Algorithm for calculating the basic parameters of cellular networks.

The algorithm for calculating the basic parameters of a cellular network requires certain input parameters based on which the main parameters will be calculated. In this algorithm, such parameters include:

- F – the frequency band allocated for use.
- F_k – the frequency band allocated per channel.
- n_a – the number of subscribers simultaneously occupying one channel (for analog systems = 1, for second-generation systems and higher = 8 or more).
- N_a – the number of subscribers that the network must serve.
- В – the activity of a single subscriber during peak load hours.
- $P_а$ – the assumed probability of call blocking.
- $\rho_{об}$ – the required signal-to-noise ratio for receivers in the cellular network.
- p_t – the percentage of time during which signal-to-noise ratio degradation is acceptable.
- S – the area to be covered by the cellular network.
- α – the range of random fluctuations in the received signal level at the reception point.
- P_{ms} – the sensitivity in dB * W of the mobile station receiver.
- G_{bs} – the gain factor of the base station antenna.
- h_{bs} – the proposed height for placing the base station antenna.

The algorithm for calculating the parameters of a base station is performed as follows:

1) Determination of the number of channels allocated for deployment:

$$n_k = int(F/F_k)$$

2) Determination of the optimal cluster size for the mobile network and sectorization:

The co-channel interference reduction factor:

$$q = \sqrt{3N}$$

The variance is calculating:

$$\sigma_e^2 = \frac{1}{\gamma^2} ln\left(1 + \left(e^{\gamma^2\sigma^2} - 1\right)\frac{\sum_1^i \beta_i^2}{\left(\sum_1^i \beta_i\right)^2}\right)$$

where,

$$\gamma = 0.1 * \ln 10 = 0.23$$

The coefficients are calculating β_i :

- if $M = 1$, $i = 6$:

$$\beta_1 = \beta_2 = (q-1)^4;\ \beta_3 = \beta_4 = q^{-4};\ \beta_5 = \beta_6 = (q+1)^{-4}$$

- if $M = 3$, $i = 2$:

$$\beta_1 = (q+1)^{-4};\ \beta_2 = q^{-4};$$

- if $M = 6$, $i = 1$:

$$\beta_1 = (q+1)^{-4}$$

The coefficients are calculating β_e , α_p^2 :

$$\beta_e = \left(\sum_1^i \beta_i\right) * e^{\frac{\gamma^2}{2}(\alpha^2 - \sigma_e^2)}$$

$$\alpha_p^2 = \alpha^2 + \sigma_e^2$$

The lower boundary of the limit, x_1, is calculating:

$$x_1 = \frac{10\log\left(\frac{1}{\beta_e}\right) - \rho_0}{\alpha^p}$$

The percentage of time that will exceed the protective signal-to-noise ratio is calculated $\rho_{об}$:

$$p(N) = \frac{1}{\sqrt{2\pi}}\int_{x_1}^{\infty} e^{\frac{x^2}{2}}\,dx * 100\%$$

The comparison is made with the percentage of time during which the signal-to-noise ratio degradation is allowed:

$$p(N) \leq p_t$$

The values of *N* and *M* are selected such that the given condition is satisfied.

3) The number of frequency channels used in a single base station (BS) is determined:

$$n_s = \frac{n_k}{M * N}$$

4) The telephone load per site is determined:

$$n_0 = n_s * n_a$$

$$A = n_0\left(1 - \sqrt{1 - \left(P_b\sqrt{\frac{\pi n_0}{2}}\right)^{\frac{1}{n_0}}}\right), \text{ if } P_b \leq \sqrt{\frac{2}{\pi n_0}}$$

$$A = n_0 + \sqrt{\frac{\pi}{2} + 2n_0 \ln\left(P_b\sqrt{\frac{\pi n_0}{2}}\right)} - \sqrt{\frac{\pi}{2}}, \text{ if } P_b > \sqrt{\frac{2}{\pi n_0}}$$

5) The number of subscribers that will be served by a single base station (BS) is determined:

$$\mathrm{N}_{bs} = \frac{A}{\beta}$$

6) The number of base stations in the mobile network is determined:

$$K = \frac{N_a}{N_{bs}}$$

7) The radius of one cell is determined:

$$R_0 = \sqrt{\frac{S}{\pi K}}$$

8) The transmit power of the base station (BS) is determined:

$$P_{bs} = -(G_{bs} - 70 - 26.16\ln(F) + 13.82 * \ln(h_{bs}) - (45 - 6.55 * \ln(h_{bs}) * * \ln(R_0)))$$

Thus, based on the given algorithm, the main basic characteristics of the mobile network can be calculated, such as: the number of base stations (BS), cluster size, sectorization, the coverage radius of a single BS, and the transmit power of the BS.