Report

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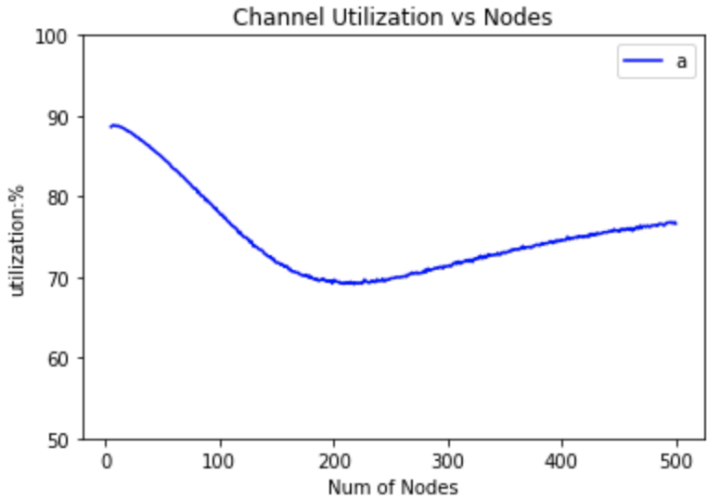
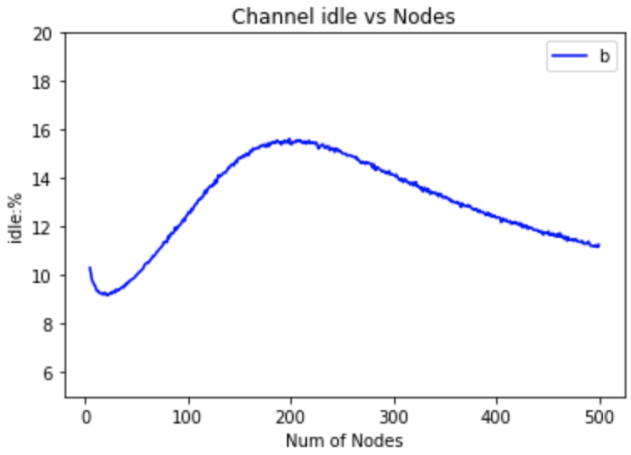
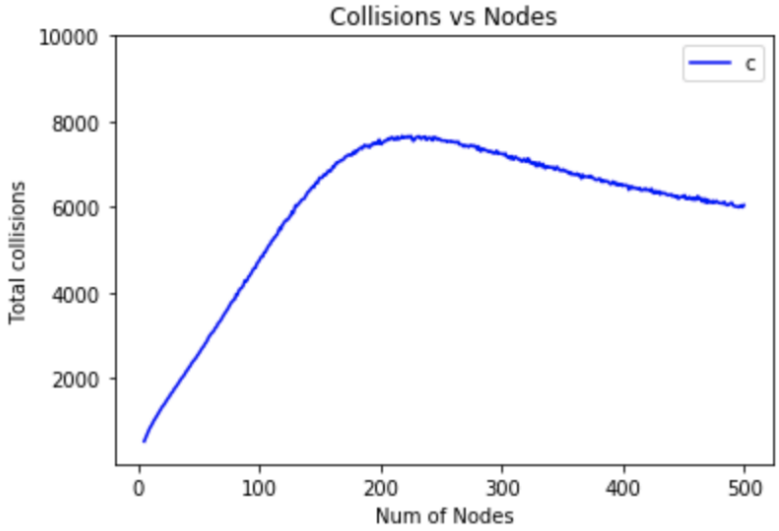
(a) Plot how channel utilization (in percentage) varies with increasing number of nodes (i.e., N varying from 5 to 500). Channel utilization is defined as the ratio of clock ticks that were used up for correct communication to the total number of clock ticks, T.



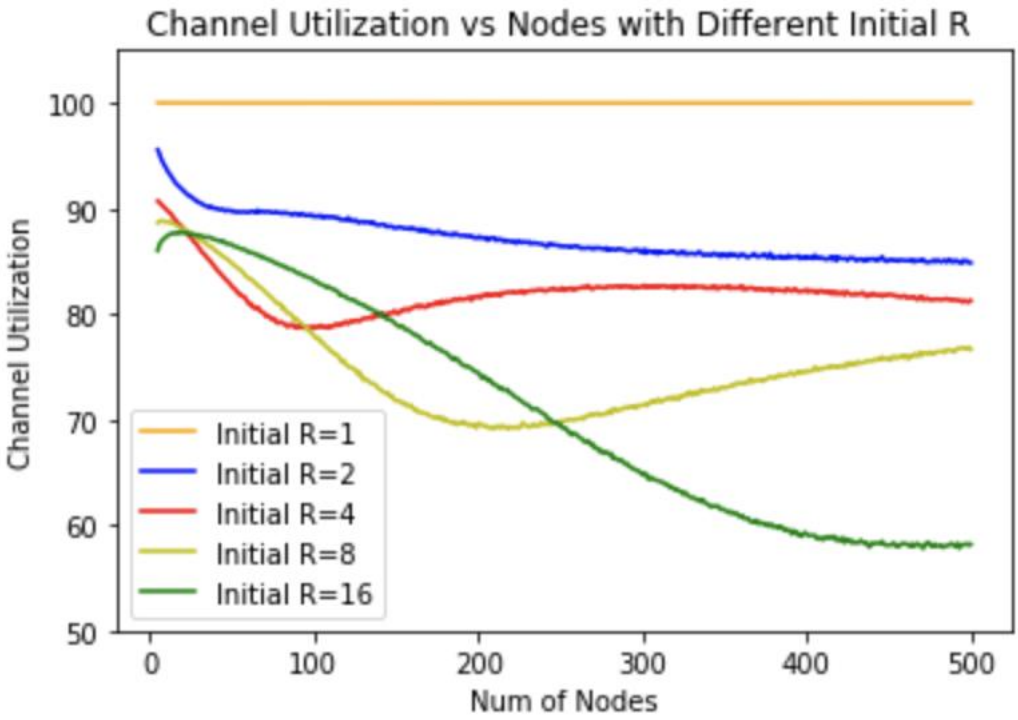

(b) Plot how the channel idle fraction (in percentage) varies with increasing number of nodes (i.e., N varying from 5 to 500). Channel idle fraction is defined as the ratio of unused clock ticks to the total number of clock ticks, T. Note that unused clock ticks do not include collisions.



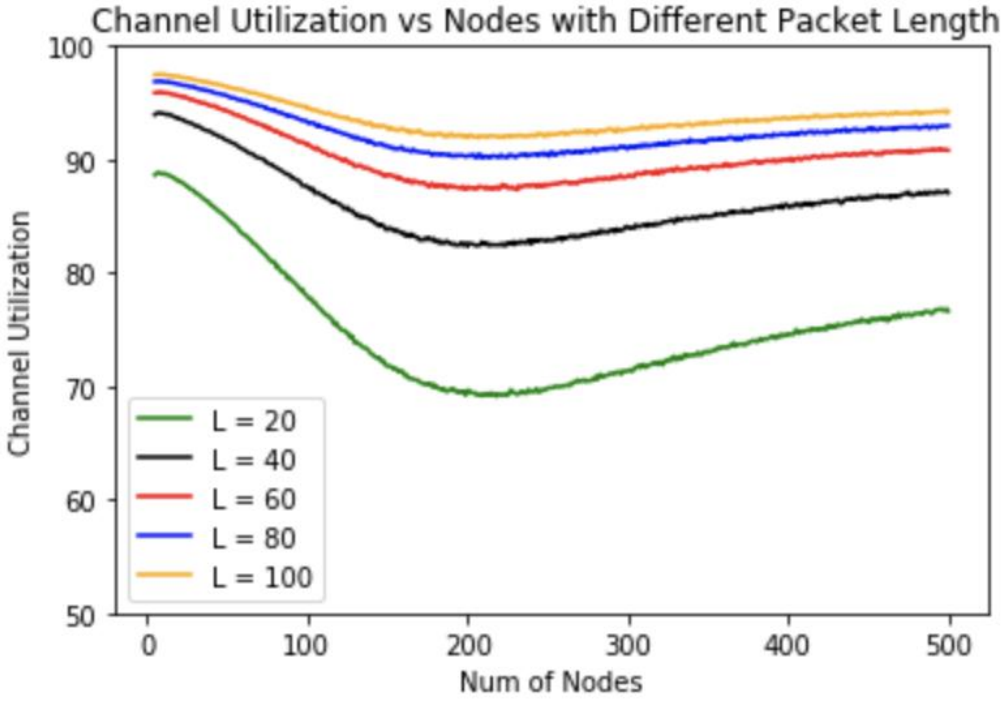

(c) Plot the total number of collisions with increasing number of nodes (i.e.,N varying from 5 to 500).




(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.

N: In the case of different nodes, when the number of nodes increases, the utilization of the channel will first increase then decrease. When there are few nodes, channels cannot be fully utilized, so the idle fraction is high, and the utilization is low. When the number of nodes increases, the idle time of the channel decreases and the utilization increases. As the node continues to increase, the likelihood of collisions will increase. When a collision occurs, channel cannot be used to send data, which reduces utilization. So when there are too many nodes, the channel utilization is low.

R: The utilization of channel depends on initial R and node number.

i. When node is small.

   When R is smaller, the nodes use less time to wait for sending data, the utilization is larger, like when R=1, the first node that succeeds will always have back off 0 and always own the channel, so the channel utilization close to 1.

ii. When node is big, say larger than 230.

   When R is smaller, the nodes use less time to wait for sending data, the utilization is larger. When R is larger, the nodes use more time in waiting, and the idle fraction of the channel is larger, the utilization is lower.

iii. When node is between 40 to 230.

R and utilization don’t follow the above correlation. When R is small, node tends to collision, which decreases the utilization, and when R is larger, more time is used to wait, which also decreases the utilization, so the utilization needs to be analyzed with concrete case.

L: In the case of different packet length, when packet length increases, the utilization of the channel will increase. Since if the packet length is larger, there will be more time used for nodes to send data and during this time the channel is utilized. So the portion of channel utilization will increase, channel idle fraction will decrease, and the number of collisions will decrease.