2023 無線行動網路 期末專案

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**.
(2) Assume the channel status is stable for **30 seconds**. If there are **20 devices**, and they all randomly select a channel, what is the average collision probability for each channel?

In the following, please conduct simulations with **varying numbers of devices (25, 50, 75)**. Marking channels as "bad" can be achieved by assigning a probability ζ. If a channel's average collision probability exceeds ζ, it is flagged as a bad channel. You need to simulate different **ζ values between 0.1 and 0.9 (0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9)** and discuss the effects of ζ.

(3) Assuming a stable channel status for **30 seconds**, within the simulation, **39 randomly selected channels remain unaffected by noise**, while **the other 40 channels are susceptible to corruption with a Poisson distribution probability of 0.4**. **A channel is labeled as a bad channel if it is corrupted or if its average collision probability surpasses a threshold ζ.**
Given the number of devices (25, 50, 75) provided in the question, what is the average collision probability for each channel? Additionally, how many channels are identified as bad when considering various thresholds ζ? (Note: containing channels corrupted by interference)
(4) 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. During the **initial 5 seconds**, each device engages in frequency hopping according to its designated frequency hopping mode. Subsequently, the average collision probability for each channel over these five seconds is computed. Channels exceeding the threshold ζ are labeled as bad channels. In the **following 25 seconds**, utilizing the marked results, **if the selected channel is identified as a bad channel, it is remapped to the nearest normal channel.** If no suitable normal channel is available, the original bad channel remains selected.
Given the number of devices (25, 50, 75) provided in the question and varying thresholds ζ, what is the average collision probability of the device **after five seconds**?