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SYNCHROINFO JOURNAL

No. 3-2020



Published bi-monthly since 2015.

**ISSN 2664-066X (Print)
ISSN 2664-0678 (Online)**

Publisher

Institute of Radio and
Information Systems (IRIS),
Vienna, Austria

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METHODOLOGY FOR THE ORGANIZATION AND DESIGN OF DISPATCH SERVICES

Kulpunai A. Adylbekova

Kyrgyz State Technical University, Bishkek

Mohammed Omar Ahmed Abdulwasea

Sana'a University, Sana, Republic of Yemen

DOI: 10.36724/2664-066X-2020-6-3-2-4

ABSTRACT

Security and stable socio-economic development of any country depends on the effectiveness of the mechanism for prompt response to emerging threats. Complex of software and hardware "System 112" is designed for automated processing of emergency calls to a single number "112". The design of unified dispatch services (UDS) allows to apply theoretical knowledge to solve urgent practical problems. It is proposed to design the UDS service for mastering the competencies of the educational standard in two stages. Namely, to make preliminary planning and preliminary estimation of the amount of equipment required to deploy the service. Further, the performance indicators of the UDS are evaluated, taking into account the possibility of routing part of the traffic to the dedicated emergency services.

KEYWORDS: *Unified dispatching service, emergency services, call service center, prompt response, special software.*

I. INTRODUCTION

Concern for the life and health of citizens, the safety of property, ensuring personal and public safety, as well as the need to counter man-made, natural threats and acts of terrorism require the development of a mechanism for a rapid response to threats. As a single emergency call number in the Russian Federation, 112 was assigned, which combined four emergency services (fire brigade, police, ambulance and gas network emergency service) and two new services (Anti-terror and emergency response service).

SYNTHESIS OF STRUCTURAL ELECTRICAL CIRCUITS OF RADIO ENGINEERING DEVICES IN A HYBRID PRODUCTION EXPERT SYSTEM

Georgy A. Dolin, Anastasiya Y. Kudryashova,
Moscow Technical University of Communications and Informatics, Moscow, Russia,
dolin1974@gmail.com, asykka@bk.ru

DOI: 10.36724/2664-066X-2020-6-2-5-9

ABSTRACT

The development of communication systems and devices requires full automation of their design process to quickly update the RED. Especially important is the development of software for the synthesis of basic electrical circuits. The article describes the algorithm of end-to-end CAD based on an expert system for the synthesis of basic electrical circuits of RED based on an object-oriented hybrid expert system. Algorithms for forming the knowledge base at the learning stage and output in the synthesis process are considered. The algorithmic and software hybrid production ES and knowledge base are described. The system organization of structured information about the synthesis of blocks and the entire RED. It allows you to effectively form and manipulate the knowledge of RED design experts. The method for introducing and using a set of constant and variable confidence coefficients in the ES has been developed, which allows using unformalized knowledge about the field of RTU design. This ensures the application of both the knowledge obtained during the training of the ES and the knowledge accumulated during the design of the RED of the ES itself. All this allows the designer to formalize knowledge faster and more accurately, as well as increase the speed of automatic design since unlikely circuit solutions are not considered.

KEYWORDS: *expert system, Radio Technical Devices, CAD, knowledge base, algorithmic structures*

INTRODUCTION

Analysis of the accumulated experience in the field of Radio Engineering Devices (RED) design automation has shown that it is possible to ensure the synthesis and modeling of RED of any structure with a high degree of reliability and optimality only by creating a CAD system containing an ES that allows you to present and programmatically implement empirical knowledge, as well as heuristic rules and techniques used by highly qualified specialists in the design of RED in traditional manual design [1].

Expert synthesis allows you to provide a lack of a priori information with greater unambiguity and reliability of decisions made during automatic structural synthesis of RED in CAD and the accumulation of design experience of qualified RED design experts. It allows unskilled or novice users to design RED at the level of expert designers by formalizing the collective knowledge of a group of highly qualified experts about the field of RED design.

ES are classified according to the following set of characteristics: purpose; stage of existence; type of PS; type of knowledge representation methods used; universality; basic properties; operating environment. For automated RED synthesis in CAD, it is advisable to develop an ES of the following type: by purpose – research; by type-developed in algorithmic programming languages; by the type of knowledge representation methods used - hybrid, combining symbolic representation of knowledge with mathematical calculations necessary for the design of RED and allowing the use of data stored in external databases in ES; by the type of universality of knowledge representation - with an integral representation, combining several models of knowledge representation; operating in Windows operating systems on a PC.

The result of this procedure is the selection of electronic components whose parameters meet the constraints specified in the request. If the query results in multiple components, the designer is asked to select one of them, or the ES automatically selects the first appropriate one. To calculate the values of mathematical expressions that contain integers and decimals, parentheses, signs of four arithmetic operations, and mathematical functions such as exponentiation, root extraction, integration, differentiation, and so on, and are written as a string, you need to implement their parsing (the SOLVE/EXPRESSION procedure).

To do this, it is advisable to use the Polish form of writing (Backus notation) mathematical expressions. The SAVE (list of objects) procedure allows you to save the design results in a text file, and the CLEAR (object) procedure allows you to clear the object value defined during the design process.

The algorithm for synthesis of RED structural schemes in a hybrid production ES includes the following steps. The analysis of the TOR includes entering the parameters of the TOR by the designer and forming the design goal. If the designer does not have the values of the required parameters, the ES cannot carry out the design process. And if it is necessary to take into account additional requirements of the TOR, the designer should make changes to the KB ES. At this stage, the reliability of heuristic information stored in the database and necessary for constructive synthesis is of particular importance [4].

The development of the device at the structural level includes the selection of the nomenclature of nodes and cascades of the structural scheme of the designed RED from the KB. The hybrid production expert system allows you to present methods for the synthesis of RED structural schemes in the form of rules. They make it possible to save the conclusions obtained for the user and request additional information from him, calculate the required parameters of structural schemes based on functional relationships, and select electronic components based on several parameters from the database. The synthesis of structural schemes is carried out in a hybrid production ES that operates with symbolic information in combination with formula relations. Structural design ends with the formation of requirements for the parameters of individual RED nodes, which should ensure the operation of the entire device.

Conclusion

Thus, the hybrid production ES allows you to implement expert circuit synthesis of structural diagrams of individual nodes and the entire RED as a whole, due to

the fact that the output process is similar to the process of reasoning of an expert designer. In addition, the ES provides the calculation of the required parameters of the RED block diagram by functional relationships and it is possible to select electronic components based on a set of parameters from the database. At the same time, the use of confidence coefficients for choosing the design direction and taking into account the variance of confidence coefficients allows you to speed up the design process by reducing the search space in depth and width.

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THE INVESTIGATION AND EVALUATION MULTISERVICE NETWORK NGN/IMS FOR MULTIMEDIA TRAFFIC

Bayram G. Ibrahimov

Azerbaijan Technical University, Baku, Azerbaijan, i.bayram@mail.ru

Mehman F. Binnatov

Azerbaijan Technical University, Baku, Azerbaijan

Yalchin S. Isayev

Military Academy of the Republic of Azerbaijan, Baku, Azerbaijan

DOI: 10.36724/2664-066X-2020-6-2-10-13

ABSTRACT

The subject of the study is multiservice communication network using the concept NGN (Next Generation Network) based on the open network architecture IMS (Internet Protocol Multimedia Subsystem), supporting a wide range services. The basis of this architecture is the IMS core, consisting of a set of specialized modules responsible for various functions for customer service. The purpose of the article is to analyze the existing technical capabilities of the IMS multimedia messaging subsystem and perspective solutions for the functioning of the NGN/IMS network efficiency in providing multimedia service. As the efficiency of the system, the capacity NGN/IMS networks is selected using the signaling system and protocols NGN. The capacity NGN/IMS networks during the establishment of a multimedia session was analyzed and the functional architecture of the IMS multimedia messaging subsystem that determine the interaction NGN signaling systems an protocols was explored. Manage the presentation Triple Play services to subscribers and simultaneously modify the media stream within the session allows the protocol for the initialization of the SIP and Diameter sessions, which are the main IMS signaling protocol. One of the important requirements for the IMS subsystem is the maintenance QoS (Quality of Service). A mathematical model for estimating the quality of communication services using a system $GI/G/1/N$ based on the theory diffusion approximation is proposed.

The research presented in this paper is very important for the theory queuing systems, since the article proposes a method for investigating multiservice communication networks with non-Poisson incoming flow and effective results are obtained for NGN/IMS networks. On the basis of the model analytical expressions are obtained, which allow evaluating the performance indicators of the Triple Play service. The proposed mathematical model can be used to solve a wide range of practical problems, including the management multiservice traffic in the process its transmission in multiservice telecommunications networks, taking into account the quality of service classes. Thus, studies NGN/IMS network capacity indicators using SIP protocols are relevant.

KEYWORDS: *throughput, NGN/IMS networks, multimedia session, SIP protocol, IMS subsystem, signaling traffic.*

Information about authors

Bayram G. Ibrahimov, *professor of Azerbaijan Technical University, Baku, Azerbaijan*

Mehman F. Binnatov, *Phd., of Azerbaijan Technical University, Baku, Azerbaijan*

Yalchin S. Isayev, *an associate of the Military Academy of the Republic of Azerbaijan, Baku, Azerbaijan*

Introduction

The constant growth of the volume of transmitted useful and service traffic in multiservice networks with packet switching requires a steady increase in their throughput when establishing a multimedia session, ensuring the quality of service of QoS packets of traffic systems and NGN signaling protocols.

System-technical analysis showed [1-3] that many telecom operators providing multimedia services use service traffic control systems that implement triple play services, such as voice services with the ability to activate multimedia applications, video telephony, IPTV, voice and high-speed access to the Internet. This approach allows the integration of various services, provides ample opportunities for personalization and increasing the number of multimedia services.

To provide telecommunications operators with the above services in multiservice communication networks, it is necessary to take into account the quality of service QoS of service and useful traffic and perception (Quality of Experience, QoE), which is assessed by several performance criteria [4]. QoS & QoE support is a key requirement for the IMS subsystem and an important indicator of the effectiveness of NGN/IMS networks in establishing a multimedia session. However, this issue has not been studied well enough and remains poorly researched [2-6].

Research problem statement

It is known [3-5] that the connection setup time is the most important QoS indicator of NGN / IMS networks and is determined from the moment when the caller's terminal transmitted all the message necessary to establish the connection until the moment when this terminal equipment (TE) received a signal about the state of the terminal of the called party.

Based on the study, it was determined [2, 4, 6] that the considered NGN/IMS network when servicing traffic packets of systems and signaling protocols is a single-channel queuing system (QS) of the G1/G1/N type with a limited queue (by designation Kendall-Basharina GI – arbitrary distribution with independent intervals between applications).

Taking into account the nature of the network traffic of NGN/IMS signaling systems and protocols, a mathematical model (MM) of a multimedia service is proposed, taking into account the efficiency indicators of NGN/IMS networks and the features of diffusion approximation methods.

The mathematical formulation of the problem of the proposed MM for assessing the performance indicators of NGN/IMS networks when establishing a multimedia session is described by the following objective function:

$$Q_{\text{эфф.}}(\lambda) = W[\arg \max_i (C_{i,\max}(\lambda))], \quad i = \overline{1, n}, \quad (1)$$

under the following restrictions

$$\begin{aligned} T_{i,\text{cp.з}} &\leq T_{i,\text{cp.з,дон.}}, \eta_i \geq \eta_{i,\text{дон.}}, T_{i,\text{ож.}} \leq T_{i,\text{ож.дон.}}, \\ i &= \overline{1, n} \end{aligned} \quad (2)$$

where $C_{i,\max}(\lambda)$ – the maximum value of the throughput of NGN / IMS networks with the rate of the incoming stream of service traffic λ when transmitting the i -th packet stream; $T_{i,\text{cp.з}}$ – average delay time when transmitting the i -th packet stream; $T_{i,\text{ож.}}$ – average waiting time in the queue when servicing the i -th packet flow; η_i – efficiency factor of NGN / IMS network resources when transmitting the i -th packet stream; $T_{i,\text{cp.з,дон.}}$, $\eta_{i,\text{дон.}}$ and $T_{i,\text{ож.дон.}}$ – accordingly, the admissible values of indicators of NGN / IMS networks when transmitting the i -th packet stream, $i = \overline{1, n}$.

Expressions (1) and (2) define the essence of the considered new approach based on a mathematical model for assessing the quality of communication services.

This paper analyzes a model of the functioning of the efficiency of NGN/IMS networks in the provision of multimedia services, such as voice services with the ability to activate multimedia applications.

The scheme of investigated model functioning of multiservice networks NGN / IMS

Based on the analysis of the quality of work of multiservice communication networks, the functional architecture of IMS was determined, which contains the following levels:

- the level of access and transport;
- session management level;
- service and application level.

Figure 1 proposes a diagram of the functioning of the multimedia service traffic model in the NGN/IMS network.

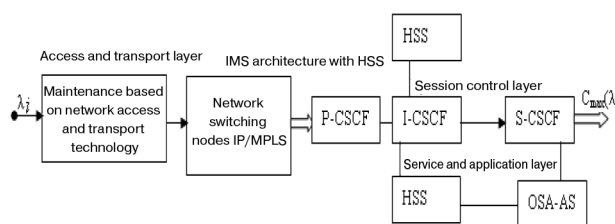


Figure 1. Block diagram of the model functioning servicing traffic in the NGN / IMS network

It follows from the diagram that the algorithm for receiving and servicing IMS multimedia traffic begins in the NGN/IMS network at the access network level, as a multi-service access node.

Further, the traffic of the multimedia service is served using the signaling gateway, the core of the IMS network using the HSS-Home Subscriber Server and is transmitted to the AS (Application Server), which interacts with the logical function S-CSGF, I-CSGF and P-CSGF (Serving,

Interrogating, Policy – Call Session Control Function) over SIP.

The analysis shows that the procedure for establishing a multimedia session is initiated by the terminal equipment and the network access gateway, transmitting the INVITE request of the switching nodes using the IP/MPLS protocols through the service access networks and gateways.

Here, SIP is used to establish, control, and disconnect communications. For authorization, authentication and accounting procedures in IMS, the Diameter protocol is also used.

The IMS core using HSS implements request functionality, proxy server functionality, and session management functionality. After receiving and processing, requests and responses of the service by the IMS are sent to the service application server and the service media server.

Evaluation of performance indicators of NGN/IMS networks

From the above described principle of operation of NGN/IMS networks using SIP terminals, it follows that the operation when providing multimedia services and when establishing a session can be considered as a single-phase single-line QS with a finite volume of the buffer storage N .

We assume that a stream of traffic packets of signaling protocols with certain characteristics arrives at the input of the buffer storage (BS) of the switching nodes of NGN/IMS networks. Such a model can be analyzed as a general QS $GI/G/1/N$ with a limited queue.

Based on the model, in order to assess the temporal characteristics of NGN/IMS networks when establishing a multimedia session, an approximate analytical method of diffusion approximation can be used, the accuracy of which is within acceptable limits. The idea of the diffusion approximation method is that the distribution P_k of the queue length in the system $GI/G/1/N$ with a limited queue with a total load ρ is approximated by the following distribution [6]:

$$P_k = \begin{cases} 0, & n_{pu} \ k = 0 \\ (1 - \rho) (\rho)^{k-1}, & n_{pu} \ k \geq 1 \end{cases} \quad (3)$$

here P_k – characterizes that at each moment of time k the system has probability distributions of phase states; ρ – load factor of NGN/IMS networks.

In this system, it is assumed that the rate of arrival of service traffic flows λ differs from the Poisson one, and the service process from the exponential distribution law μ . Taking into account the quadratic coefficients of variation of the distribution of intervals C_A^2 between incoming multimedia messages and the distribution of message lengths C_B^2 , the load factor of the QS is expressed as follows:

$$\rho = \exp[(\mu \cdot C_B^2 - \lambda \cdot C_A^2) / 2(\lambda - \mu)], \quad (4)$$

Suppose that due to system failures $\lambda_{o\delta c} = 0$.

Then, the mean $E[T_{omk}]$ the failure time interval is expressed as follows:

$$E[T_{omk}] = \frac{\lambda_{ex} \cdot \lambda_{\delta bx}}{\lambda_{ex} - \lambda_{\delta bx}} \leq T_{omk.\delta on}, \quad (5)$$

where $\lambda_{ex}, \lambda_{\delta bx}$ – accordingly, the rate of the incoming and outgoing packet traffic of the NGN/IMS protocols when establishing multimedia sessions.

Thus, based on the model $GI/G/1/N_{\delta n}$ of expression (5), the average failure time is characterized and is an indicator of QoS & QoE.

Determining the capacity of NGN/IMS networks when establishing a multimedia session

Taking into account the features of the general QS type $GI/G/1/N$ with a limited queue, the average queue length $E[L_{cp}]$ in BS switching nodes of NGN/IMS networks can be determined by Little's formula by the following expression:

$$E[L_{cp}] = \lambda_{ex} \cdot \{1 - E[P_{omk}]\} \cdot E[T_{omk}], \quad (6)$$

Based on the proposed MM, the average time to establish a multimedia session for providing Triple Play services, corresponding to the average stay time of traffic packets in the NGN/IMS switching node, is expressed as follows:

$$E[T_{ycm}] = \{E[T_{omk}] + \mu^{-1}\} \cdot (1 - P_{omk}), \quad (7)$$

It should be noted that expressions (6) and (7) determine the probabilistic-temporal characteristics of systems and signaling protocols of NGN/IMS networks and are indicators of the quality of service QoS of multiservice traffic.

Taking into account (5), (6) and (7) the maximum value of the throughput of NGN/IMS networks when establishing a multimedia session is determined as follows:

$$C_{max}(\lambda) = 1 / E[T_{ycm}(\lambda)], \quad (8)$$

The last obtained expressions (5), (6), (7) and (8) are an indicator of the effectiveness of NGN/IMS networks in establishing a multimedia session.

Numerical analysis results

Figure 2 shows the dependence of the NGN/IMS network bandwidth on the system load factor and the transmission rate of multimedia traffic.

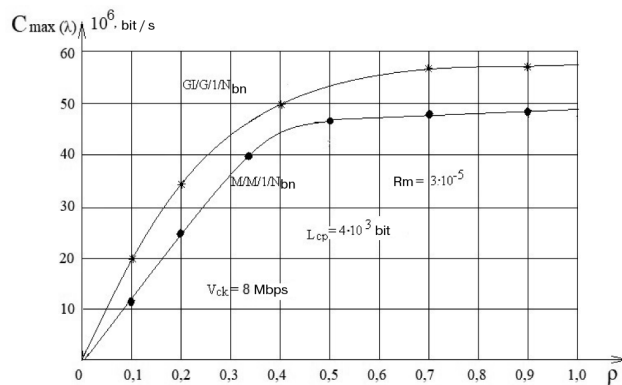


Figure 2. Graphical dependence of NGN/IMS network bandwidth on the system load factor when establishing a multimedia session

Graphical tendency family analysis $C_{\max}(\lambda) = W(\rho, \lambda_{ax}, V_{ck})$ shows that with an increase in the CMO load factor, the NGN/IMS throughput using the HSS home subscriber servers increases, thereby reducing the average multimedia session setup time for a given $V_{ck} = 155$ Mbit/s.

Thus, a comparative analysis of the QS of the general type $GI/G/1/N$ and $M/M/1/N$ shows that the contribution of the IMS core to the delays in establishing a multimedia session is significant and should be taken into account when designing NGN/IMS networks.

Conclusions

As a result of the study, an MM was proposed, in the form of a QS of the general type $GI/G/1/N$ with queues, based on the approximate method of diffusion approximation. Analytical expressions have been obtained that make it possible to assess the quality of service QoS & QoE of multiservice traffic and analyze the characteristics of the NGN/IMS network bandwidth when establishing a multimedia session.

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QUALITY OF SERVICE ASSESSMENT IN LTE NETWORKS WITH A LIMITED NUMBER OF USERS

Ndayikunda Juven,
University of Bujumbura, Bujumbura, Burundi,
juvndayi@mail.ru

DOI: 10.36724/2664-066X-2020-6-2-14-19

ABSTRACT

Narrow Band Internet of Things (NB-IoT) is the latest cellular radio access technology that was based on LTE technology and implemented as part of the 3GPP 3GPP 3GPP for Low-power Wide-area Network (LPWAN). The paper considers the features of NB-IoT standards based on the characteristics of the physical and channel layers of NB-IoT technology based on release 14-15 of the 3GPP group. The aim of this work is also to build and study a model for serving heterogeneous traffic in an isolated cell of the LTE standard, which supports the functionality of the Internet of Things IoT (Internet of Things), in particular eMTC (enhanced Machine Type Communication). The constructed mathematical model takes into account the heterogeneity of the arrival of requests and their dependence on the number of users of cellular services. Depending on the number of sources, incoming requests are described by Poisson or Engset models. The studied model makes it possible to dynamically allocate resources that have LTE.

KEYWORDS: *Internet of Things (IoT), LTE, eMTM, dynamic allocation, rate of lost requests, resource blocks, NB-IoT, bandwidth*

INTRODUCTION

The current stage of development of infocommunication networks requires solving urgent problems of analyzing the characteristics of the quality of service of incoming requests. Over the past few years, there has been a rapid growth in the number of telecommunication devices. According to Cisco forecasts, the number of devices connected to the Internet is growing rapidly and already exceeds the world's population [1, 2]. These include eMTC devices and various IoT sensors [6]. The increase in the number of devices connected to the Internet has made it necessary to develop new methods for assessing the quality of communication. The existing communication infrastructure is used to transfer the data traffic. Such networks are often deployed in locations where wired communication is limited. Wired Internet connection of telecommunication devices is not always possible in some areas. For the transmission of video information, voice messages, etc. in such places where there is no possibility of using wired communication at all, a wireless communication network is used. The LTE standard in the last 10 years has been a leader in the field of mobile communications.

In 2014, the 3rd Generation Partnership Project (3GPP) began development on the Internet of Things standard i.e. provision of services to users using the technology "energy efficient long-range network LPWAN (Low-power Wide-area Network)". In the LPWAN category, there are licensed technologies such as M1 (LTE-M) and unlicensed technologies, for example. Long Range (LoRa), SigFox, Ingenu, etc. In this paper, we consider servicing requests from a finite number of users, which are surveillance cameras and requests from traditional LTE devices.

This paper examines the features of the NB-IoT standard in comparison with the characteristics of LTE technology at the physical layer. When writing this article, the materials of the LTE Rel.14, 15 specifications were used, published in December 2016 - November 2017.

DYNAMIC PARAMETERS OF ELASTIC PLATE OPTICAL SWITCH DRIVES

Vagif Ali Magerramov,
Baku Technical University, Baku, Azerbaijan, mvg476@mail.ru

Mehman Huseyn Hasanov,
Baku Technical University, Baku, Azerbaijan, mhasanovnew@gmail.com

DOI: 10.36724/2664-066X-2020-6-2-20-23

ABSTRACT

The methods and means of improving the efficiency and the parameters of the dynamic parameters of the elastic plate of the optical commutator drive using advanced information and telecommunication technologies are analyzed. The bandwidth of optical communication networks based on systems with flat spring-loaded optical drive switch rods is investigated. On the basis of the study, the dynamic parameters of the elastic plate of the optical commutator drive are proposed a structural-functional scheme of a system with flat spring-loaded plates and linear algebraic equations for the dynamics of an elastic plate with the aid of which the equation for small oscillations of a rod near a rectilinear position is compiled. The equations of dynamics of systems with flat spring-loaded optical drive switch rods are considered and determined. On the basis of the system-technical analysis, a general integral of the spring deflection equation is determined. With the help of the solution, the equation for the dynamics of an elastic plate obtained a mathematical expression of the displacement of the upper end of the rod vertically of the spring-loaded drive system of the optical commutator.

KEYWORDS: *dynamics equations, optical commutator drive, integral of the deflection equation, fiber-optic networks*

Information about authors

Vagif Ali Magerramov, *Doctor of Mathematics, Professor, The department "Radiotexnika and televisions systems", Baku Technical University, Baku, Azerbaijan*

Mehman Huseyn Hasanov, *Cand. Tech Science, Associate Professor, The Department "Multi-channel telecommunication systems", Baku Technical University, Baku, Azerbaijan*

ABOUT RELATIONSHIP BETWEEN THE SIGNAL POWER, NUMBER OF M-QAM POSITIONS AND NOISE IMMUNITY IN BROADBAND WIRELESS ACCESS SYSTEMS

Isa Mammadov,

Azerbaijan Technical University, Baku, Azerbaijan,
isamamedov@bk.ru

Ilham Afandiyev,

*State Management of Radiofrequencies of Ministry of Transport,
Communication and High Technology, Baku, Azerbaijan,*
ilham.afandiyev@gmail.com

DOI: 10.36724/2664-066X-2020-6-2-24-28

ABSTRACT

Is studied the effect of measurement error on the accuracy of selecting the modulation type in the transmitter of the base station. The article discusses changes in the statistical characteristics of the measured signal as it passes through the stage of the feedback loop of the system of the LMDS type. Probabilistic characteristics of pilot-signal are determined at the output of this loop. The aim of the work was to find a compromise between the type of modulation and the power of the BS transmitter to maintain the transmission faithfulness within the given limits in the forward channel of an interactive wireless broadband radio access system of the LMDS. In this system a transition is made from one type of modulation to another in order to maintain the noise immunity of the system within the admissible limits. An adaptive controlling method of modulation type makes it possible to obtain an energy gain in the forward channel of the system.

It is useful to determine the type of modulation by measuring the current value of the signal-to-interference ratio at the base station (BS) receiver. For this purpose a pilot signal is transmitted on the reverse channel of the system. This signal, passing through the turbulent medium, undergoes attenuation, and therefore at the input of the BS receiver we have a random process. Moreover, the distribution law of this process can be different and is determined by the communication channel model. The problem consisted in

determining the necessary probabilistic characteristics of the output process by using the system parameters and probabilistic characteristics of the input random process. For this purpose the cumulants of the input random process and the random process at the output of the linear inertial system are determined. An expression for the probability density of the random process at the output of a linear inertial system is obtained.

The graphics of the error probability on the energy parameter at 16-QAM and 64-QAM type of modulation are constructed. The influence of the measurement error on the accuracy of the choice of the modulation type in the transmitter of the BS is studied. The limits of the change in the energy parameter are defined graphically, under which the modulation type changes to ensure a given error probability. It is determined, that the system is more critical to the measurement error at high admissible error probability, i.e. at high error probabilities, small errors in the measurement of the signal-to-noise ratio make it necessary to transition to a more noise-immune modulation mode.

KEYWORDS: *broadband wireless access system, base station, amplitude-phase modulation, power control, cumulant, adaptive selection of the modulation type*

Information about authors

Isa Mammadov, *Azerbaijan Technical University, professor, Baku, Azerbaijan*

Ilham Afandiyev, *State Management of Radiofrequencies of Ministry of Transport, Communication and High Technology, Chief Engineer, Baku, Azerbaijan*

ENHANCING 5G WITH MICROWAVE

Git Sellin (Executive Editor)

Maria Edberg (Editor)

Magnus Berggren, Mikael Coldrey, Jonas Edstam, Dennis Eriksson, Jonas Flodin,
Jonas Hansryd, Andreas Olsson, Mikael Ohberg, *Ericsson, Stockholm, Sweden*
Dimitris Siomos (Co-written article), *Deutsche Telekom*

Ericsson White Paper
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ABSTRACT

To meet the rapid deployment of 5G around the globe, it is evident that a variety of transport solutions are required in order to fulfill the needs of communications service providers. The international rollout of 5G is progressing much more quickly than anticipated and the necessity for high capacity backhaul and fronthaul has never been more apparent. Suburban and urban high capacity sites in 2022 will require capacities of up to 2 and 10Gbps respectively, while towards 2025 we will see examples of sites stretching between 5 and 20Gbps. Microwave is already well positioned to support all backhaul capacity needs using stand-alone E-band or multi-carrier solutions. In regards to fronthaul, microwave can act as a complement to fiber for antenna site capacities in a range of 10Gbps in 2019 and 25Gbps by 2022.

Now that commercial 5G services have gathered a strong global momentum, the dust settles on future spectrum use. Some backhaul frequency bands will eventually be transitioned to 5G access use, such as 26GHz in Europe. In contrast, the E-band and 32GHz band are acknowledged as essential for the backhaul of 5G. The solutions which are viable for each service provider and country are dictated by microwave spectrum availability, which in turn impacts both capacity and the total cost of ownership. In order to enable higher capacities in both traditional spectrum and E-band, access to wider bandwidths is important. Without this, more complex and spectrum-efficient solutions are required. MIMO is an important enabler for countries with limited spectrum availability to reach high capacity links of 1Gbps

and beyond. By using MIMO and E-band radios, Deutsche Telekom and Ericsson were able to smash the 100Gbps barrier during a trial in Athens, Greece. With optimal antenna arrangement, the trial achieved 139Gbps over 1.5km, with high availability and low latency. Such microwave links will be ideal as cost- and time-efficient complements to optical fiber for closure and redundancy of metro and core fiber rings, fiber extension applications, campus and enterprise connections and backups to existing high-capacity fiber links. As a result of technological developments, we expect that the first 100Gbps links will be deployed in 5 to 8 years, depending on the market demands. After almost a decade of experience in commercial E-band deployment, we have gained a number of insights to assist in E-band's future usage. For example, we foresee an increased use of E-band for longer hops, even if that means accepting a slightly lower availability. The widespread use of E-band increasingly supports our prediction that E-band will account for 20 percent of all new microwave links by 2025. It is evident that microwave is well prepared for the network evolution of 5G and beyond.

KEYWORDS: *E-band, MIMO for microwave, 100Gbps barrier, 5G*

This article was written in collaboration with Deutsche Telekom – one of the world's leading integrated telecommunications companies, with some 178 million mobile customers, 28 million fixed-network lines, and 20 million broadband lines in more than 50 countries. They provide fixed-network/broadband, mobile communications, Internet, and IPTV products and services for consumers, and information and communication technology (ICT) solutions for business and corporate customers.

QUANTUM TECHNOLOGIES “MADE IN AUSTRIA” – AIT COORDINATES PILOT PROJECT OF EUROPEAN QUANTUM COMMUNICATION INITIATIVE (QCI)

21.04.2020, Austria. **AIT is Austria’s center of expertise for quantum technologies, driving key initiatives to create a secure networked Europe.**

Magnus Brunner, State Secretary of the Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK), signed the EuroQCI Declaration on behalf of Austria in Brussels in late February 2020. In signing up to this European quantum communication infrastructure (QCI) initiative, 24 EU Member States have now confirmed their intention to create a European cybershield based on quantum communication infrastructure within the next 10 years. The AIT Austrian Institute of Technology, Austria’s largest applied research organisation, has been running the first European pilot project in the EuroQCI initiative – the Open European Quantum Key Distribution Testbed (OPENQKD) – since September 2019. The project is aimed at deploying quantum encryption to create a secure networked Europe. AIT expertise gained from many years of research will also play a key role in the first European QCI4EU study, which was launched in February 2020. This study aims to specify the user requirements and use cases which will drive development of the EuroQCI in close cooperation with the participating Member States. The findings will then be used to develop an overall system architecture for EuroQCI, composed of space-based and terrestrial solutions which are secure by design and will cover the entire European Union. The aim of EuroQCI is to facilitate the ultra-secure transmission and storage of information and data, and to link critical public communication assets throughout the entire European Union.

Over the past decade AIT has established an excellent international reputation as a quantum technologies specialist and coordinator of major European projects. They include the highly-competitive European Quantum Flagship programme aimed at developing quantum technologies for the mass market.

OPENQKD: quantum encryption for a secure networked Europe

In September 2019 the EU launched the EUR 15 million Horizon 2020 project OPENQKD. The findings of this 3-year project will flow directly into the EuroQCI initiative. The AIT-led consortium comprises 38 partners from 9 EU Member States, as well as the UK, Switzerland, Bosnia and Herzegovina, and Israel, consisting of manufacturers, network operators, system integrators, SMEs, research institutions, universities, certification and standardisation bodies, as well as end users, and together covering a broad range of expertise. Designed to establish a secure quantum communications network in Europe, as well as initiating a European ecosystem for quantum technology providers and application developers, the project will focus on developing a variety of demonstrators and future applications. They will include, amongst others, secure data transmission via telecommunication networks and appropriate storage in cloud infrastructures, the protection of sensitive medical information, official communication data, and the secure transmission of control signals used to operate critical infrastructure (telecommunication networks, energy supply). These activities are intended to protect Europe’s digital data economy against present and future threats, such as those from quantum computers, and to secure Europe’s strategic autonomy in the digital age. Further information: <https://www.openqkd.eu>

Quantum Flagship projects UNIQORN and CiVIQ

Launched in 2018 for a period of 10 years and with EUR 1 billion in funding, the Quantum Flagship programme is one of the European Commission’s largest initiatives. Its goals include the development of a competitive European quantum technology industry, and establishing Europe as a dynamic and attractive region for quantum research.

The AIT-led project UNIQORN (Affordable Quantum Communication for Everyone: Revolutionizing the Quantum Ecosystem from Fabrication to Application) involves 17 partners from across Europe. It focuses on pioneering, user-focused research using photonic technologies to miniaturise quantum applications and create system-on-chip solutions. The aim is to optimise the costs of quantum technologies, making them available to the general public. Using specialised quantum-optical sources, miniaturised QKD transmission units and detector technologies on mainstream fabrication platforms, the project will provide important stimuli and breakthroughs, particularly for generating true random numbers, and thus for highly-secure key distribution. Further information: <https://quantum-uniqorn.eu/aktuelle-news/>

Research in the CiVIQ project focuses on the cost-efficient integration of quantum communication technologies in emerging optical telecommunication networks. A total of 21 partners, including leading telecom companies, integrators and QKD developers, are working to develop state-of-the-art flexible and cost-efficient systems for quantum key distribution (QKD), as well as novel quantum cryptography systems and protocols. In future, it should be possible to provide consumers, industry and institutions with innovative services which meet the needs of a secure telecommunications market. In this project, AIT is developing QKD prototypes and specialised software for field use. Further information: <https://civi-quantum.eu/>

QUARTZ: quantum cryptography via satellite

Since 2018 AIT has played a significant role in a consortium coordinated by SES, the world's leading satellite operator, which is using quantum encryption to develop a satellite-based cybersecurity system. The QUARTZ (Quantum Cryptography Telecommunication System) project is supported by the European Space Agency (ESA). In addition to AIT and project coordinator SES, the QUARTZ consortium comprises a further 8 prestigious research institutions, universities and companies. Together, they will work until 2021 to design solutions for the distribution of secure keys between optical terrestrial ground stations, each connected to a quantum-enabled satellite via quantum links, and to develop the first software and hardware components this requires. Unlimited satellite coverage will help overcome the limits of today's fibre-based QKD systems, which are only able to transmit over a range of a few hundred kilometres, while also providing a globally available cybersecurity system, including networks in geographically dispersed areas.

Further information: <https://www.ait.ac.at/quartz>

Special note about data protection and privacy considerations at the AIT Austrian Institute of Technology

Protecting data and safeguarding privacy are essential in a modern society, and create the fundamental basis of trust upon which a society's cultural, social and economic development depends. Consequently, creating "security" is a core mission at the AIT Austrian Institute of Technology. In view of the many and constantly changing threats faced by our society, our task is to develop innovative approaches to combatting these threats. For that reason, a particular focus of the research undertaken at AIT lies in methods, architectures and technologies which take privacy-by-design approaches in order to integrate the greatest possible level of data security into any technical solution. Data security and privacy are sensitive issues and must be protected, making them the primary consideration in all research activity undertaken at AIT.

POSTPONEMENT OF ITU DIGITAL WORLD 2020 ICTS IN THE COVID-19 CRISIS AND RISK OF A NEW DIGITAL DIVIDE



Geneva, 27 April 2020. As a result of the ongoing COVID-19 crisis, the International Telecommunication Union (ITU) and the Ministry of Information and Communications, Viet Nam have taken the difficult decision to postpone ITU Digital World 2020, the global tech event for government, industry and SMEs. The event will now take place as ITU Digital World 2021 in September 2021 in the same venue in Ha Noi, Viet Nam. We believe this is the best and safest course of action to ensure the well-being and safety of all event participants and guarantee a successful event.

The world is facing an unprecedented threat from COVID-19 and ICT has become a key ally in combatting this threat and helping to prevent, detect and diagnose disease. It has taken on a new importance in connecting us for health, work, education, entertainment, news, public announcements and to our friends and families. For the first time, digital solutions and platforms are being used on a massive scale to help cope with and respond to a pandemic.

The COVID-19 crisis has also, however, highlighted its own digital divide, where many families, workers, businesses and populations are not able to access or afford the benefits of digital technology. Action is urgently needed to ensure a fair access to ICTs, for the benefit of all. Now, more than ever, governments, industry, international organizations, NGOs, academia and other stakeholders must work together to find mutually beneficial solutions.

We must set ambitious, measurable goals for ensuring an equitable transition to the digital age. The SDGs offer an ideal framework for this, and ICTs themselves are essential tools for the achievement of these goals.

The Government of Viet Nam and ITU call upon global leaders, governments and the tech industry to ensure they are present and fully engaged, to rise to the challenge and strengthen the multilateral, collective digital response to this crisis. International events such as ITU Digital World 2021 are more important than ever as a platform bringing together the global ICT community to learn, share knowledge, debate and network.

We must work together to highlight the critical importance of ICT in the wake of COVID-19, address the stark inequalities of access and adopt concrete, urgent measures to accelerate digital transformation across all sectors and to connect all global citizens to digital services. Only by international cooperation and collaborative action will we be able to combat these types of threat, close the digital divide and build strong foundations for the future wellbeing of all.

EUROPEAN BROADCASTING UNION (EBU) RECOMMENDS MEASURES TO MITIGATE INTERNET CONGESTION



Geneva, 25 March 2020. The EBU has issued a recommendation for public service media organizations to continue their efforts to avoid internet congestion and manage the potential impact of streaming media consumption during the COVID-19 pandemic. The full text of the EBU Technical Recommendation is available on the EBU T&I website.

The Recommendation was approved by EBU Member representatives serving on the EBU's Technical Committee in conjunction with the members of the Digital Steering Committee. It suggests to temporarily cap streaming bitrates at appropriate levels for different end-user devices, particularly during day-time, and that public service media (PSM) organizations encourage audiences to consume their offerings over broadcast rather than broadband, and on fixed broadband rather than mobile, where possible. It also calls on EBU Members to take an active role in coordinating national efforts and to engage with other media, network operators and regulatory agencies to collectively analyse and respond to the situation.

“Public service media organizations are playing a key role in managing the crisis – not only by continuing to inform, educate and entertain, but also by actively engaging with all stakeholders to ensure that broadcast and broadband infrastructure is used in the most efficient way”, said EBU Director of Technology & Innovation Antonio Arcidiacono.

Published as EBU R 149, the Technical Recommendation follows a call by the European Commission to help coordinate a European response to potential internet congestion issues that could be caused by stronger media consumption and the increased reliance on online collaboration tools during the COVID-19 crisis. PSM are the primary means of communicating with citizens in national emergencies. The EBU Technical Recommendation reaffirms the commitment of all EBU Members to their public service media obligations when weighing measures to reduce the impact of their services on the internet.

Recommends that during a time of crisis:

1) EBU Members, their local telecommunications network providers and administrations analyse the change in traffic patterns that may lead to Internet network congestion.

2) EBU Members act as facilitators at a national level for consensus amongst local OTT (over-the-top) providers in their efforts to address the challenges of Internet network congestion.

3) EBU Members seek to adapt their streaming services based on this analysis to address the challenge of network congestion while respecting their public service media obligations. Such measures could include:

a. Reducing the streaming bitrate by appropriate reduction of the top level of quality offered to clients particularly during office hours;

b. Arranging the adaptive streaming manifests to serve premium quality to fixed largescreen devices over mobile devices;

4) EBU Members might communicate with their audiences to adapt their viewing/listening patterns to help address the potential for network congestion. Where beneficial, measures could include informing their consumers to:

a. For linear services, favour the use of broadcast reception, via radio broadcast (FM, DAB/DAB+) and television broadcast DTT (Digital Terrestrial Television), DBS (Direct Broadcast Satellite) and Cable TV, which do not impact Internet network congestion;

b. At home, switch to WiFi/Internet where available rather than using 5G/4G/3G reception, as the former is more resilient to network congestion.

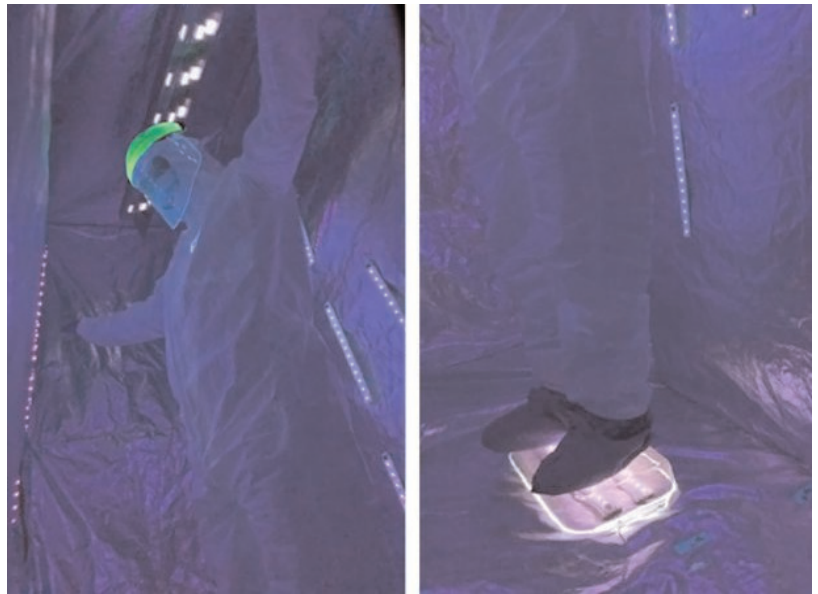
It is designed to provide guidelines to EBU Members and other broadcasters regarding adaptation of their streaming services and their audience's viewing and listening choices. The aim is to mitigate Internet network congestion brought about by massive use of the internet for home networking and education purposes during the current COVID-19 pandemic. It is envisaged that this recommendation be updated as the crisis evolves.

Full text is available here: <https://tech.ebu.ch/docs/r/r149.pdf>

INNOVATIVE SOLUTION PROTECTS PEOPLE FROM THE CORONAVIRUS

Olching, Germany, 20-03-17, LASER COMPONENTS GmbH. Deep UVC LED arrays from Bolb, Inc. are helping to combat the coronavirus epidemic in the Chinese metropolis of Wuhan. Emitter arrays with a power output of between 1.2 W and 2.5 W emit strongly disinfecting UVC light that kills not only antibiotic-resistant germs such as MRSA but also dangerous viruses such as the coronavirus (SARS-CoV-2).

In the newly built Huoshenshan Hospital, this technology is already being used to decontaminate doctors and nursing staff when they enter or leave the corona isolation ward in their infectious disease protective clothing. To do this, doctors and nursing staff simply have to be irradiated from all sides with highly efficient UVC light for around 30 seconds.



The wavelength is selected in such a way that it changes the RNA of the viruses in a short amount of time so that they no longer pose a threat. Since the epidemic suit also protects against UVC radiation, there is no danger to humans. To make the invisible UVC radiation visible, the headpiece of the protective equipment is coated with a fluorescent paint that glows as soon as the emitters are activated.

Germicidal LEDs (G-LEDs) from the US manufacturer Bolb are available from LASER COMPONENTS in Europe and the USA. In addition to use in hospitals and biomedical applications, UVC modules enable mobile and on-site solutions for treating drinking water, for example. In agriculture and horticulture, this technology can replace chemical pesticides and thus promote cost-effective, environmentally friendly forms of cultivation. UVC emitters can also be used in refrigerators to increase the shelf life of food.

Bolb Inc has introduced a powerful germicidal photonic platform based on their proprietary patented technical breakthrough - Germicidal LED (GLED), which is considered the world's best performing deep ultra-violet (DUV) LED and is capable of delivering a 10x performance improvement compared to current state of the art devices. These devices will have a dramatic impact on the worldwide disinfection and pathogen destruction industries enabling a new wave of solutions in critical market segments, such as Water Treatment, HAI Prevention, and Horticulture and Food Safety. By replacing mercury-based germicidal lamps with LEDs, Bolb opens up new applications of light-based pathogen destruction for surface, water, and air treatment, whenever form factor, upfront and operations costs, energy efficiency, convenience, and workflow considerations demand flexible and tailored photonic configurations.

To meet customer specifications quickly and flexibly, LASER COMPONENTS opened its own electronics production facility. At this facility, circuit boards are designed to drive PLDs and APDs. We also manufacture prototypes before they go into series production. Another major field is the individual production of customer-specific products!

Production Steps. *Our customers state their electronics requirements, and our R&D engineers create an appropriate CAD design. This software directly controls the circuit board milling machine for the production of prototypes. Electronic components are applied manually during this developmental stage. The results of a comprehensive inspection of these prototypes determine whether they proceed to series production.*

PLD Modules. *One example of a series product is our PLD modules. With these modules pulsed laser diodes can be operated safely, resulting in an optimal and thus reliable driver. The PLD is already integrated into the module. One unique product is our adjustable modules, which allow the continuous adjustment of both the output power and pulse length. They are particularly well suited for product R&D to test the ideal settings.*

High Voltage Modules for the Operation of APDs. *Temperature-stabilized high voltage modules are particularly well suited for the operation of Avalanche photodiodes (APDs). Output voltage and temperature compensation can both be matched exactly to the APD being used. Connecting the module and the APD is simple, and can be done with the help of the supplied diagram.*

APD Modules. *The APD modules are based on low-noise avalanche photodiodes made of either silicon or InGaAs with a built-in pre-amplifier and high voltage supply. A temperature compensation function allows the APD to be operated at constant gain across a wide operating temperature range.*