«Yuri Gagarin State Technical University of Saratov»

Presentation subject :
«Using the LTE technology in the construction of wireless communication»

Relevance

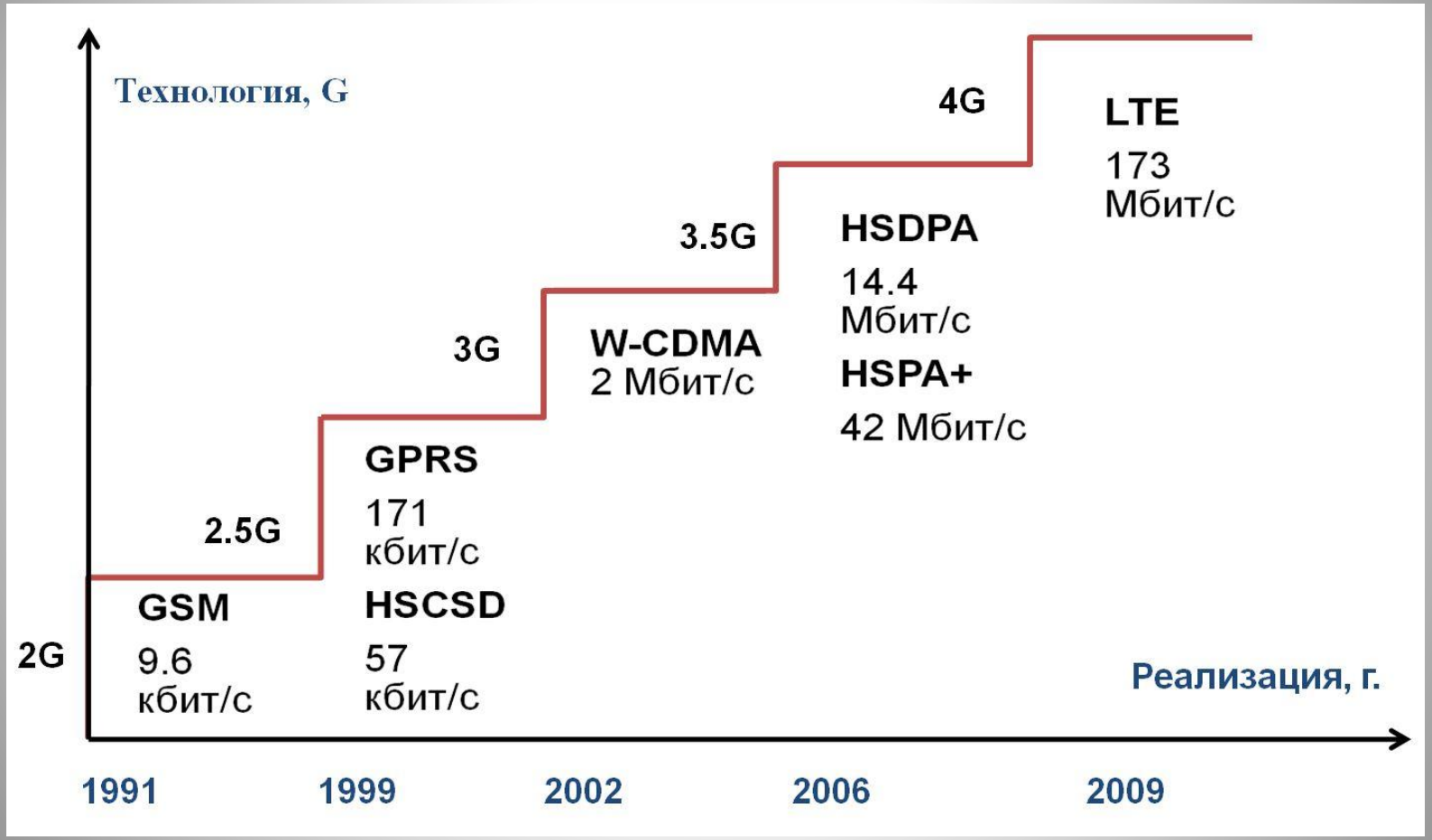
Suffice it to rapid development of the Internet makes ever greater demands for data transfer speed in terms of mobility. mobile communication technology of the 3rd and the younger generations do not always have sufficient speed for streaming video in high definition, the use of cloud services and other demanding tasks speed.

To satisfy these requirements enable mobile network based on the LTE technology.

To ensure good quality of provided access to the Internet, you must take into account the losses resulting from the propagation of signals.

Research carried out in this paper will help to choose the optimal parameters in the construction of wireless networks based on LTE technology.

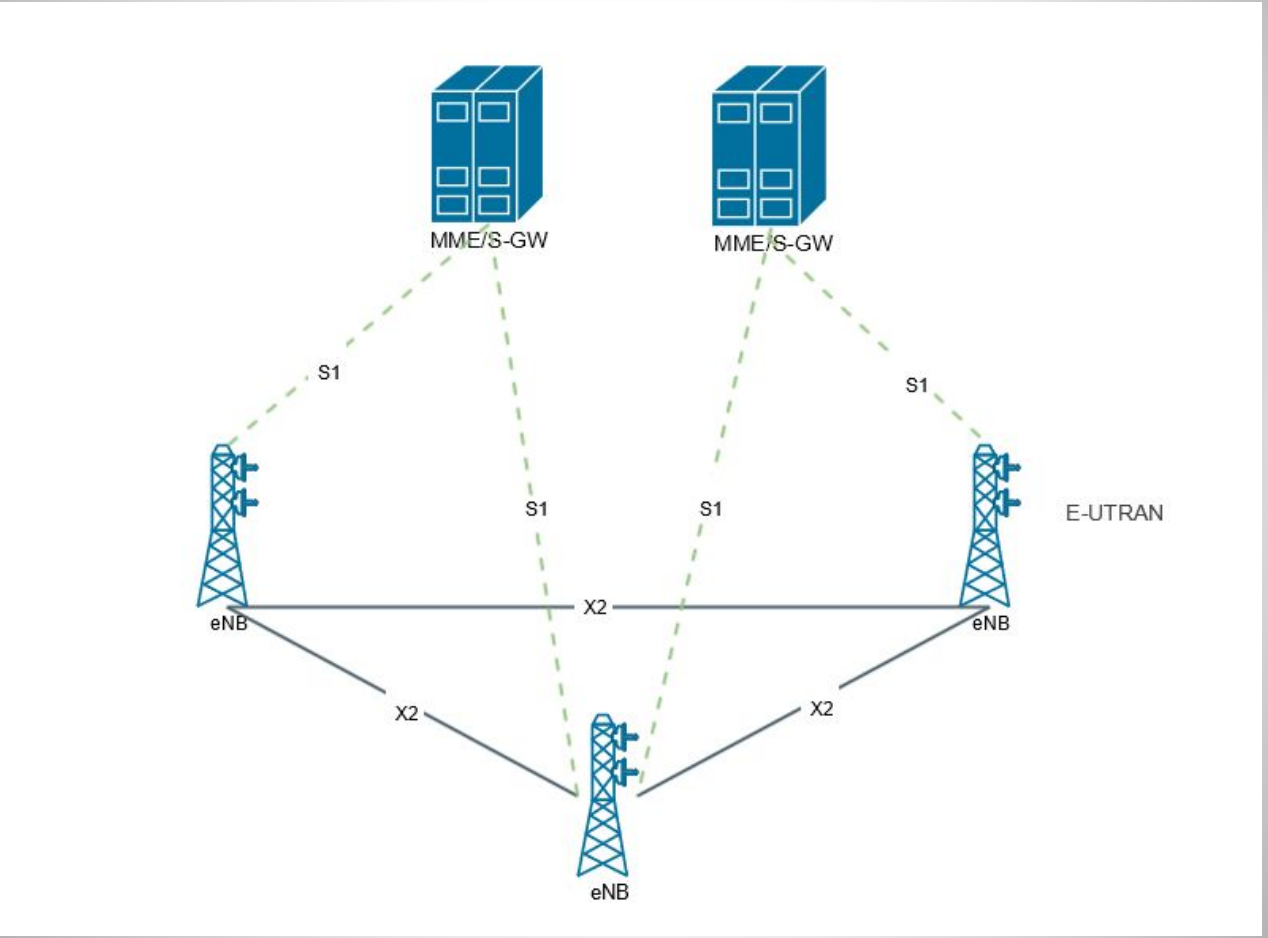
Generation of wireless networks



In telecommunication , Long-Term Evolution (LTE) is a standard for high-speed wireless communication for mobile phones and data terminals, based on the GSM / EDGE and UMTS / HSPA technologies.

LTE provides a theoretical peak data rate of up to 326.4 Mbit / s from the base station to the user and to 172.8 Mbit / s in the opposite direction.

LTE network structure



Calculation part. Initial data

Calculation of the main parameters of the radio access using LTE technology in some areas in urban areas.

Area- 100 km^2

Population- 250 thousand people

Used frequency band– Band 7(2600MHz).

Used frequency duplex FDD

Downlink: 2500—2570 MHz (using 10 MHz 2500 – 2510)

Uplink: 2620—2690 МГц (using 10 MHz 2620 - 2630)

The average height of the base stations suspension - 50 m.

The average height of the mobile station - 1.5 m.

Choice of equipment

Base frequencies processing unit BBU3900

Radio Module RRU3201

Panels Antenna Kathrein 80010689

Calculation of the receiver's sensitivity

Ширина полосы, МГц	*Nвсего*	*Nисп*	*NданDL*	*NданUL*
1,25	128	85	72	56
5,00	512	421	360	280
10,00	1024	841	720	560
20,00	2048	1681	1440	1120

LI (realization of losses) = 5 dB
Ksh (noise factor) = 7 dB
Kc / w = 16 dB (at QAM64)

$$P_{т.ш.} = -174 + 10 \cdot \log\left[BW \cdot n \cdot (N_{исп} / N_{всего})\right] + K_{с/ш} + K_{ш} + L_I$$

$$P_{т.ш.} = -174 + 10 \cdot \log\left[10 \cdot \frac{28}{25} \cdot (\frac{841}{1024})\right] + 16 + 7 + 5 = -136.363 дБм$$

$N_{исп}$ The number of used subcarriers

$N_{всего}$ The total number of subcarriers

n- sampling rate

BW - bandwidth

Calculation of the energy budget for the LTE network

Тип застройки	*Uc*
Сельская местность	5
Пригород	0
Городской район	-3
Плотная городская застройка	-4

Link budget for the downlink (base station to subscriber station):

$$DL_{БП} = P_{ТхБС} - P_{АОАС} + G_{ТхБС} + G_{RxxA} - L_f - F - I_{DL} + U_c$$

$$DL_{БП} = 49 + 133.863 + 18 + 0 - 0.4 - 10 - 2 - 4 = 184.463 дБ$$

Link budget for upstream direction (from subscriber station to base station):

$$UL_{БП} = P_{ТхАС} - P_{АОБС} + G_{ТхАС} + G_{RxxБ} - F - I_{UL} + U_c$$

$$UL_{БП} = 30 - 105 + 0 + 19 - 10 - 3 - 4 = 137 дБ$$

Calculation of the coverage area

To calculate the level of losses applicable Erceg – Greenstein model.

$$L = 20 \cdot \log_{10}(4\pi d_0 \lambda) + 10 \cdot \gamma \cdot \log_{10}(d / d_0) + s + \Delta L_f + \Delta L_h$$

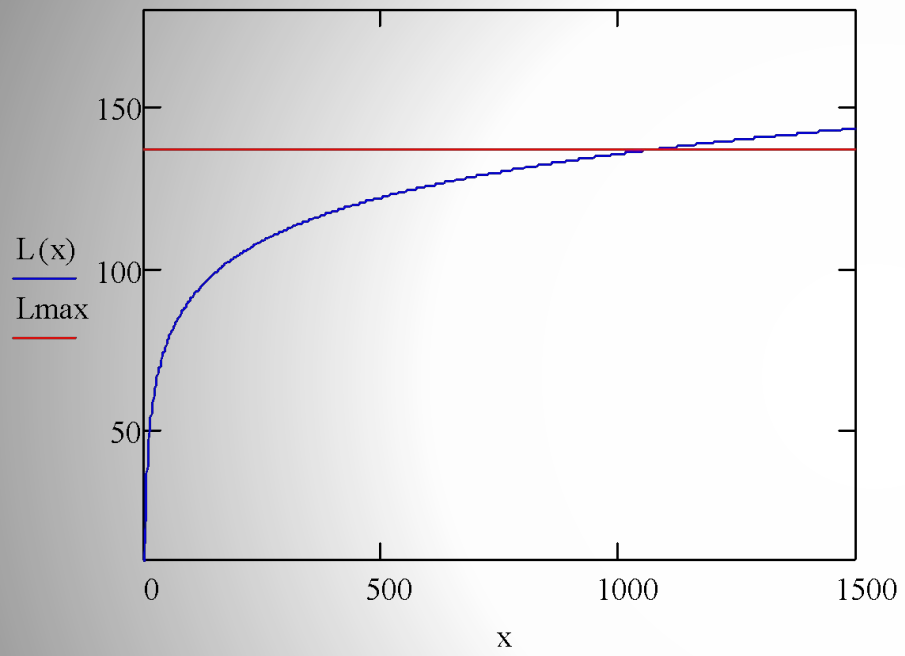
Параметр	*A*	*B*	*C*
a	4,6	4,0	3,6
b	0,0075	0,0065	0,005
c	12,6	17,1	20,0
s,∂Б	10,6	9,6	8,2

$$\gamma = a - b \cdot h_b + c / h_b$$

$$\gamma = 4.6 - 0.0075 \cdot 50 + 12.6 / 50 = 4.477$$

$$L = 20 \cdot \log_{10}\left(\frac{4 \cdot 3.14 \cdot 100}{0.114}\right) + 10 \cdot 4.477 \cdot \log_{10}(1077 / 100) + 10.6 + 0.709 - 1.349 = 136.996 \partial Б$$

A plot of the loss of cell radius



Let's calculate the coverage area of a three-sector eNodeB

$$S_{eNodeB} = 9 \cdot \frac{\sqrt{3}}{8} \cdot d^2 = 9 \cdot \frac{\sqrt{3}}{8} \cdot 1.077 = 2.26 \text{км}^2$$

To cover the area of 100 km2 in size will require the following number of cells:

$$N_{node} = \frac{100}{2.26} = 44.244 \approx 45$$

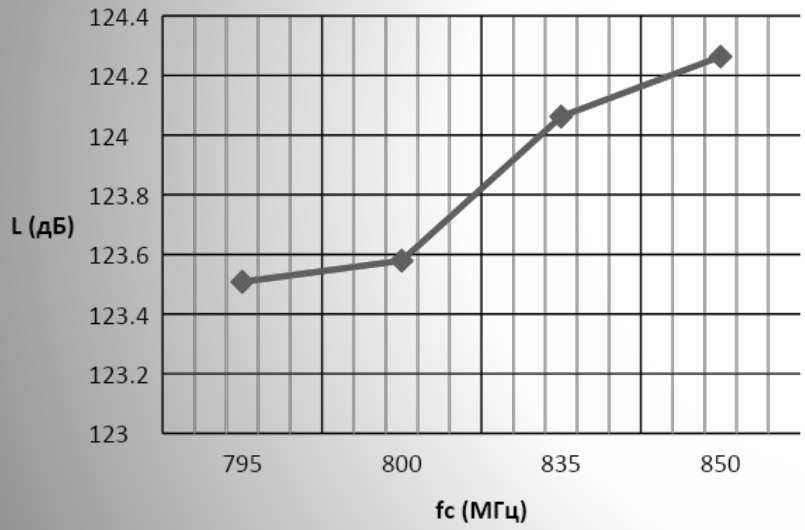
Given

$L(d) = Lmax$ Lmax= 137 дБ

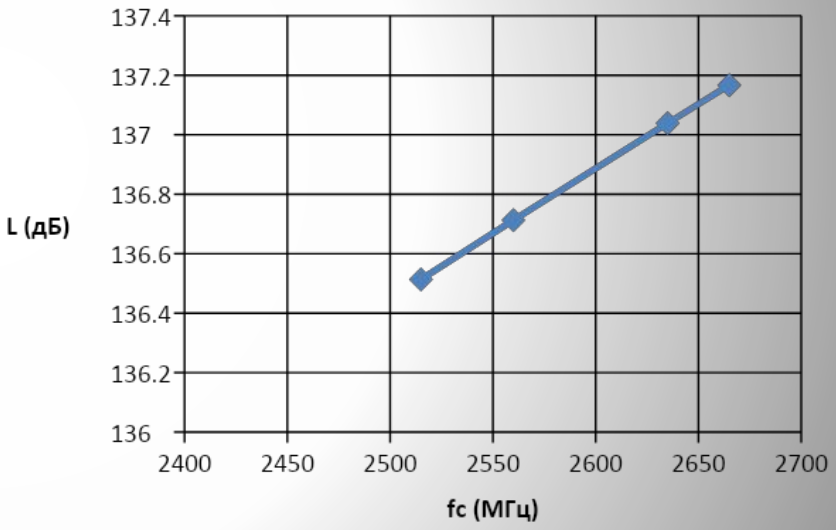
Find(d) → 1077.2264153035148133

In the following graphs depict the dependence of the loss of the radio frequency.
BS antenna suspension height is taken to be 50 m. Distance from the MS - 1077 m.

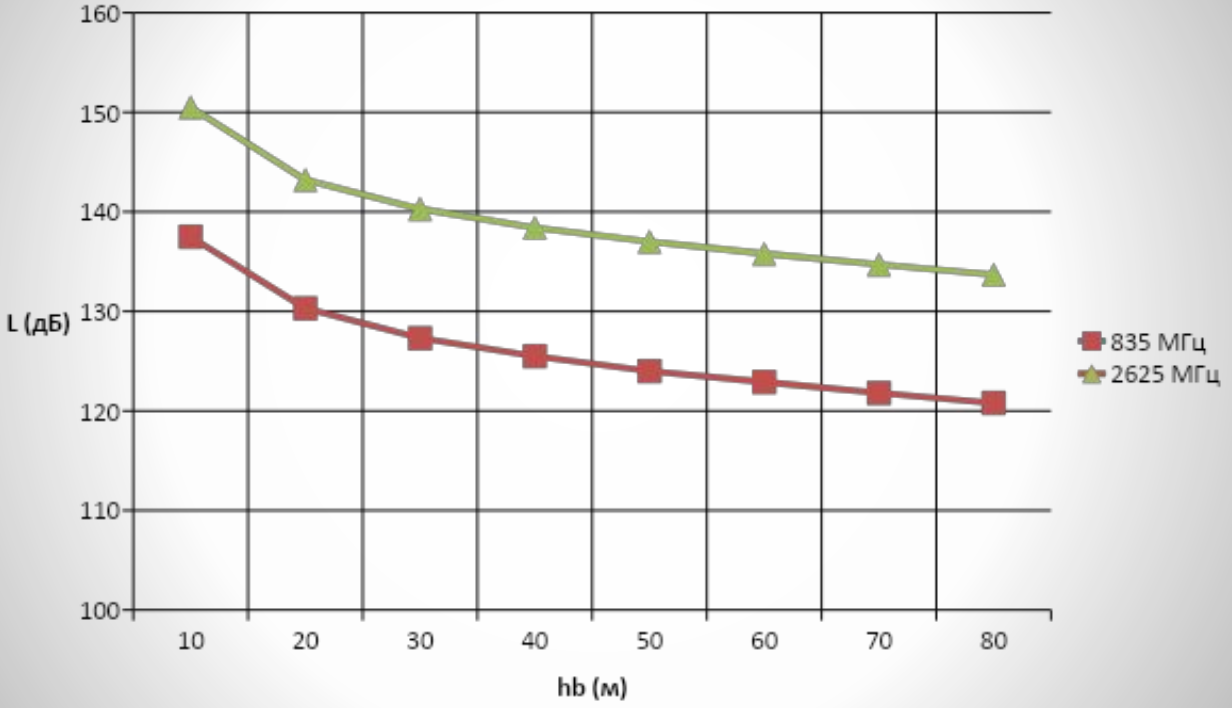
At a frequency of 795 MHz to 850 MHz



At a frequency of 2515 MHz to 2665 MHz



A plot of the loss of the height of the suspension at the BS antenna radio frequency of 835 MHz and 2635 MHz at a distance of 1077m.



Thank you for attention!