AN ALTERNATIVE METHOD OF CALCULATION OF ELECTROMAGNETIC WAVE RADIATION FIELD IN THE MOBILE COMMUNICATION SYSTEM

M. Melibayev
Uzbekistan, Associate Professor of the Kokand State Pedagogical

ABSTRACT

In the Mobile connection system radiation field calculation methods are considered.

Keywords: mobile systems, base antenna , regular hexagon, radiation intensity, atmospheric conditions, mathematical model.

The methods of calculating the electromagnetic radiation field in the e communication system are considered in the article.

The fact that cellular communication is widely used in the public economy and technical means of communication, It is necessary to optimize the design works in this direction. A cellular base antenna is arranged like a honeycomb at the center and sides of a regular hexagon.

This is the primary requirement for optimal cellular setup. In some cases, there are options that are exempt from this requirement.

While the cellular communication system has great potential, there are also some disadvantages. It is advisable to improve the area calculation in this direction if the communication is interrupted or the antenna does not come out in some zones.

The problem of electromagnetic wave propagation has an analytically easy solution for open space, homogeneous media. If the environment between the base antenna and the mobile phone in motion is terrain, buildings, landscape, trees and other objects, the communication problem will not have a clear analytical solution.

This problem can be solved by semi-empirical or specific methods. The method we are looking at is simple and can give a good result in estimating the field value.

Formulas using empirical coefficients can be used to calculate the field level.

Considering the atmosphere as an absorbing layer, the Jones formula is appropriate

$$E = \frac{K\sqrt{P_{ý}}}{r}\exp\left(-\frac{\alpha S}{\lambda^{x}}\right)ìkB \ / \ ì \qquad (1)$$

here

P_Y - efficiency of radiation power ;

λ - wavelength

α, k, x empirical coefficient;

R is the distance between the antenna and the receiver, M;

S is the equivalence of the absorbing layer

$$S = r \cdot \frac{d-h_2}{h_1-h_2}\left(1+\frac{h_1+h_2}{r^2}\right)^{0,5} \qquad (2)$$

h1, h2 - the height of the transmitting and receiving antenna.

d is the height of the absorbing layer.

For the city, d is the height of buildings.
α is the attenuation constant.

The Rubin formula recommended by the State Design Institute for Radio and Television

$$E = 89\sqrt{P_э \cdot h_2 h_1^{1.2}} / r^{2.7}, \text{ мкВ/м} \qquad (3)$$

or dB relative to 1 μV/m

$$E=39+10\lg P_э+24\lg h_1+10\lg h_2-54\lg r \qquad (4)$$

Based on the Okomura-Hata model, the height of the cellular base antenna operating in the (1500-2000) MHz range is hI(30÷200 m), the height of the mobile station is h2(1÷10m) and the distance r=(1÷20km).
The Okamura Hata model attenuation coefficient L for the city
$L=48,5-13,82\lg h_1+35\lg f-(1,11\lg f-0,7)h_2+(44,9-6,55\lg h_1)\lg r$, gБ
$E=(-9,304\cdot 10^{-4}f+13,207)\lg h_1-2,73 10^{-1}f+53,67+$
$+\{1,783\cdot 10^{-1}f+5,137]\lg(h_1)-5,468\cdot 10^{-1}f-41,626\}\lg r$ (5)
For each region, the coefficients are appropriate.
In our opinion, an alternative method is to use the radio wave intensity emitted from the base antenna. In this method, the attenuation coefficient is within the analytical value of the intensity, and there is no place to calculate it separately.
The intensity of a radio beam propagating within a given spatial angle dΩ does not change when the medium is transparent.
If we fill the space along the beam with light absorption or radiation medium, the radiation intensity will change, and we will consider the differential equation of this change.
Surface d transverse to the direction of the beam has intensity Iν, spatial angle dΩ, ν, ν+dν - energy in frequency interval Ivd dΩdvdt. Absorbed energy in the medium ds
$\alpha_v ds I_v d\sigma d\Omega dvdt$ (6)
given by the expression where αν(s) is the absorption coefficient.
If the medium is capable of radiating energy, then its radiation energy in the direction of the spatial angle dΩ in volume dV at time dt

$\varepsilon_v dVdvdt$ (7)
In a cellular communication system, it can be signals from a neighboring radio station or external noise or cosmic radiation, magnetic storms. ν in our case, we can also say external noise or "radiation" coefficient.
If we take the element of the cylinder and calculate the difference between the energy entering and leaving it
$dM=d\sigma ds$
$(I_v+dI)d\sigma d\Omega dvdt=I_v d\sigma d\Omega dvdt - \alpha_v ds I_v d\sigma d\Omega dt$
$dv+E_v d\sigma ds d\Omega dvdt$ (8)
after appropriate reduction

$$\frac{dI_\nu}{ds} = -\alpha_\nu dI_\nu + E_\nu \qquad (9)$$

In our opinion, the sign of ν¬ may change depending on the conditions, as this is the generally recognized form of the equation.

Let's consider special cases of Eq. If the station is in a cellular system, the base station is located in the center of a regular hexagon, forming a configuration like a beehive. the mobile station moves in the hands of people.

There may also be a relay station in between. This system can also be in FM and TV communication system. This communication is called type II radio communication system. If there is only absorption in the medium, and there is no additional emitter, that is, for the case ($\alpha\nu \neq 0$, $\nu = 0$), we write equation (9) as follows.

$$\frac{dI_\nu}{ds} = -\alpha_\nu I_\nu \qquad (10)$$

By integrating this equation

$$I_\nu(s) = I_\nu(0) e^{-\int \alpha\nu(s`)ds`} \qquad (11)$$

$I\nu(0)$ intensity at radiating base antenna s=0. It is immeasurable here

$$\int_0^s \alpha_\nu(s`)ds` \qquad (12)$$

serves as the optical distance between two points. At a unit distance, the intensity decreases by a factor of e.

In the general case ($\alpha\nu \neq 0$, $\nu \neq 0$) is the solution of equation (10) for $I\nu$

$$I_\nu(s) = I_\nu(0) e^{-\int_0^s d_\nu(s`)ds`} + \\ + \int_0^s \varepsilon_\nu(s`) e^{-\int_{s`}^s \alpha_\nu(s`)ds`} \qquad (13)$$

This equation (13) is called the radiation energy transfer equation.

In general, the radiation intensity consists of two parts.

The first part is the primary radiation on the antenna, which represents the decrease in intensity from s=0. The second part (0-s) shows the external factors radiated along the way.

For qualitative cellular communication, the value of the first integral must be at least one order larger than the second integral. Otherwise, the connection may be poor or interrupted. The given mathematical model opens up good possibilities for calculation of electromagnetic field radiation of cellular communications by taking into account topological maps of places and atmospheric conditions, density of buildings.

REFERENCES

1.Ерохин Г.А., Черncитев О.В., Козирев Н.Д. Антенно-дифференци-устройства и распростроение родиоволн. М. Радио и связь. 1996.

2.Радотўлқинларнинг тарқалиши ва антенна-фидер қурилмалари. I қ. Тошкент ахборот технология университети. Т, 2009.

3.Соболев В.В. Курс теоретической астрофизики М. Наука. 1985.

4. M. Hata. Empirical formula for propagation loss in land mobile radio services 01 Aug 1980-IEEE Transactions on Vehicular Technology
5. Theodore S. Rappaport. Wireless Communications: Principles and Practice 15 Jan 1996
6. William C. Jakes, Donald C. Cox. Microwave Mobile Communications 01 Feb 1975
7J. D. Parsons. .The mobile radio propagation channel. 01 Jan 1991
8. R. H. Clarke. A statistical theory of mobile-radio reception. 08 Jul 1968-Bell System Technical Journal