FACULTY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF COMPUTER ENGINEERING

WIRELESS AND MOBILE NETWORKS
ENCS5323

Project – Online Calculator for Wireless and Mobile Network

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Section: 3

Date: 21 June, 2024

Project Question

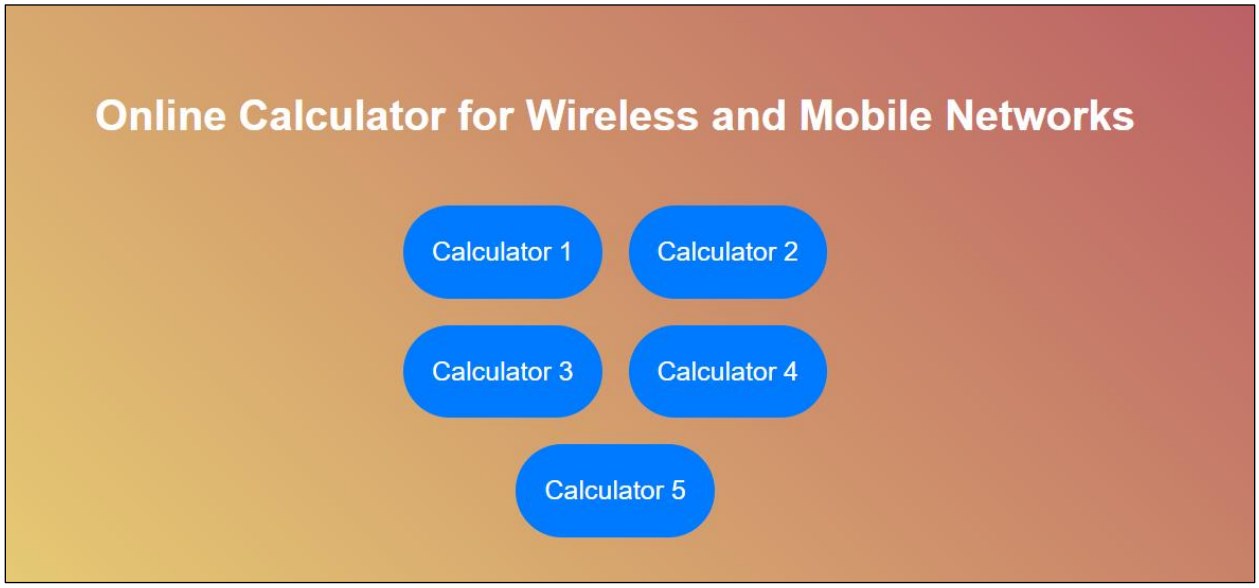
Design and build an online calculator for the following:

1. The number of bits and rate of the sampler, quantizer, source encoder, channel encoder, and interleaver.
2. The number of bits and rate for resource elements, OFDM symbol, Resource Blocks, and maximum transmission using parallel resource blocks.
3. Power transmitted in a flat environment based on the transmitter and receiver specifications.
4. Throughput in percent of Multiple Access techniques.
5. Design of cellular system.

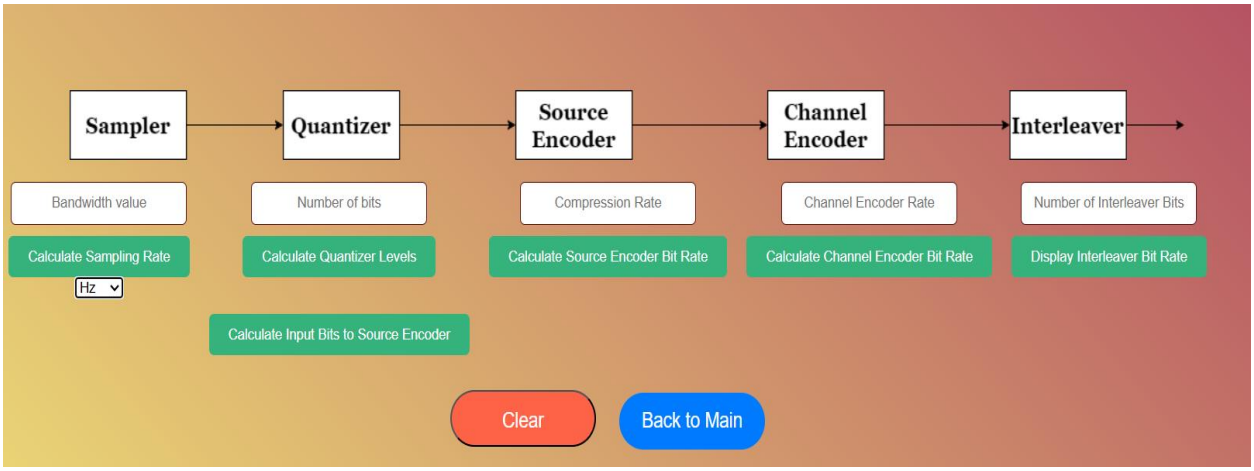
For each of the items above, you must let the user input the maximum system parameters required to solve the computations (refer to the explanation in the video recording of the project). Work in groups of at most two students. Submit, as a reply to this message, a short report that includes the screenshots of each calculator with at least three scenarios.

In our project, we built five calculators to determine various parameters. We used HTML, CSS, and JavaScript to develop these calculators.

The main page:



Calculator One:



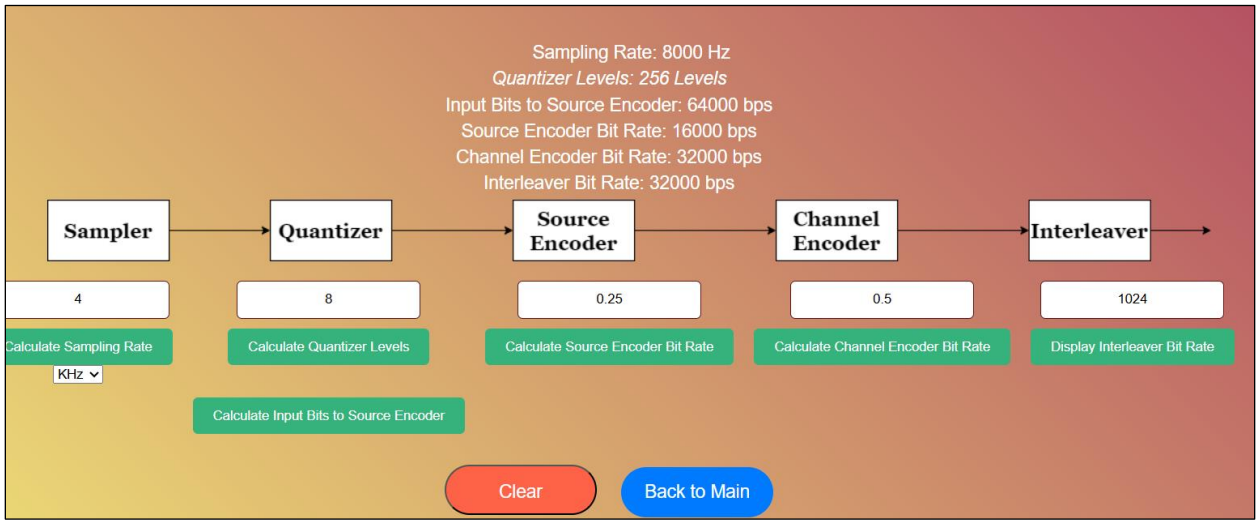
In the first calculator, we need the following inputs:

1. Bandwidth
2. Number of bits for quantization
3. Compression rate
4. Channel encoder rate
5. Number of bits per interleaver

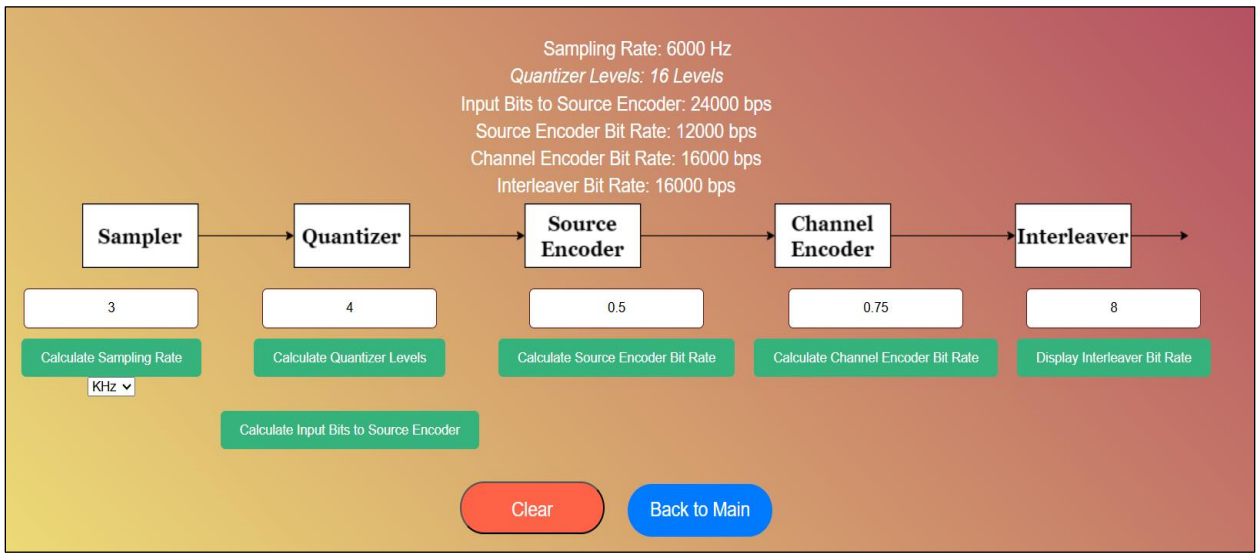
The outputs include:

1. Calculate the sampling frequency.
2. Find the number of quantization levels.
3. Determine the bit rate at the output of the source encoder.
4. Calculate the bit rate at the output of the channel encoder.
5. Calculate the bit rate at the output of the interleaver.

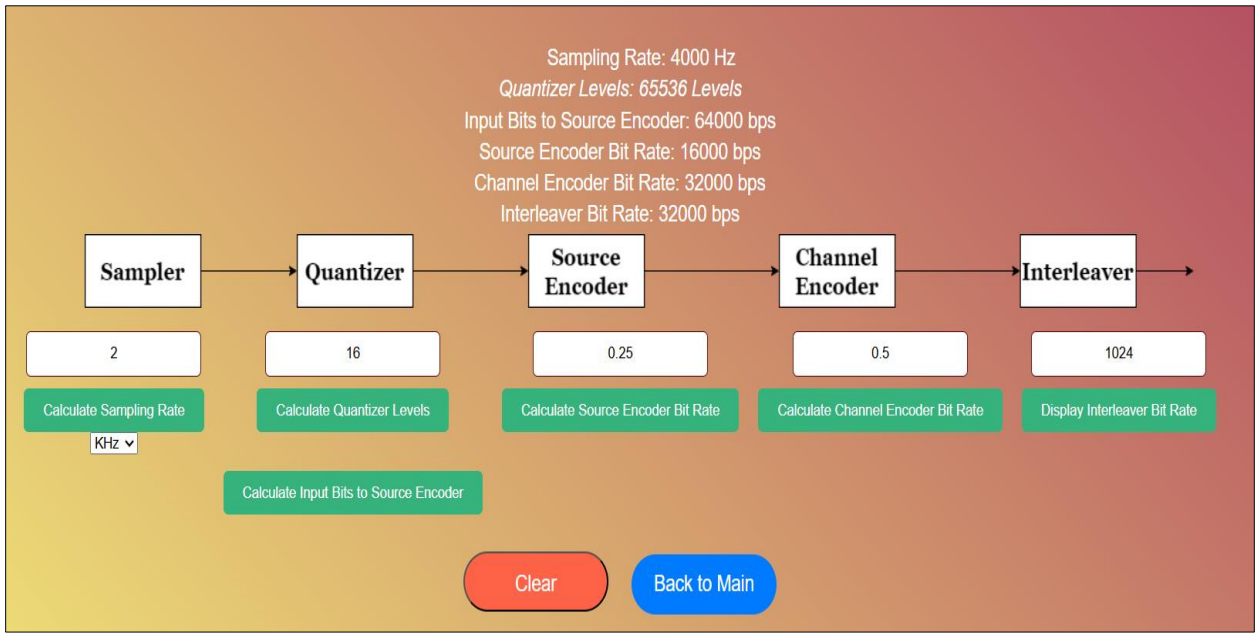
First scenario:



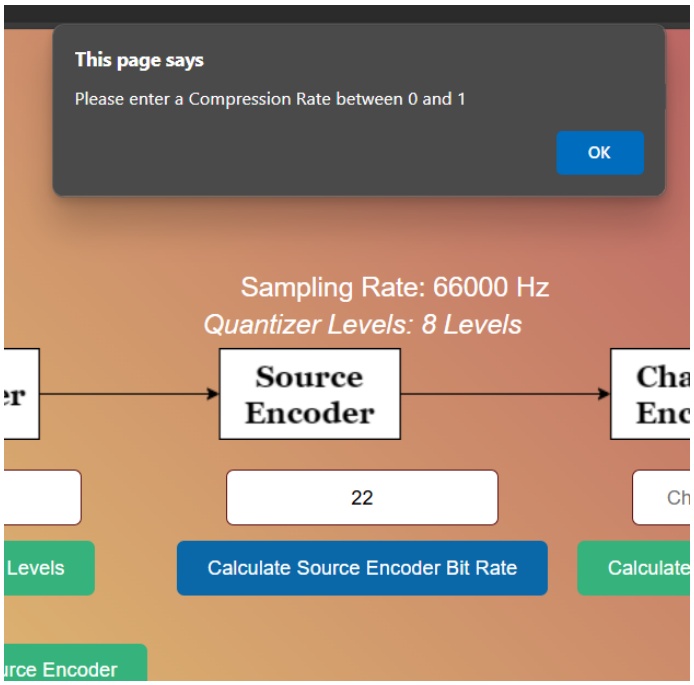
Second scenario:



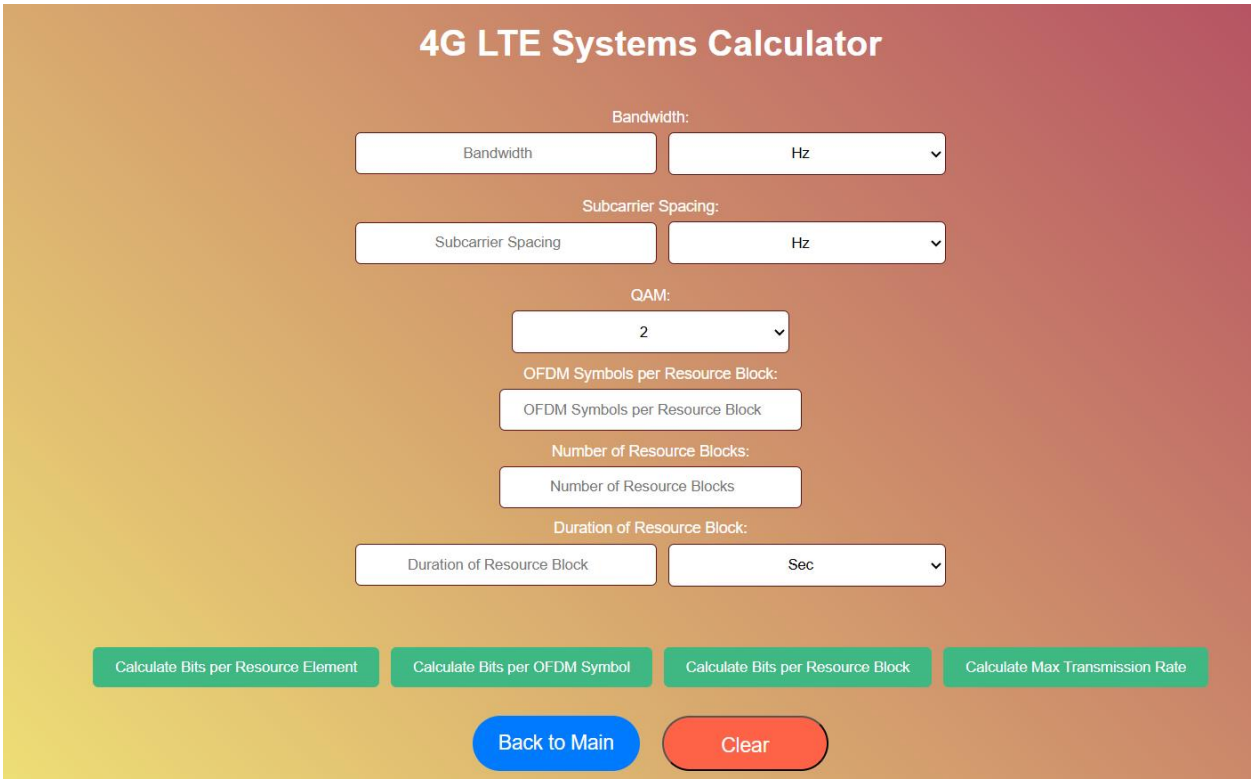
Third scenario:



For the following figure it shows an Error case that the user enter invalid value of rate larger than one:



Calculator Two:



Inputs:

1. Bandwidth of a resource block
2. Subcarrier spacing
3. Number of OFDM symbols per resource block
4. Duration of a resource block
5. Modulation type
6. Number of parallel resource blocks assigned continuously

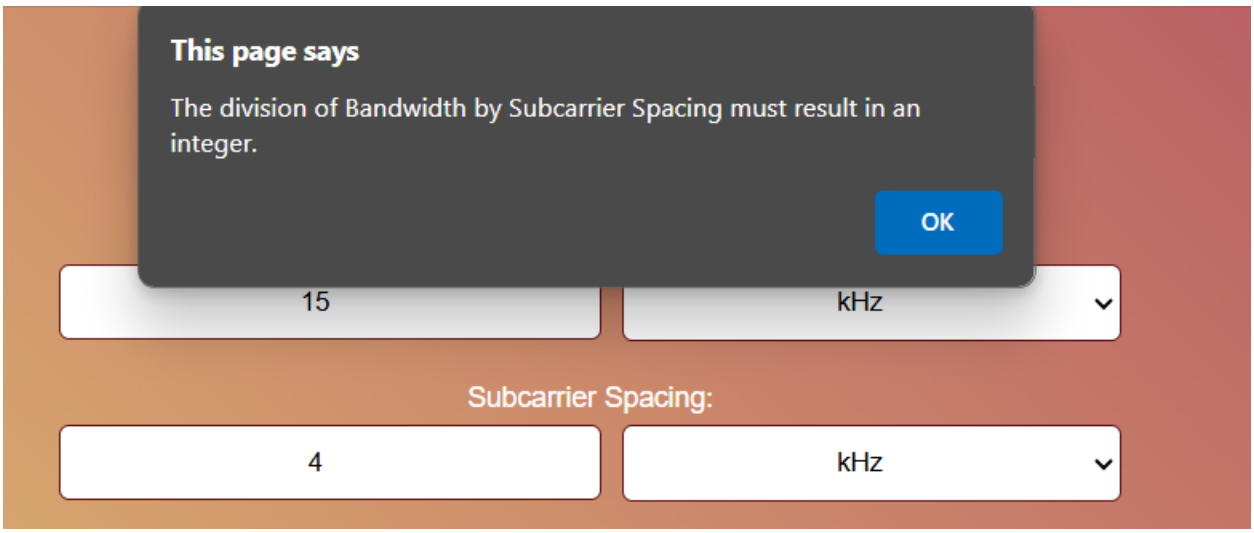
Outputs:

1. Number of bits per resource element
2. Number of bits per OFDM symbol
3. Number of bits per OFDM resource block
4. Maximum transmission rate for a user assigned 4 parallel resource blocks continuously

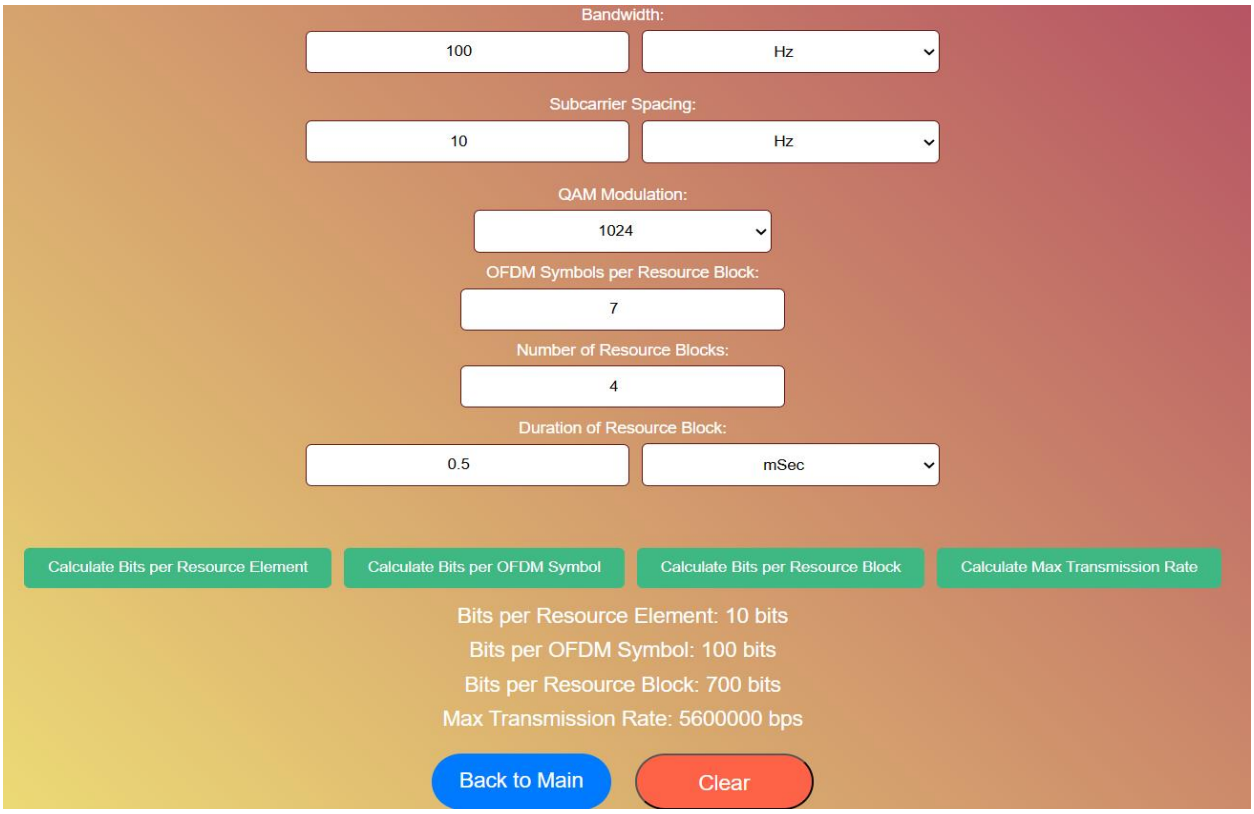
First scenario

Note: The division of Bandwidth of a resource block by Subcarrier spacing must result in an integer. If not, an error message will be displayed.

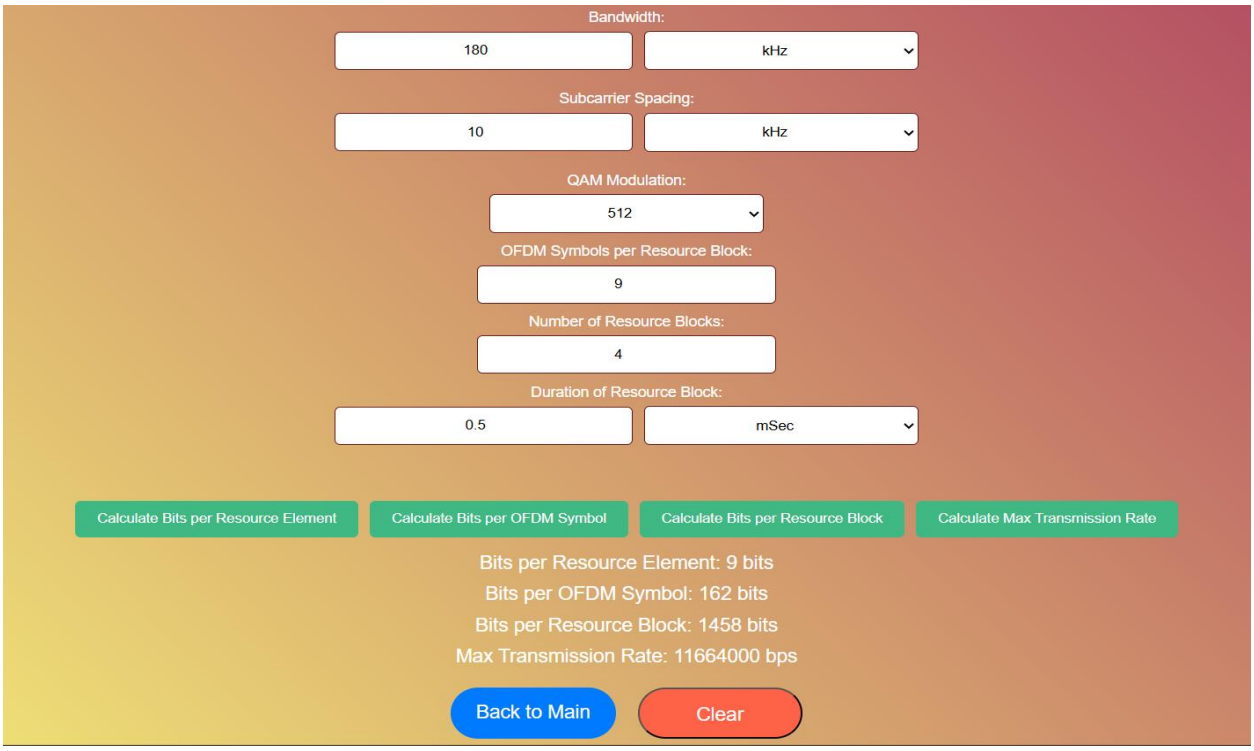
For example:



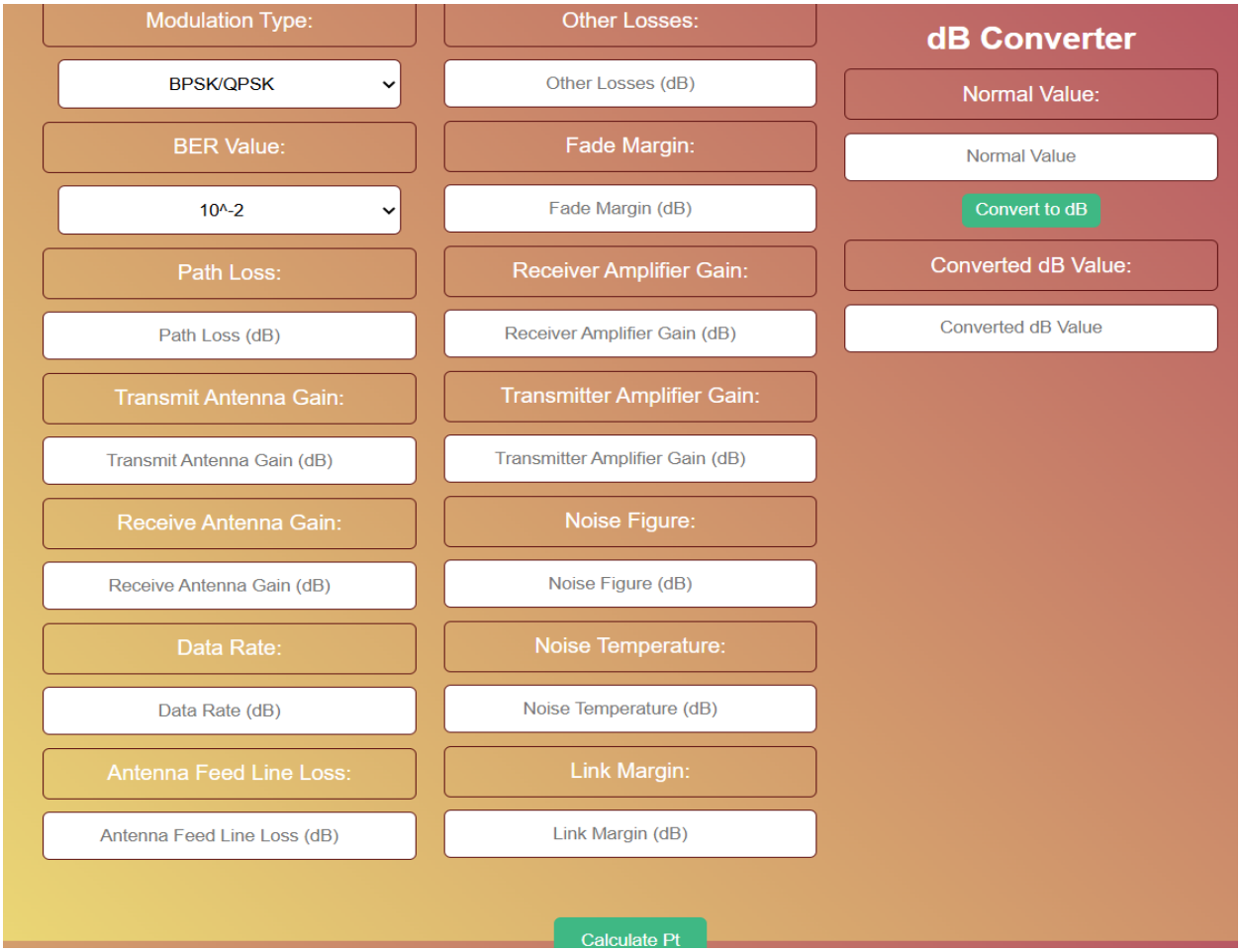
Second scenario:



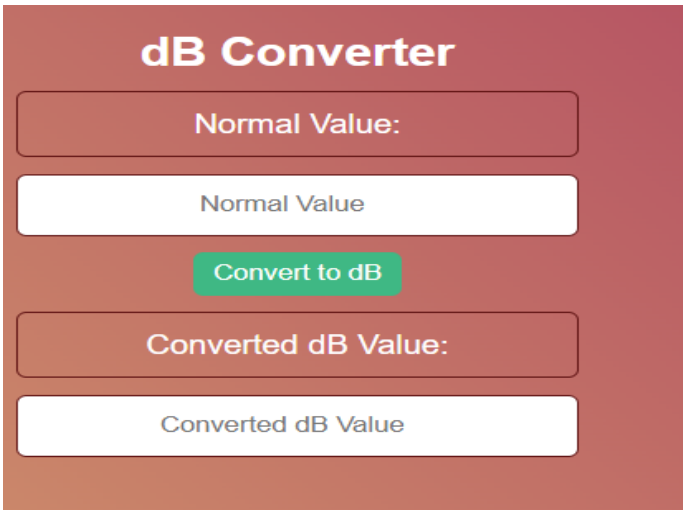
Third scenario:



Calculator Three:



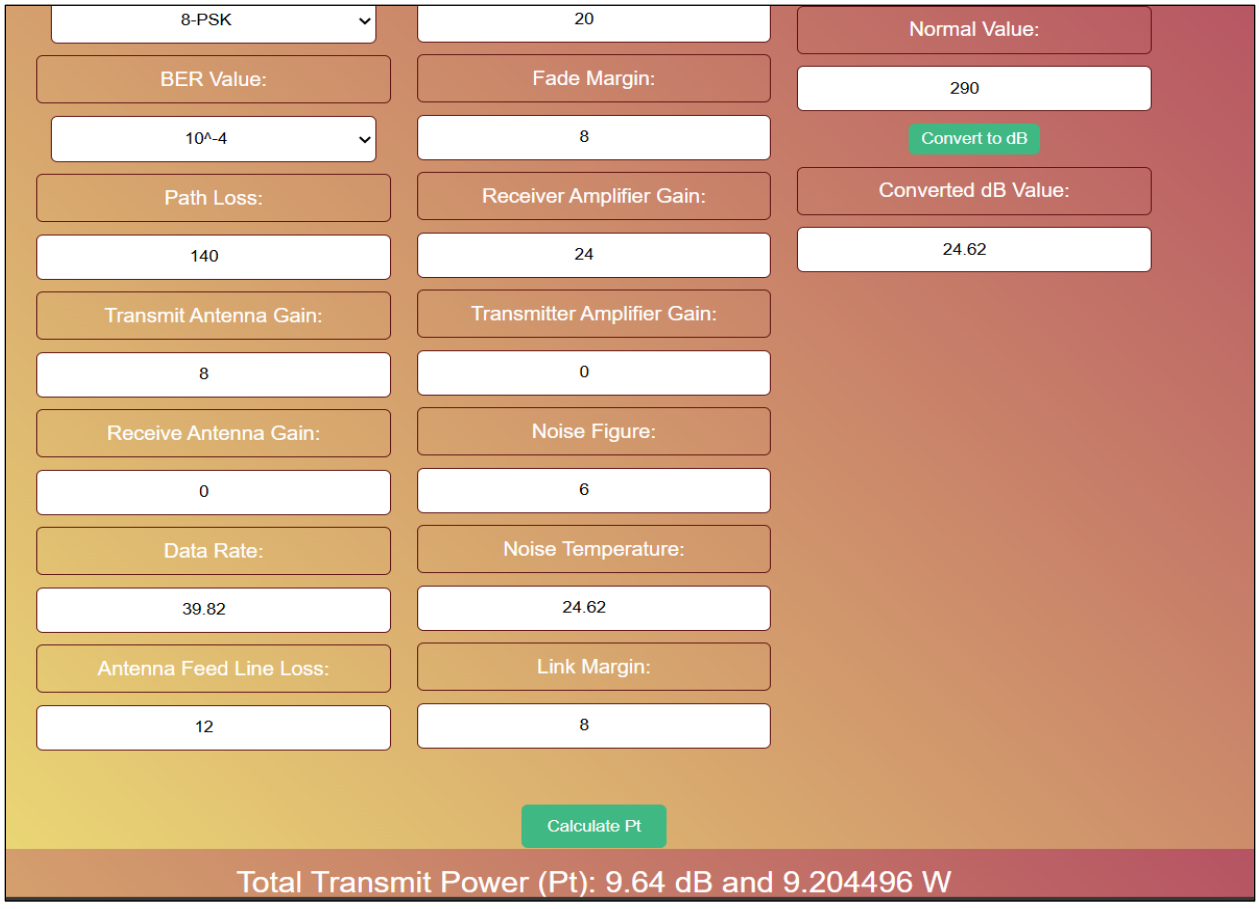
We built a separate calculator to convert numbers to dB. If you have a value not in dB, you can first convert this value using the calculator, then use the output to find the transmit power in the main calculator:



First scenario:

The problem was solved using the online calculator:

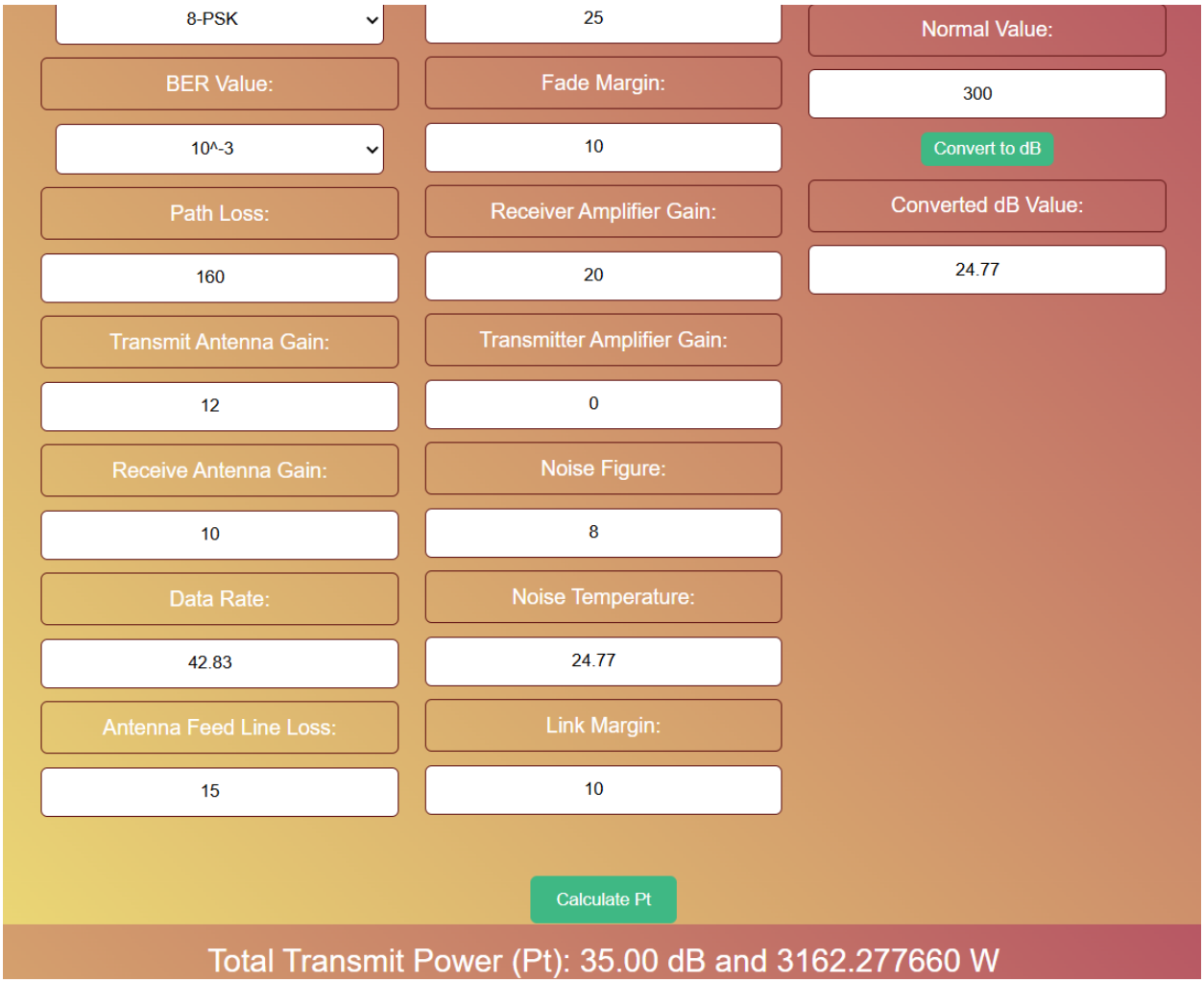
Given a flat rural environment with a path loss of 140 dB, a frequency of 900 MHz, 8dB transmit antenna gain and 0dB receive antenna gain, data rate of 9.6kbps, 12dB in antenna feed line loss, 20dB in other losses, a fade margin of 8dB, receiver amplifier gain of 24dB, noise figure total of 6dB, a noise temperature of 290K, and link margin of 8 dB. Find the total transmit power required of an 8-PSK modulated signal with a maximum bit error rate of 10^{-4}.



Second scenario:

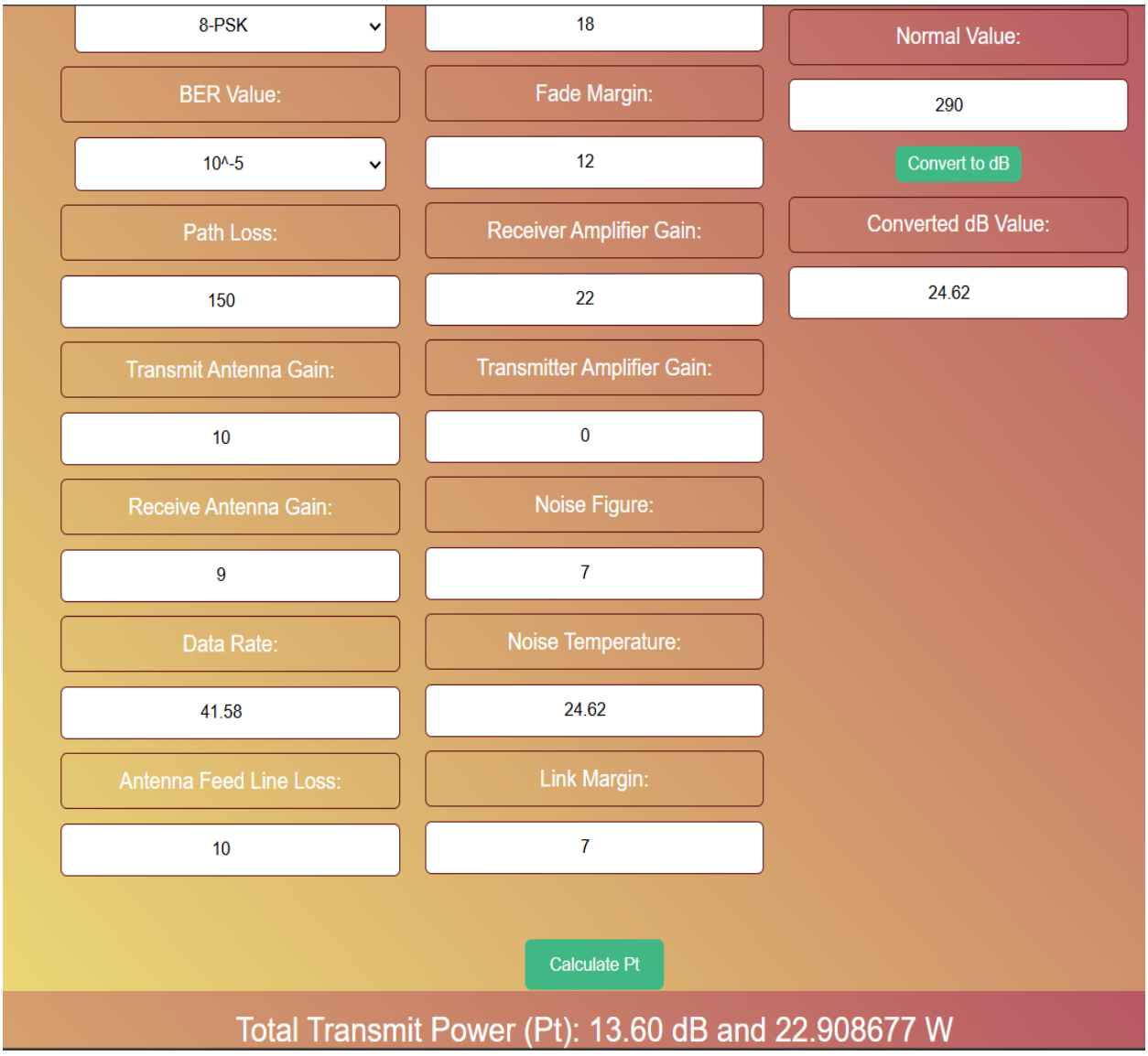
The problem was solved using the online calculator:

Given an urban environment with a path loss of 160 dB, a frequency of 1800 MHz, 12 dB transmit antenna gain, and 10 dB receive antenna gain, a data rate of 19.2 kbps, 15 dB in antenna feed line loss, 25 dB in other losses, a fade margin of 10 dB, receiver amplifier gain of 20 dB, noise figure total of 8 dB, a noise temperature of 300K, and a link margin of 10 dB. Find the total transmit power required of an 8-PSK modulated signal with a maximum bit error rate of 10^-3.



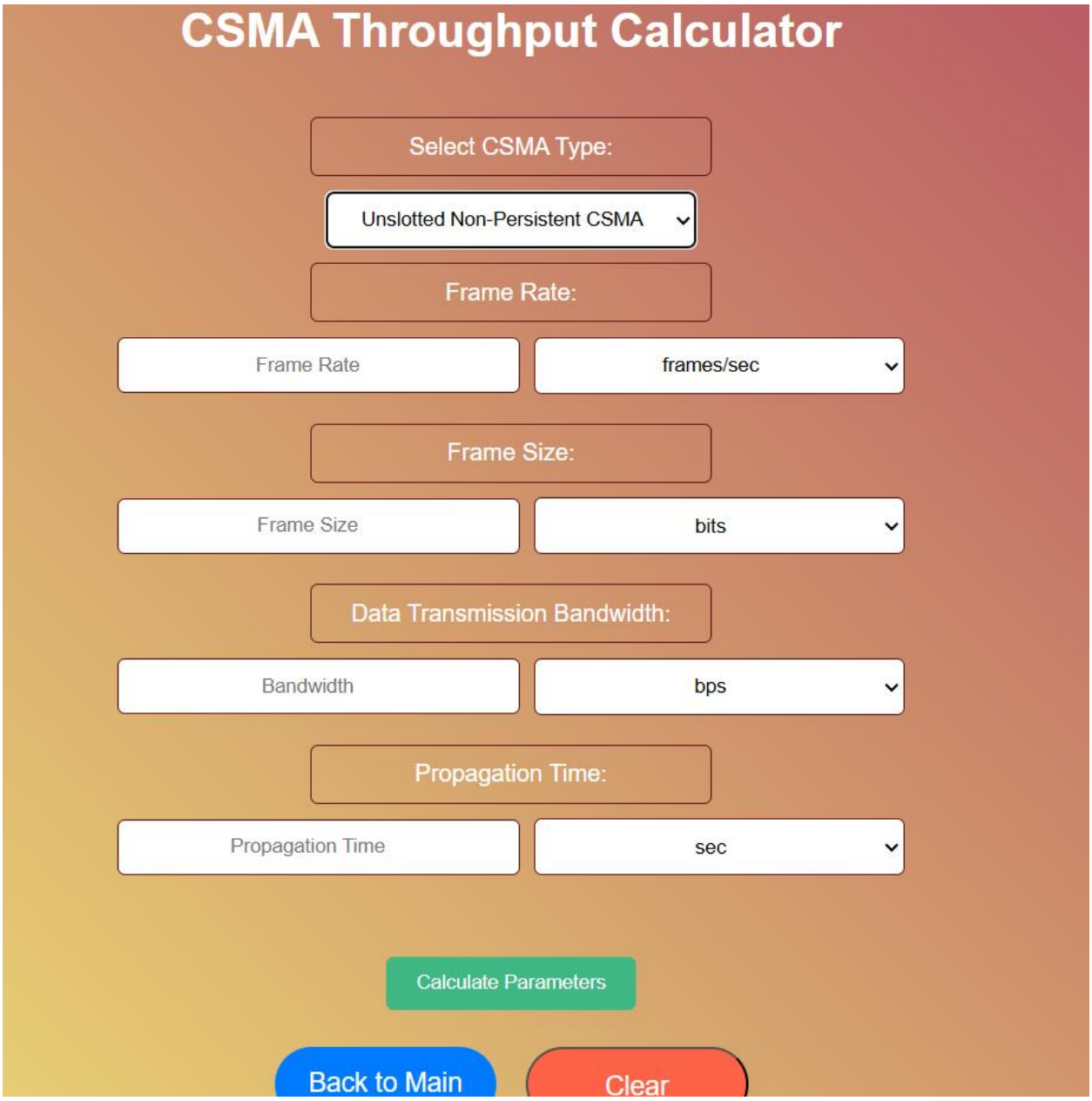
Third scenario:

Given a suburban environment with a path loss of 150 dB, a frequency of 2500 MHz, 10 dB transmit antenna gain, and 9 dB receive antenna gain, a data rate of 14.4 kbps, 10 dB in antenna feed line loss, 18 dB in other losses, a fade margin of 12 dB, receiver amplifier gain of 22 dB, noise figure total of 7 dB, a noise temperature of 290K, and a link margin of 7 dB. Find the total transmit power required of an 8-PSK modulated signal with a maximum bit error rate of 10^-5.



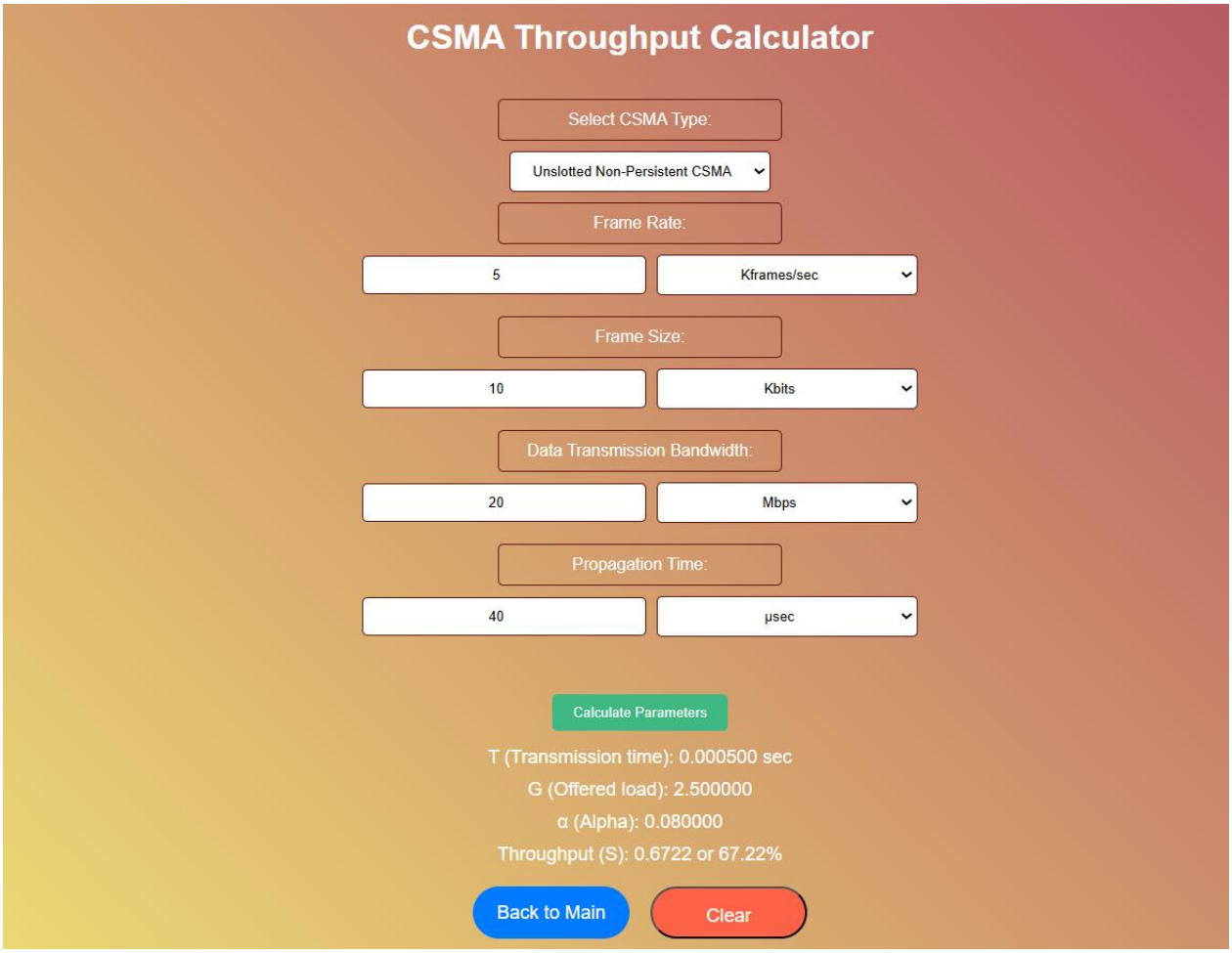
Calculator Four:

This calculator is designed to determine the throughput of various types of Carrier Sense Multiple Access (CSMA) protocols. By inputting specific parameters, users can calculate the throughput in percentage for different CSMA types (Unslotted Non-Persistent, Slotted Non-Persistent, Unslotted 1-Persistent, Slotted 1-Persistent).

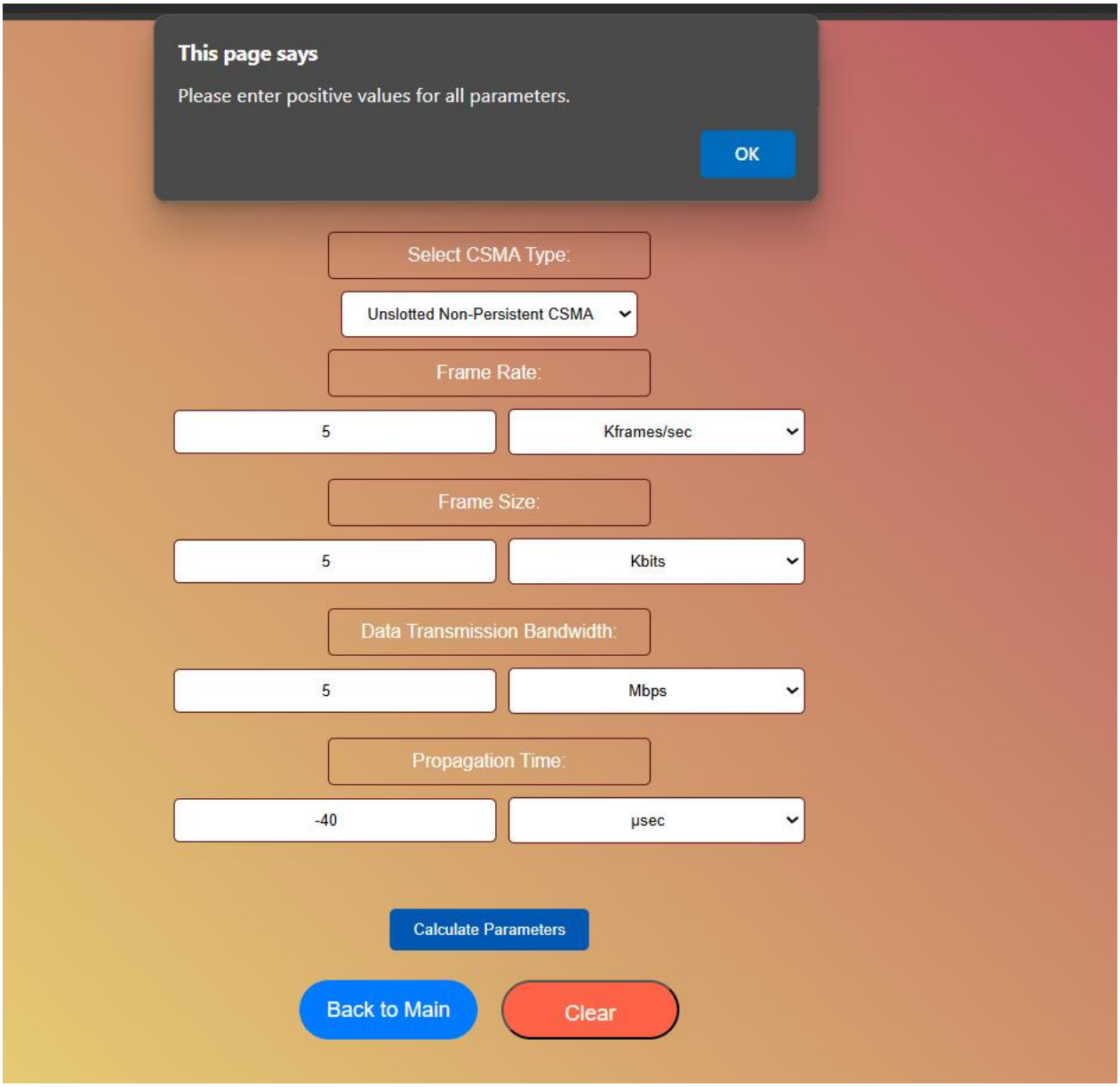


First scenario:

In this scenario, we calculate the throughput of an unslotted non-persistent CSMA protocol.

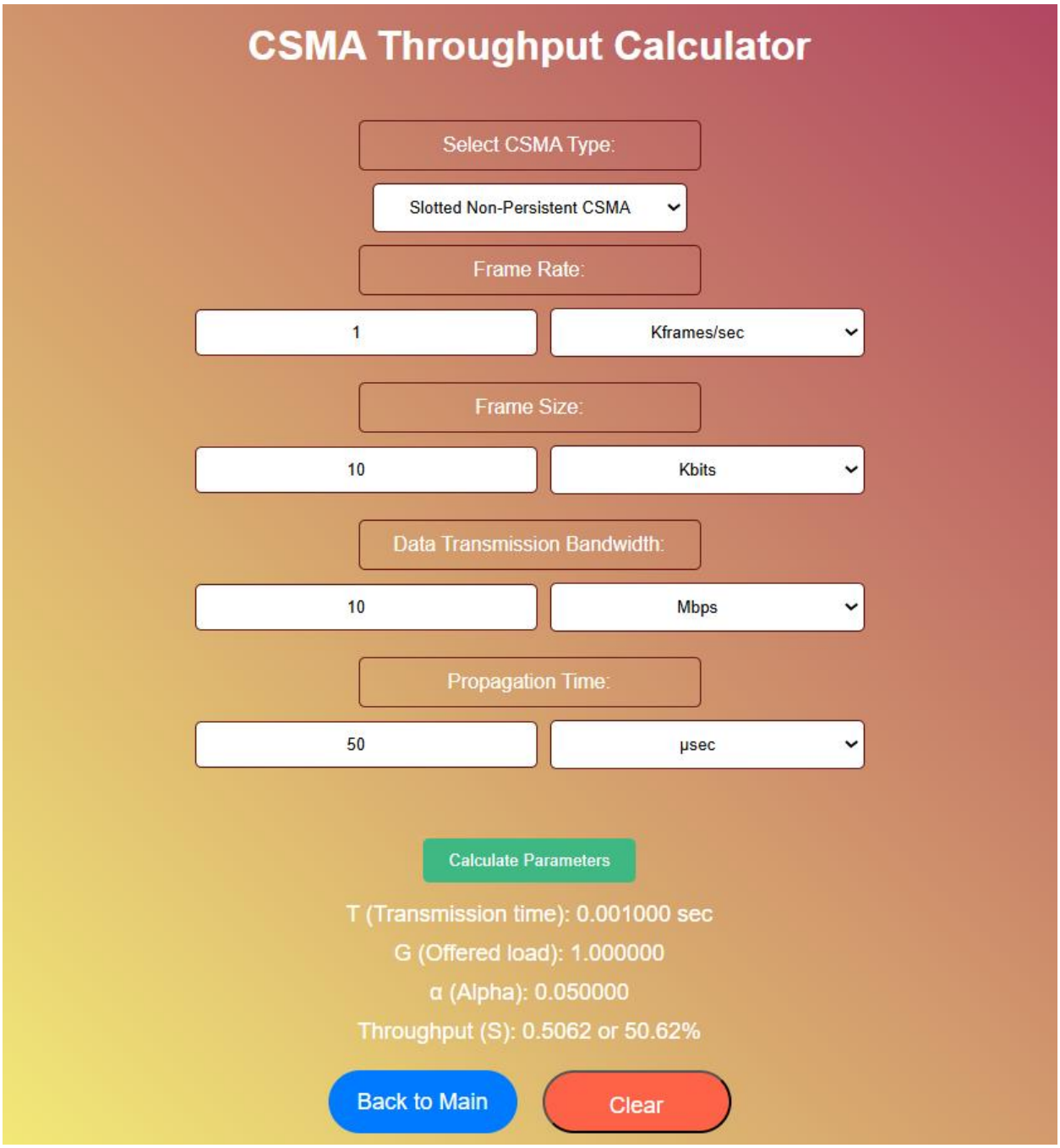


Note: Users must input positive values for all parameters. The system validates the inputs to ensure the calculations are accurate.



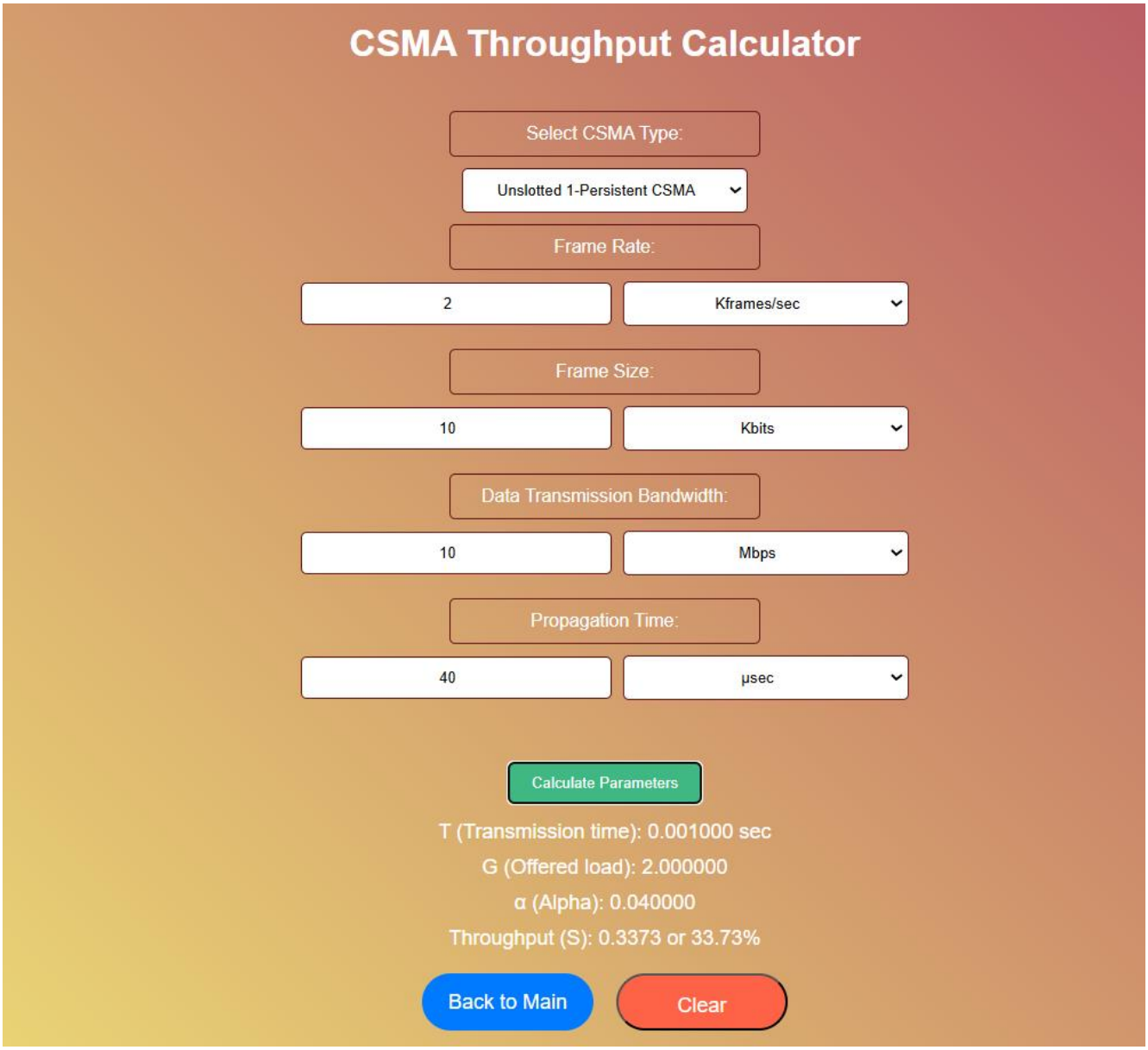
Second scenario:

In this scenario, we calculate the throughput of a Slotted non-persistent CSMA protocol.



Third scenario:

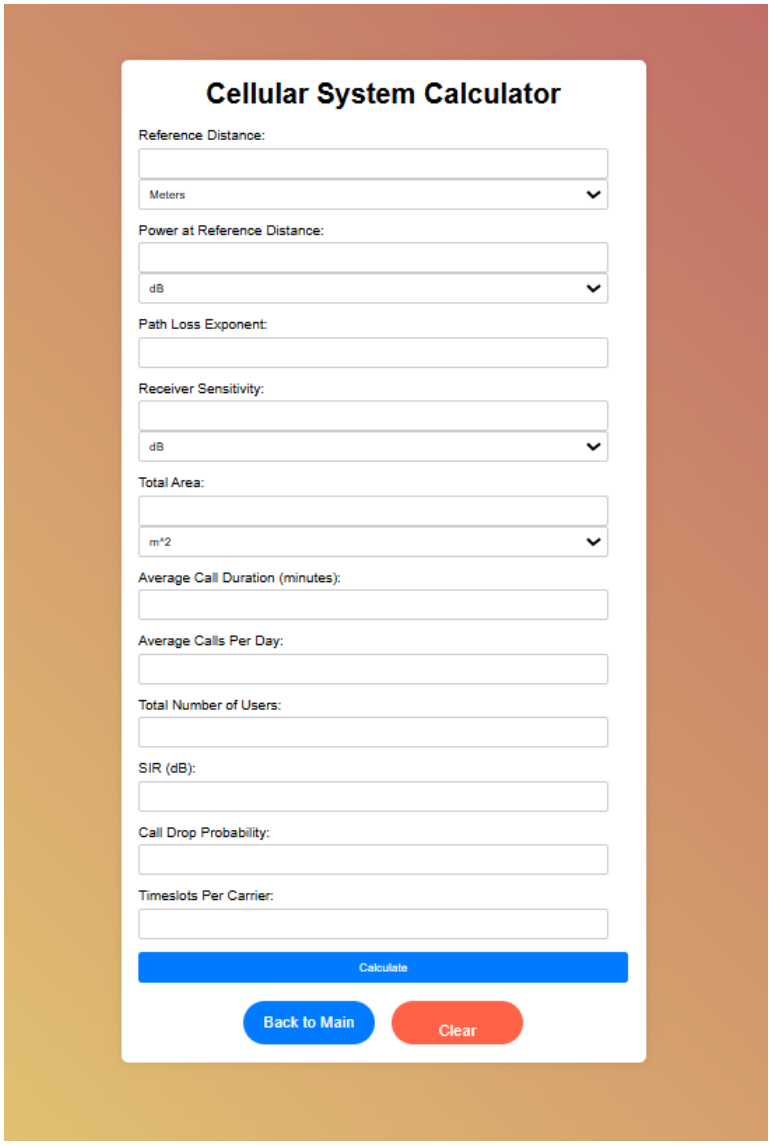
In this scenario, we calculate the throughput of an Unslotted 1-persistent CSMA protocol.



Calculator Five:

This calculator is cellular system, to calculate several parameters, the maximum distance, maximum cell size, number of cells, total traffic, cell traffic, Number of Cells in Cluster, and Number of carriers in whole system.

the following figure shows the design of the calculator:



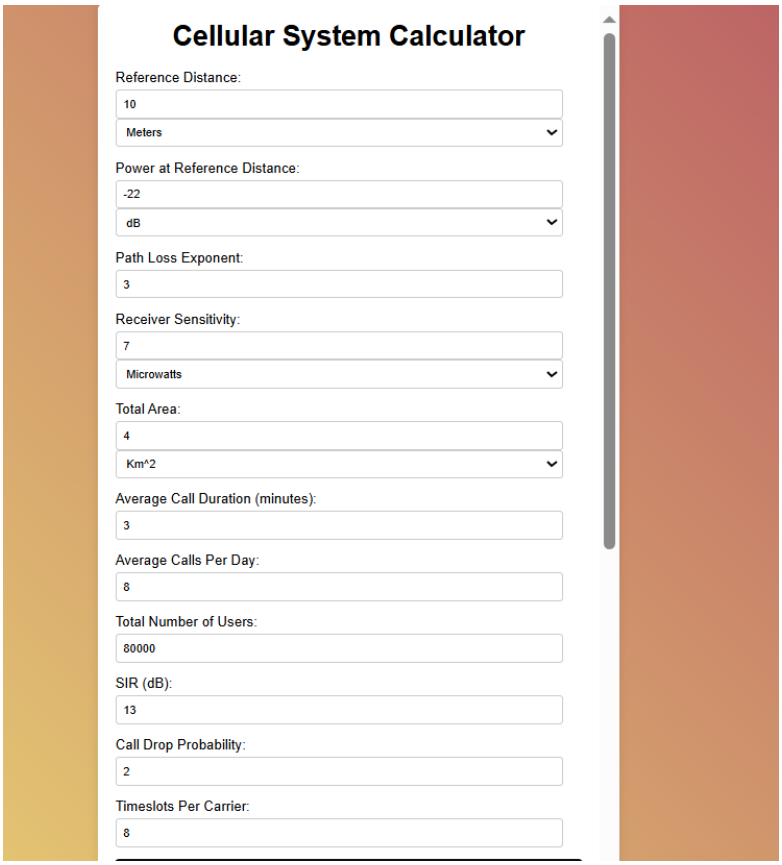
First scenario:

Problem #1:

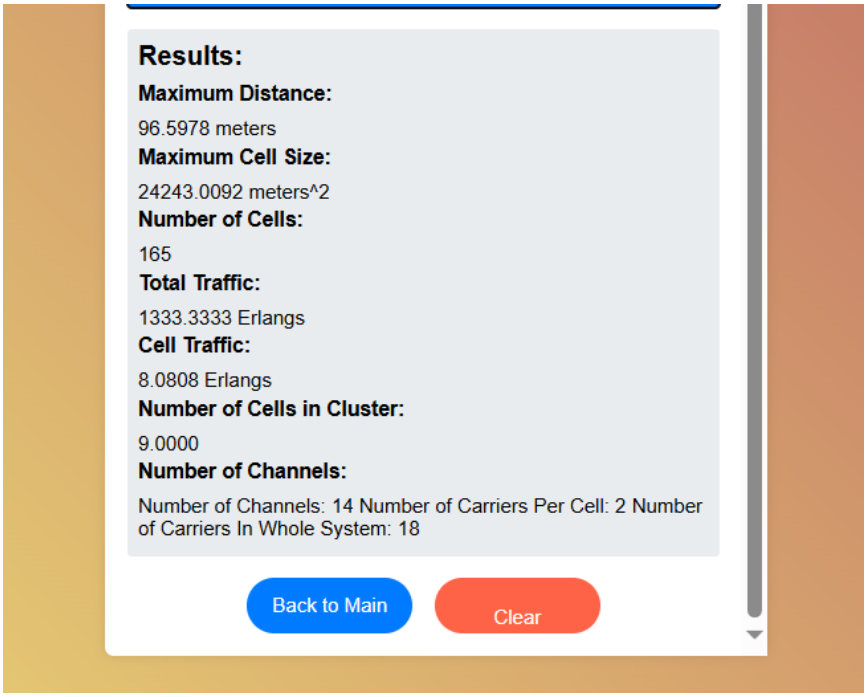
A new mobile network provider acquired the license to provide full-rate duplex voice communication using GSM900 technology in certain city (8 timeslots per carrier). The Area of the city is equal to 4 Km^2 (4,000,000 m^2). The mobile network provider is interested to provide service to 80 thousand subscribers. Subscribers in this city make an average of 8 calls per day and the average call duration is 3 minutes. The service provider is interested to provide the subscribers with a quality of service that guarantees a call drop probability equal to 0.02. The minimum SIR needed to correctly provide the service is equal to 13dB. Assuming -22.0 dB power is measured at a reference distance of 10 meters from base stations, the path loss exponent equals 3 (cellular urban area), receiver sensitivity = 7μ watts, calculate the following

a) Maximum distance between transmitter and receiver for reliable communication.
b) Maximum cell size assuming hexagonal cells.
c) The number of cells in the service area?
d) Traffic load in the whole cellular system in Erlangs.
e) Traffic load in each cell in Erlangs.
f) Number of cells in each cluster (*hint: number of co-channel interfering cells=6*)?
g) Minimum number of carriers needed (in the whole system) to achieve the required Quality of Service.

The following figure shows the process of enter the inputs

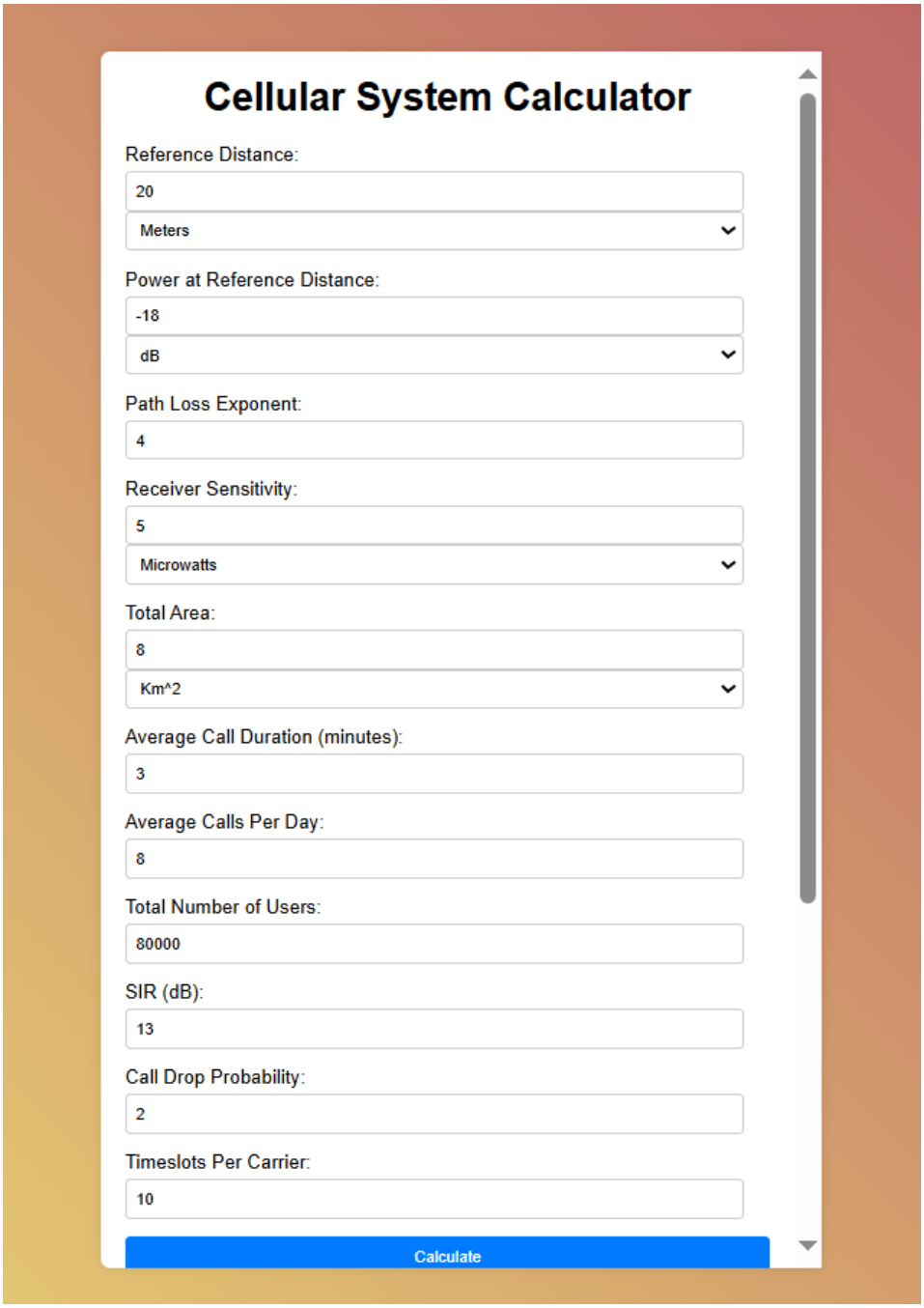


The following figure shows the Results

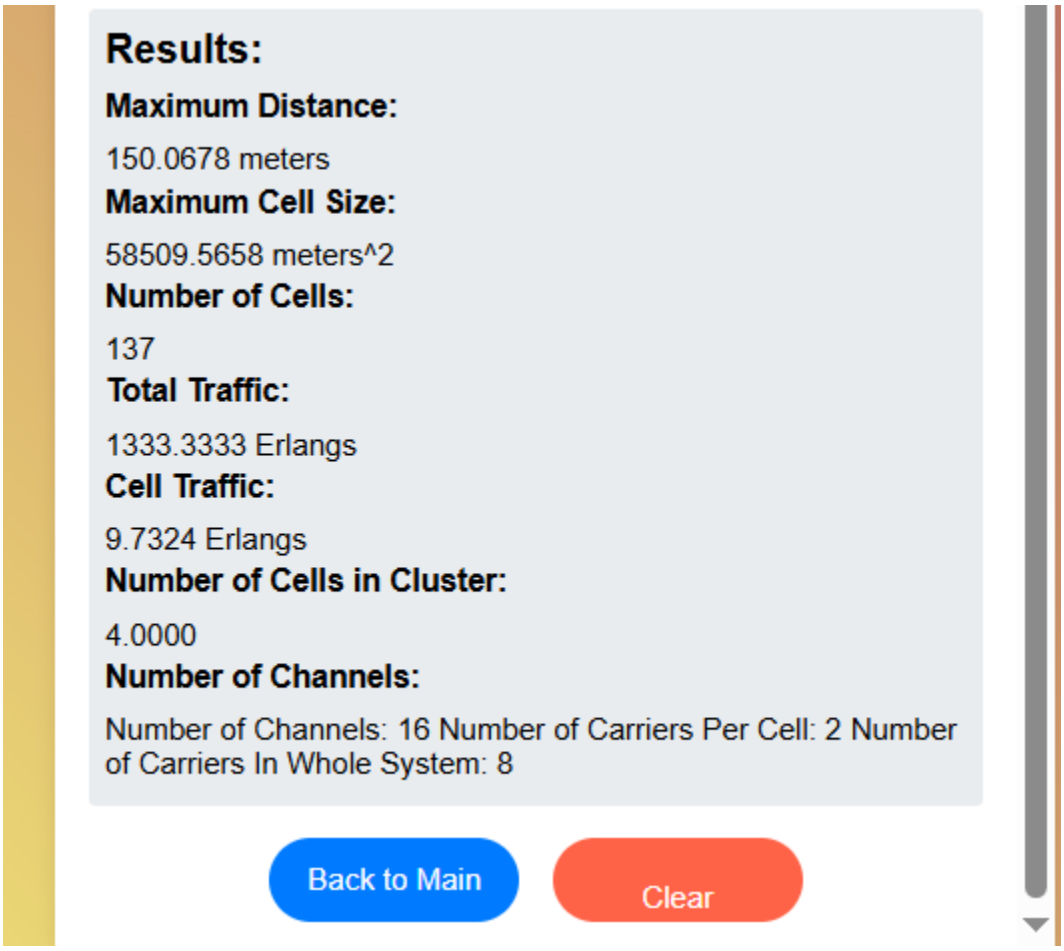


Second scenario:

The following figure shows the second scenario inputs

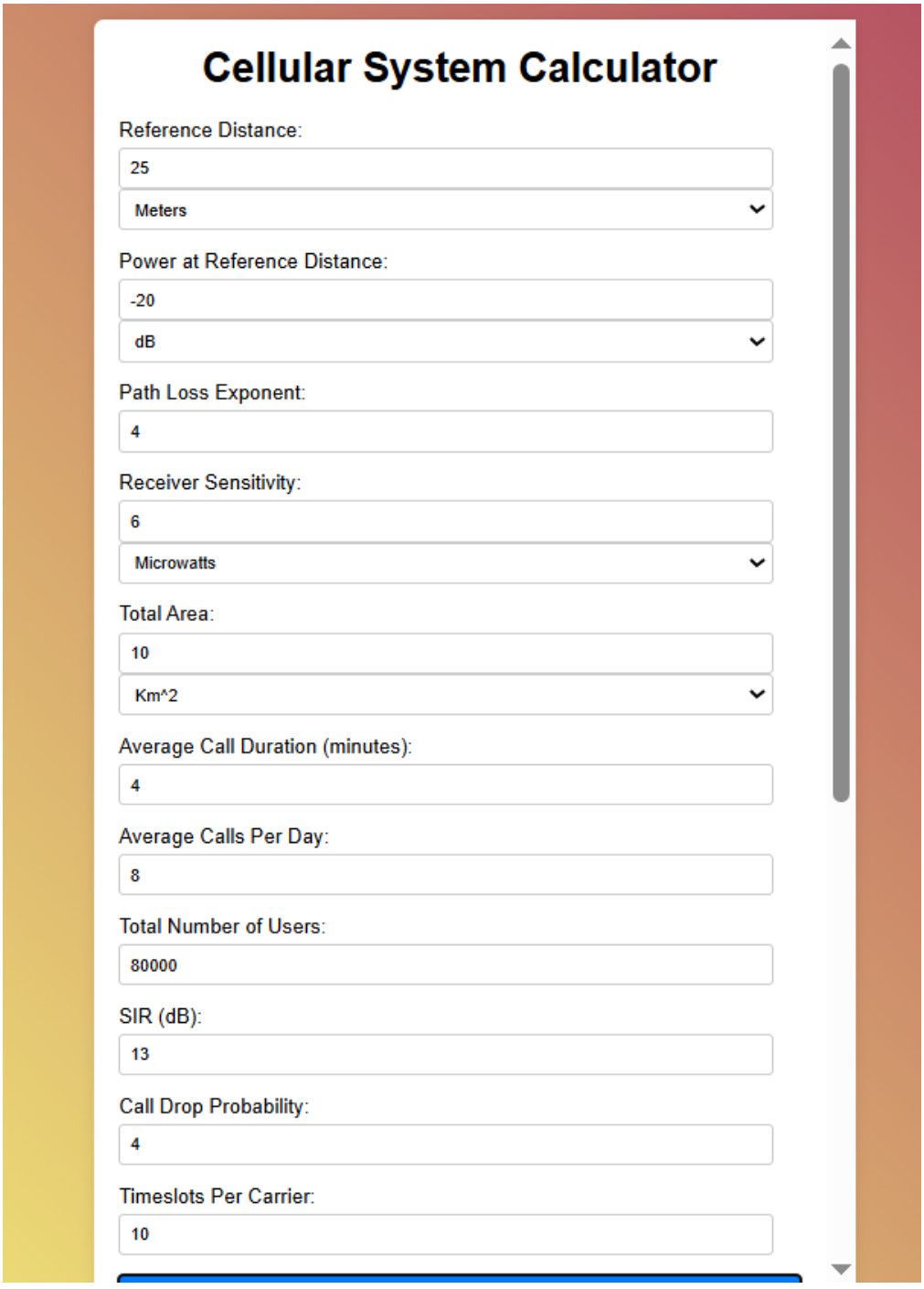


The following figure shows the Results of the second scenario

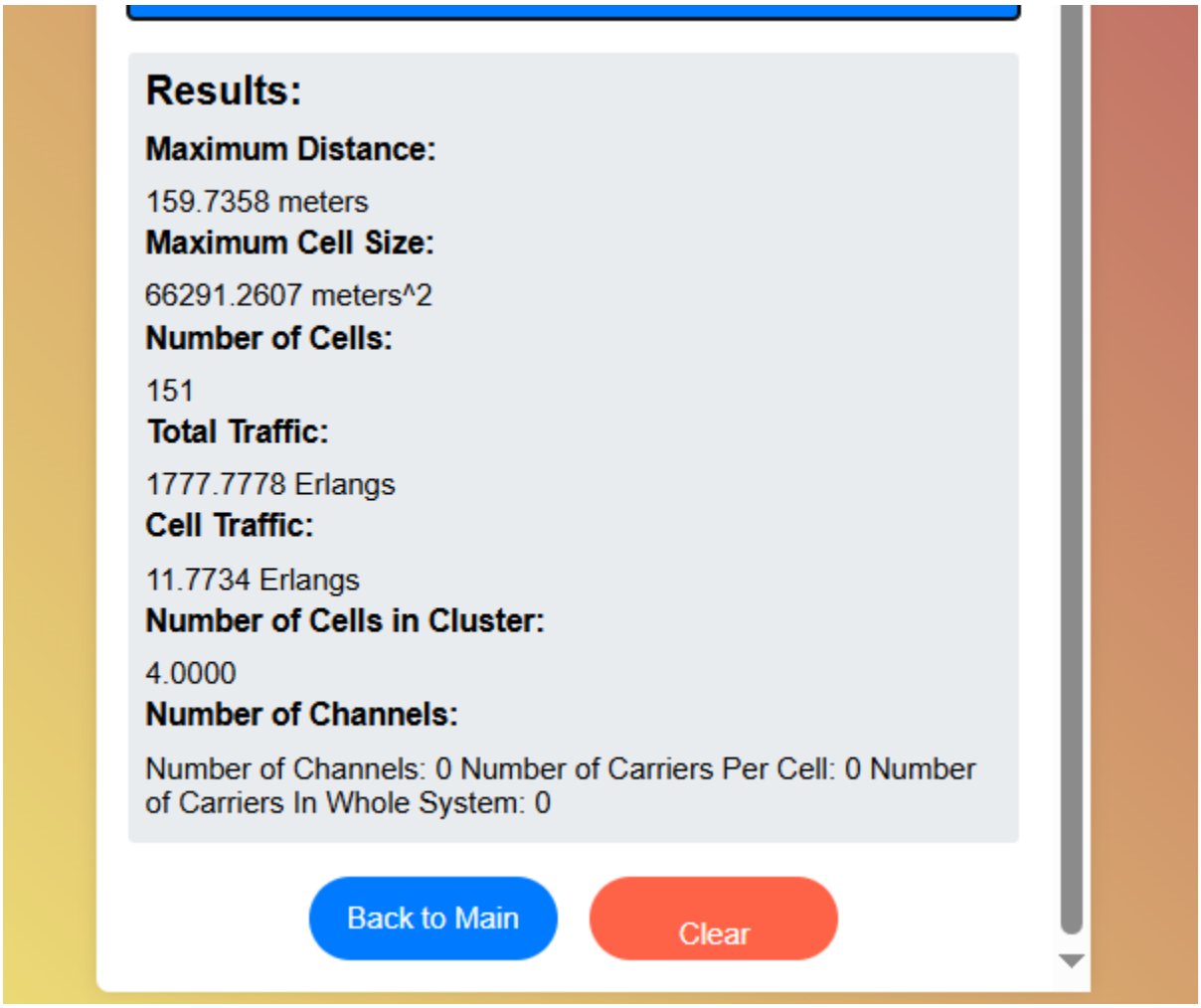


Third scenario

The following figure shows the inputs for third scenario



The following figure shows the results of the third scenario



The following figure shows Error case, for example, users must input positive values for the distance