EE597 Lab Assignment Report

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Codes:

1. **Node_Throughput.cc**

   Objective: The code aims to explore the relationship between throughput and data rate variation in a Wi-Fi network, demonstrating the effects of adding more transmitting nodes on network performance.

   Network Topology: Using a single receiver node and numerous transmitter nodes (n0, n1, n2,..., nN) arranged diagonally from one another, the simulation models a Wi-Fi network (10.1.1.0) with each successive node's x and y coordinates rising by 1. With this configuration, an organized analysis of the network's behavior with an increase in nodes is achievable.

   Configuration: The script employs command-line arguments to facilitate modifications of a few parameters, such as the data rate (R), the step size for increasing the number of transmitter nodes (stepsize), the simulation time (simulationTime), the minimum (cwmin) and maximum (cwmax) contention window sizes, and the initial number of Wi-Fi transmitter nodes (nWifi). A versatile setup for a range of simulation scenarios is made possible by these parameters.

   Simulation Procedure Overview: The code installs the internet stack, configures the nodes' mobility models, and initializes the network's MAC and physical layers.
   To simulate data transmission, it uses the OnOffHelper and PacketSinkHelper classes to create UDP connections between the transmitter and receiver nodes as well as dynamically assign IP addresses to each node. To track changes in network throughput, the simulation iterates over a predetermined number of scenarios (max_it), increasing the number of transmitter nodes by the given step size each time. Furthermore, both the overall network throughput and the throughput per node is determined following each simulation run, offering valuable information on how well data is transmitted across the network as the number of nodes varies.

Results: Two plots are generated by the script:

- *Rate vs. Throughput Plot*: Provides insights into the network's capacity and efficiency at different rates by highlighting how the overall network throughput changes with different data rates.
- *Throughput Per Node Plot*: Provides the average throughput attained per node and provides additional insight into the network's scalability and performance with respect to variations in the transmission of data.

In conclusion, the "Node_Throughput.cc" code provides an extensive framework for investigating the dynamics of Wi-Fi network performance, with an emphasis on how variations in the quantity and speed of transmitting nodes impact throughput.

2. **Fixed_Node_Throughput.cc**

Objective: Objective: The primary aim is to understand how varying data rates influence the throughput in a Wi-Fi network, by keeping the number of nodes fixed, offering insights into network capacity and performance optimization.

Network Topology: This code simulates a Wi-Fi network with one receiver and several transmitters, much like their earlier code. In order to replicate a distributed network environment, these nodes are organized in a diagonal layout.

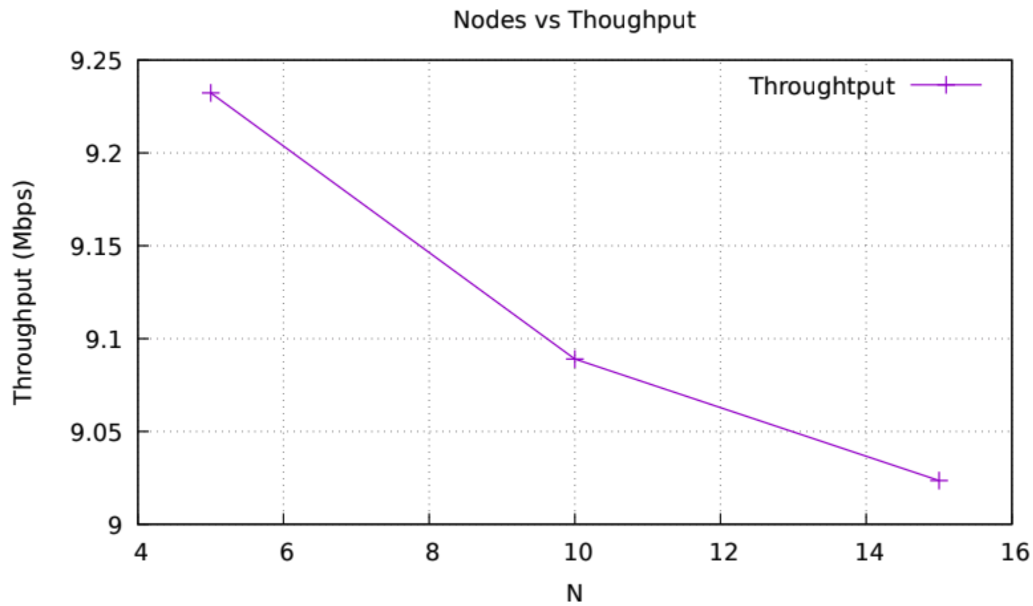
Configuration: The number of Wi-Fi transmitter nodes (nWifi) is fixed at 20. Beginning at 20 Mbps, data rates (R) rise by 10 Mbps stepsizes per iteration. To cover a range of data speeds, the simulation time is set to one second, and iterations (max_it) can run up to ten times. Customizable parameters include the minimum and maximum contention window sizes (cwmin and cwmax), impacting the backoff algorithm in Wi-Fi MAC protocols.

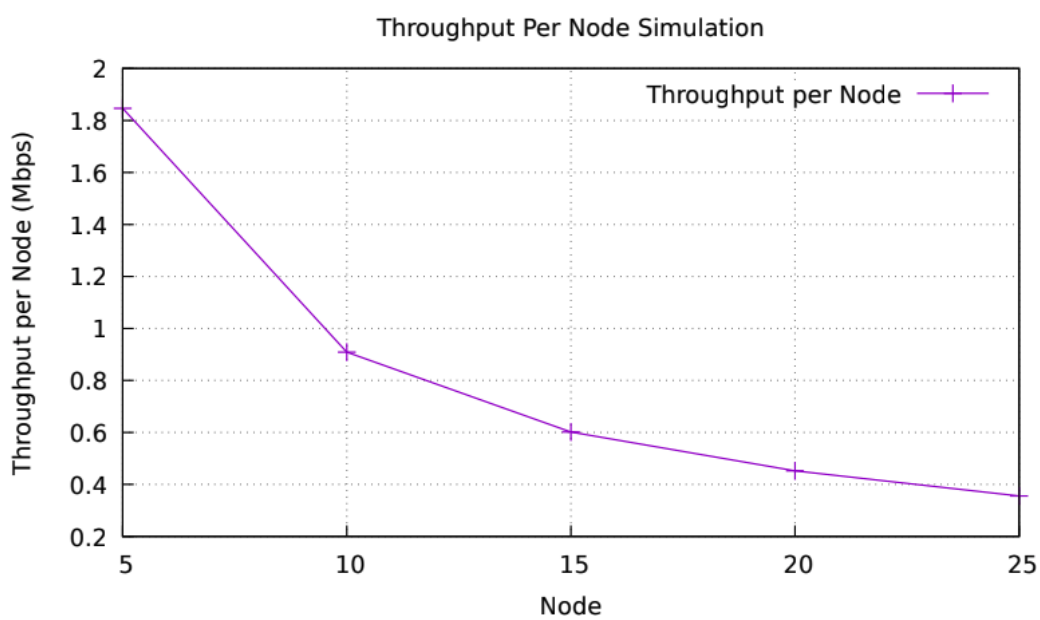
Simulation Procedure Overview: The network is set up with the designated number of nodes and the current data rate each time the simulation runs over a range of data rates. The NS-3 models and helpers (such as YansWifiChannelHelper, WifiHelper, and InternetStackHelper) are used to simulate data transmission and mobility, assign IP addresses, and establish the physical and MAC layers of the network. Modeling data flows and measuring the resulting throughput requires the establishment of UDP connections from the transmitter nodes to the receiving node.

Results: Same as the previous code.

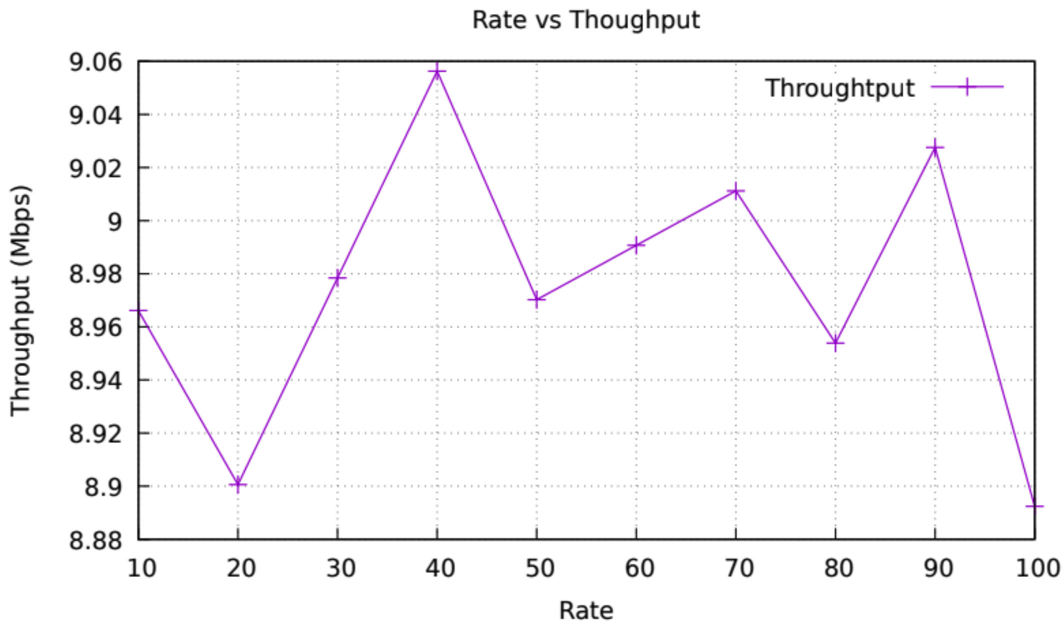
Plots

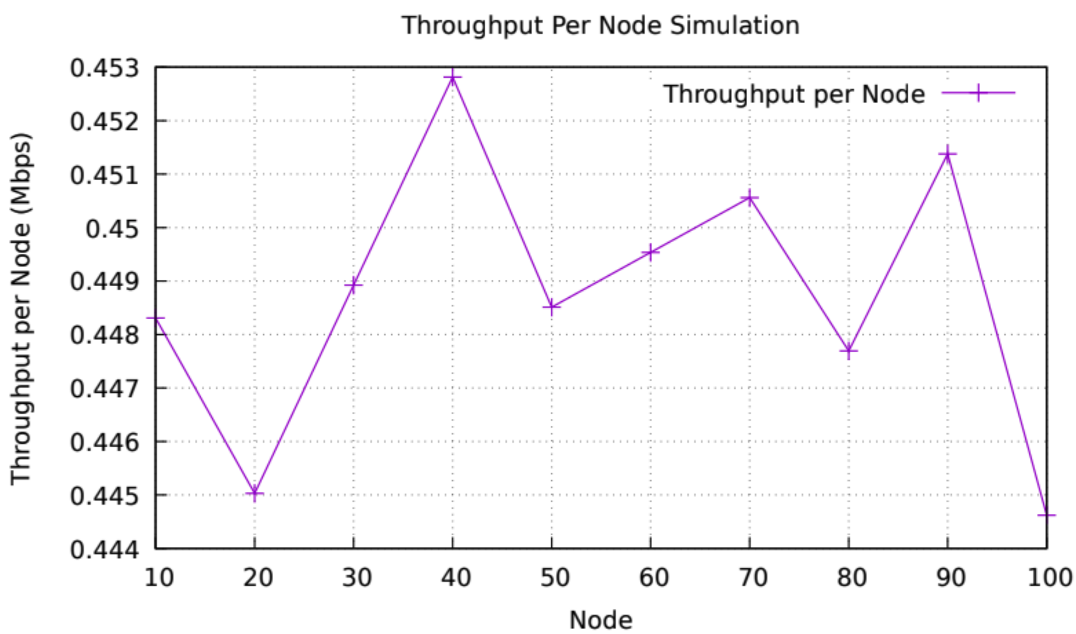
1. **Case A (cwmin: 1 cwmax: 1023) E1 (vary N, fixed R)**



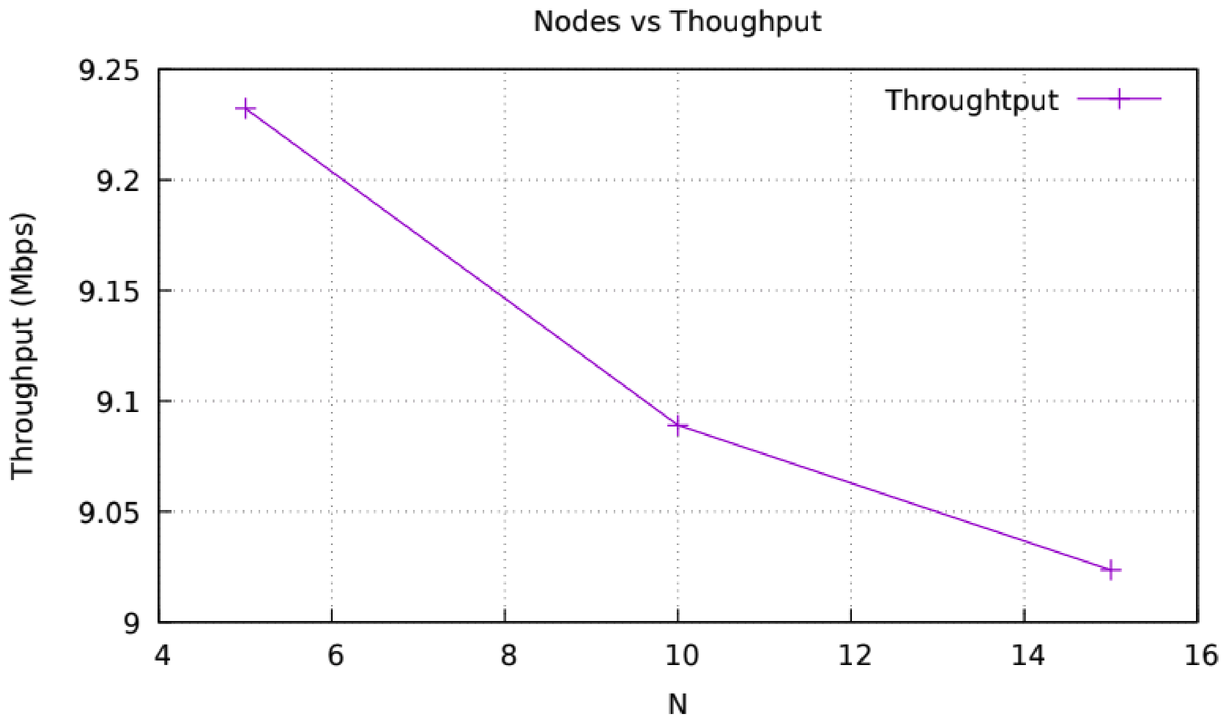


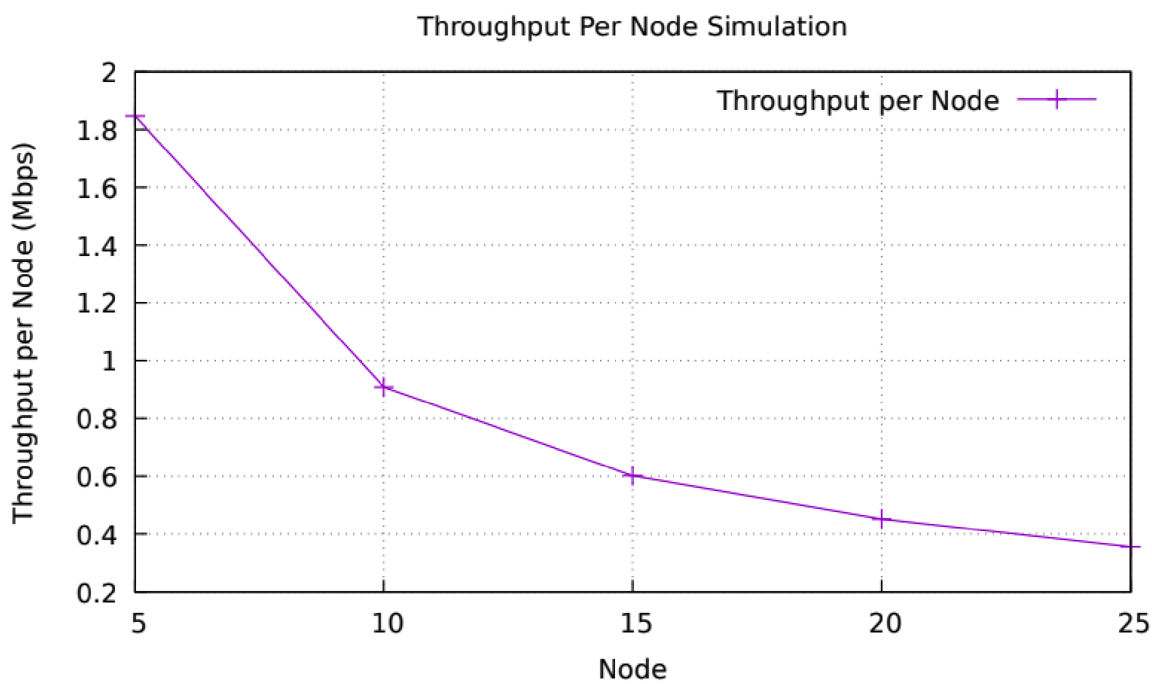
2. **Case A (cwmin: 1 cwmax: 1023) E2 (vary R, fixed N)**



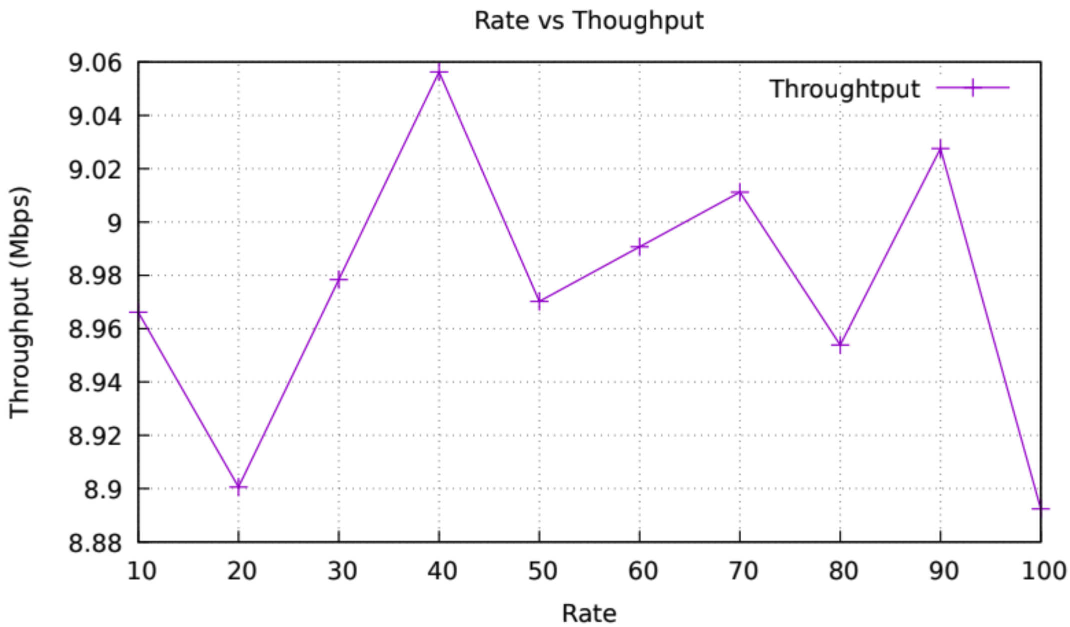


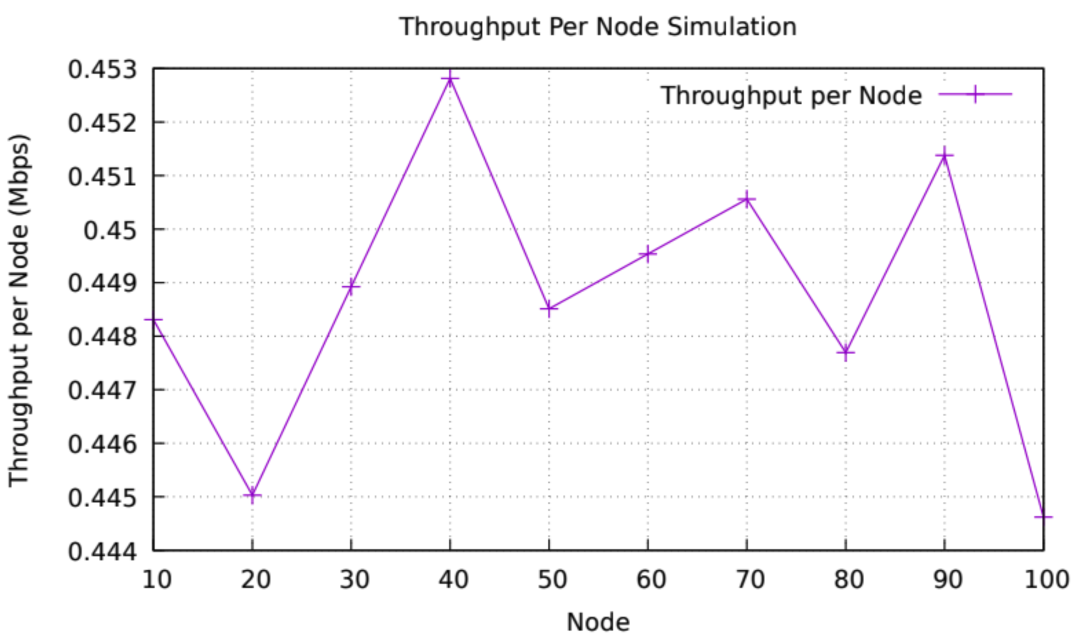
3. **Case B (cwmin: 63 cwmax: 127) E1 (vary N, fixed R)**





4. **Case B (cwmin: 63 cwmax: 127) E1 (vary R, fixed N)**


Rate vs Thoughput
Throughtput
Throughput (Mbps)
9.06
9.04
9.02
9
8.98
8.96
8.94
8.92
8.9
8.88
10
20
30
40
50
60
70
80
90
100
Rate


Throughput Per Node Simulation
Throughput per Node
Throughput per Node (Mbps)
0.453
0.452
0.451
0.45
0.449
0.448
0.447
0.446
0.445
0.444
10
20
30
40
50
60
70
80
90
100
Node

Discussion:

The results provide a good insight into how the throughput drops when the number of users is increased over the shared channel. For the different backoff windows values no significant was achieved, as it can be seen in the plots, the max throughput was approximately 9 Mbps, configuring a rate of 10 Mbps. Then in terms of throughput per node its clear that as more users used the channel it only decreased. On the other hand, when the users got fixed to 10, and we varied the Rate a different characteristic was shown. The change was that the throughput and throughput per node was oscillating, yet its worth mentioning that the oscillation was not significant, as the Rate increased no significant drop on the throughput was noticeable, which tells us that an increase in rate over a fixed number of users will not impact the network, this agrees with the theory because the contention mechanism of 802.11 sets the behavior for the throughput performance of the system