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IMPROVING THE QUALITY OF COMMUNICATION AND INCREASING THE CAPACITY OF MOBILE TELECOMMUNICATIONS FIBER-OPTIC COMMUNICATION NETWORKS BY REDUCING THE COVERAGE RANGE OF THE BASE STATION

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Abstract
The article discusses the improvement of the quality of communication and the increase in the bandwidth of mobile telecommunication fiber-optic communication networks by reducing the range of the base station coverage area.

Keywords: base station, coverage area, density, subscriber share, optimization, reliable reception, bandwidth.

Introduction

A couple of years ago, experts were racking their brains trying to figure out what enticing app could boost average revenue per subscriber (APRU) and offset ever-declining voice revenues. Eventually, it became clear that voice and stable, high-speed Internet connections could take on this role that already existed in the wireless world. But when building a new generation of wireless networks, it is necessary to ensure two main indicators: excellent speech quality and high data transfer speed.

3G/4G networks provide consumers and providers with a host of convenience and benefits. However, there is also a drawback: the radio interface, through which such desirable functions are carried out, is highly susceptible to interference, therefore, the effectiveness of each of them is always determined by the quality of the antenna system and radio signal, so the urgent problem is considered to be the search for solutions to problems related to the quality of information and increasing the bandwidth of mobile telecommunications, fiber-optic communication networks. It is in this work that one of the options for improving the quality and increasing the bandwidth of mobile telecommunications fiber-optic communication networks is determined.

Body

The signal strength at the location of the mobile station should be negative, in the range from -40 to -140. The closer it is to the upper limit (-40), the stronger the reception signal, this is found out by the fact that the closer the subscriber is to the base station, the higher the signal strength. A value close to -140 indicates a weak signal. Values from -40 to -80 indicate reliable

reception and the absence of communication problems. and low data rates. If the range of the BS coverage area is on average 20 km, then the number of subscribers with unreliable reception can be approximately from 10% to 30% of the total number of subscribers, and these mobile stations (MS) create interference due to unreliable connections. Excrement showed that subscribers who are far from the base station (BS), where they have a level of less than -85dBm, connect with the level of unreliable reception

If the range of the BS coverage area is on average 20 km, then the number of subscribers with unreliable reception can be approximately from 10% to 20%, which create interference due to an uncertain connection.

If the range of BS coverage areas by frequencies is:

- **800 MHz (4G LTE)** — up to 45-50 km;
- **900 MHz (2G, 3G)** — up to 40 km;
- **1,800 MHz (2G, 4G)** — up to 5-8 km;
- **2,100 MHz (3G, 4G)** — up to 3-5 km.

Below is a mathematical model that assumes that each of the subscribers uses the same base station resources. But this mathematical model can also be adapted in case of uneven use of resources by subscribers. Let's consider a mathematical model using an example for several BS

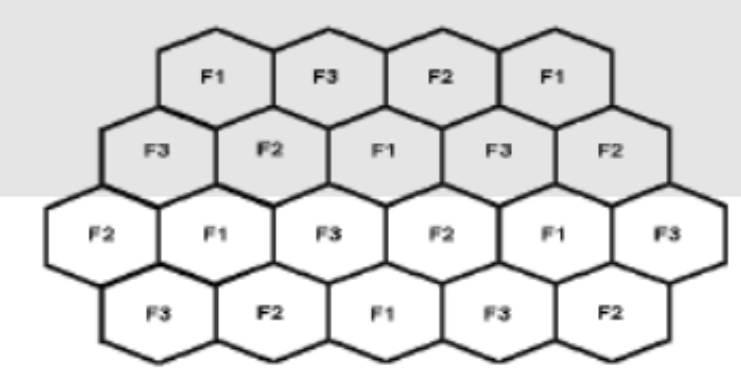

Fig-1 Optimal distribution of honeycombs, where F1,F2,F3 are different base station frequencies

Base station power and range are shown in the table below.

Base Station Number	Power, dBm	Range, m
1	35	745
2	39	970
3	34	780
4	34	780
5	33	720
6	37	915
7	41	1050
8	33	720

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Fig-2 clearly shows the antenna ranges when using three frequency subchannels, as well as the number of subscribers in the coverage area of each of the base stations.

Fig-2 Antenna range and number of subscribers in the area Base Station Actions

Let's determine the number of subscribers in the coverage area of each base station. Since only three base stations can have their coverage areas intersect at the same time, the following formulas can be used for these three arbitrary base stations:

$Ni=Sipi+k_{ijSijpij}+ k_{ijkSijkpijk}+S_{ikkikpik}$;

$Nj= S_{jpj}+k_{ijSijpij}+k_{ijkSijkpijk}+S_{jkkjkpjk}$;

$Nk=S_{kpk}+k_{ikSikpik}+k_{ijk}$ Sijkpijk$+k_{jkSjkpjk}$;

Where Ni is base station i; N j-base station j; N k-base station k; Si – BS i coverage area; S_{ij} is the coverage area of BS_{ij}; S_{ijk} is the coverage area of the BS_{ijk}; $S_{jk\text{-}BS}$ coverage $area_{jk}$; Sik is the coverage area of the BS_{ik}; pi is the population density in the BS coverage $area_i$; p_{ij} is the population density in the BS coverage $area_{ij}$; $p_{ijk\ is}$ the population density in the BS coverage $area_{ijk}$; p_{jk} is the population density in the BS coverage $area_{jk}$; $p_{ik\ is}$ the population density in the BS coverage $area_{ik}$; ki is the share of subscribers located in the BS coverage $area_i$; k_{ij} is the share of subscribers located in the BS coverage $area_{ij}$; $k_{ijk\ is\ the}$ share of subscribers located in the BS coverage $area_{ijk}$; $k_{ik\ is\ the}$ share of subscribers located in the BS coverage $area_{ik}$;

The solution to this optimization problem is the coefficients showing the number of subscribers in the coverage area of each base station. Having solved the optimization problem and substituting the values of the k coefficients in the formulas for determining the number of subscribers served by the base station, we get:

N1=1300+650k12+350k126+450k16+300k146+500k14=2316 чел.

N2=1500+650 k12+350k126+700k26+400k236+600k23=2724 чел.

N3=1200+600k23+400k236+800k36+500k356+500k35=2449чел.

N4=1500+500k14+300k146+1000k46+350k467+1000k47=2966чел.

N5=1200+500k35+500k356+1100k56+300k567+900k57=2716чел.

N6=1900+450k16+350k126+700k26+400236+
+800k36+500k356+1100k56+300k567+400k67+350k467+
+1000k46+300k146=4856чел.
N7=2000+400k67+300k567+900k57+900k78+1000k47+350k467=3816
N8=2500+900k78=2950 чел.
The total number of subscribers can be represented as:
Na = Cu + Kn
Here Cu is the number of subscribers of reliable reception
Kn is the number of uncertain reception subscribers
Uncertain reception from -80 dBm to -140 dBm
If the total number of subscribers for the N1 base station is 2316 people.
N1= K1y+K1н=2316
K1e is the number of subscribers to the base station N_1 with confidence reception
K1n is the number of subscribers of uncertain reception of base station N1
If the number of uncertain subscribers is approximately 10% of the total number of subscribers, then
K1n=231 subscribers K1y=2316- 231=2085
By reducing the coverage area of the base station to the required value, we will achieve better quality of communication and free up 231 places to improve the quality and to increase the capacity of the N1 base station
Thus, for each base station of the number of subscribers of reliable reception:
K1u=2316- 231=2085
K2y=2724- 272=2452
K3u=2449-245=2204
K4y=2966-297=2669
K5u=2716-272=2444
K6y=4856-486=4370
K7y = 3816-382 = 3434
K8y = 2950-295 = 2655

No BS	Number of subscribers before optimization, people	Number of subscribers of reliable reception after optimization, people	Increase in bandwidth for subscribers, people
1	2316	2085	231
2	2724	2452	272
3	2449	20204	245
4	2966	2669	297
5	2444	2444	272
6	4370	4370	486
7	3434	3434	382
8	2655	2655	295

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Inference

Thus, the quality of communication has been improved and the bandwidth of each base station has been increased.

By reducing the coverage area of the base station to the required value, it has been achieved to improve the quality of communication and increase the bandwidth of this telecommunications network.

References

1. Babkov V.Yu., Voznyuk M.A., Mikhailov P.A. Networks of mobile communications. Frequency-Territorial Planning, Moscow: Hot Line, 2007. 98 p. (in Russian)

2. Lte frequency planning. [Electronic resource]. Available at: http//1234g.ru/4g/he/ planirovanie-setej-he/ (accessed: 25.04.2020).

3. Berlin A.N. Cellular communication systems: textbook. Moscow: BINOM, 2009.29p.

4. Control of Frequency Resource in Lte Networks. URL: https//infopedia.su/llxelal. HTML (accessed: 26.04.2020). Мацур Г.А., 2020