

Group M20 | Computer Networks Lab 4

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Analysing Airport Security Lines Report

Introduction

Airport security screening plays a vital role in safeguarding passenger safety and enhancing their overall satisfaction. The objective of this report is to assess the effectiveness of airport security screening protocols and investigate methods for enhancing passenger experience and overall airport operational efficiency. This report aims to analyze the efficiency of airport security screening processes and explore optimization strategies to enhance passenger experience and overall airport efficiency.

Methods Used:

A discrete-event simulation model was developed to simulate the airport security screening process. The key parameters considered in the simulations are:

- Arrival Rate (λ): The rate at which passengers arrive at the security checkpoint.
- Service Rate (μ): The rate at which passengers are processed by the security scanner.

Simulation Results:

Single Server with No Buffer

S.No	λ	μ	Observed Average Waiting Time	Observed Average Queue Length	System Utilization
1.	3	6	0	-	33.6803
2.	5	15	0	-	24.8653
3.	10	50	0	-	16.7724
4.	4	2	0	-	67.0453

Single Server with Finite Buffer

S.No	λ	μ	K	Observed Average Waiting Time	Observed Average Queue Length	System Utilization
1.	3	6	7	0.1543	0.9611	49.843
2.	3	15	5	0.0140	0.2426	19.999
3.	8	33	10	0.0073	0.3006	24.242
4.	4	2	10	3.8998	8.9881	99.944

Single Server with Infinite Buffer

S.No	λ	μ	Observed Average Waiting Time	Observed Average Queue Length	System Utilization
1.	3	6	0.10647	0.8174	49.9982
2.	5	15	0.02383	0.4509	33.3328
3.	10	50	0.00428	0.24282	19.9995
4.	4	2	1272.88	2512.59	99.9966

Multi-Server with No Buffer

S.No	λ	μ	m	Observed Average Waiting Time	Observed Average Queue Length	System Utilization
1.	3	6	5	0	-	33.2288
2.	5	12	7	0	-	29.5933
3.	6	2	3	0	-	74.3163

Multi-Server with Finite Buffer

S.No	λ	μ	m	k	Observed Average Waiting Time	Observed Average Queue Length	System Utilization
1.	3	6	5	5	~0	0.3321	33.2189
2.	12	5	2	10	1.3435	7.9813	99.7334
3.	6	2	3	7	1.6355	4.31809	97.8216

Multi-Server with Infinite Buffer

S.No	λ	μ	m	Observed Average Waiting Time	Observed Average Queue Length	System Utilization
1.	3	6	5	~0	0.3292	32.9212
2.	12	5	3	0.2229	1.9496	87.095
3.	6	2	3	7.45491	15.9312	98.9777

Optimization Strategies:

1) Using Multiple Servers:

Introducing multiple security lines having multiple security scanners improves the overall efficiency of the airport security screening process, thereby improving passenger experience. Introducing multiple security lines having multiple security scanners also reduces packet drop rate, average waiting time and average queue length. But it comes at the cost of a low server utilization, meaning that the security lines remain idle for some amount of time, leading to a great wastage of resources. Around 3 or 4 servers seem to be optimal for our case which seems to balance both the issues.

2) Optimizing the Buffer Size

Increasing the buffer size (denoted as K) has a notable effect on reducing the number of dropped packets and improving server utilization significantly. However, this enhancement comes at the cost of longer average waiting times and larger average queue lengths. In our single-

server model, it is feasible to set the buffer size to around 10, which results in nearly 100% server utilization while maintaining an average packet drop rate of 10%. If the priority is to minimize dropped packets even further and accept longer average waiting times and larger queue sizes, it's possible to further increase the buffer size.

Conclusion:

The findings from our simulation demonstrate that improving the airport security screening process can have a substantial impact on both passenger satisfaction and airport efficiency. By fine-tuning parameters like buffer size, the quantity of security scanners, and the implementation of buffers in multi-server scenarios, airports can customize their security screening procedures to handle different passenger volumes and reduce wait times. These optimizations are crucial for guaranteeing a more seamless and effective experience for passengers.