Exercise 1. Example 8.7 from the course book [1] presents the following scenario. Assume a straight highway with 8 km length. Traffic intensity follows a location-dependent Poisson distribution with the intensity

\[
\rho(x) = \begin{cases} 
    x^2 & \text{if } 0 \leq x < 2 \\
    4 - \frac{x^2}{2} & \text{if } 2 \leq x \leq 8 \\
    0 & \text{otherwise}
\end{cases}
\]

For deploying two base stations that cover the highway, Example 8.7 shows how to estimate the position \( z \) of the handover point so that the traffic load is equally distributed between the two base stations. This example assumes that the propagation loss is distance dependent and fading effects are neglected. The result is \( z = 3.17 \) km. Using this information, do the following:

A. Example 8.7 assumes that \( z \) lies between 2 and 8 (i.e., \( 2 \leq z \leq 8 \)). Using the same procedure described in Example 8.7, examine the case where \( z \) lies between 0 and 2 (i.e., \( 0 \leq z \leq 2 \)) and demonstrate that a feasible solution does not exist in this case.

B. Let us now find the best possible location of the right base station (located somewhere between \( z \) and 8). In this example, we consider only the downlink. We want to find the location of the base station such that the overall power radiated by the base station can be kept minimal. Use the traffic intensity distribution presented above as an approximation of the number of terminals in a particular location. Assume the terminals to be static. Refer to the SNR equation below, and assume that the propagation exponent \( \alpha \) is equal to 2. (hint: the base station should be placed in such a way that the weight of the traffic of all terminals at its left is equal to the weight of those placed at its right).

\[
\Gamma = \frac{c_t P_t}{r^\alpha N},
\]

where:

- \( r \) is the distance from receiver to base station
- \( P_t \) is the transmitted power
- \( N \) is the noise power
- \( c_t \) is the antenna constant
- \( \alpha \) is the propagation constant
Exercise 2 (Exercise 8.5 from course book [1]). Cellular CDMA systems employ soft handover for both coverage and link reliability. A mobile receiver within an IS-95 system has been communicating for a while and receives the pilot signals shown in Figure 1. We assume that this mobile receiver is in soft handover and your task is to identify the set of cells that are in the active set of the mobile unit at time $\tau = \tau_0$. The handover drop time is 10 seconds and the handshaking time between the base station and the mobile can be neglected.

![Figure 1: Channel variations](image)

A. Going through each pilot signal, identify the status (in the active set, candidate set or neighbor set) of each pilot signal at time $\tau_0$. Clearly explain your results.

B. Deduce the set of cells that are in the active set of the mobile unit at time $\tau_0$.

References