The Researching and Modeling of Structures of Mobile Networks for Providing of Multiservice Radio Access

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Abstract – **In this paper the method of granting of multimedia services to subscribers of mobile network which consists in the replacement of segment access has been proposed. The algorithm of radio resources management of convergent device of mobile communication technologies has been created.**

Keywords – **handover, technology, femtocell, resources, convergent device.**

I. Introduction

In the XXI century, it was not enough for mobile user that he will be able to receive voice services and send text messages. Development of cell communication accompanied the process of creating of innovative products such as video telephony, speed data transmission, Internet and other data. Multimedia applications require higher of maintenance requirements to the parameters of QoS. One of the major problems that appears for the mobile operators in providing these of services is "narrow" place at the level of access. Creating of device that would provide the possibility to avoid this limitation and significantly would reduce cost of implementation of multiservices and enhance quality of service provider.

II. The Algorithm of Radio Interfaces and Resources Management of Device at the Access Layer

The main device that must to unite of mobile technologies has been selected femtocell (fig.1).

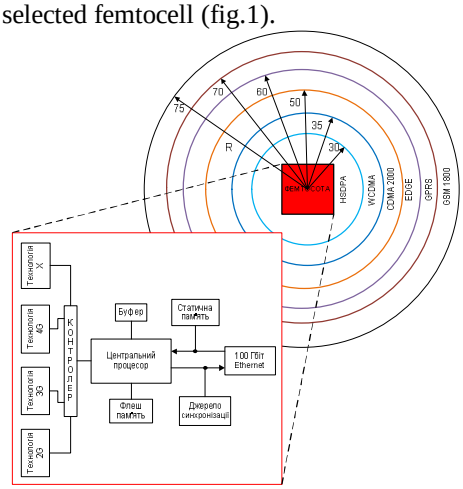

Fig.1. The model of device for providing of multiservices at the access layer

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Radio modules 2G, 3G, 4G, X – to ensure access for users of different mobile communication technologies (module X - reserve module for perspective technology of the future).

Controller - microcontroller that provides a choice of active radiomodul to connect the end device (mobile phone, smartphone) to femtocell or a combination of these modules if to femtocell seek to simultaneously connect multiple users that use of different standards of radio communications.

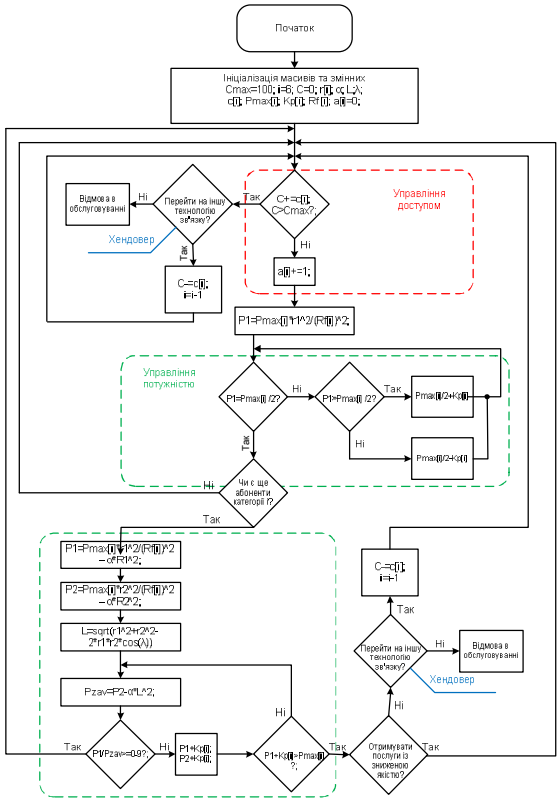

Fig.2. The algorithm of radio interfaces and physical resources management

Description of the algorithm:

Step 1. Initialization of variables and arrays that will be processed in radiocontroller.

They are:

Cmax – maximum bandwidth femtocell;

i - counter that indicates which interface is active:

i= 0 –GSM -1800 technology;

i = 1 – GPRS technology;

i = 2 – EDGE technology;

i = 3 – CDMA 2000 technology;

i = 4 – WCDMA technology;

i = 5 – HSDPA technology

C – variable to find sum of bandwidth needed to service of interfaces that are connected to femtocell.

c[i] – array of values of bandwidth to ensure QoS;
Pmax [i] – array maximum powers of interfaces;
Rf[i] – array of radius coverage area of different generations of mobile communication (see Fig.1);
a [i] – array-counter that shows how many subscribers each technology are connected in the moment;
Kp[i] – array of values step configuration of power;
r[i] – array of change distance location of user from source of radiation;
λ – the angle between r1 and r2 (0 –360);
α – loss of signal in space;
L – distance between subscribers A and B;

Step 2. Passes the test on allowable bandwidth (it should not exceed 100 Mbit/s). If the condition is met, the move to the 3rd step if not - the subscriber is asked to switch to other mobile technology. If the user agrees to transition of the service area, the technology [i] is replaced by less resource intensive [i-1] with variable C is removed value bandwidth which requires the technology [i], the algorithm returns to step 2. If the subscriber does not agree with the transition he receives a denial of service.

Step 3 . Counter of the number of subscribers increased by 1 according to the category of mobile communications, to which he belongs; performed calculation of required power, which should radiate radio interface for qualitative of service to the user.

Step 4. At the beginning of its work all interfaces of femtocell configured on the radiation half of its maximum power. Calculated in step 3 capacity is compared with the initial power. If the value is greater than the original, is attached size of the initial power control step, but if it lower – is subtracted size of the step. The cycle continues, if P[1]<Pmax [i].

Step 5. Occurs verification of the presence of another category of subscribers [i]? If so, then:
a) The calculated capacity received by user A taking into account the damping at a distance r1 from the source;
b) The calculated capacity received by user B taking into account the damping at a distance r2 from the source;
c) The calculated distance from subscriber A to subscriber B;
d) The calculated value of interference that occurs as a result of the impact of B on A.

Step 6. If the SRN over 0.9, the subscriber will receive high quality services, if less than 0.9 – respectively preforms recalculation of radiated power source. Is carried out re-calculation of P1 and P2.

Step 7: the comparison of capacities: if radiated power exceeds Pmax - reducing service quality because the power exceeds the maximum for a particular technology. In accordance performed a transition to another technology or if the recipient refuses of transition - the denial of service.

The presence of two or more subscribers that use the same technology of access (GSM-1800) causes the formation of barriers that accordingly to reduces the SRN in the radio channel (Fig. 3).

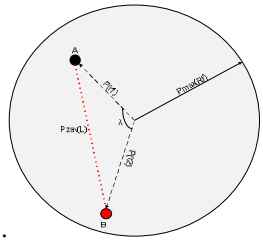

Fig.3. Mutual influence of interference between two subscribers of the same technology

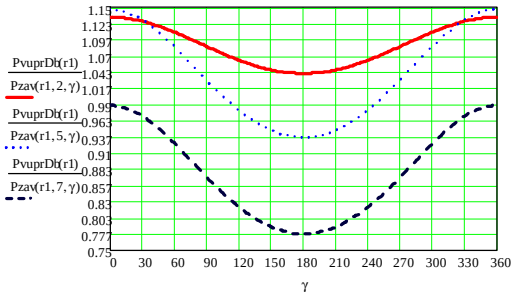

Fig.4. The signal-to-noise ratio (SRN) between 2 subscribers dependency from the angle and their distance to femtocell

where: PvuprDb (r1) – capacity, which receives subscriber A, taking into account losses (formula 1);

Pzav – capacity of interference which arises as a result of connections subscriber B

Subscriber A is at a distance 1m from femtocell subscriber B changes its location in a radius 2m (red line) 5 and 7m (blue and black, respectively).

$$PvuprDb(r1) = 10\log\frac{Pvupr(r1)}{P_0} - a * r1^2 \quad (1)$$

where: Pvupr (r1) – calculated capacity received by subscriber A [W];
P0 - reference power [1mW];

$$Pzav(r1, r2, g) = 10\log\frac{Pvupr(r2)}{P_0} - a * (\sqrt{r1^2 + r2^2 - 2r1 * r2\cos(g * \frac{p}{180})})^2 \quad (2)$$

where: Pvupr (r2) – calculated capacity received by subscriber B [W];

γ – the angle between subscribers A and B.

III. Conclusion

The method of granting of multimedia services to subscribers of mobile network which consists in the replacement of segment access has been proposed. The algorithm of radio interfaces management of improved device that relies on function: capacity, bandwidth and ensuring handover between technologies has been created. The signal-to-noise ratio (SRN) for 2 subscribers that use the same technology of mobile communications has been calculated.

References

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