

$$y_3(t) = W_{11}(p) y_1(t) + W_3(p) y_2(t);$$

$$y_2(t) = W_1(p) W_2(p) e(t) + W_{13}(p) n_2(t);$$

$$y_1(t) = W_9(p) W_{10}(p) x(t) + W_{12}(p) n_1(t).$$

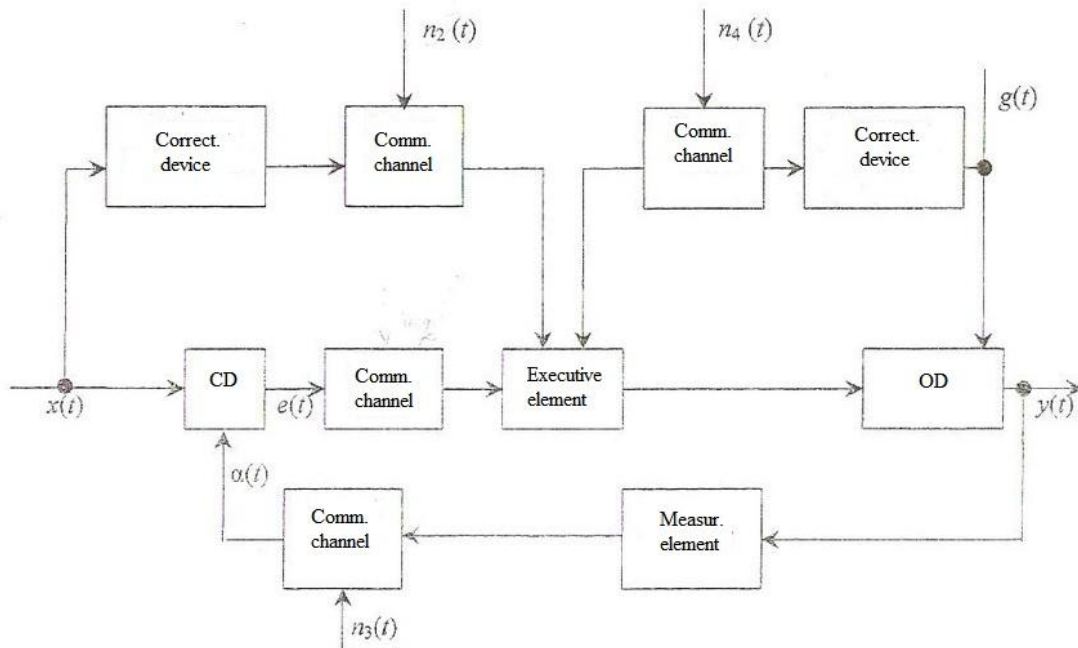


Fig. 1

In the case of physical realizability operators $W_9(p)$ and $W_{18}(p)$ error components will be equal to 0. When physical unrealizability operators $W_9(p)$ and $W_{18}(p)$, the condition can be performed approximately. In this case, will be achieved partial invariance. This increases the value of the error components caused by the effect of noise and distortion in the cables connection. Consequently, the construction of error-correcting communication channels for control of communication networks is an urgent task.

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CONSTRUCTION OF LTE-NETWORK FOR PRIMORSKIY REGION OF ODESSA

Annotation. In this work is given the evaluation of real perspective of technology 4G in Ukraine and is done an implementation project of test segment of LTE-network for Primorskiy region of Odessa. Also in this project is given the list of the real equipment for realization and given characteristic why was chosen LTE technology for the realization of this project.

The rapid development of different communication technologies is lead to the increasing people interest to Internet. People have the possibility to work, chat, watch streaming video, listen the music in the global network.

There are all possibilites for rapid deployment of 4G networks in Ukraine. The segment of the wireless (mobile) networks in Ukraine situate in the saturation area – the increasing of the subscriber number of network service stopped and further increase in revenues is impossible without the introduction of new services. During the entering to the saturation point the network must be possible to provide new services, that allow to increase the subscribers number in the network and therefore to increase the reveueus of network provider. It is clear that in this case it is necessary to work proactively, i.e. moment of entry into the saturation point of the new services should be already formed and ready to provide to users. Providers have to define accurately the time of of entering in the saturation point. For this purpose we can use such method – the presence of the statical information of data confirmation for regular time periods to allow the defining the type of the math function and to do the forecast the further development of the states of the function with the method of extrapolation. In the case of the forecasting the growing of the number of subscribers it’s necessary to use the logarithmic function, that was proposed by Lancold and Trahzel [1]. In general case the dependence of subscriber density is a function og hyperbolic tangens (fig.1).

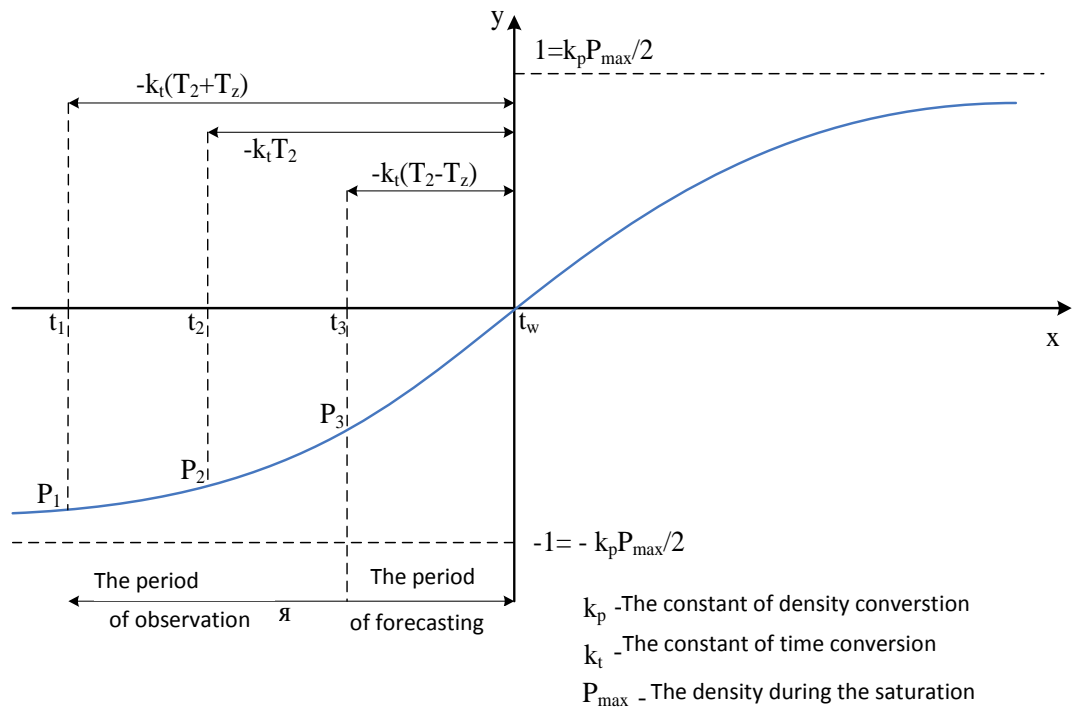


Figure 1 – Function of hyperbolic tangens

The idea – in the moment of time T (the interval of time from point that discovered in the point of saturation) we can constact the system of equations for 3 choosing investigation moments, in which between the fixed values of subscribers density with equal increment T_z :

$$\begin{cases} 1 - k_p P_1 = th[-k_t(T_2 + T_z)], \\ 1 - k_p P_2 = th[-k_t T_2], \\ 1 - k_p P_3 = th[-k_t(T_2 - T_z)] \end{cases} \quad (1)$$

where k_p – the constant of conversion of the subscribers density ; k_t – the constant of time

conversion; T_z – interval of time increment.

This system has the next solutions:

$$k_p = \frac{2(P_1P_3 - P_2^2)}{P_2(2P_2P_3 - P_2P_3 - P_1P_2)} \quad (2)$$

$$T_2 = T_z \frac{\text{arth}(1 - k_p P_2)}{\text{arth}(1 - k_p P_2) - \text{arth}(1 - k_p P_3)} \quad (3)$$

$$P_{max} = \frac{2}{k_p} \quad (4)$$

where T_2 – time period, $T_2 = t_0 - t_2$, t_0 – the moment of transient to the saturation area, t_2 – the moment of appearing of the action P_2 [2].

In table 1 you can see the statistical data about the subscribers of wireless networks during some period of time. Like the investigation interval we can choose 5 years and like start point we will choose 2003 year. So, the intervals are 2003, 2008, 2013.

Table 1 – The dynamics of the increasing of the subscribers number of wireless networks

Year	Numb. of subscribers	Population of Ukraine	%
2003	5600	48000	11,6
2008	45 935	46608	98,3
2013	53451	45770	116,7

So : $P_1 = 11,6\%$, $P_2 = 98,3\%$, $P_3 = 116,7\%$, $T_z = 5$

Using formulas (1)-(4) we receive that the period of transient time to the saturation area $T_2 \approx 2,5$ yaers, so the entering point to the saturation area is $t_0 = 2013 + (-2,5) = 2011$ year.

So the wireless networks of Ukraine pass to the saturation area in 2011 and because of it it was necessary to provide the new technologies (it was 3G). Nowadays the providers of wireless networks of Ukraine to delete the technology delay it's necessary to build new network or renew thr existing wireless networks on the base of 4G technology.

The most appropriate is the deployment of new wireless network segments based on technology LTE, which has significant technical advantages [2, 3].

In this work was developed the project on the base of LTE technology, the throughput of the planned network is equal to 4,576 Gbps. Also here was built the coverage map of Primorskiy region and was calculated the necessary number of base stations -31 BS (eNB). Carry out Engineering traffic for the planned network LTE [4]. As the service platform was chosen the equipment “Cisco Systems”. The core of the network realized on a multiservice platform “Cisco ASR 5000 PCS3”, as an equipment of radioaccess – base stations “Flexi Multiradio” of company “Nokia Siemens Network”. The functional scheme you can see on the figure 2.

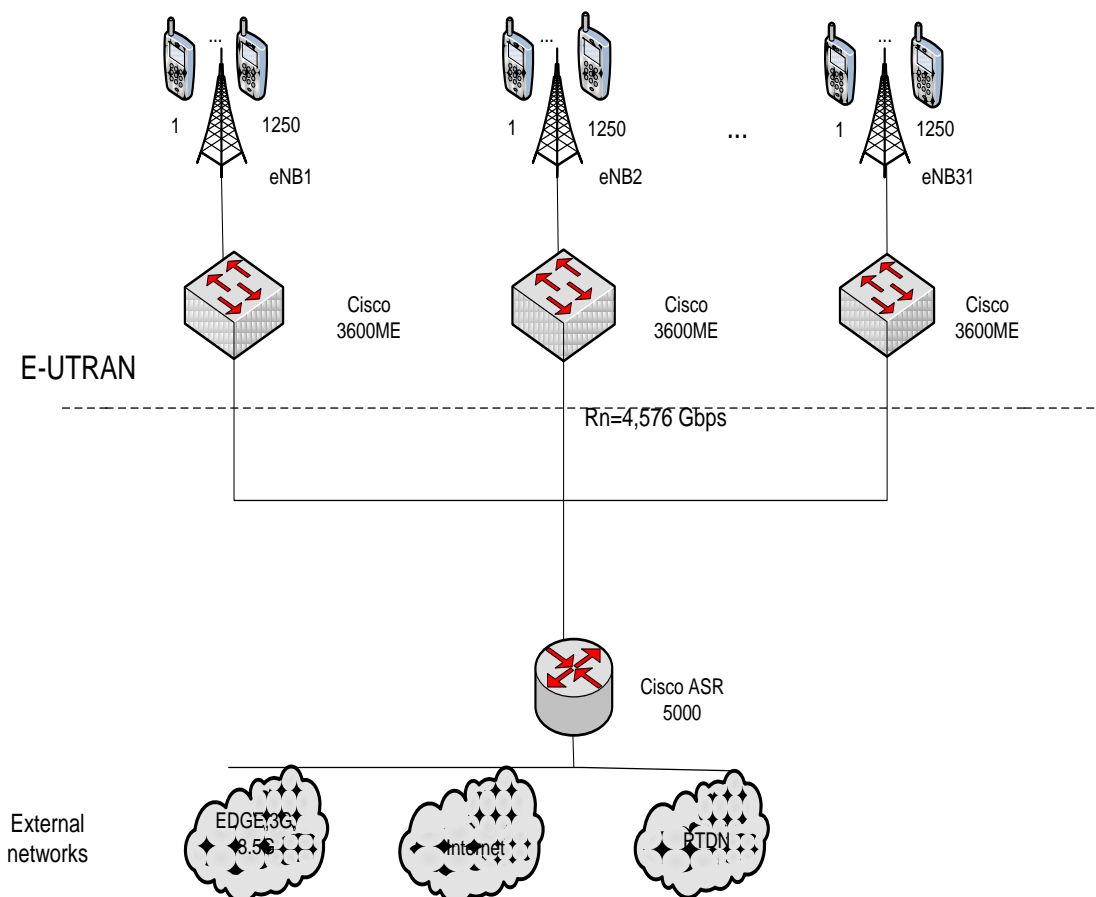


Figure 2 – Functional scheme of LTE network

Conclusion. Increased needs of users, the transition of wireless networks in the saturation region requires operators to introduce new services and the transition to new technologies. At present, the most promising technology is the technology of LTE. Wide range of services, broadband, high quality of service, high mobility – all dignity technology LTE. Create new segments of wireless networks based on LTE technology provides the user with a wide range of broadband services. This provides integration with existing networks and Cordless opportunity to further develop a new generation of network segments 4G.

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