Key Principles for the Provision of High Quality Telecommunication Services 4G Mobile Users at Speeds up to 300 Km/H

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Abstract – **In this paper on the example of the network, which delivers signals 4G services mobile users moving at speeds up to 300 km/h, considered issues of quality of these services [1]. Schematically shows the architecture of building such network. Defines the key principles of quality signal transmission service 4G mobile terminal moving at speeds up to 300 km/h.**

Keywords – **Mobile communications, digital signal processing, OFDM- technology.**

I. INTRODUCTION

In the mobile communication 4G network - is not only high data rate, but also the possibility of obtaining multimedia information while driving subscriber.

Such networks will provide the following services: digital telephony, high speed Internet access, data transmission, mobile video services, video on demand, high definition television, mobile commerce, banking, mobile office, entertainment and education, mobile search, mobile video surveillance, control of transport, remote medical diagnostics, etc.

The primary tasks for the market and the more customers are to ensure their high quality popular services through the introduction of new technologies.

II. DATATSENTRIZM AND DIGITAL PROCESSING

The quality of popular broadband services 4G telecommunication services can be estimated by such parameters as the integrity and timeliness of delivery, which are characterized by the probability of bit errors in bit rate, signal delay, etc.

The probability of bit errors determined by the ratio of signal power to noise power at the input of the receiver-decoder, which depends on the inter-symbol and inter-channel interference, attenuation, Doppler effect, the saturation of the receiver, etc.

Bit rate depends on the operating frequency band, the choice of type modulators, the duration of OFDM – symbols, number of subcarriers in OFDM – symbol, the length of guard interval, etc. The delay signal is a function of distance, the number of service information in the protocol packet switching, and other parameters.

To ensure high quality provision of telecommunications services 4G mobile users need to balance the values of these parameters to adapt to the conditions of signal reception. Providing these conditions are made possible by the application of the principle datatsentrizm and digital signal processing.

This explains the widespread use of encryption, randomization, adaptive modulation, etc.

OFDM technology can in the receiver to group all the services spectrum, signals are transmitted base station, provide targeted services [2].

An important issue for digital processing of the received signal is a direct channel of ultra-wide aggregate bandwidth of all the services, which equals more than 1GHz, while the main electronic components of digital signal processing operates in the frequency range below 1 GHz.

Where does this band? The length of the route Moscow-St.Petersburg is 651 km. Speed of the express "Sapsan" is 300 km/hr. The number of carriage in both directions = 6.

The number of subscribers is 10 people in each carriage. Type of Service: Multimedia, Internet. Excess data transfer rate equal to 10-100 Mb/s. The required maximum speed to transfer traffic is 60 Gb/s. Even with the modulation of QAM in 1024 to handle the aggregate bandwidth of operating frequencies subcarrier group signal spectrum of services equal Δf_c^{Σ}=6GHz. The carrier frequency of a band of working frequencies in the millimeter range, and digital processing available today at a frequency of <1 GHz. Heterodyne frequency conversion reduces the absolute frequency of the carrier, but the band remains the same.

III. WIRELESS ACCESS

The area of wireless base stations to the railway train, as shown above, to organize a direct channel uses signals 40-60 GHz.

The topology of the entire network is built on technology "is not symmetrical Internet". The signal from the central receiving station (CRS) railway of subscribers to have on the local network structure in which to either side of the CRS provide a resource for data rate 5 Gb/s at other equal conditions the role of channel questions from railway composition to a base station in the middle of the road network performs public network (WiMAX, LTE, etc.).

When creating mobile networks operating in the millimeter wave range, coverage of one base station in the tens or hundreds of times less than in modern mobile networks. To provide the given service area of such a network requires a large number of base stations. So the question is simplified construction of the base station and thus its cheaper.

The basis of the utility model has been charged with improving the design of the base station by facilitating two-way radio and restriction mode base station only work in the direct channel.

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The base station operates as follows (Fig. 2). Central station 6 forms the overall information flow that contains All services ordered network subscribers. The light beam of the laser is modulated information signal and transmitted to the first fiber optical fiber cable. The second fiber is transmitted monochromatic light beam which is formed from the first in its modulation. The difference wavelength rays in the fiber signal corresponds to a wavelength in the millimeter range. Through an optical repeater and fiber-optic cable topology "bus" optical signal is sent to base stations that perform optical-electronic conversion and signal emitted mobile station 10, which it is taken and selectively process that allows you ordered service. [3-5]

Tasks are solved by the fact that mobile network architecture in the range of millimeter waves contains content server, multiple base stations, many subscriber stations, intermediate level, which connects the server content and multiple base stations. According to the utility model, the new is that the intermediate level contains one central station that connects the server content and multiple base stations, fiber-optic cable using the topology of "bus", optoelectronic converter, used as a base station that provides technical achievements result of simplifying the intermediate level, base stations and the removal of restrictions on the speed of the subscriber stations in receipt of orders telecommunications service.

Intermediate level simplified to one base station that connects the server content and multiple base stations, fiber-optic cable using the topology of "tire". This significantly reduces the required cable length (compared with topology "star" in N times, where N is the number of base stations in the network and the number of additional equipment. Options base station is the conversion of the adopted optical signal in a range of electromagnetic radiation of millimeter waves without any selective transformation or selection of individual services and, therefore, the construction of base stations are quite simple. According All base stations emit a signal that contains All services ordered are currently online, in the same frequency range and so the subscriber stations moving from one base station to another at any speed there is no failure to provide services as subscriber station receiver continues to receive all the same signal in the same frequency band, which is set and the receiver input circuit.

Received signals of all services can only be in the millimeter range. In this range select a single group with the right service can not be due to limitations band-pass filters. This means that all the necessary signal to convert to an intermediate frequency (IF). This transformation will not be enough, because to put the entire signal band 6 GHz in the range from 0 to 1 GHz will fail. In Figure 1 shows the architecture of the MT receiver.

The input circuit 1 receives a signal in the millimeter range, the amplifier 2 amplifies it to the desired level, the first degree of conversion of 3-5 brings the signal to the first intermediate frequency, filter 6 identifies one group of services or a group of services, second stage conversion 7-8 brings a group of services group or groups of services for the second IF in the range (0 ... 1) GHz, where the digital signal processing, filter 9 identifies a group of services, including services ordered by the user, 10 - the second intermediate frequency amplifier, 11 - quadrature mixer, 12 – analog-to-digital converter, 13 - digital receiver OFDM. On the frequency axis 15 is shown schematically the location of the signal in the millimeter range of 14 one group of services or group of groups of services of 16 and 17 groups of services in which the service is ordered to digital processing.

The task of partitioning the signal into groups or zones (groups of groups) is very important because it determines the frequency and effectiveness of many types of equipment MT used in the system.

The signals of services, service groups of signals should be placed in individual OFDM-symbols. The solution of the problem of optimizing the signal to the central station will respond as OFDM-symbols will be contained in the signal

IV. CONCLUSION

Digital signal processing and wireless access - the key principles to ensure quality of signal transmission of telecommunications services in 4G mobile communications.

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