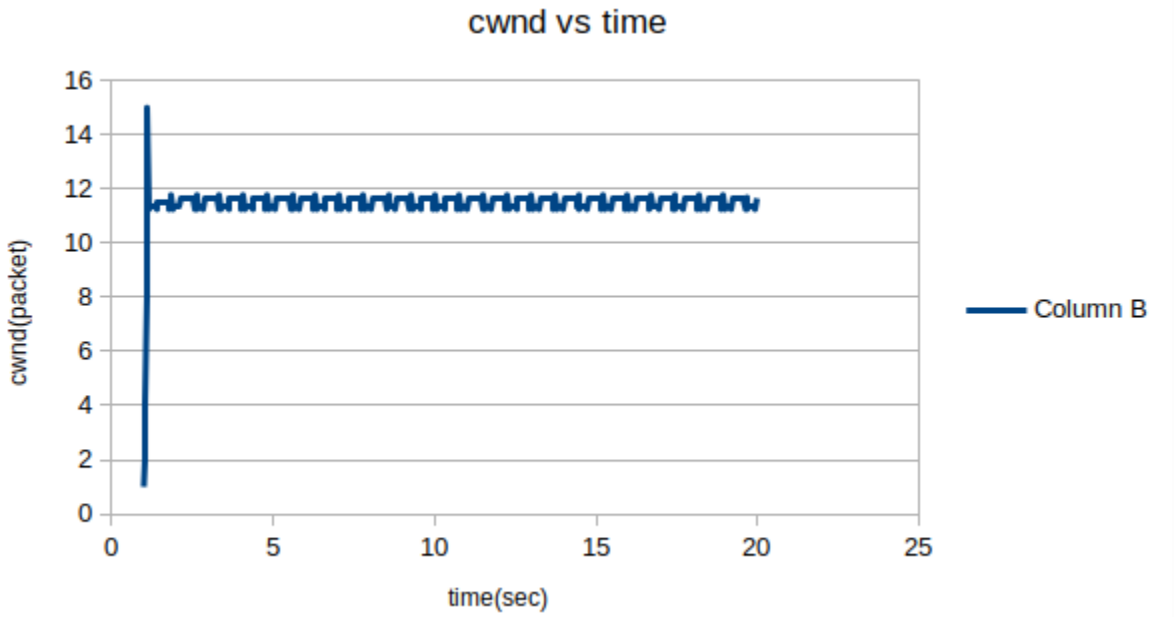


Figure:Paper Suggested topology

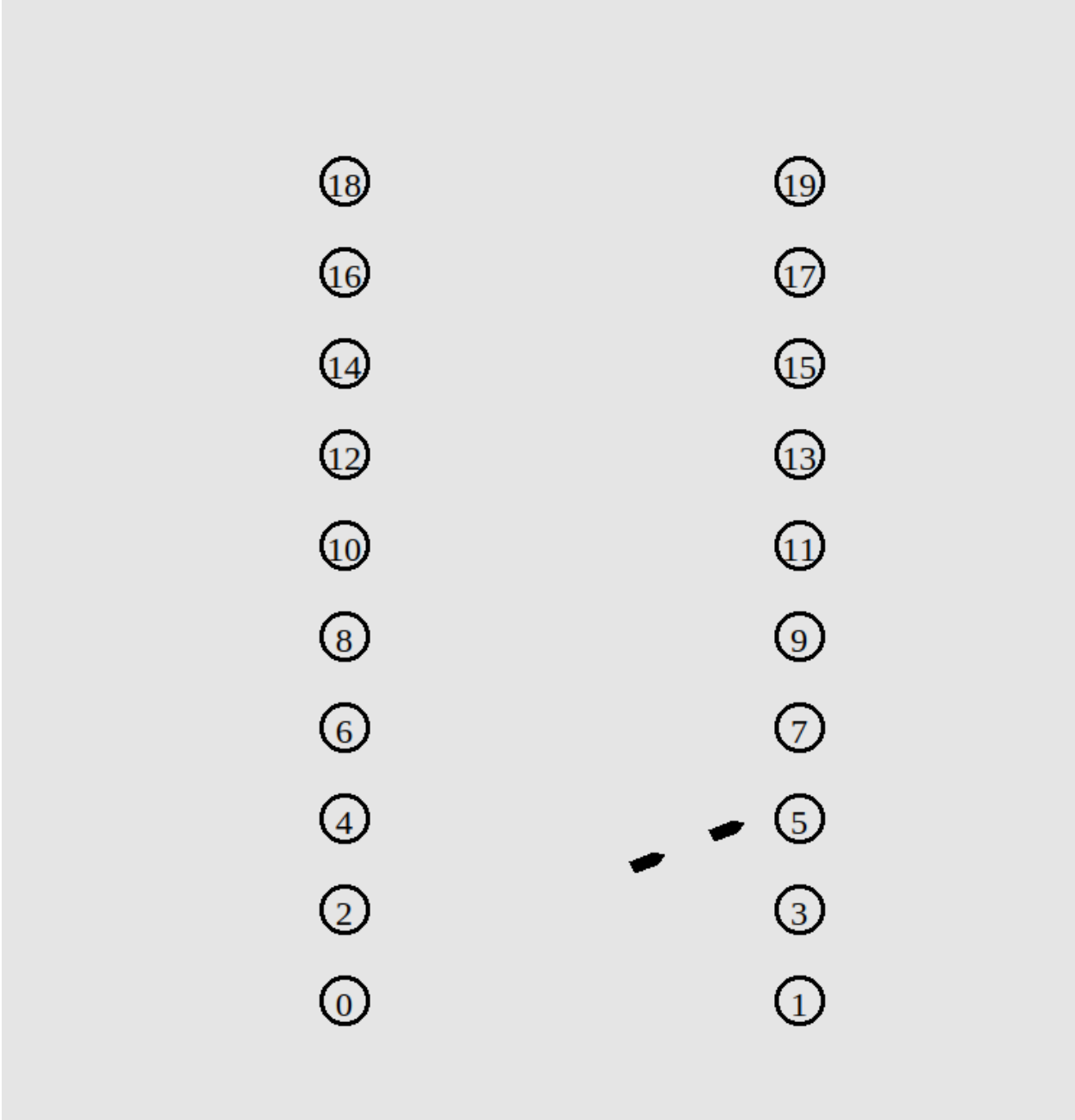
Congestion window vs time(Existing implementation):



Congestion window vs time(Modified implementation):



Wireless topology:



PLOTS(For 802.11 static) :

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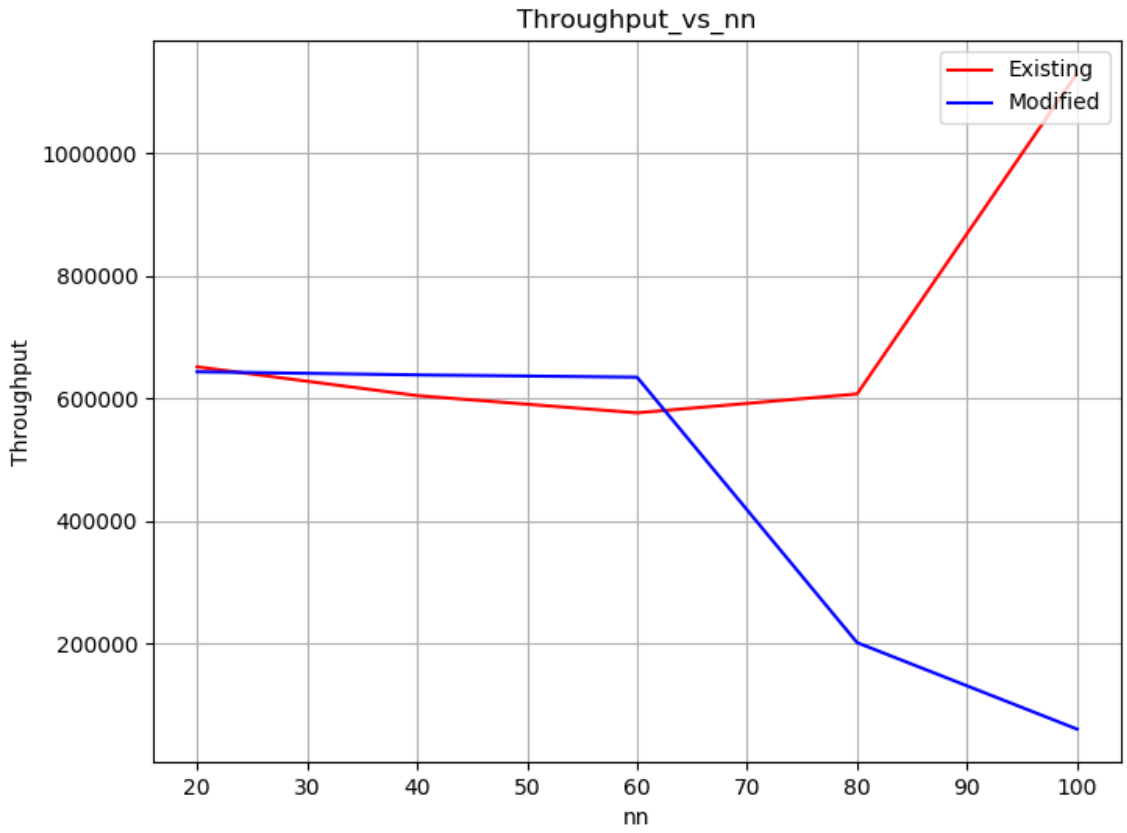

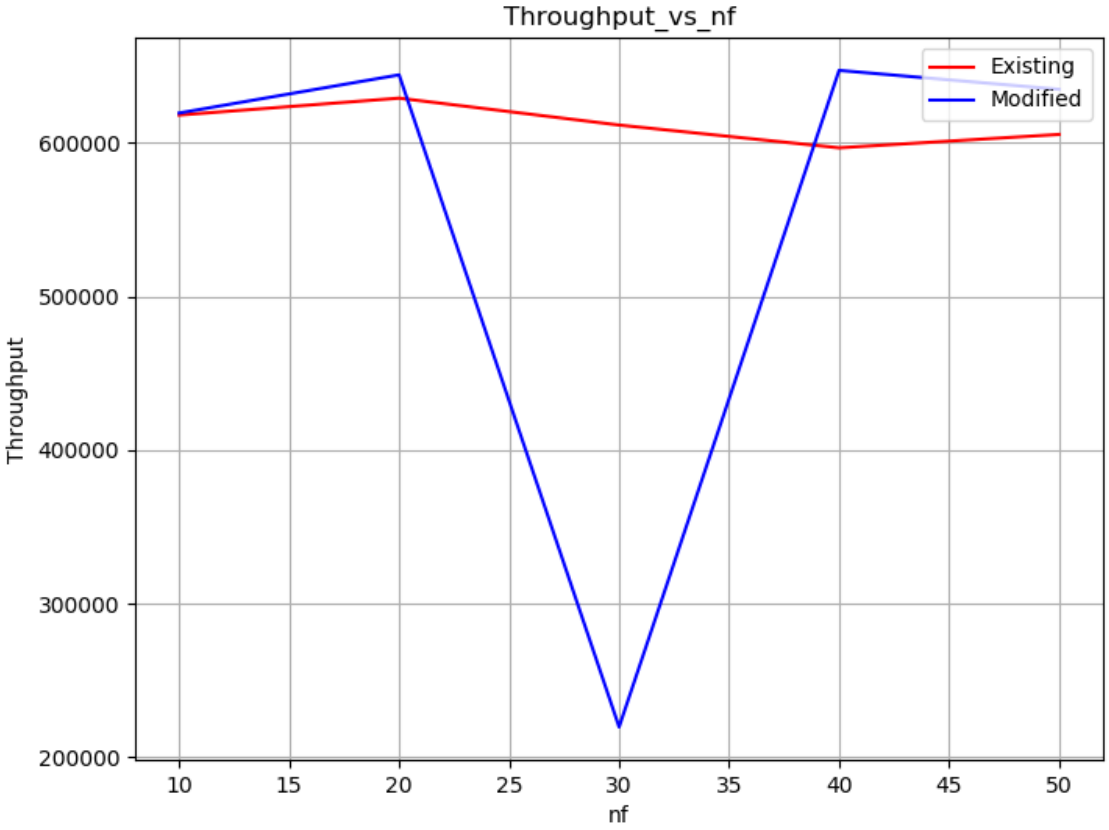
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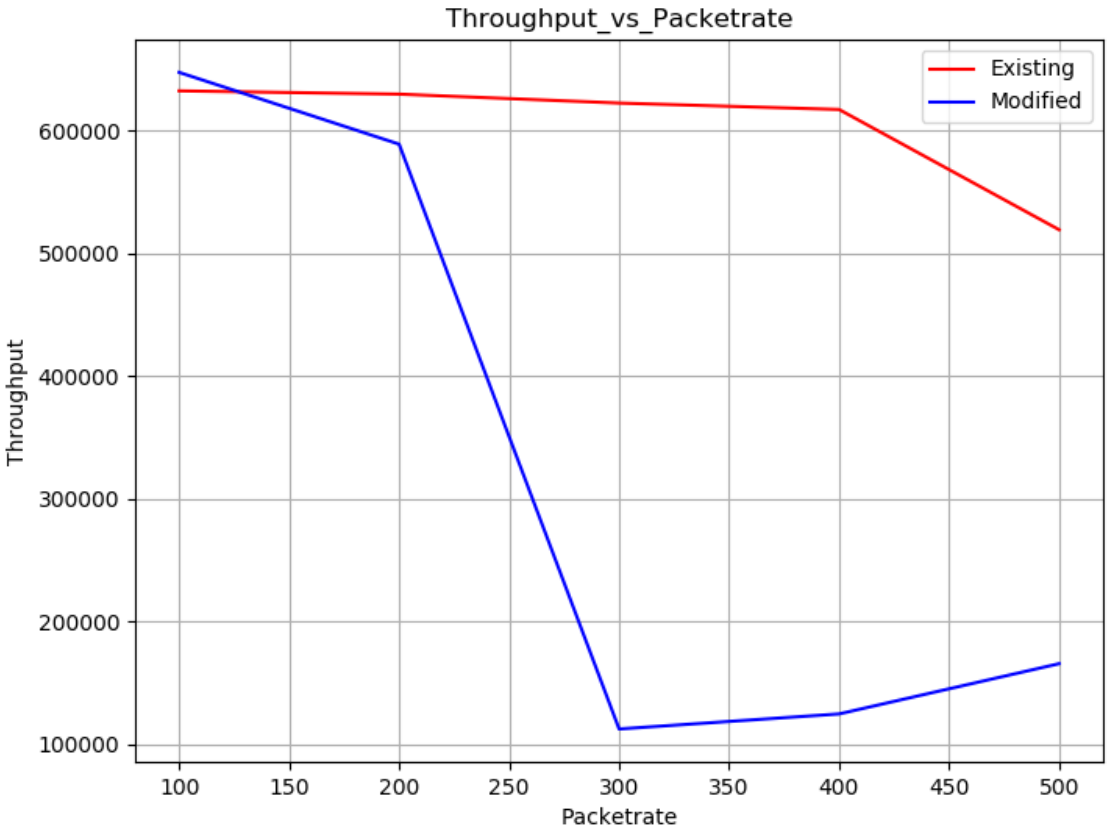
45
50
nf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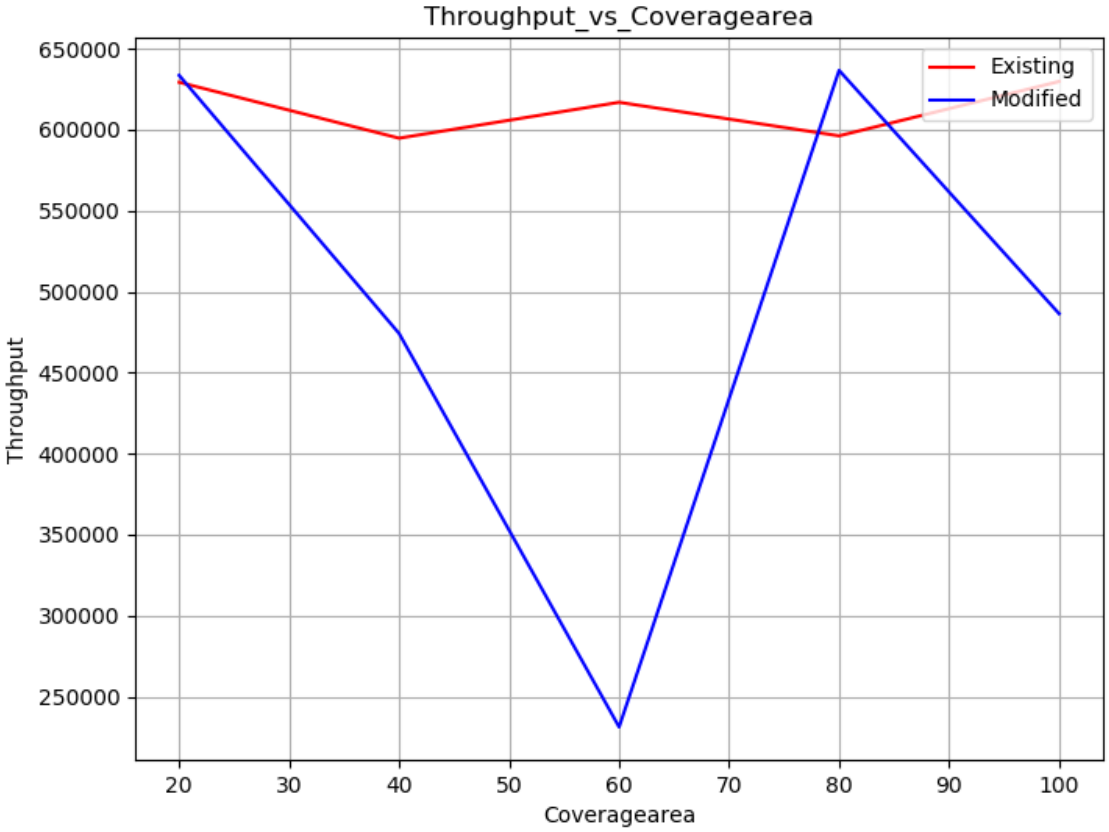
500
Packetrate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Modified
Throughput
Coveragearea
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50
60
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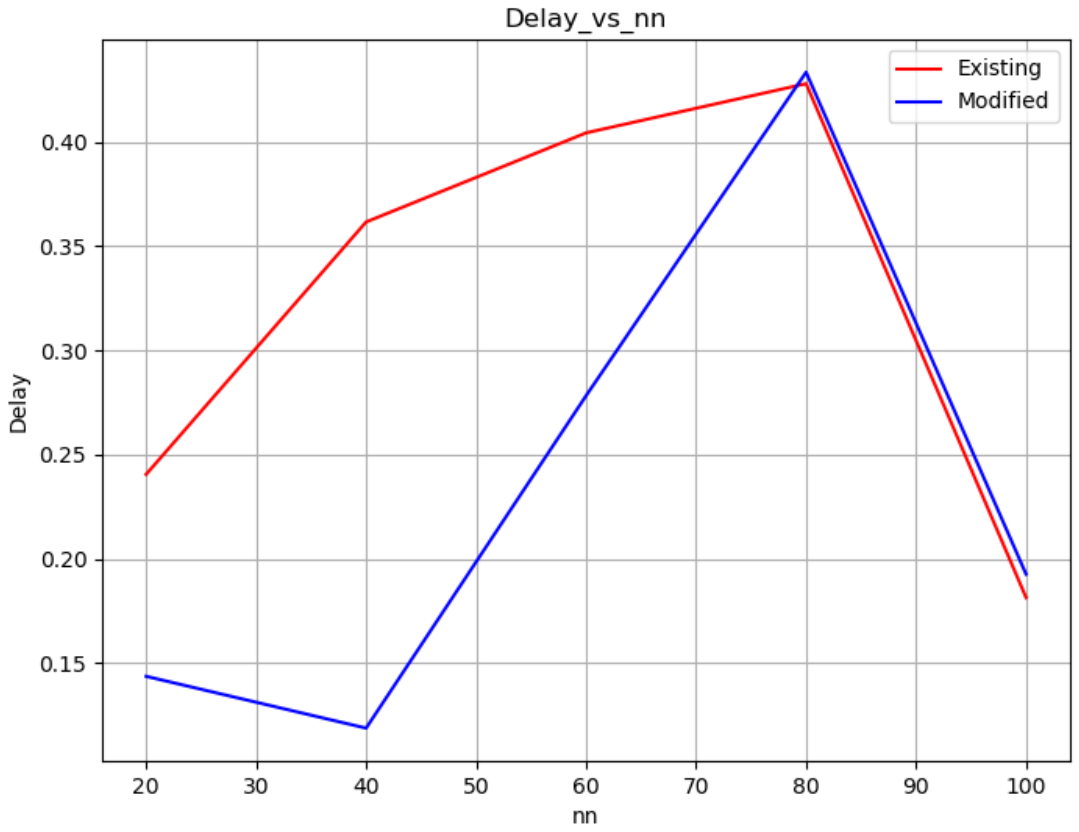
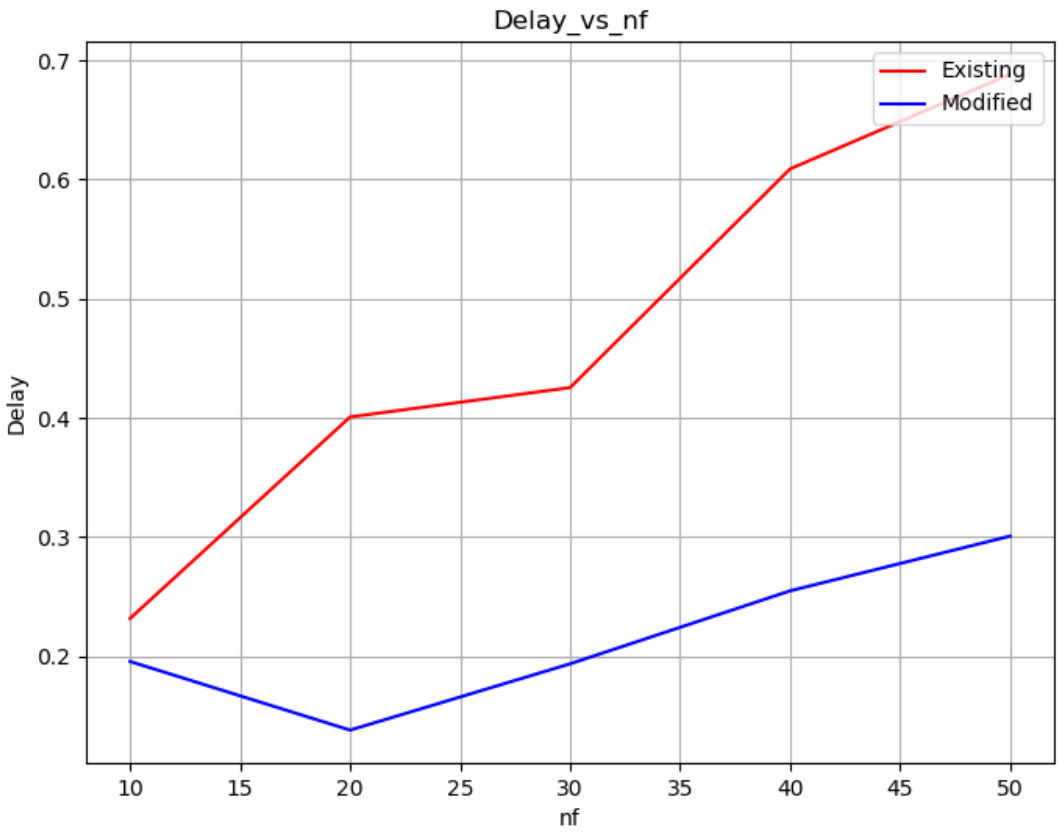
80
90
100

End to End delay:

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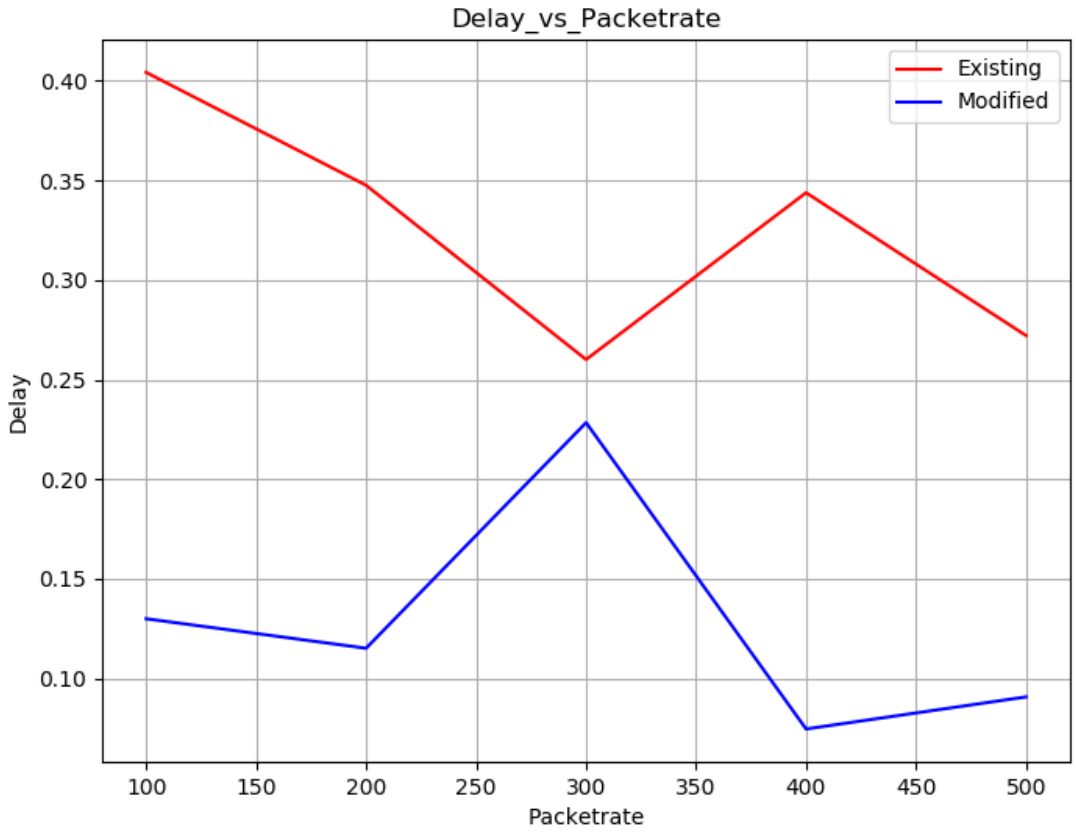
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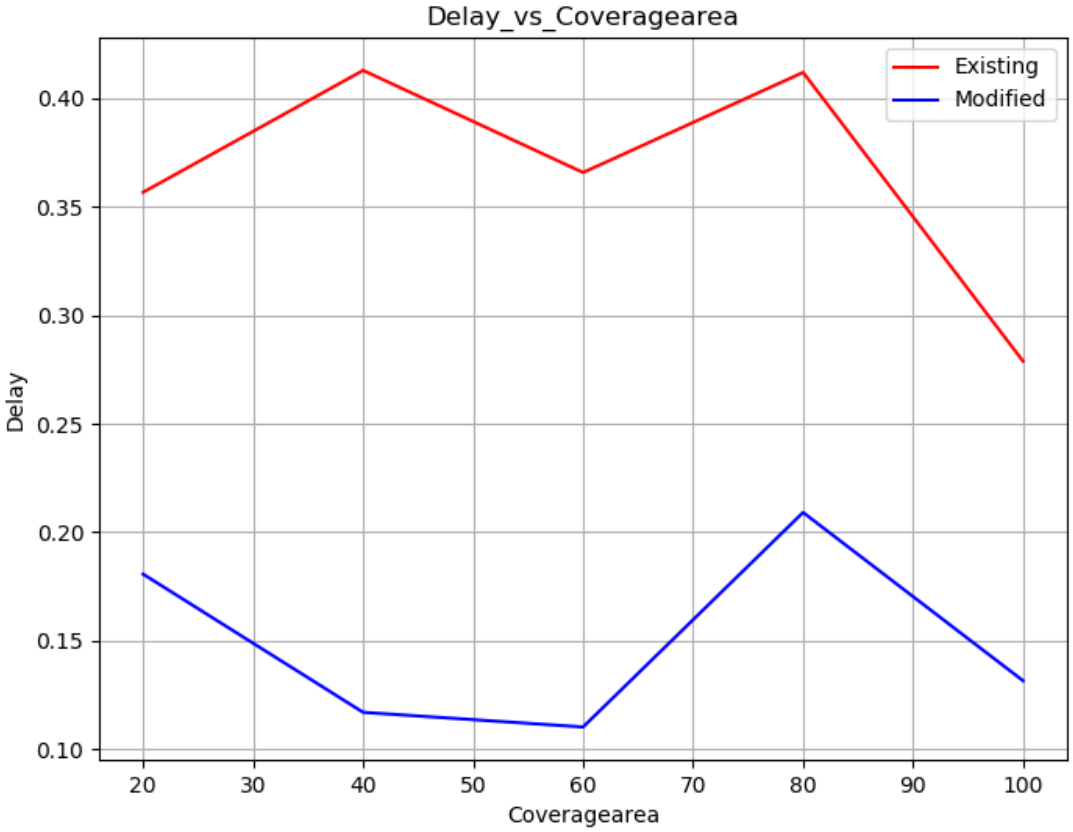
Packetrate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Modified
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0.30
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Delay
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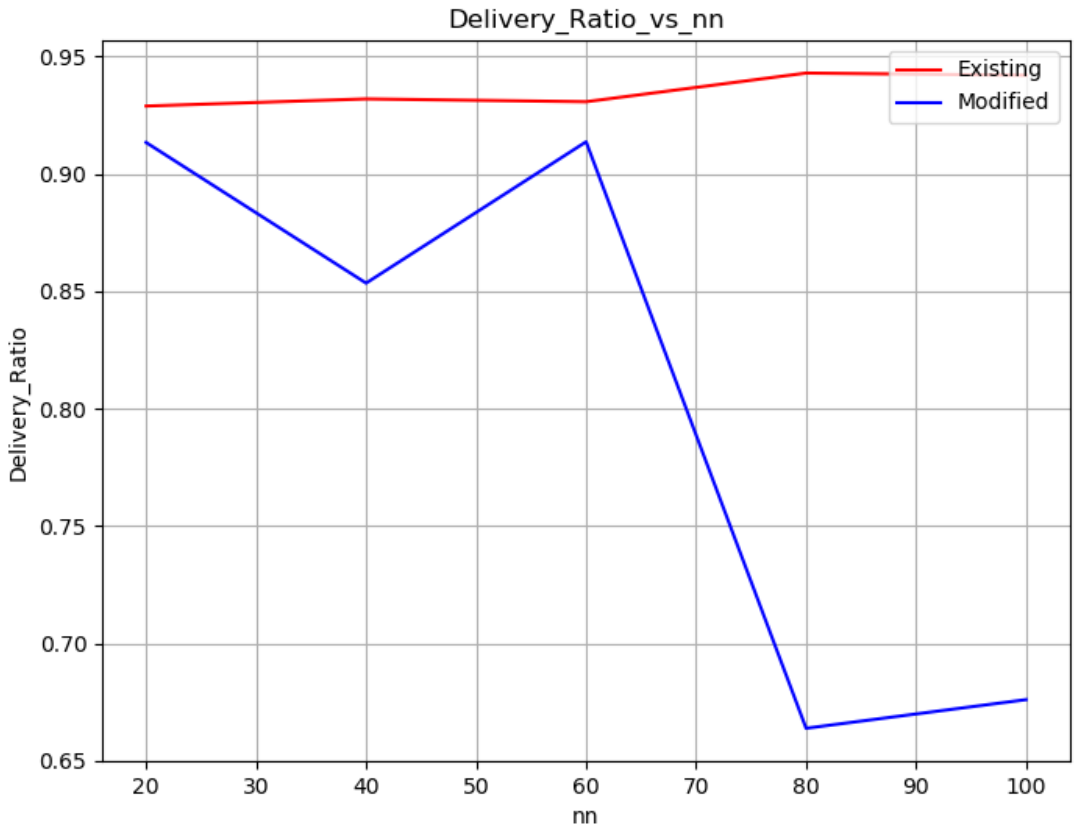
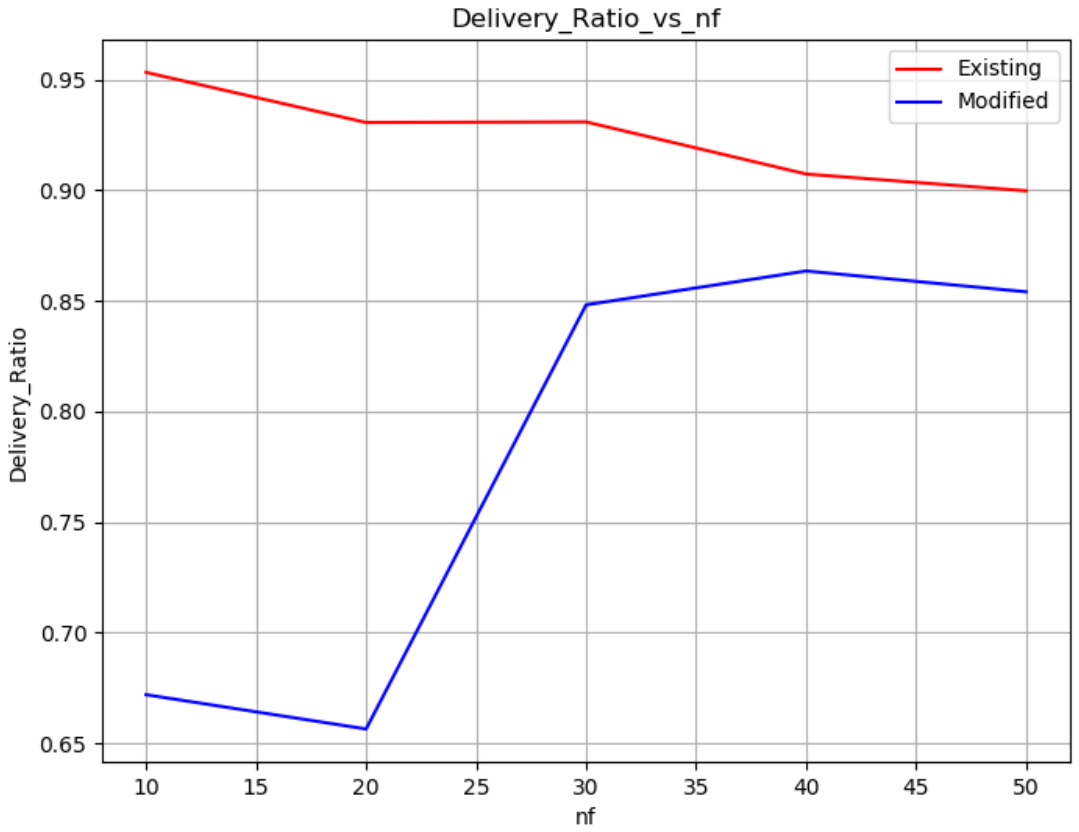
Coverageare

Delivery Ratio:

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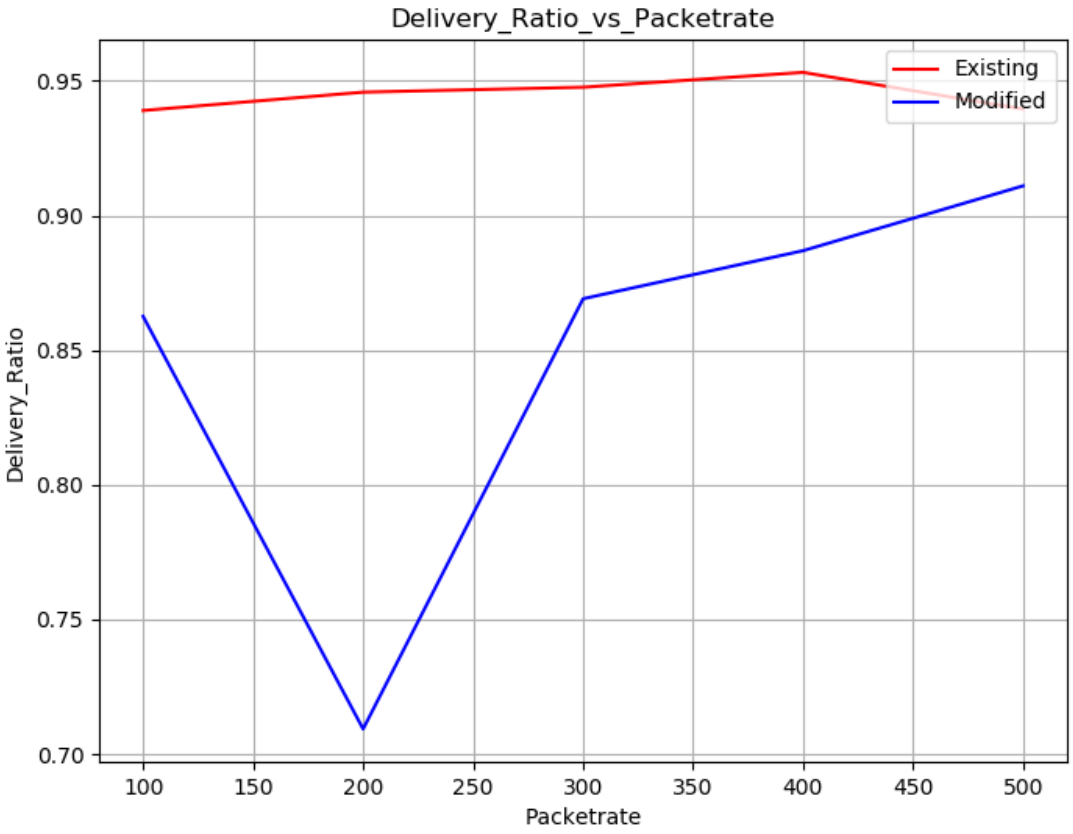
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Modified
Delivery_Ratio
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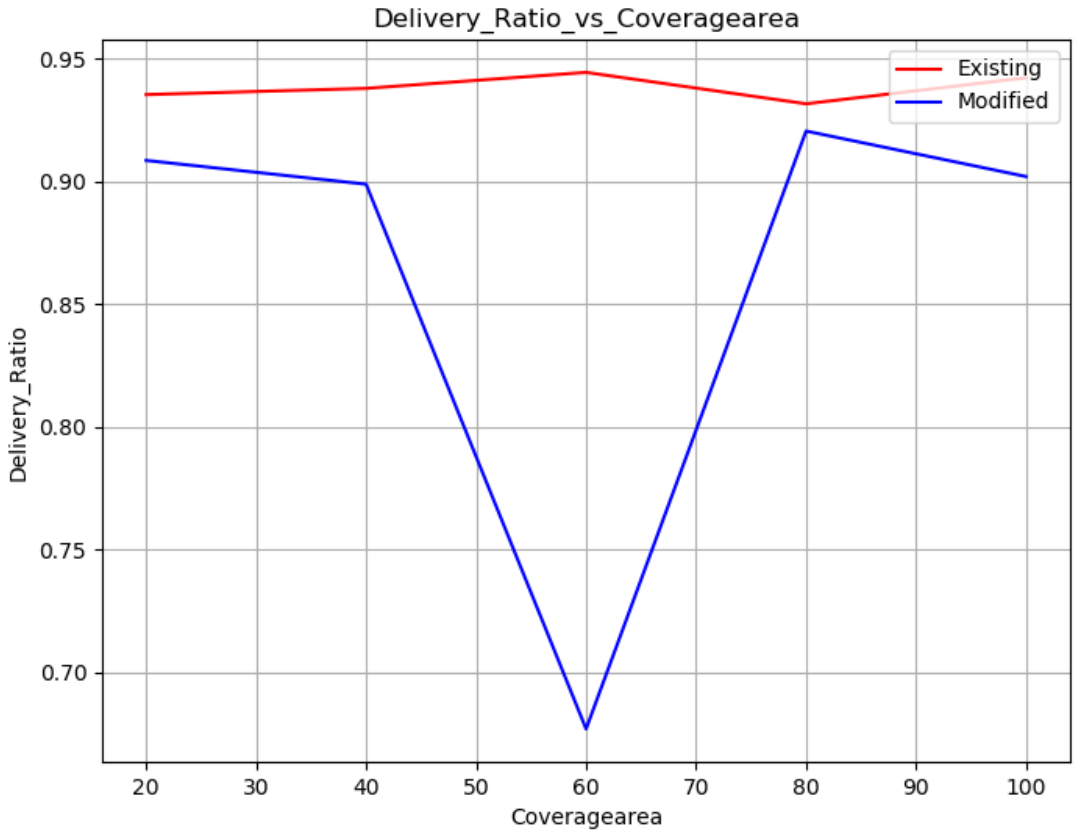
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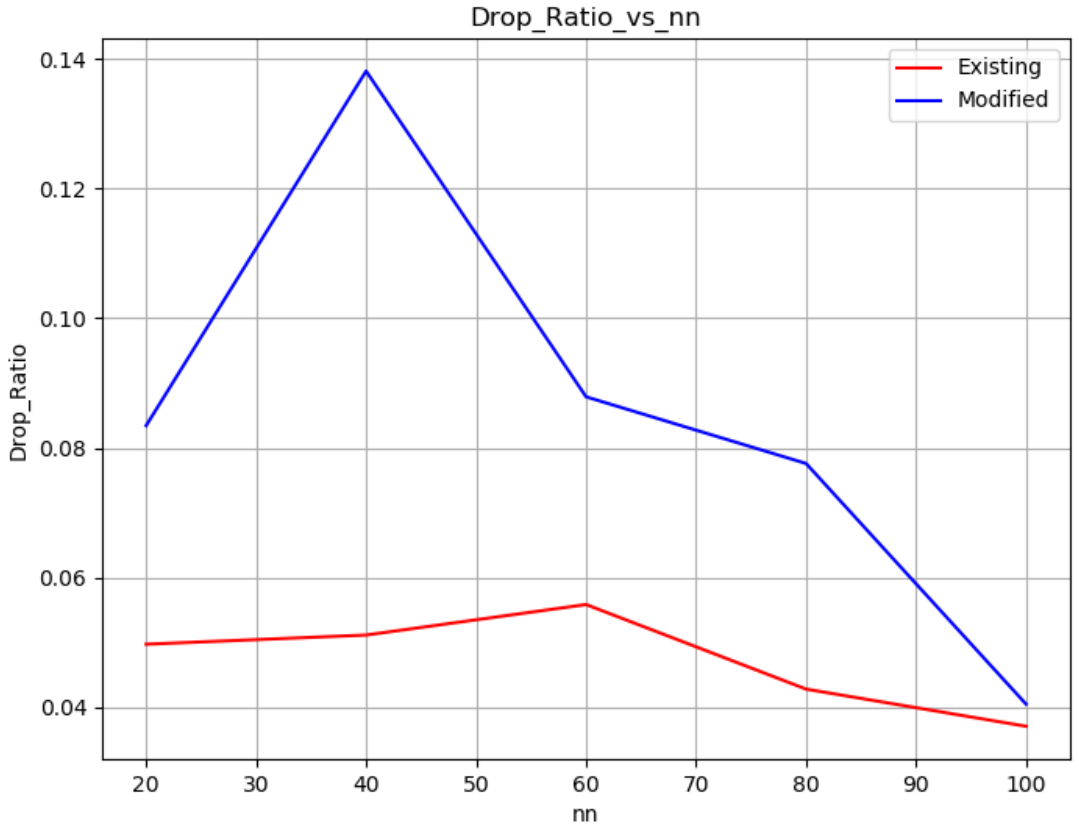
Coveragearea

Drop Ratio: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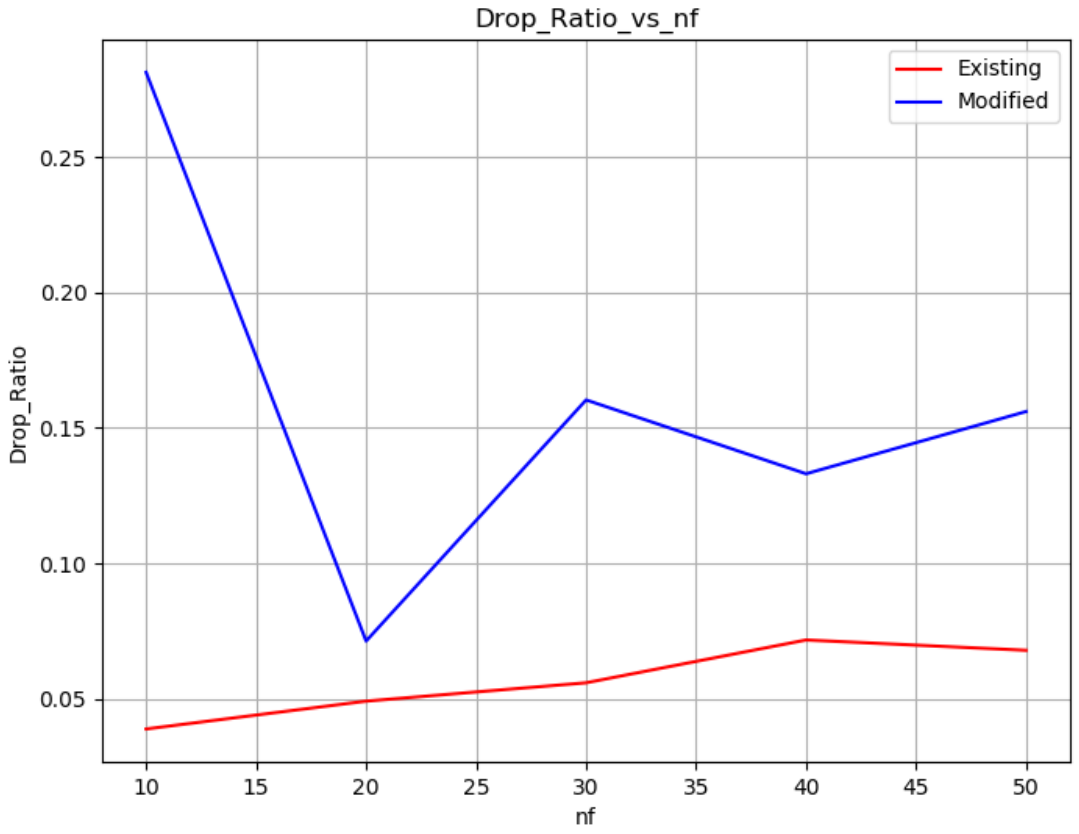
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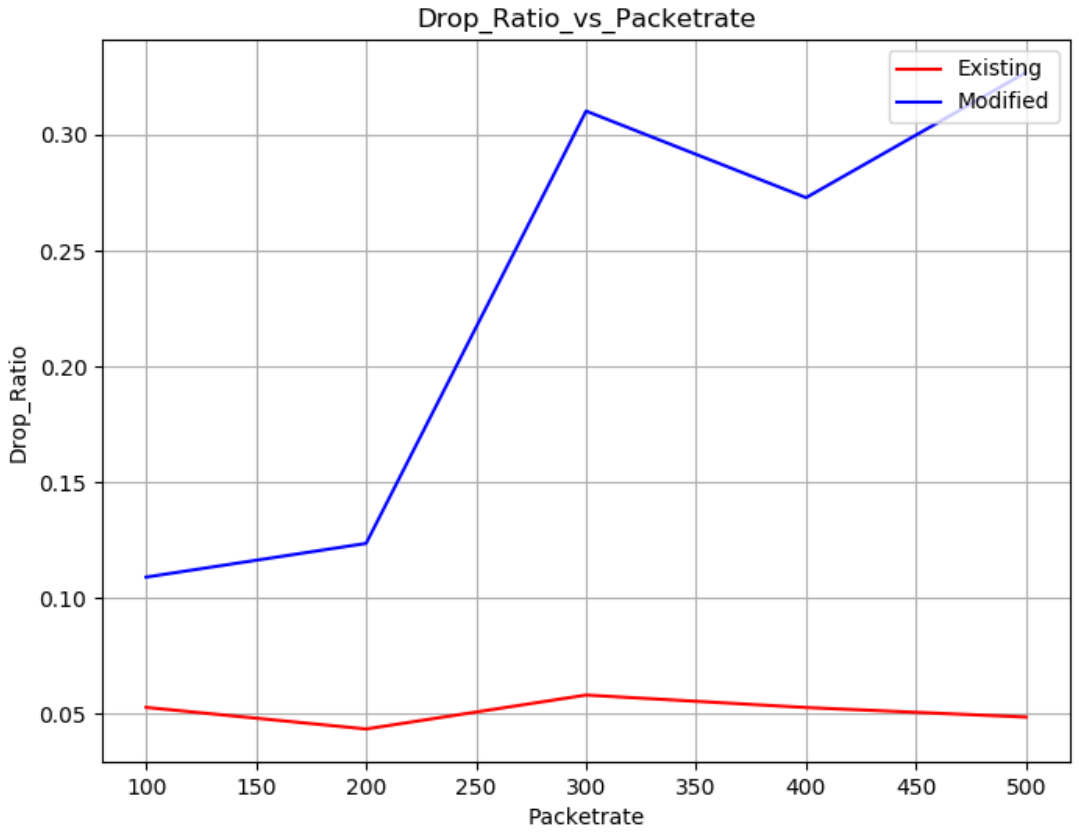
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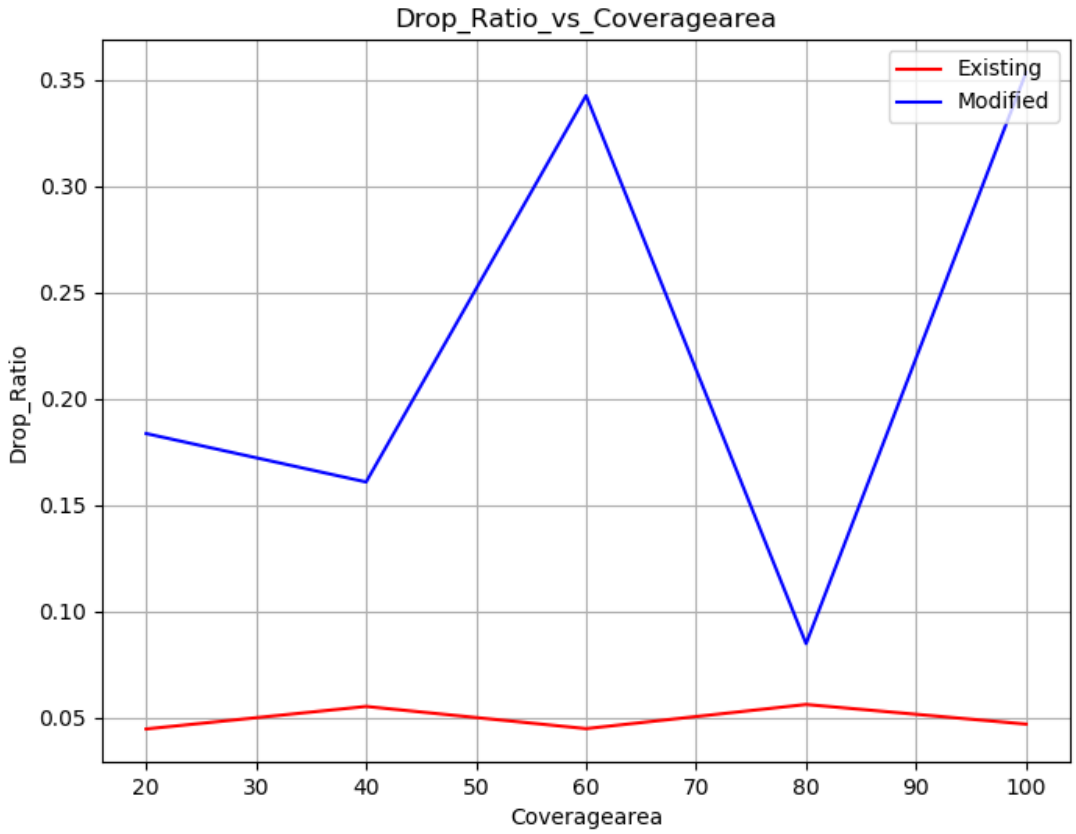
Packetrate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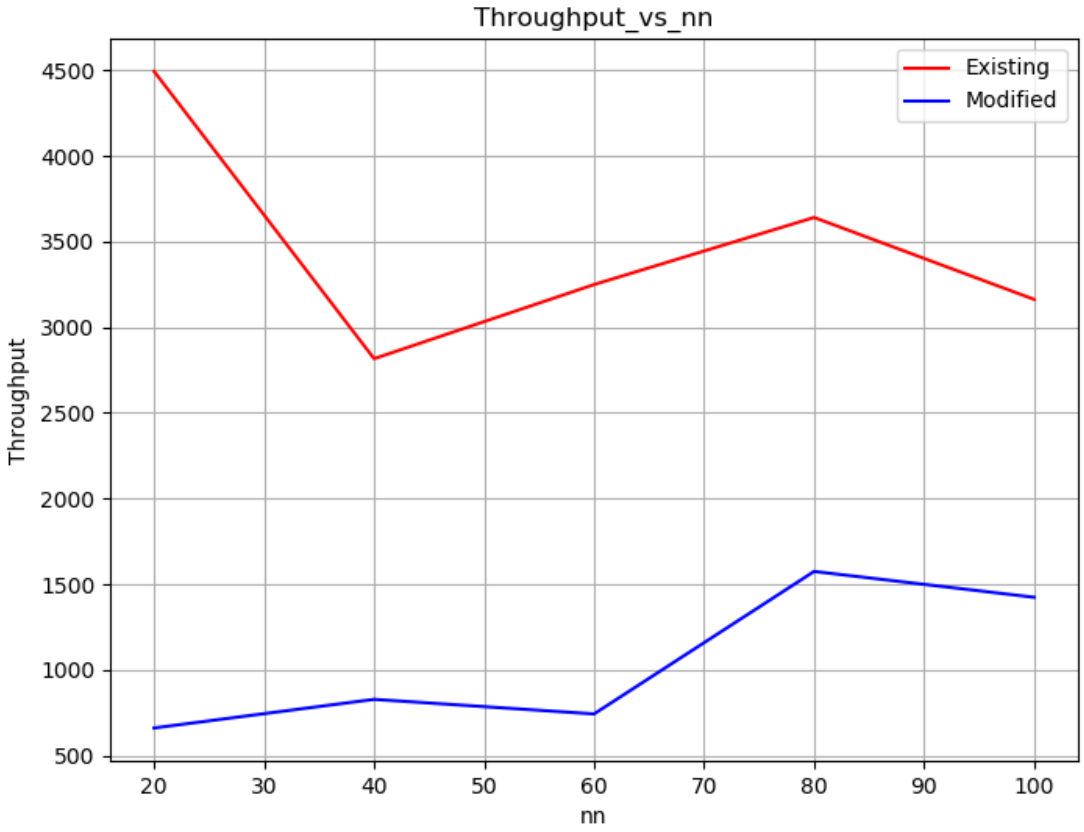
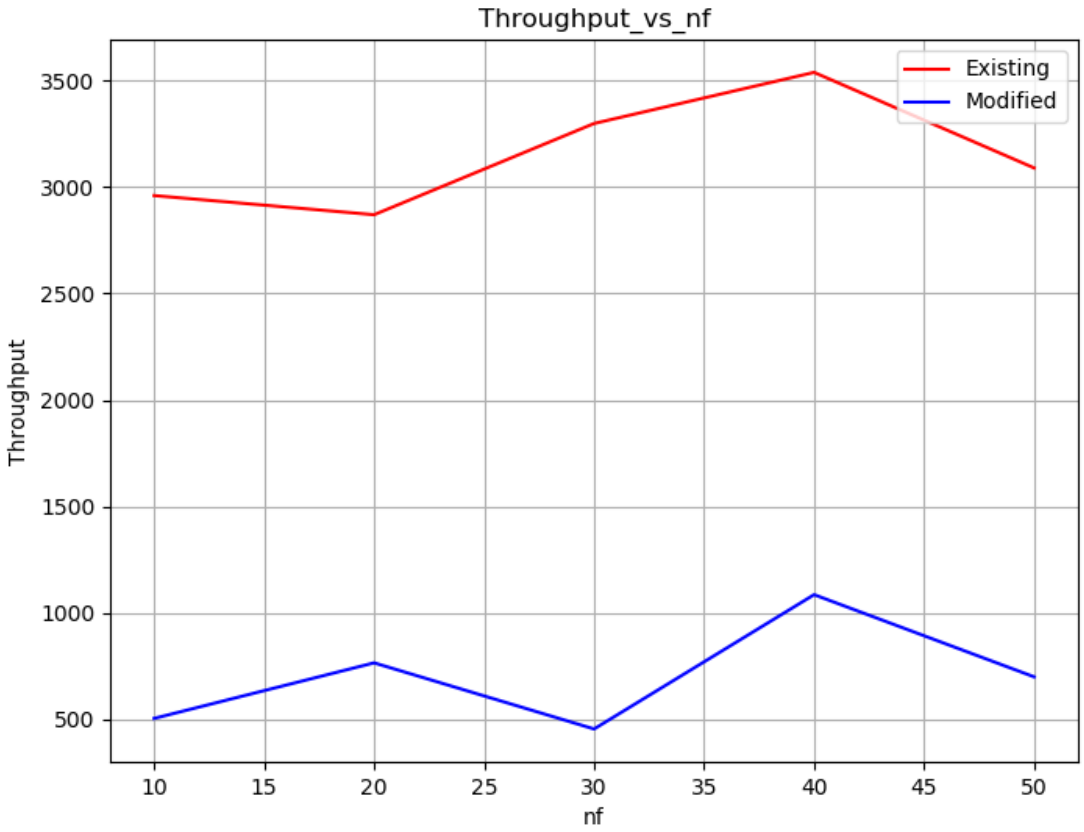
Coveragearea

PLOTS(For 802_15_4 static):

Throughput:

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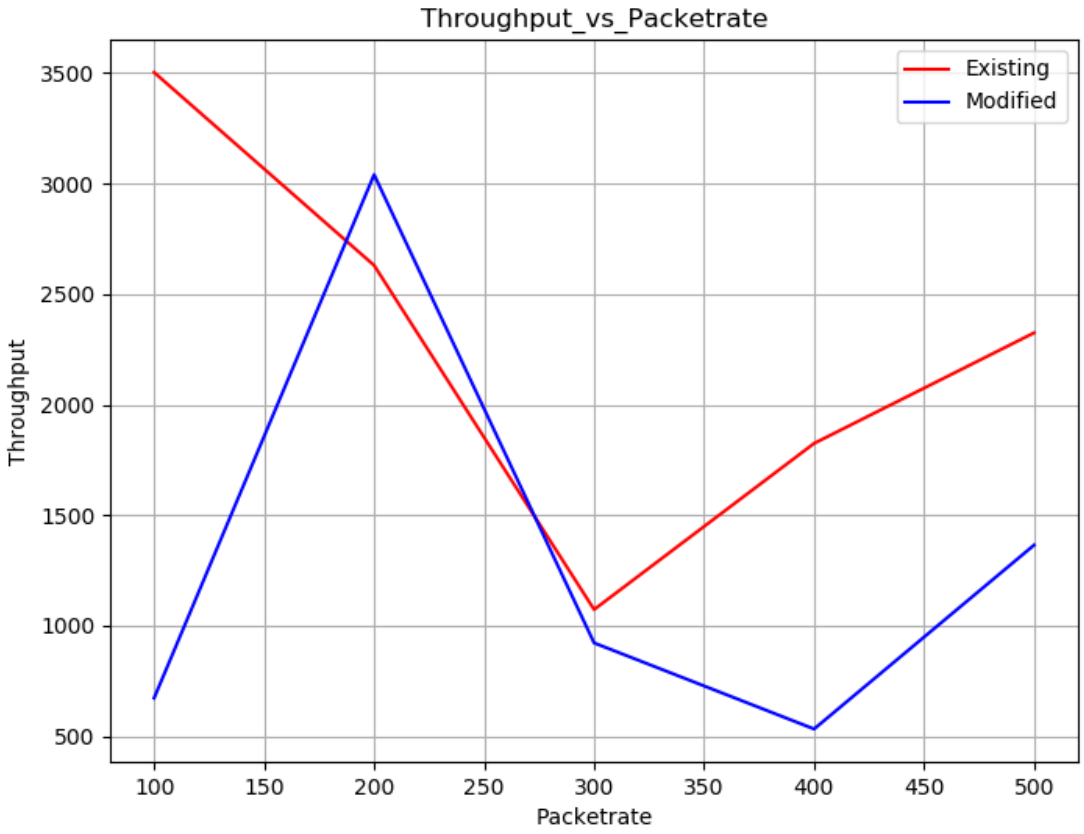
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Throughput
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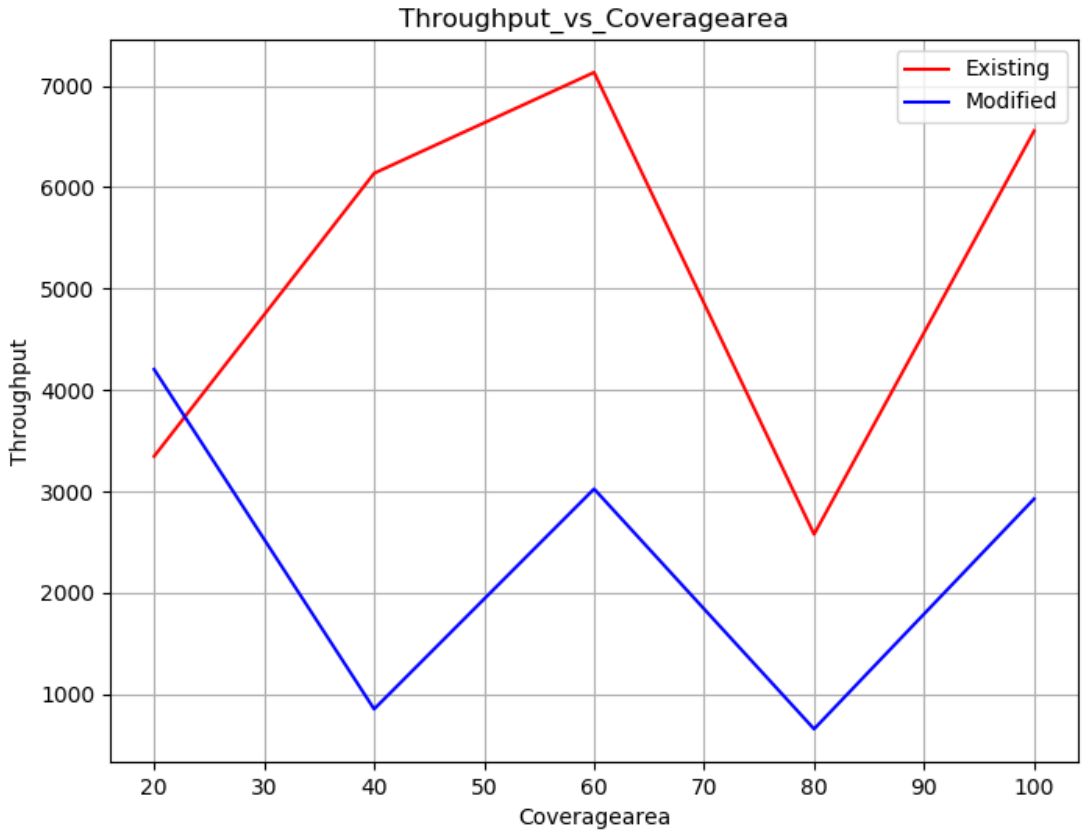
Throughput_vs_Coverageareа
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Modified
Throughput
Coverageareа
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80
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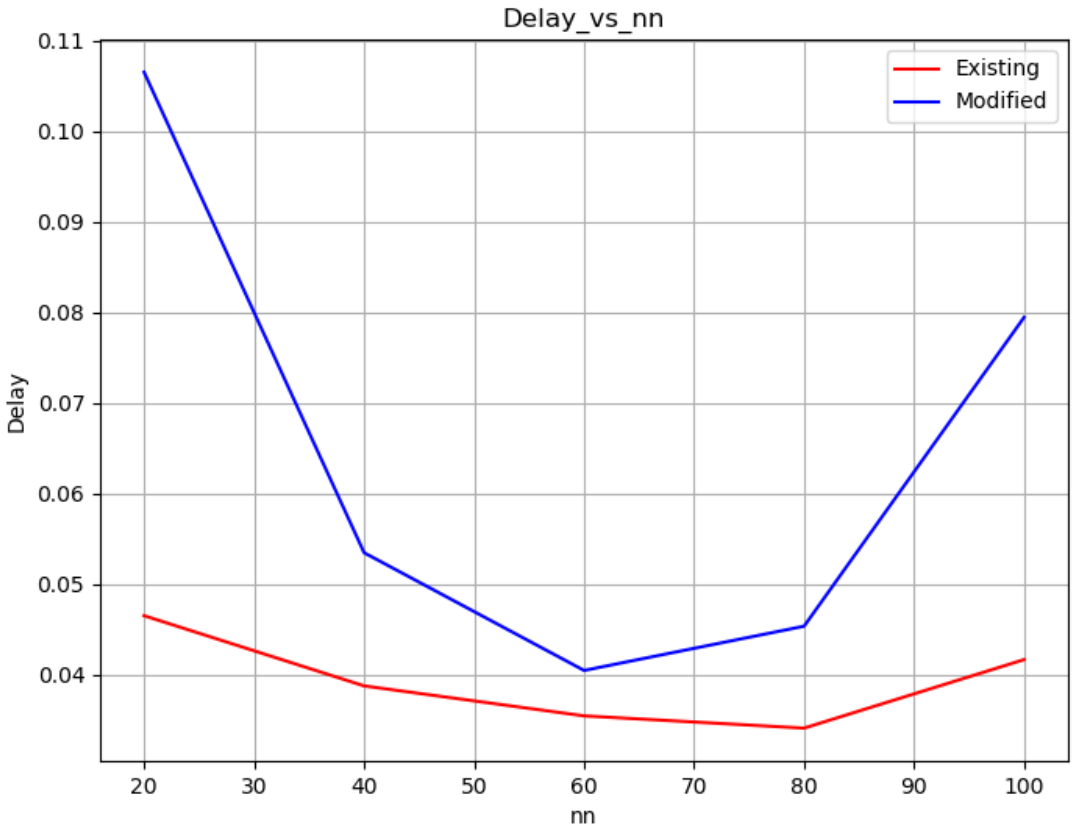
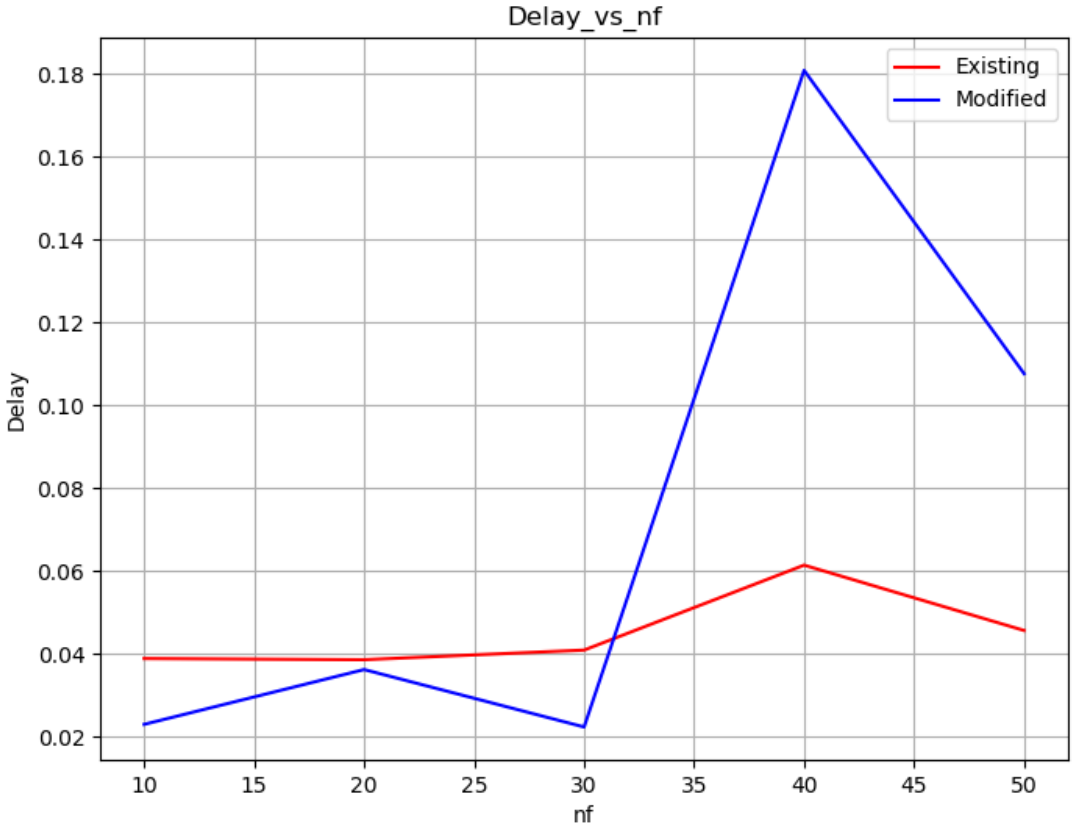
100

End to End Delay:

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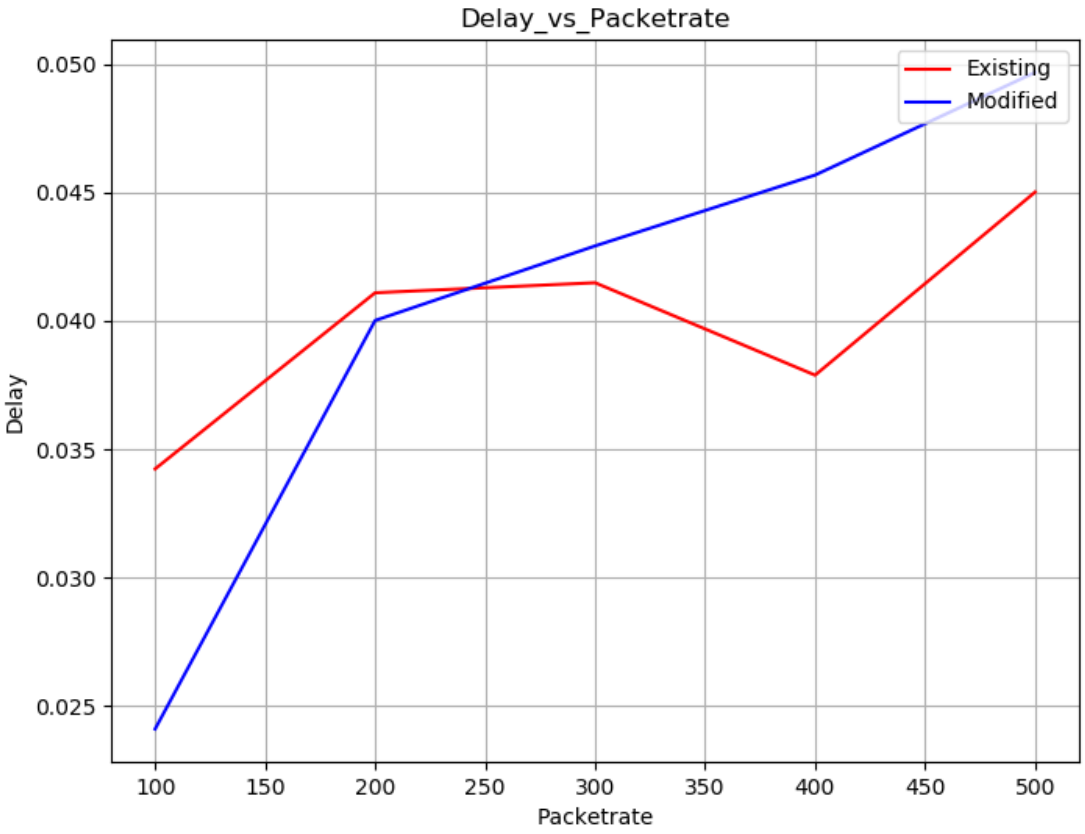
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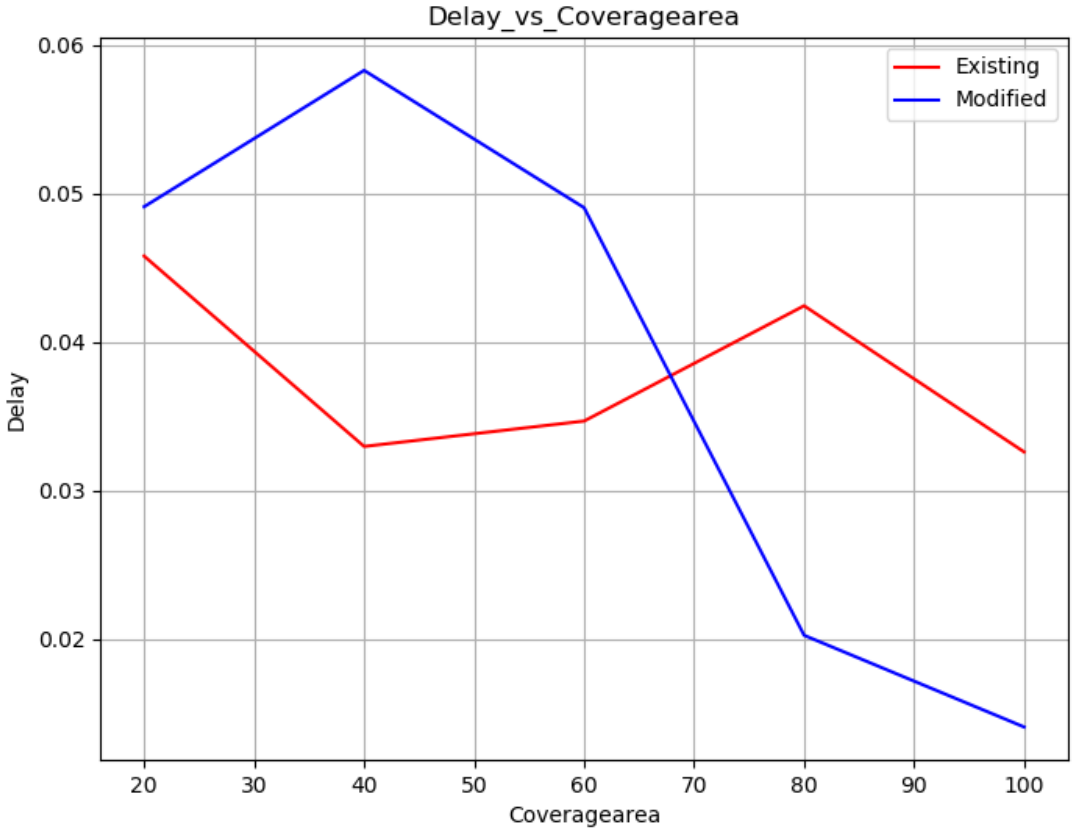
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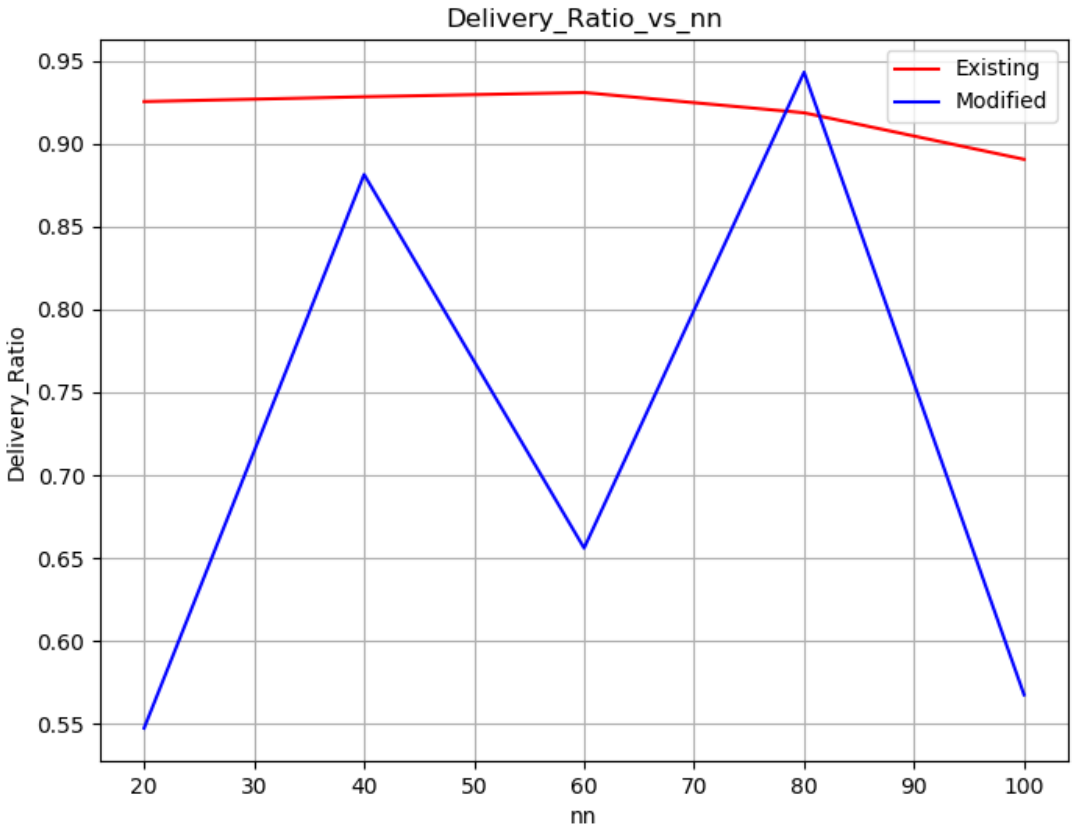
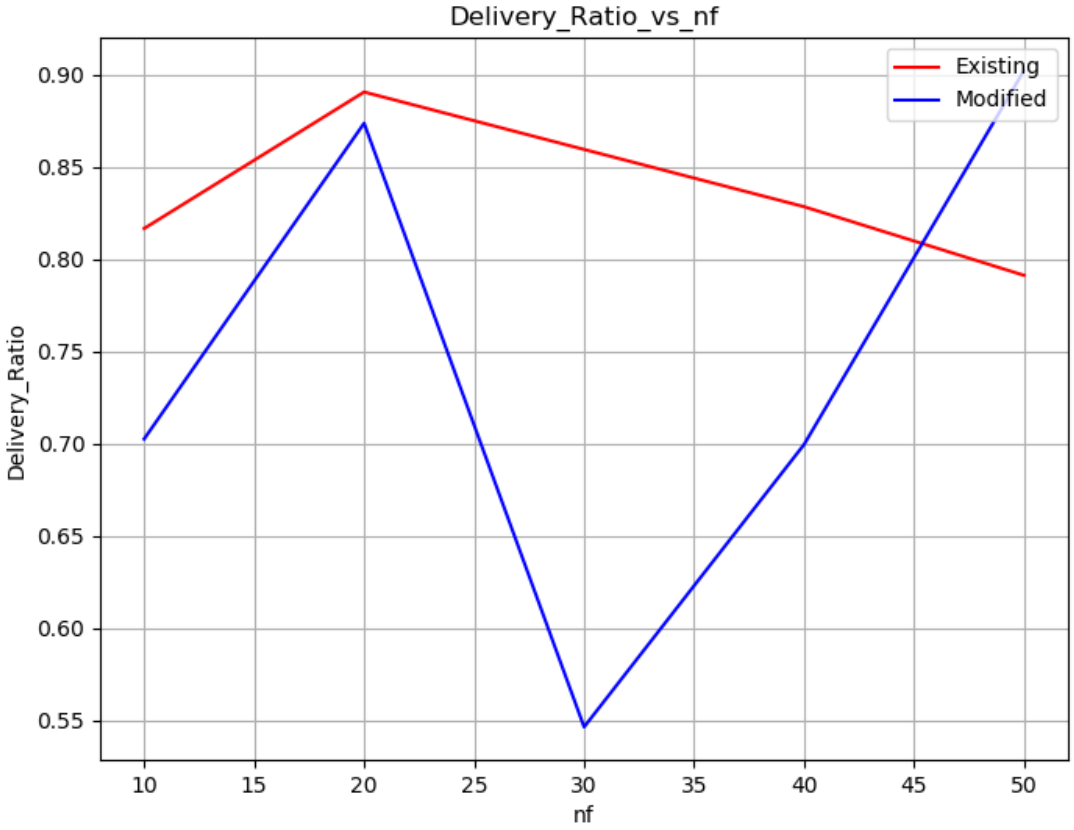
Delivery Ratio:

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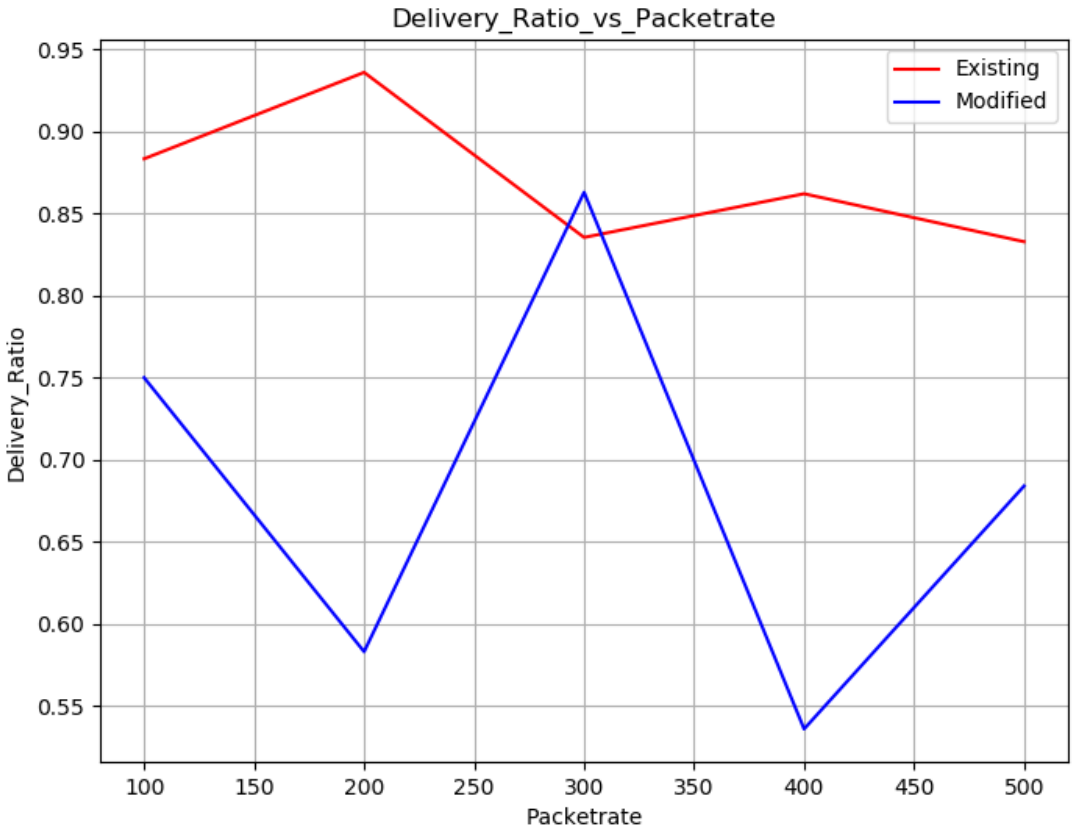
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Delivery_Ratio
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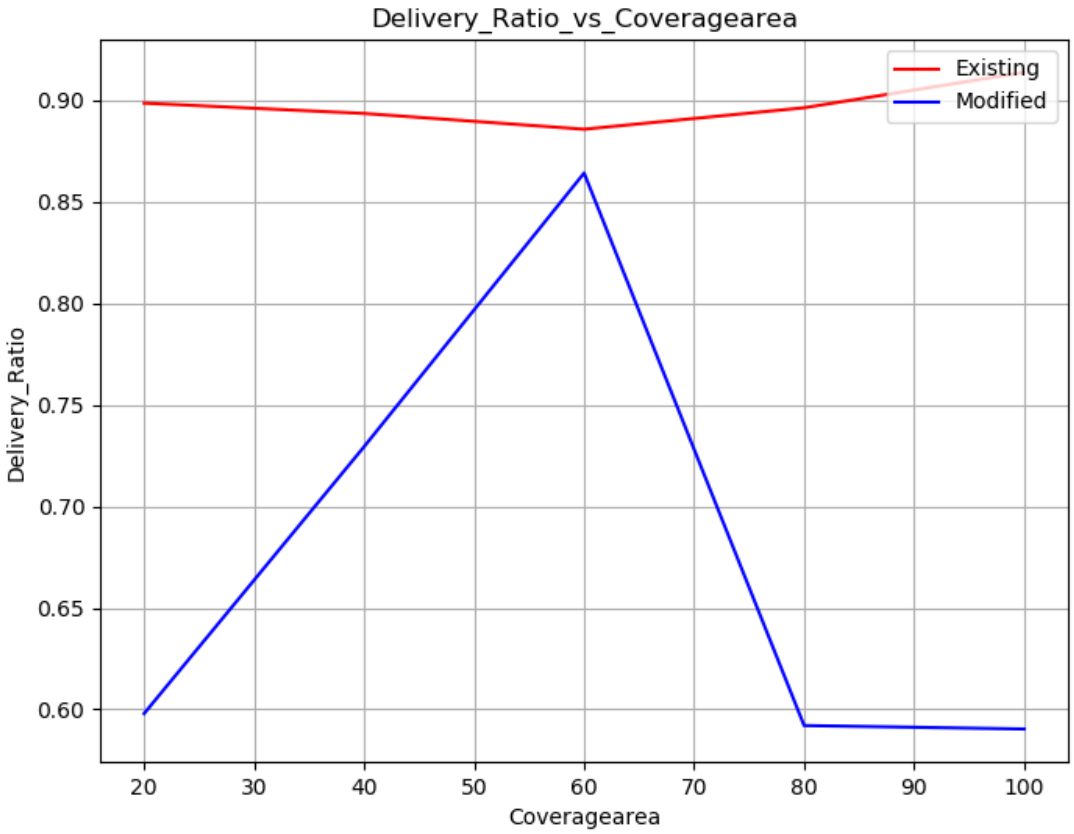
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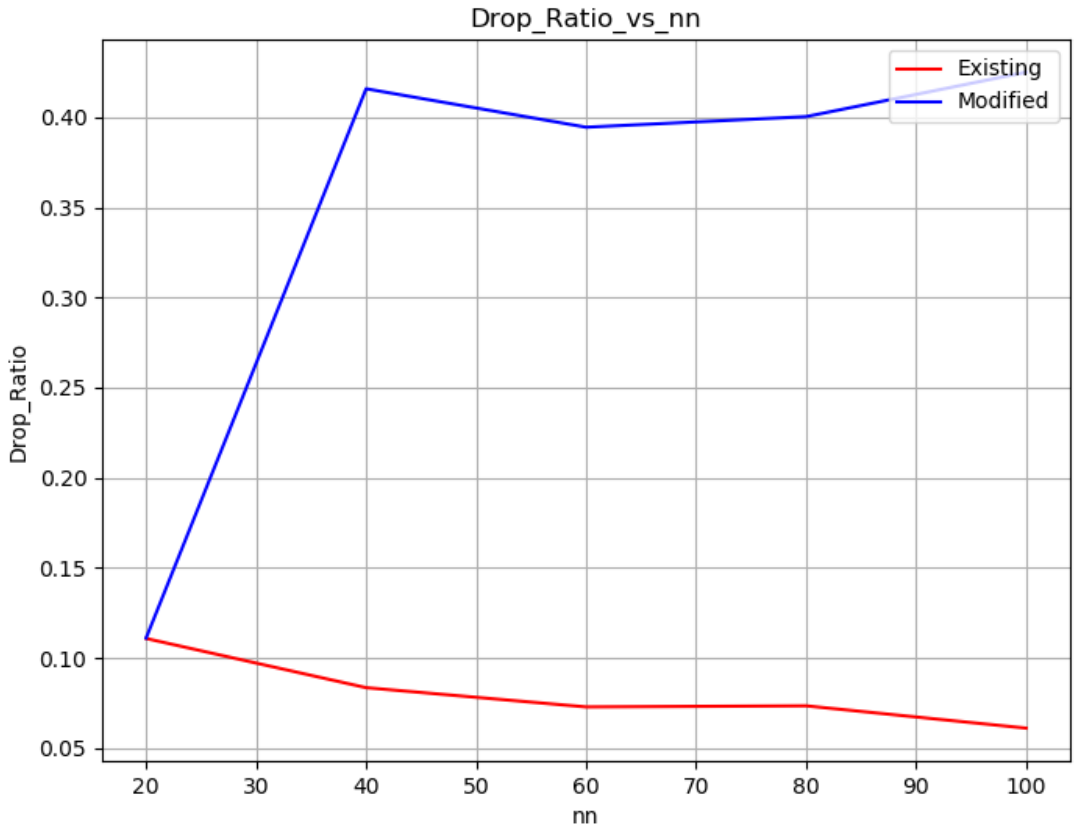
100
Coveragearea

Drop Ratio: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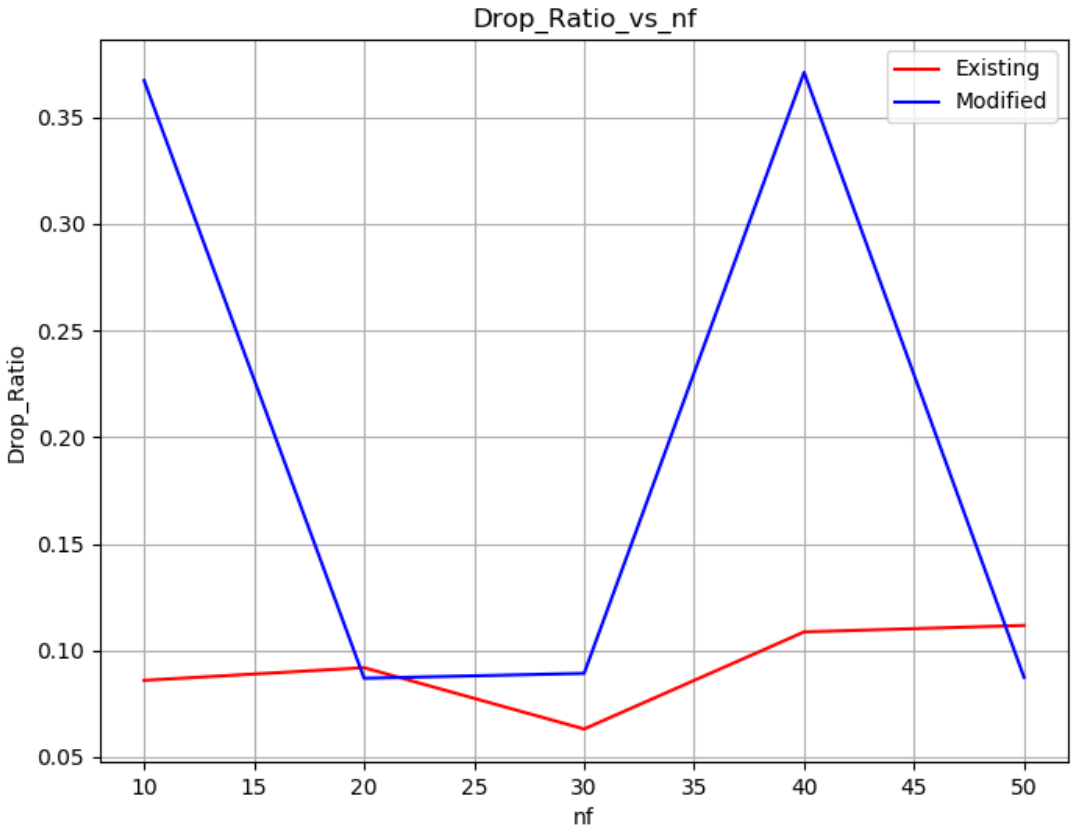
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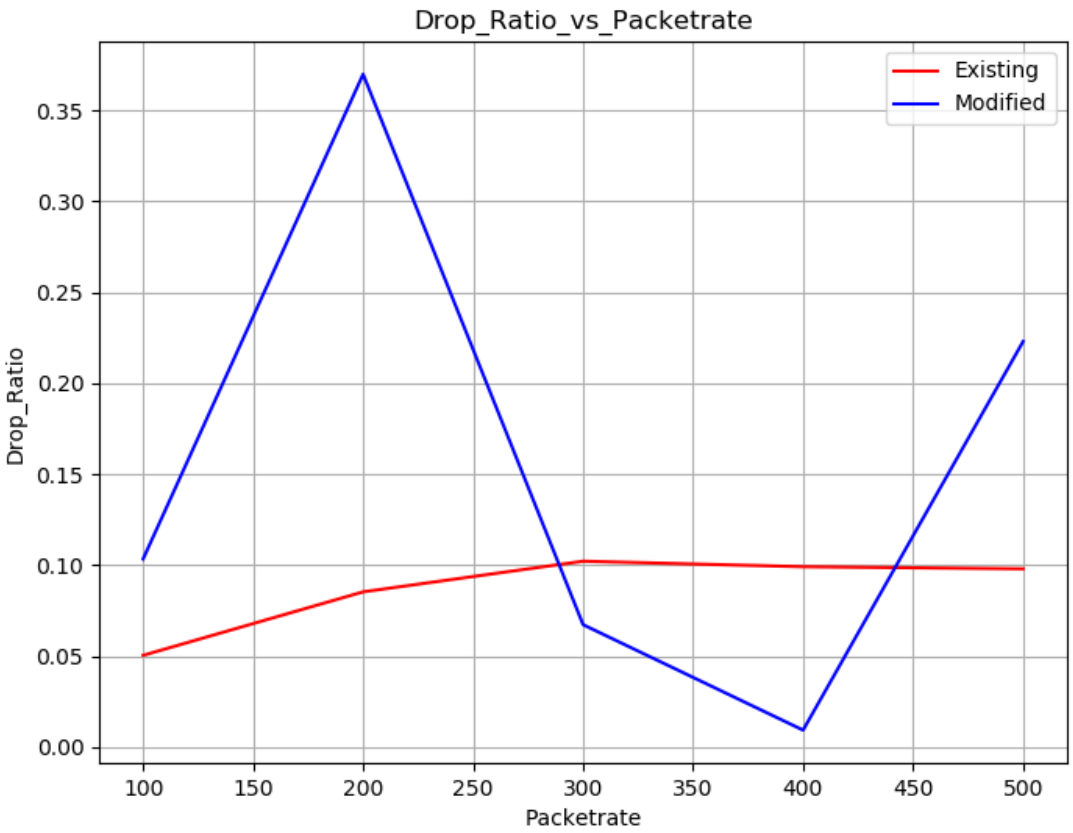
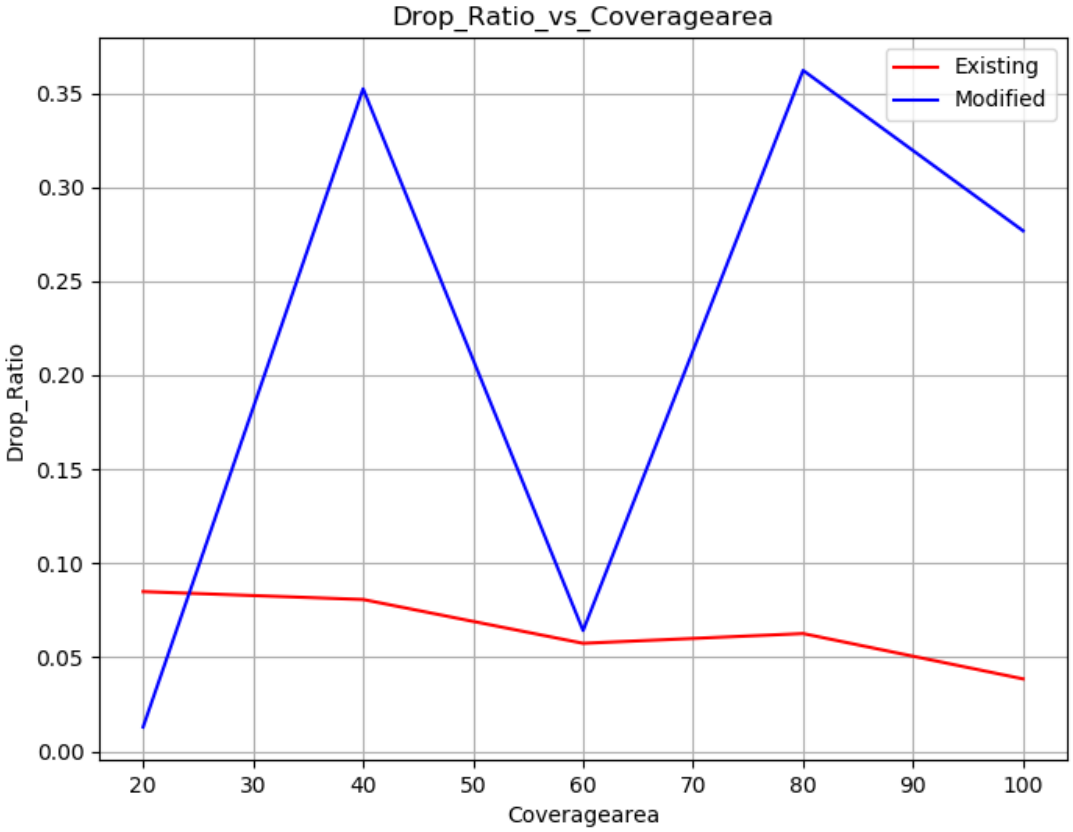
50
nf


Drop_Ratio_vs_Packetrate
Existing
Modified
Drop_Ratio
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
100
150
200
250
300
350
400
450
500
Packetrate


Drop_Ratio_vs_Coveragearea
Existing
Modified
Drop_Ratio
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
20
30
40
50
60
70
80
90
100
Coveragearea

Summary:

In my modification,I wanted to stabilize the variation of congestion window size(cwnd) around a certain value.Because I thought stabilizing the congestion window size will improve the average throughput.But unfortunately this did not work.To stabilize the variation of congestion window I limited the increment of congestion window size to a certain value(the value of cwnd when very first packet drop was detected).

That's why on average more packet drops are occurred due to limited window size.That's why from the above figures we can observe that modified implementation has lower throughput, delivery ratio and higher drop ratio on average.