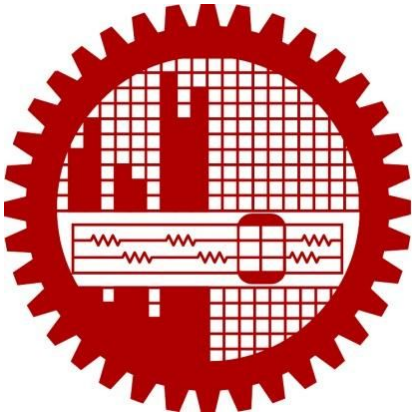

**BANGLADESH UNIVERSITY OF ENGINEERING & TECHNOLOGY**

# NETWORK SIMULATOR - 2

COURSE NUMBER: **CSE 322**

LAB GROUP: **$B_1$**


**SUBMITTED BY:**

**SAJID HASAN APON**

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

LEVEL – 3, TERM – 2

**#1305026**

**SUBMITTED TO:**

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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY

## Topologies Under Simulation:

1. Wireless 802.11 (mobile)
2. Wireless 802.15.4 (mobile)

## Parameters Under Variation:

1. Number of mobile nodes
2. Number of flows
3. Number of packets per second
4. Speed of the mobile nodes

## Modifications Made In The Simulator:

1. Change in DSDV protocol: All the logical checks for “sequence_number” have been omitted in dsdv/dsdv.cc. Hence, the DSDV routing protocol has basically been reduced to Distance Vector Routing(DVR).
   The affected variable in the TCL files is rp.

2. The Interface queue between LLC and MAC, which was a drop-tail queue, has been modified to evict a random entry when a new packet arrives and the queue is full, in lieu of the pre-existing drop-from-end method.
   The affected variable in the TCL files is ifq, which subsequently affects ll and mac.

3. The gain of the omni-antennae (both transmitter and receiver) has been increased from 1.0 to 3.0 (in file mobile/omni-antenna.cc).
   The affected variable in the TCL files is ant.

4. The drained powers for transmission and reception of AT&T's Wavelan PCMCIA card (mac/wireless-phy.cc) have been changed.
   The affected variable in the TCL files is netif.

5. Frequency of the radiowave has been increased (gen/ns-tcl.cc) and as a result, wavelength has decreased. This change affects omni-antenna and tworayground mechanisms.
   The affected variables in the TCL files are prop and ant.

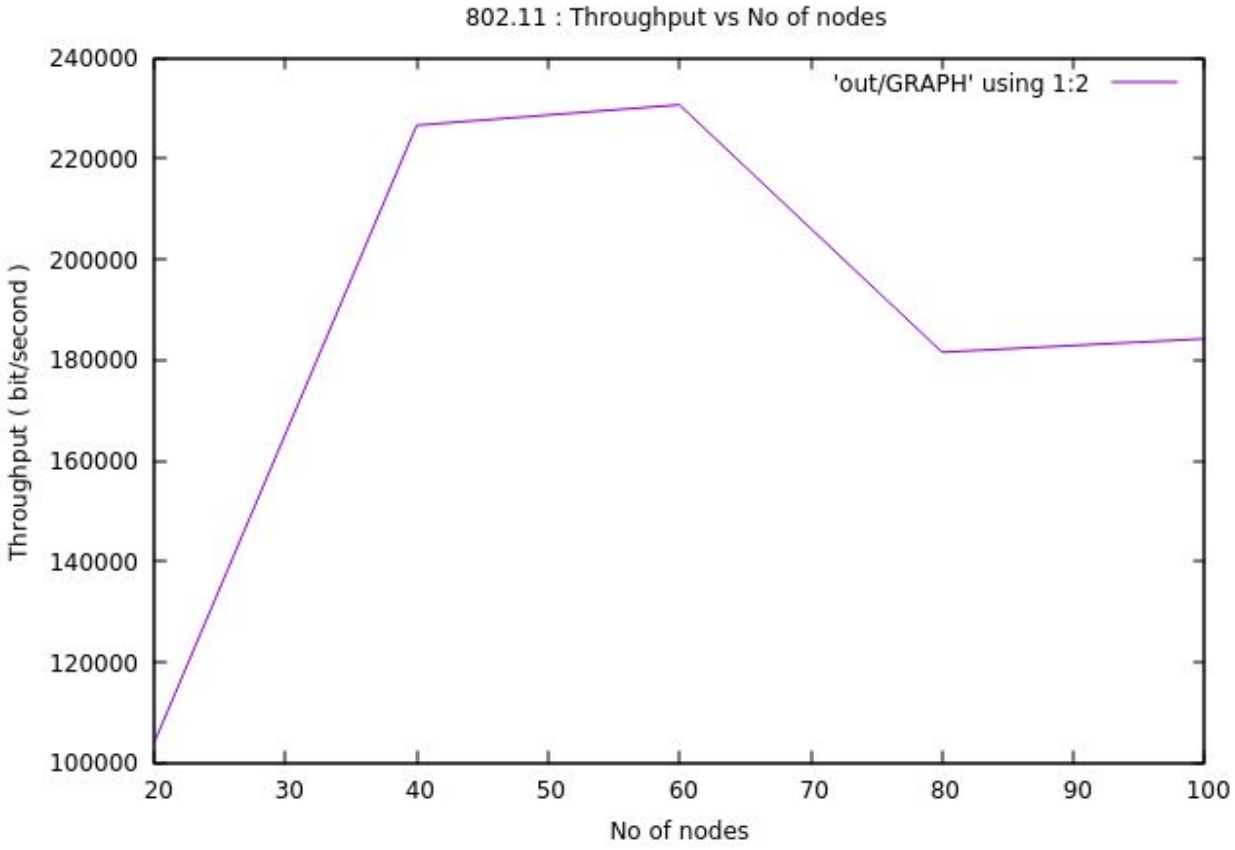
## Results with Graphs:

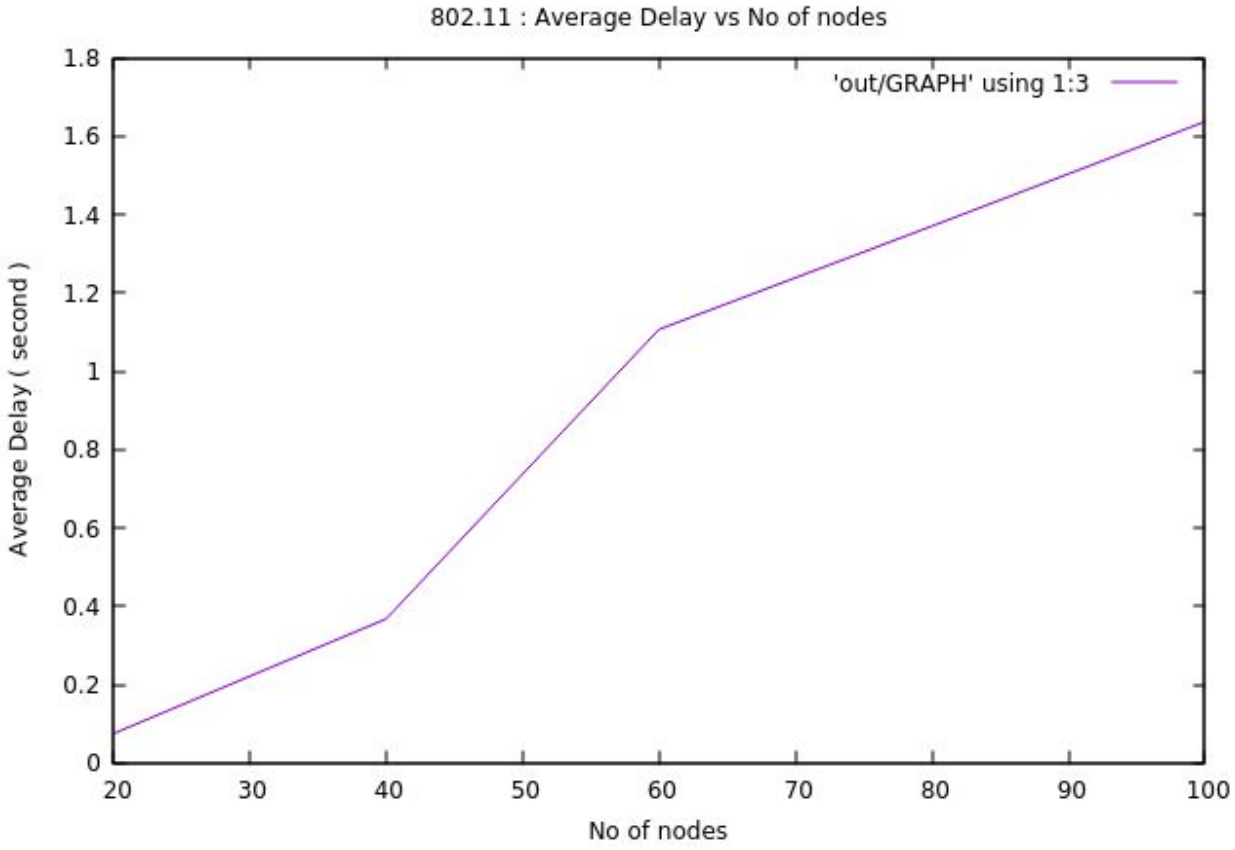
For each parameter under variation, 5 (five) sets of data were generated.
The metrics that were observed are listed below:

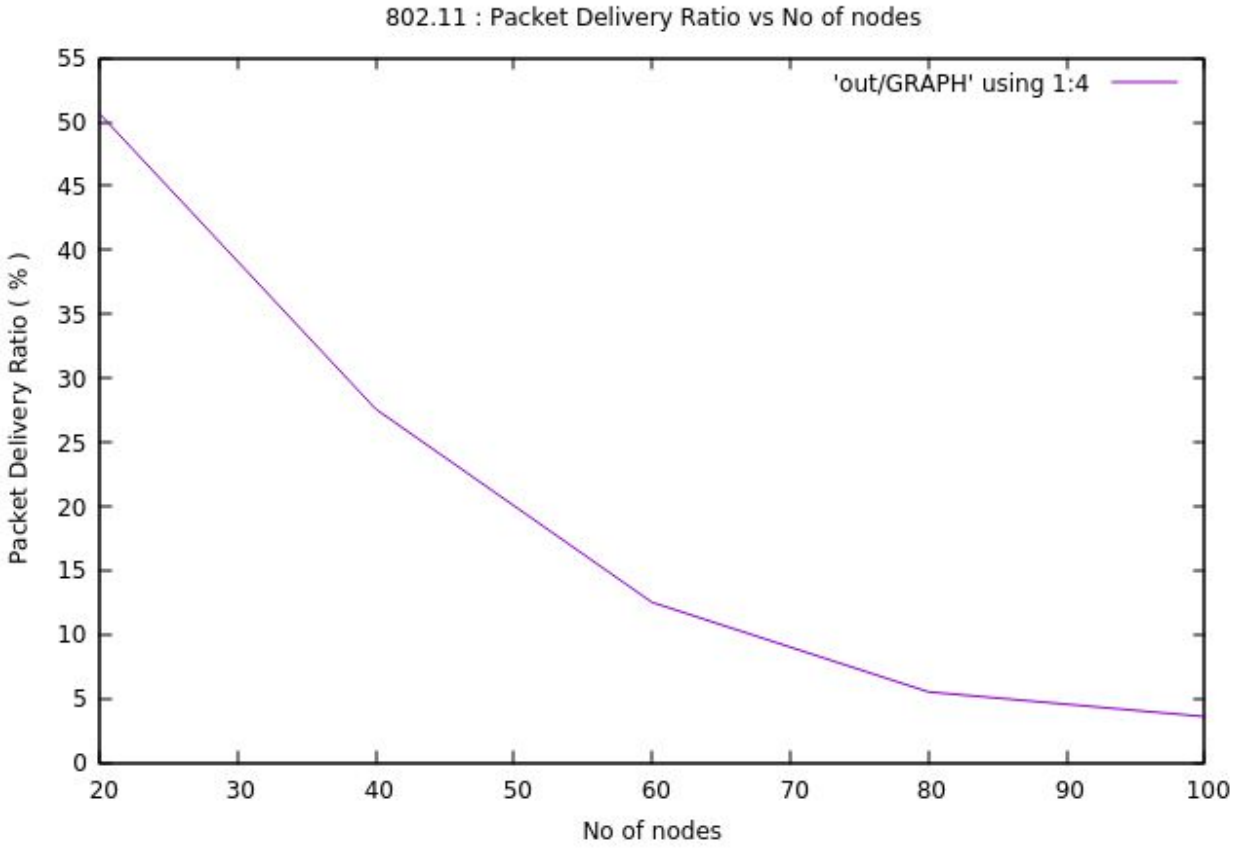
1. Network throughput
2. End-to- end delay
3. Packet delivery ratio (total # of packets delivered to end destination / total # of packets sent
4. Packet drop ratio (total # of packets dropped / total # of packets sent)
5. Total energy consumption
6. Energy consumption per byte of data

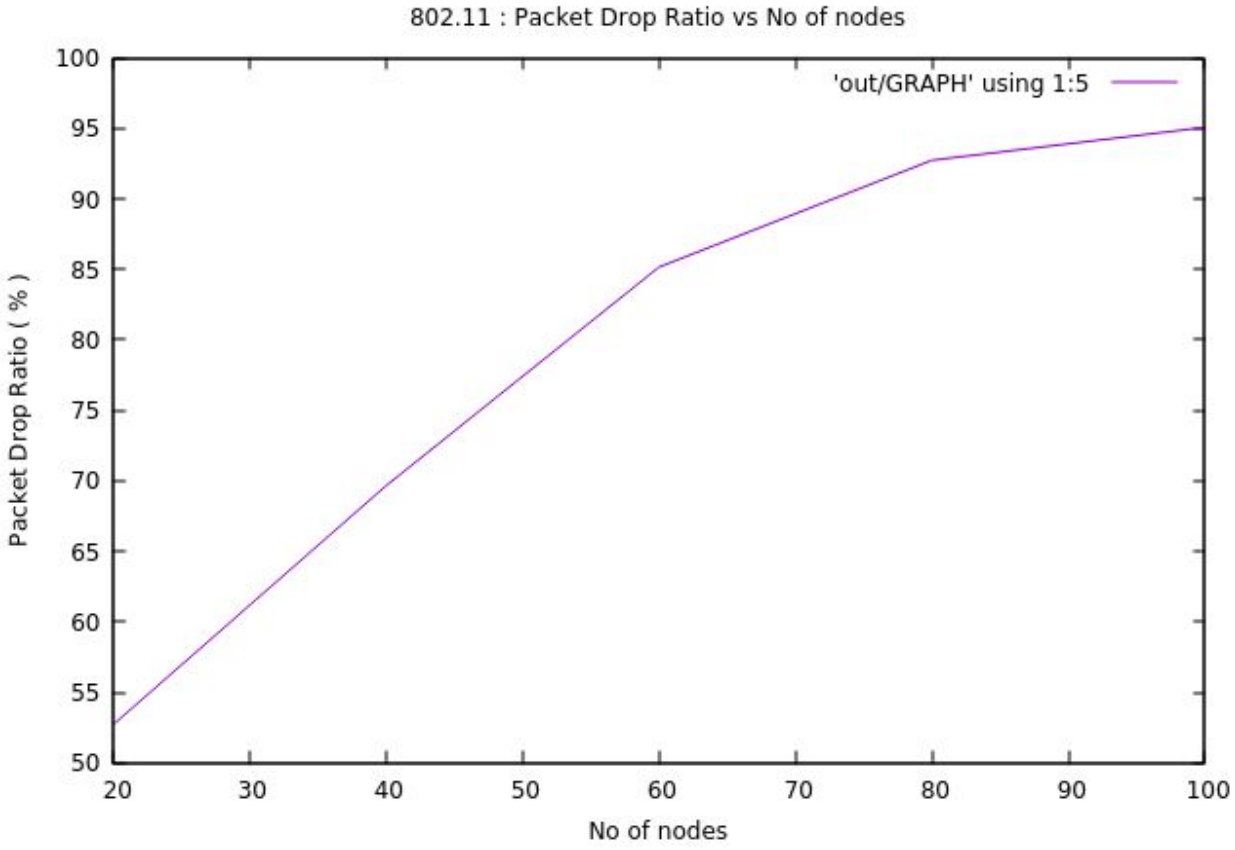
The graphs were generated using the gnu gnuplot tool.

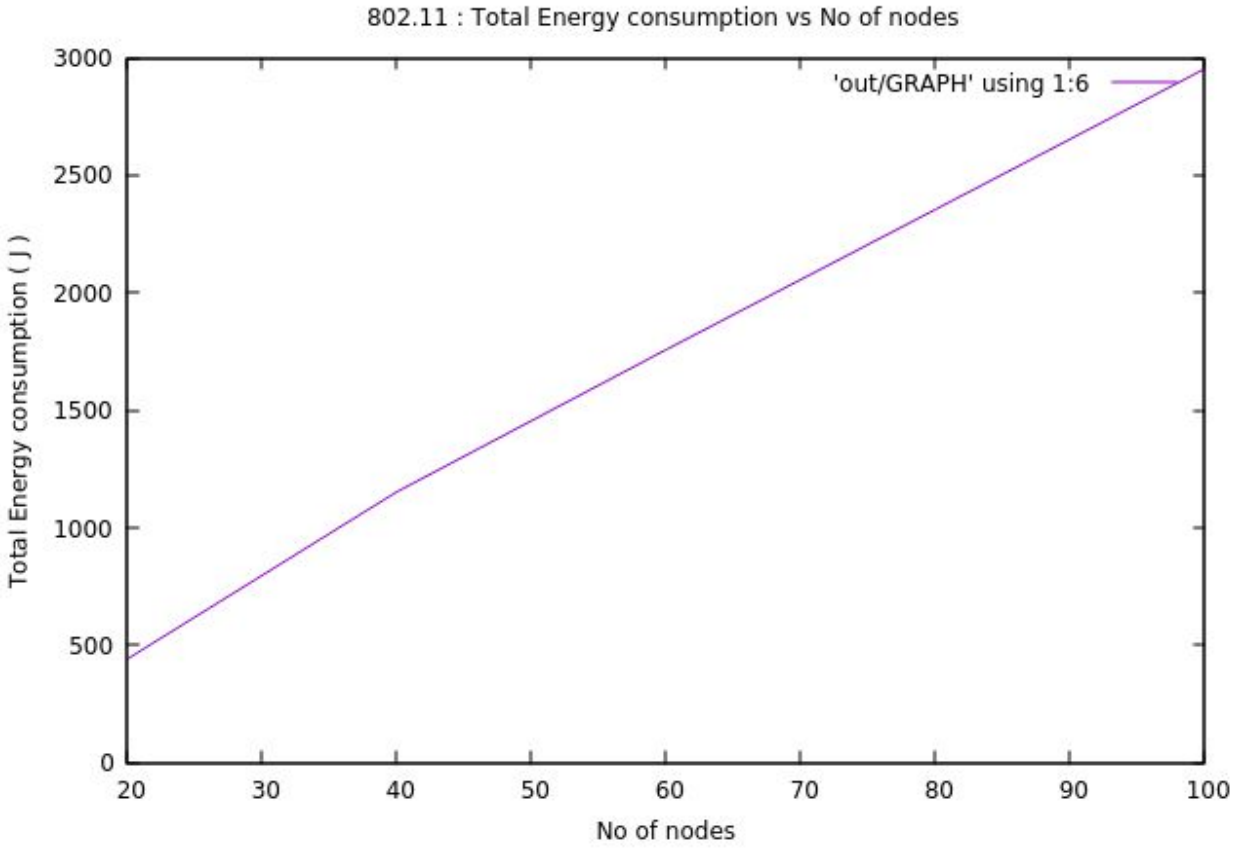
# 802.11

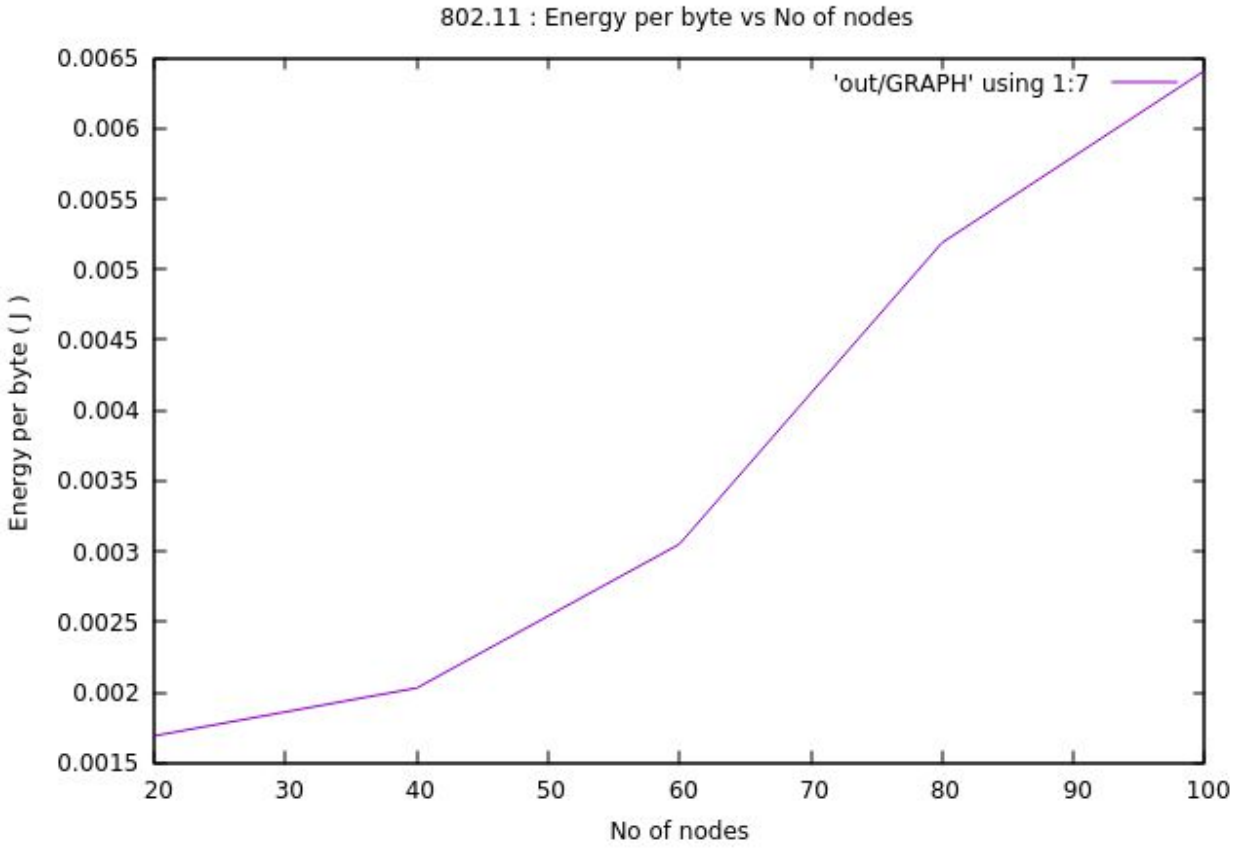

802.11 : Throughput vs No of nodes
'out/GRAPH' using 1:2
Throughput ( bit/second )
No of nodes
240000
220000
200000
180000
160000
140000
120000
100000
20
30
40
50
60
70
80
90
100

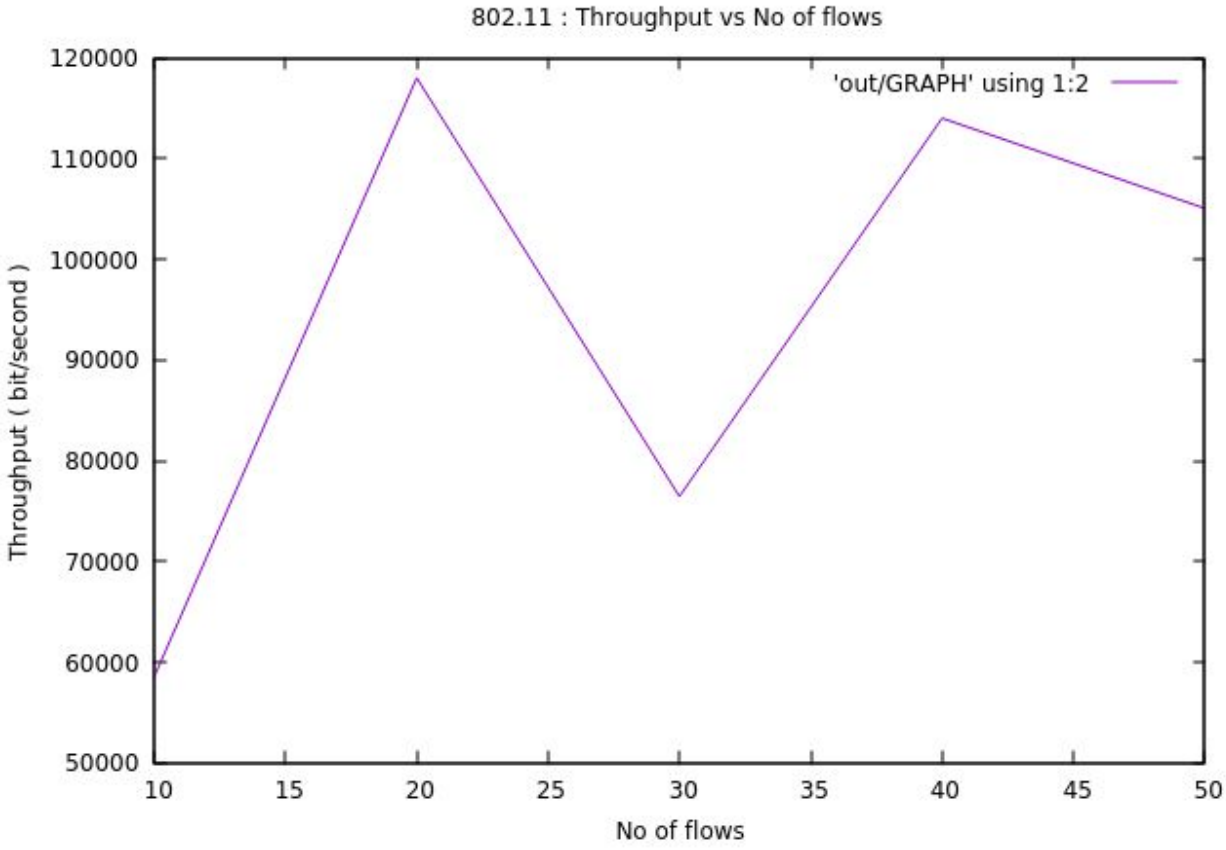

802.11 : Average Delay vs No of nodes
'out/GRAPH' using 1:3
Average Delay ( second )
No of nodes
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
20
30
40
50
60
70
80
90
100

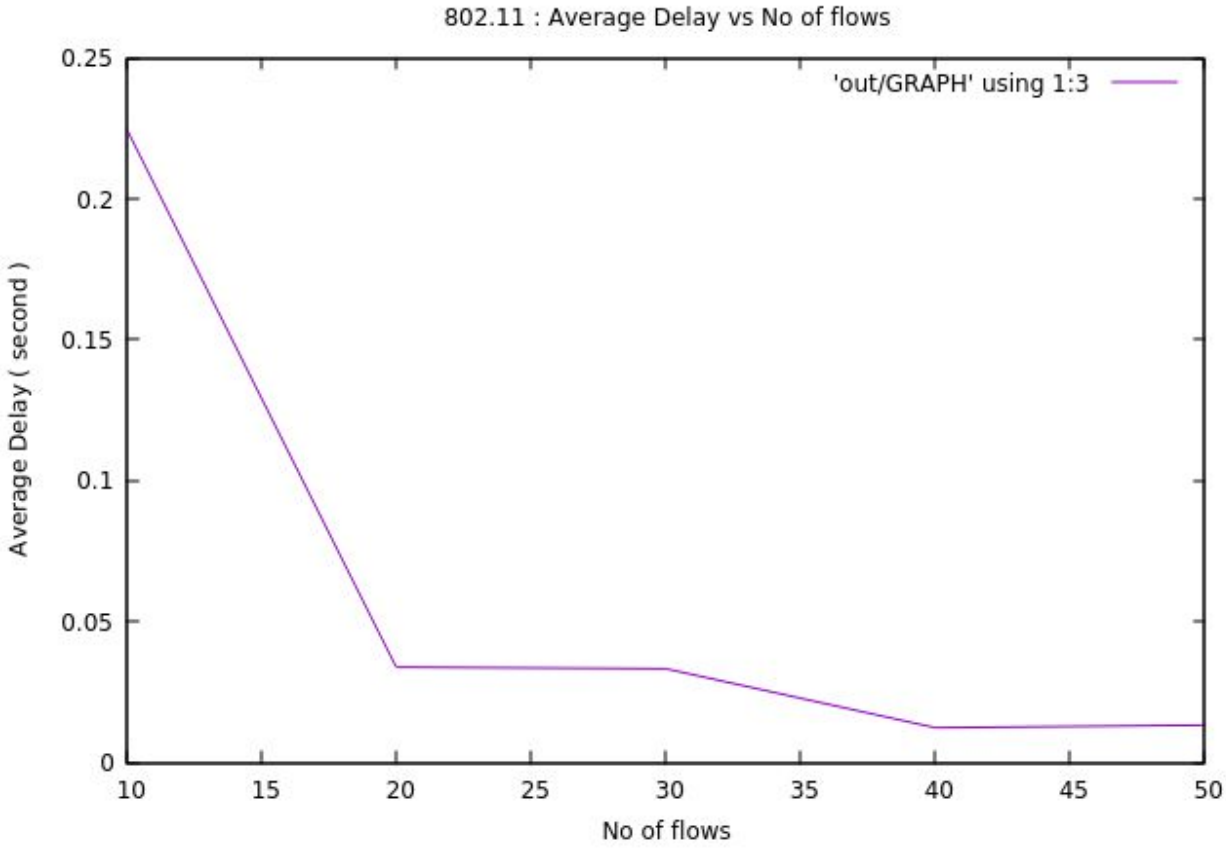

802.11 : Packet Delivery Ratio vs No of nodes
'out/GRAPH' using 1:4
Packet Delivery Ratio ( % )
No of nodes
0
5
10
15
20
25
30
35
40
45
50
55
20
30
40
50
60
70
80
90
100

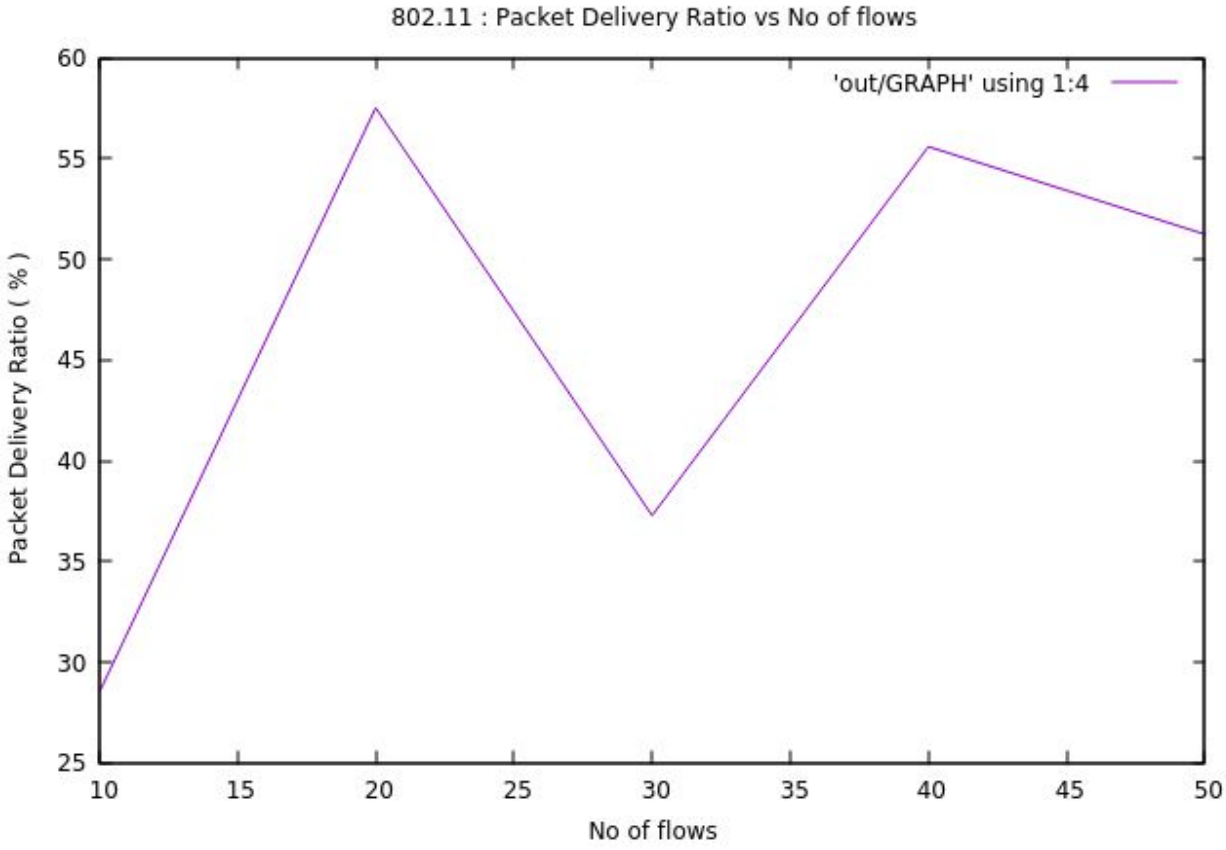

802.11 : Packet Drop Ratio vs No of nodes
'out/GRAPH' using 1:5
Packet Drop Ratio ( % )
No of nodes
100
95
90
85
80
75
70
65
60
55
50
20
30
40
50
60
70
80
90
100

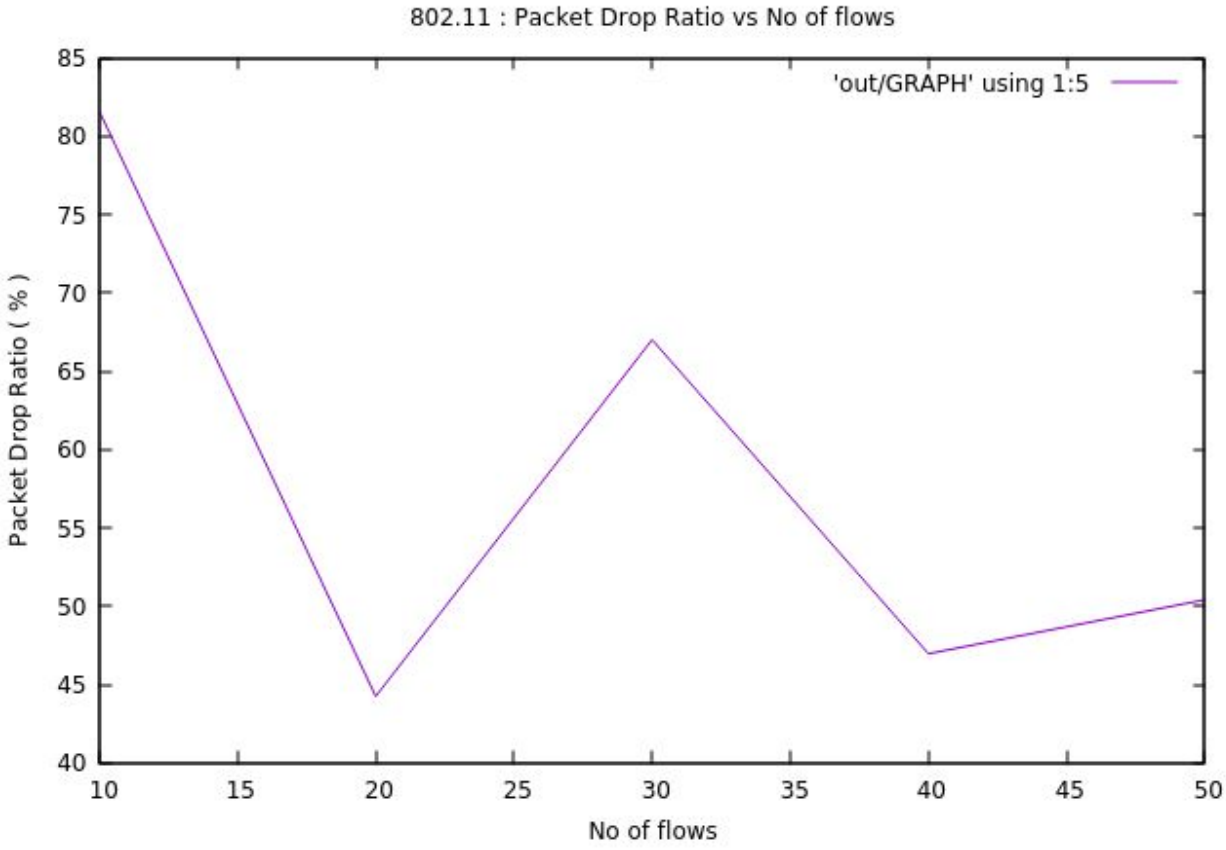

802.11 : Total Energy consumption vs No of nodes
'out/GRAPH' using 1:6
Total Energy consumption ( J )
No of nodes
0
500
1000
1500
2000
2500
3000
20
30
40
50
60
70
80
90
100

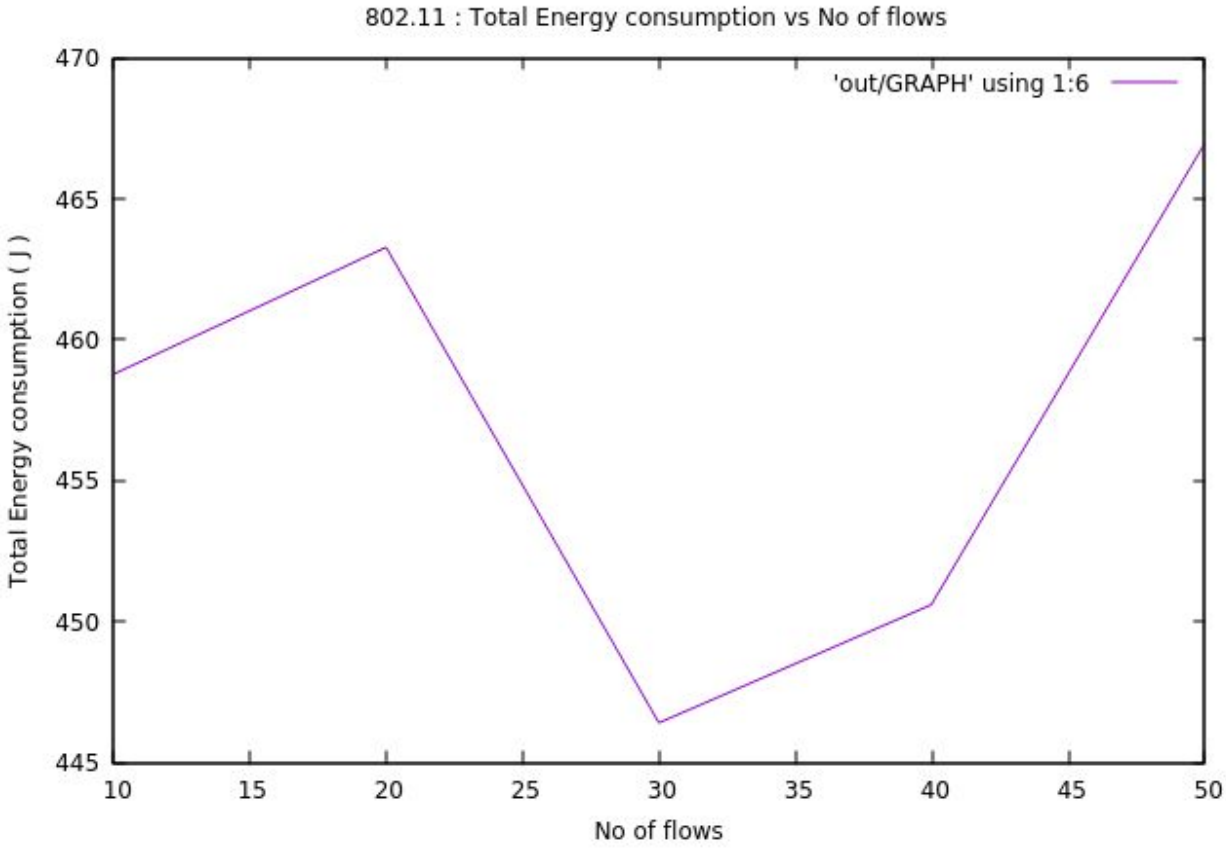

802.11 : Energy per byte vs No of nodes
'out/GRAPH' using 1:7
Energy per byte ( J )
No of nodes
0.0065
0.006
0.0055
0.005
0.0045
0.004
0.0035
0.003
0.0025
0.002
0.0015
20
30
40
50
60
70
80
90
100

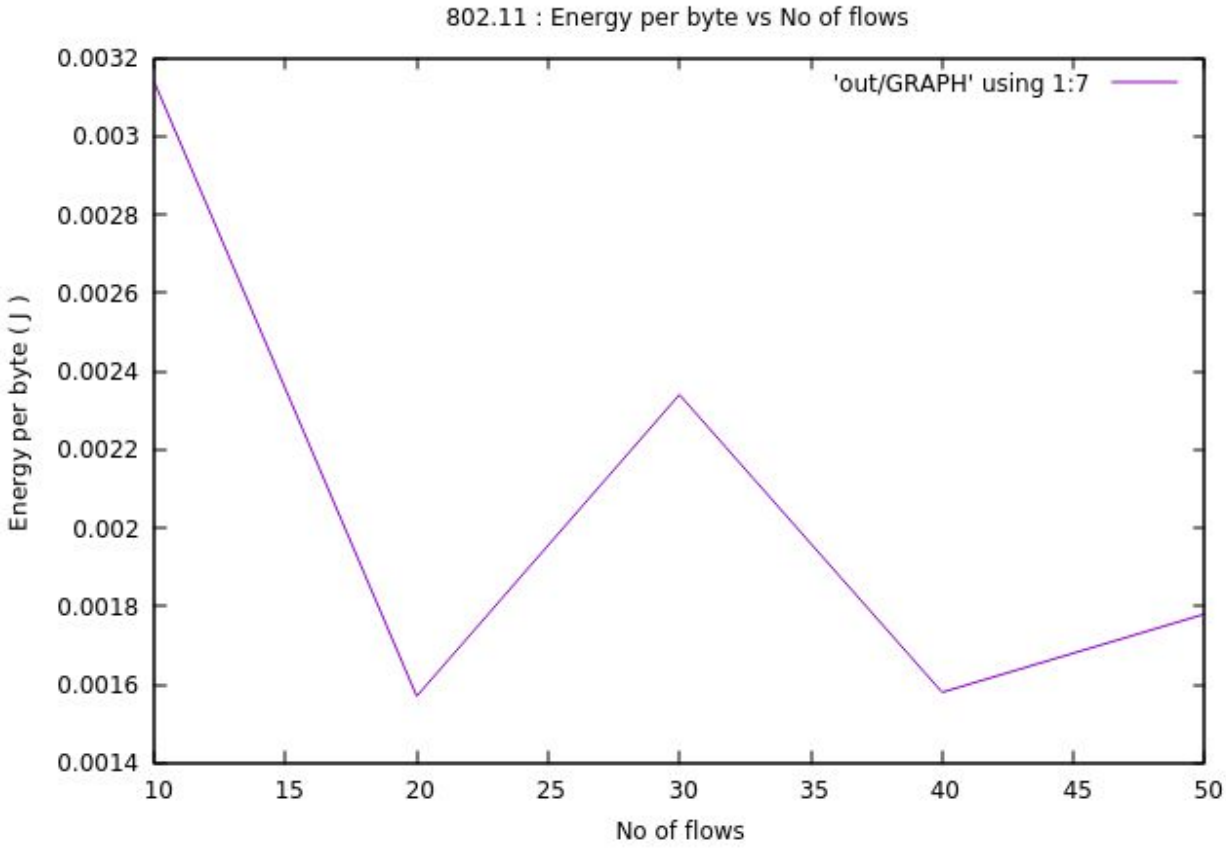

802.11 : Throughput vs No of flows
'out/GRAPH' using 1:2
Throughput ( bit/second )
No of flows
120000
110000
100000
90000
80000
70000
60000
50000
10
15
20
25
30
35
40
45
50

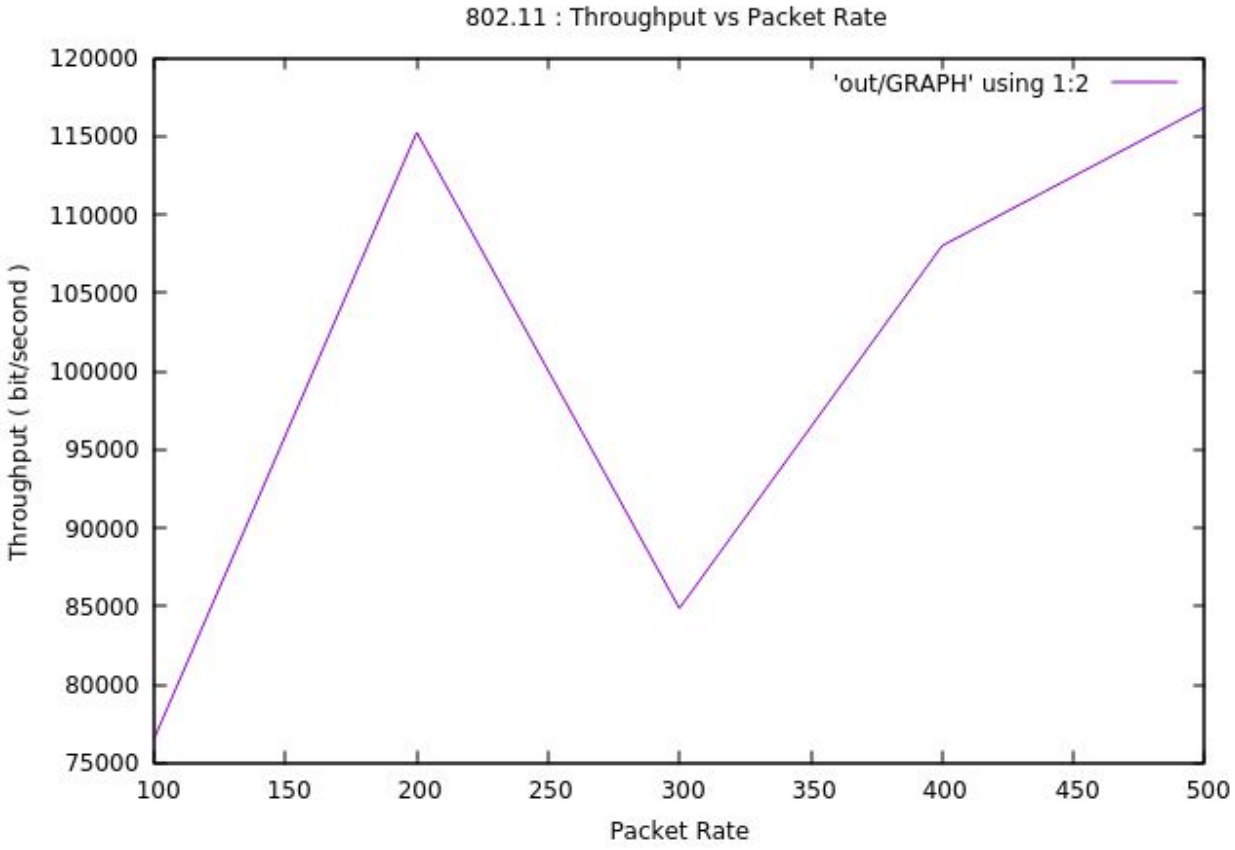

802.11 : Average Delay vs No of flows
'out/GRAPH' using 1:3
Average Delay ( second )
No of flows
0.25
0.2
0.15
0.1
0.05
0
10
15
20
25
30
35
40
45
50

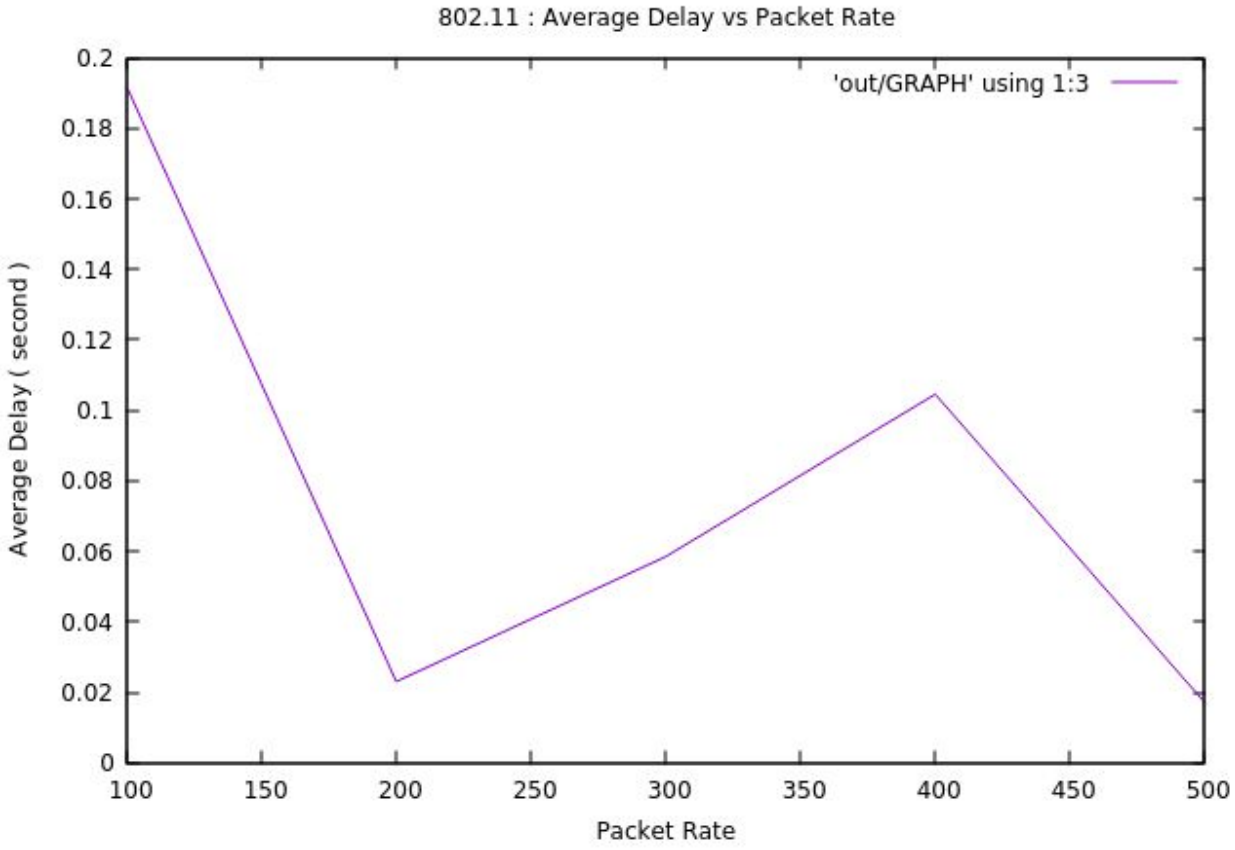

802.11 : Packet Delivery Ratio vs No of flows
'out/GRAPH' using 1:4
Packet Delivery Ratio ( % )
No of flows
60
55
50
45
40
35
30
25
10
15
20
25
30
35
40
45
50

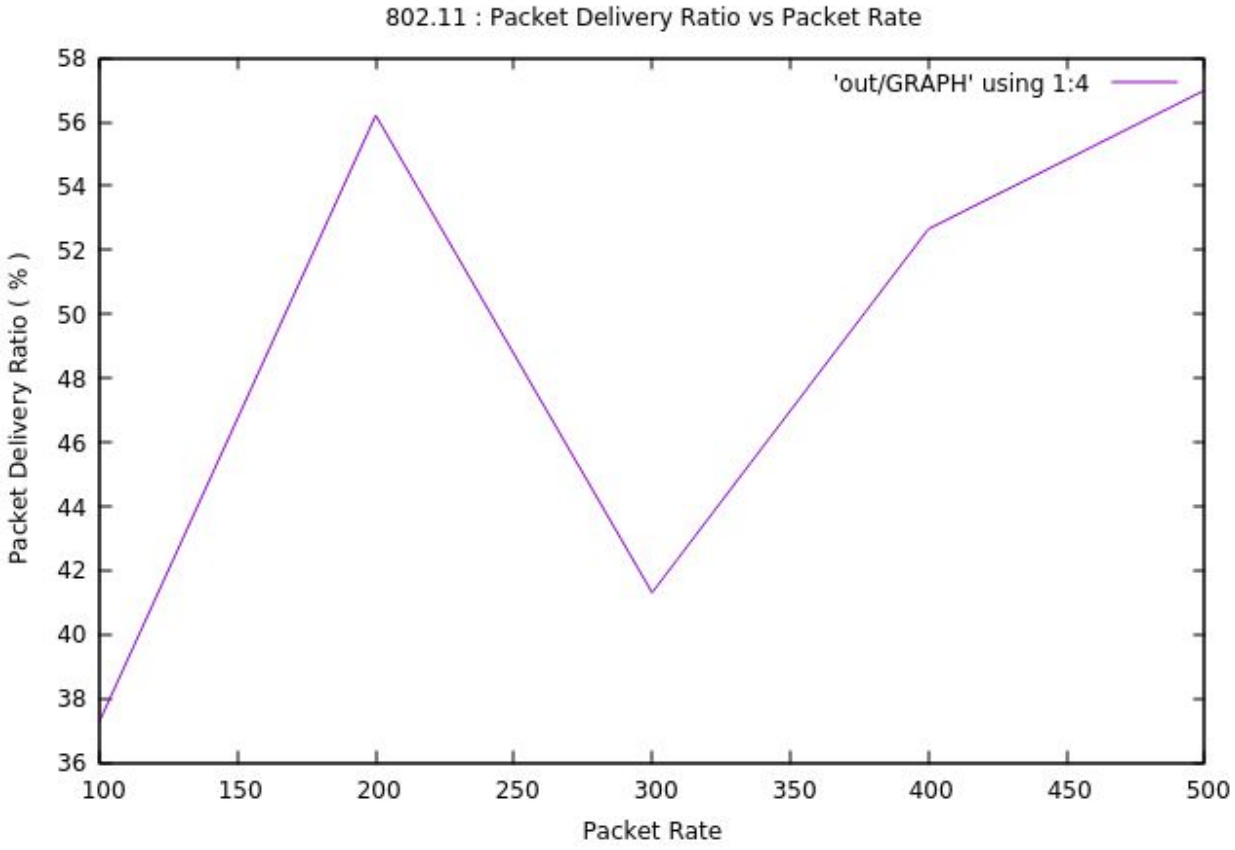

802.11 : Packet Drop Ratio vs No of flows
'out/GRAPH' using 1:5
Packet Drop Ratio ( % )
No of flows
85
80
75
70
65
60
55
50
45
40
10
15
20
25
30
35
40
45
50

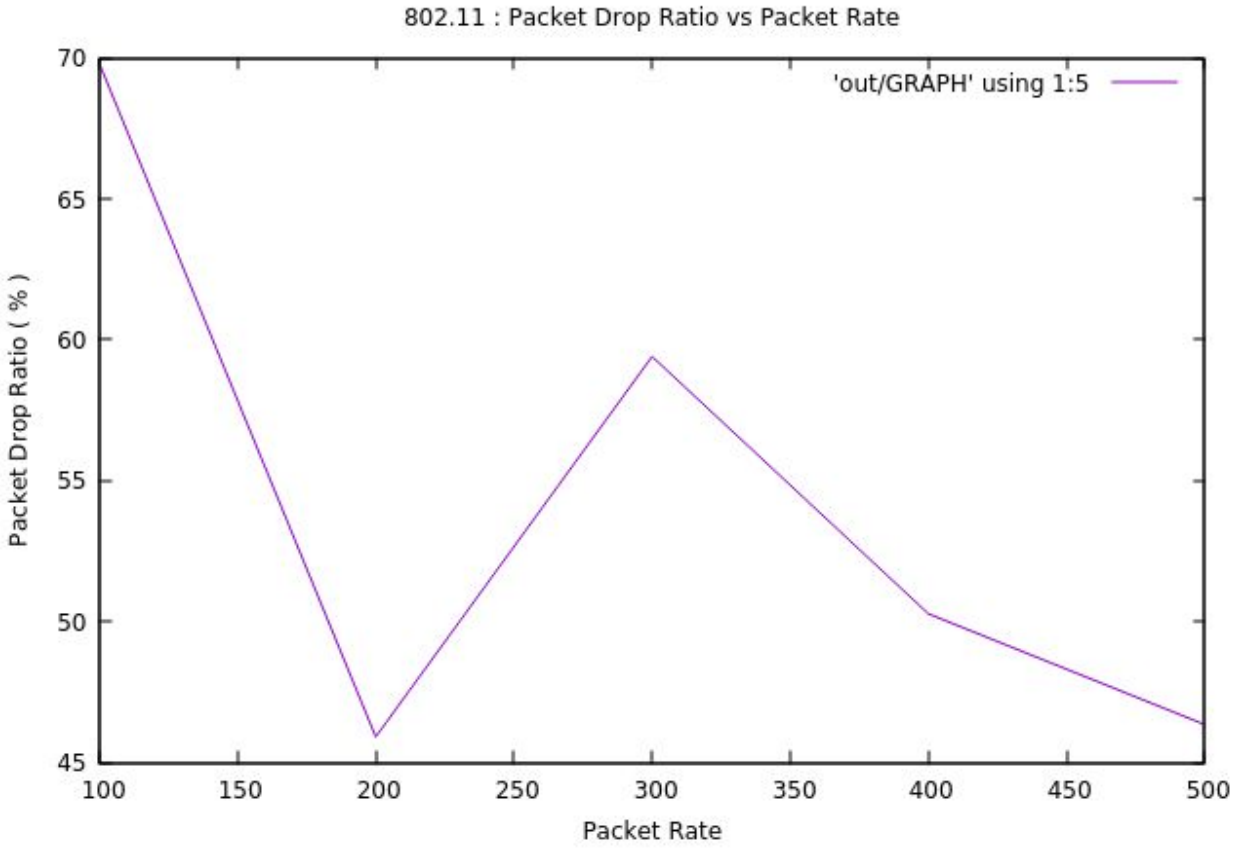

802.11 : Total Energy consumption vs No of flows
'out/GRAPH' using 1:6
Total Energy consumption ( J )
No of flows
470
465
460
455
450
445
10
15
20
25
30
35
40
45
50

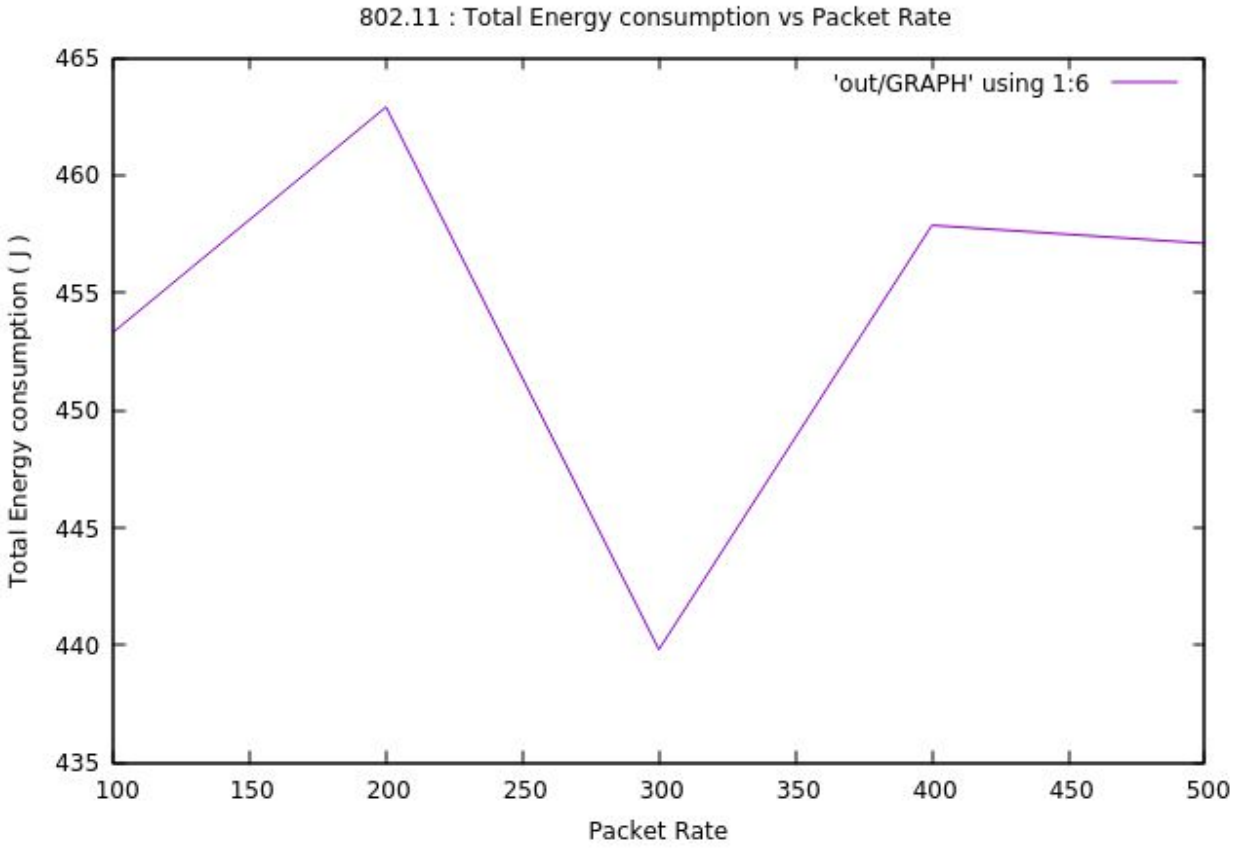

802.11 : Energy per byte vs No of flows
'out/GRAPH' using 1:7
Energy per byte ( J )
No of flows
0.0032
0.003
0.0028
0.0026
0.0024
0.0022
0.002
0.0018
0.0016
0.0014
10
15
20
25
30
35
40
45
50

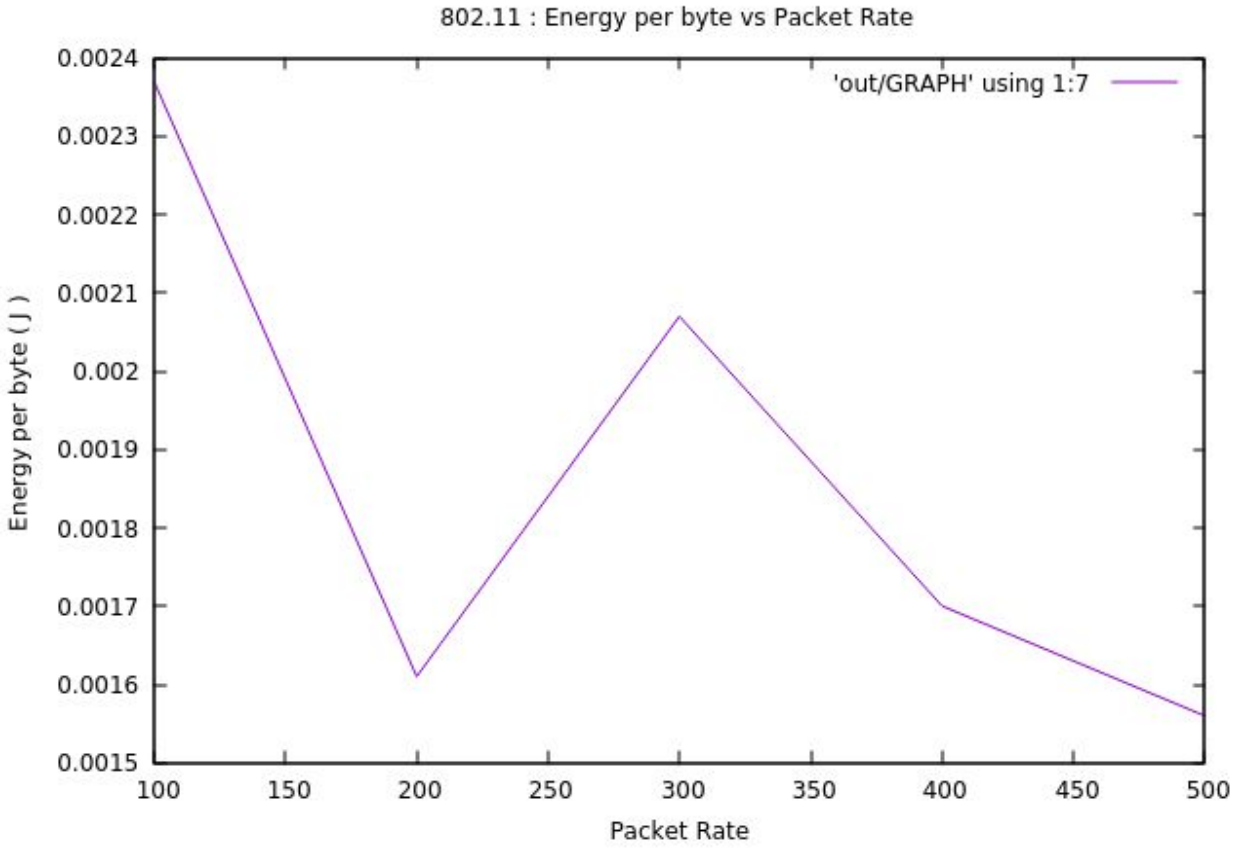

802.11 : Throughput vs Packet Rate
'out/GRAPH' using 1:2
Throughput ( bit/second )
Packet Rate
120000
115000
110000
105000
100000
95000
90000
85000
80000
75000
100
150
200
250
300
350
400
450
500

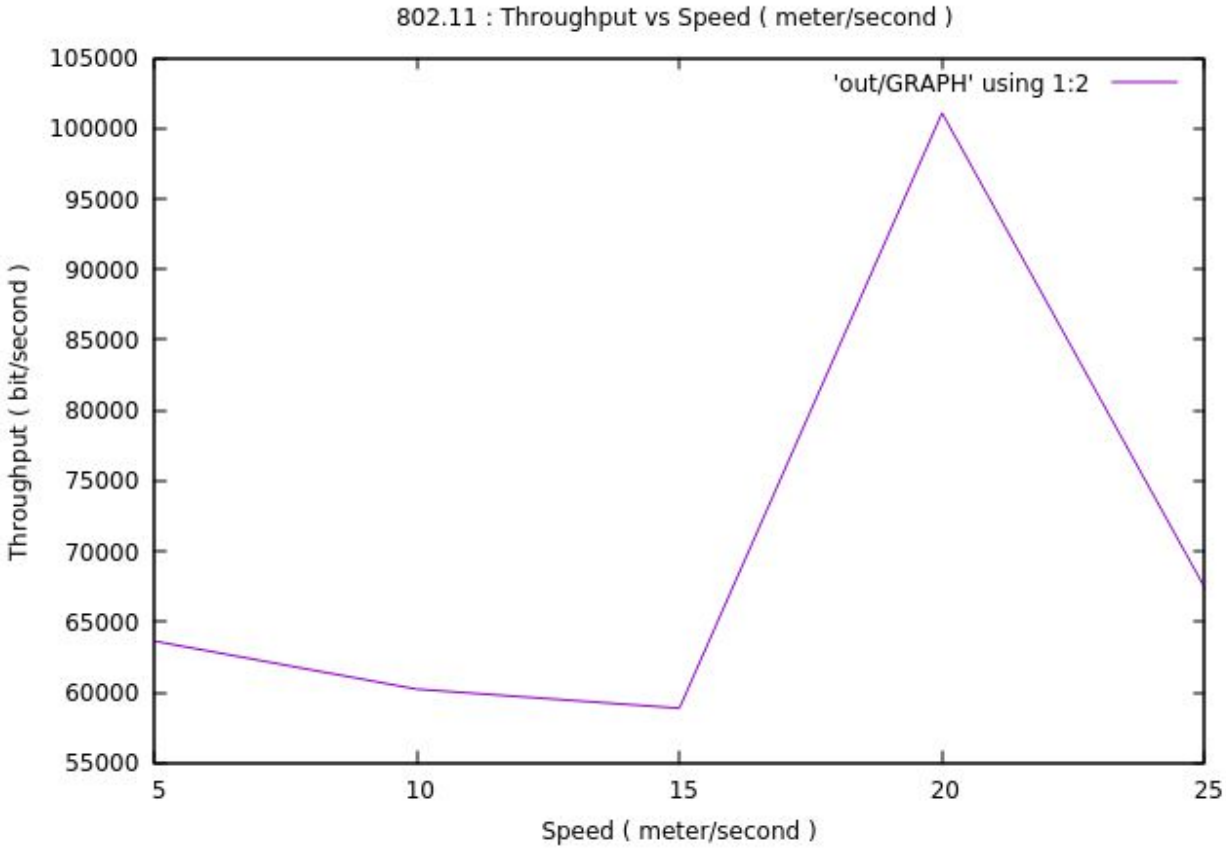

802.11 : Average Delay vs Packet Rate
'out/GRAPH' using 1:3
Average Delay ( second )
Packet Rate
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
100
150
200
250
300
350
400
450
500

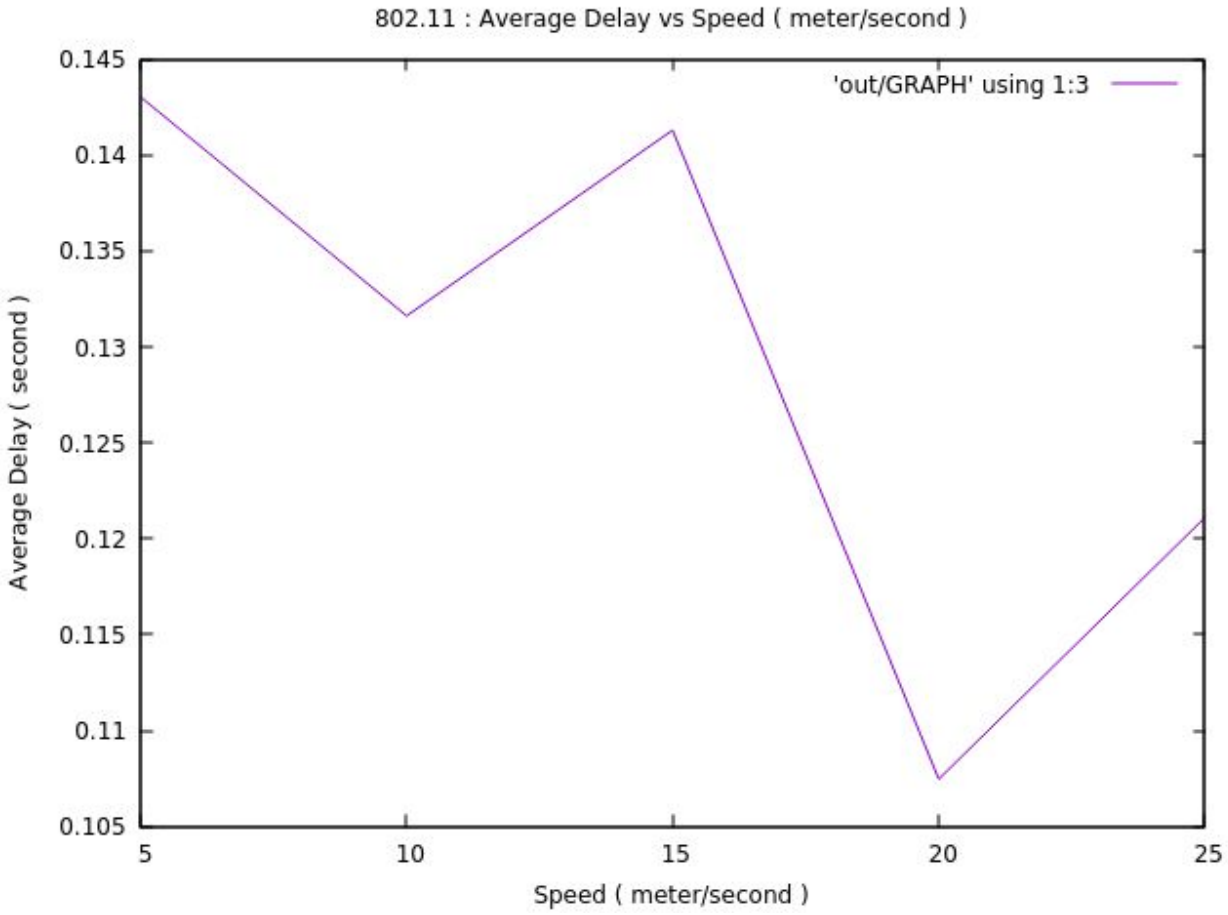

802.11 : Packet Delivery Ratio vs Packet Rate
'out/GRAPH' using 1:4
Packet Delivery Ratio ( % )
Packet Rate
58
56
54
52
50
48
46
44
42
40
38
36
100
150
200
250
300
350
400
450
500

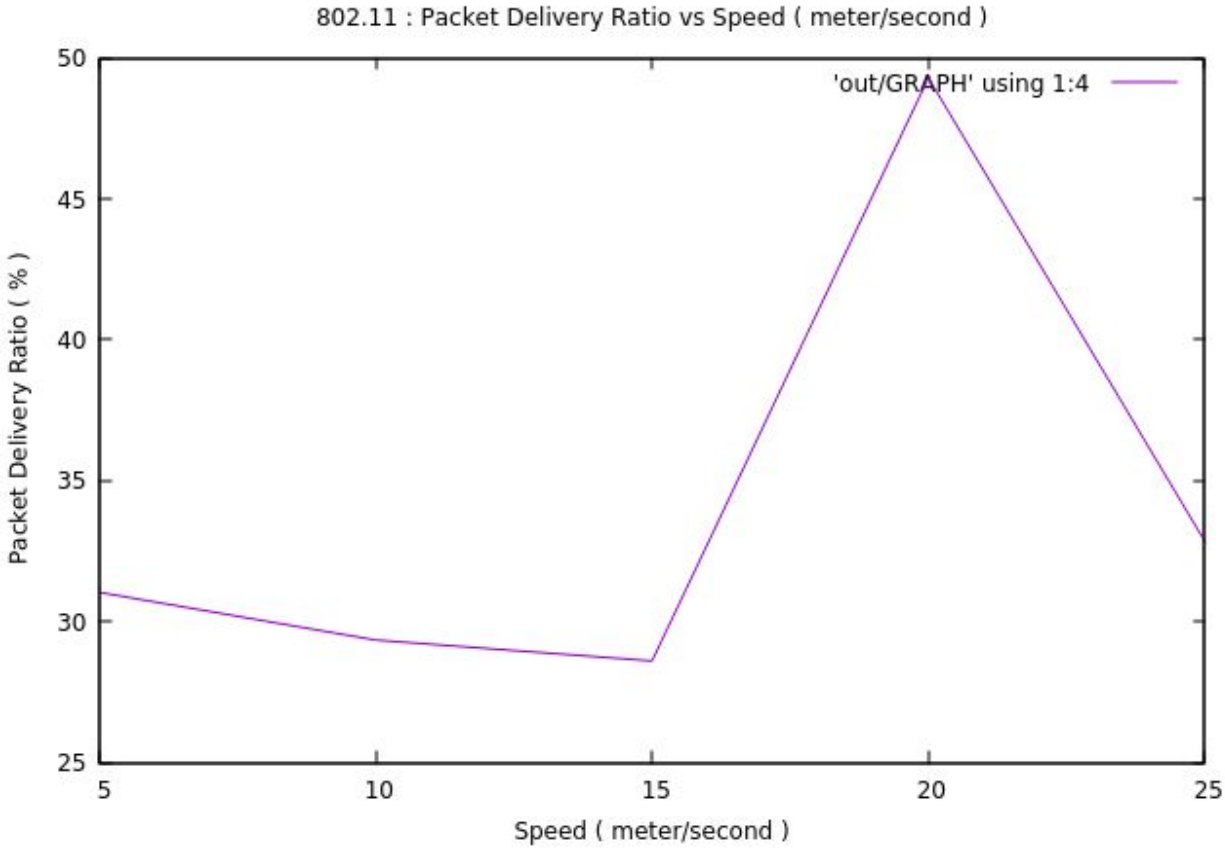

802.11 : Packet Drop Ratio vs Packet Rate
'out/GRAPH' using 1:5
Packet Drop Ratio ( % )
Packet Rate
70
65
60
55
50
45
100
150
200
250
300
350
400
450
500

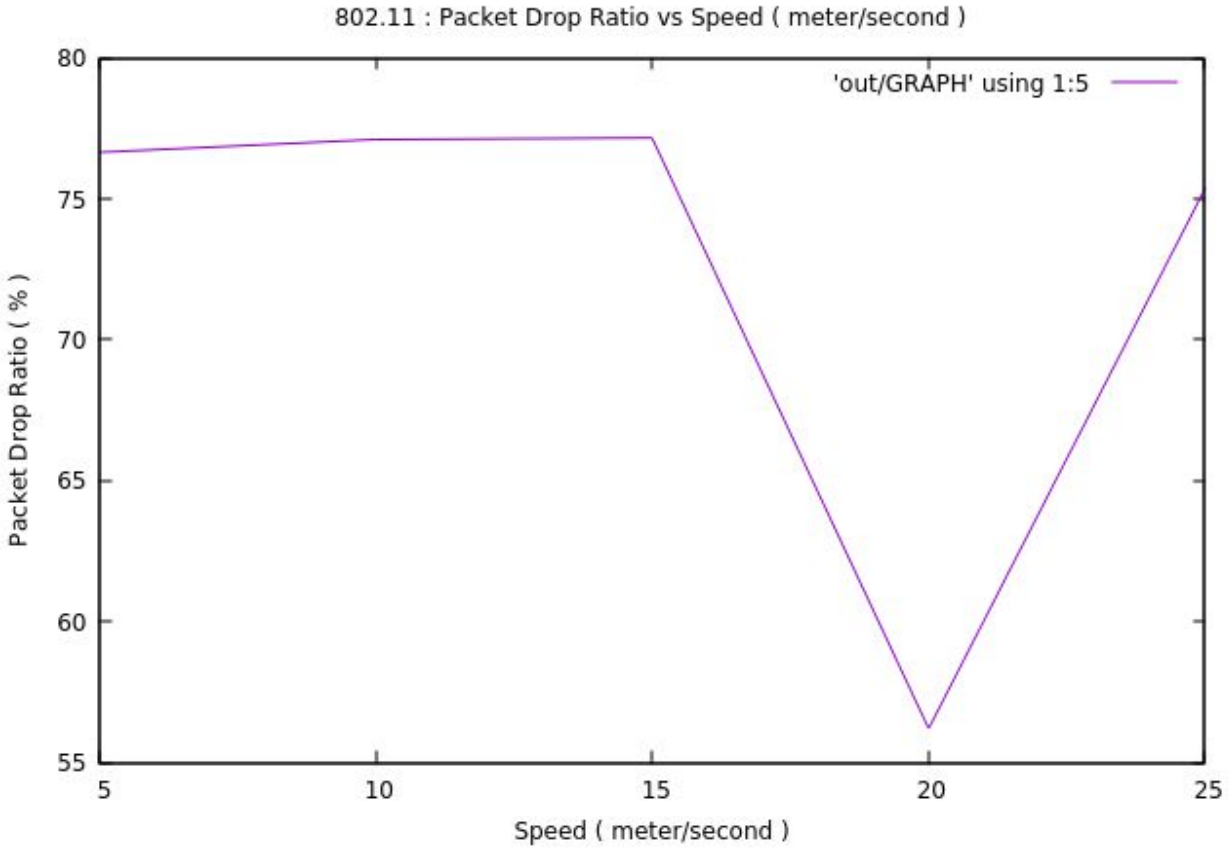

802.11 : Total Energy consumption vs Packet Rate
'out/GRAPH' using 1:6
Total Energy consumption ( J )
Packet Rate
465
460
455
450
445
440
435
100
150
200
250
300
350
400
450
500

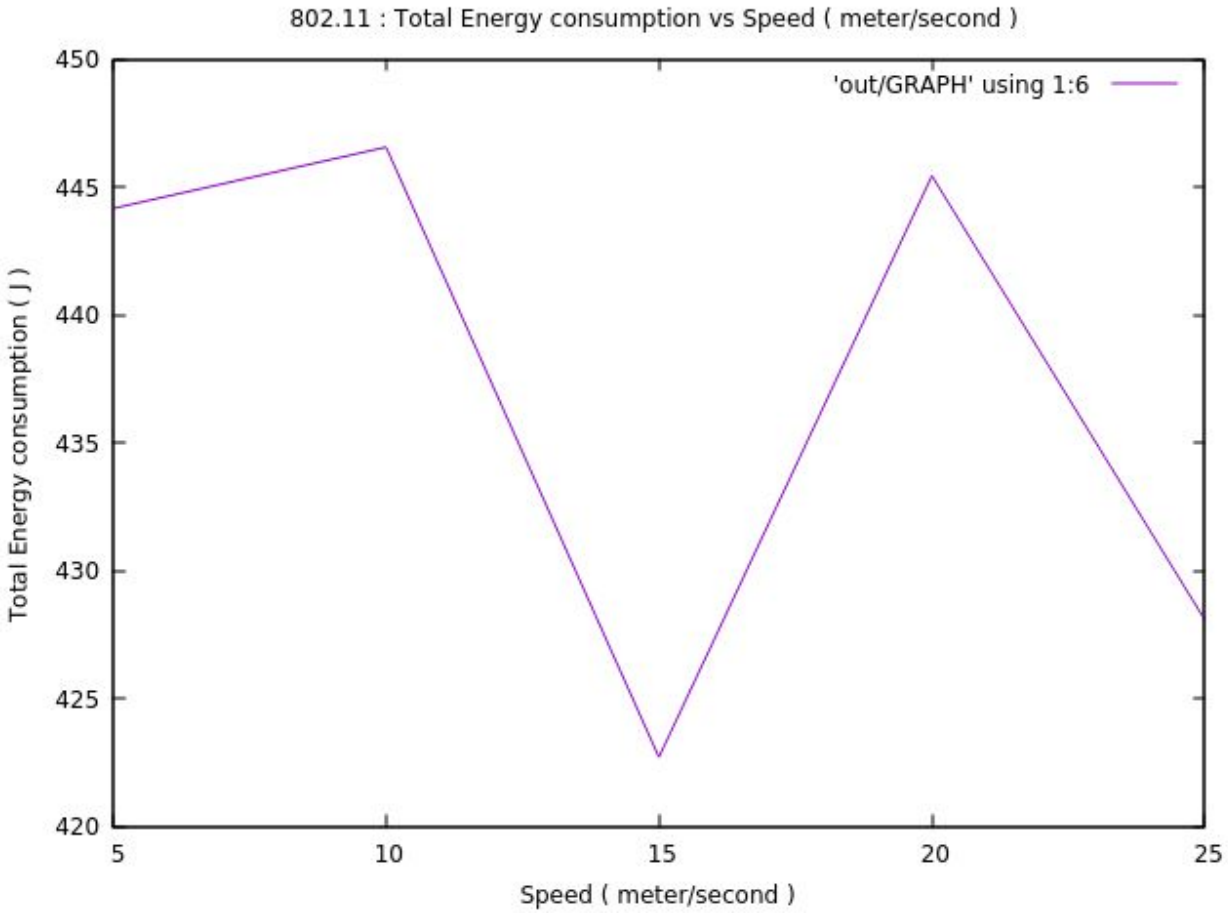

802.11 : Energy per byte vs Packet Rate
'out/GRAPH' using 1:7
Energy per byte ( J )
Packet Rate
0.0024
0.0023
0.0022
0.0021
0.002
0.0019
0.0018
0.0017
0.0016
0.0015
100
150
200
250
300
350
400
450
500

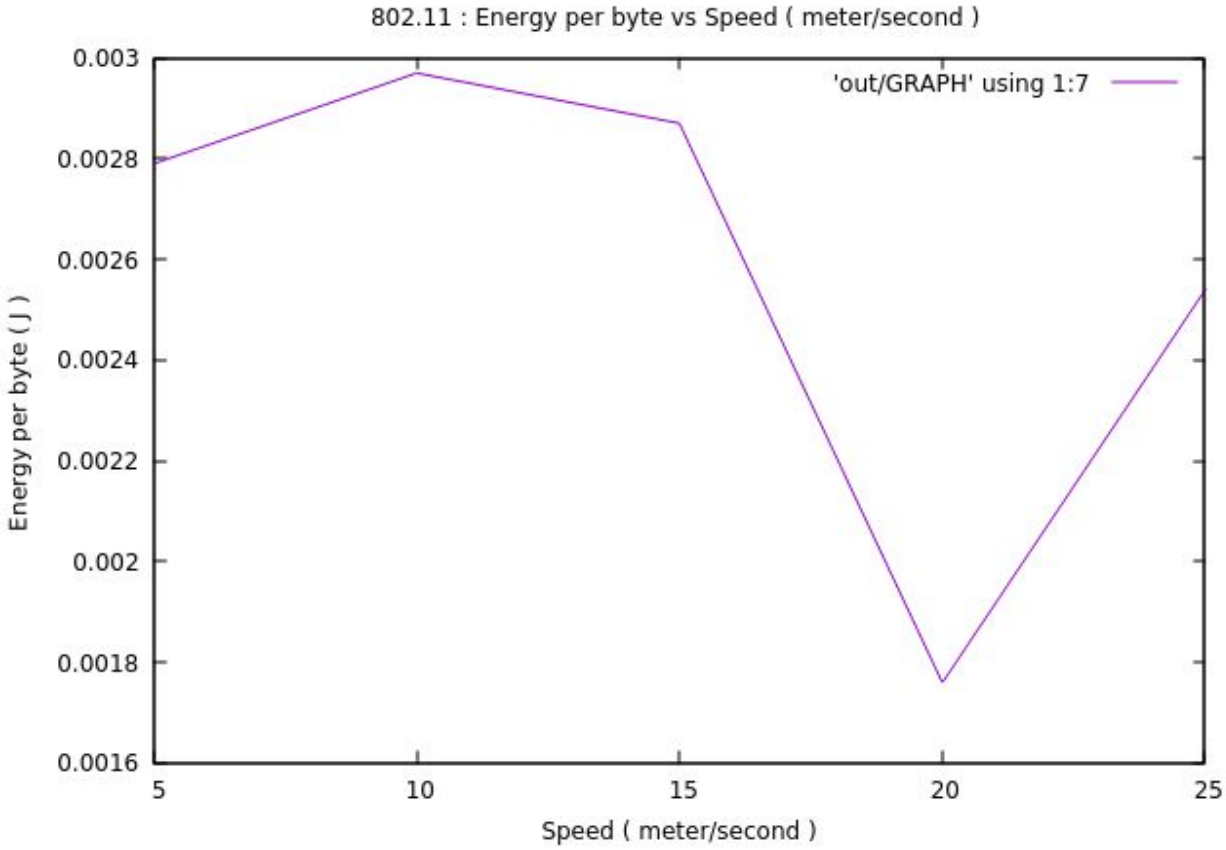

802.11 : Throughput vs Speed ( meter/second )
'out/GRAPH' using 1:2
Throughput ( bit/second )
Speed ( meter/second )
105000
100000
95000
90000
85000
80000
75000
70000
65000
60000
55000
5
10
15
20
25


802.11 : Average Delay vs Speed ( meter/second )
'out/GRAPH' using 1:3
Average Delay ( second )
Speed ( meter/second )
0.145
0.14
0.135
0.13
0.125
0.12
0.115
0.11
0.105
5
10
15
20
25

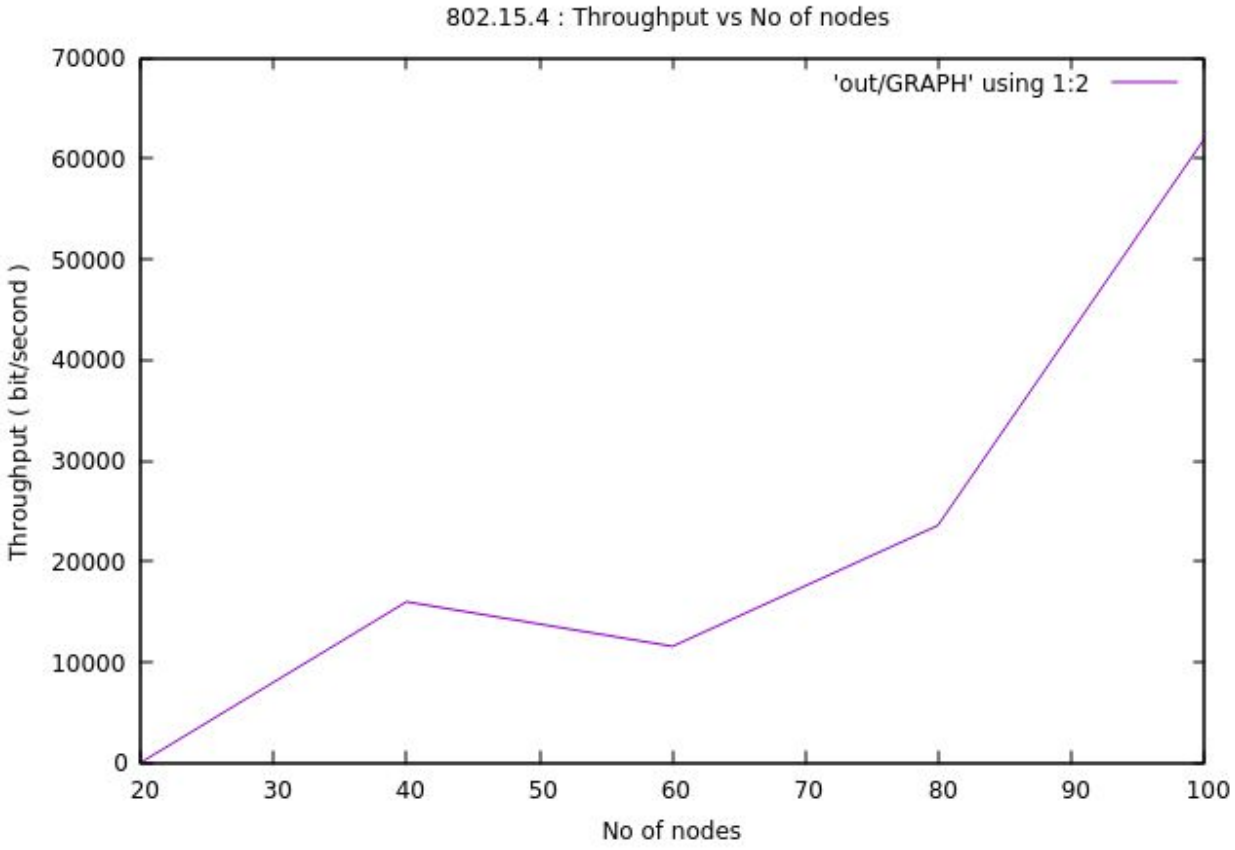

802.11 : Packet Delivery Ratio vs Speed ( meter/second )
'out/GRAPH' using 1:4
Packet Delivery Ratio ( % )
Speed ( meter/second )
50
45
40
35
30
25
5
10
15
20
25

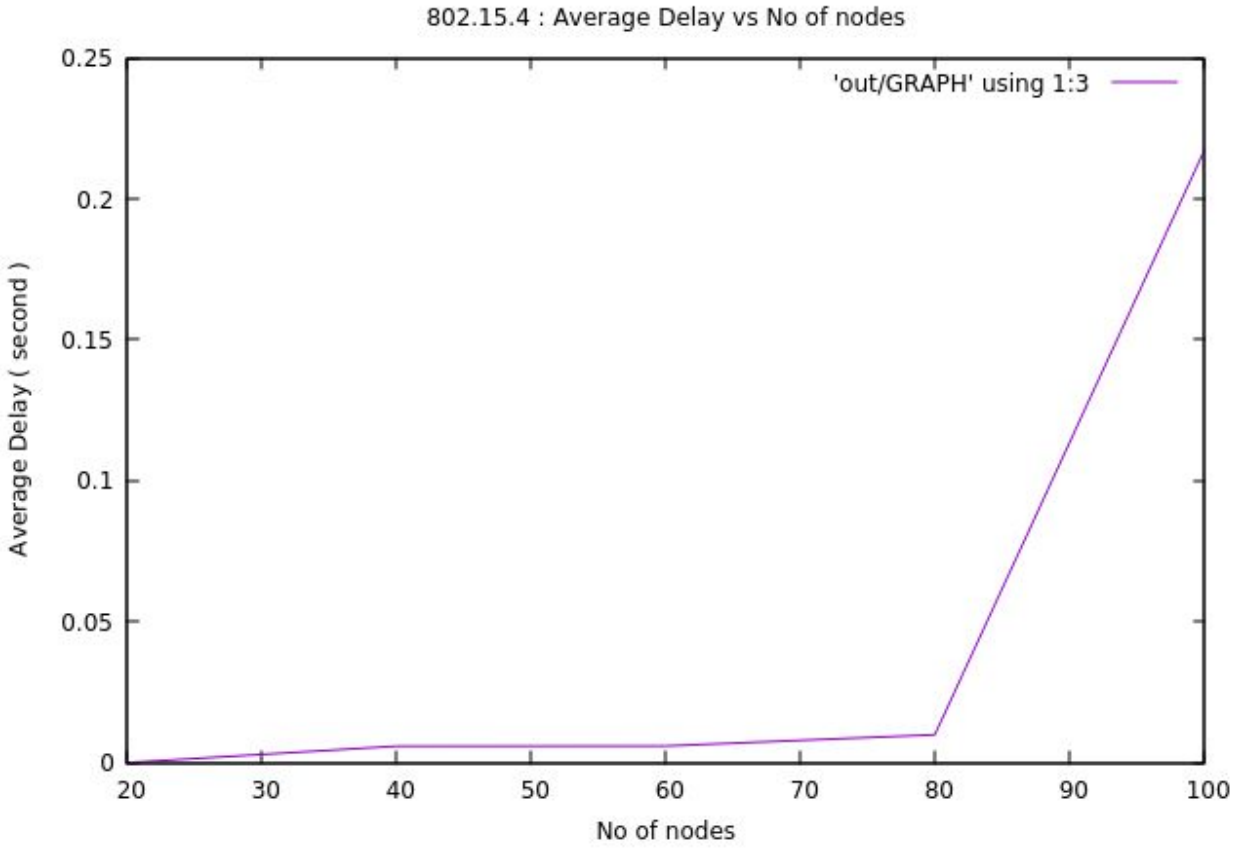

802.11 : Packet Drop Ratio vs Speed ( meter/second )
'out/GRAPH' using 1:5
Packet Drop Ratio ( % )
Speed ( meter/second )
80
75
70
65
60
55
5
10
15
20
25

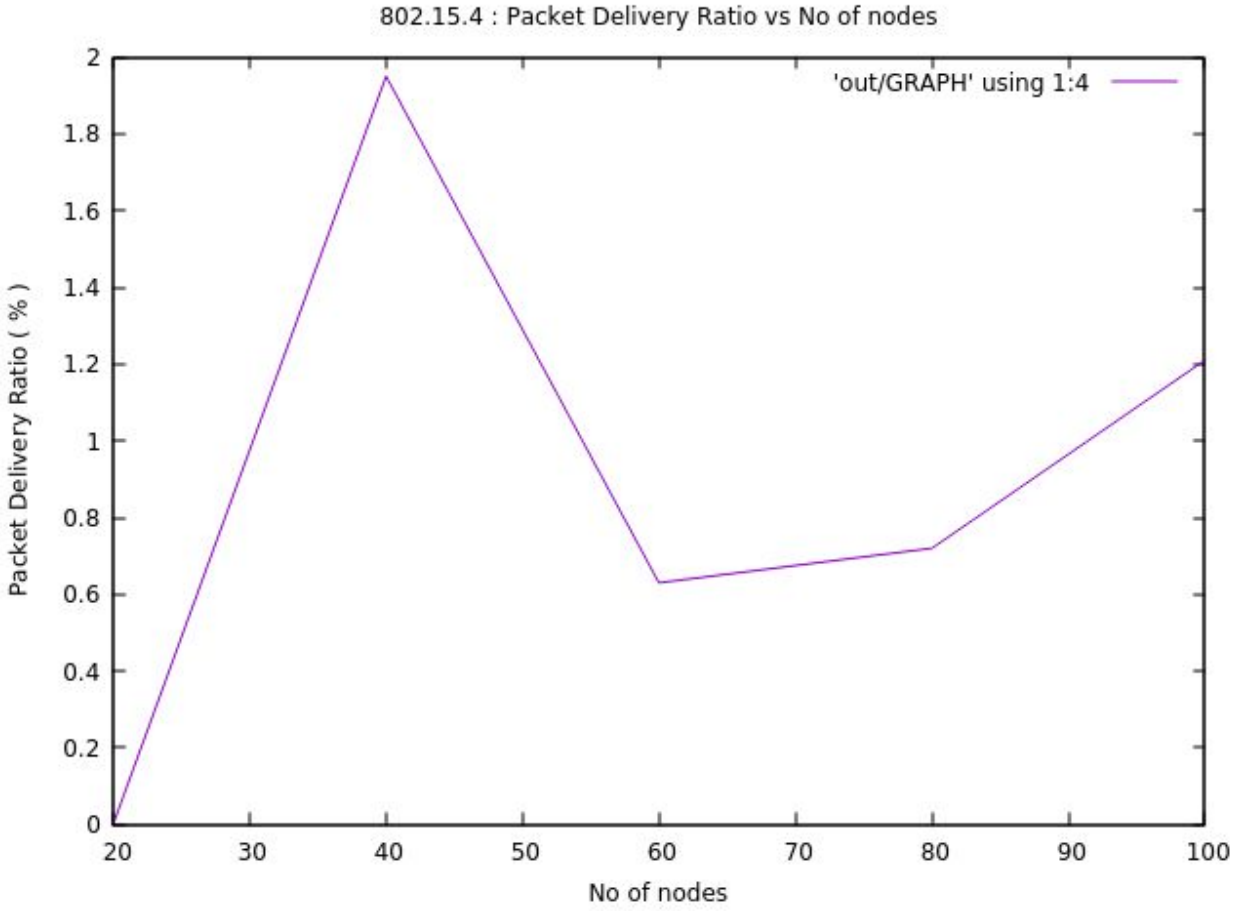

802.11 : Total Energy consumption vs Speed ( meter/second )
'out/GRAPH' using 1:6
Total Energy consumption ( J )
Speed ( meter/second )
450
445
440
435
430
425
420
5
10
15
20
25

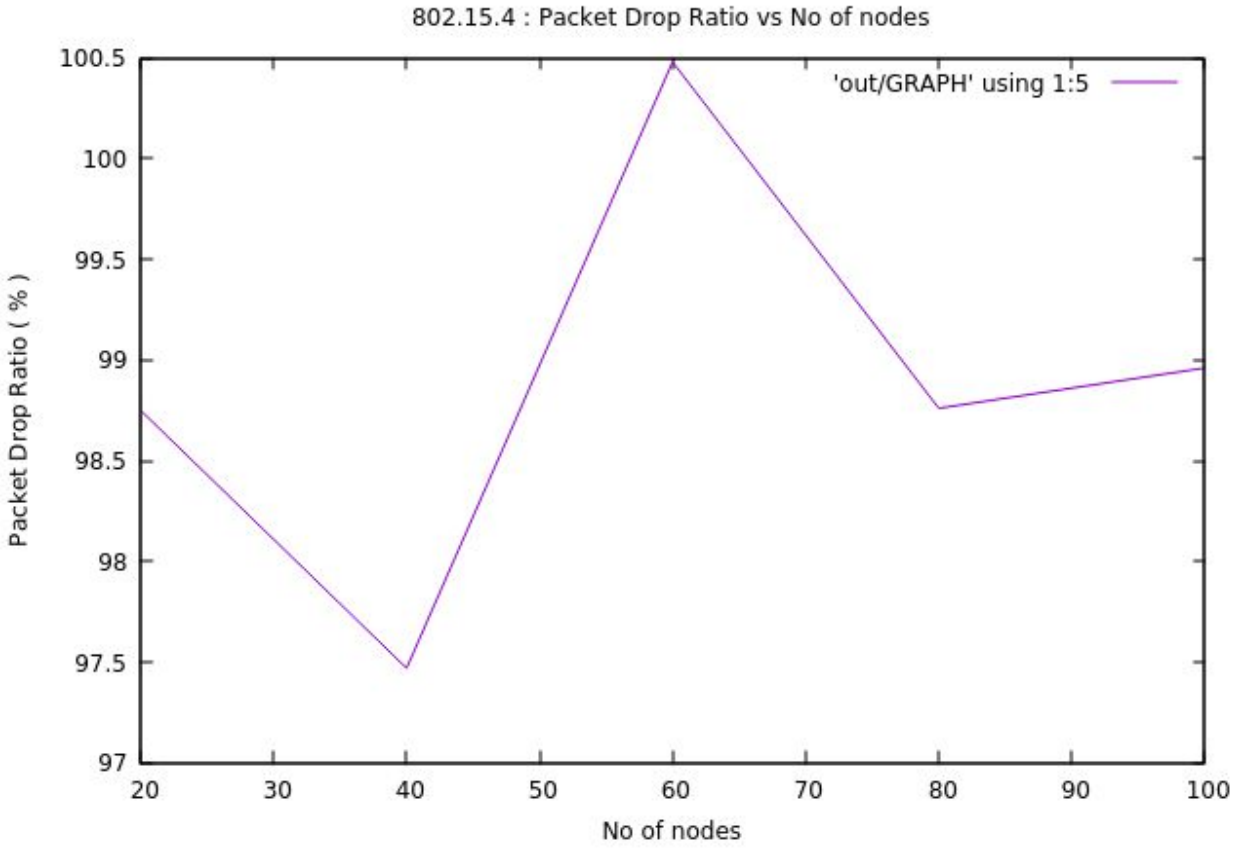

802.11 : Energy per byte vs Speed ( meter/second )
'out/GRAPH' using 1:7
Energy per byte ( J )
Speed ( meter/second )
0.003
0.0028
0.0026
0.0024
0.0022
0.002
0.0018
0.0016
5
10
15
20
25

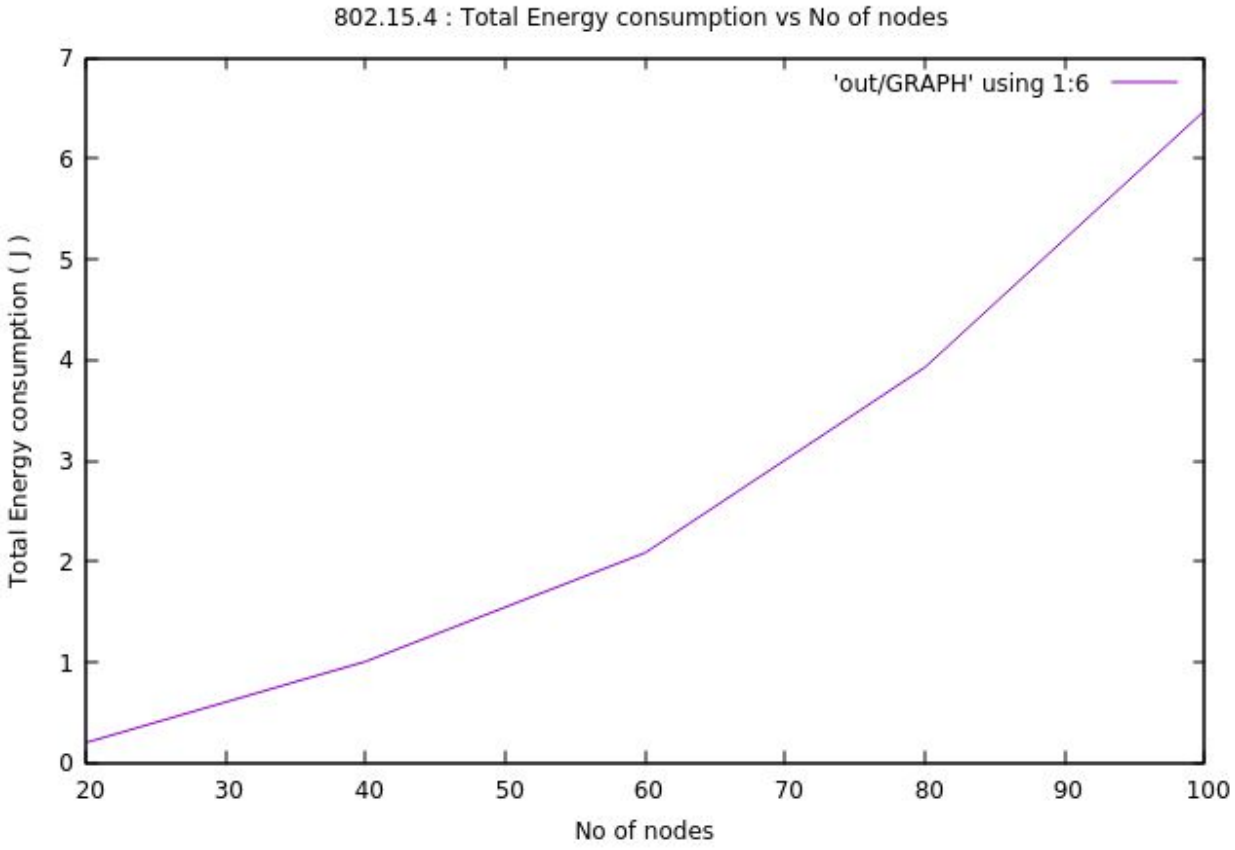
# 802.15.4

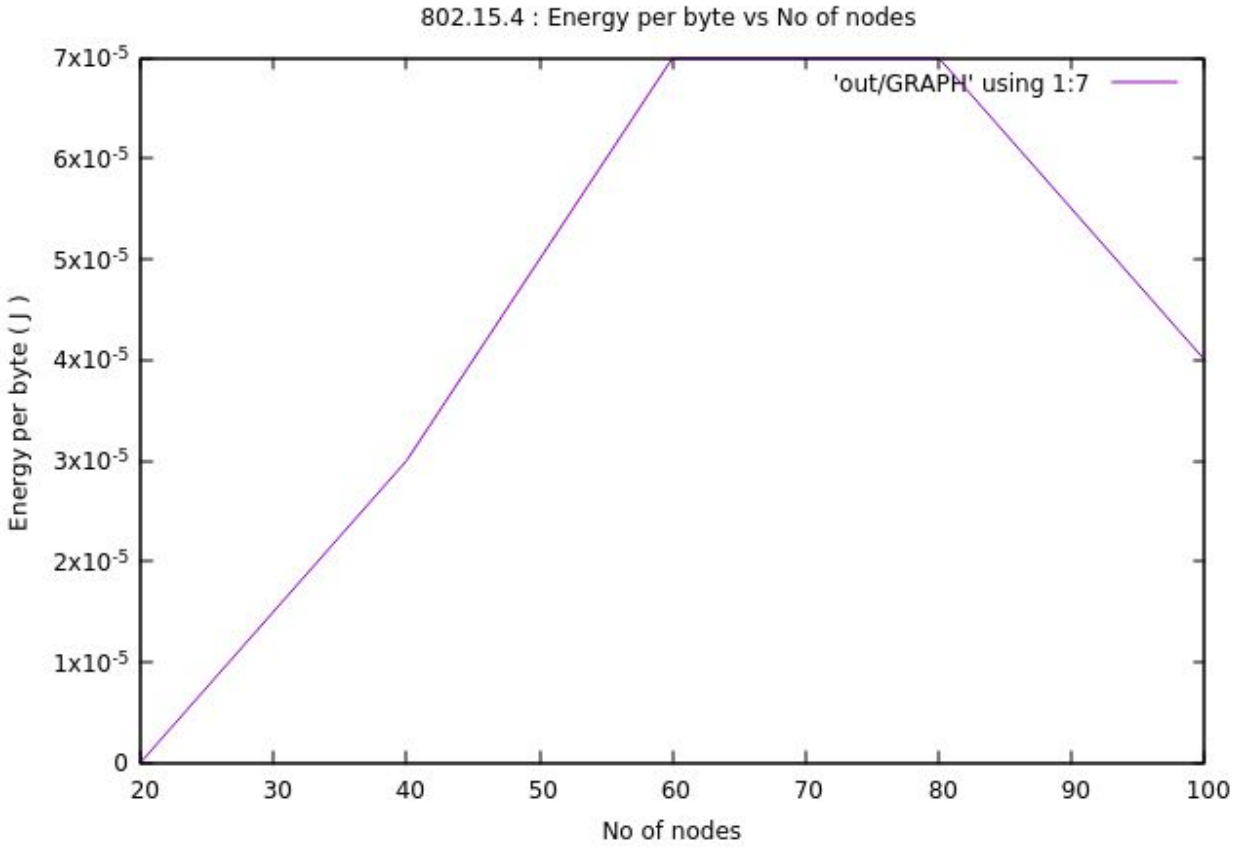

802.15.4 : Throughput vs No of nodes
'out/GRAPH' using 1:2
Throughput ( bit/second )
No of nodes
0
10000
20000
30000
40000
50000
60000
70000
20
30
40
50
60
70
80
90
100

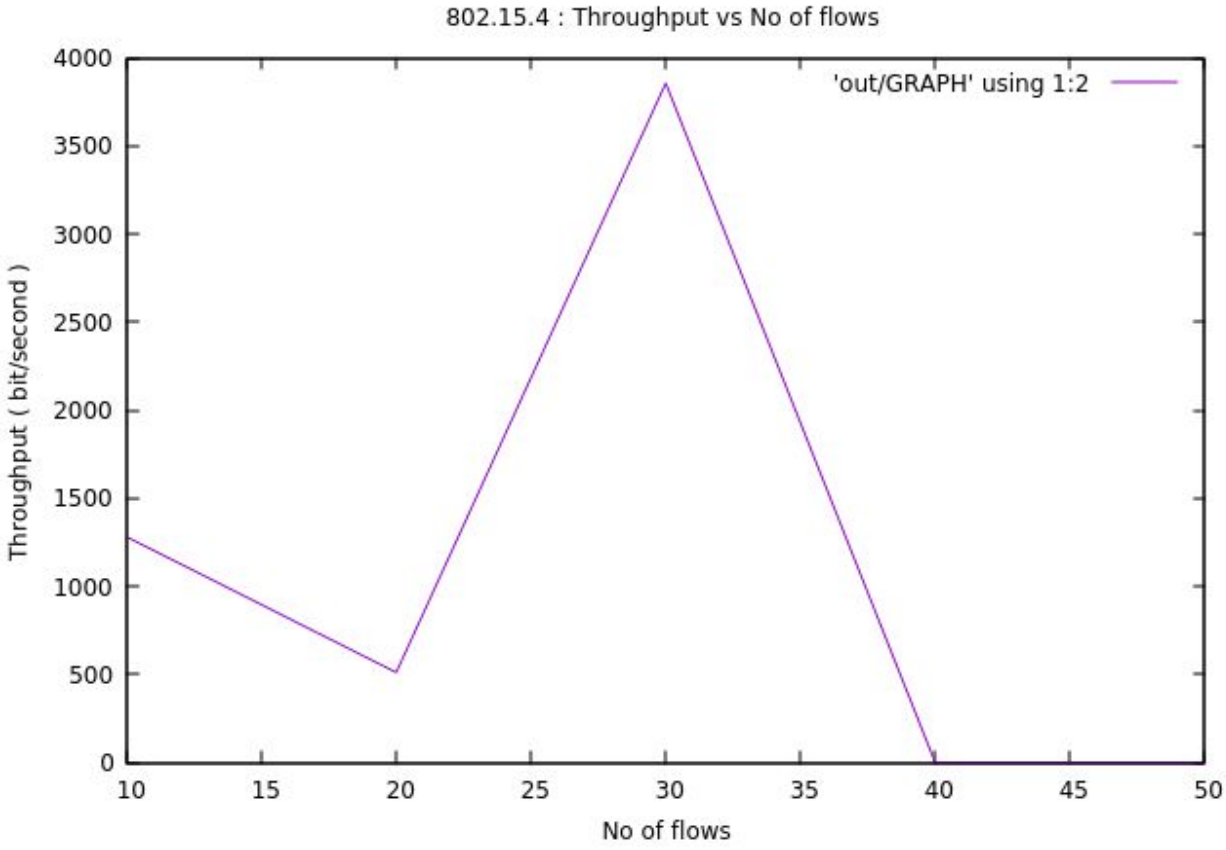

802.15.4 : Average Delay vs No of nodes
'out/GRAPH' using 1:3
Average Delay ( second )
No of nodes
0.25
0.2
0.15
0.1
0.05
0
20
30
40
50
60
70
80
90
100

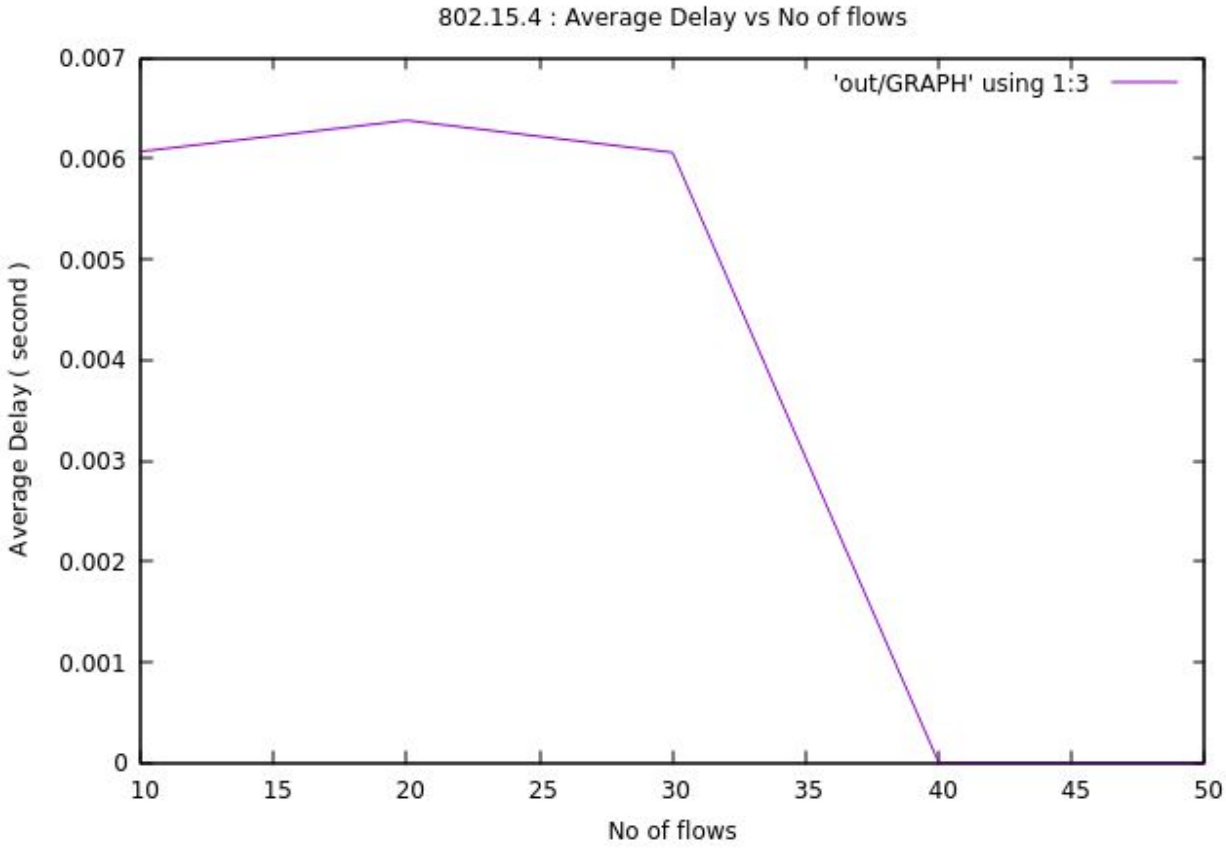

802.15.4 : Packet Delivery Ratio vs No of nodes
'out/GRAPH' using 1:4
Packet Delivery Ratio ( % )
No of nodes
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
20
30
40
50
60
70
80
90
100


802.15.4 : Packet Drop Ratio vs No of nodes
'out/GRAPH' using 1:5
Packet Drop Ratio ( % )
No of nodes
100.5
100
99.5
99
98.5
98
97.5
97
20
30
40
50
60
70
80
90
100

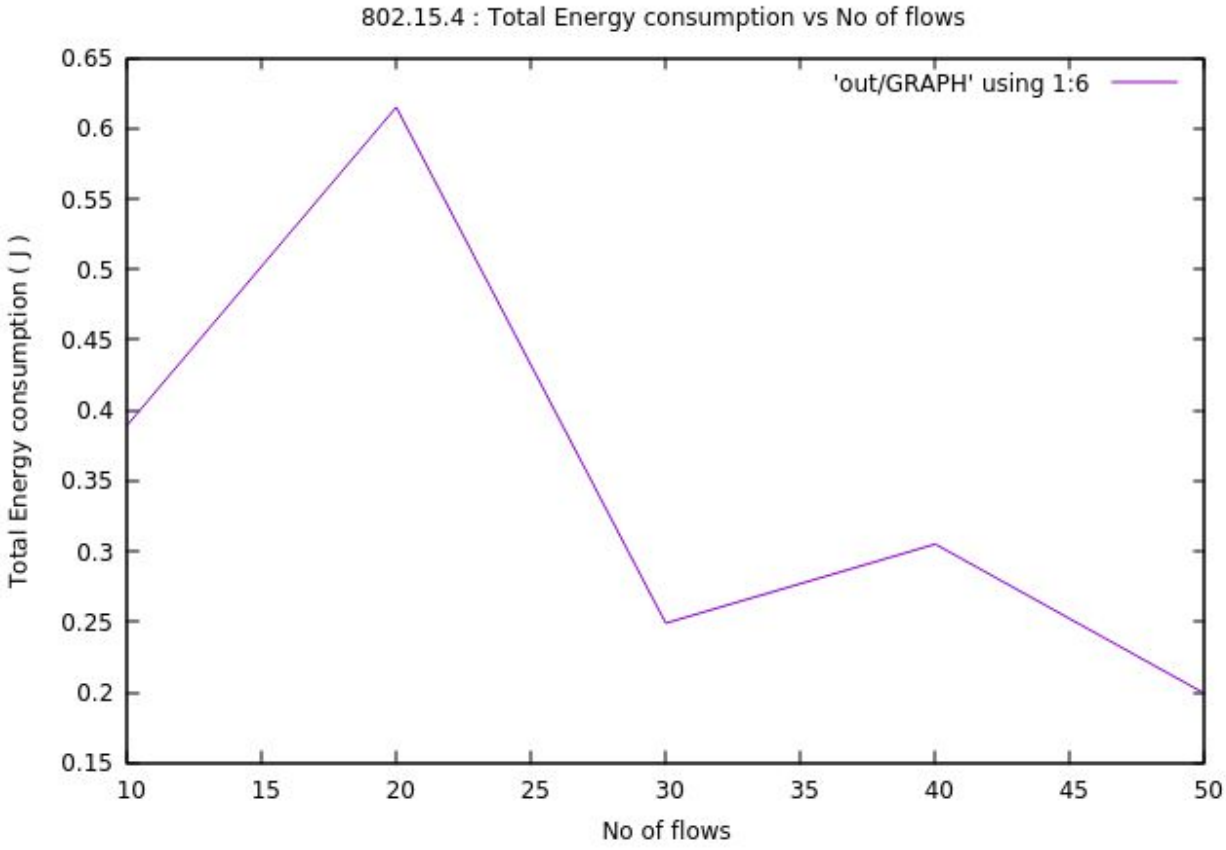

802.15.4 : Total Energy consumption vs No of nodes
'out/GRAPH' using 1:6
Total Energy consumption ( J )
No of nodes
0
1
2
3
4
5
6
7
20
30
40
50
60
70
80
90
100

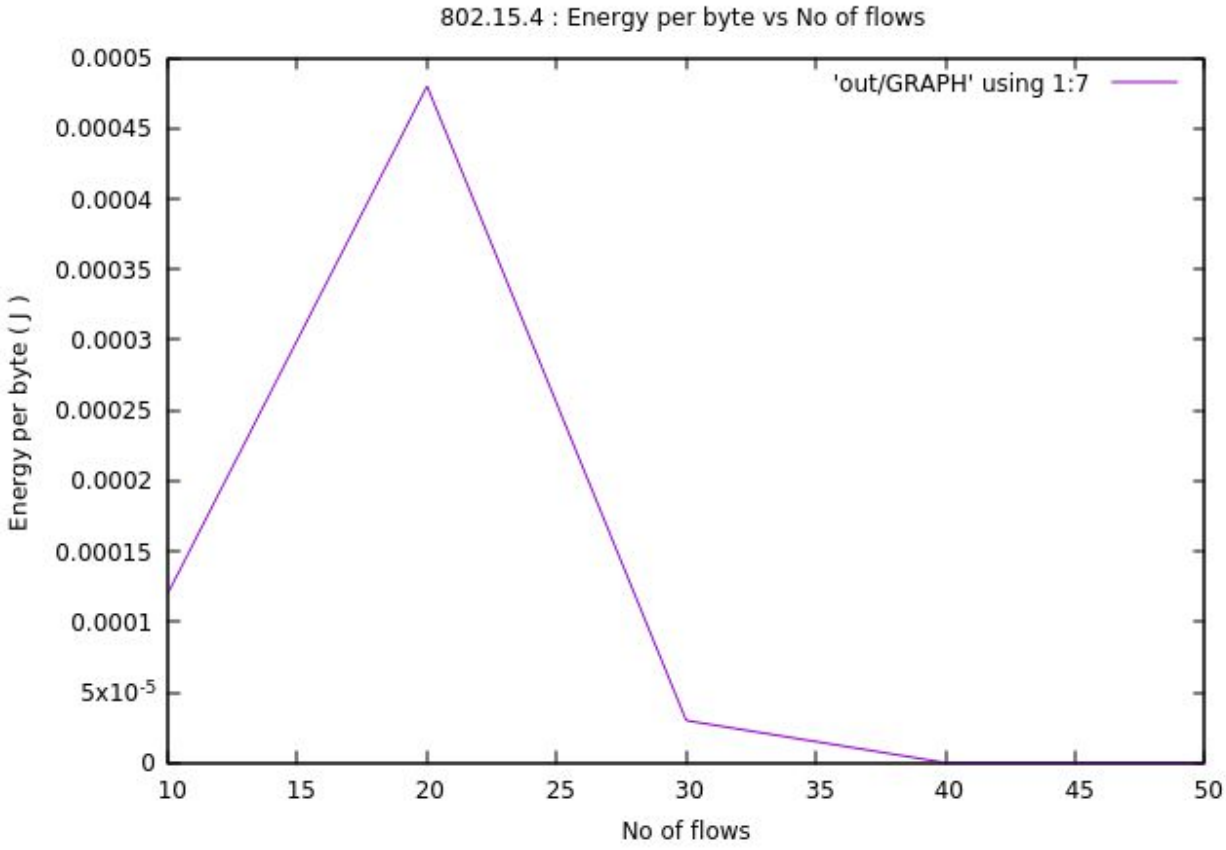

802.15.4 : Energy per byte vs No of nodes
'out/GRAPH' using 1:7
Energy per byte ( J )
No of nodes
7x10-5
6x10-5
5x10-5
4x10-5
3x10-5
2x10-5
1x10-5
0
20
30
40
50
60
70
80
90
100

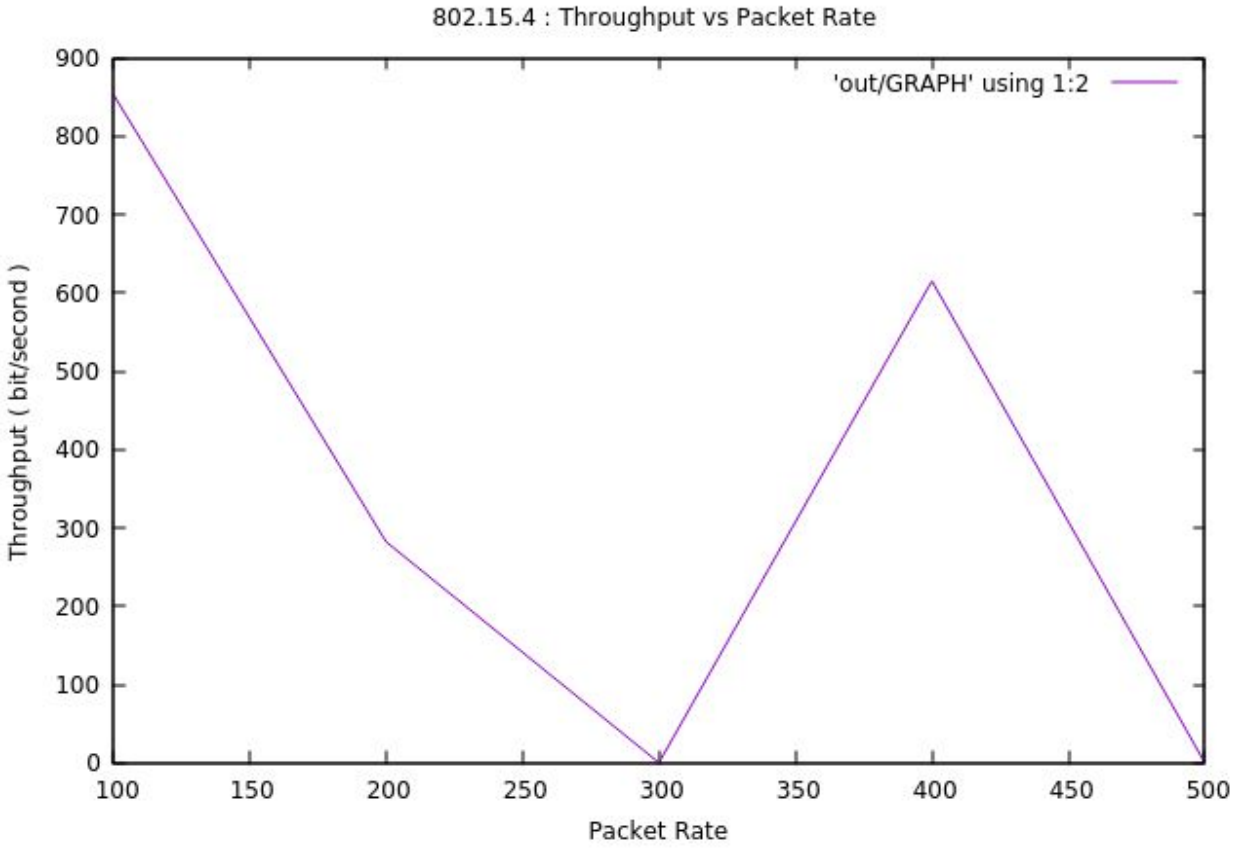

802.15.4 : Throughput vs No of flows
'out/GRAPH' using 1:2
Throughput ( bit/second )
No of flows
0
500
1000
1500
2000
2500
3000
3500
4000
10
15
20
25
30
35
40
45
50

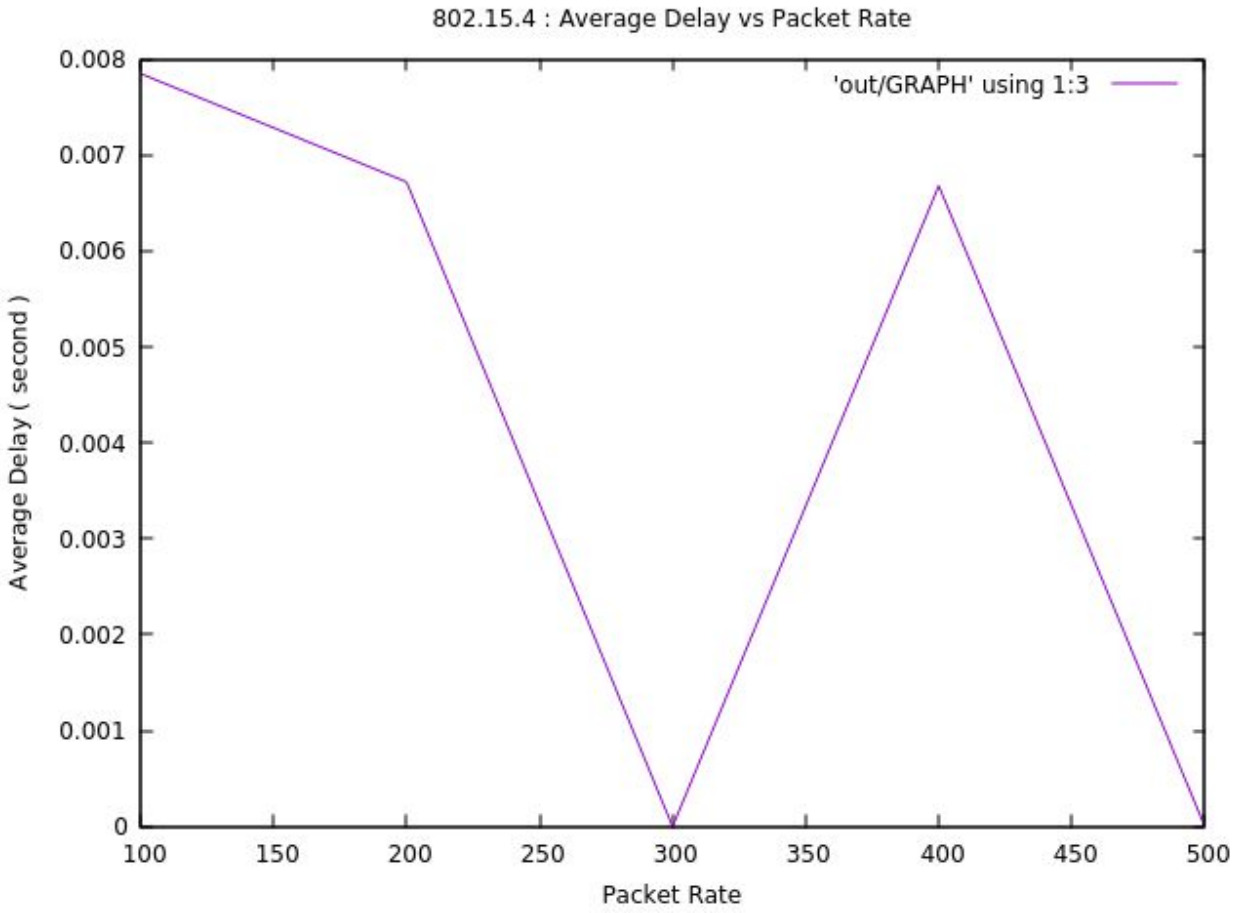

802.15.4 : Average Delay vs No of flows
'out/GRAPH' using 1:3
Average Delay ( second )
No of flows
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
10
15
20
25
30
35
40
45
50

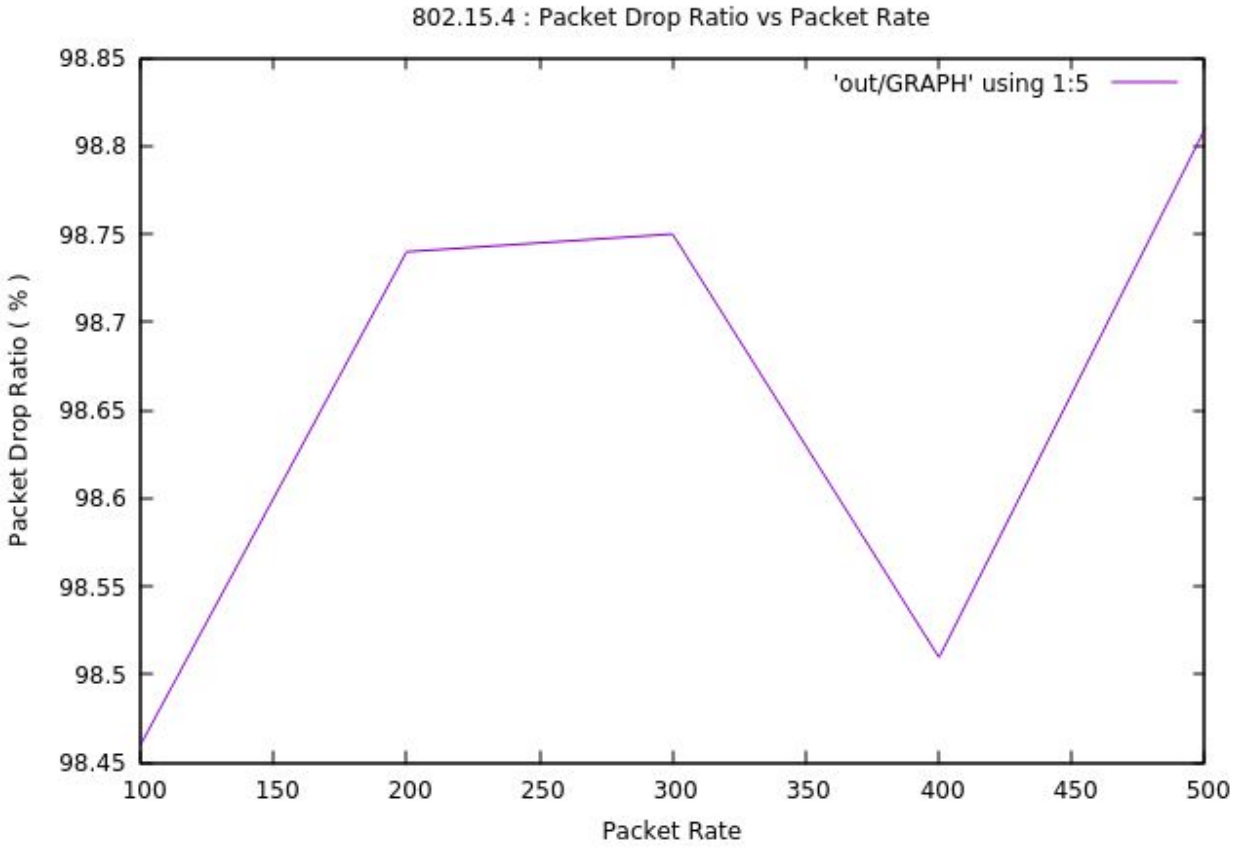

802.15.4 : Packet Delivery Ratio vs No of flows
'out/GRAPH' using 1:4
Packet Delivery Ratio ( % )
No of flows
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
10
15
20
25
30
35
40
45
50

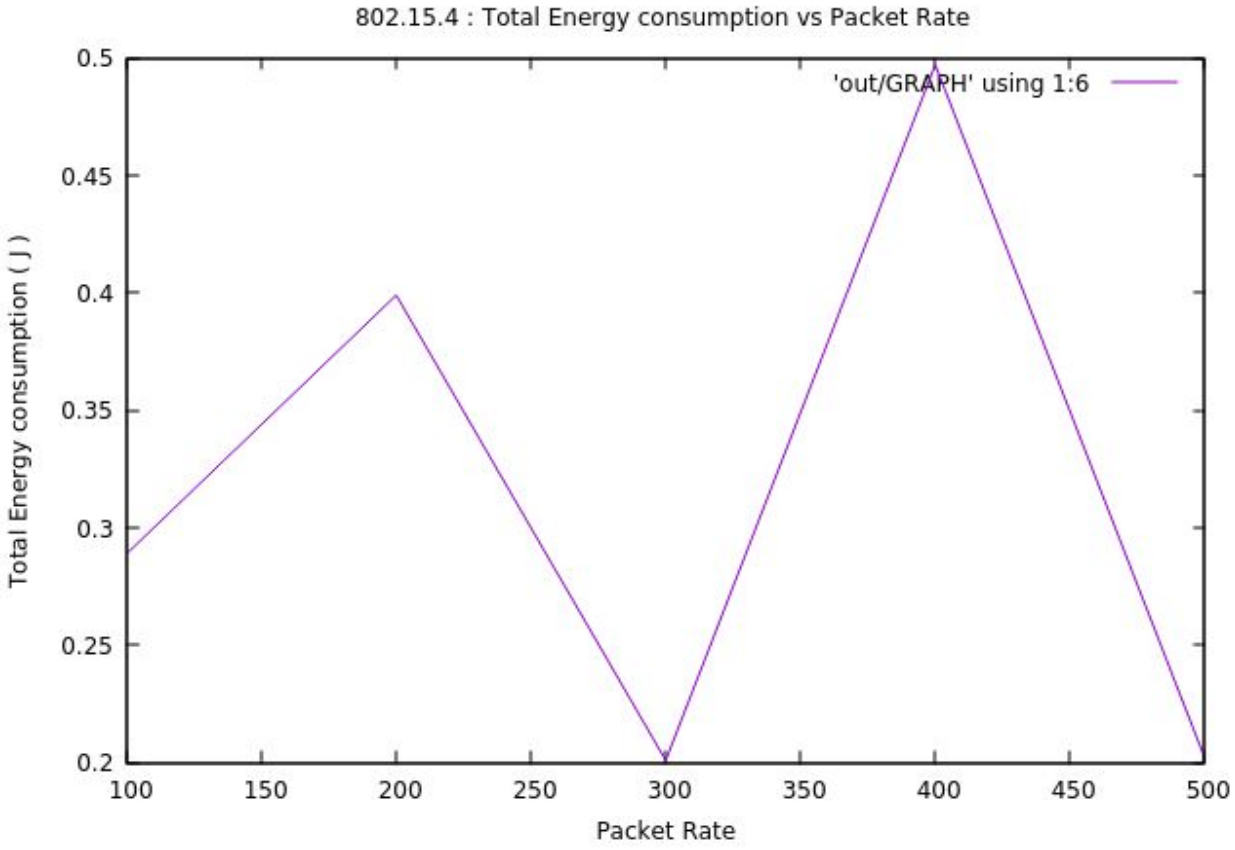

802.15.4 : Total Energy consumption vs No of flows
'out/GRAPH' using 1:6
Total Energy consumption ( J )
No of flows
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
10
15
20
25
30
35
40
45
50

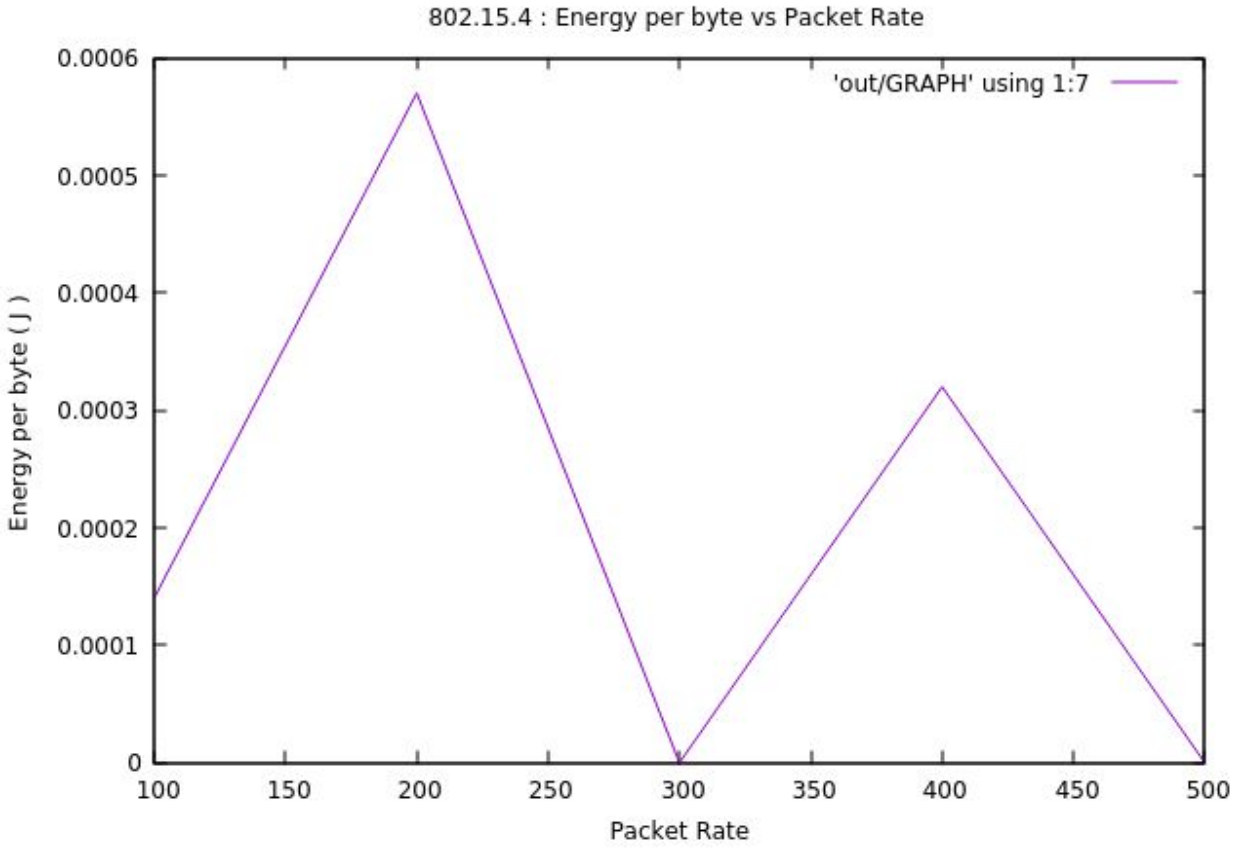

802.15.4 : Energy per byte vs No of flows
'out/GRAPH' using 1:7
Energy per byte ( J )
No of flows
0.0005
0.00045
0.0004
0.00035
0.0003
0.00025
0.0002
0.00015
0.0001
5x10-5
0
10
15
20
25
30
35
40
45
50

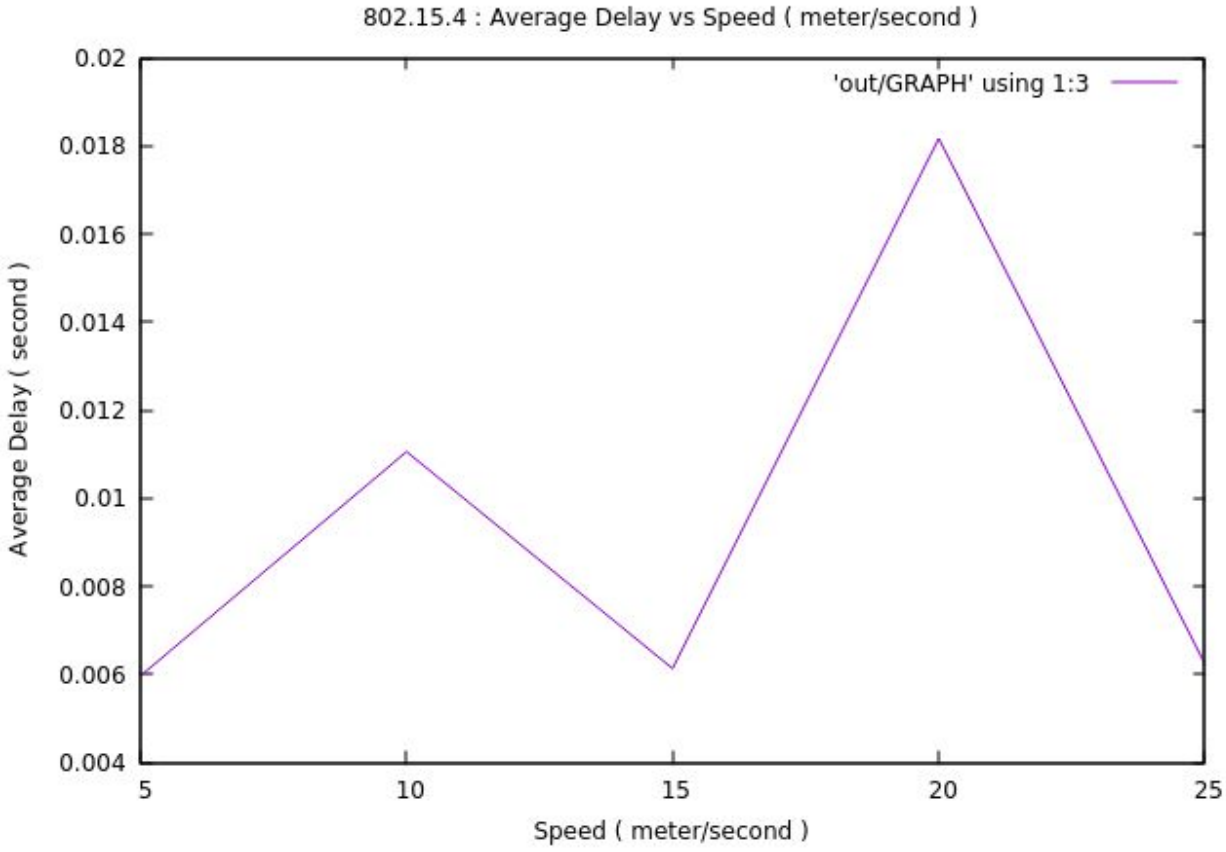

802.15.4 : Throughput vs Packet Rate
'out/GRAPH' using 1:2
Throughput ( bit/second )
Packet Rate
900
800
700
600
500
400
300
200
100
0
100
150
200
250
300
350
400
450
500

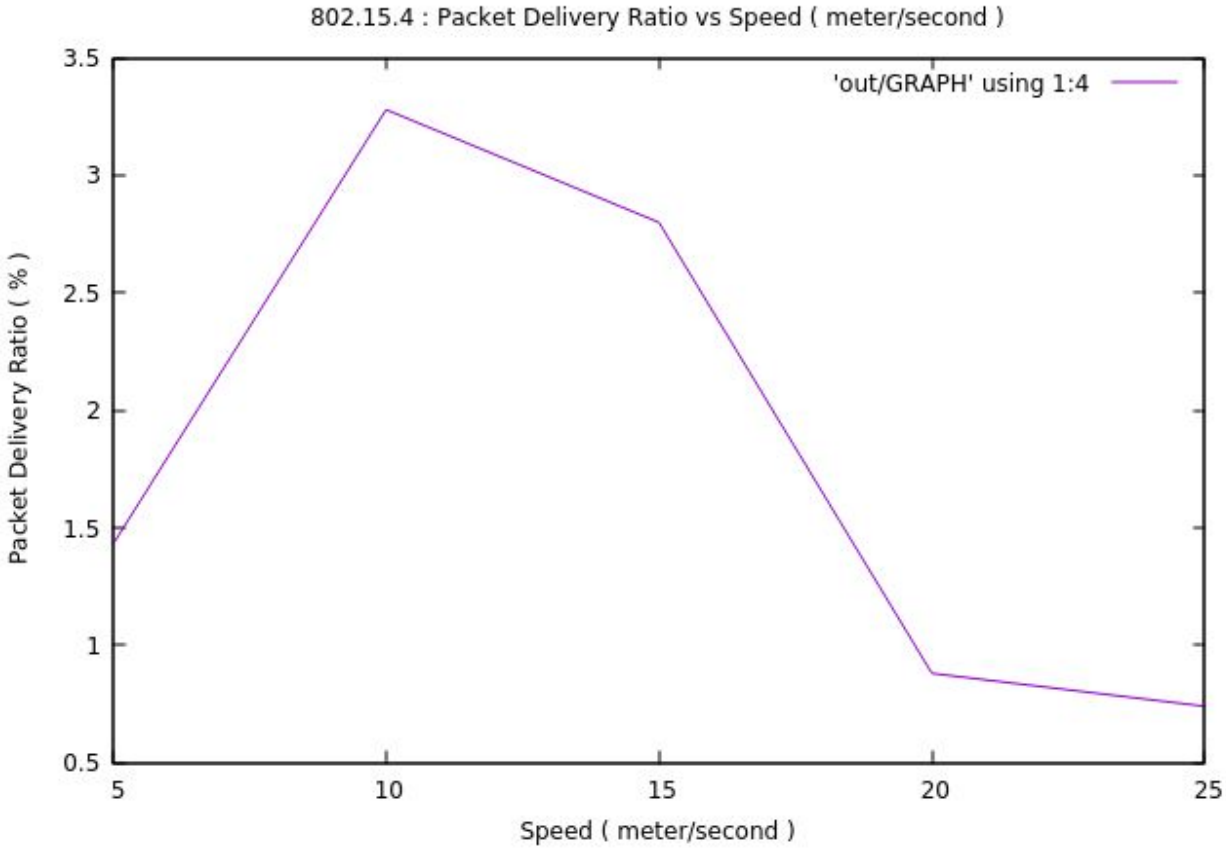

802.15.4 : Average Delay vs Packet Rate
'out/GRAPH' using 1:3
Average Delay ( second )
Packet Rate
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
100
150
200
250
300
350
400
450
500

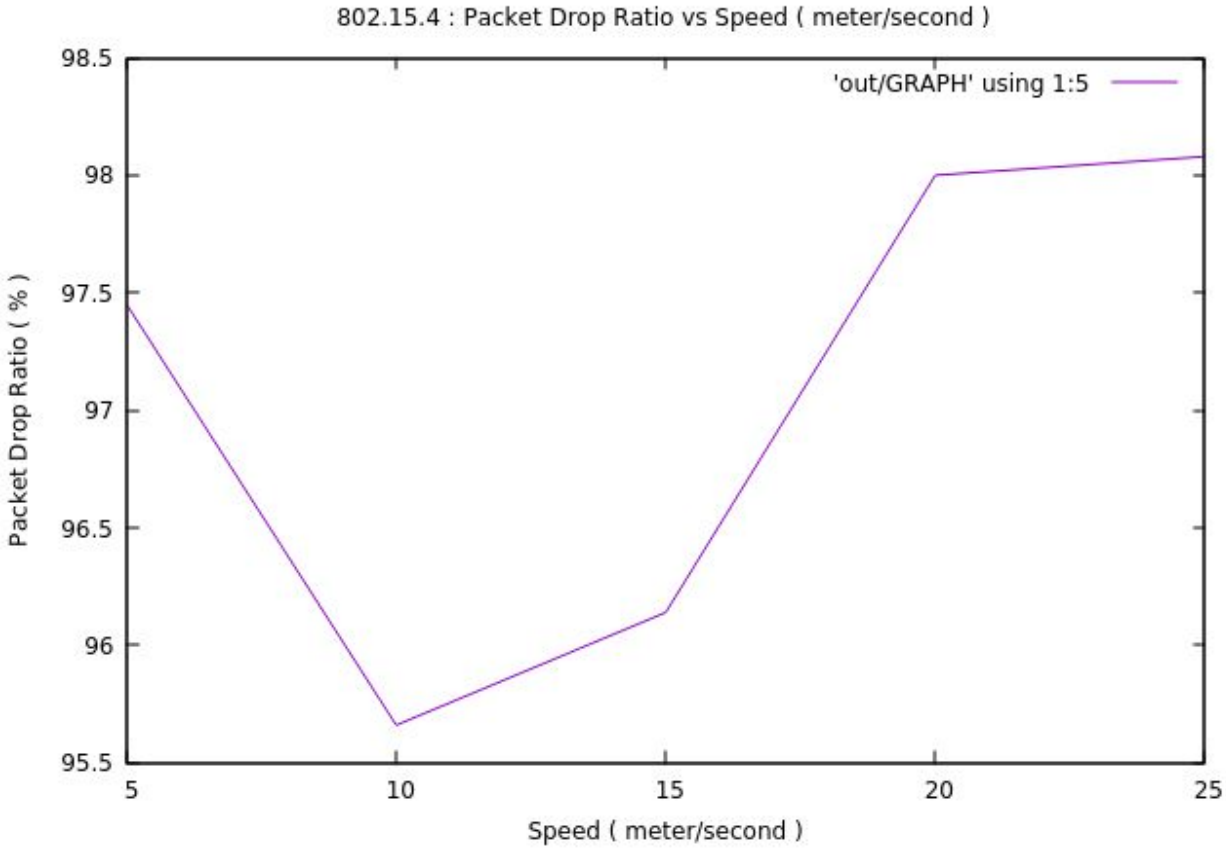

802.15.4 : Packet Drop Ratio vs Packet Rate
'out/GRAPH' using 1:5
Packet Drop Ratio ( % )
Packet Rate
98.85
98.8
98.75
98.7
98.65
98.6
98.55
98.5
98.45
100
150
200
250
300
350
400
450
500

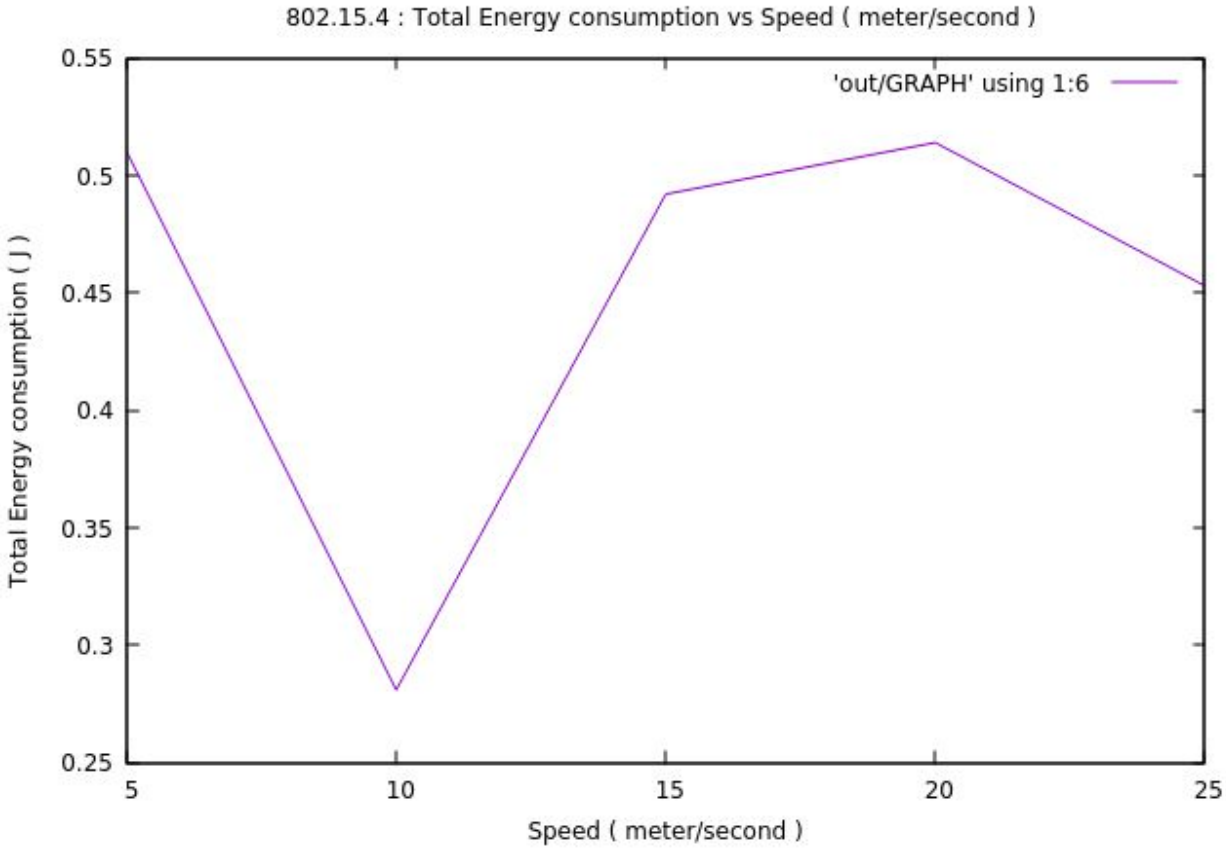

802.15.4 : Total Energy consumption vs Packet Rate
'out/GRAPH' using 1:6
Total Energy consumption ( J )
Packet Rate
0.5
0.45
0.4
0.35
0.3
0.25
0.2
100
150
200
250
300
350
400
450
500

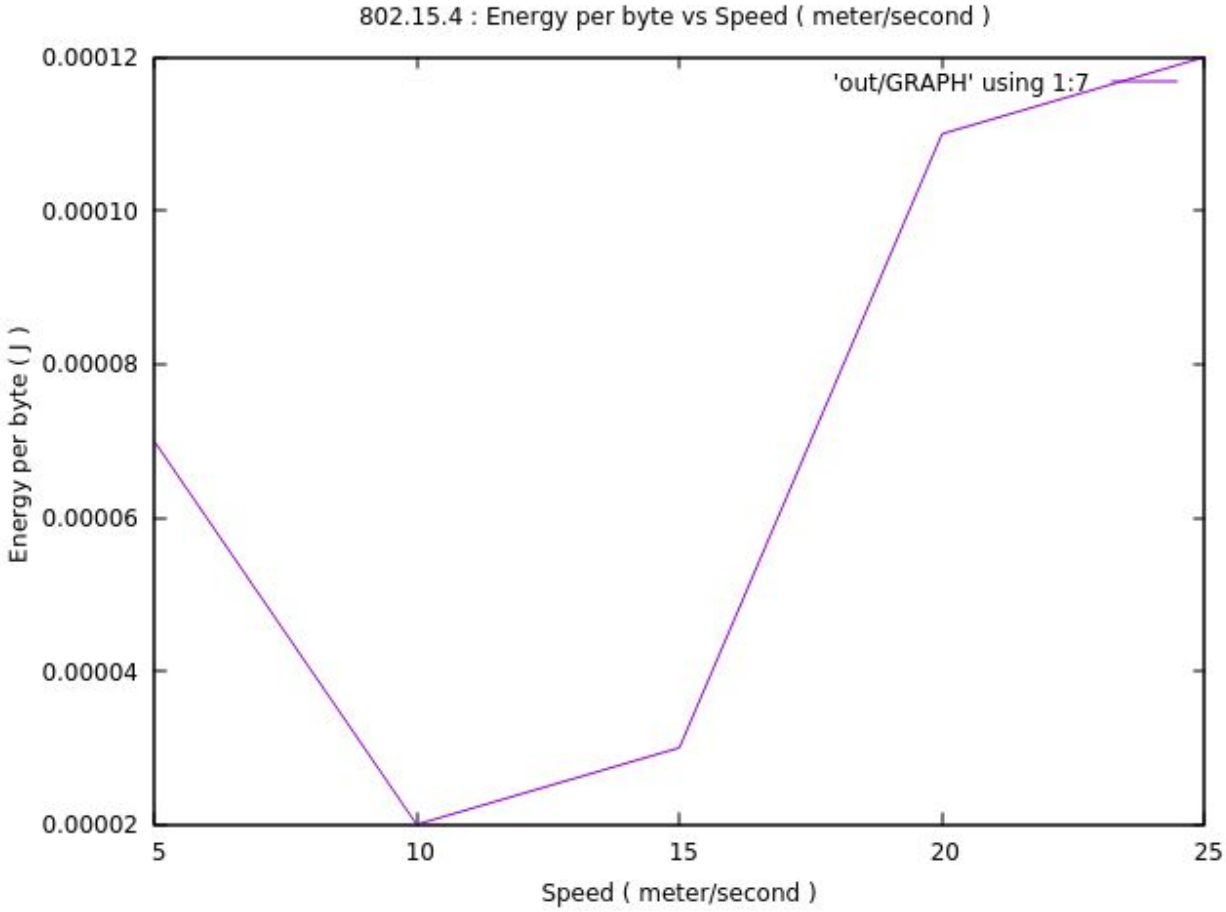

802.15.4 : Energy per byte vs Packet Rate
'out/GRAPH' using 1:7
Energy per byte ( J )
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
100
150
200
250
300
350
400
450
500
Packet Rate


802.15.4 : Average Delay vs Speed ( meter/second )
'out/GRAPH' using 1:3
Average Delay ( second )
Speed ( meter/second )
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
5
10
15
20
25

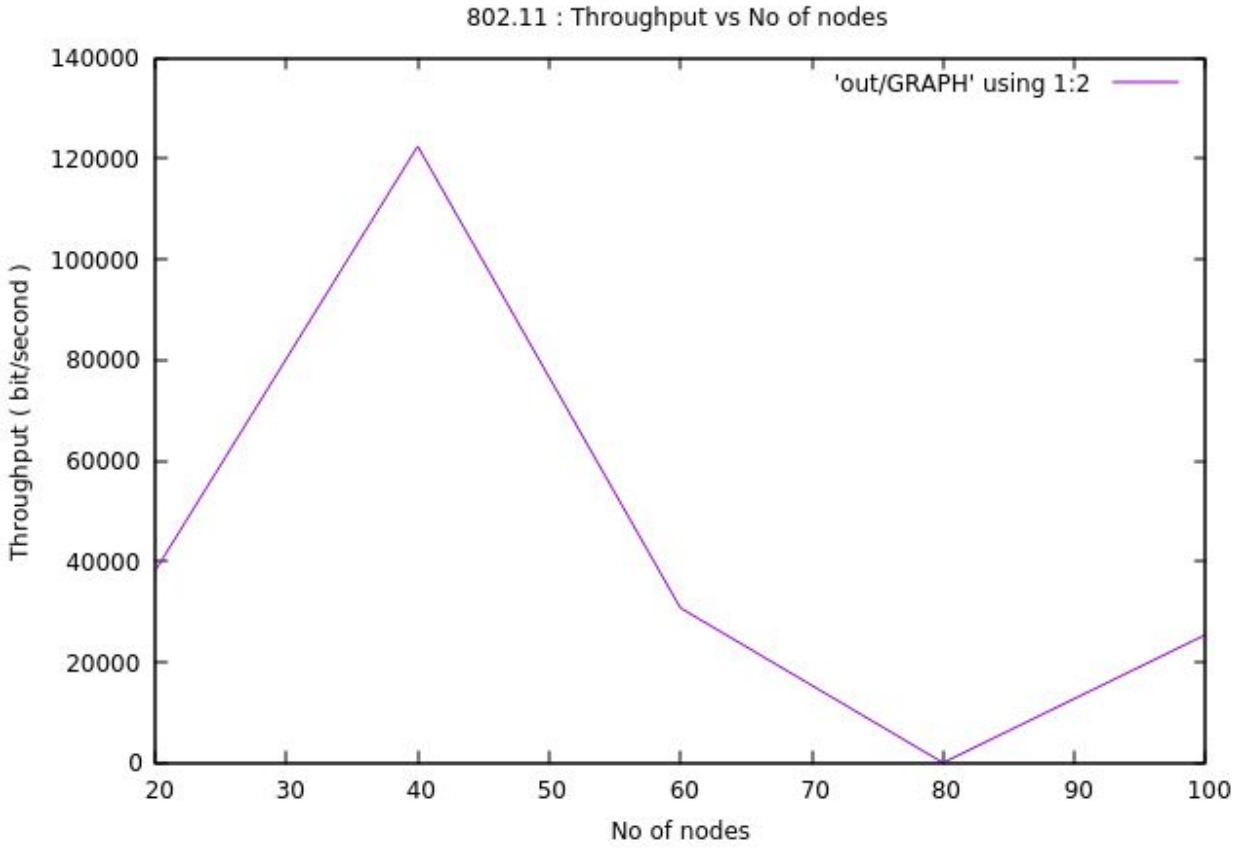

802.15.4 : Packet Delivery Ratio vs Speed ( meter/second )
'out/GRAPH' using 1:4
Packet Delivery Ratio ( % )
Speed ( meter/second )
3.5
3
2.5
2
1.5
1
0.5
5
10
15
20
25

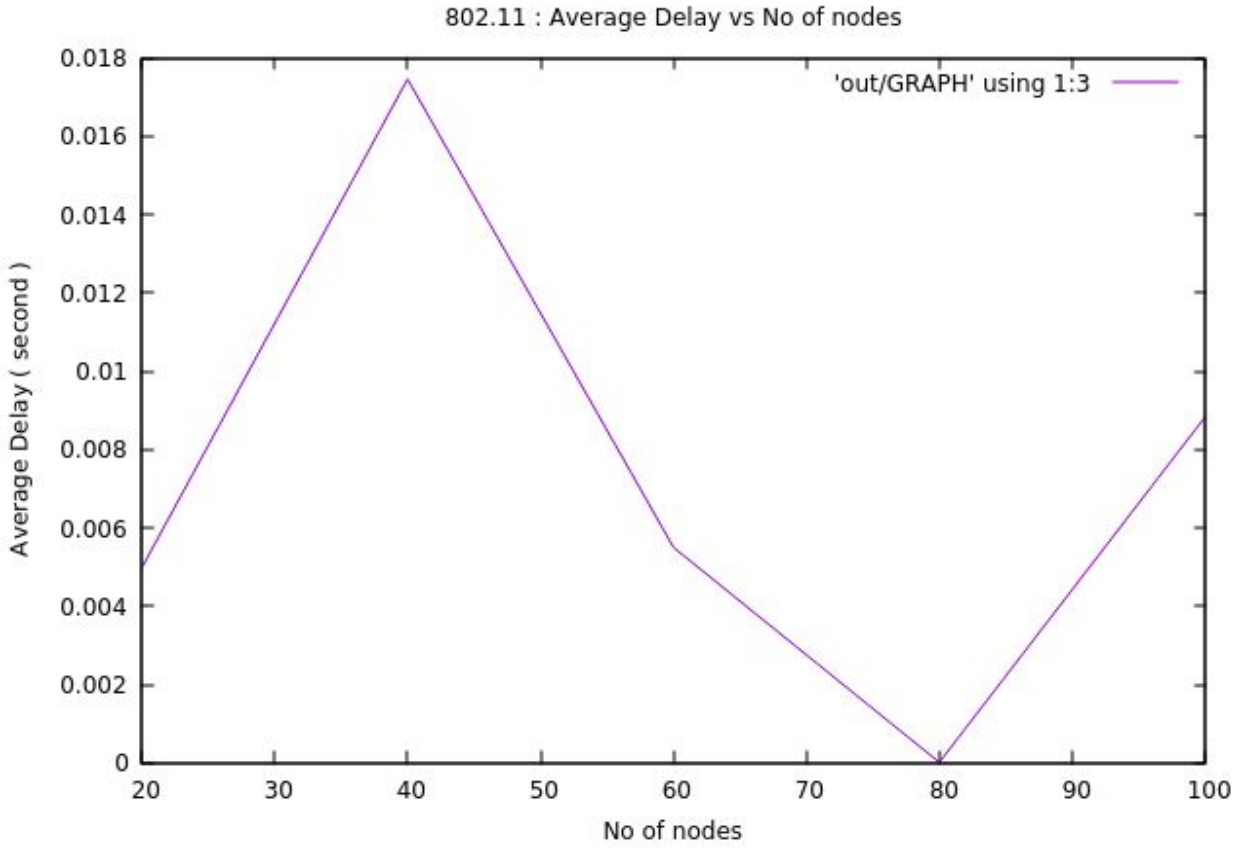

802.15.4 : Packet Drop Ratio vs Speed ( meter/second )
'out/GRAPH' using 1:5
Packet Drop Ratio ( % )
Speed ( meter/second )
98.5
98
97.5
97
96.5
96
95.5
5
10
15
20
25

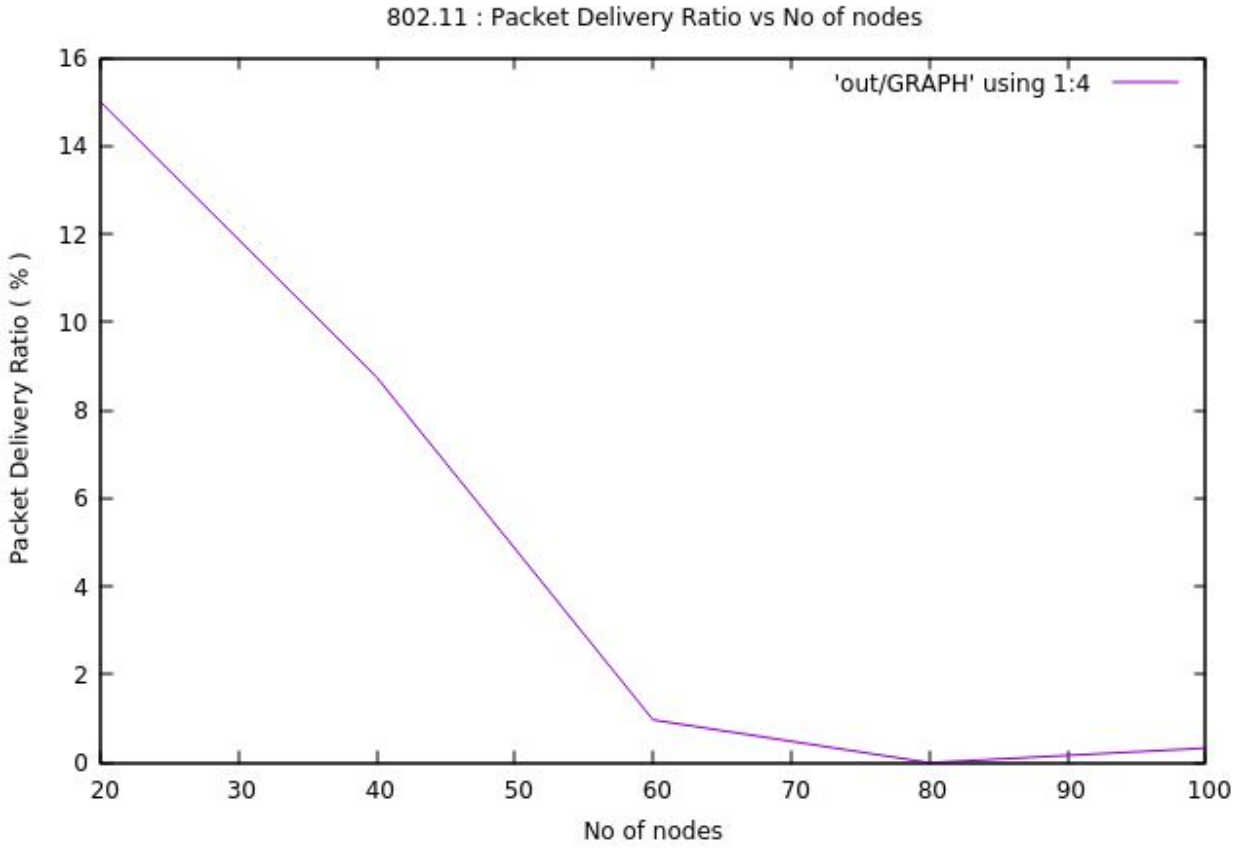

802.15.4 : Total Energy consumption vs Speed ( meter/second )
'out/GRAPH' using 1:6
Total Energy consumption ( J )
Speed ( meter/second )
0.55
0.5
0.45
0.4
0.35
0.3
0.25
5
10
15
20
25

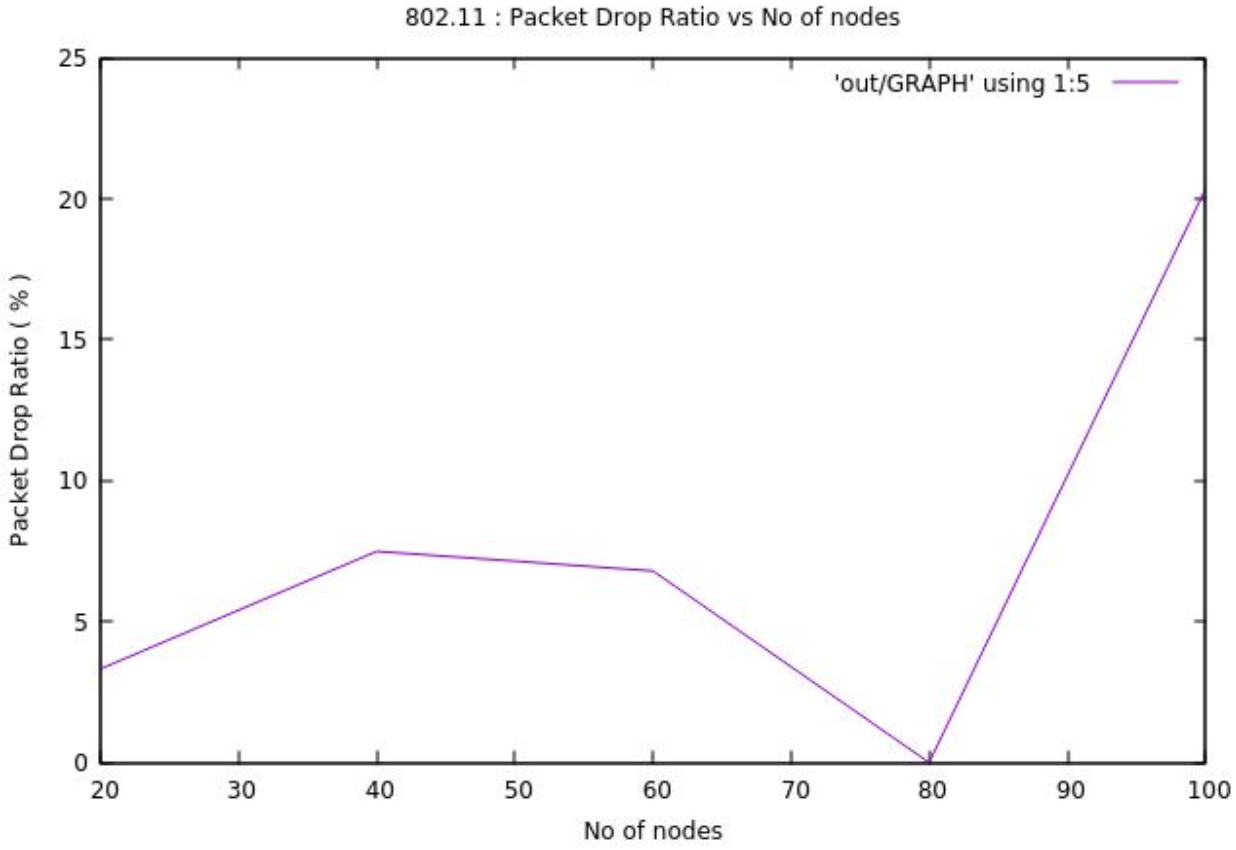

802.15.4 : Energy per byte vs Speed ( meter/second )
'out/GRAPH' using 1:7
Energy per byte ( J )
0.00012
0.00010
0.00008
0.00006
0.00004
0.00002
5
10
15
20
25
Speed ( meter/second )

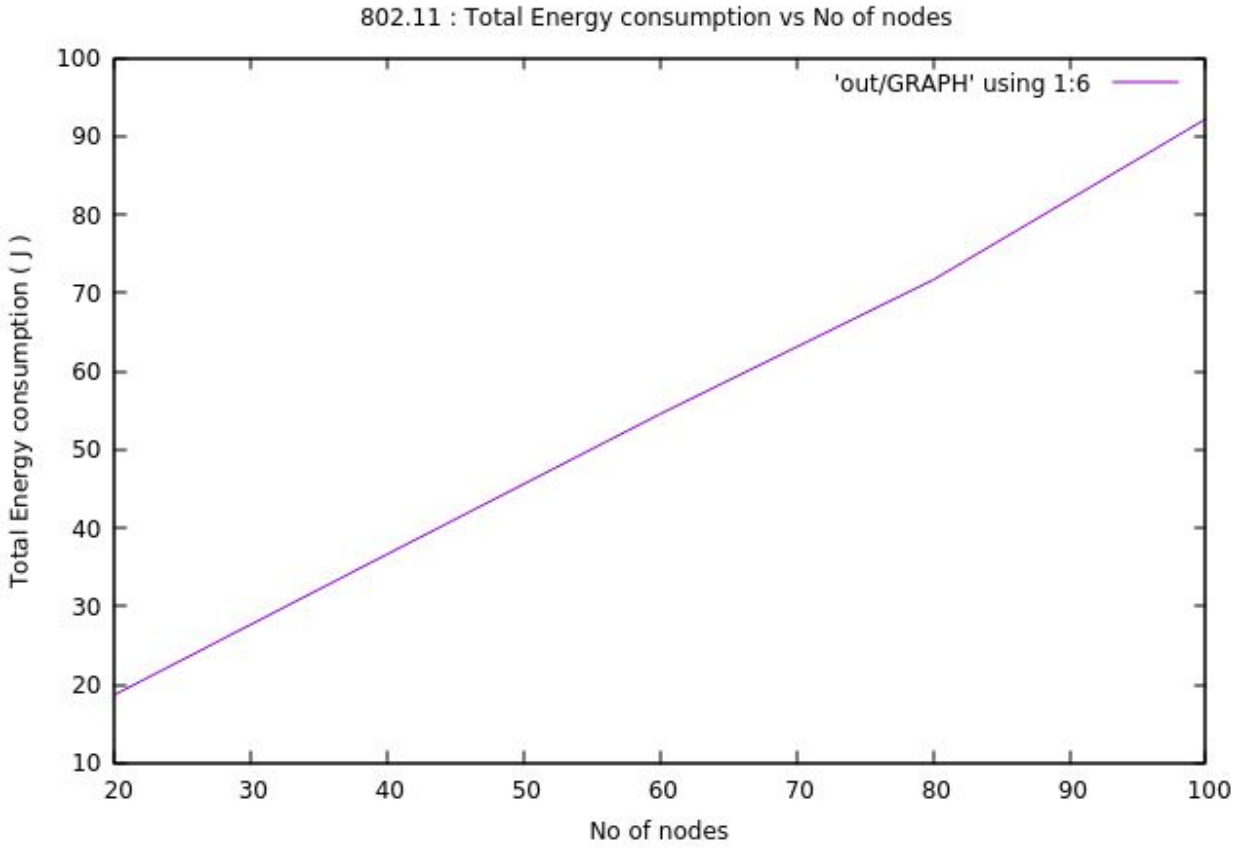
# 802.11 Modified

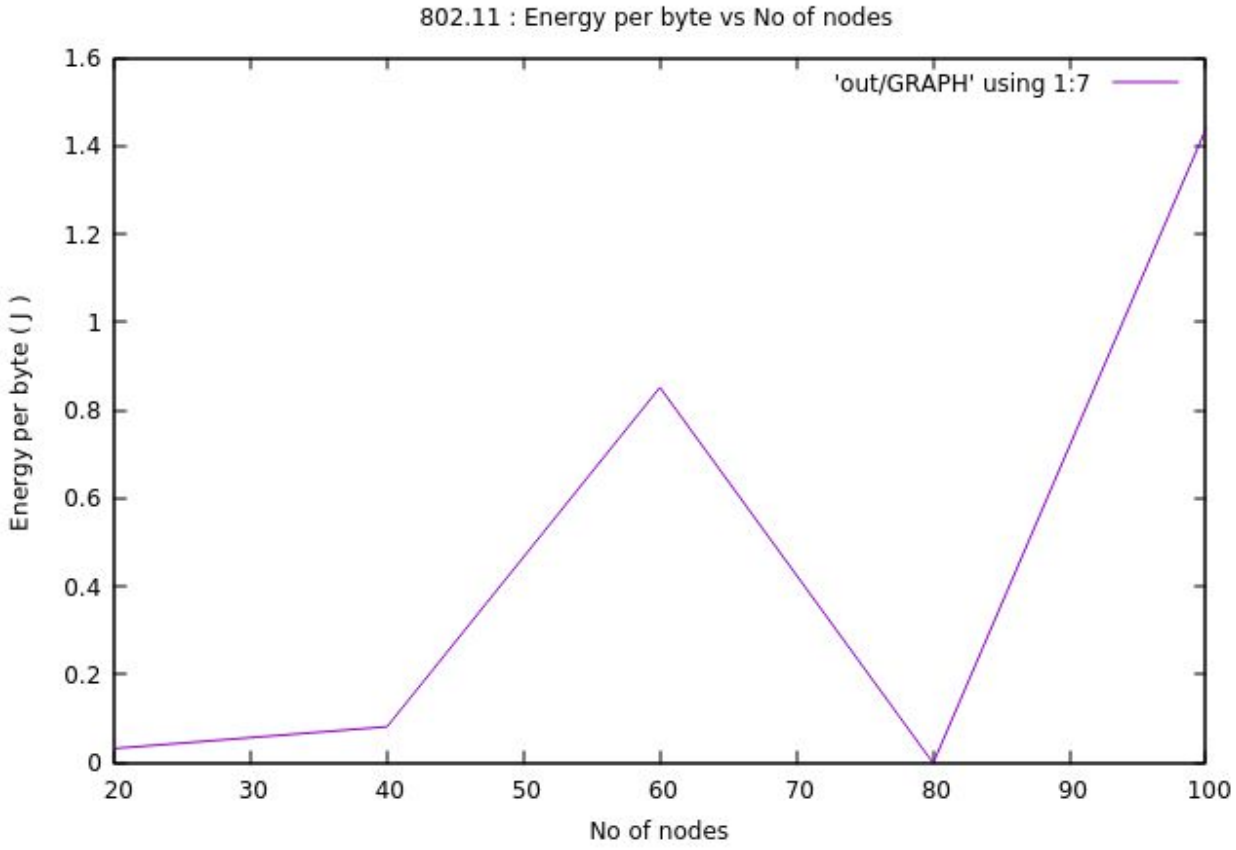

802.11 : Throughput vs No of nodes
'out/GRAPH' using 1:2
Throughput ( bit/second )
No of nodes
140000
120000
100000
80000
60000
40000
20000
0
20
30
40
50
60
70
80
90
100

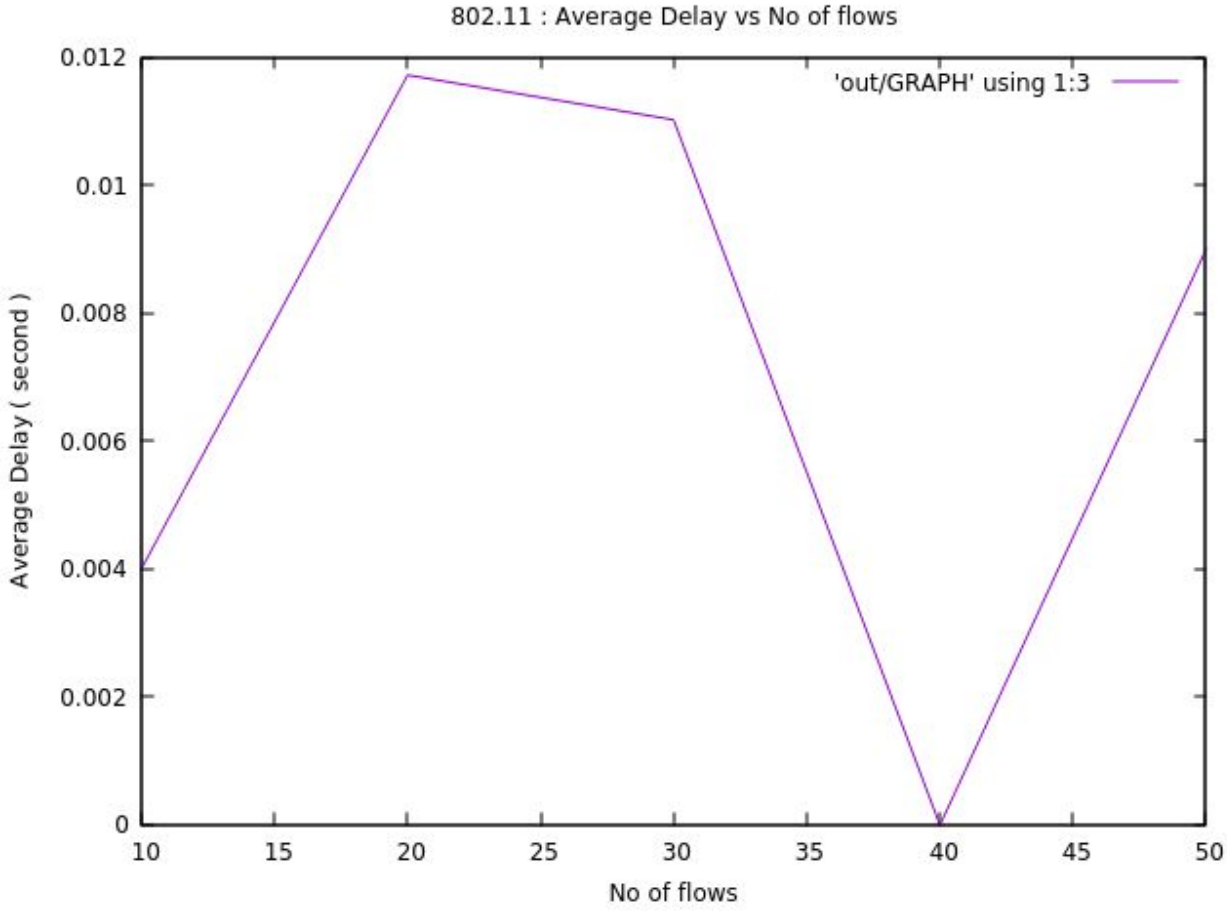

802.11 : Average Delay vs No of nodes
'out/GRAPH' using 1:3
Average Delay ( second )
No of nodes
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
20
30
40
50
60
70
80
90
100

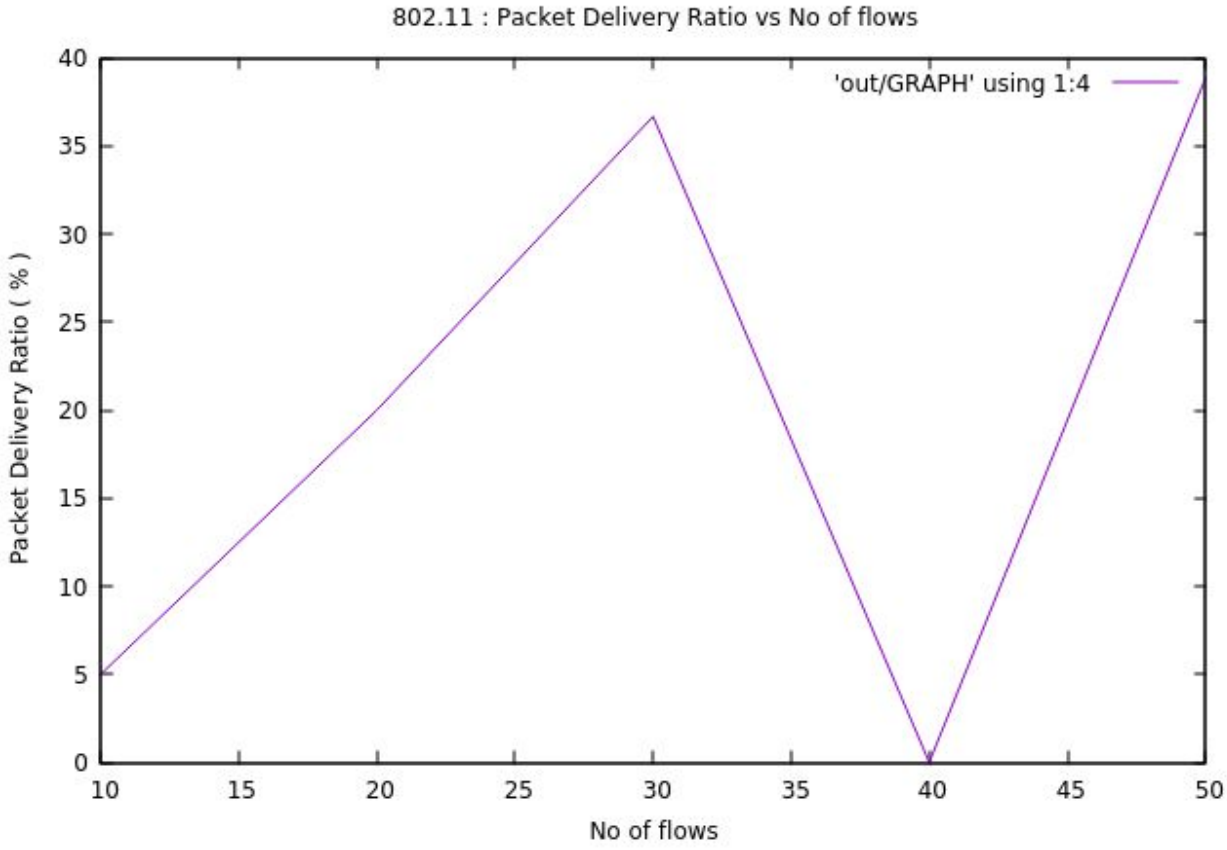

802.11 : Packet Delivery Ratio vs No of nodes
'out/GRAPH' using 1:4
Packet Delivery Ratio ( % )
No of nodes
0
2
4
6
8
10
12
14
16
20
30
40
50
60
70
80
90
100

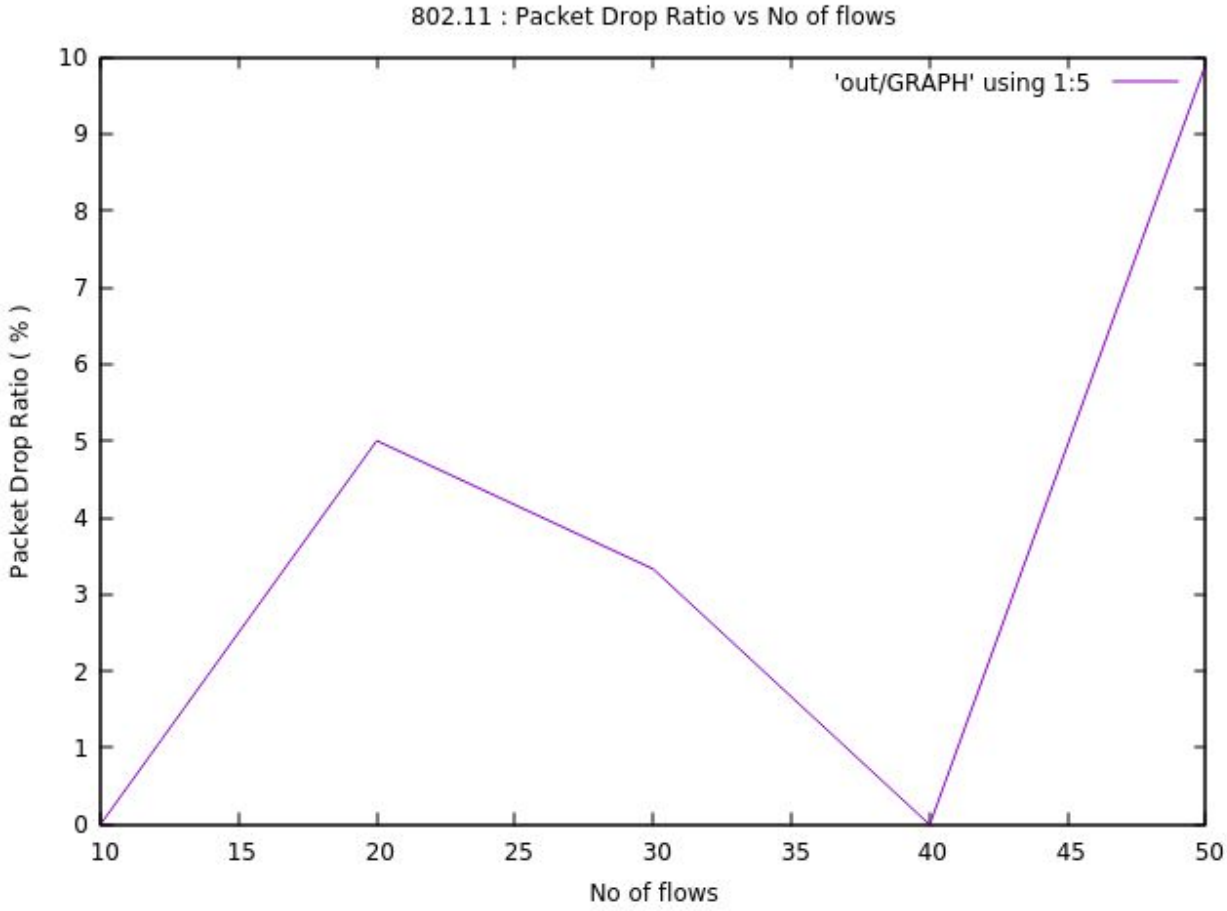

802.11 : Packet Drop Ratio vs No of nodes
'out/GRAPH' using 1:5
Packet Drop Ratio ( % )
No of nodes
0
5
10
15
20
25
20
30
40
50
60
70
80
90
100

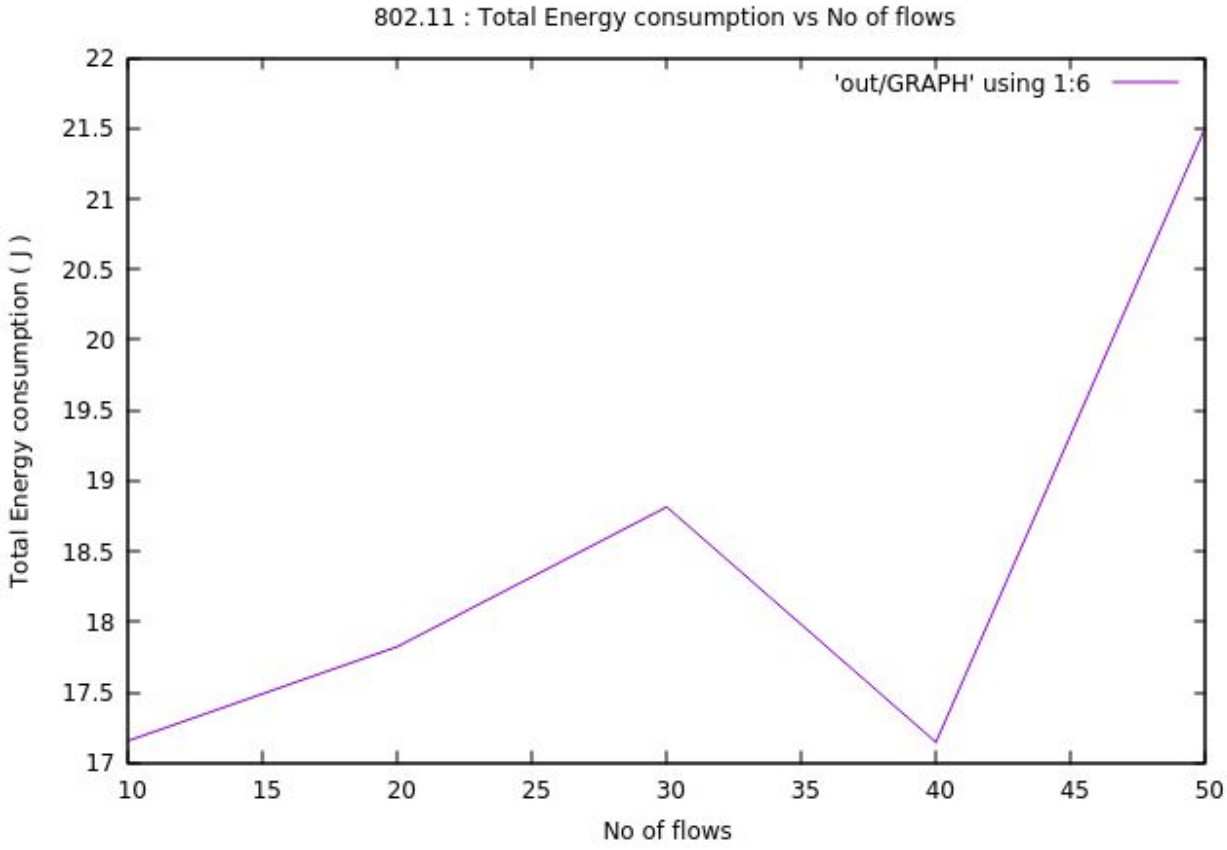

802.11 : Total Energy consumption vs No of nodes
'out/GRAPH' using 1:6
Total Energy consumption ( J )
No of nodes
100
90
80
70
60
50
40
30
20
10
20
30
40
50
60
70
80
90
100

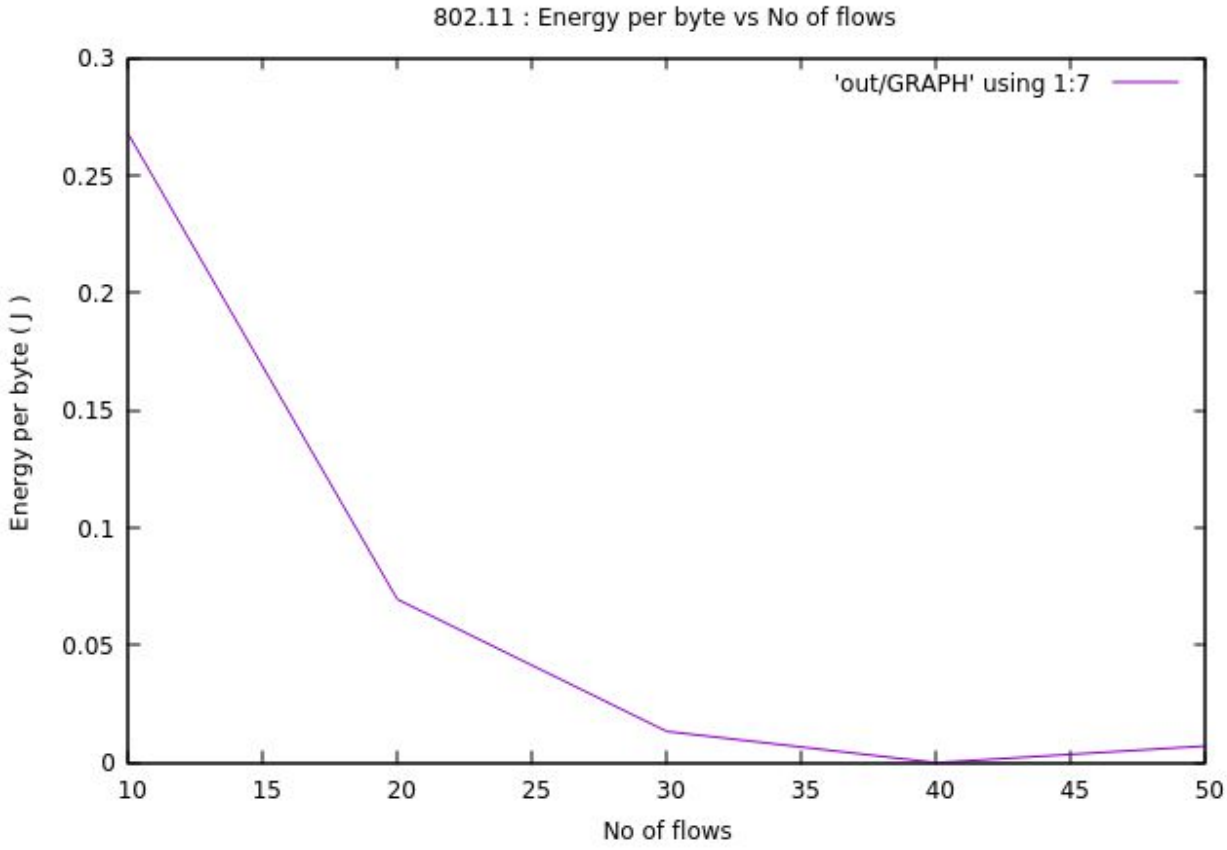

802.11 : Energy per byte vs No of nodes
'out/GRAPH' using 1:7
Energy per byte ( J )
No of nodes
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
20
30
40
50
60
70
80
90
100

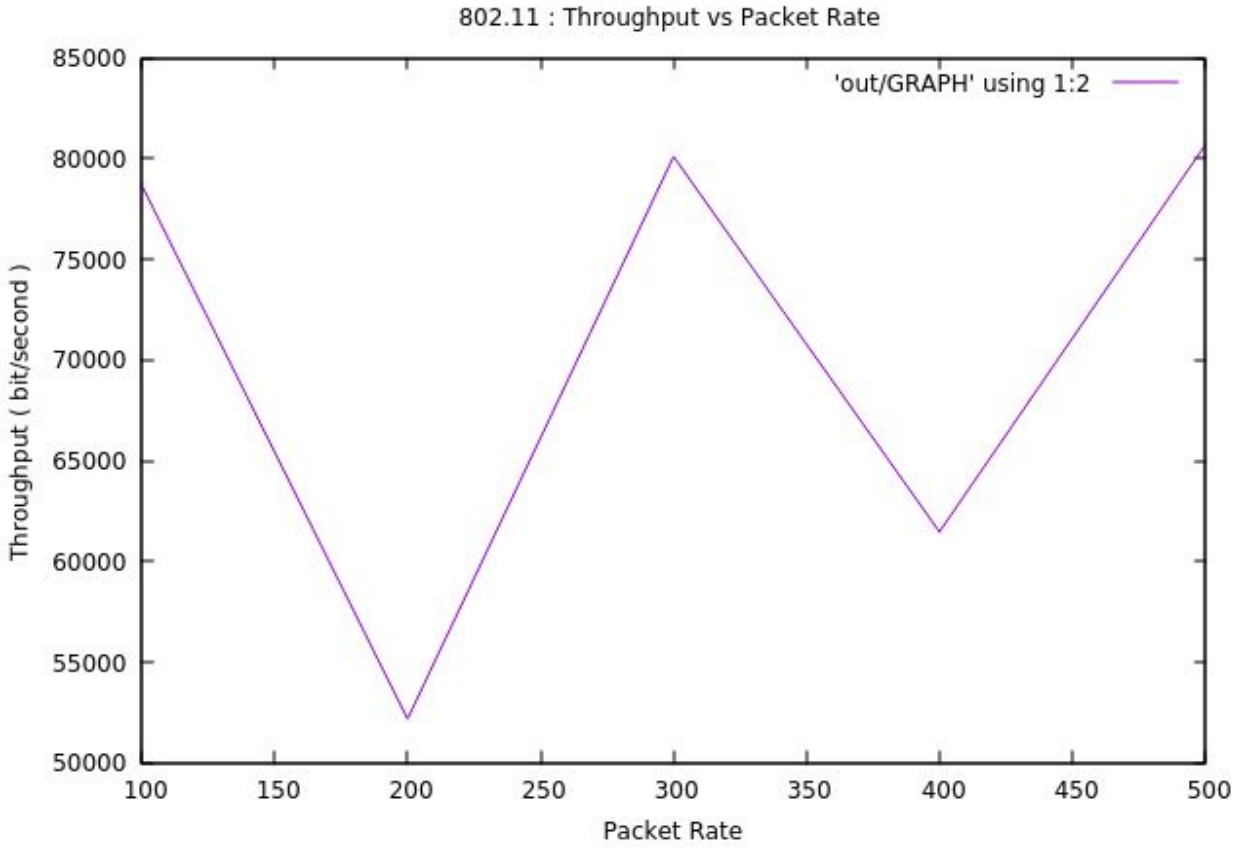

802.11 : Average Delay vs No of flows
'out/GRAPH' using 1:3
Average Delay ( second )
No of flows
0.012
0.01
0.008
0.006
0.004
0.002
0
10
15
20
25
30
35
40
45
50

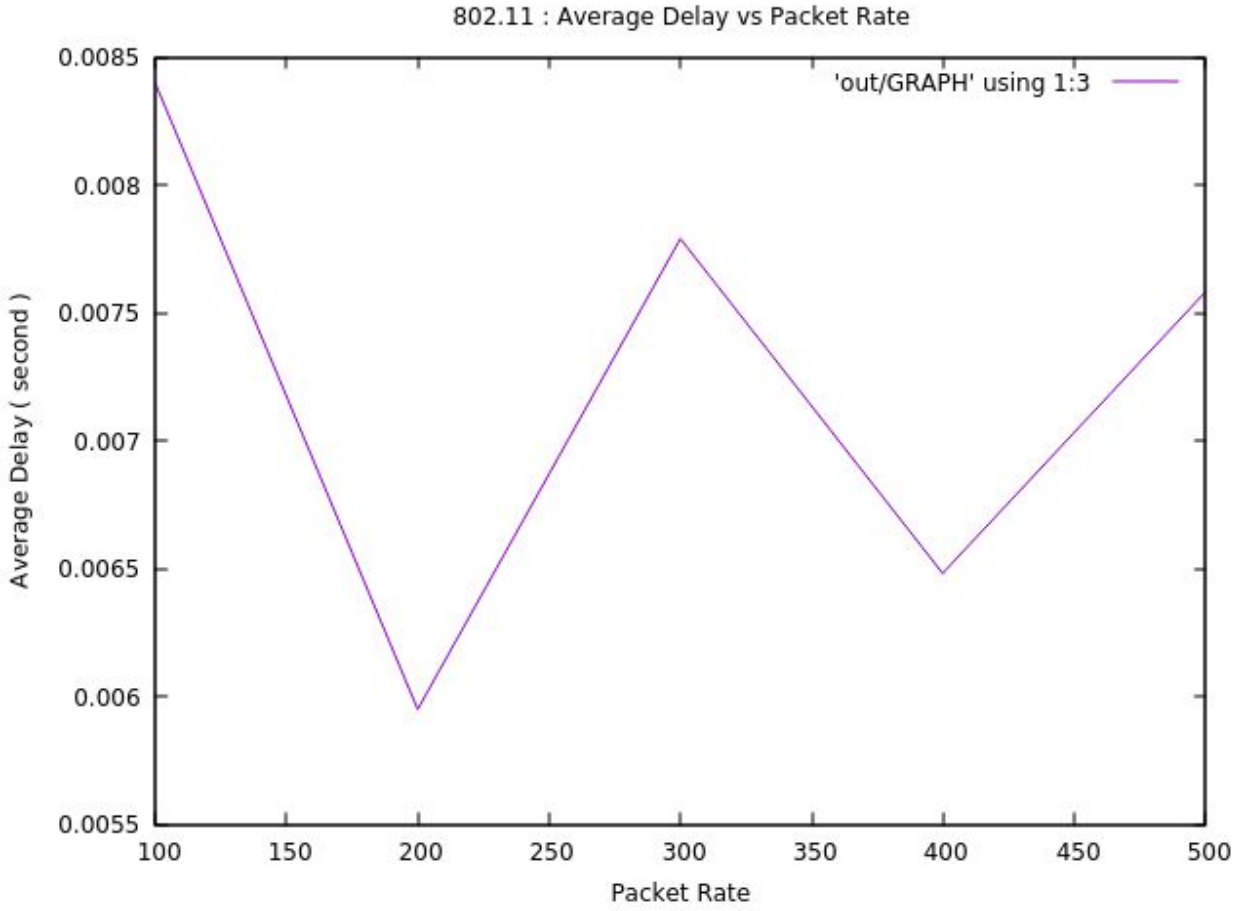

802.11 : Packet Delivery Ratio vs No of flows
'out/GRAPH' using 1:4
Packet Delivery Ratio ( % )
No of flows
0
5
10
15
20
25
30
35
40
10
15
20
25
30
35
40
45
50

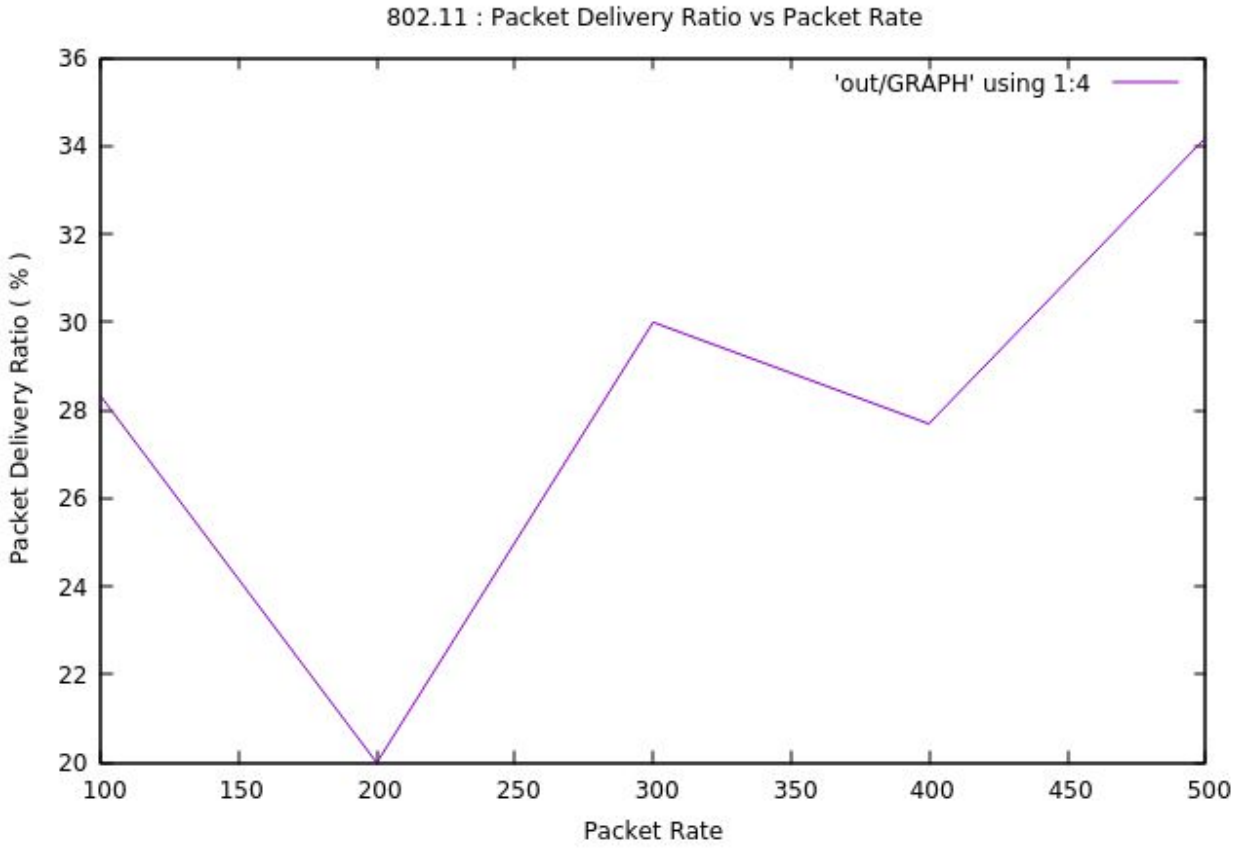

802.11 : Packet Drop Ratio vs No of flows
'out/GRAPH' using 1:5
Packet Drop Ratio ( % )
No of flows
0
1
2
3
4
5
6
7
8
9
10
10
15
20
25
30
35
40
45
50

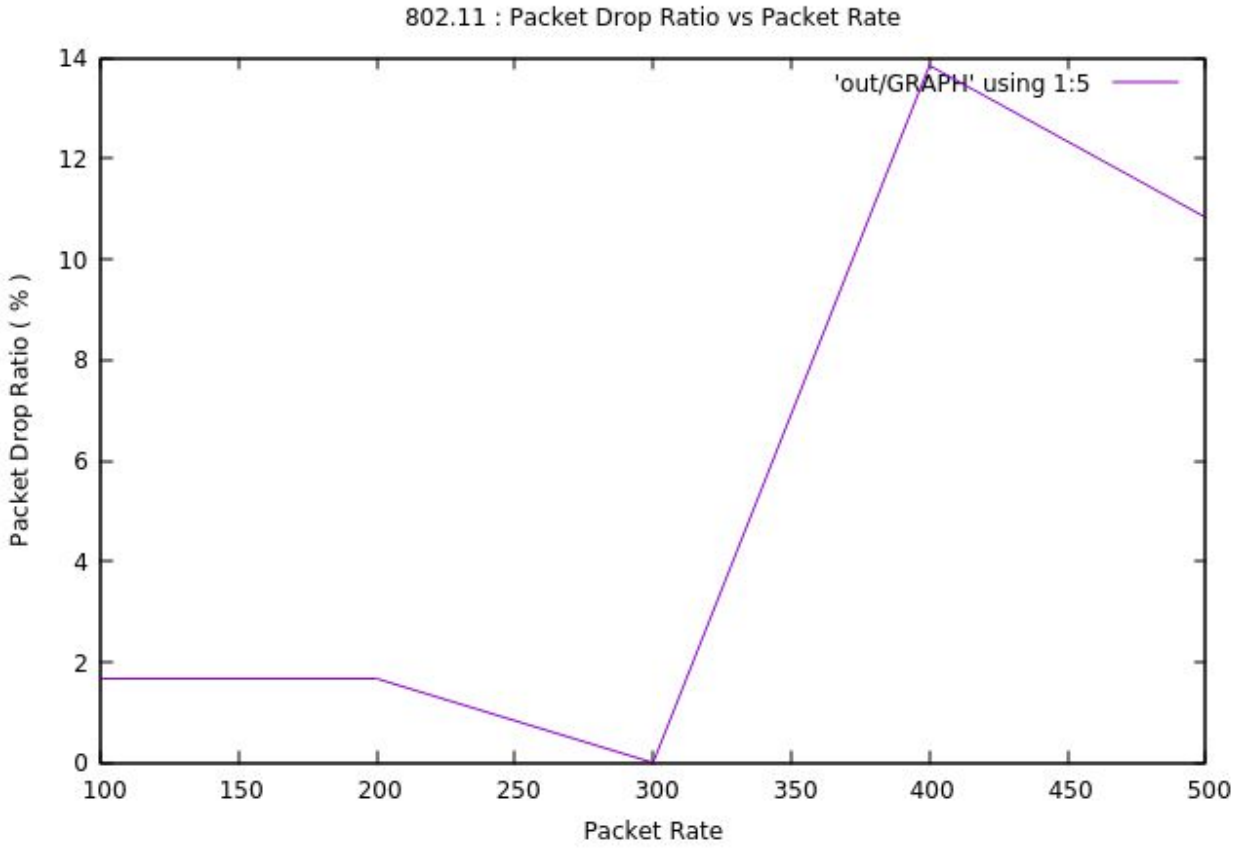

802.11 : Total Energy consumption vs No of flows
'out/GRAPH' using 1:6
Total Energy consumption ( J )
No of flows
22
21.5
21
20.5
20
19.5
19
18.5
18
17.5
17
10
15
20
25
30
35
40
45
50

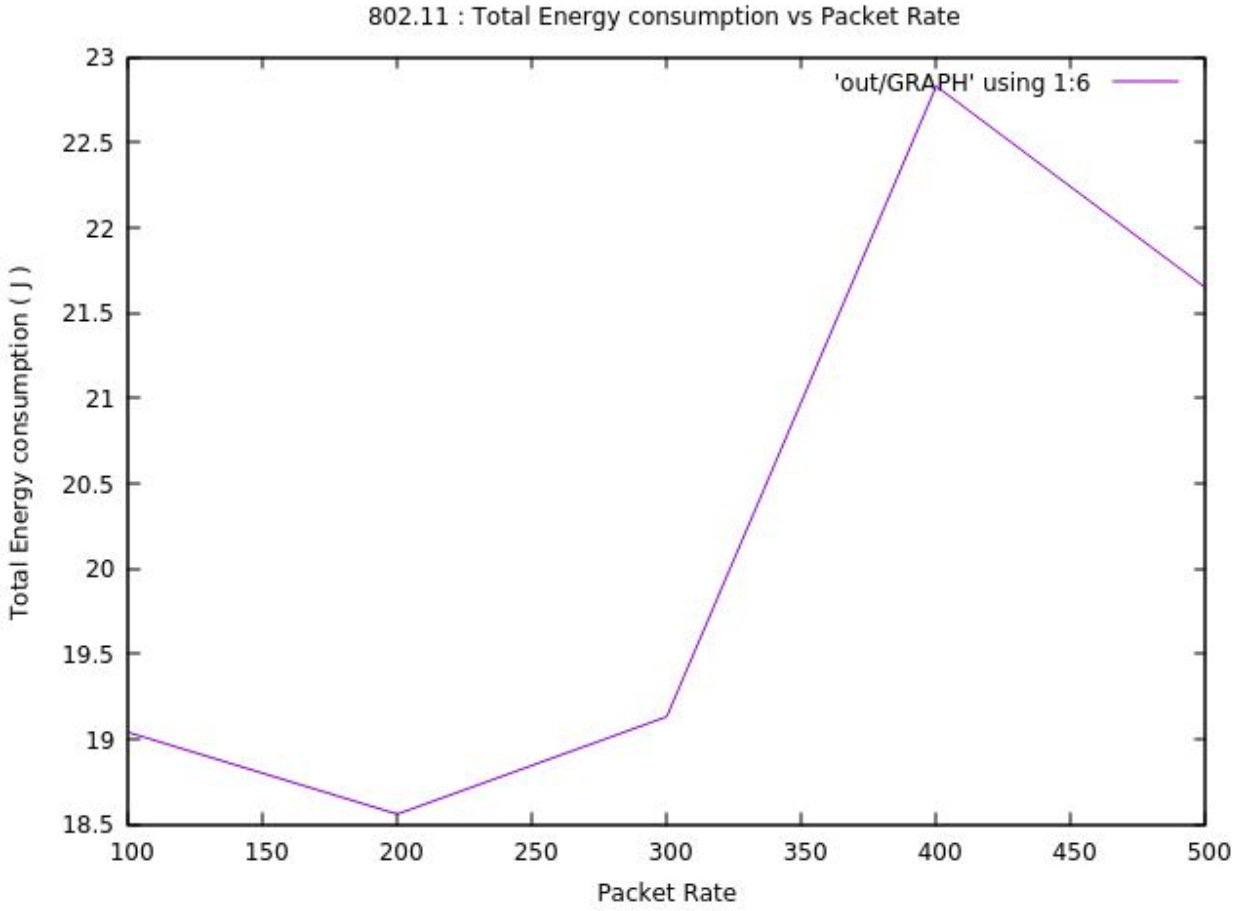

802.11 : Energy per byte vs No of flows
'out/GRAPH' using 1:7
Energy per byte ( J )
No of flows
0.3
0.25
0.2
0.15
0.1
0.05
0
10
15
20
25
30
35
40
45
50

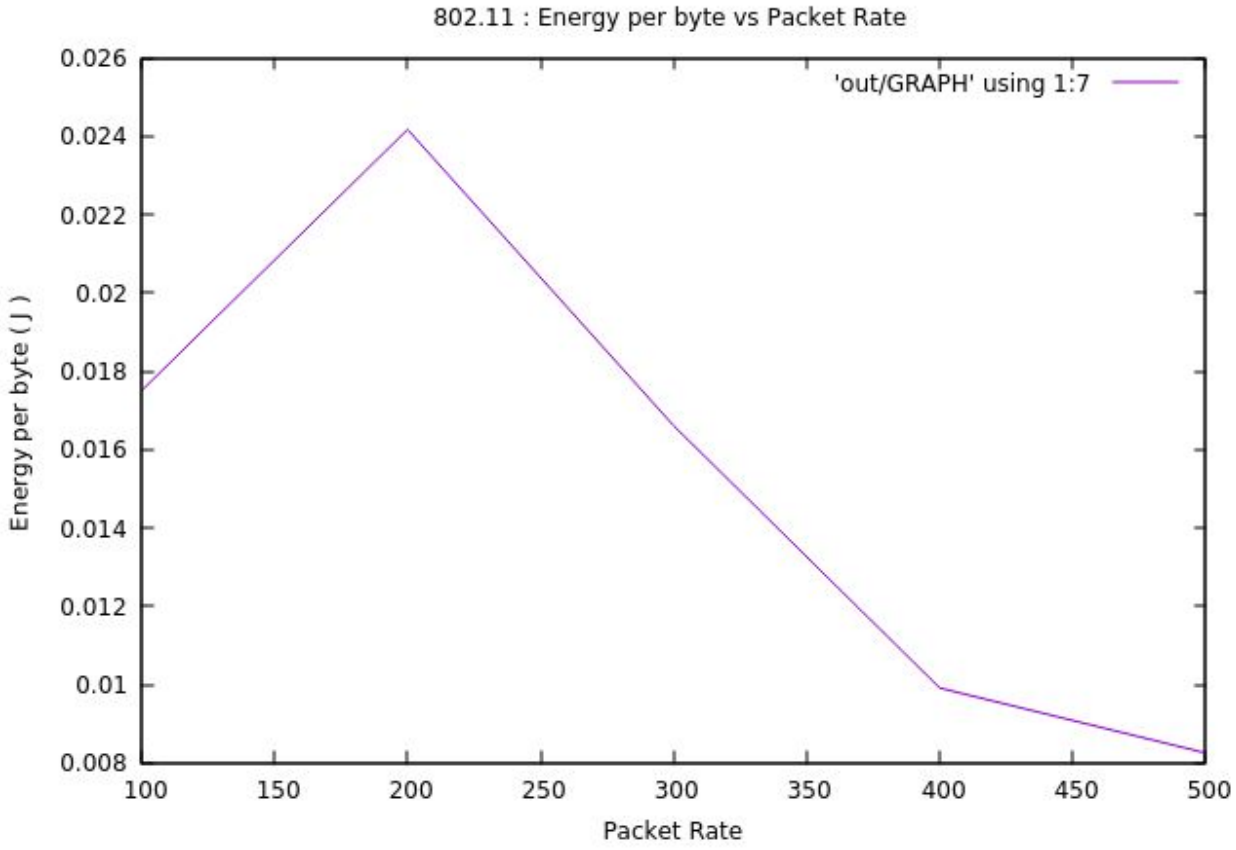

802.11 : Throughput vs Packet Rate
'out/GRAPH' using 1:2
Throughput ( bit/second )
Packet Rate
85000
80000
75000
70000
65000
60000
55000
50000
100
150
200
250
300
350
400
450
500

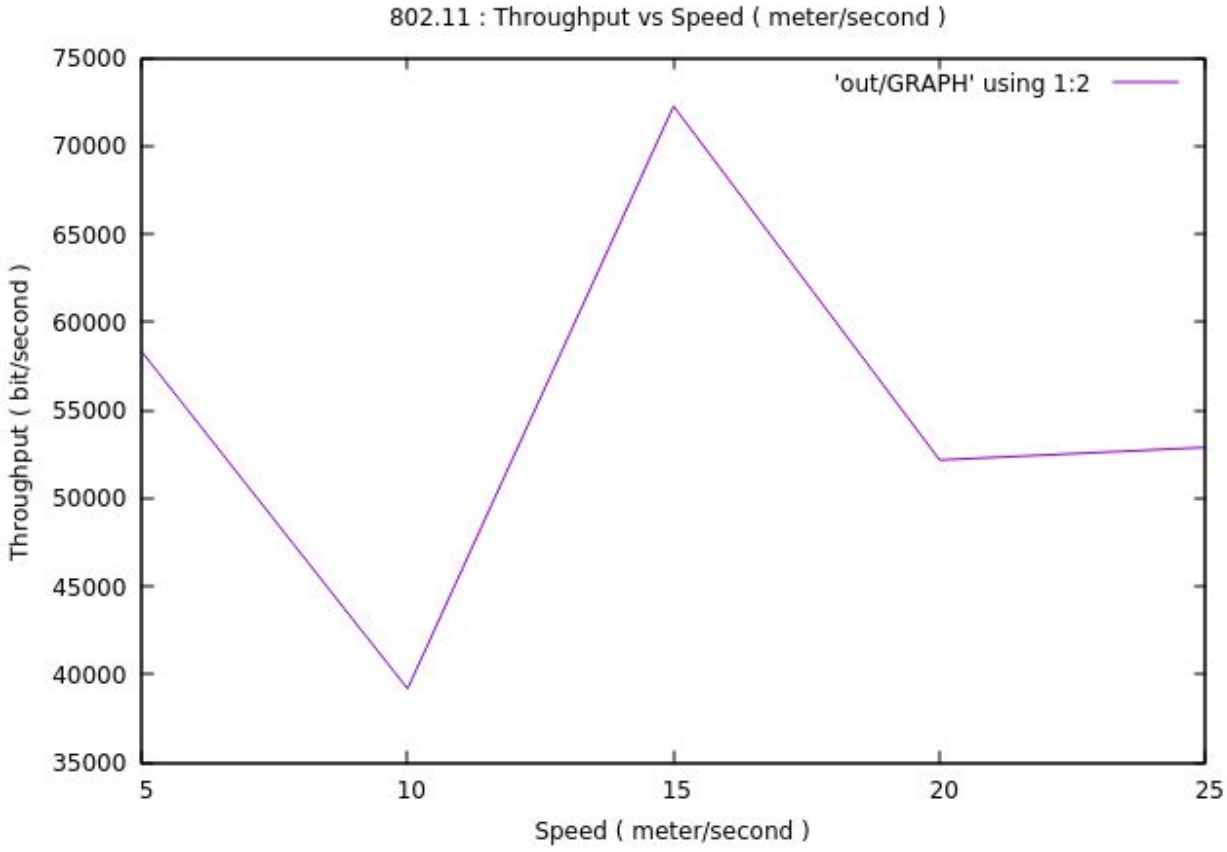

802.11 : Average Delay vs Packet Rate
'out/GRAPH' using 1:3
Average Delay ( second )
Packet Rate
0.0085
0.008
0.0075
0.007
0.0065
0.006
0.0055
100
150
200
250
300
350
400
450
500

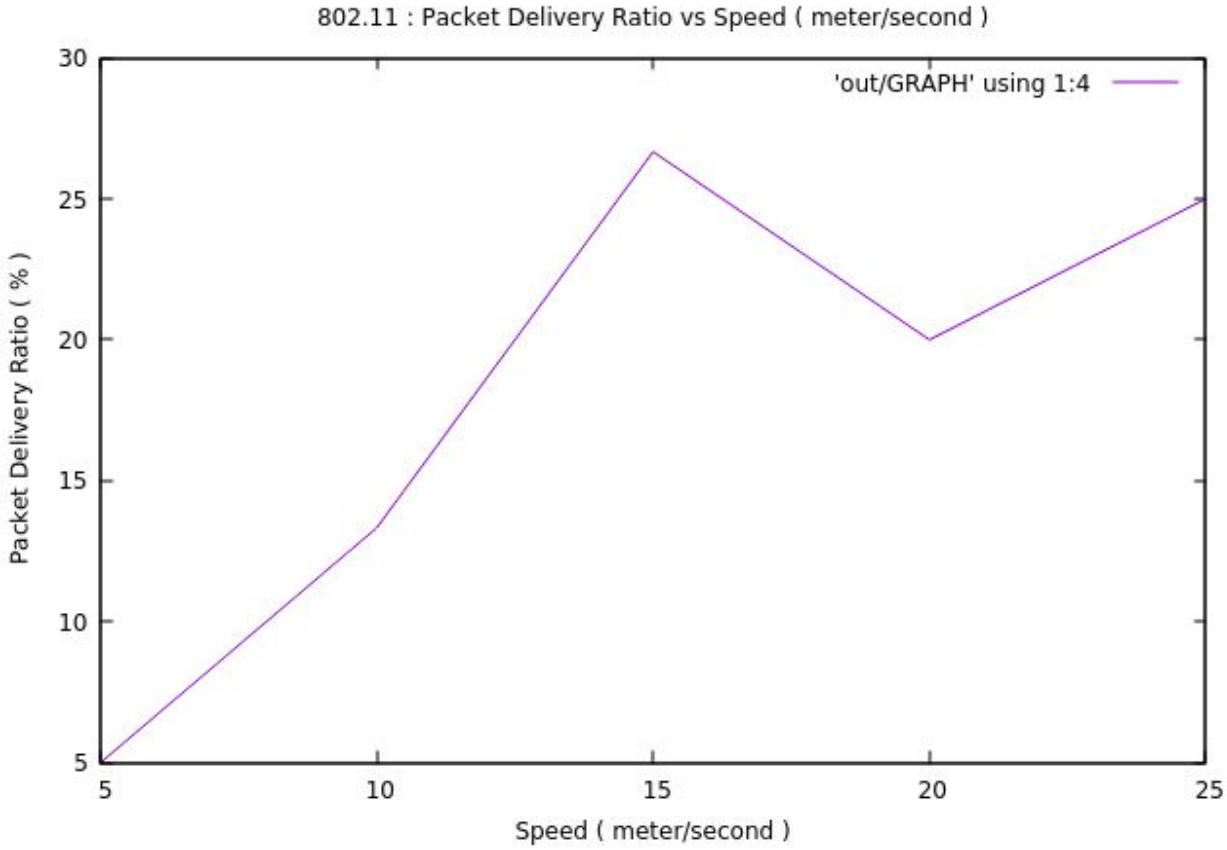

802.11 : Packet Delivery Ratio vs Packet Rate
'out/GRAPH' using 1:4
Packet Delivery Ratio ( % )
Packet Rate
36
34
32
30
28
26
24
22
20
100
150
200
250
300
350
400
450
500

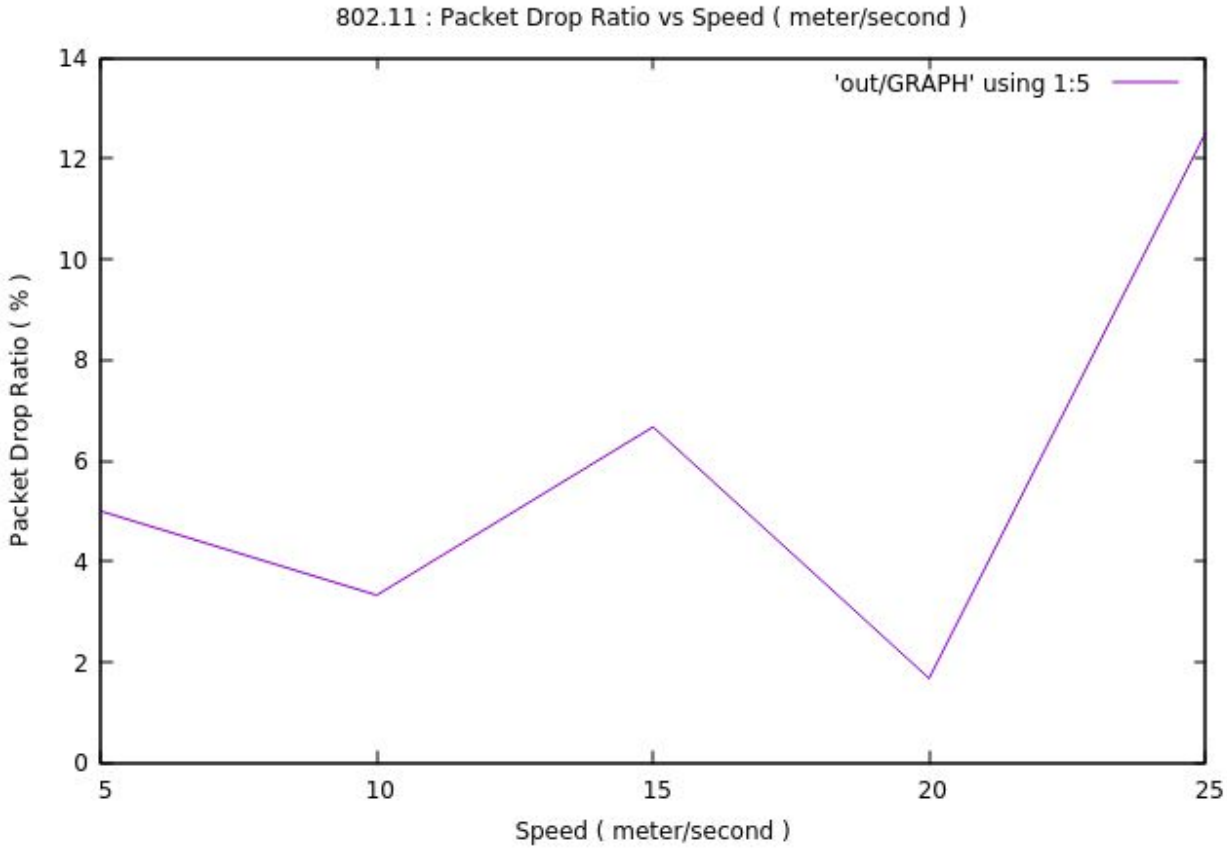

802.11 : Packet Drop Ratio vs Packet Rate
'out/GRAPH' using 1:5
Packet Drop Ratio ( % )
Packet Rate
0
2
4
6
8
10
12
14
100
150
200
250
300
350
400
450
500

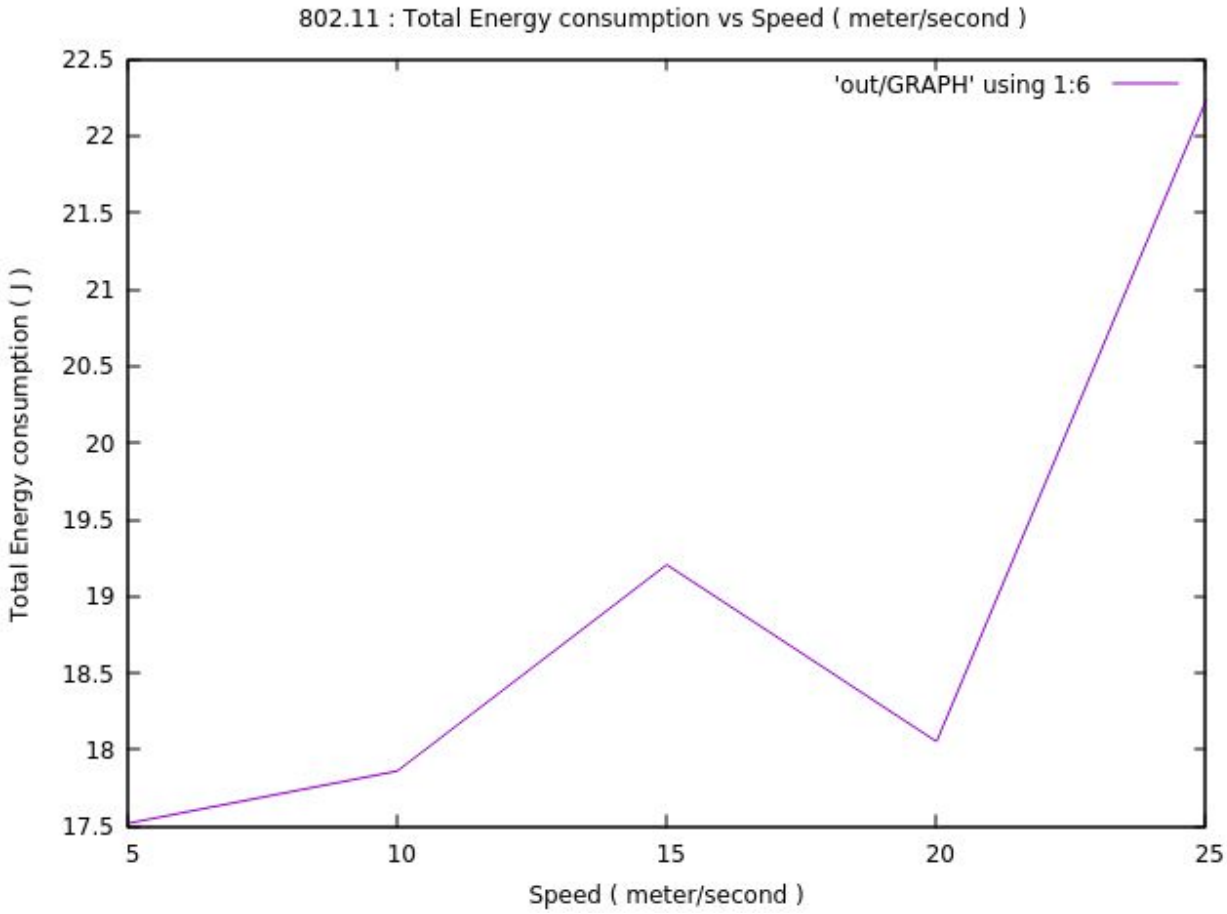

802.11 : Total Energy consumption vs Packet Rate
'out/GRAPH' using 1:6
Total Energy consumption ( J )
Packet Rate
23
22.5
22
21.5
21
20.5
20
19.5
19
18.5
100
150
200
250
300
350
400
450
500

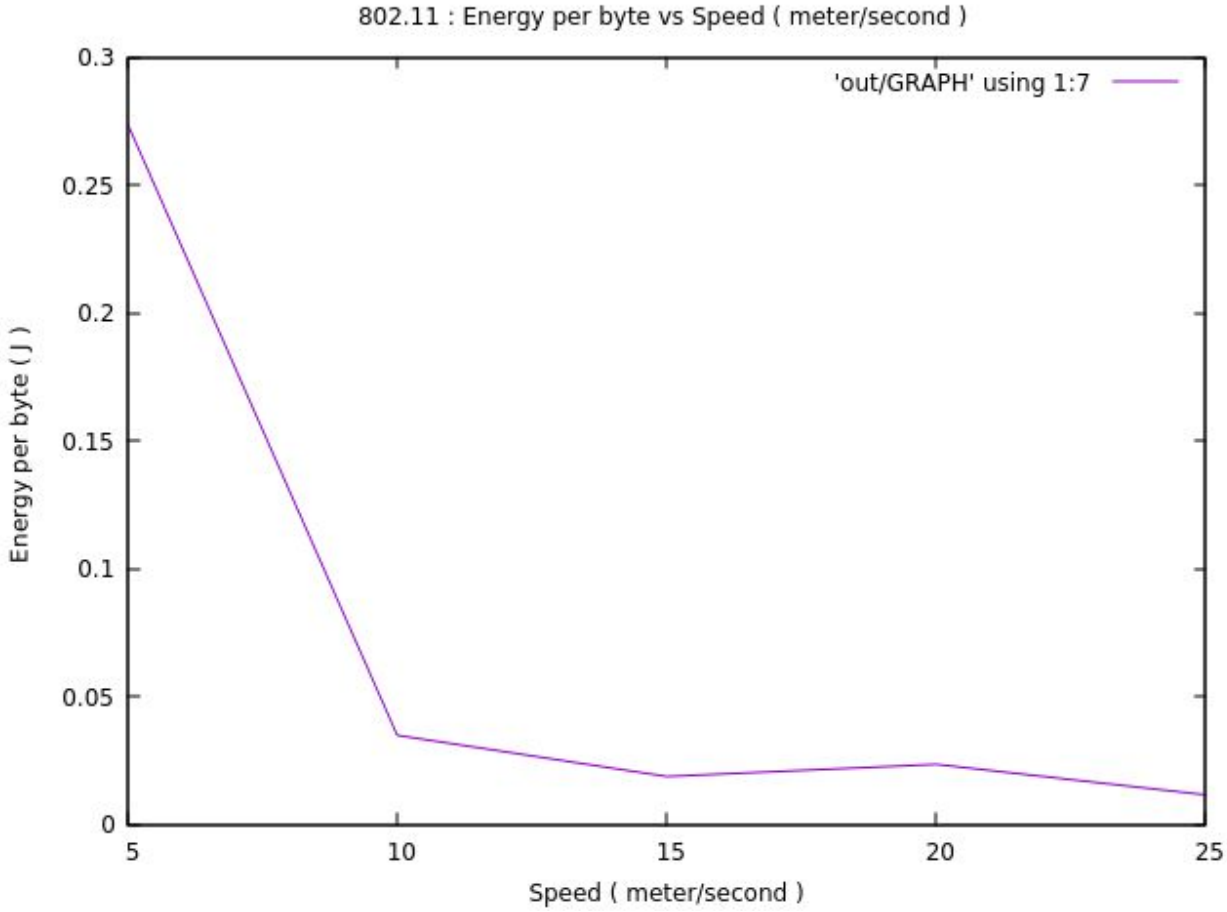

802.11 : Energy per byte vs Packet Rate
'out/GRAPH' using 1:7
Energy per byte ( J )
Packet Rate
0.026
0.024
0.022
0.02
0.018
0.016
0.014
0.012
0.01
0.008
100
150
200
250
300
350
400
450
500


802.11 : Throughput vs Speed ( meter/second )
'out/GRAPH' using 1:2
Throughput ( bit/second )
Speed ( meter/second )
75000
70000
65000
60000
55000
50000
45000
40000
35000
5
10
15
20
25

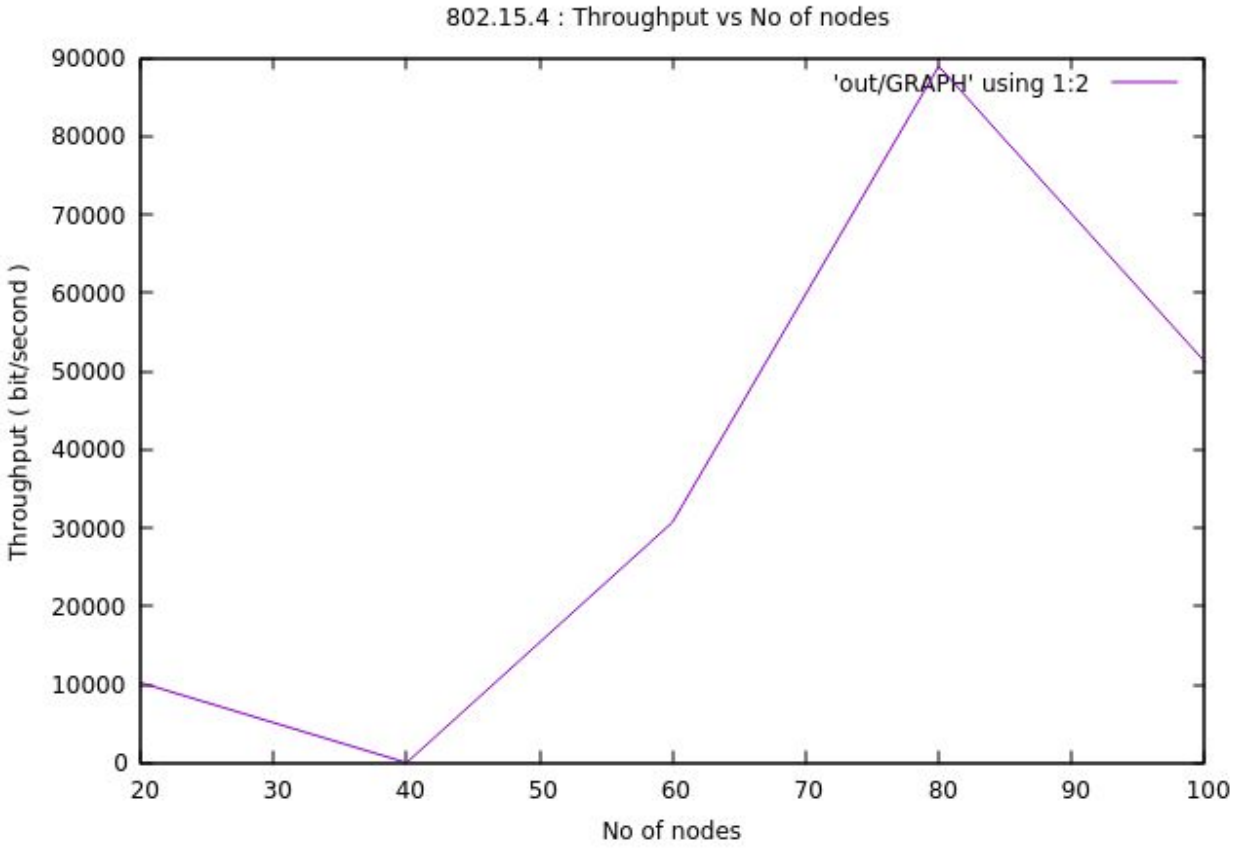

802.11 : Packet Delivery Ratio vs Speed ( meter/second )
'out/GRAPH' using 1:4
Packet Delivery Ratio ( % )
Speed ( meter/second )
30
25
20
15
10
5
5
10
15
20
25

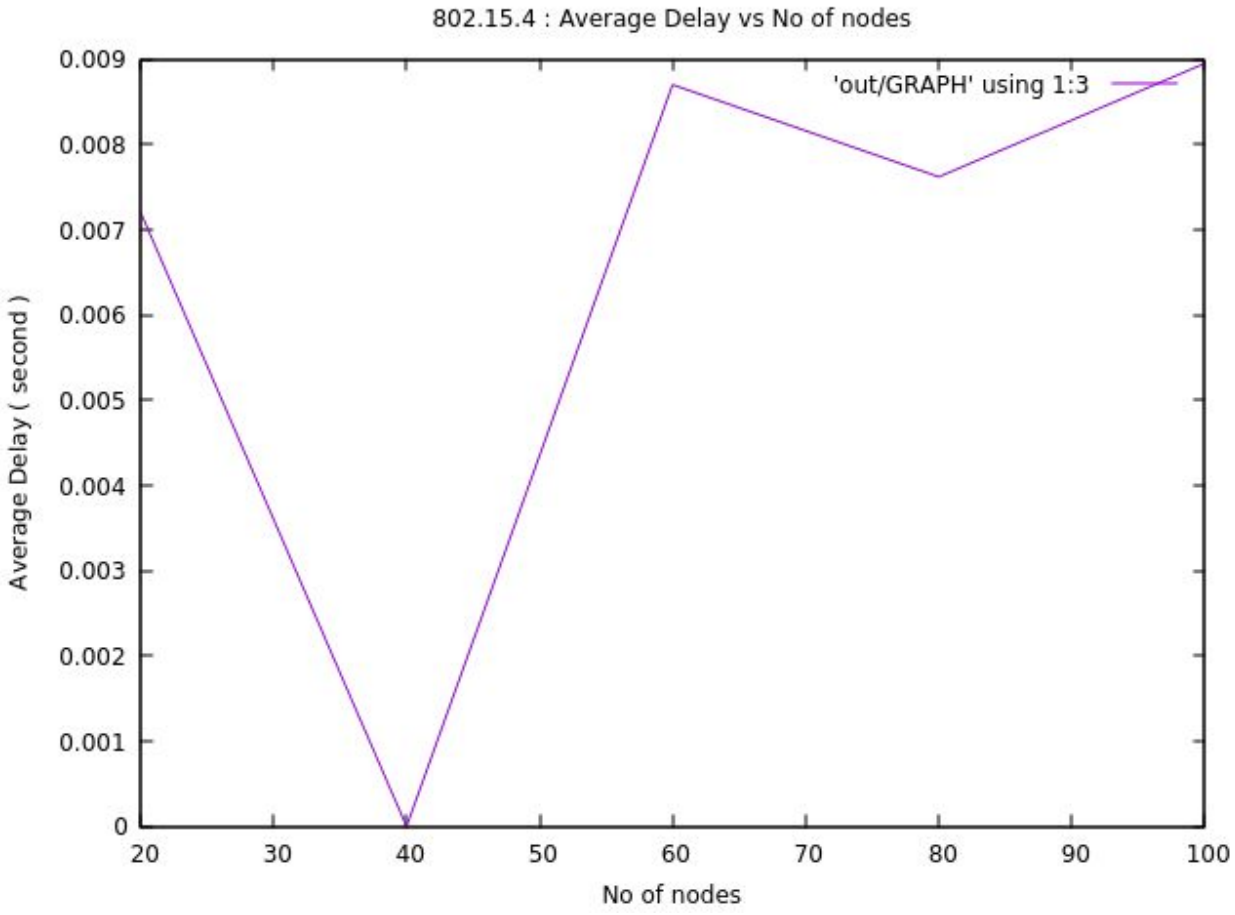

802.11 : Packet Drop Ratio vs Speed ( meter/second )
'out/GRAPH' using 1:5
Packet Drop Ratio ( % )
Speed ( meter/second )
0
2
4
6
8
10
12
14
5
10
15
20
25

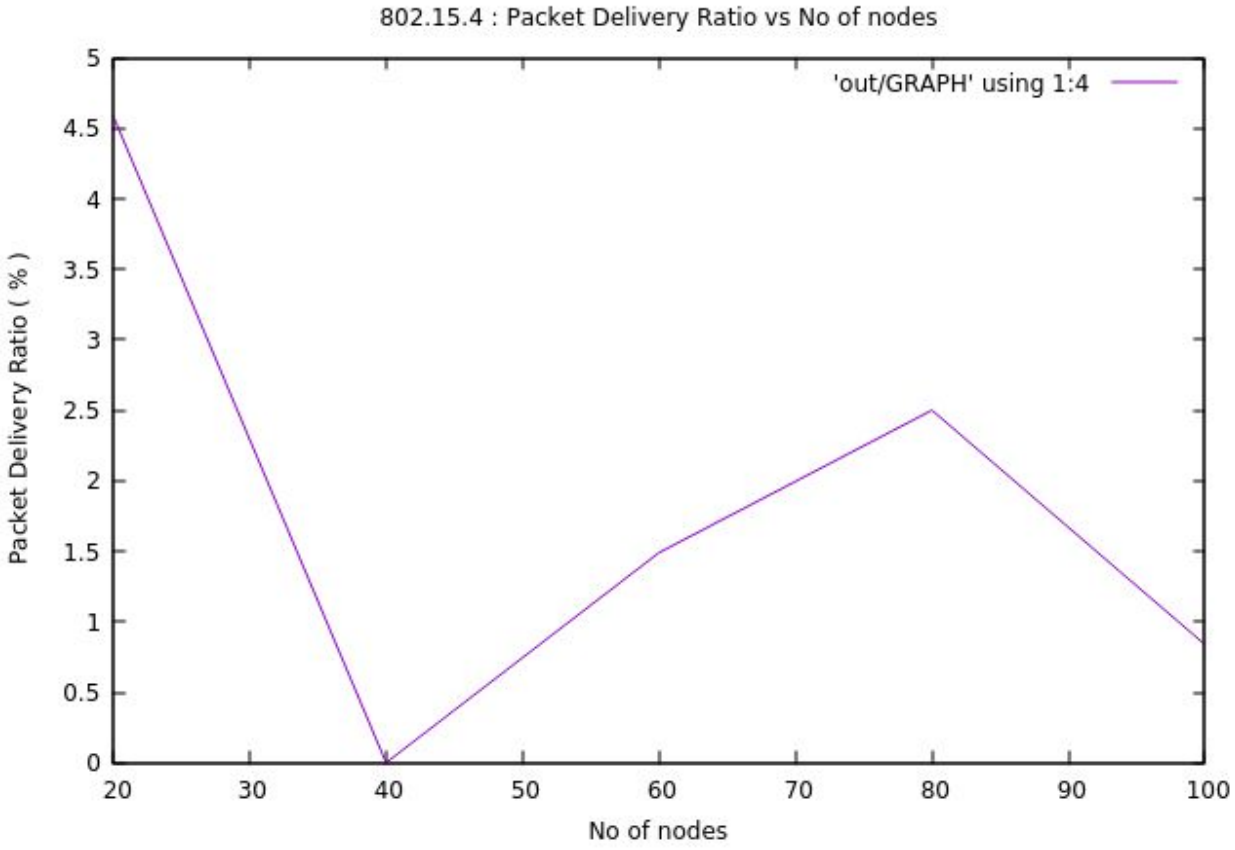

802.11 : Total Energy consumption vs Speed ( meter/second )
'out/GRAPH' using 1:6
Total Energy consumption ( J )
Speed ( meter/second )
22.5
22
21.5
21
20.5
20
19.5
19
18.5
18
17.5
5
10
15
20
25

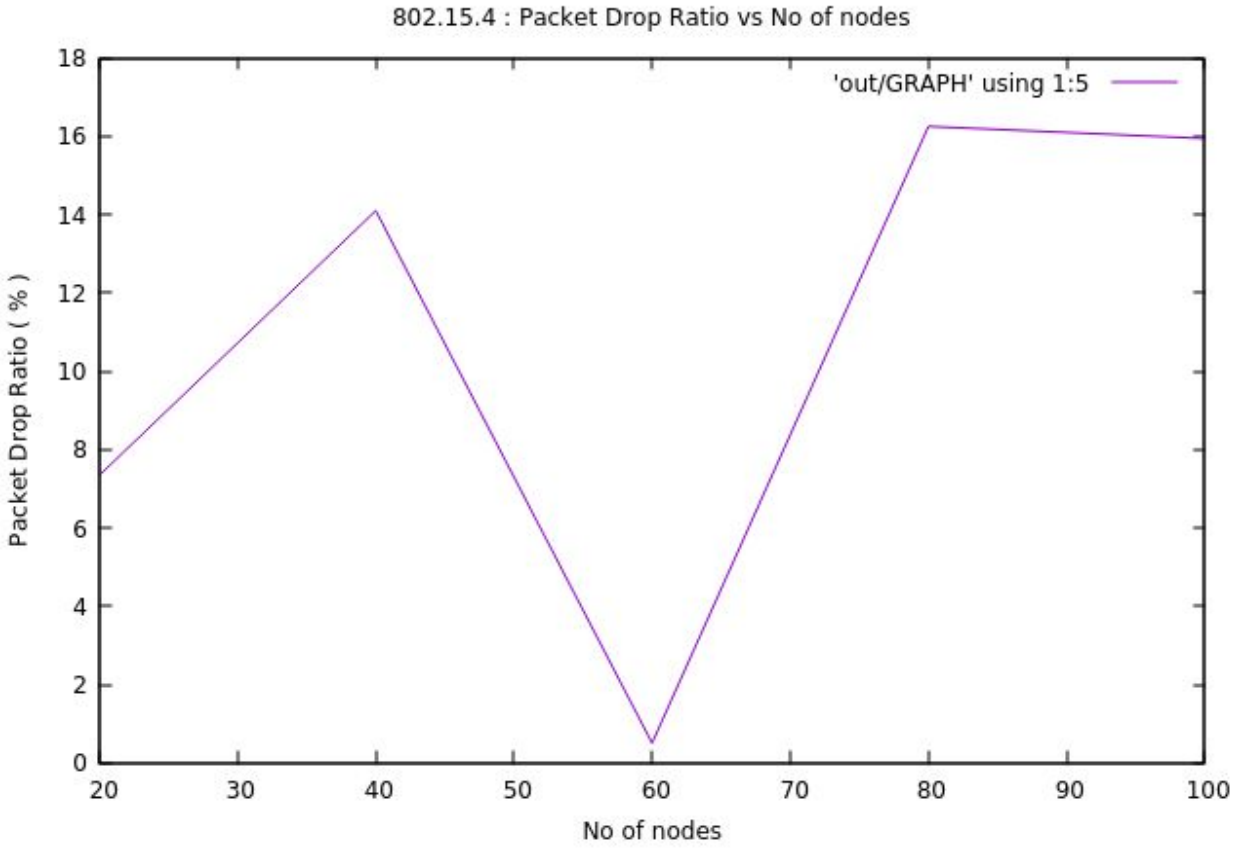

802.11 : Energy per byte vs Speed ( meter/second )
'out/GRAPH' using 1:7
Energy per byte ( J )
Speed ( meter/second )
0.3
0.25
0.2
0.15
0.1
0.05
0
5
10
15
20
25

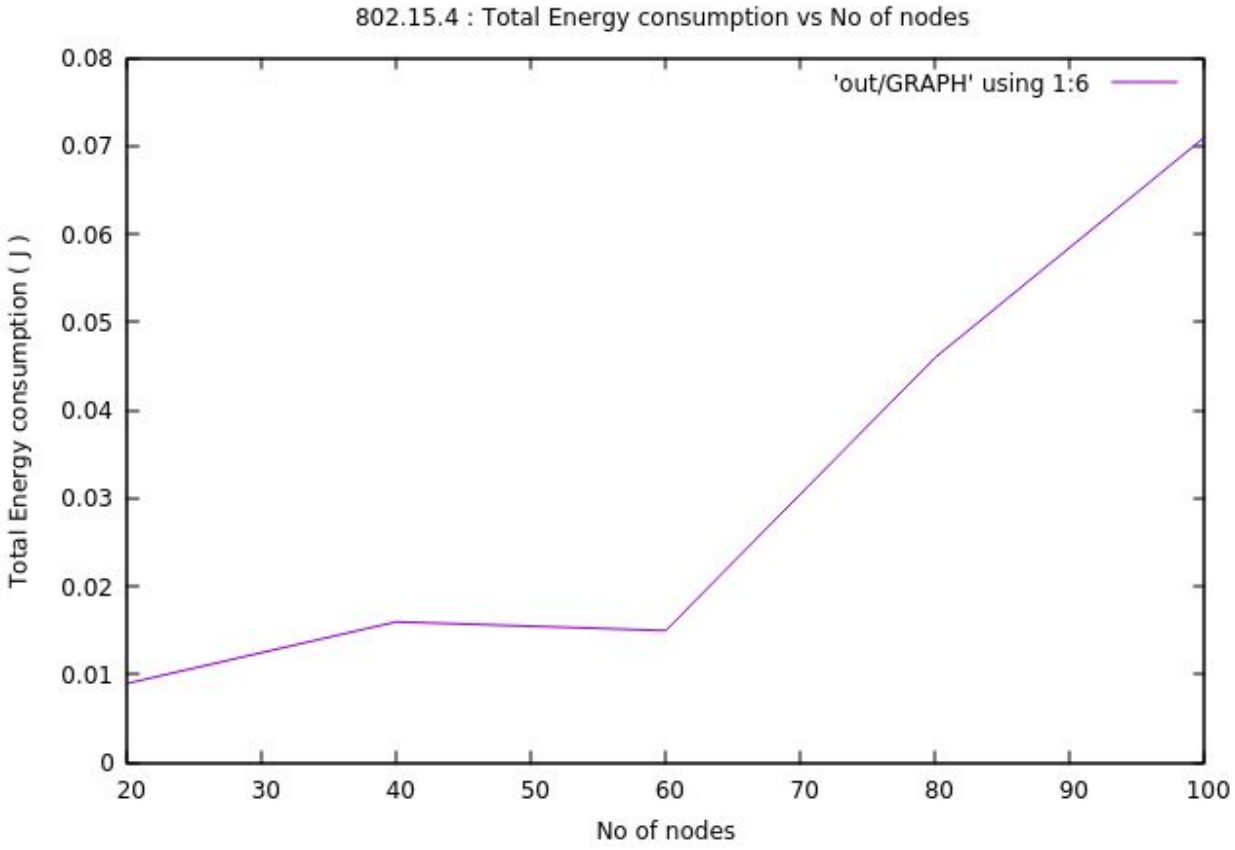
# 802.15.4 Modified

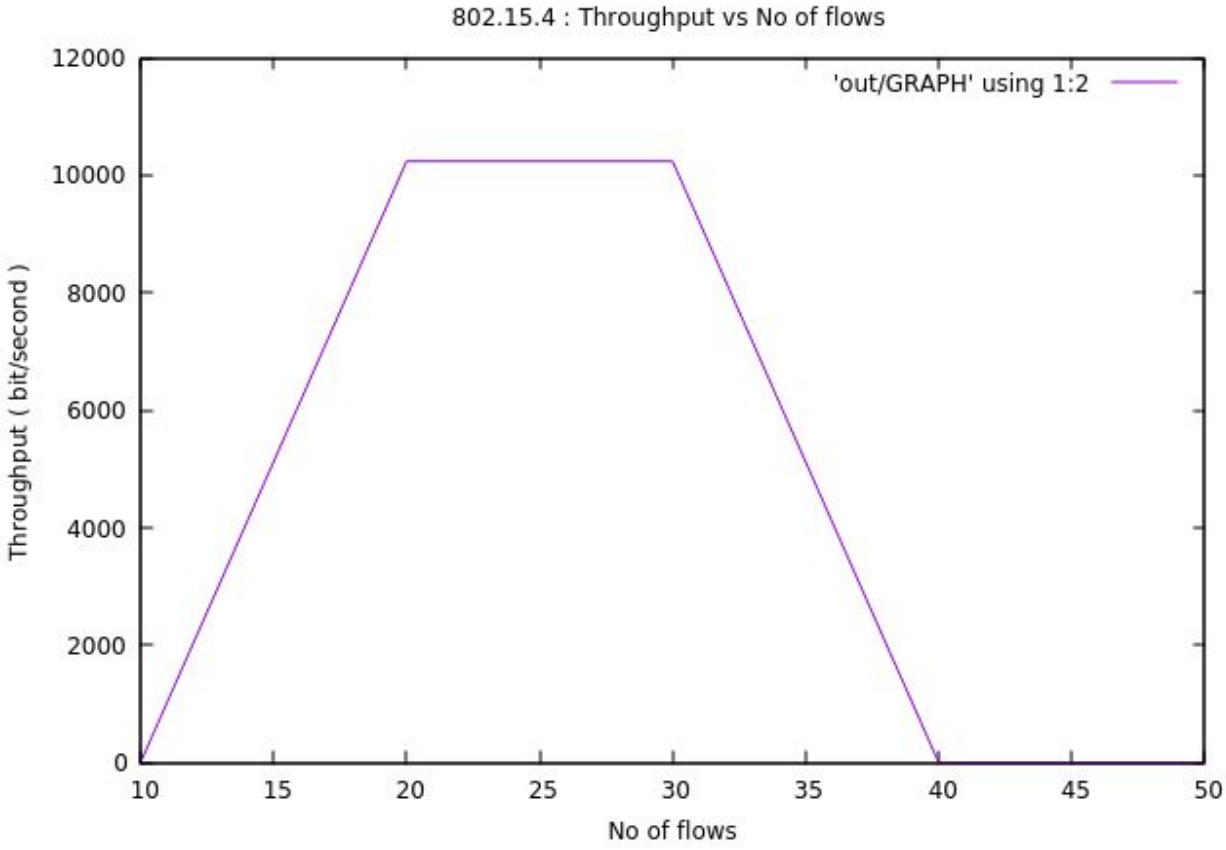

802.15.4 : Throughput vs No of nodes
'out/GRAPH' using 1:2
Throughput ( bit/second )
No of nodes
0
10000
20000
30000
40000
50000
60000
70000
80000
90000
20
30
40
50
60
70
80
90
100

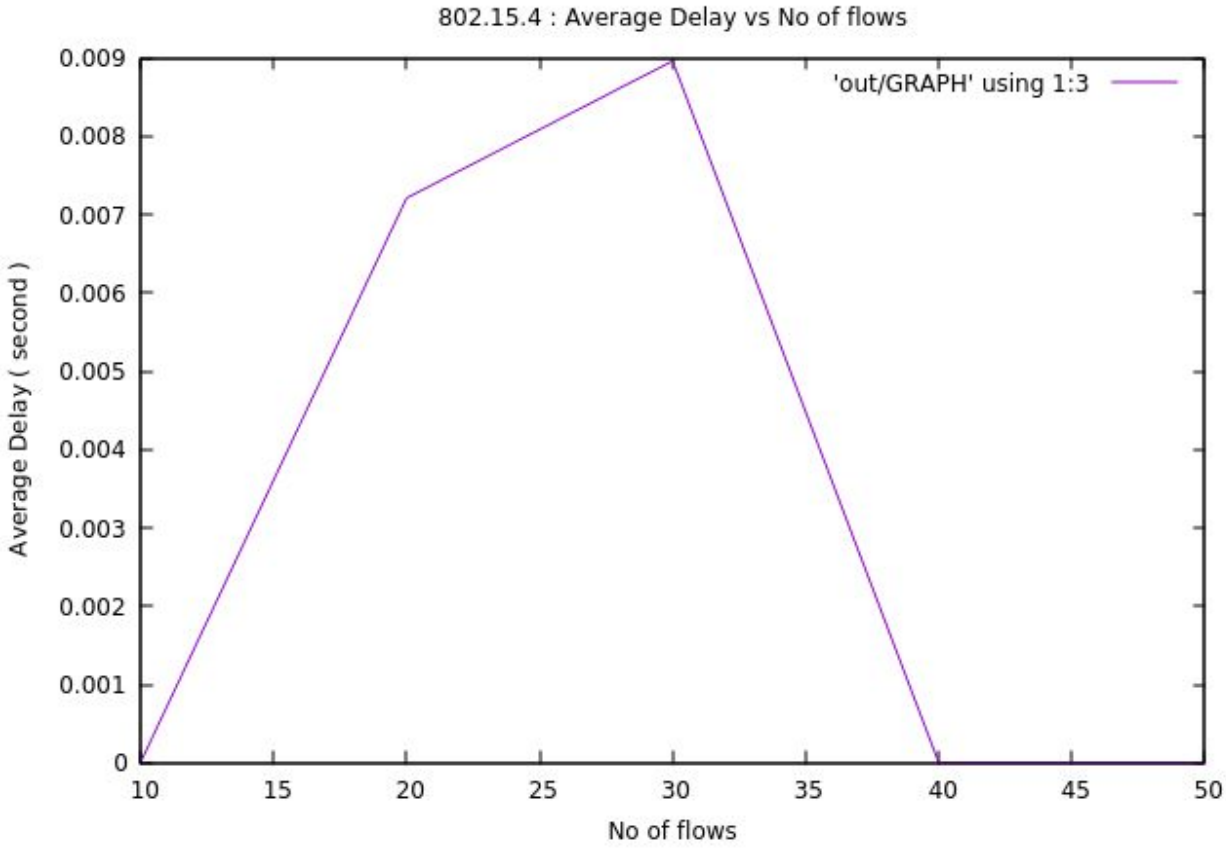

802.15.4 : Average Delay vs No of nodes
'out/GRAPH' using 1:3
Average Delay ( second )
No of nodes
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
20
30
40
50
60
70
80
90
100


802.15.4 : Packet Delivery Ratio vs No of nodes
'out/GRAPH' using 1:4
Packet Delivery Ratio ( % )
No of nodes
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
20
30
40
50
60
70
80
90
100

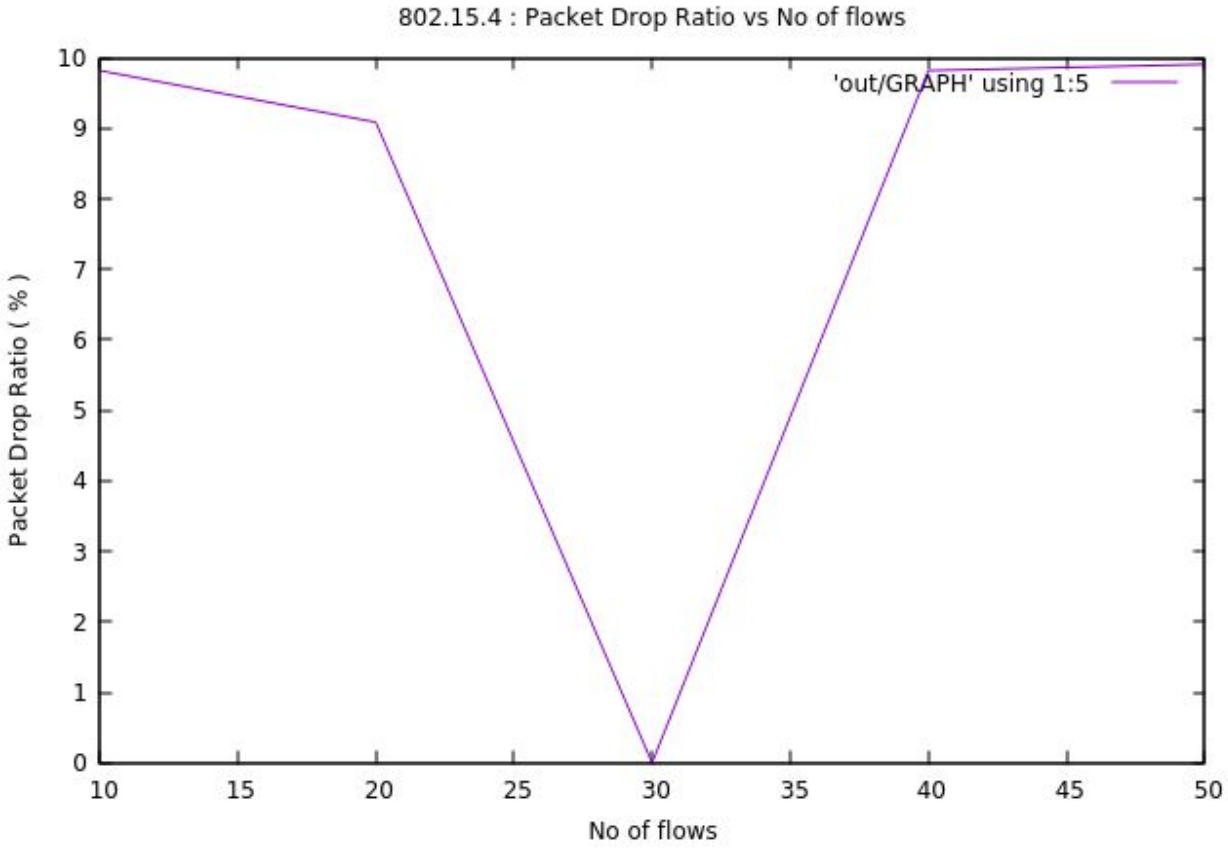

802.15.4 : Packet Drop Ratio vs No of nodes
'out/GRAPH' using 1:5
Packet Drop Ratio ( % )
No of nodes
0
2
4
6
8
10
12
14
16
18
20
30
40
50
60
70
80
90
100

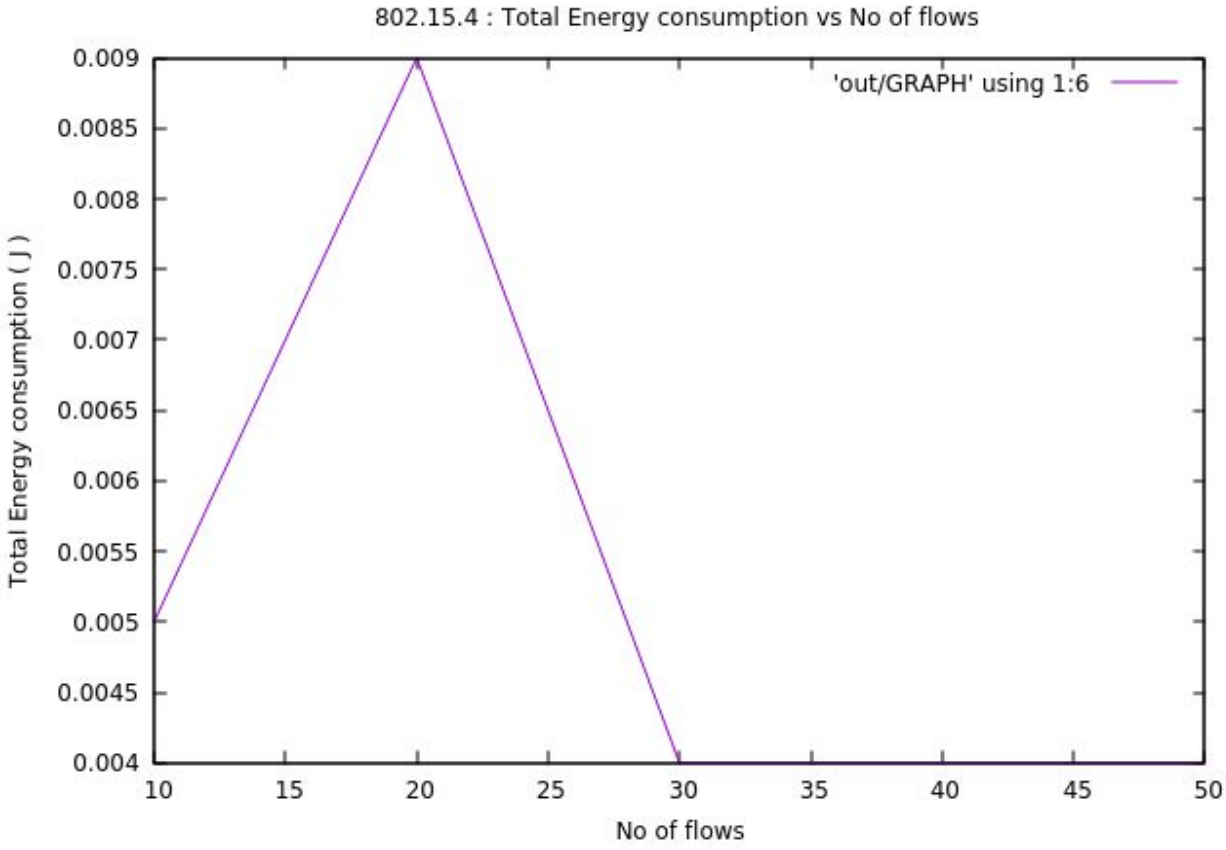

802.15.4 : Total Energy consumption vs No of nodes
'out/GRAPH' using 1:6
Total Energy consumption ( J )
No of nodes
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
20
30
40
50
60
70
80
90
100

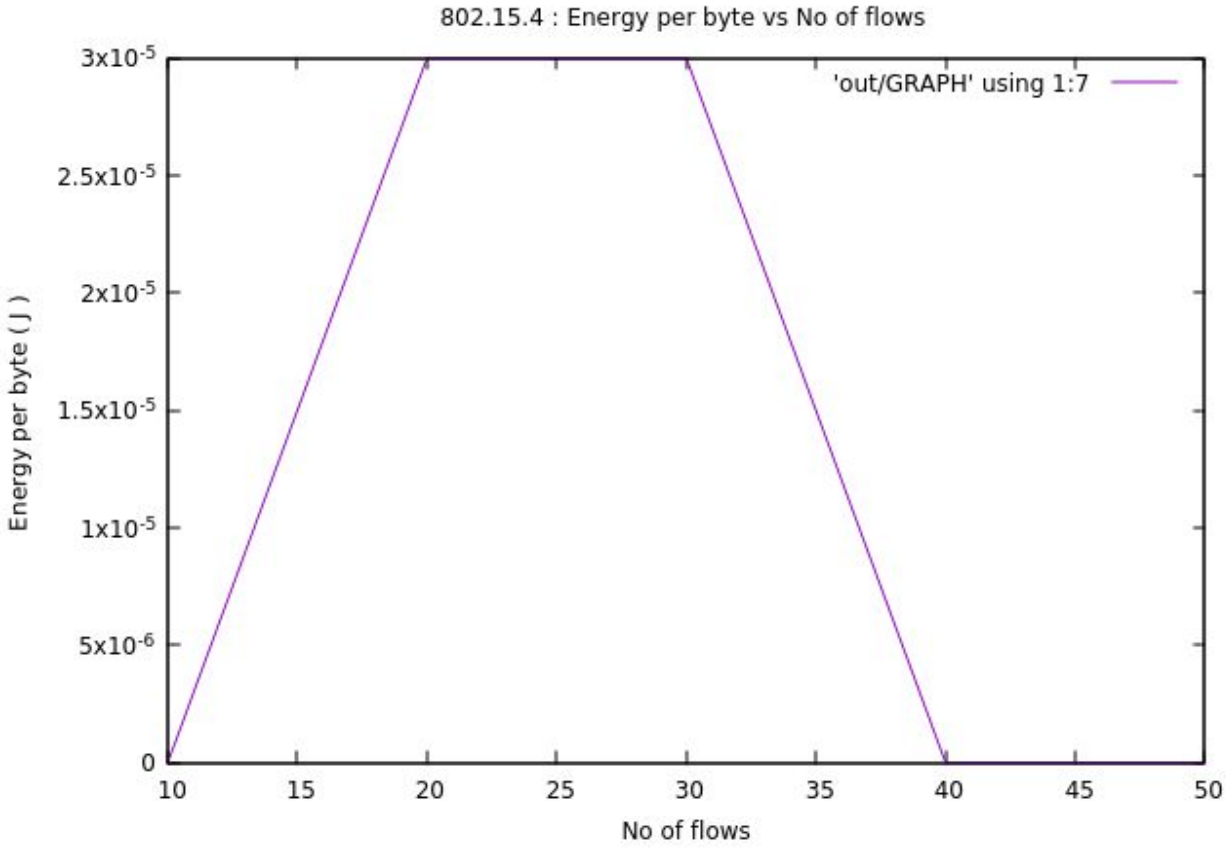

802.15.4 : Throughput vs No of flows
'out/GRAPH' using 1:2
Throughput ( bit/second )
No of flows
12000
10000
8000
6000
4000
2000
0
10
15
20
25
30
35
40
45
50

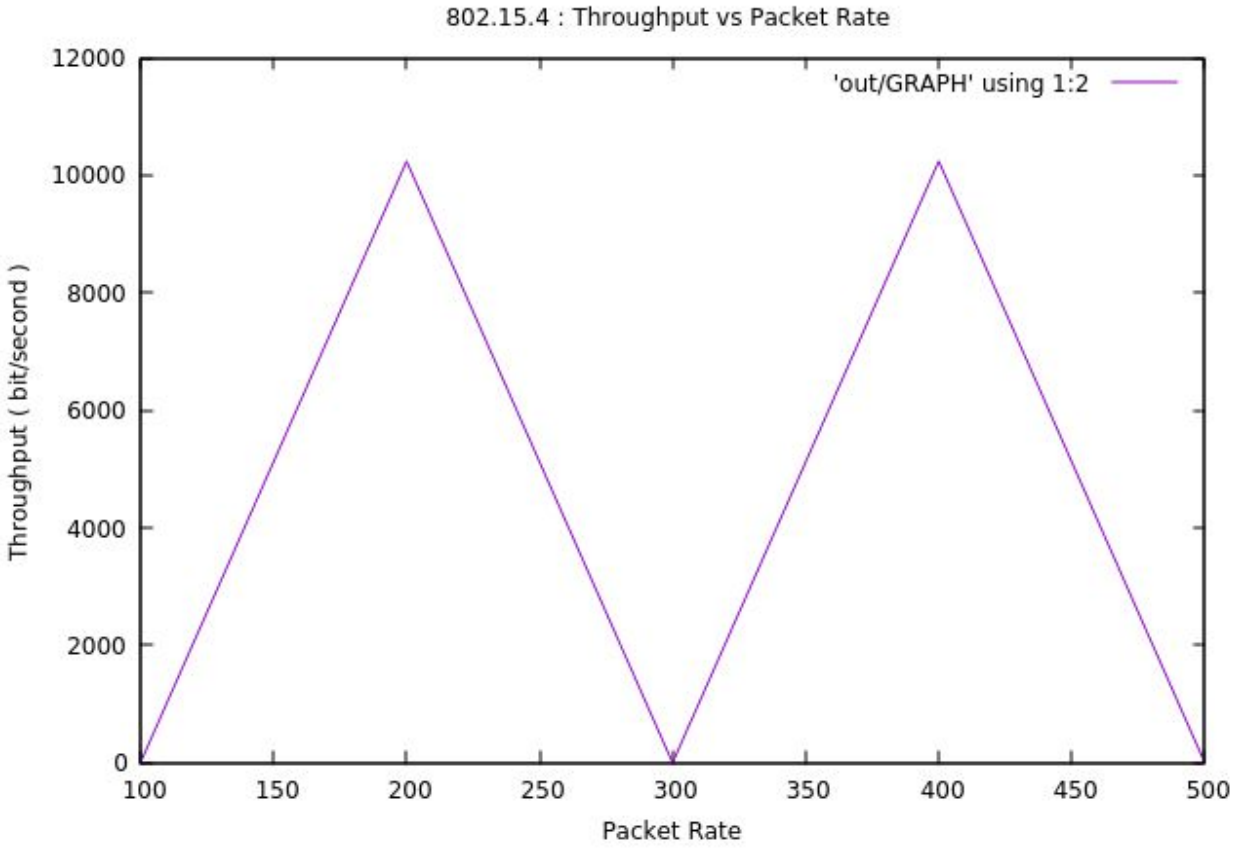

802.15.4 : Average Delay vs No of flows
'out/GRAPH' using 1:3
Average Delay ( second )
No of flows
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
10
15
20
25
30
35
40
45
50

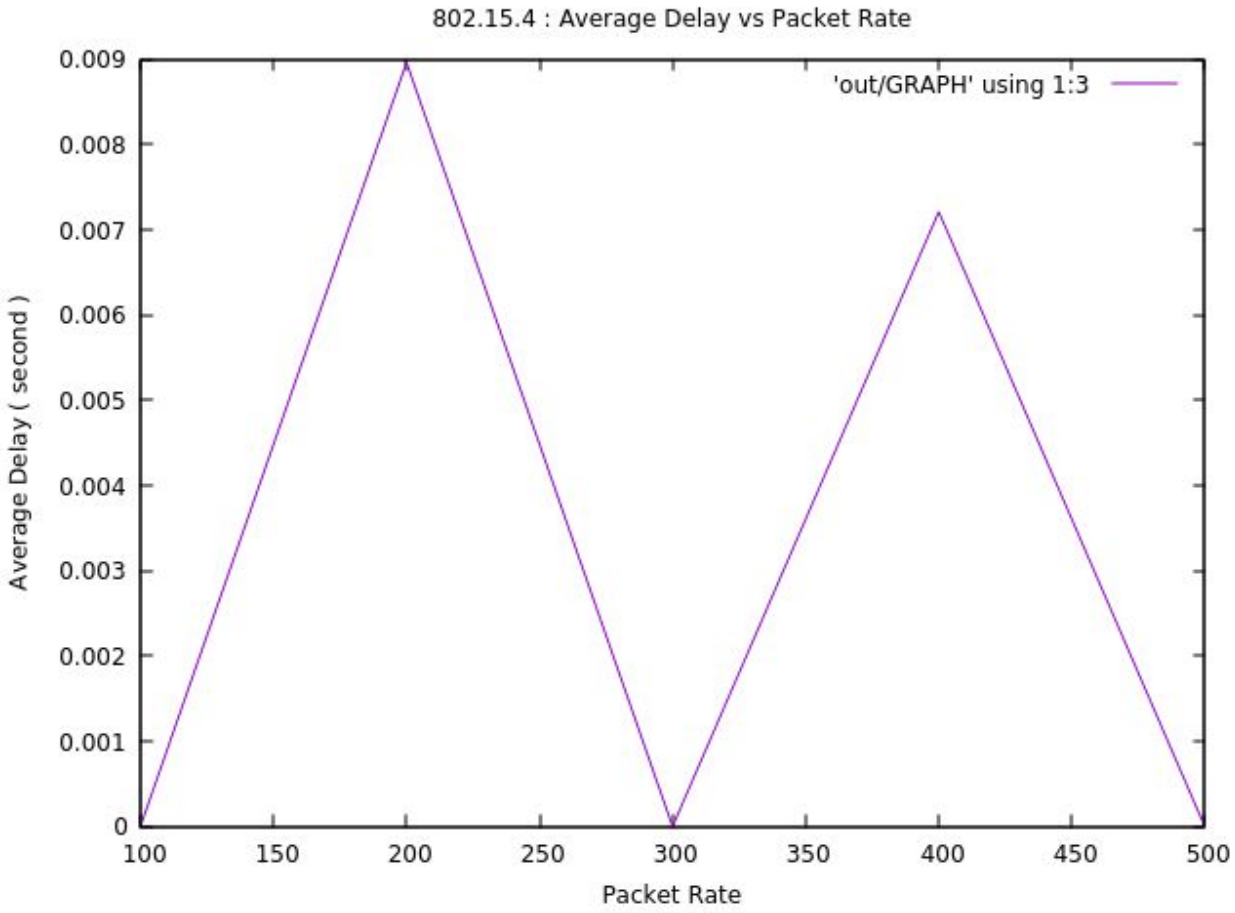

802.15.4 : Packet Delivery Ratio vs No of flows
'out/GRAPH' using 1:4
Packet Delivery Ratio ( % )
No of flows
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
10
15
20
25
30
35
40
45
50

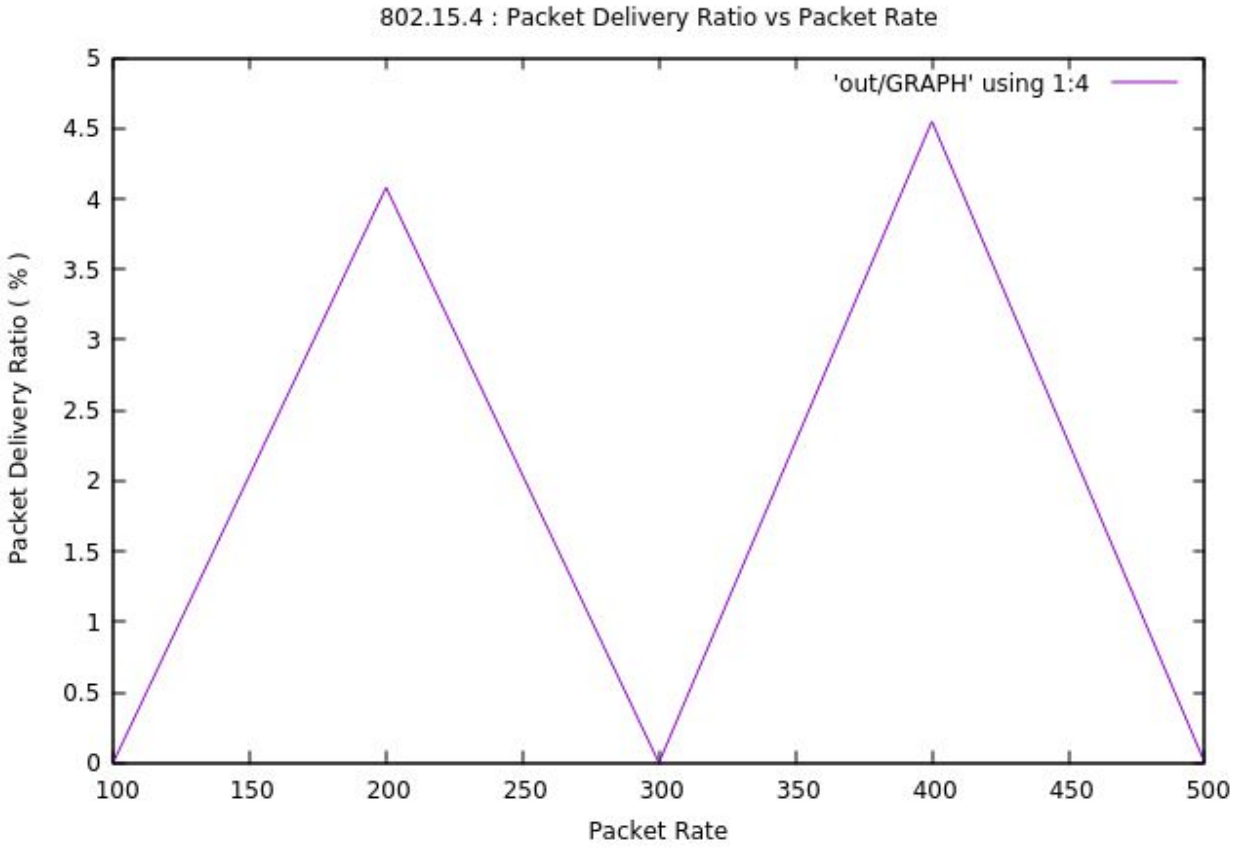

802.15.4 : Packet Drop Ratio vs No of flows
'out/GRAPH' using 1:5
Packet Drop Ratio ( % )
No of flows
0
1
2
3
4
5
6
7
8
9
10
10
15
20
25
30
35
40
45
50

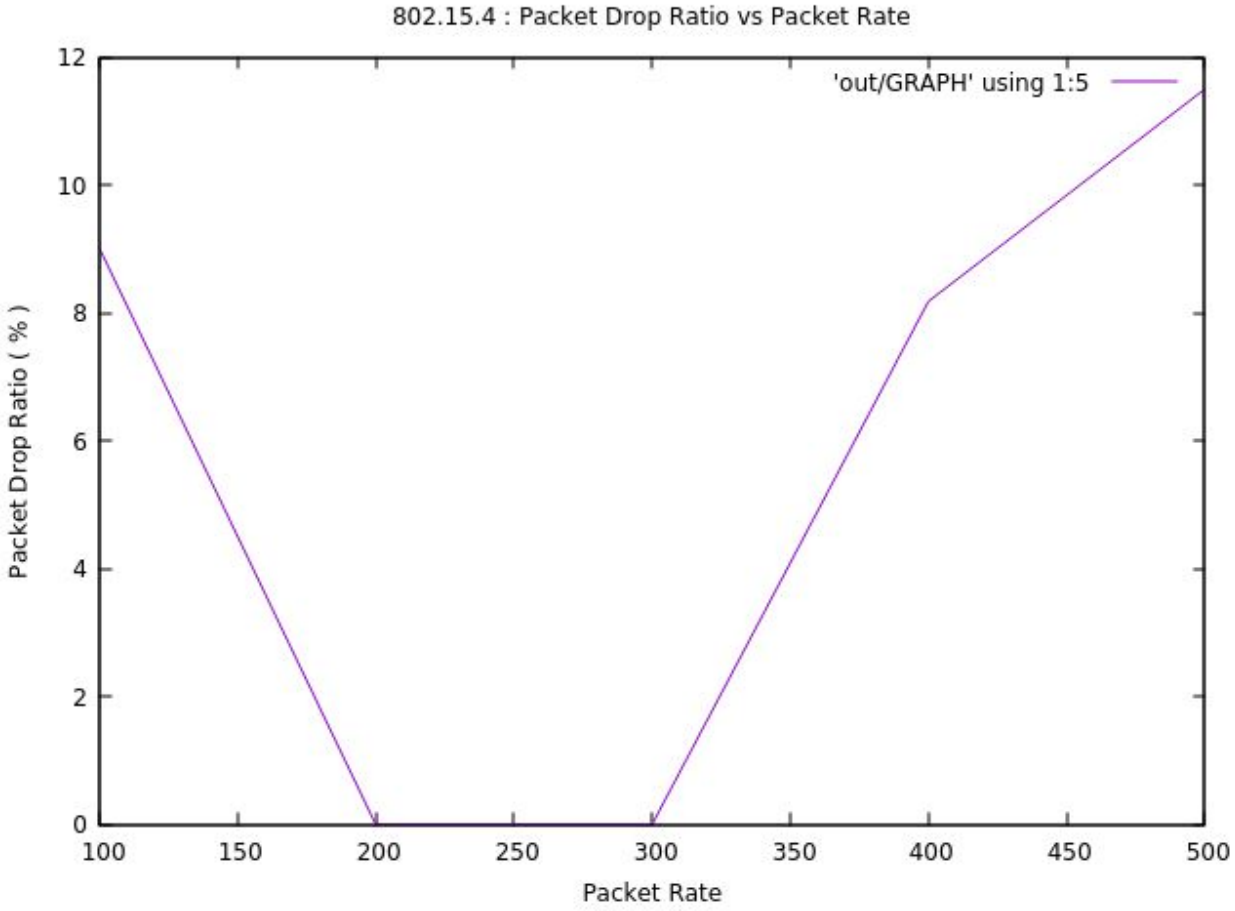

802.15.4 : Total Energy consumption vs No of flows
'out/GRAPH' using 1:6
Total Energy consumption ( J )
No of flows
0.009
0.0085
0.008
0.0075
0.007
0.0065
0.006
0.0055
0.005
0.0045
0.004
10
15
20
25
30
35
40
45
50

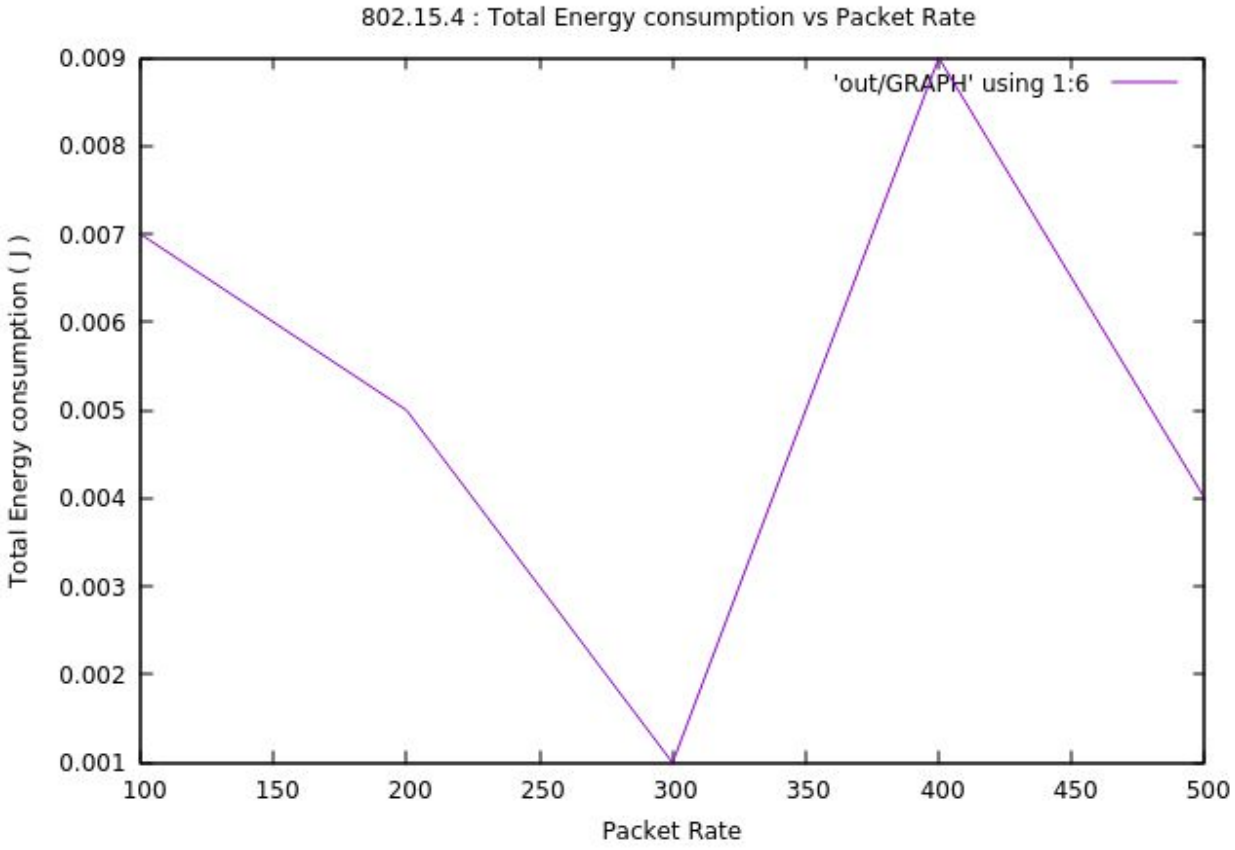

802.15.4 : Energy per byte vs No of flows
'out/GRAPH' using 1:7
Energy per byte ( J )
No of flows
3x10-5
2.5x10-5
2x10-5
1.5x10-5
1x10-5
5x10-6
0
10
15
20
25
30
35
40
45
50

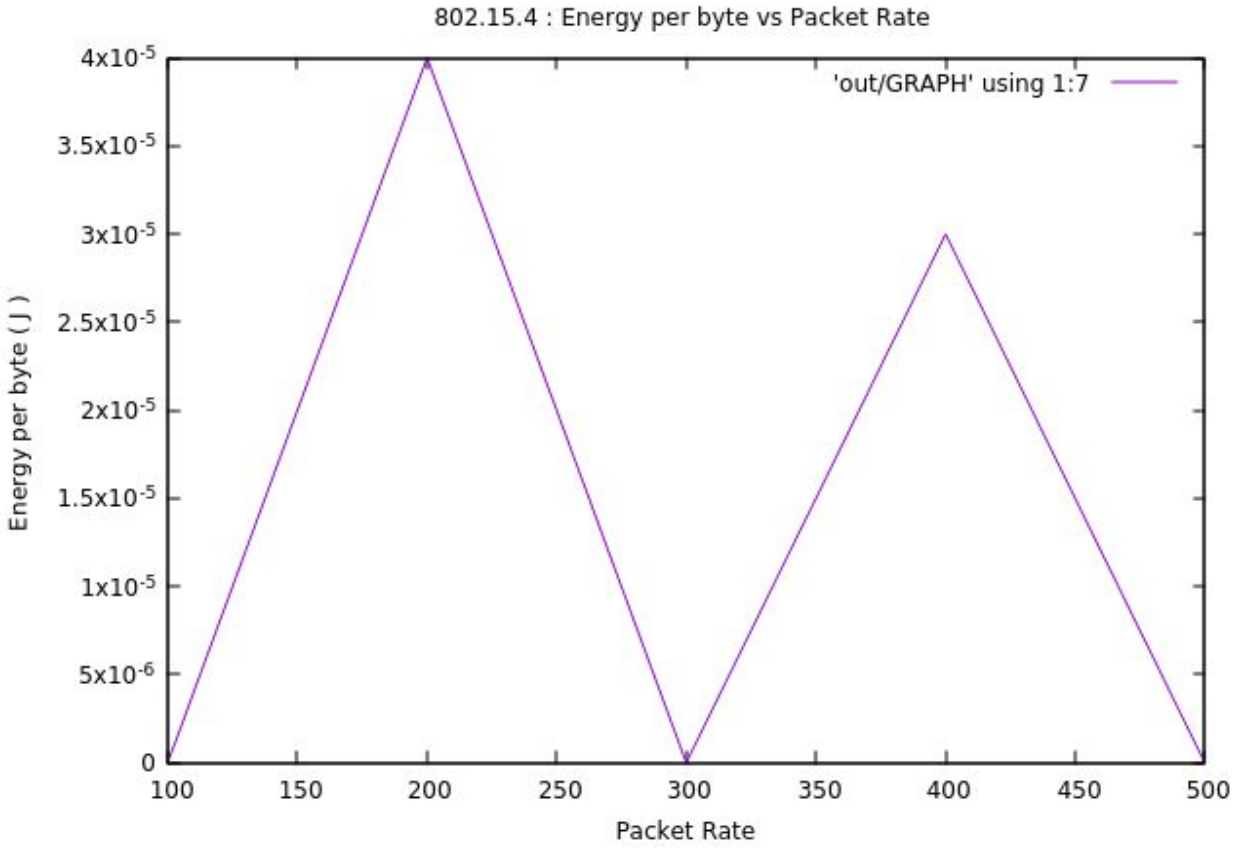

802.15.4 : Throughput vs Packet Rate
'out/GRAPH' using 1:2
Throughput ( bit/second )
Packet Rate
12000
10000
8000
6000
4000
2000
0
100
150
200
250
300
350
400
450
500

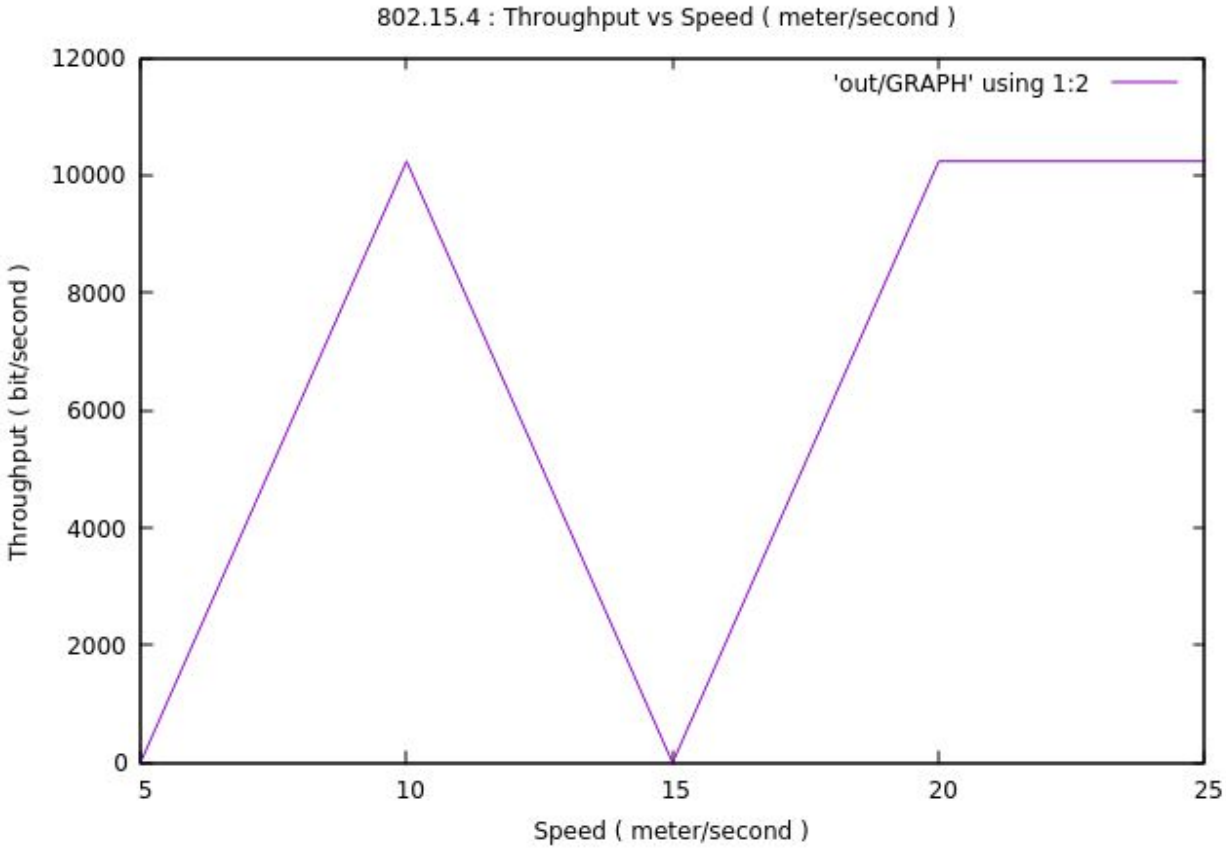

802.15.4 : Average Delay vs Packet Rate
'out/GRAPH' using 1:3
Average Delay ( second )
Packet Rate
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
100
150
200
250
300
350
400
450
500

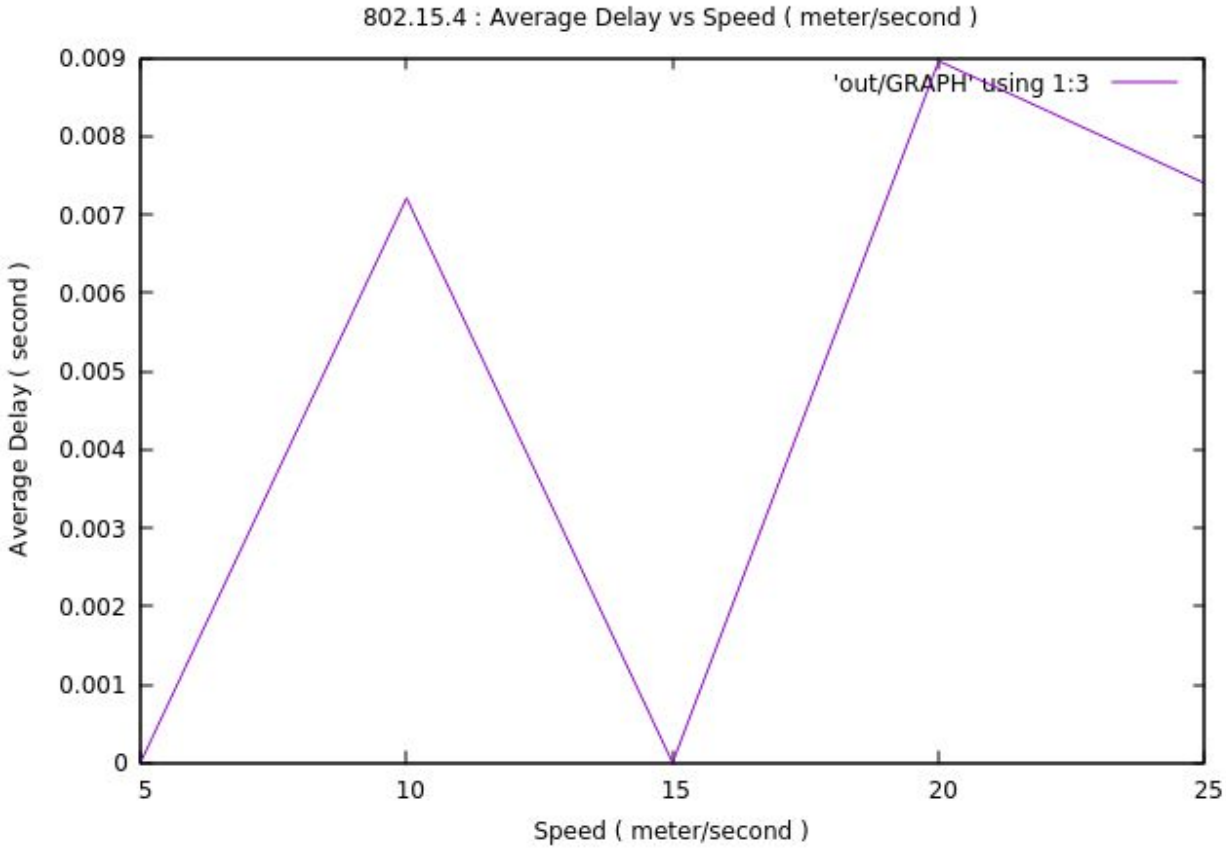

802.15.4 : Packet Delivery Ratio vs Packet Rate
'out/GRAPH' using 1:4
Packet Delivery Ratio ( % )
Packet Rate
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
100
150
200
250
300
350
400
450
500

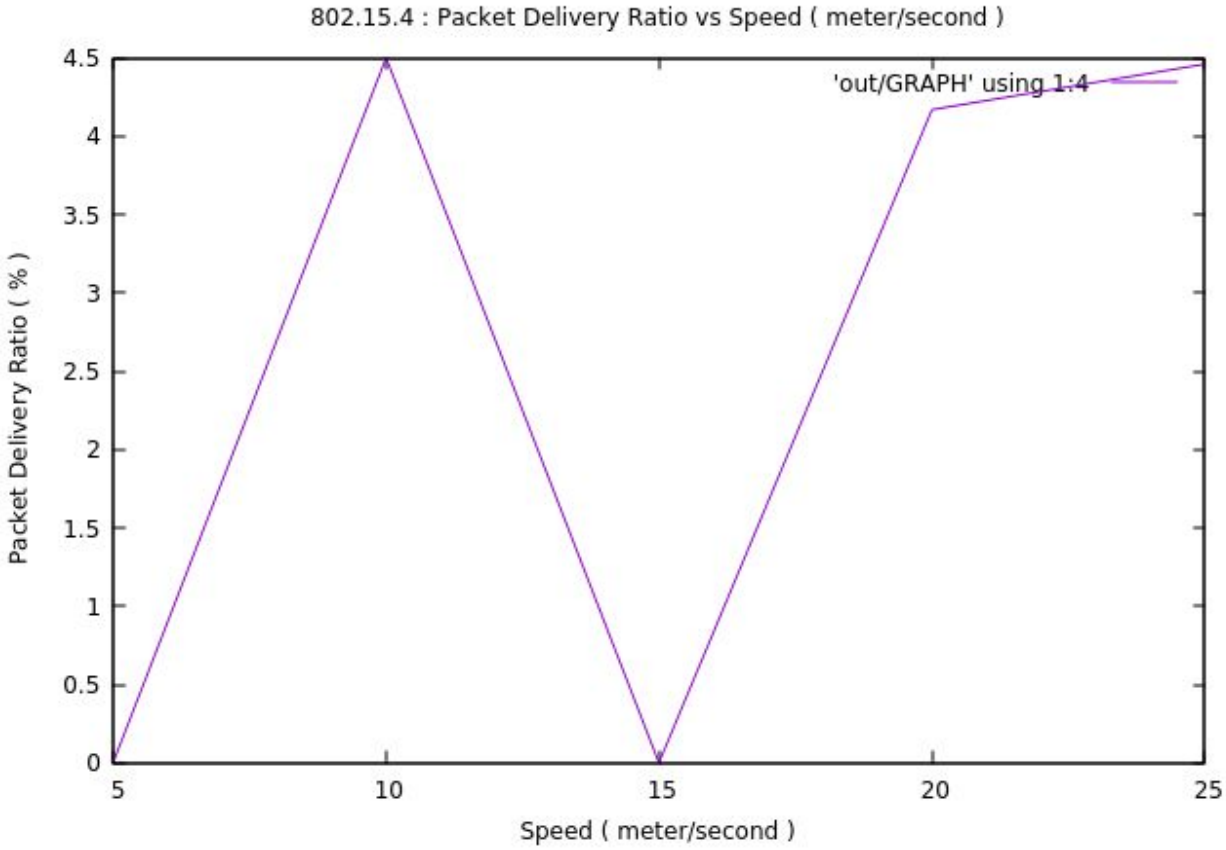

802.15.4 : Packet Drop Ratio vs Packet Rate
'out/GRAPH' using 1:5
Packet Drop Ratio ( % )
Packet Rate
0
2
4
6
8
10
12
100
150
200
250
300
350
400
450
500

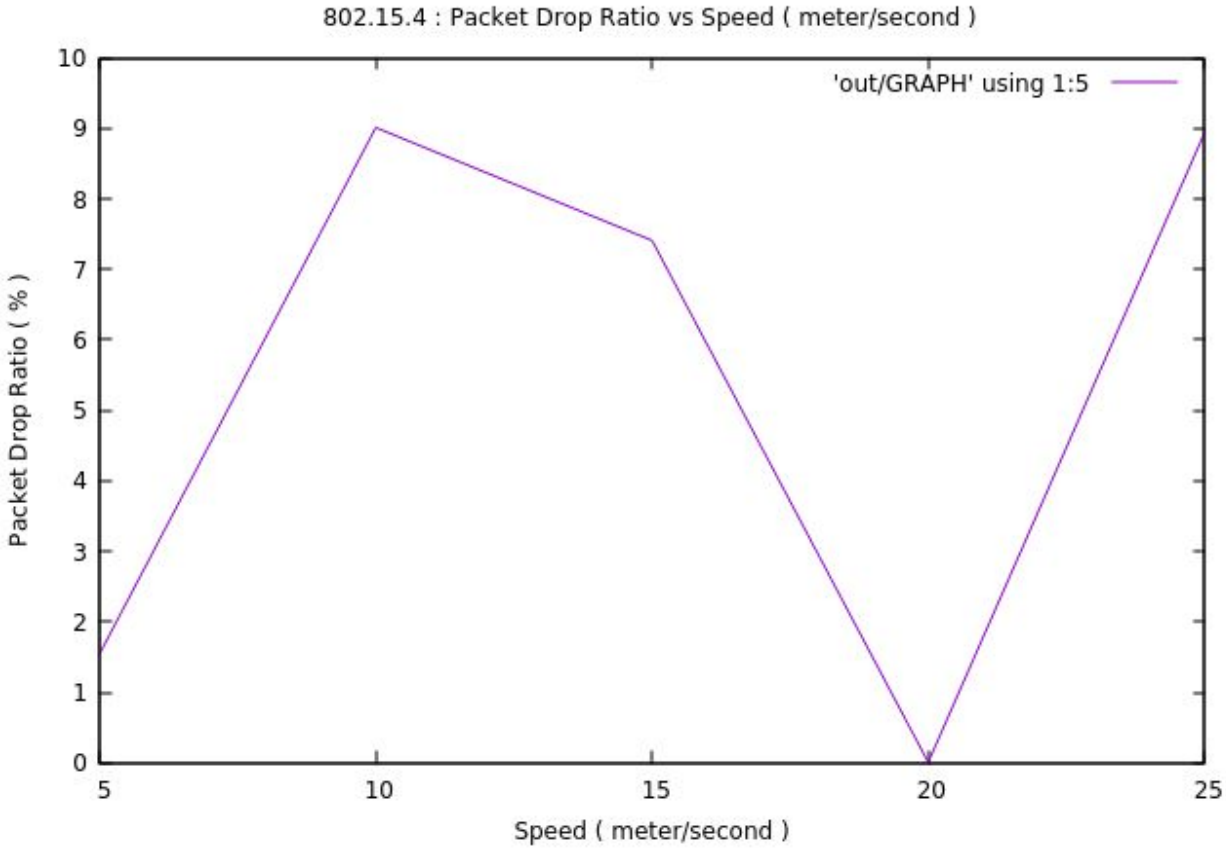

802.15.4 : Total Energy consumption vs Packet Rate
'out/GRAPH' using 1:6
Total Energy consumption ( J )
Packet Rate
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
100
150
200
250
300
350
400
450
500

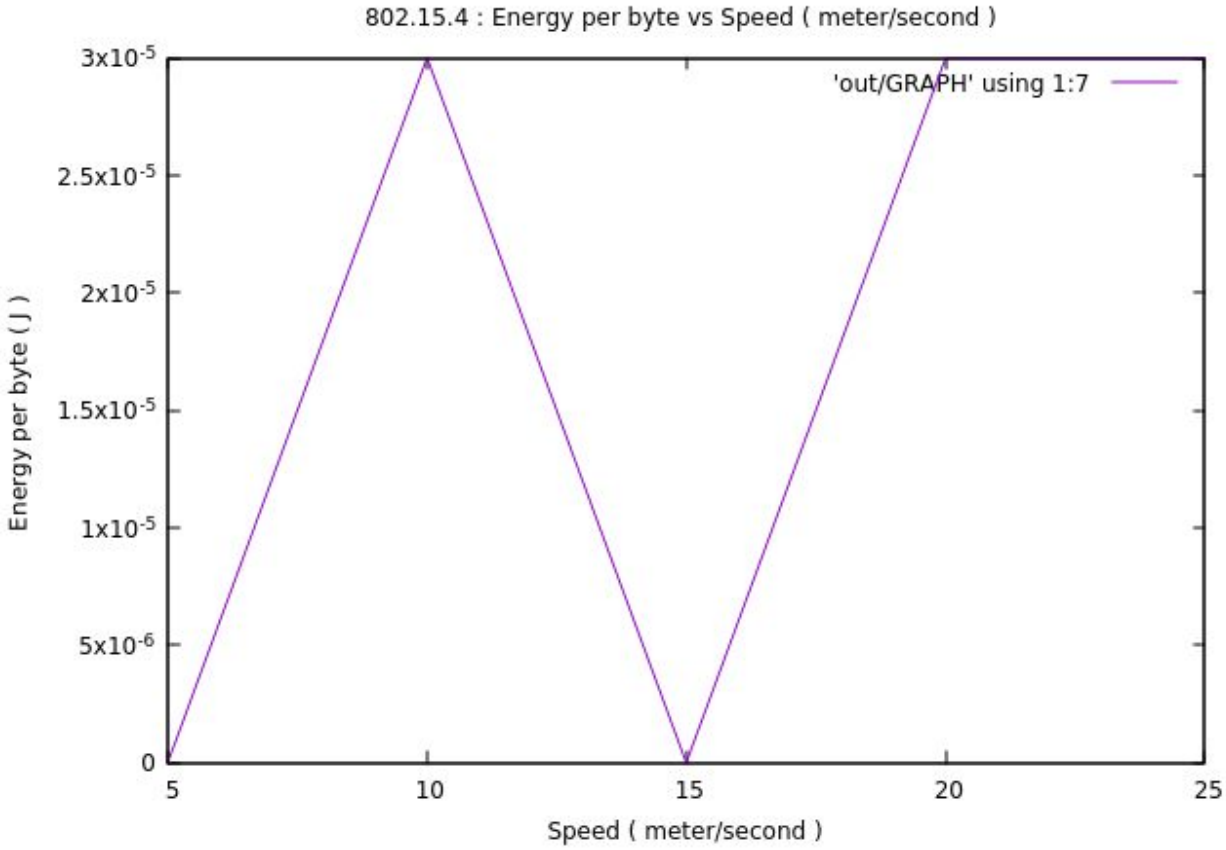

802.15.4 : Energy per byte vs Packet Rate
'out/GRAPH' using 1:7
Energy per byte ( J )
Packet Rate
4x10-5
3.5x10-5
3x10-5
2.5x10-5
2x10-5
1.5x10-5
1x10-5
5x10-6
0
100
150
200
250
300
350
400
450
500

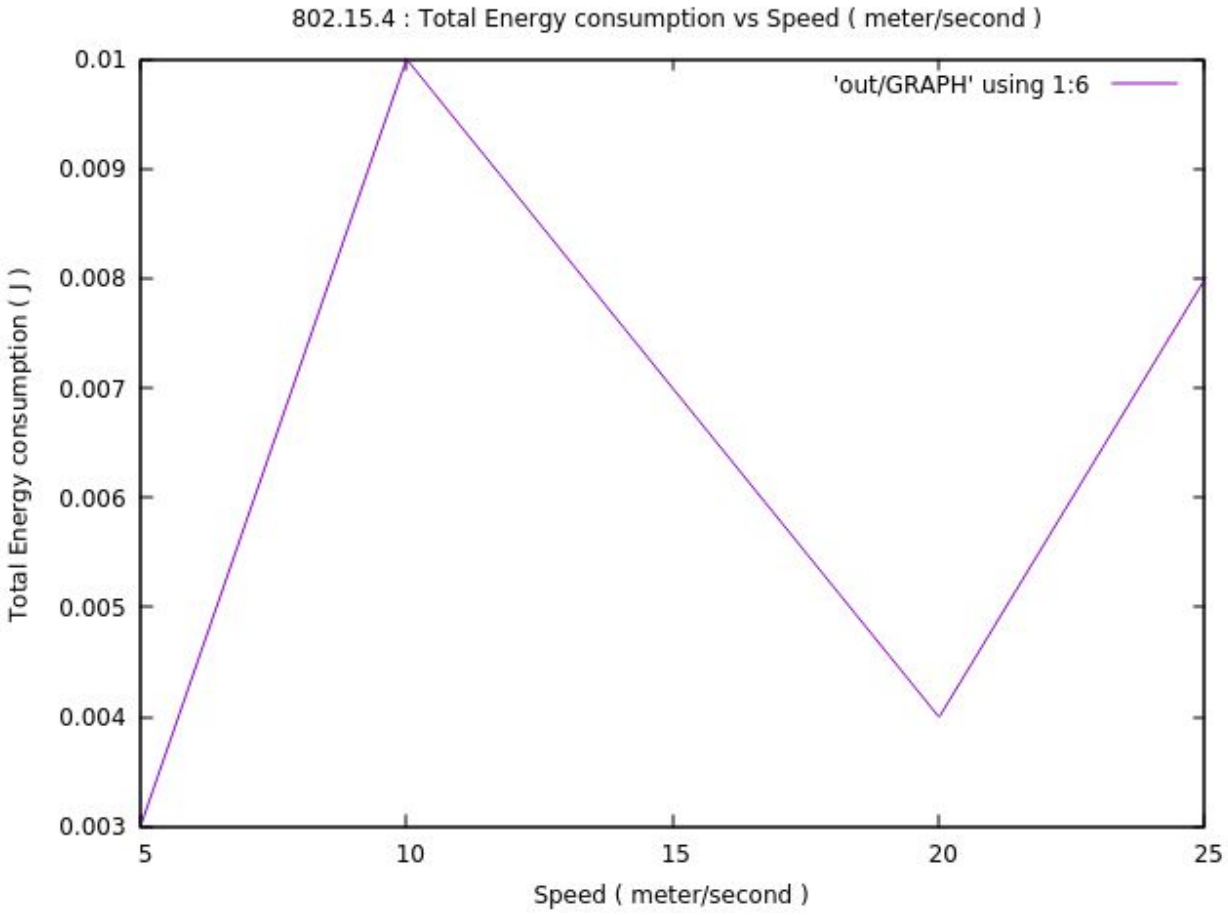

802.15.4 : Throughput vs Speed ( meter/second )
'out/GRAPH' using 1:2
Throughput ( bit/second )
Speed ( meter/second )
12000
10000
8000
6000
4000
2000
0
5
10
15
20
25


802.15.4 : Average Delay vs Speed ( meter/second )
'out/GRAPH' using 1:3
Average Delay ( second )
Speed ( meter/second )
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
5
10
15
20
25


802.15.4 : Packet Delivery Ratio vs Speed ( meter/second )
'out/GRAPH' using 1:4
Packet Delivery Ratio ( % )
Speed ( meter/second )
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
10
15
20
25


802.15.4 : Packet Drop Ratio vs Speed ( meter/second )
'out/GRAPH' using 1:5
Packet Drop Ratio ( % )
Speed ( meter/second )
0
1
2
3
4
5
6
7
8
9
10
5
10
15
20
25


802.15.4 : Energy per byte vs Speed ( meter/second )
'out/GRAPH' using 1:7
Energy per byte ( J )
Speed ( meter/second )
3x10-5
2.5x10-5
2x10-5
1.5x10-5
1x10-5
5x10-6
0
5
10
15
20
25


802.15.4 : Total Energy consumption vs Speed ( meter/second )
'out/GRAPH' using 1:6
Total Energy consumption ( J )
Speed ( meter/second )
0.01
0.009
0.008
0.007
0.006
0.005
0.004
0.003
5
10
15
20
25

## Summary Findings:

1. Packet delivery ratio is much higher in 802.11 than 802.15.4.

2. Energy consumption is very low in 802.15.4.

3. The origin routing protocol (simulated first) was DSDV and the modified routing protocol was DVR, which, in respect of performance, is theoretically inferior to DSDV. The generated graphs support this theory.

4. Changing the droptail queue between LLC and MAC sublayers to a random drop queue increased drop ratio.

5. The increased gain of the antennae helped improve performance, but at the cost of higher power dissipation.
6. Increasing the frequency of the radio wave might have caused higher power dissipation. A number of simulation performed only by changing the frequency can give a definite answer.

7. he drained powers for transmission and reception of AT&T's Wavelan PCMCIA card (mac/wireless-phy.cc) were increased, which evidently increased overall power consumption.