Faculty of Engineering and Technology

Department of Electrical and Computer Engineering

Wireless and Mobile Networks, ENCS5323

Project – Online Calculator for Wireless and Mobile Networks

Prepared By:

Mariam Hamad 1200837

Leena Affouri 1200335

Supervised By:

Dr. Mohammad K. Jubran

Birzeit University

23/6/2024

Table of Contents

Table of Figure:

Design and build an online calculator:

First Question:

The number of bits and rate of the sampler, quantizer, source encoder, channel encoder, and interleaver:

After making the user enter the inputs then click calculate the outputs will show based on these equations:

Sampling Frequency = 2 × bandwidth

Quantization Levels = $2^{\text{number of bits}}$

Input source Encoder = sampling frequency × number of bits

Source Encoder Rate = sampling frequency × number of bits × compression rate

Channel Encoder Rate = $\frac{\text{Source Encoder Rate}}{\text{Encoder Rate}}$

Interleaver Rate = Channel Encoder Rate

First scenario:

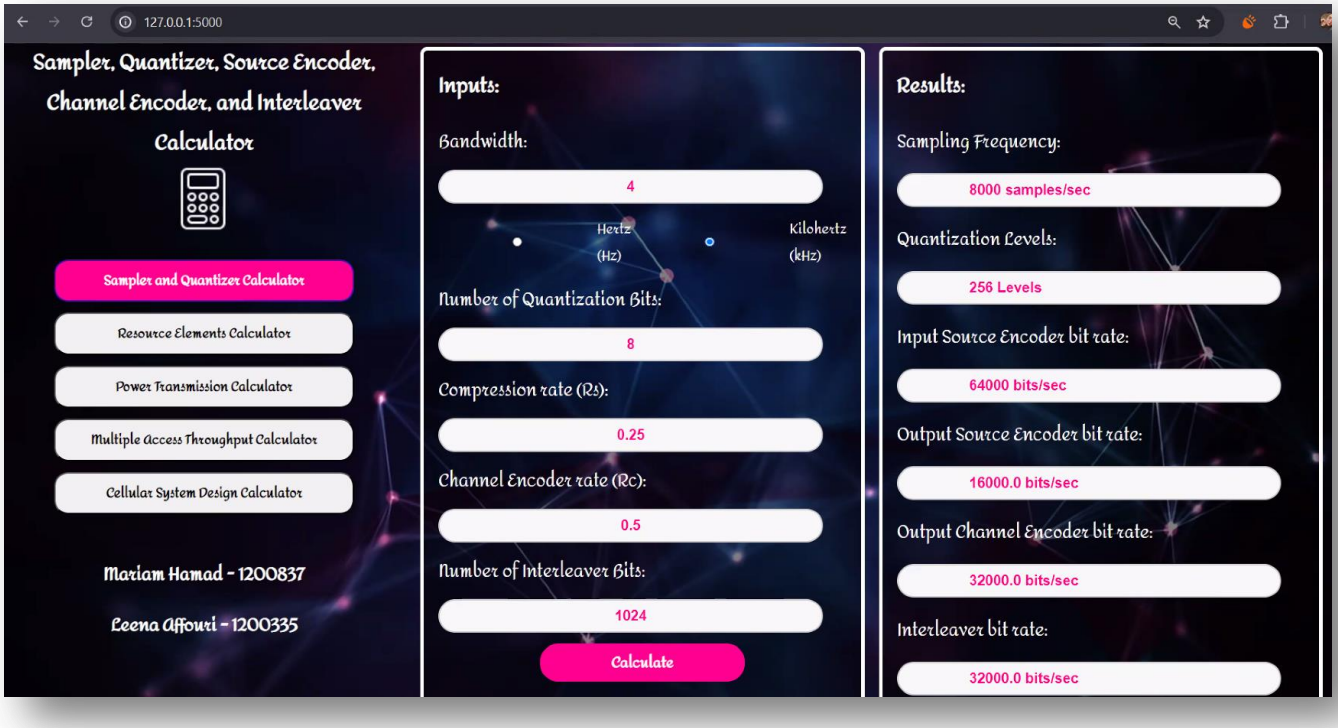

Figure 1: First question first scenario

Second scenario:

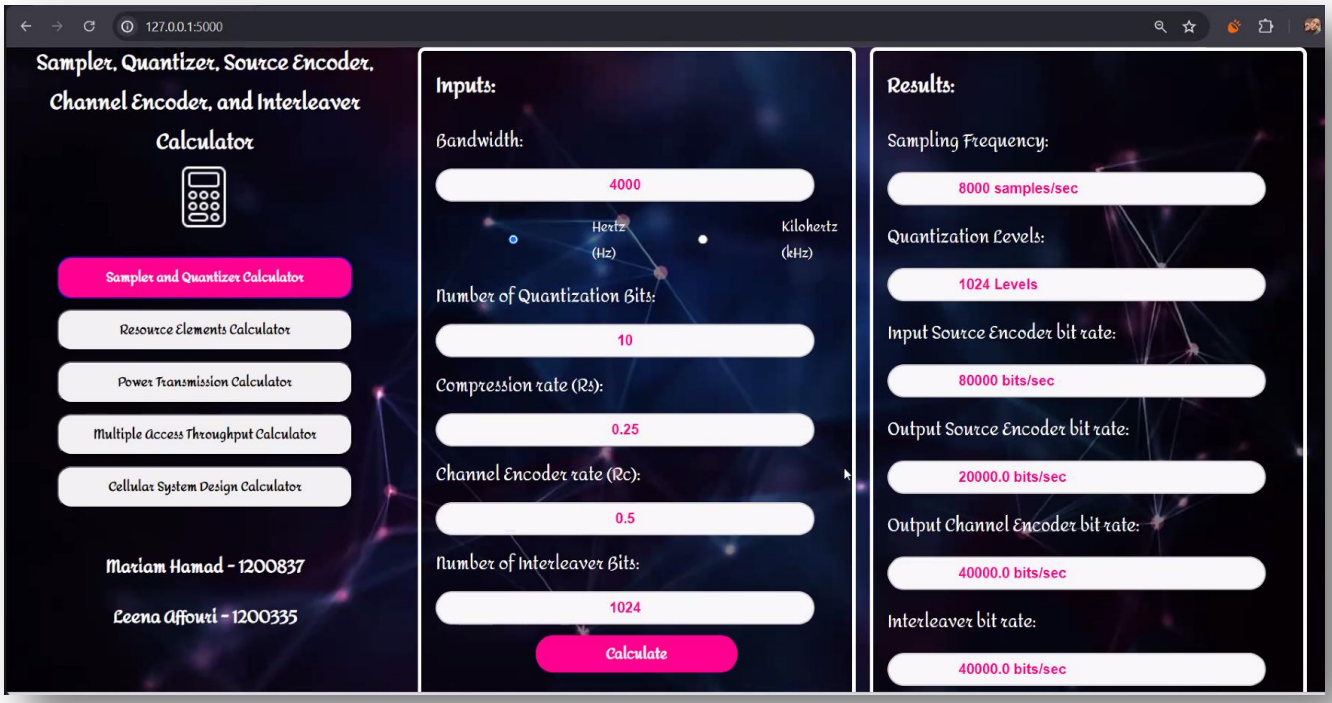

Figure 2: First question second scenario

Third scenario:

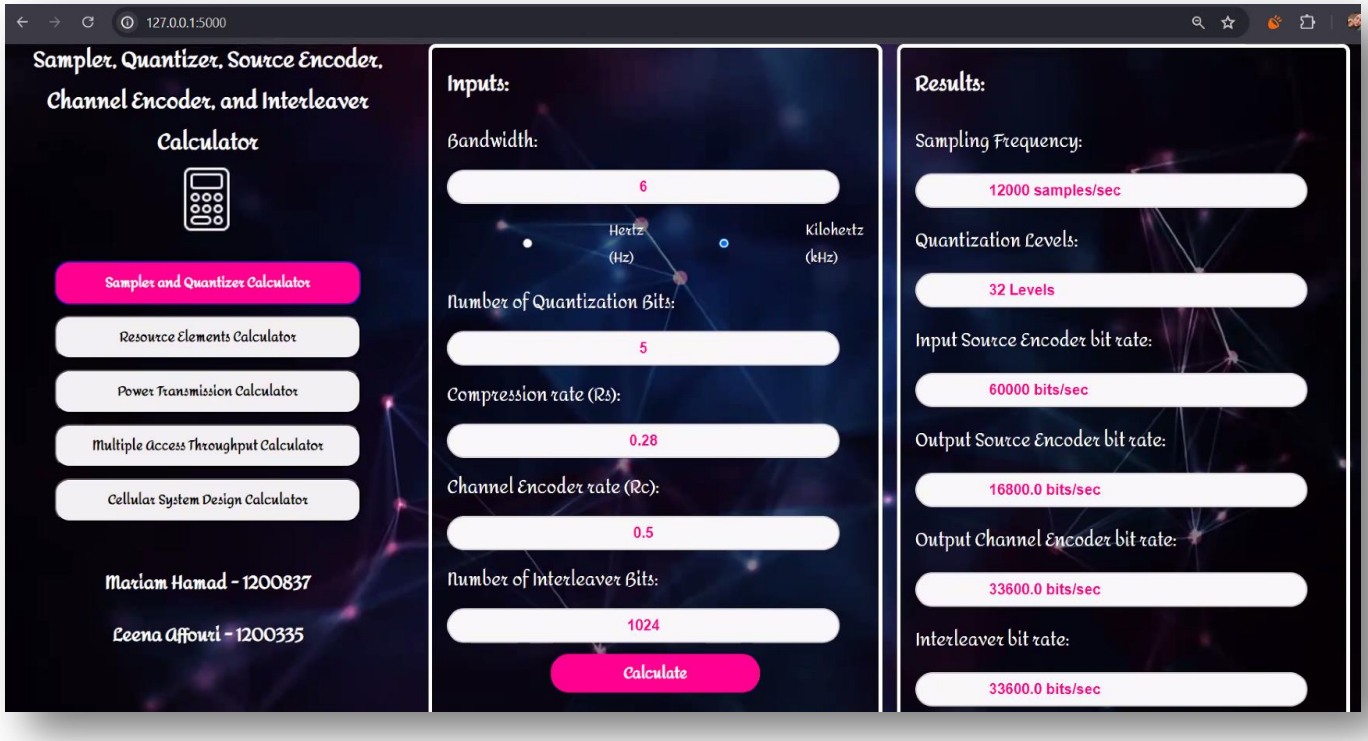

Figure 3: First question third scenario

Second question:

The number of bits and rate for resource elements, OFDM symbol, Resource Blocks, and maximum transmission using parallel resource blocks:

After making the user enter the inputs then click calculate the outputs will show based on these equations:

$$\text{Subcarriers} = \frac{\text{bandwidth}}{\text{spacing}}$$

$$\text{bits Per Resource Element} = \log_2 \text{modulation Val}$$

$$\text{bits Per OFDM Symbol} = \text{bits Per Resource Element} \times \text{subcarriers}$$

$$\text{bits Per OFDM Resource Block} = \text{bits Per OFDM Symbol} \times \text{OFDM Symbols}$$

$$\text{transmission Rate} = \frac{(\text{number Of Parallel Rb} \times \text{bits Per OFDM Resource Block})}{(\text{resource Block Duration} \times 10^{-3})}$$

First scenario:

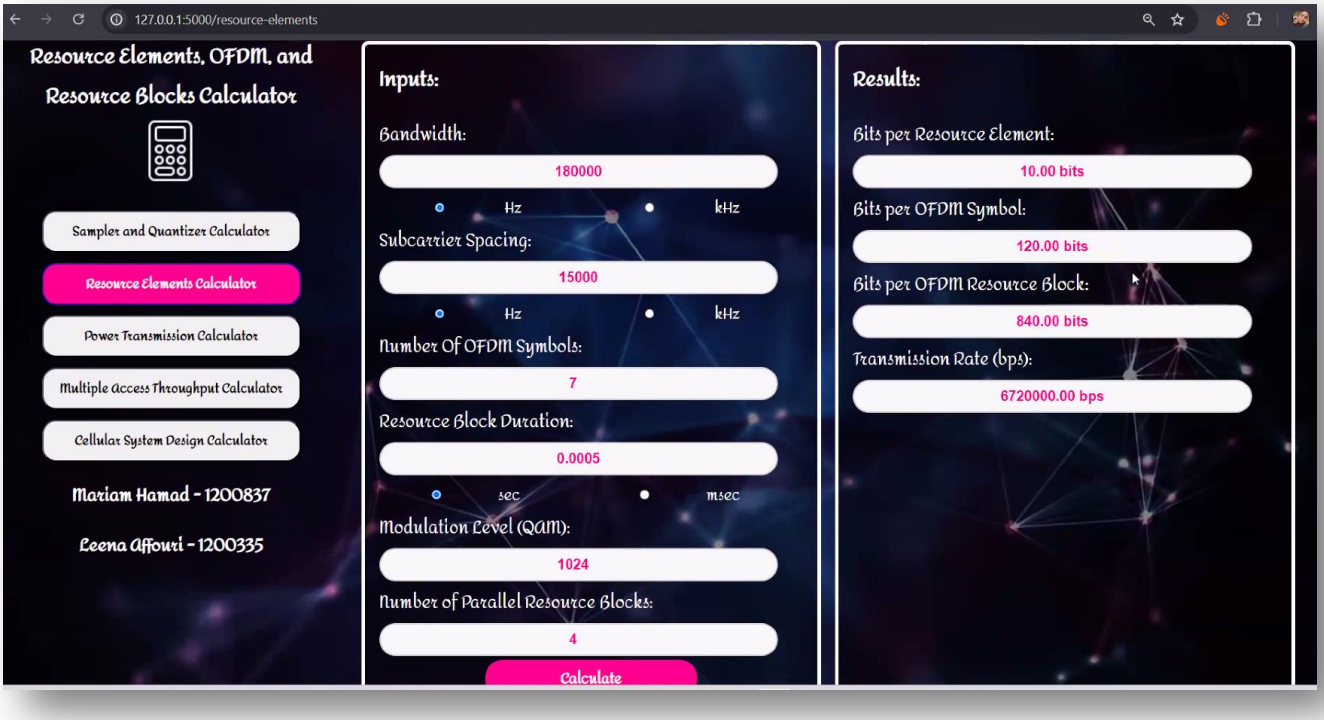

Figure 4: Second question First scenario

Second scenario:

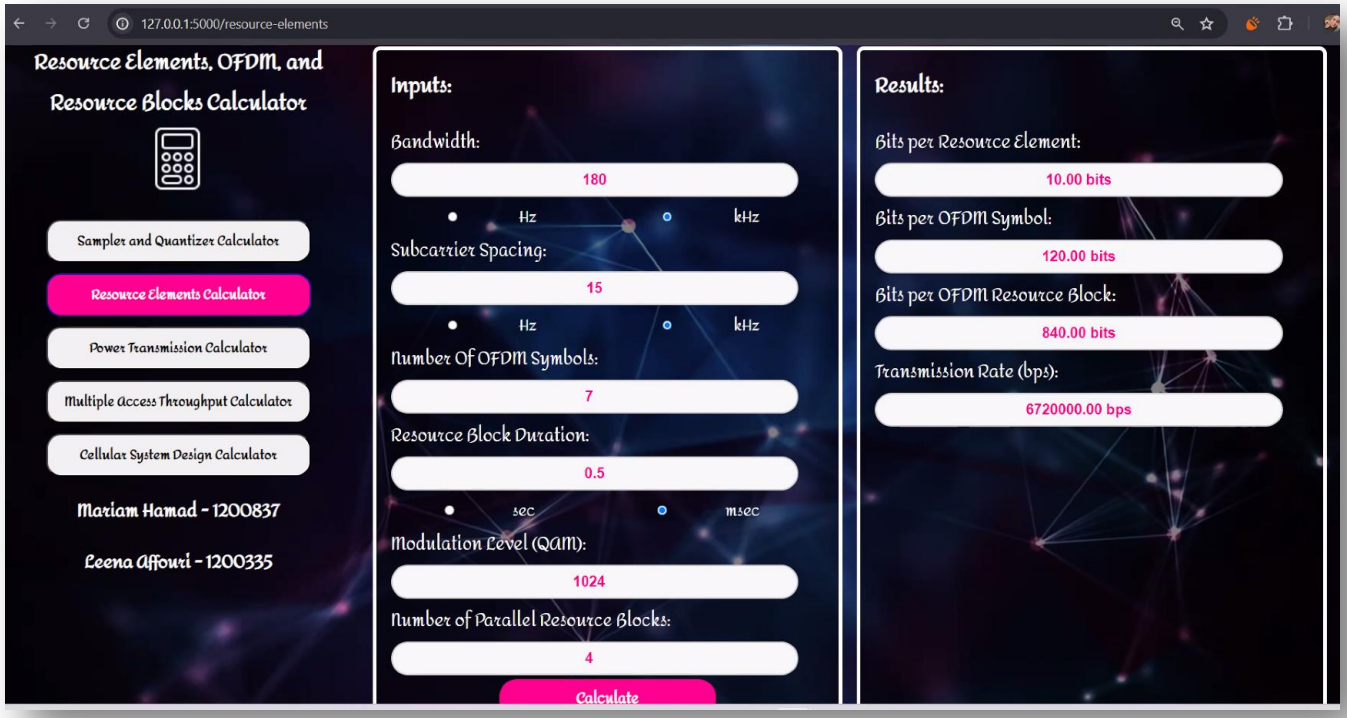

Figure 5: Second question second scenario

Third scenario:

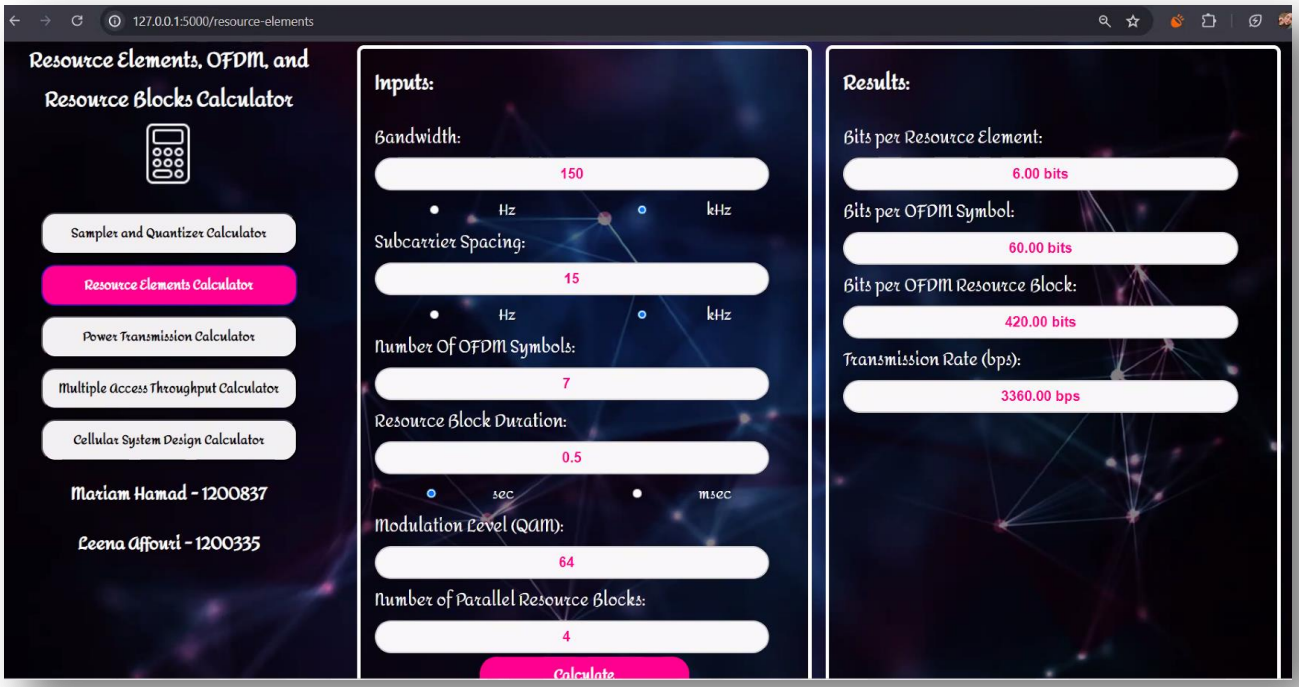

Figure 6: Second question third scenario

Third question:

Power transmitted in a flat environment based on the transmitter and receiver specifications:

After making the user enter the inputs then click calculate the outputs will show based on these equations:

pr = link margin + k + noise temp + noise figure + data rate + results['EbN0']

pt = pr + path loss + antenna feed line loss + other losses + fade margin – transmit antenna gain – receive antenna gain – receiver amplifier gain

First scenario:

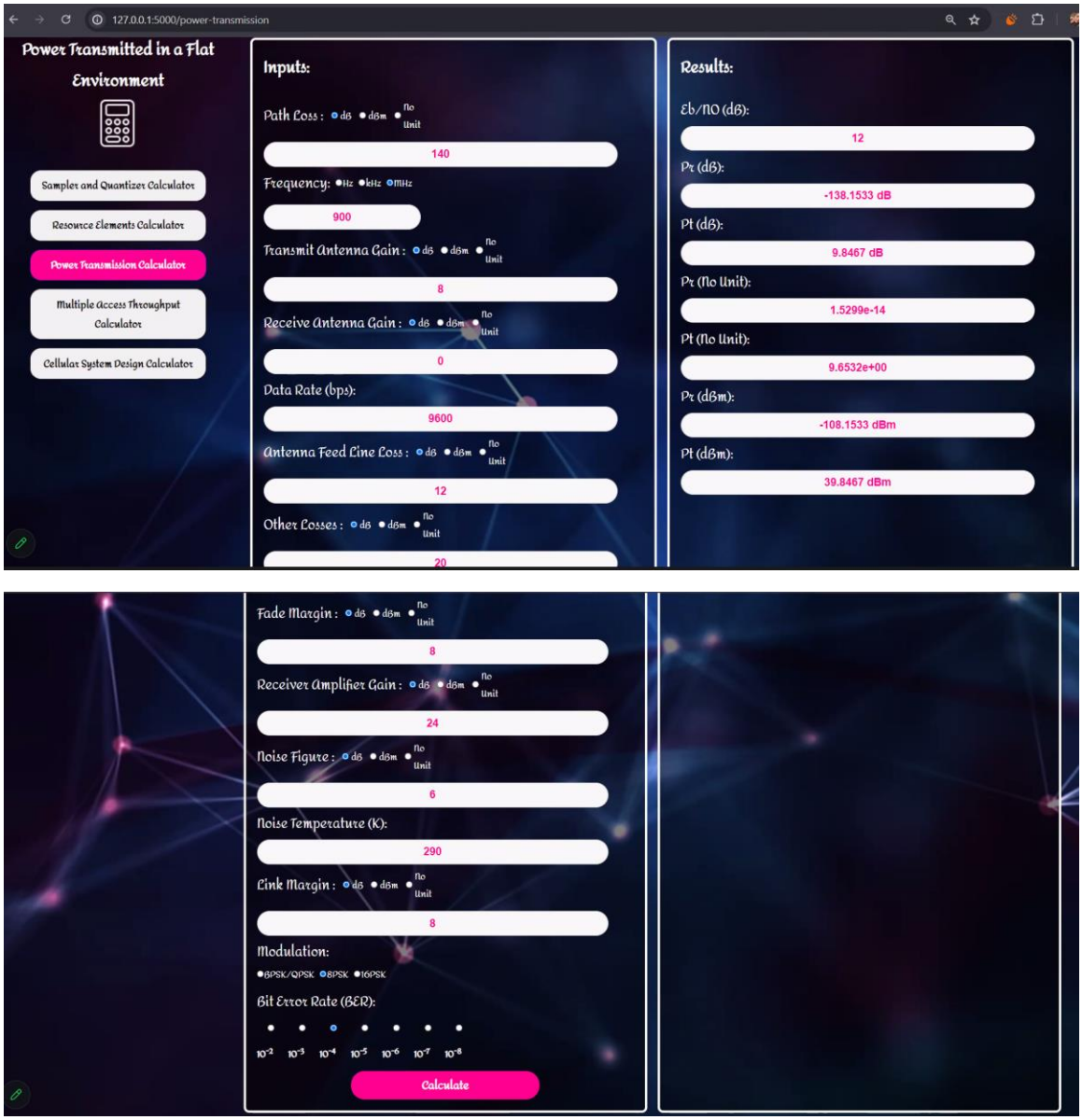

Figure 7: Third question first scenario

Second scenario:

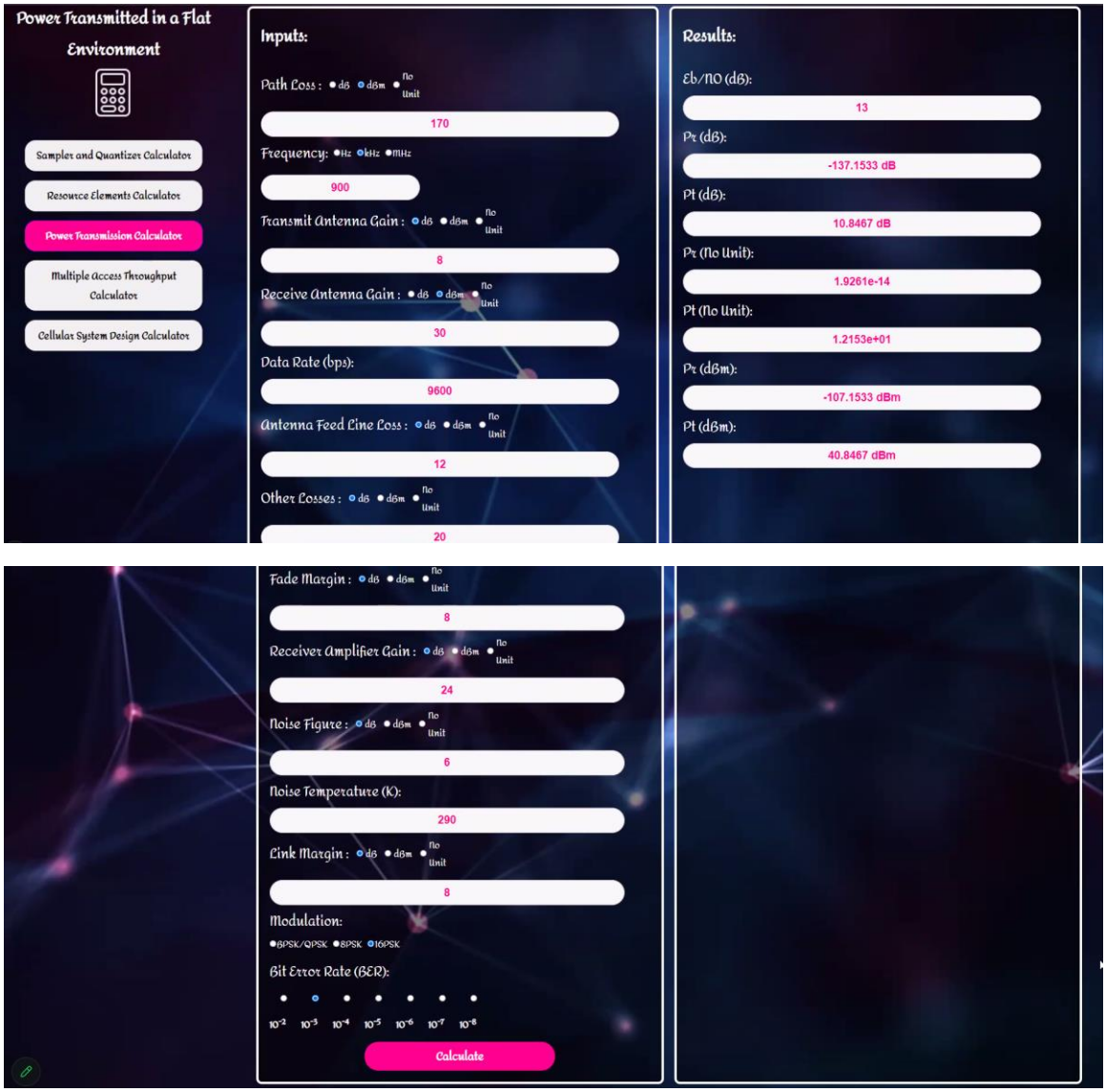

Figure 8: Third question second scenario

Third scenario:

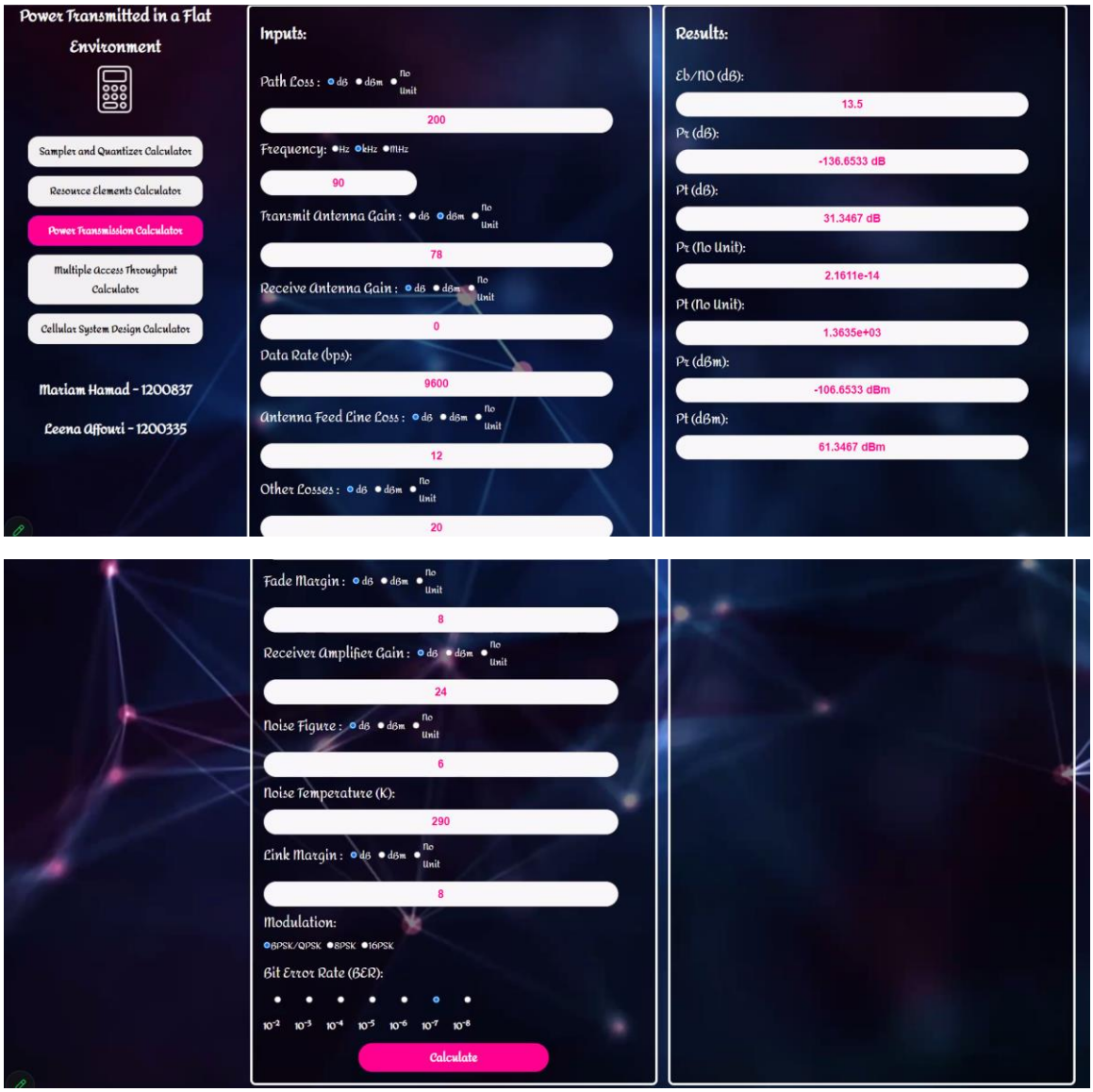

Figure 9: Third question third scenario

Fourth question:

Throughput in percent of Multiple Access techniques:

After making the user enter the inputs then click calculate the outputs will show based on these equations:

"Throughput of Pure ALOHA": throughput = $G \times T \times e^{(-2 \times G \times T)}$

"Throughput of slotted ALOHA": throughput = $G \times T \times e^{(-G \times T)}$

"Throughput unslotted nonpersistent CSMA": throughput = $\frac{(G \times e^{(-2 \times \text{alpha} \times T)})}{G \times (1 + 2 \times \text{alpha}) + e^{(-\text{alpha} \times G)}}$

"Throughput slotted nonpersistent CSMA": throughput = $\frac{(\text{alpha} \times G \times e^{(-2 \times \text{alpha} \times T)})}{G \times (1 - e^{(-2 \times \text{alpha} \times G)} + \text{alpha})}$

"Throughput unslotted 1-persistent CSMA":throughput = $\frac{(G \times (1 + G + \text{alpha} \times G \times (1 + G + \frac{\text{alpha} \times G}{2})) \times e^{(-G \times (1 + 2 \times \text{alpha}))})}{(G \times (1 + 2 \times \text{alpha}) - (1 - e^{(-2 \times \text{alpha} \times G)}) + (1 + \text{alpha} \times G) \times e^{(-G \times (1 + \text{alpha}))})}$

First scenario:

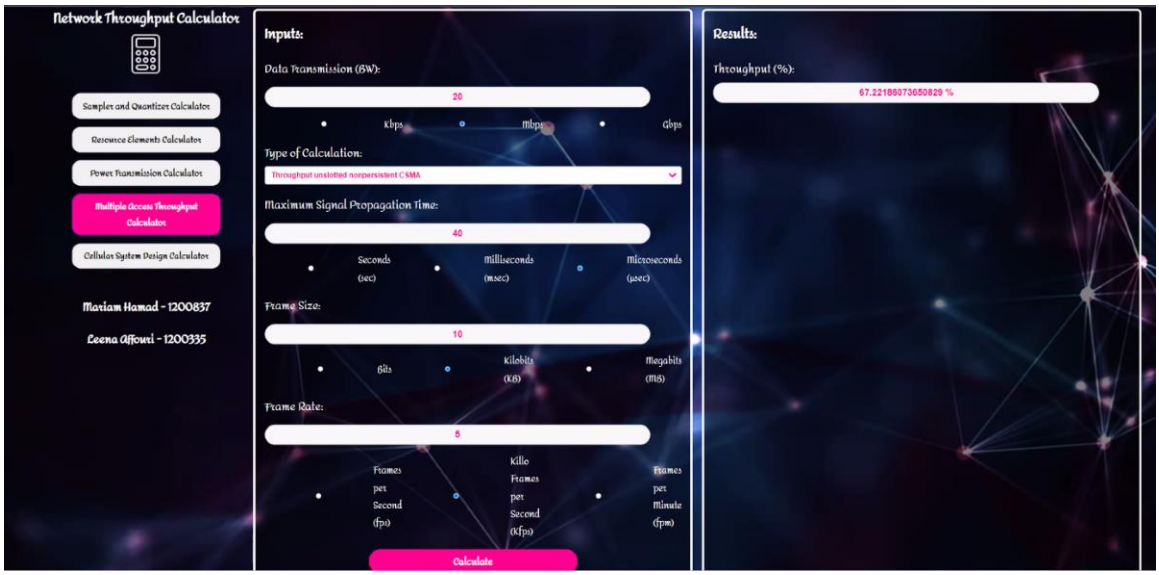

Figure 10: Fourth question first scenario

Second scenario:

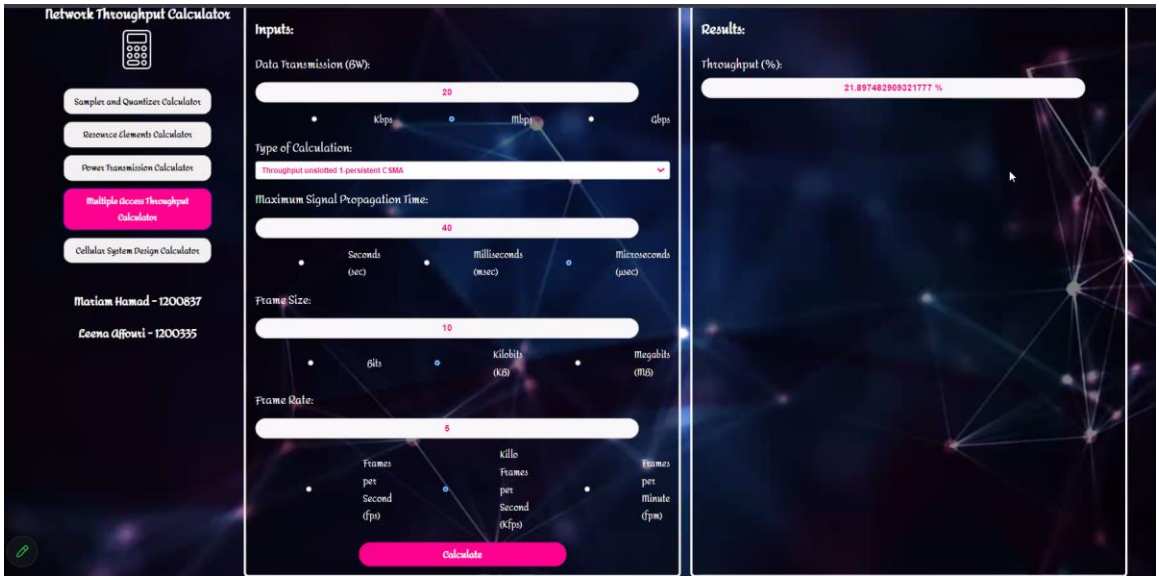

Figure 11: Fourth question second scenario

Third scenario:

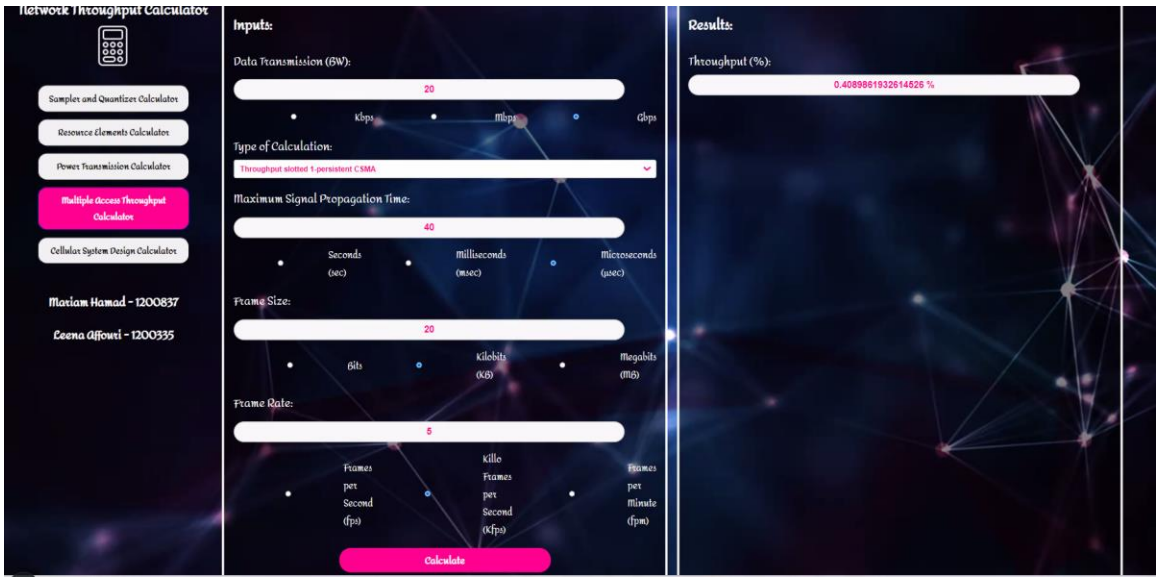

Figure 12: Fourth question third scenario

Fifth question:

Design of cellular system:

After making the user enter the inputs then click calculate the outputs will show based on these equations:

max Distance = ref Distance $\times$ $\left(\frac{\text{probD0}}{\text{receiver Sensitivity}}\right)^{\left(\frac{1}{\text{path Loss Exponent}}\right)}$

cell Size = $\left(\frac{3 \times \sqrt{3}}{2}\right) \times (\text{max Distance}^{\,2})$

number Cells = $\frac{\text{city Area}}{\text{cell Size}}$

system Traffic = $\frac{\text{num Users} \times \text{calls Per Day} \times \text{call Duration}}{(24 \times 60)}$

traffic Per Cell = $\frac{\text{system Traffic}}{\text{num Cells}}$

cells Per Cluster = $\frac{(\text{minimum SIR} \times \text{co Channel Cells})^{\left(\frac{2}{\text{path Loss Exponent}}\right)}}{3}$

min number of carrier = $\frac{\textit{the number of channel for the GOS probability with the traffic load for each cell in earlang table}}{\textit{number of channel in timeslot}}$

First scenario:

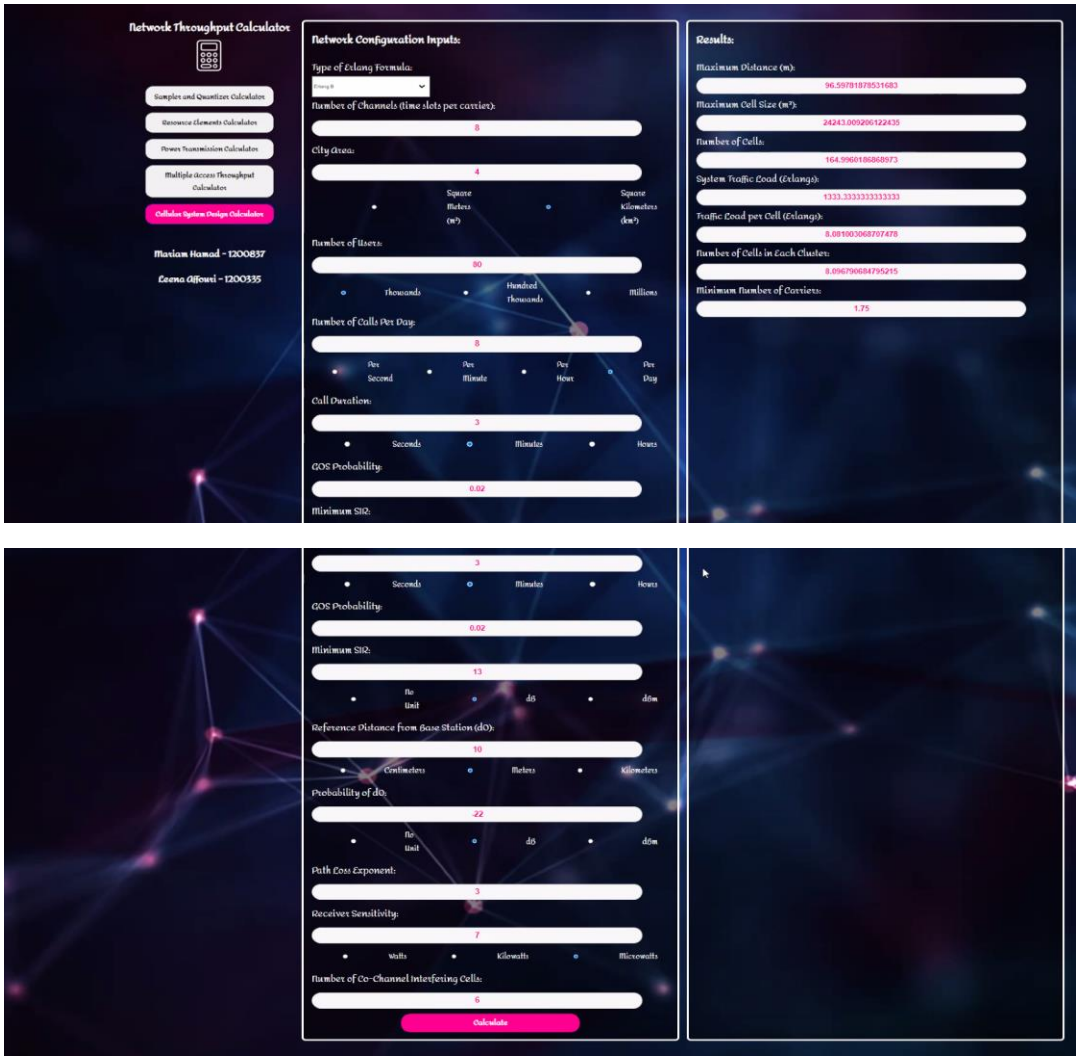

Figure 13: Fifth question first scenario

Second scenario:

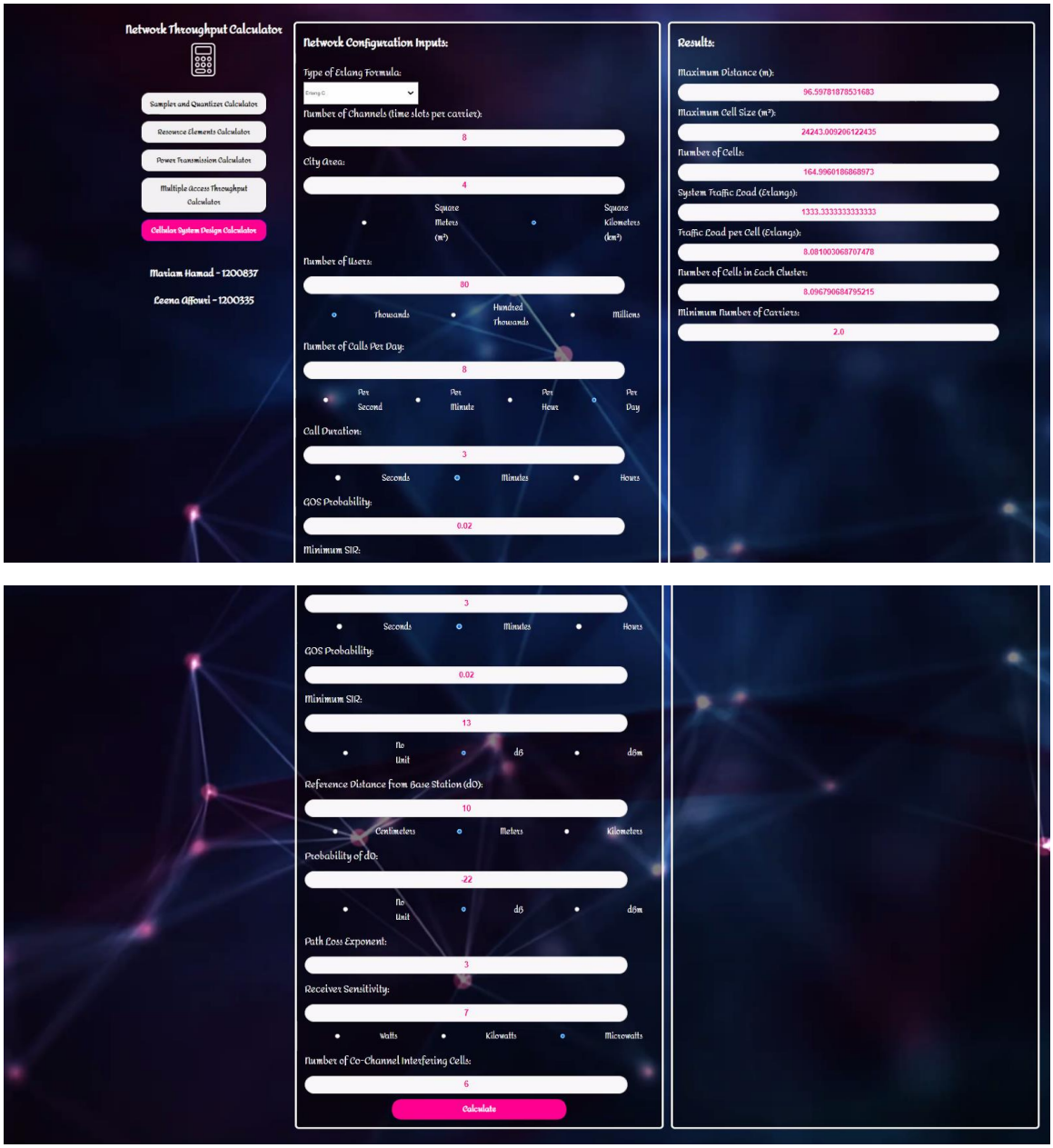

Figure 14: Fifth question second scenario

Third scenario:

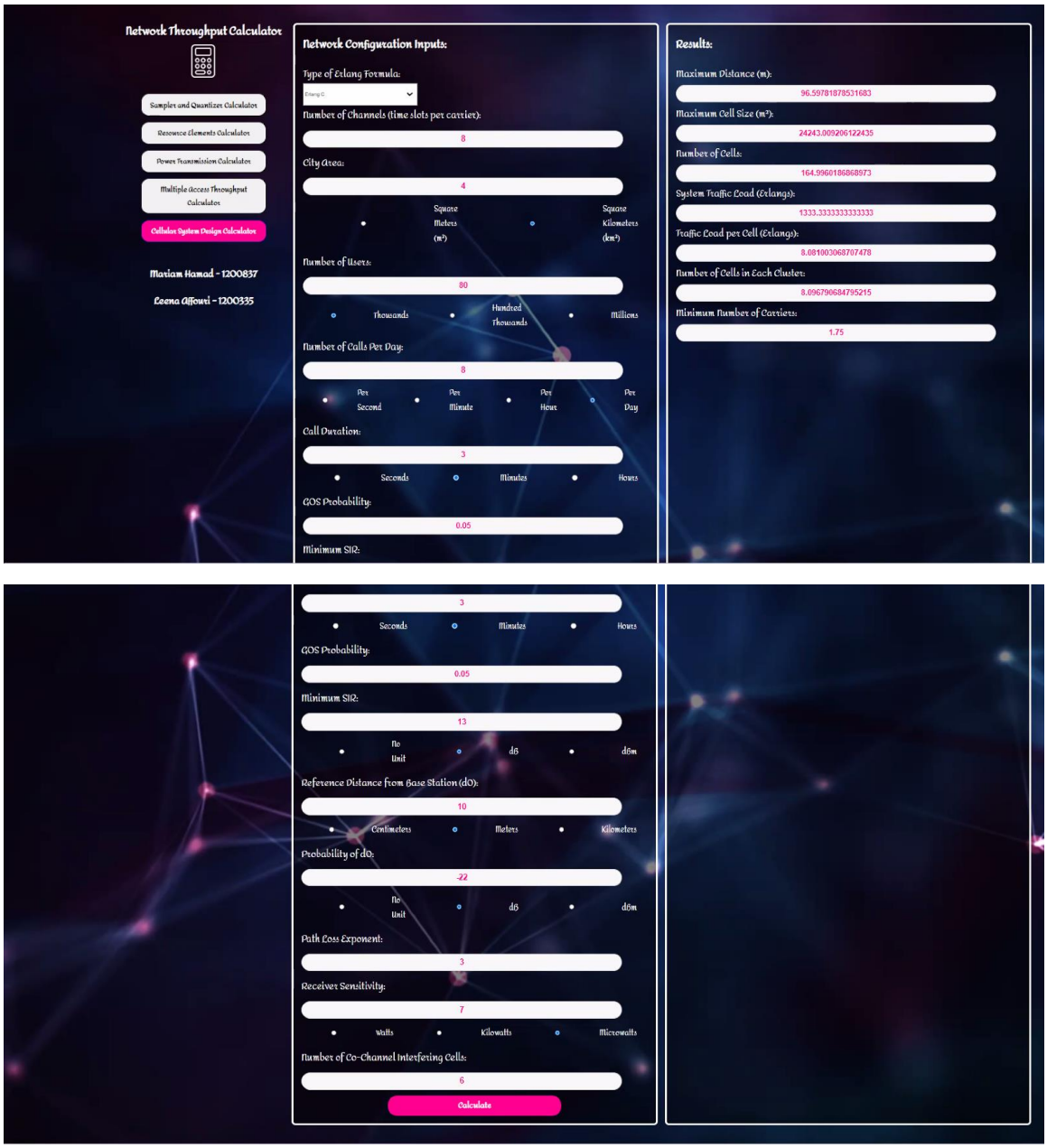

Figure 15: Fifth question third scenario