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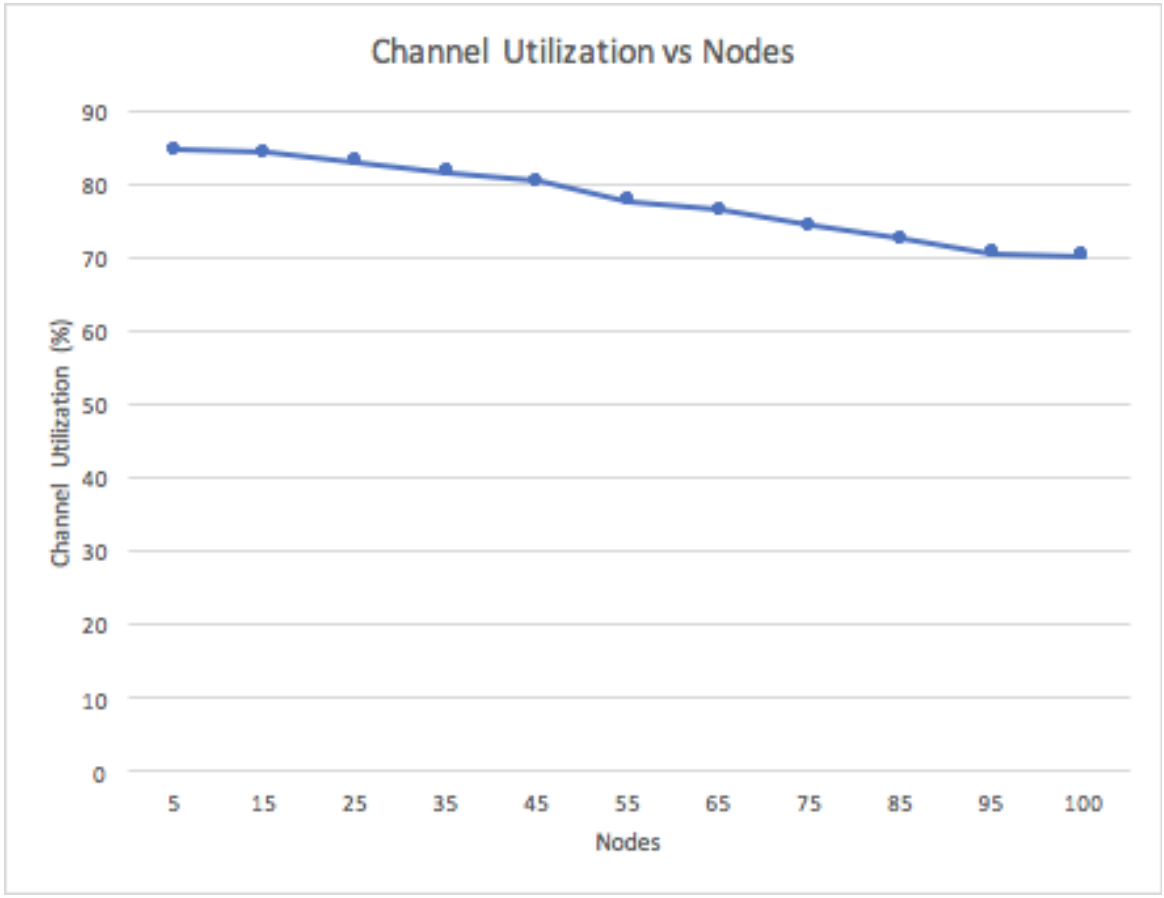
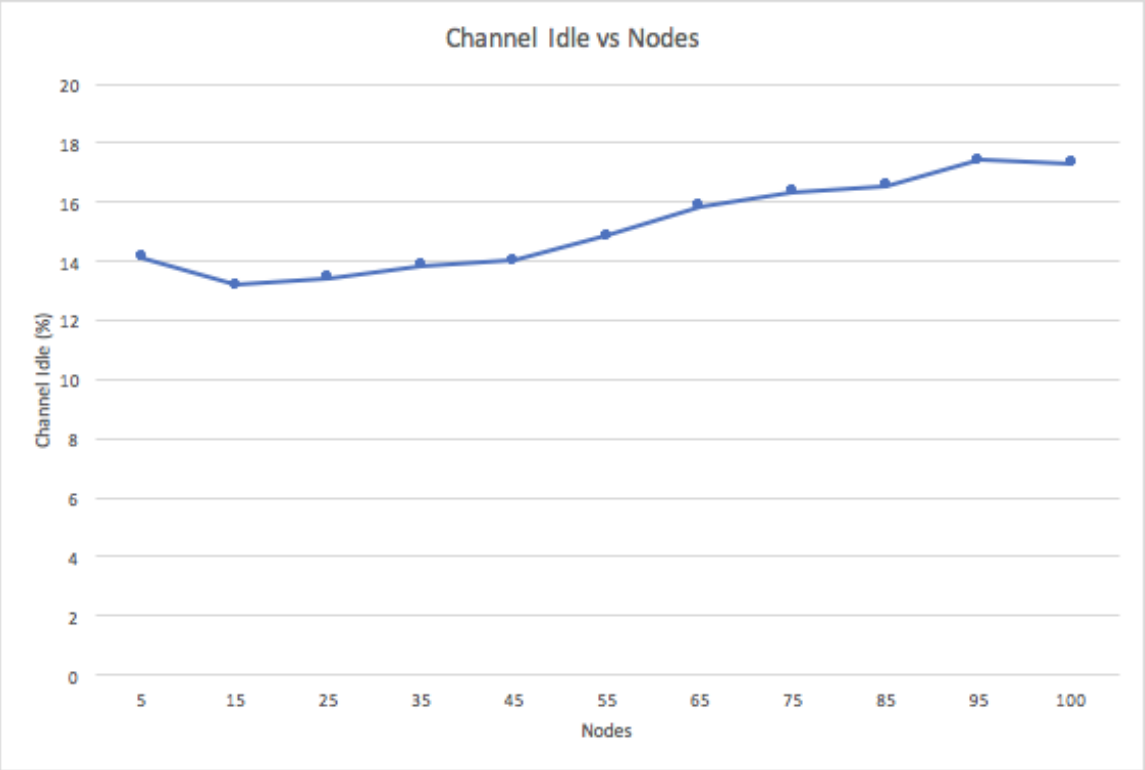
ECE/CS 438 Fall 2017
MP4 - Analysis

3a: Channel utilization varying with increasing number of nodes



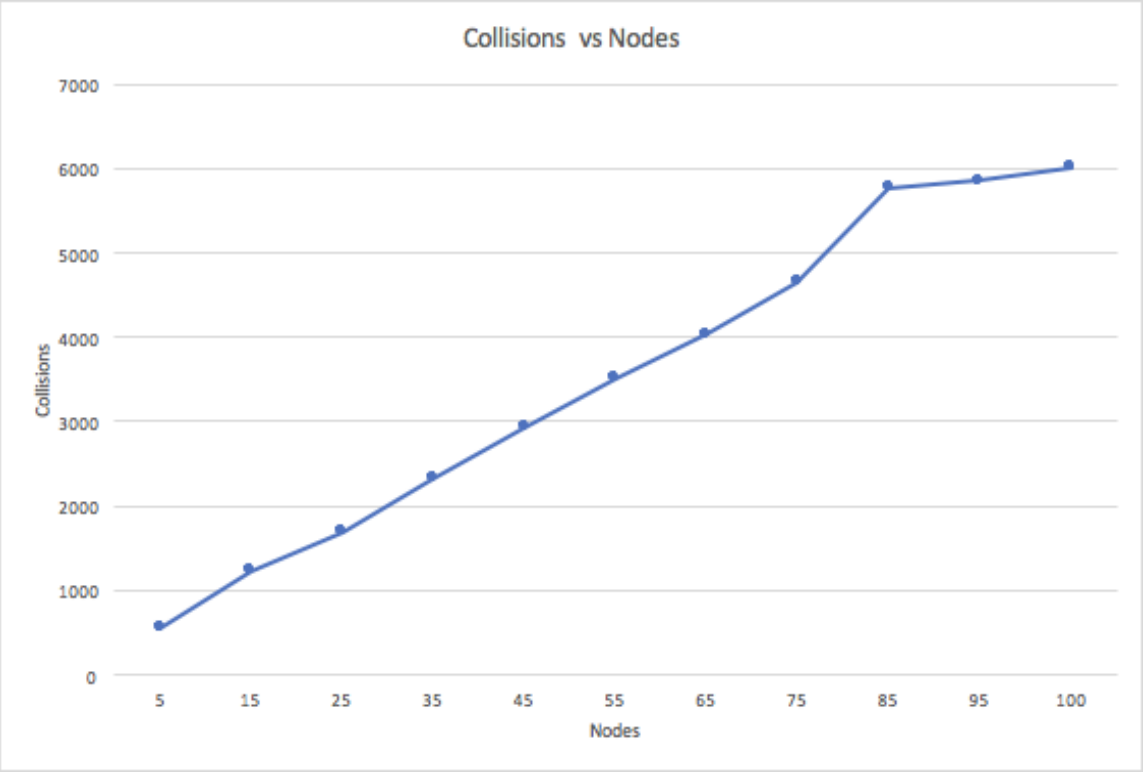
Evidently, the plot of our channel utilization (%) and the number of nodes from the output of our program shows the relationship between the two parameters. When increasing the number of nodes, channel utilization decreases. This is because when there are more nodes, more collisions occur and ultimately, successful transmissions occupy less of the *T* number of clock cycles available during our program execution.

3b: Channel idle varying with increasing number of nodes



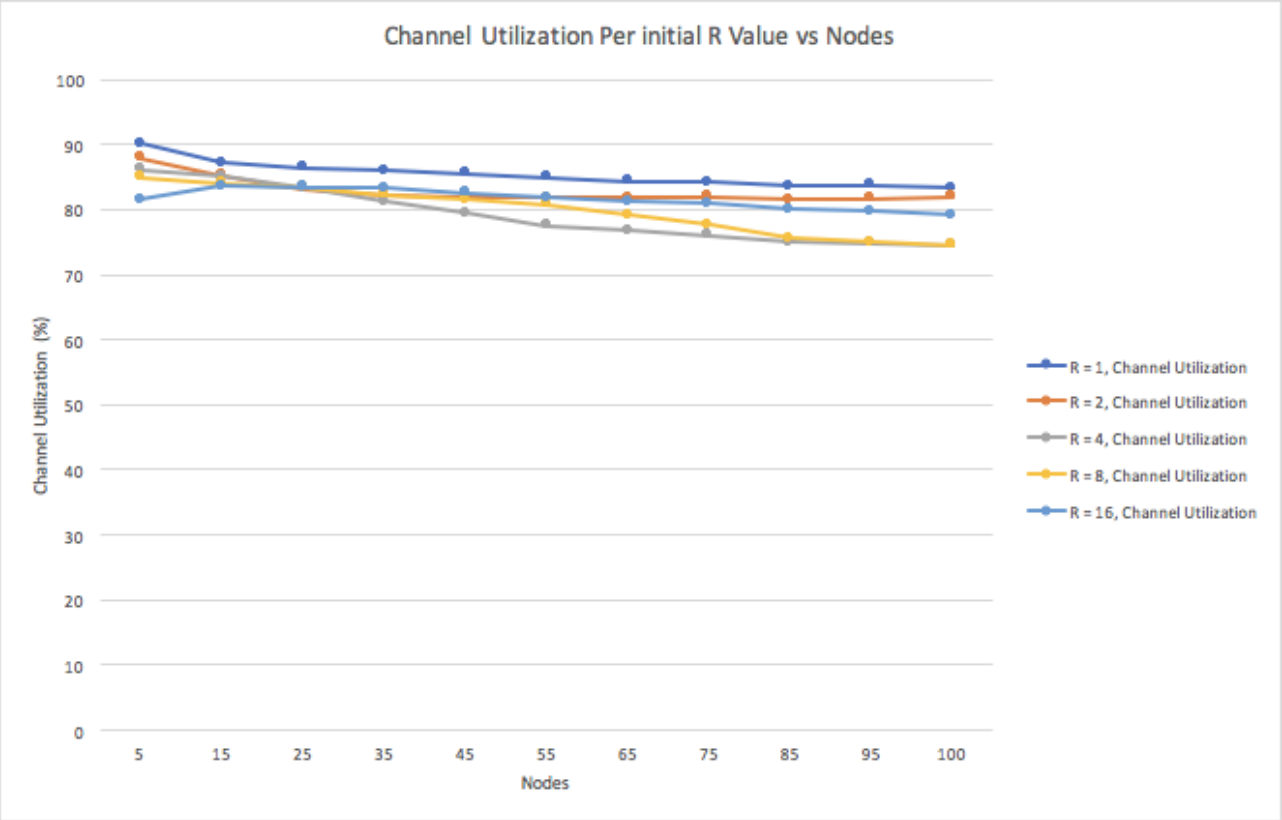
This graph displays the relationship between the time the channel is idle (%) and the number of nodes. When the number of nodes increase, the greater the number of collisions that occur. As a result, the number of clock cycles or “clock ticks” where nothing is happening decreases. It was provided in our MP documentation that “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”. Thus, channel idle percentage is computed by: 100% - [channel utilized %] - [clock ticks where there is a collision]*L/T.

3c: Total number of collisions varying with increasing number of nodes



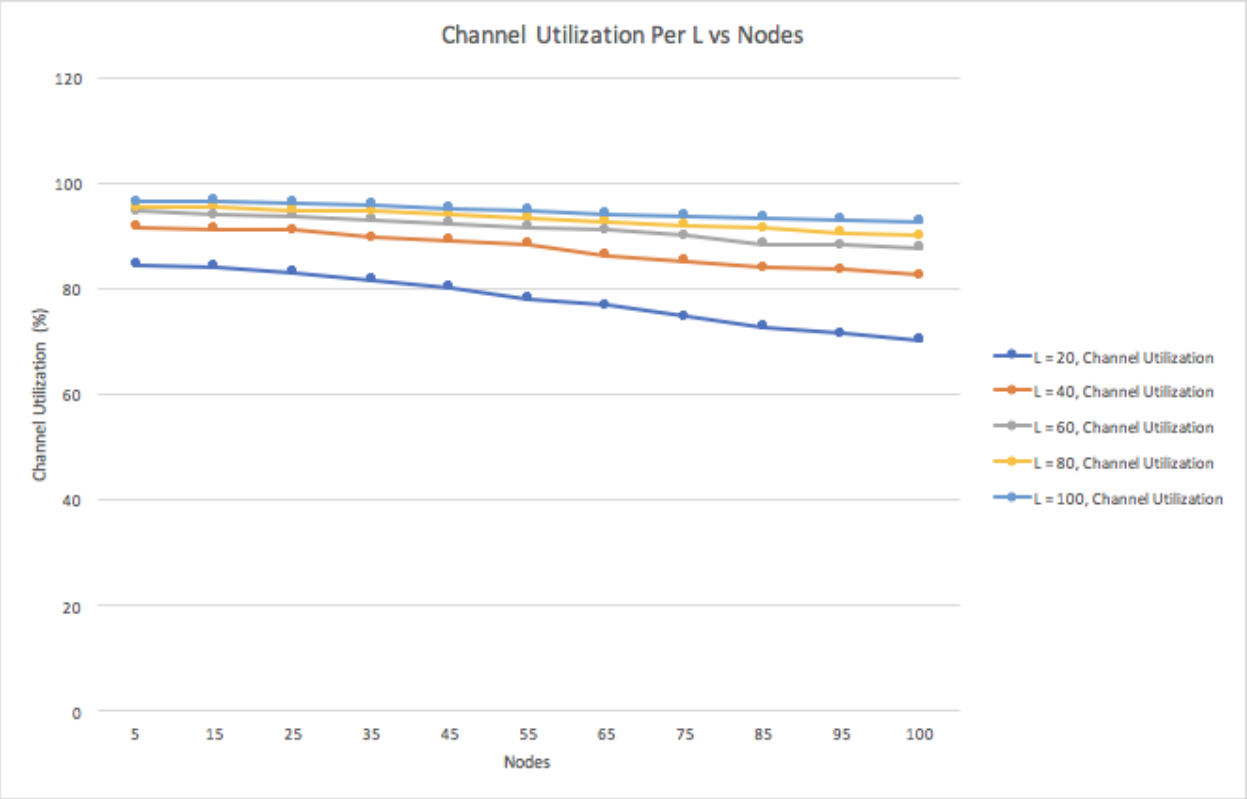
With more nodes attempting to utilize the same channel, the number of collisions increases. This relationship is a mostly linear relationship, as shown in the graph above. This makes sense, because more nodes that are attempting to utilize the channel translates to more nodes that will count down to the transmission back off on that clock tick, which will result in a collision on that clock tick.

3d: Channel utilization with increasing number of nodes and different initial R values



There are multiple things of importance to note from this graph. At the start of the graph, the trials with higher R values have a smaller channel utilization. This is because the backoff times are more distributed, and with smaller nodes, too high off a range in backoff times will result in unused slots. This trend reverses as we linearly increase the number of nodes. With more nodes, there are more collisions are likely to occur. Distributing the backoff numbers in a greater range decreases the likelihood of these collisions. The perfect spot between number of nodes and backoff range has to be found to properly maximize channel utilization.

3e: Channel utilization with increasing number of nodes and different packet lengths L



L represents the number of clock ticks it takes to send a packet (simulates sending a packet of a certain size). Therefore, increasing the value of L increases the percentage of clock ticks where the channel is utilized. It is important to note that L does not influence the number of collisions because the backoff rate does not change during the time of transmission. It is observed in part 3a that increasing the number of nodes will increase the channel utilization. This remains true in the above plot as the channel utilization is still gradually decreasing when the number of nodes increases. However, with increasing L values it's clear that more of the channel is utilized from the initial start and the decreasing trend would start from this particular point. For example, for L = 100, L= 80, L = 60 and L = 40, these plots all start at a very high channel utilization (close to high 90%s) and end around value above 80%. This demonstrates how L is a strong factor when interpreting channel utilization.

3f: Effects of increasing the value of N, R, and L impact channel utilization

As discussed in the previous pages N, R and L all directly impact channel utilization. Increasing the number of nodes N, will cause there to be more contention for slots and thus more collisions, resulting in a smaller channel utilization. Because no node decreases its backoff values when another node is transmitting, L does not affect collision rate at all. Thus a larger packet size will directly result in more transmittance, increasing the channel utilization. R has a deeper impact of channel utilization which is dependant on the number of nodes. At higher values of initial R with low number of nodes, there is too much unused time when no node is transmitting. With a large number of nodes, this becomes beneficial as it prevents collisions from happening all the time by introducing a larger set of backoff values.