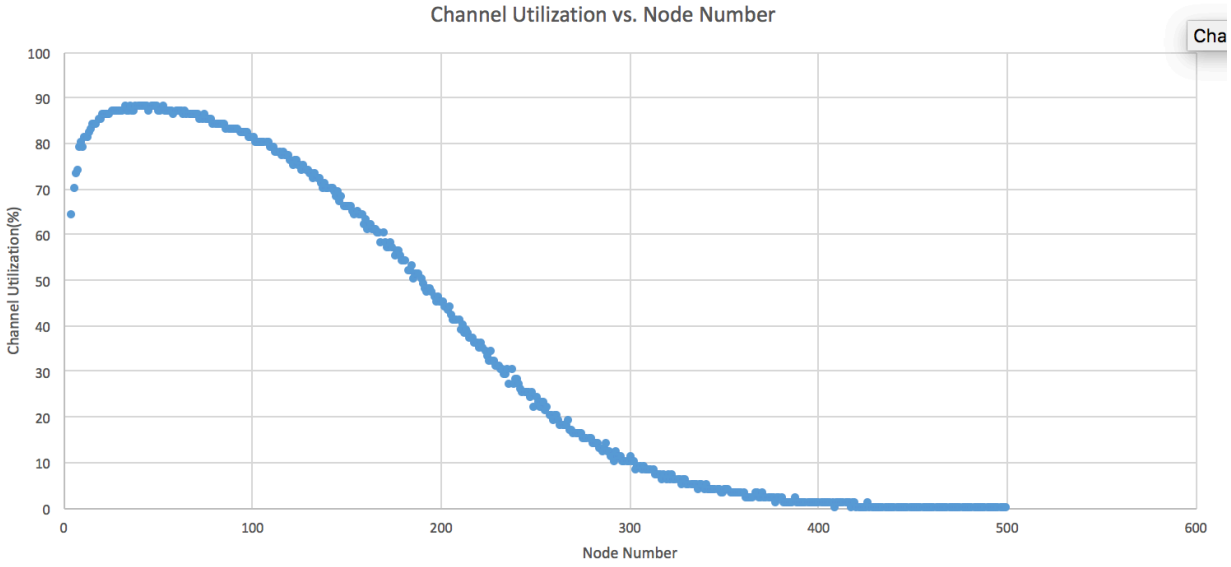
By default, assume the following parameters: N=25, L=20, R=8 16 32 64 128 256 512, M=6, T=50000 provided to your program through an input.txt file. Now, plot graphs for the following scenarios where certain parameters are varying.

. (a) Plot how channel utilization (in percentage) varies with increasing number of nodes (i.e., N varying from 5 to 500). Channel utilization is defined as the ratio of clock ticks that were used up for correct communication to the total number of clock ticks, T.



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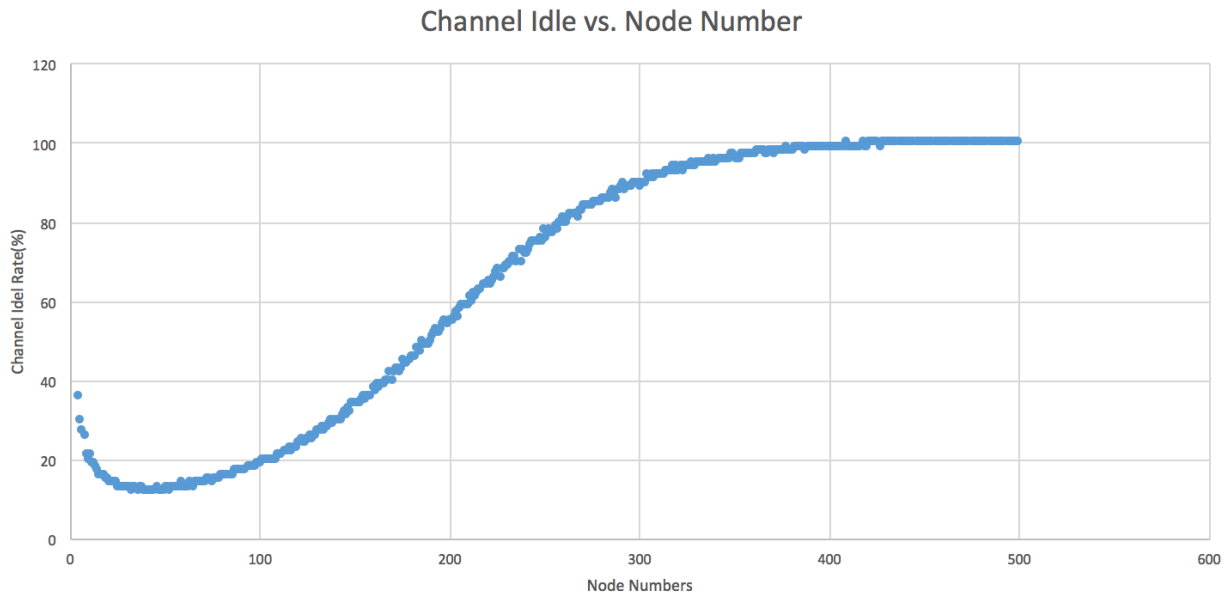
. (b) Plot how the channel idle fraction (in percentage) varies with increasing number of nodes (i.e., N varying from 5 to 500). Channel idle fraction is defined as the ratio of unused clock ticks to the total number of clock ticks, T. Note that unused clock ticks do not include collisions.



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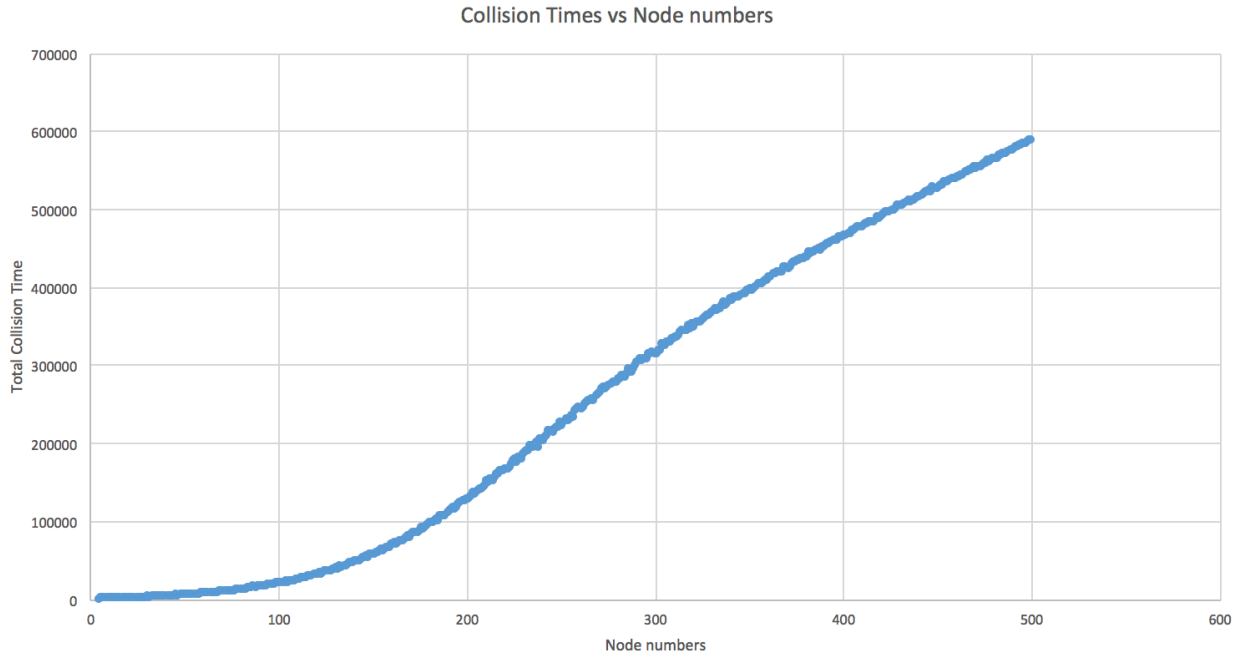
. (c) Plotthetotalnumberofcollisionswithincreasingnumberofnodes(i.e.,Nvaryin gfrom 5 to 500).



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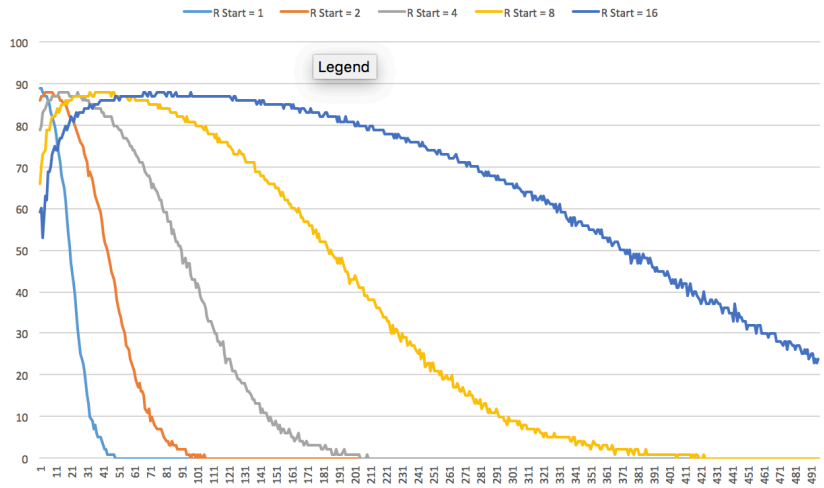
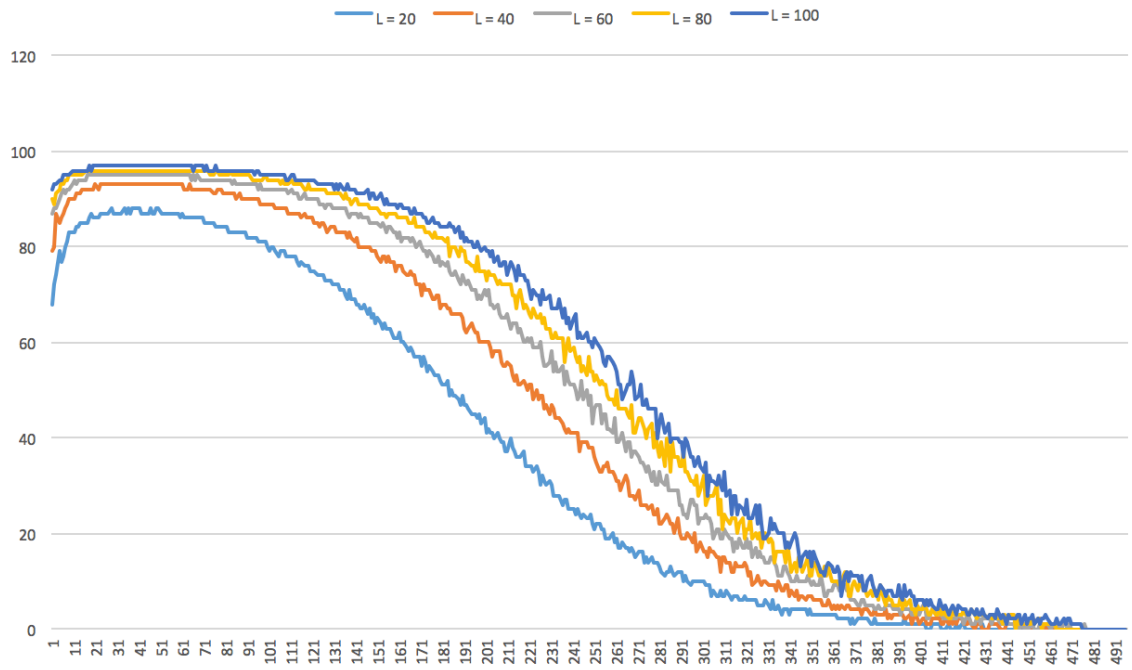
. (d) Repeat part (a) but plot 5 curves on the same graph, each curve corresponding to different initial values of R: 1, 2, 4, 8, 16. For each of the 5 cases, let R double upon collisions.



. (e) Repeat part (a) but plot 5 curves on the same graph, each curve corresponding to different packet lengths L: 20, 40, 60, 80, 100.



. (f) Explain the shape of the curves in (d) and (e) by elaborating on how/why increasing value of N, R, and L impact channel utilization.

Each time we increase the initial R doubly, the utilization of the channel for little amount of nodes will be lower, since the ratio of slot range to number of nodes is quite large so that there will be much time wasted when nodes keep counting down to reach the transmission point. As the node number increases, the utilization will increase a a bit for each situation. As for the changes for latter half of the curves, the curve with smaller initial R will have more extensive decay rate. It is obvious that when the minimum R is smaller, nodes have to go through a longer process to leverage its R, which means more nodes will have to stuck at situation to choose random backoff from a smaller range.

Answer: As the number of nodes increases, the utilization of the channel rises then decay quickly due to the crowdness of the channel. And the utilizaiton increases as the packet length increases. This is mostly due to the increase of transmission duration. With the same level of node density in the network(probability of collision), the same average amout of time a node has to decrease and the same success times for success transmission, the increase of single transmission duration will increase the utilization of the channel.