In most countries, there are 79 channels for frequency hopping in Bluetooth.

The hopping rate is 1600 hops/sec or 0.625ms per slot. In each piconet, the same hopping sequence is shared by all hopping devices. For this project, each device is assumed to be synchronous, homogeneous, and the distance between any two devices is within the transmission range. Each device hops from one channel to another channel independently by choosing its hopping patterns from 79 channels.

1. If there are two devices, what are their average collision probabilities if they both choose a channel randomly? You must simulate your program long enough to get a stable value. (30)

In the following, please simulate the number of devices between 20 and 70. One way of marking bad channels is to give a probability ζ. When a channel is occupied more than ζ, the channel is marked as a bad channel. You need to simulate different ζ values between 0.1 and 0.9 and discuss the effects of ζ.

1. Assume the channel status is stable for 30 seconds. If all channels have the same probability of being bad channels, marking bad channels would not improve performance. In order to show the effects of marking bad channels, some channels should be subject to interference more frequently than other channels. Therefore, please first write a program to generate two kinds of channels. 39 of randomly selected channels are not interfered with by noises during the simulation period and the other 40 channels are probably corrupted due to noises with a Poisson distribution of probability 0.3. Overall, a channel is marked as a bad channel if it is corrupted or if it is occupied by a different device. (30)
2. When there are no coordinated mechanisms among devices, we can first produce a set of at most 79 hopping patterns, and each device selects its hopping pattern independently by device id and hopping pattern (device id mode 79). When a randomly chosen hopping channel is a bad channel, a channel re-mapping function will remap the bad channel to a normal channel which is the closest to the bad channel. If there are no normal channels, the original bad channel is selected anyway. Each device continuously senses the channels for a period (4 sec) to mark bad channels. That is, each device keeps marking bad channels for the first 4 sec and use the marked result for the following 26 sec. Please show the average collision probability for each device after 4 sec. (40)