Term Project Phase 1

CENG519 - Network Security

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Objective: Analyze how increasing the mean of an exponential delay affects average round-trip time (RTT) in an asynchronous messaging system using `asyncio.sleep(delay)`.
Purpose: Exponential delays are commonly used in networking and distributed systems to introduce randomness in event timing. This randomness increases *entropy*, reduces synchronization between concurrent actors, and lowers the chance of repeated collisions or conflicts. By spreading out retries or responses over a wider time window, systems can avoid congestion and emulate more realistic, unpredictable conditions.

Setup:

- 100 ping packets per mean value
- RTT = round-trip time per packet
- Mean values: 5×10^{-10} to 5×10^{-1} seconds

Mean Values (s)	Avg RTT (ms)
5×10^{-10}	6.403
5×10^{-9}	6.328
5×10^{-8}	6.575
5×10^{-7}	5.890
5×10^{-6}	6.106
5×10^{-5}	8.194
5×10^{-4}	8.503
5×10^{-3}	18.830
5×10^{-2}	114.552
5×10^{-1}	1605.767

Table 1: *
Table 1: Mean Values vs. Average RTT

Findings:

- RTT remains stable (∼6 ms) when delay $\leq 5\times10^{-6}$ due to system jitter.
- RTT increases from 5×10^{-5} and sharply rises for delays $\geq 5\times10^{-3}$.

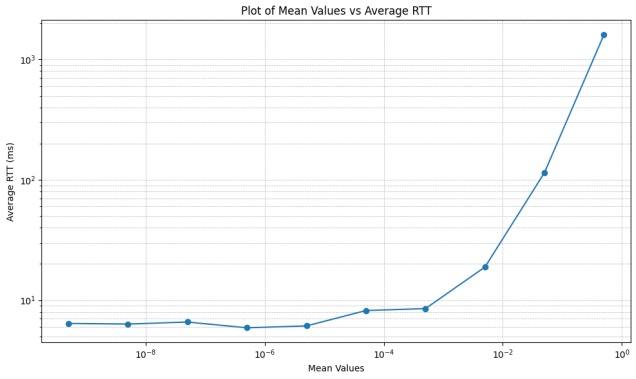

Figure 1: *
Figure 1: Plot of Mean Delay vs Average RTT

Conclusion: With very small delays, RTT is bounded by OS-level and scheduler noise. As the delay mean increases, RTT scales accordingly. The trend confirms this behavior, marking the point where delay surpasses system overhead.

Repository Link: https://github.com/furkan-aksakal/middlebox