CSE 322:Computer Networks Sessional

Term Assignment

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Varying parameters without modification(Task A):

In task A of our term assignment,we had to simulate two networks.We simulated wireless high rate(static) and wireless low rate(static) networks.Detailed description of the simulation is given below:

Wireless high rate(static):

Network topology: For simulating wireless high rate(static), we created two separate wifi lans connected by a point to point connection through their access points.Number of station nodes in each wifi lans are varied.We used IEEE 802.11 data link type for this simulation.

Parameters under variation: There are four parameters that were varied.They are:

- Number of nodes
- Number of flows
- Packets sent per second
- Coverage area

For changing each of these parameters,we calculated the following metrics:

- Throughput
- End to end delay
- Packet drop ratio
- Packet delivery ratio

Results with graphs:

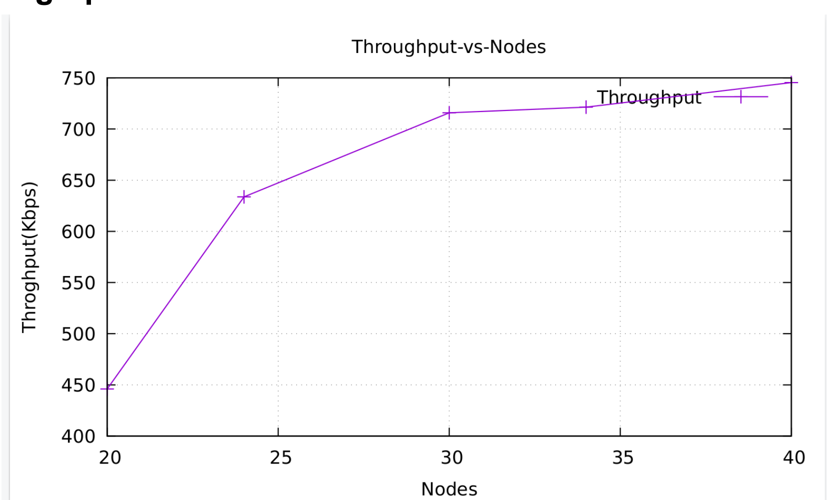


Figure 1: Throughput vs number of nodes

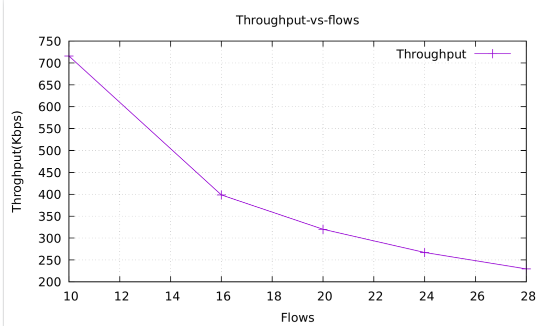


Figure 2: Throughput vs number of flow

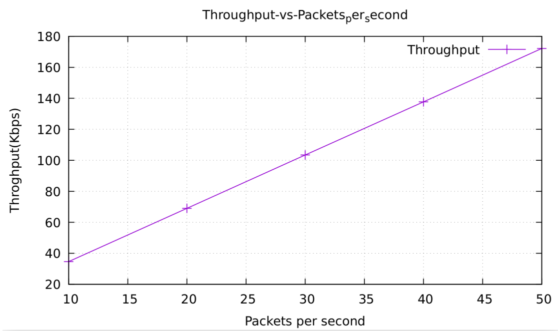


Figure 3: Throughput vs packets per second

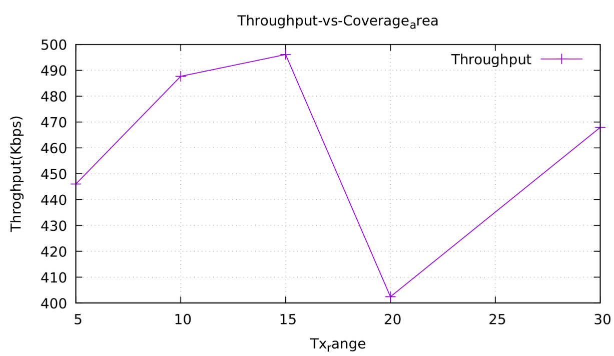


Figure 4: Throughput vs coverage area

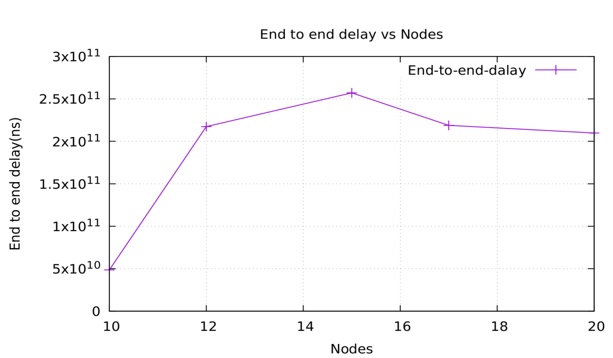


Figure 5: End to end delay vs nodes

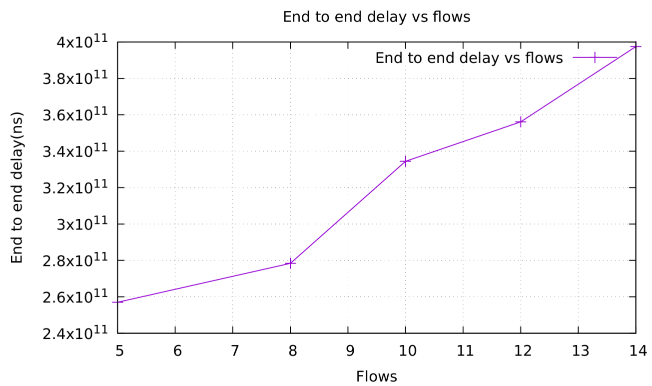


Figure 6: End to end delay vs flows

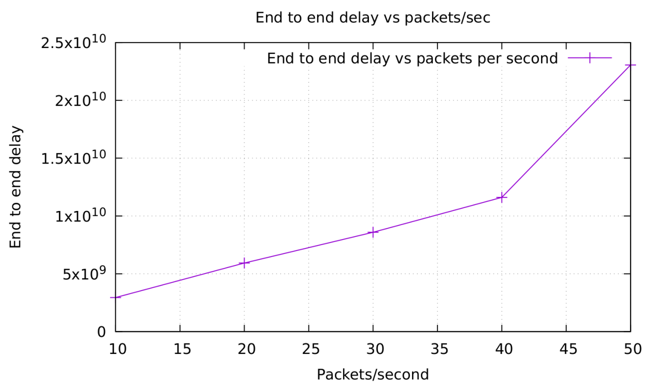


Figure 7: End to end delay vs packets/second

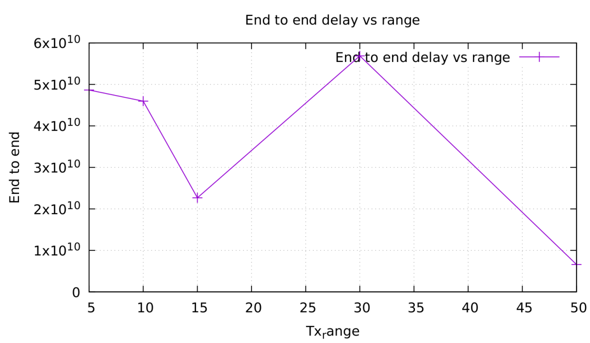


Figure 8: End to end delay vs coverage area

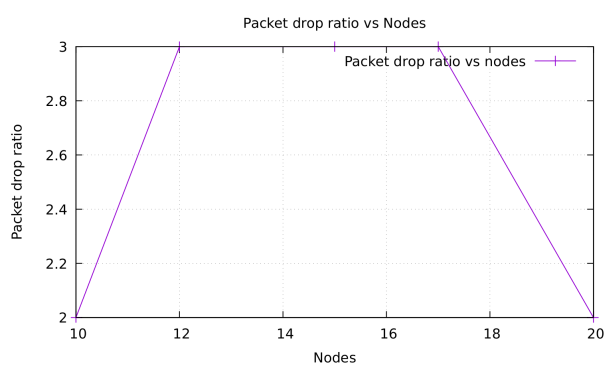


Figure 9: Packet drop ratio vs nodes

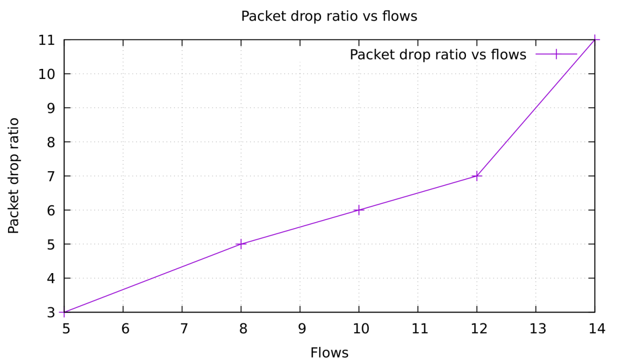


Figure 10: Packet drop ratio vs flows

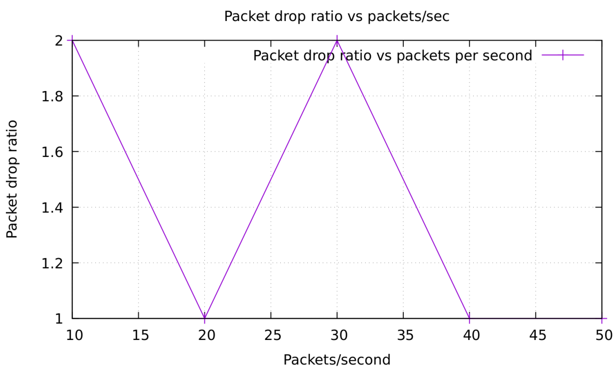


Figure 11:Packet drop ratio vs packets per second

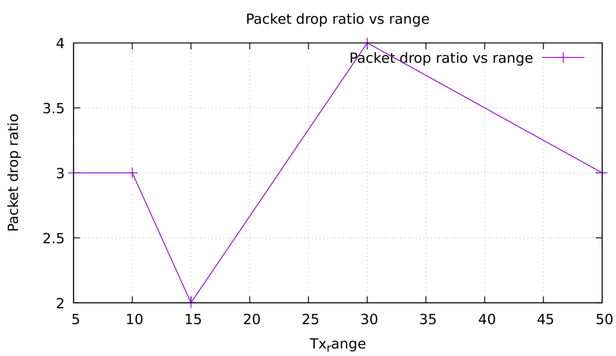


Figure 12: Packet drop ratio vs coverage area

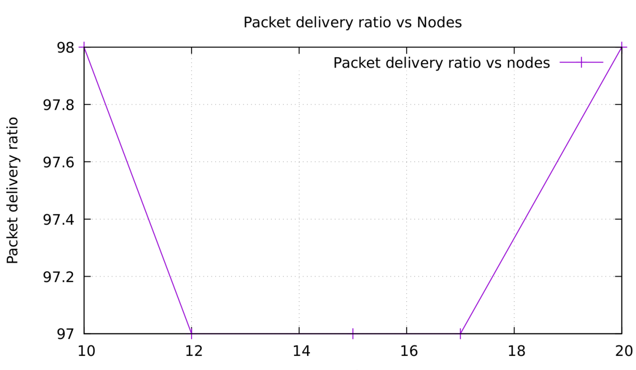


Figure 13: Packet delivery ratio vs nodes

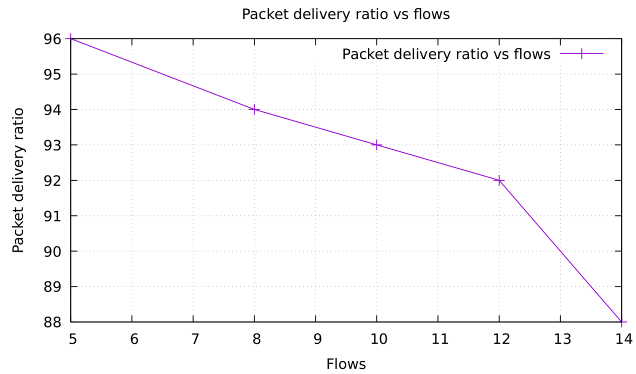


Figure 14: Packet delivery ratio vs flows

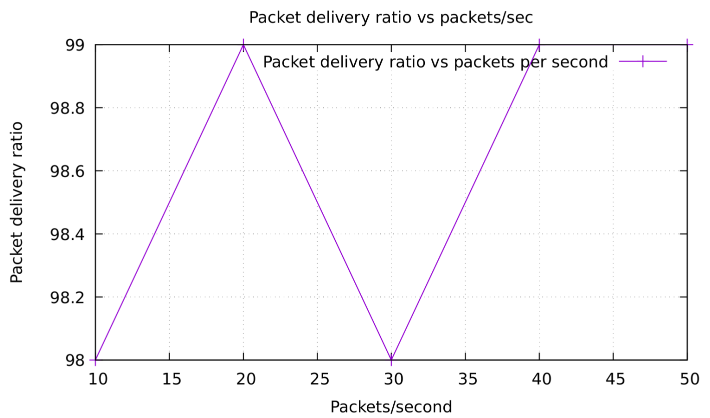


Figure 15: Packet delivery ratio vs packets/second

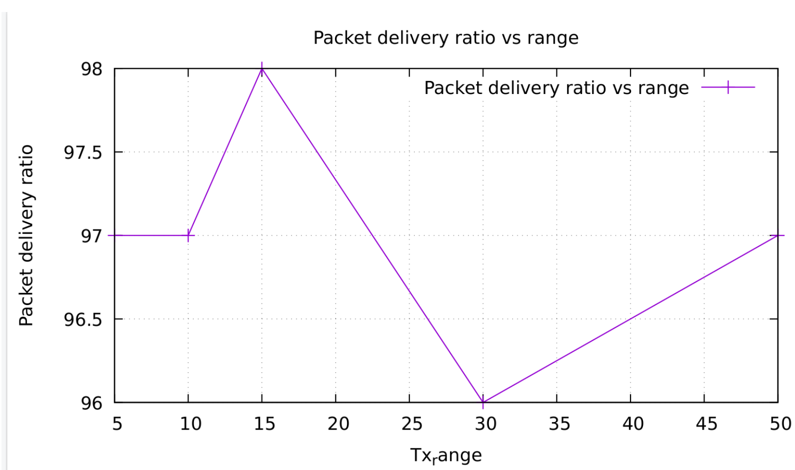


Figure 16: Packet delivery ratio vs coverage area

Summary findings: Average throughput increases with the increase of number of nodes and decreases with the increase of number of flows.Besides,average throughput is almost proportional with the number of packets.On the contrary,throughput does not seem to depend on the coverage area

End to end delay increases with the increase of number of nodes,number of flows and number of packets per second individually.But end to end delay seems to generally decrease with the coverage area.
Packet drop ratio gradually increases with the number of flows.On the other hand,number of nodes,number of packets per second and coverage area do not affect the drop ratio.It is because the packet drop ratio generally depends on the queue management scheme that is being used.
Packet delivery ratio decreases with the number of flows.But other three parameters do not affect the delivery ratio in this simulation.

Wireless low rate(static):

Network topology: For simulating wireless low rate(static), we created two separate wifi lans connected by a point to point connection through their access points.Number of station nodes in each wifi lans are varied.We used IEEE 802.15.4 data link type for this simulation.

Parameters under variation: There are four parameters that were varied.They are:

- Number of nodes
- Number of flows
- Packets sent per second
- Coverage area

For changing each of these parameters,we calculated the following metrics:

- Throughput
- End to end delay
- Packet drop ratio
- Packet delivery ratio

Results with graphs:

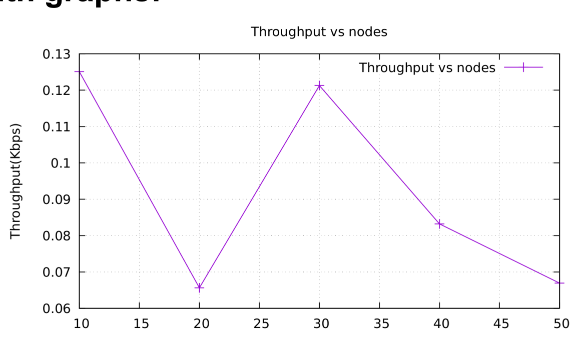


Figure 17: Throughput vs nodes

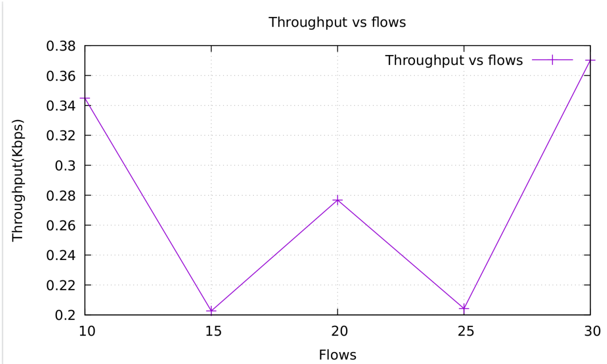


Figure 18: Throughput vs flows

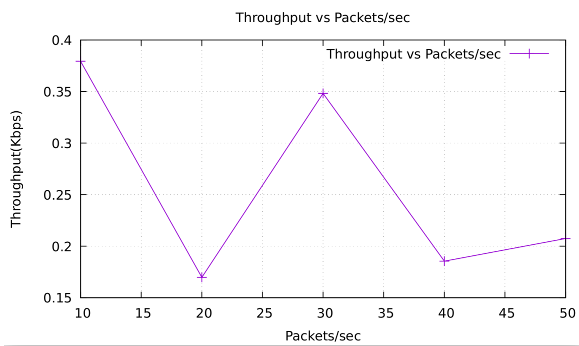


Figure 19: Throughput vs packets/second

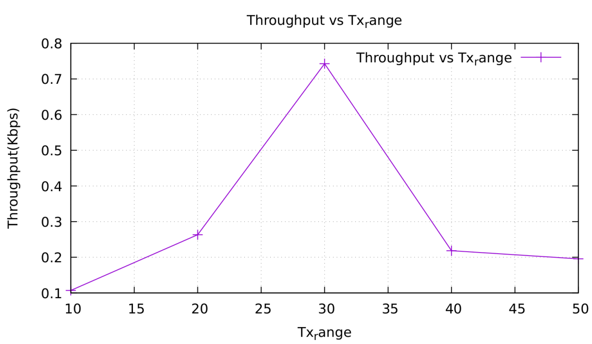


Figure 20: Throughput vs coverage area

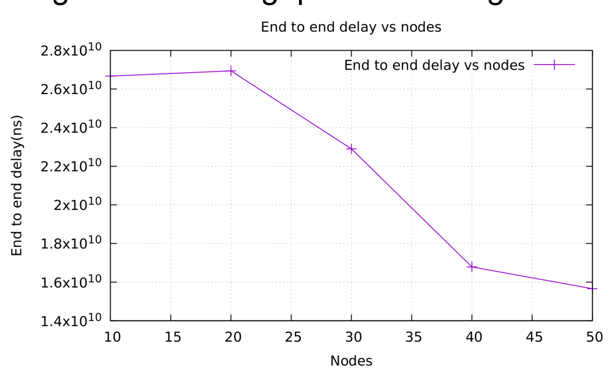


Figure 21: End to end delay vs nodes

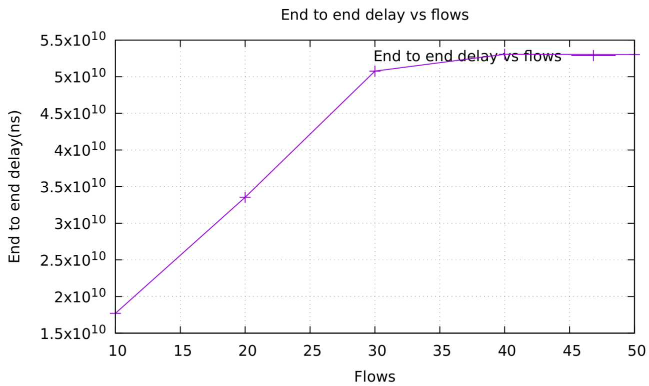


Figure 22: End-end delay vs flows

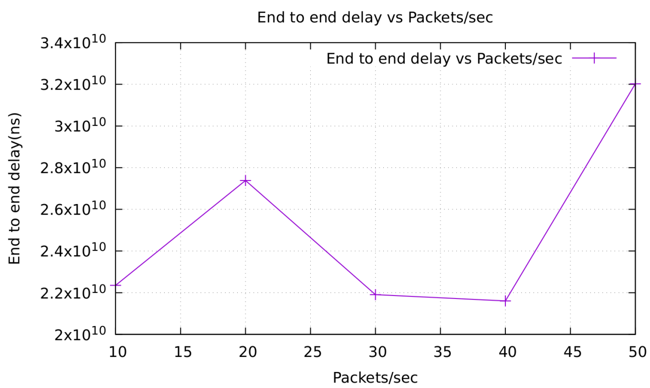


Figure 23: End-end delay vs packets/sec

Figure 24: End-end delay vs coverage area(meter)

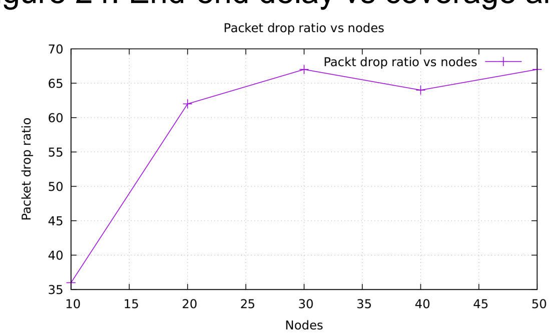


Figure 25: Drop ratio vs nodes

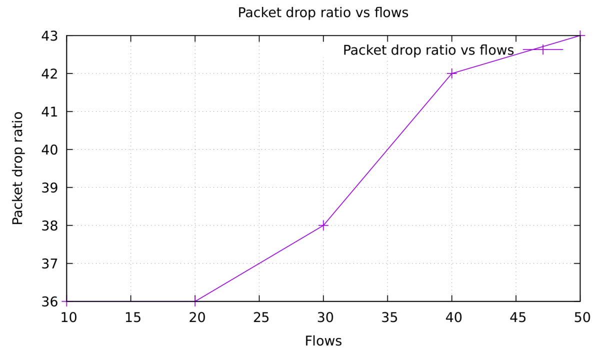


Figure 26: Drop ratio vs flows

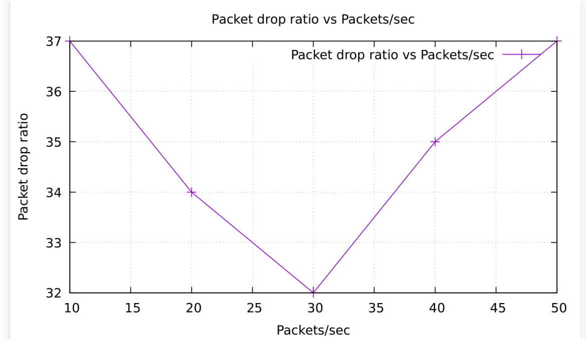


Figure 27: Drop ratio vs packets/sec

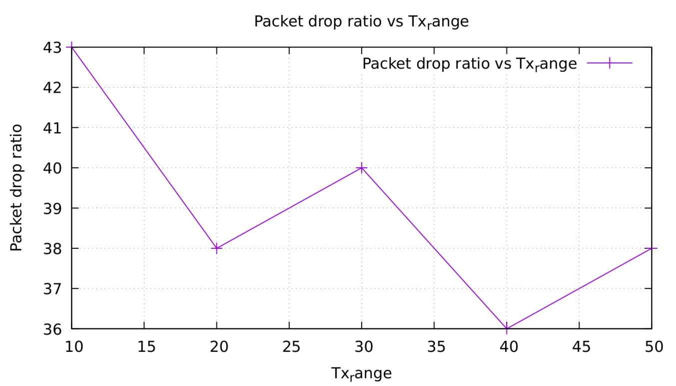


Figure 28: Drop ratio vs coverage area

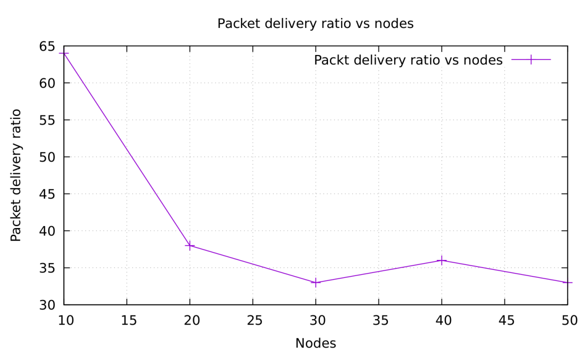


Figure 29: Delivery ratio vs nodes

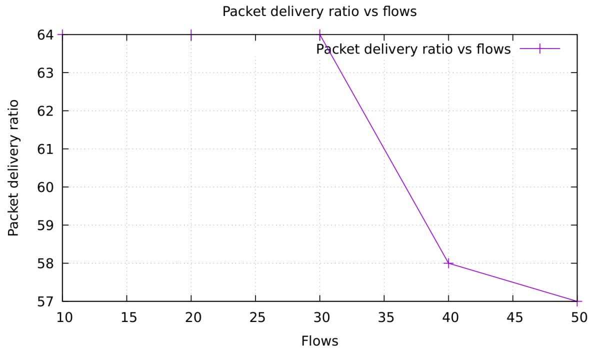


Figure 30: Delivery ratio vs flows

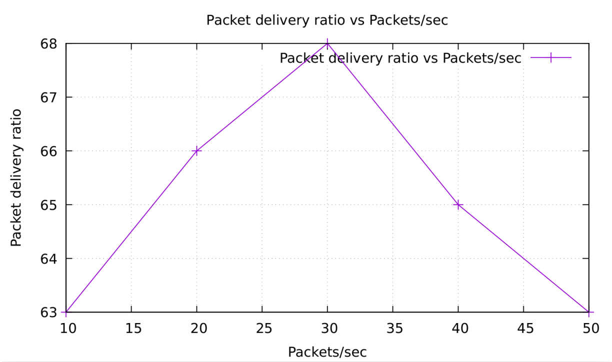


Figure 31: Delivery ratio vs packets/sec

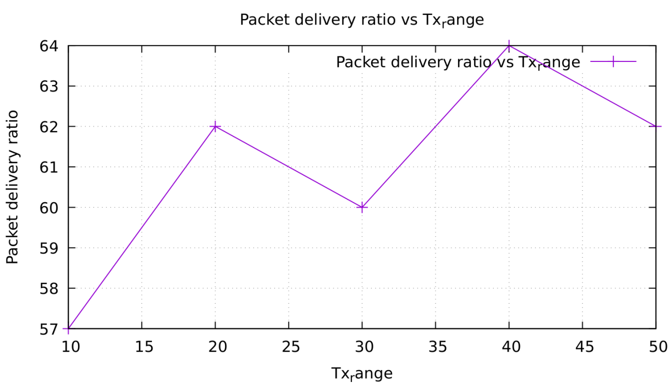


Figure 32: Delivery ratio vs coverage area

Summary findings: All four parameters mentioned do not have a significant impact on the average throughput.End to end delay decreases with increase with the number of nodes and increases with the number of flows.End to end delay does not depend on the packets sent per second in low rate wireless personal area network but decreases with the expansion of the coverage area.

Packet drop ratio increases with the increase of both number of nodes and number of flows,decreases with the expansion of coverage area.But does not depend on the number of packets sent per second.

Packet delivery ratio increases with the increase of transmission range.But decreases with increase of both number of nodes and number of flows.

Simulation with proposed modification(Task B):

Overview of the proposed algorithm: We modified the Random Early Detection(RED) algorithm to attain a refined Active Queue Management(AQM) scheme.In RED, average queue size is maintained which varies between the minimum and maximum threshold.Packet dropping probability linearly varies with the average queue size.If the average queue size becomes larger than maximum threshold,all incoming packets are dropped forcefully.RED performs well in most cases but is sensitive to traffic load.

In a low load scenario,small packet dropping probability should be used so that link utilization becomes proper.In a high load scenario,higher packet dropping probability should be used so that queue does not overflow.Thus,number of forced dropped packets will be lessened and thus the retransmission will be reduced.

Considering the above facts,we divide the packet dropping probability in two sections to distinguish between lower and higher load scenarios. We introduce a new variable “Target” which is defined as

$$Target = Min_{th} + (Max_{th} - Min_{th}/2)$$

If the average queue size is lower than Target, then it is a low load scenario. Otherwise,it is a high load scenario.Packet dropping probability is defined as:

$$P_d = \begin{cases} 0, avg \in [0, Min_{th}) \\ P_{max} \times \left(\frac{avg - Min_{th}}{Max_{th} - Min_{th}}\right)^2, avg \in [Min_{th}, Target) \\ P_{max} \times \sqrt{\frac{avg - Min_{th}}{Max_{th} - Min_{th}}}, avg \in [Target, Max_{th}) \\ 1, avg \in [Max_{th}, +\infty) \end{cases}$$

The modified algorithm is called Smart RED or SmRED algorithm.The goal is to achieve higher throughput at low load and reduce delay at highload.

Modifications made in the simulator:

We modified four files in the ns3 simulator:

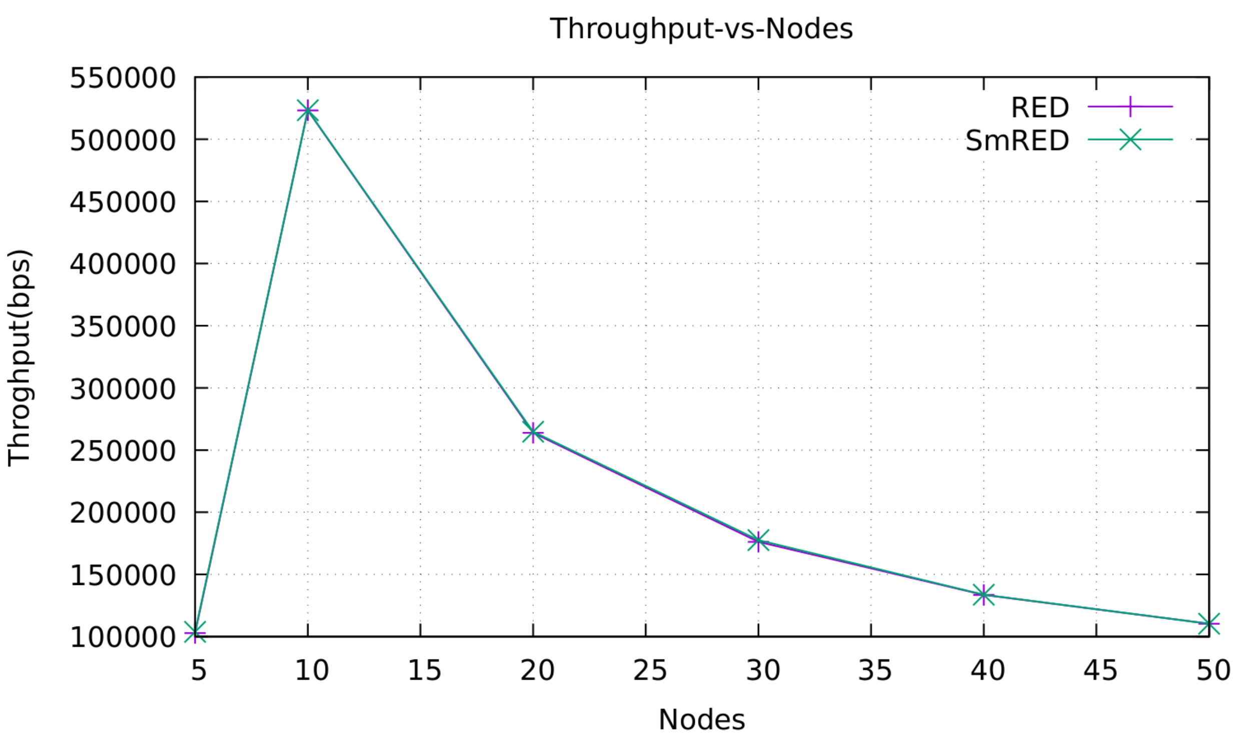
- src/traffic-control/model/red-queue-disc.cc

- src/traffic-control/model/red-queue-disc.h
- src/traffic-control/test/red-queue-disc-test-suite.cc
- examples/traffic-control/wscript

Network topology under simulation:
We created two wifi lans with a varied number of nodes connected by a point to point connection.We used the PointToPointDumbleHelper class in ns3 to create a bottleneck in the topology.

Parameters under variation:
Number of nodes.

Results with graphs:



We varied the number of nodes.Throughput in SmRED is better than that of RED.This will become clear in the following table:

Nodes	Throughput(bps) in RED	Throughput(bps) in SmRED
5	102869	103776
10	523181	523228

20	263888	264785
30	176141	177573
40	133514	133673
50	110316	110332

Here is the table for end to end delay

Average end-end delay(ns) in RED	Average end-end delay(ns) in SmRED
3.79701e+12	3.81128e+12

Summary Findings:
From the table,it is evident that SmRED gives better throughput than RED.But end to end delay is degraded.So there is a tradeoff between throughput and end to end delay.