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SYNTHESIS TO THE SEGMENT OF NETWORK 5G WITH SUPPORT OF IOT

In the work offered approach concerning assessment of ability to integrate the existing infrastructure of mobile communication and IoT for the benefit of motor transport. During the researches the main focus is placed on technology eMTC and NB-IoT. For their realization use 694-790 MHz and 3.4-3.8 GHz of frequency ranges is supposed. As an example the site "Reshetylivka - Tsyganske" routes M03 was analyzed that has a difficult relief. The assessment of zones of service of base stations of mobile communication was carried out by means of the open software Radio Mobile. For increase in efficiency of the specified integration it is expedient to lean on mesh-technology.

Keywords: Base station (BS), Internet of things (IoT), mesh-technologies, Radio Mobile, 5G.

Introduction

It is known that the existing V2X LTE specification (so-called "transport modification 5G") provides mutual connections of thousands of devices in a radius of several hundred meters. It will allow to get a number of powerful advantages of integration 5G and motor transport. It is possible to distinguish the following from them.

1. Road safety. Networks 5G will allow cars to exchange with high degree of reliability data about traffic, weather conditions, sudden malfunctions or road accident.

2. Traffic. 5G will help to organize highly effective traffic control. Managing signs and traffic lights, sending messages to cars, the dispatcher redirects transport streams to avoid traffic jams.

3. Parking. High capacity of communication channels 5G gives an opportunity to equip with sensors "freely / it is busy" each place of the parking. At the sensor price ≈ $5 it will be available practically to any parking of the big city.

4. Unmanned vehicles. High speed of data exchange, universal coverings of network and its reliability will give a new impetus of development of unmanned cars. Removed communication of cars among themselves and/or with specially equipped infrastructure facilities (intersections, multi-level interchanges, parking, etc.) will increase traffic safety of so-called autonomous transport.

At the same time, it is necessary to pay attention to deficiency of a frequency resource for full introduction 5G. On the present, for the benefit of motor transport, 5G has to provide communication portability of the equipment on Internet of things technologies (IoT) in the ranges of 0.7 and 3.6 GHz. Respectively, there is a need for check of ability of the existing infrastructure to support new frequency ranges. All this testifies about relevance of subject to this work.

The Aim of Research

The main purpose of the study is to increase the efficiency of interaction of the 5G system with mobile subscribers and mobile objects by using the bands 0.7 and 3.6 GHz.

Main Results of the Study

The main objective of researches consists in justification of offers on integration 5G and the systems of information service of traffic flow on highways on the basis of IoT.

The main applicants should be considered technologies eMTC and NB IoT (tab. 1). The technology eMTC (also the names LTE-M, LTE Cat.M1) is adaptation of IoT for LTE networks. It has high capacity (to 1 Mbps in each direction from / to the subscriber). eMTC has to provide depreciation of the final equipment of IoT due to refusal of the LTE functions.

In turn, NB IoT realizes the low speed of data transmission (as a result of narrow bandwidth, for example, 200 kHz) with appropriate level of reliability of the equipment. Therefore, use of the traditional equipment for the IoT applications means use the equipment which is very expansive for the solution of these tasks. NB IoT the equipment has to be simple, compact and cheap to receive positive economic justification of application including simple in installation.

Table 1 – Summary for eMTC, NB-IOT

	eMTC (LTE Cat M1)	NB-IOT
Deployment	In-band LTE	In-band & Guard-band LTE, standalone
Coverage*	155.7 dB	164 dB for standalone, FFS others
Downlink	OFDMA 15 KHz tone spacing, Turbo Code, 16 QAM, 1 Rx	OFDMA, 15 KHz tone spacing, 1 Rx
Uplink	SC-FDMA, 15 KHz tone spacing Turbo code, 16 QAM	Single tone, 15 KHz and 3.75 KHz spacing SC-FDMA, 15 KHz tone spacing, Turbo code
Bandwidth	1.08 MHz	180 KHz

Peak rate (DL/UL)	1Mbps for DL and UL	DL: ~50kbps UL: ~50 for multi-tone, ~20kbps for single tone
Duplexing	FD & HD (type B), FDD & TDD	HD (type B), FDD
Power saving	PSM, ext. I-DRX, C-DRX	PSM, ext. I-DRX, C-DRX
Power class	23 dBm, 20 dBm	23 dBm, others TBD

Thus, NB IoT is focused rather on immovable (stationary) the equipment because in this mode automatic switching between cells (Handover) is not supported. The equipment of NB IoT needs to be registered in network, when moving to another of cells.

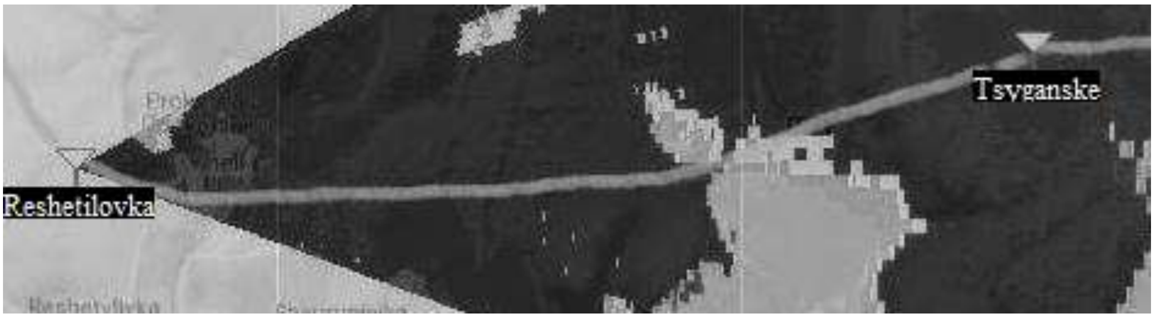
In general, NB IoT is appointed, first, for such applications as automatic collecting indications from counters, sensors, remote control of street lighting, monitoring of traffic of motor transport, etc. Unlike NB IoT, eMTC supports as switching between cells, and provides several times big speeds of reception / transfer.

Respectively, for implementation of the specified technologies in the ranges of 0.7 and 3.6 GHz assessment of zones of service on concrete certain sites of motor transportation infrastructure was executed. The software “Radio Mobile” was for this purpose used. This software allows carrying out modeling taking into account features of the area (height of a relief, vegetation, etc.) at frequencies up to 20 GHz.

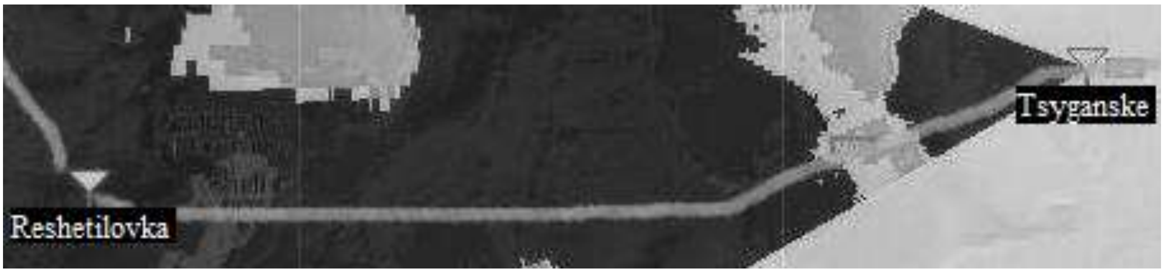
As an example, the site "Reshetylivka - Tsyganske" routes M 03 with a total length of 13.9 km was considered. Its preliminary analysis allows choosing several options of installation of base stations: in Reshetylivka, village Tsyganske, in both settlements and also between them.

The analysis of cover zones in the range of 694-790 MHz demonstrates that this segment of network of mobile communication provides stable and constant reception of a signal without loss and dead zones.

The other situation will be when using the frequency range of 3.4-3.8 GHz. For example, the location of BS in one of terminal points (fig. 1.a, b) the specified site leads to emergence of dead zones (a light shade). Respectively, it is unacceptable. For the solution of this task modeling of a situation of use of BS on both terminal points is executed (fig. 1.c). However, such option can influence project cost.



a)



b)

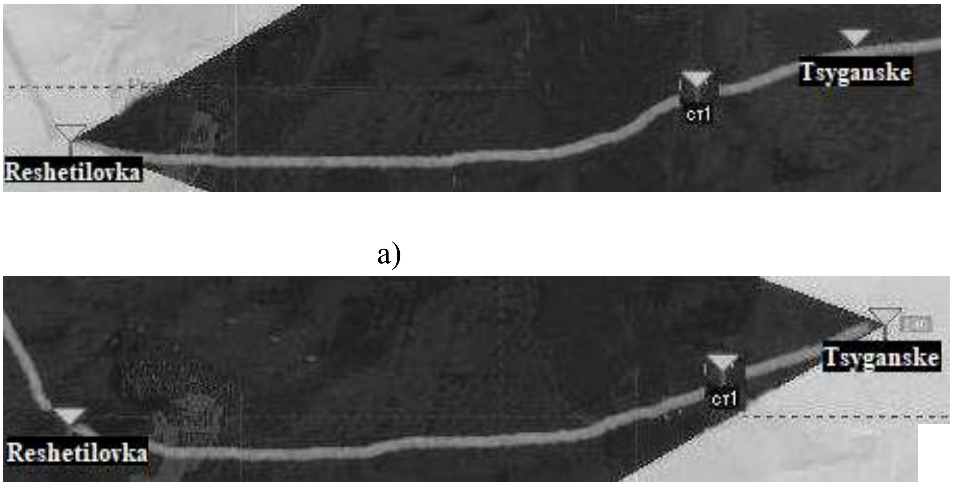
c)

Fig. 1. A fragment of cover zones in the range 3,4-3,8 GHz at placement BS:
a) – Reshetylivka; b) - Tsyganske; c) – in both terminal points

Therefore, it is possible to provide solutions of this task at the expense of mesh-technology, having created networks of auxiliary stations. It is known that the principle of creation of mesh-network consists in self-organized to architecture which realizes the following opportunities: resistance of network to loss of elements; scalability of network in the self-organization mode (increase in density and a cover zone of information support); creation of a covering of the big area of zones of a continuous information covering; use of wireless transport channels for connection in the mode "everyone with everyone".

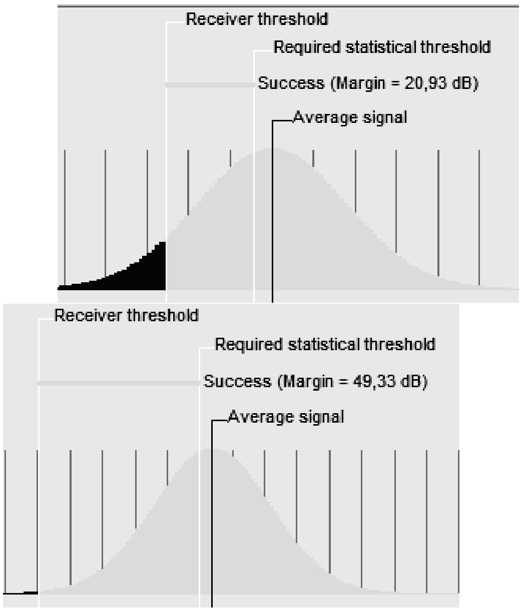
Thus, further it is executed modeling of cover zones taking into account placement of auxiliary stations. For example, cover zones in the presence of one such station are given in fig. 2 (has the designation "ст1"). In that case, stable reception of a signal (fig. 3) without loss and dead zones is provided.

Expansion of the intermediate station can be executed by option which is given in fig. 4.



б)

Fig. 2. Fragment of cover zones in the range of 3.4-3.8 GHz with use of the auxiliary station at placement BS: a) – Reshetylivka; b) - Tsyganske



a) б)

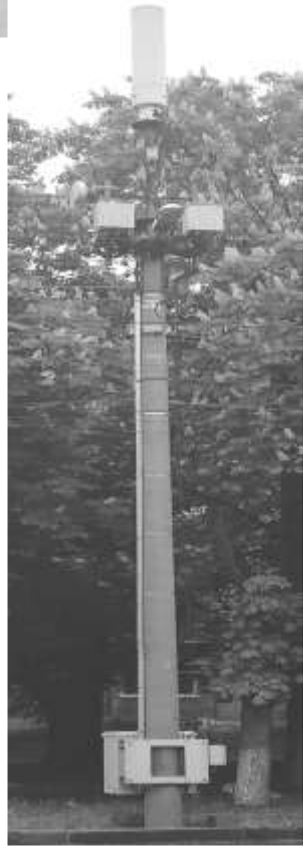


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Fig. 3. Statistics to a radio channel: a) – BS « Reshetylivka» and «ст1»; b) – BS «Tsyganske» and «ст1»

Fig. 4. Example of placement BS

In the course of modeling, imitation of base stations was carried out on the basis of characteristics Ericsson RBS 6201 LTE. Power of the transmitter is recorded at the level 43 dBm, receiver sensitivity: -128,7 dBm and the coefficient of strengthening of the antenna equals 17 dBi. In turn, the power of the transmitter of the mobile station was chosen at the level 20 dBm and receiver sensitivity: -102 dBm.

Conclusions

The results received during the researches confirmed theoretical regulations on ability to integrate IoT and the system of mobile communication for the benefit of motor transport. Introductions of mobile communication 5G on the basis of the existing infrastructure 4G with attraction of ranges of low frequencies, for example: Band 8 and 20, will provide realization of necessary services. However, attraction of higher frequencies, for example, of Band 22 and 42, demands additional optimization of the existing system of mobile communication. The specified technique is offered to use for other regions and sites of the terrain.

References

1. Sliusar I.I., Slyusar V.I., Chernikov R.A. Segment meregi 5G z pidtrymkoju M2M [5G segment with M2M support]. // Theses of the 71st scientific conference of professors, teachers, researchers, graduate students and students of the university. – Poltava: NUPP, 2018 p. – T. 1. – P. 354-355. (in Ukrainian).

2. Sliusar I.I., Slyusar V.I., Kondratenko V.I. Realizacija pidtrymky IoT perspektivnymi meregami mobilnogo zwjazku [Implementing IoT support for promising mobile networks]. / Modern information system and technologies. – Poltava: NUPP, 2018. – № 10. [On-line]. Available: http://reposit.pntu.edu.ua/handle/PoltNTU/5318. (in Ukrainian)

3. Obzor techologij Cellular Network [Technology Overview Cellular Network]. // Communication technology. [On-line]. Available: https://itechinfo.ru/content/обзор-технологий-cellular-network. (In Russian).

4. Basovaja stancia Ericsson RBS 6201 LTE [Base station Ericsson RBS 6201 LTE] // 4g-faq. [On-line]. Available: https://ru-4g.livejournal.com/85770.html. (In Russian).

5. Radio Mobile [On-line]. Available: https://www.ve2dbe.com/english1.html.

6. Next Future: Next Step in Automated Transportation [Electronic resource]. // NEXT Future Transportation Inc. – 2019. [On-line]. Available: https://ru-ru.facebook.com/next.future.transportation/.