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C O N T E N T S

1.

DEVELOPMENT OF A MODERN COMMUNICATIONS INFRASTRUCTURE - A PREREQUISITE FOR ACCELERATED INTRODUCTION OF HIGH-SPEED BROADBAND INTERNET ACCESS

Dimitar Dimitrov – Head of "Radiocommunications Section"
Directorate of "Communications " MTITC

2.

PRESENTATION FROM THE COMMUNICATIONS REGULATION COMMISSION

Tsvetelina Sevlievska – Acting General Secretary of the CRC
and Director of the "Technical Regulation and Electronic Signature"

3.

DYNAMIC MANAGEMENT OF CAPACITY IN THE LOW LOAD OF 3G BASE STATIONS

Mihail Mihailov – Mobiltel EAD

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EUROPEAN STRATEGY FOR ECONOMIC DEVELOPMENT AND PROSPERITY OF BULGARIA

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NEW STANDARDS IN TELEVISION

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GLIMPSES ON TELECOMMUNICATIONS - IV

Kamen Rangelov – UBS

7.

INSIGHTS IN MODERN HUMAN-MACHINE INTERFACES IN SYSTEMS FOR CYBERSECURITY

Simeon Angelov – Omnitel Ltd.

8.

SOFTWARE-DEFINED NETWORKS: DESIGN GLOBALLY, APPLY LOCALLY

Ivan Iordanov, Stefan Dimitrov

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In this paper, an overview of the challenges associated with Software-Defined Networking (SDN) implementation is provided and a general strategy for adoption of Network function virtualization (NVF) in medium to large size enterprise and service provider networks is proposed. We discuss the benefits that can be accrued by creating a fully virtualized data center. The savings and efficiencies that can follow migrating to SDN are analyzed. The role of unified design, centralization of control and standardization in configuration is highlighted.

Keywords: Software-Defined Networking (SDN), Network function virtualization (NVF), Implementation strategy

9.

A SURVEY ON THE CONTROLLER PLACEMENT IMPACT OVER THE RELIABILITY AND PERFORMANCE OF SDN NETWORKS

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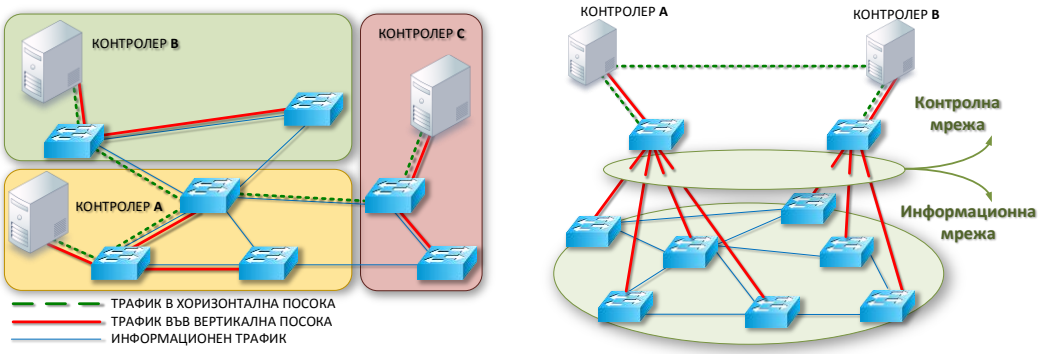
In recent years Software-Defined Networks have gained a lot of attention. Often these networks are related to the concept of Next Generation Networks (NGN) since they introduce a new ideology that radically changes our vision about networking. The main idea behind the SDN concept is the separation of control and data planes which are tightly coupled inside the network infrastructure devices. Now the network control logic is move out from the infrastructure boxes and the control mechanism is implemented by separate device called controller. This radical change opens many questions regarding the performance and reliability of the networks.

The goal of this paper is to analyze the primary developing challenge in Software-Defined Network topologies: determine the best controller placement and controller number for SDN control plane. In order to specify the problem, the focus is on ensuring the reliability of control plane. Experiments have been carried out based on real network. The results show that the controller placement and the number of controllers might vary a lot depending on different parameter sets.

Different approaches for implementation of the SDN's control plane have also been analyzed with some considering. One of the considerations is ensuring the integrity and reliability of control plane functionality.



(a) In-band control plane, (b) Out-of-band control plane

With in-band control, control traffic is sent like data traffic over the same infrastructure. Out-of-band control requires a separate control network in addition to the data network. A separate physical control network might not be cost-efficient or viable, but the security is improved. A shared network infrastructure for forwarding and control on the other hand might fit into cost requirements but it is less secure.

Keywords: software defined networks, node-to-controller delay, control plane, SDN parameters trade-off

10.

A SIMULATION EVALUATION ON THE IMPACT OF THE CONTROLLER LOCATION AND NUMBER ON THE PARAMETERS OF THE SDN

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The rapid development of the SDN networks and the new strategy for separation of the control from the data plane has presented to the researchers and the service providers several key challenges. The primary task, which needs to be solved, is the development of adequate algorithms and methodologies for balanced distribution of the resources within the network. This publication will present an analysis on the results from several simulation experiments on the factors that affect the placement of the controllers from the control plane. Solving the problem with the controller placement depends on many criteria, including the stability of the control plane. In this sense, there is more than just one solution to this problem, but it is important to implement the one that provides the best trade-off between the input criteria.

The concepts of the software defined networks can be applied to a very wide range of systems and even in some cases, which are currently considered as unthinkable. The idea of the NFV is to virtualize the network functionality including the main processes, such as data monitoring and filtering, the load-balancing of the traffic, etc., which makes the SDNs the right tool for the implementation of this functionality. This paper focuses on the implementation of the SDN paradigm in the backbone networks as an approach to extend the possibilities of the NFV. The study follows the concept that in the backbone SDN networks the controllers and the standard network nodes can be placed interchangeably in the topology.

When designing a centralized SDN network architecture a crucial moment is to determine the number and the locations of controllers. This paper presents how to overcome these problems by using the minimum delay between the nodes and the controllers, while at the same time the integrity and the reliability of the control plane remains unchanged. Several simulation scenarios are analysed and presented in the paper and they are used to prove that the optimal network conditions and the integrity of the control plane are two mutually exclusive parameters. In this sense, it is necessary to find the right trade-off between them. It is also proven that in the most cases up to 18 percent of the end nodes to have to provide control functions in order to ensure the full connectivity between the nodes and the controllers.

Keywords: software defined networks, node-to-controller delay, control plane, SDN parameters trade-off

11.

SCP-RPSC AND SC-CDMA TECHNOLOGIES IN THE TELECOMMUNICATION SYSTEMS FOR THE DEVELOPPING COUNTRIES

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In the last several months the world and the global media attention were focused exclusively toward the refugees, going from Near east to the developed Central European countries. It was explained, that most of them are economical, not political migrants. One of the possible ways to solve this problem is to create good political and economical opportunities in the developing countries in order to hold back the refugees in their own birth places. One of the first steps that should be done there is the building of telecommunication infrastructure, based on cheap and effective wireless technologies.

An analytical review of the wireless communication systems, suitable for the developing countries, is given in this report. Special attention is given to their antenna systems and associated problems. The advantages of the proposed by the author SCP-RPSC and SC-CDMA principles and technologies are comment. Their particular applications for developing countries are listed below:

Satellite radio and TV broadcasting - SCP;

Wireless access to Internet for urban areas – HAPS, WIMAX;

Wireless access to Internet for suburban areas – RPSC-MA;

Feeder lines for terrestrial and LEO base stations;

Personal mobile communications using integrated terrestrial-satellite systems – SC-CDMA.

It is shown in the conclusion that the practical implementation of SCP-RPSC and SC-CDMA principles and technologies will solve many global telecommunication problems. The results will be economical and cultural improvement of the life in the developing countries.

Keywords: Developing countries, SCP-RPSC, RPSC-MA, SC-CDMA

12.

TECHNICAL CHALLENGES TO THE MEDIA, OPERATORS AND USERS

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"Multimedia" BG

This article was prompted by a number of publications in the world related to the rapid development of technology for audio-visual streaming digital signal processing with the use of previously unimaginable facilities of the screen displays and the problems faced in the media production and distribution of content.

In the basis of the presentation stands basic formula CONTENT - TRANSFER - Consumers and rapid technological development of the on-screen displays and on their base etc. multi screen platforms.

We examine and analyze new opportunities of televisions based on embedded computer technologies presented as: Smart TV (Smart TV), Internet TV, Android TV, LAN, WEB browser, Wi-Fi, Bluetooth and related applications and games (App @ Games), and introduced media technologies and capabilities such as HbbTV (Hybrid Broadcast Broadband TV), MHL (Mobile High-Definition Link, NFC (Near Field Communication), Miracast, DLNA (Digital Living Network Alliance), IR blaster (infrared blaster), PVR (Prived Vodeo Record - recording on USB HDD - Hard Disk Drive), voice and other assistance.

The review is useful for a wide range of users of media services that can virtually navigate the technological description of the TV park and opportunities and trends in this market, as well as media professionals to expand the reach and wider penetration of services related to delivery content.

13.

APPLICATIONS OF SPECTRAL GRAPH THEORY IN THE FIELD OF TELECOMMUNICATIONS

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This paper gives on overview of the applications of graph theory in telecommunication networks. In the beginning is made an overview of the classic problems in telecommunication networks that are solved with graph theory algorithms. The classic problems and their solutions are:

 - Depth-First and Breadth-First Searches

 - Shortest Path Search – Dijkstra’s Algorithm, Floyd’s Algorithm

 - Discovery of Critical Links and Nodes

The second part is focused on the parameters of graphs according to the spectral graph theory and gives description of each. This chapter also focuses on application of spectral graph theory in the evaluation of the network topologies.

The benefit of using graph spectra in evaluating graphs is that it is calculated out of several graph matrices and it can be quickly computed. Spectral graph parameters contain a lot of information on the graph structure (both global and local) including some information on graph parameters that, in general, are computed by exponential algorithms. In spectral graph theory the following parameters are used for evaluation of graphs:

 - Diameter of graph

 - Algebraic connectivity

 - Graph spectrum

 - Effective resistance

 - Network criticality

Each of these parameters can be used in evaluation of the topology, depending on the end goal – either for choosing initial topology, or for further optimization of the network. These parameters are also correlated with each other and when modifying a topology, an evaluation of several of them should be made.

Cospectral graphs are also reviewed, as they are families of non-isomorphic graphs with the same (or similar) spectrum and can be used in choosing a topology with appropriate graph spectrum when having other constrains – like geographical, economical, etc.

Also some of the correlations between spectral parameters of graph are reviewed. The future work on this topic is on in-depth study of all the relationships between these parameters, specify stronger bounds to the parameters and finding optimal topologies by optimizing the graph spectral characteristics in given bounds.

14.

OSI REFERENCE MODEL IN THE CONDITION OF POSTAL MARKET

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This paper is devoted to application of OSI reference model to the specific conditions of postal system. The postal sector belongs to the network industry, but also to the communications industry and it is possible to look similarity with other systems such as transport and telecommunications.

In the manuscript is described the selection of package and its distribution between postal systems and the way of its connection on the basis of the model principles OSI. Authors described not only the immediate shipment of package between the systems, but also the abilities of the new system to collaborate and to solve tasks of relocation with other systems, through which the package is going during its transfer until the delivery to the addressee. On

these principles, the paper shows that by use of sufficient disaggregation, the postal system can be analysed by network layers.

This new “network layers approach” will be represented by designed postal model based on three layers. The first consists of applications/services provided by postal infrastructure, the second layer consisting of the active part network layer (technology of transportation) and the third layer is passive infrastructure (vehicles, transport routes…) of postal network.

The paper will be include important aspects of layer model such as makes the possibility to define rules for regulating, technical and technological requirements and interfaces to communicate with other postal systems.

Keywords: postal system, network layer model, OSI reference model

15.

ECONOMIC ASPECTS OF MARKET SATURATION IN THE MOBILE MARKET

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JEL: D22, L 96

The aim of the mobile operators to lower prices for calls in its network and higher prices for competing networks, forcing users to become subscribers of other operators. Tray increase telephone density over custom required. High density led to market saturation. Market saturation and intensifying competition among regulatory intervention to reduce termination rates negatively mobile operators. Negative consequences are expressed in reduced revenues and investments; reduced average revenue (ARPU) and profitability (EBITDA); number portability and loss of customers. Recommendations have been made to keep the customers. Referred to is the need for greater consumer orientation operators.

Keywords: market saturation, competition, loss of customers.

16.

ABOUT SOME CONCEPTUAL PROBLEMS WITH REGARDS TO THE APPLICATION OF THE METHODOLOGY OF THE NET AVOIDED COSTS IN THE POSTAL SECTOR

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JEL: L, L 8, L 87

The current report identifies conceptual problems related to the application of the methodology of the net avoided costs. Improvement of the methodology of the net avoided costs is proposed by developing of:

New reference scenario according to which the net costs of the designated operator are calculated within the universal service obligation;

New principles and rules for calculation of the net costs of the operator having the obligation to provide the universal postal service.

Criteria for determination of a threshold over which the net costs represent unfair financial burden for the operator with obligation to provide the universal postal service.

Keywords: Conceptual problems with regards to the application of the methodology of the net avoided costs in the postal sector, new caunterfactual scenario, new principles and rules for calculation of the net costs of the operator having the obligation to provide the universal postal service; criteria according to which the net costs of the obliged operator represent excessive financial burden.

17.

DEMOGRAPIC TENDENTIOUS AND STUDENTS RECROUTING – PROBLEMS AND DECISIONS

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One of the major challenges of Bulgarian universities today, especially technical, is the lack of prospective students. Obviously resolving the "new" challenge requires new thinking, decisions and action by the managements of universities and discussing foreign experience in this area is one of reasonable steps.

The article presents current issues and discuss some concepts of management of higher education and in particular high-tech marketing strategies and communication practices for recruiting students and can be useful in our academic life. It comes to the use of advertising tools, marketing mix (7Ps), social media, PR, models for decision-making choice of study, SEM, CMS and CRM - technologies, concepts of consumer behavior, social media and platforms to enhance the competitiveness of higher education.

To provide sufficient candidates for universities is imperative that our universities should radically change understanding of the management of higher education policies and to switch from primarily passive practices to proactive with modern web-based technologies for communication with school students and for lifelong learning.

In conclusion several trends of recent years in the use of different marketing approaches have outlined and related statistics on the use of global networks and social media by most colleges and universities in the world. The need for unification efforts and create teams from academia, professionals from the business and the local community and public authorities to rethink the educational strategies and practices have motivated. The goal is to overcome the difficulties with the shortage of prospective students and carrying out the mission of universities for economic development of the country and the prosperity of the nation.

Keywords: recruitment, higher education, communications, management

18.

DEVELOPMENT A MANAGEMENT MATHEMATICAL MODEL TO CREATE AN EFFECTIVE FUNCTIONING HIGH-TECH CLUSTER

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High-tech cluster stimulate innovation activity of high-tech small and medium-sized enterprises (SMEs). In this way SMEs have opportunity for production of high-tech products and services, to be competitive of Bulgarian and international markets. The enterprises in the cluster cooperate between them, while are competitors in the market. A management mathematical model is proposed a project to create effective functioning high-tech cluster with maximal common efficiency, as taking into account the influence of the links between the different levels in the cluster - leading companies, economic interaction between enterprises, suppliers, economic infrastructure. This is a problem of multi-criteria optimization (Multiple Pareto and Pareto point).

Keywords: 3-5 keywords: cluster, high-technology enterprises, management, mathematical model, multi-criteria optimization.

19.

STUDY OF FULL AVAILABILITY LOSS SYSTEM WITH GENERALIZED ARRIVAL AND DEPARTURE PROCESSES

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In this paper, a summary of the classic full availability loss system with generalized Poisson arrival process and generalized Bernoulli departure process is proposed. The generalized full availability loss system has a nonlinear dependence of the arrival and departure intensities from the system states, which allow defining different arrival and departure flows with two parameters - mathematical expectation and variance. For the generalized system, formulas are defined and the state probabilities and the time congestion probabilities are calculated and shown graphically. Investigated teletraffic system is marked by Kendall notation as - Mg/Mg/n/0/S and is described by a birth and death process.

The proposed approach allows with one model to investigate full availability loss systems with smooth, regular and peaked distribution of the system states. The numerical results and experience show that the proposed new model has interesting features and is useful for analysis of teletraffic systems.

20.

APPROACHES AND METHODS IN PLANNING OF MPLS NETWORKS

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Capacity planning of an MPLS network is necessary to ensure good quality of service, whether it works properly or where there some damages. The mechanisms for differentiation of services for providing transport for various applications with different quality of service (QoS) are analyzed. An overview of various architectural guidelines and strategies for the design of MPLS networks is made. The switching based on labels and roles in planning is viewed. The mandatory components of planning, that any model must have, are determine. Some problems of the use of the traffic matrix and solutions to these problems are discussed.

Keywords: MPLS, Traffic engineering, Planning telecommunication networks

21.

ESTIMATION OF THROUGHPUT IN LTE NETWORK, DEPENDING ON MIMO ANTENNA SYSTEMS

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Multiple-input-multiple-output (MIMO) technology is used by fourth generation mobile networks, especially in Long Term Evolution standard in order to achieve very high data rates in both the uplink and downlink channels. MIMO is based on the use of multiple antenna systems within the mobile terminal and the base station. The throughput depends on the number of the antennas used and the type of modulation. The estimation of the throughput is necessary in order to meet the users requirements for high quality of mobile services in LTE network. In our paper we present results for the throughput dependence on the antenna systems, the specific type of modulation and bandwidth.

Keywords: LTE network, multiple-input–multiple-output (MIMO), throughtput.

22.

DIMENSIONING AND EVALUATION OF THE RADIO FREQUENCY SPECTRUM

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Radio frequency spectrum is assumed as valuable resource one pubication is „Radio Spectrum The Oil of the 21st Century" - the pre-Davos summit, and outher - „Is radio spectrum more valuable than oil?". Radio spectrum throughout the world is valued at well over $2 trillion.

The Radio Frequency Spectrum resource value is necessary to obtain for comparing efficiency of the communications systems. This resource has physical dimensions, quality characteristics and market dependent unit price. The methodology for dimensioning and evaluation of the radio frequency spectrum is proposed in this report.

Keywords: Radio Frequency Spectrum, Spectrum-Orbit resource, dimensioning and evaluation of the radio frequency spectrum, grade of the spectrum utilisation, market price of the Spectrum-Orbit resource, efficient spectrum-orbit utilisation.

23.

A METHODOLOGY FOR EVALUATION OF THE RADIATION PATTERN AND THE CHARACTERISTICS OF DIFFERENT TYPES OF ANTENNAS USING A SPECIALIZED PLATFORM

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The antennas are very important and integral part of all wireless communication systems. They are designed in a variety of sizes and shapes, can be constructed from different materials and are characterized by different features. This makes some of them extremely suitable for the integration and use in portable devices, while others may only be used for long range data transmissions between stationary objects. The adequate methods for analysis of the parameters and the characteristics of the antennas enables their classification into several types and provides the ability to define the most suitable applications for their use.

The main emphasis of this paper is the presentation of a specialized laboratory platform that allows the studying and the evaluation of various types of antennas and provides the possibility for analysis of their characteristics and parameters. This laboratory platform consists of a radio frequency spectrum analyser with an embedded signal generator, a personal computer with specialized software for management and capturing of the radiation patterns of the different types of antennas, a stationary transmitter module and a motorized receiver module that can rotate at 360 degrees and allows the mounting of different antennas. In order to adequately test the monopole and the dipole antennas and the conduction of the corresponding analyses of their parameters, within the studies presented in this paper, a methodology for the conduction of several series of practical experimental is

presented and the results of these experiments are provided. The studies of the antennas were conducted in laboratory conditions and include three sets of experiments for each antenna type and provide their radiation patterns with different level of accuracy. The presented laboratory platform and the methodology for the analysis of the parameters and the characteristics of the antennas are suitable for studies and experiments not only with monopole and dipole antennas, but also with other types of antennas such as the spiral antennas, the micro-strip and the patch antennas, the telescopic and the parabolic antennas and others.

Keywords: antennas, radiation pattern, wireless communications, laboratory platform

24.

A METHODOLOGY FOR EVALUATION THE PROCESSES OF RF SIGNALS TRANSFER USING A SPECIALIZED LABORATORY PLATFORM

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The rapid development of the telecommunication systems in the past two decades has led to the global adoption of the wireless technologies for data transfer and at the present moment of time the end-user devices are equipped with at least one and in many cases even more radio interfaces. This widespread of wireless communications systems defines the need for the use of different methods and means for overcoming the various harmful signal sources that affect the transmission of the radio signals. An additional challenge is the lack of available frequency ranges or the excessive fees for the use of the existing standards for most services. This causes the wider use of the unlicensed frequency bands and leads to their overcrowding with signals. For these reasons, the most recent global research efforts are focused on the improvement of the available technologies and on the development of new methods for effective wireless information transfer.

Following the abovementioned trends, this paper presents a specialized laboratory platform for investigation and evaluation of the processes of radio-frequency signal transmission. This platform consists of a radio frequency spectrum analyser, a RF signal generator and a pair of transmitter and receiver units.

In order to use the laboratory platform for evaluation of the different stages of the wireless data transfer process, a methodology is also presented in the paper. This methodology includes the choosing the signal type and the analysis of its characteristics, the generation of the selected signal, its transmission using the transmitter unit and its reception using the receiver unit and the analysis of the signal with the help of the spectrum analyser. Additionally, in order to demonstrate the impact and the effect of the external signal sources on the transmission of the radio signals and to present some of the modern methods to overcome these problems, the experimental platform provides the possibility to use several auxiliary modules (filters, amplifiers and synthesizers), which allow the processing of the signals before and after their transmission and the following analysis.

Keywords: methodology, RF signals, specialized laboratory platform, wireless data transfer

25.

OVERVIEW OF ELECTROMAGNETIC INTERFERENCE IMPACT OVER WIRELESS SYSTEMS FOR CONTROL AND DATA ACQUISITION ADOPTING LORA™ TECHNOLOGY

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Electromagnetic interference (EMI) causes a wide spectrum of difficulties including momentary, minor inconveniences to system failures in wireless electronic devices. This paper gives a review of the interference problem in 868MHz ISM Band. It focuses on one of the newly presented wireless technologies LoRaTM a technology especially developed to serve the need of the constantly growing IoT. This paper examines several interference scenario examples and provides an overview of the expected performance deterioration which is resulting from interference based on several published results in literature.

Keywords: Electromagnetic interference, susceptibility, LoRa™, IoT

26.

APPLICATION OF COMPRESSED COSINES APPROXIMATION FOR 2-D DIGITAL FILTERS SYNTHESIS WITH MINIMIZING APPROXIMATION ERROR MINIMIZATION

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In this paper, a new approximation method of compressed cosines is discussed. Analytical relations for minimization of the approximation error are derived. Method for high-speed synthesis of 2-D digital filters, as well as formulas for filters with different geometric contours are proposed.

27.

EXPERIMENTAL STUDY ON ELECTROMAGNETIC INDUCTION OF AC IN AREAS WITH ZERO MAGNETIC FLUX DENSITY

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The report describes experimental studies of the phenomenon of electromagnetic induction with an alternating voltage. Specific research on that coil, which induces a voltage in the area lies entirely with zero magnetic induction. These results coincide with the results of previously proposed mathematical model, which allows description of the phenomenon in a differential form. On the basis of proposals made mathematical model experimental measurements of induced voltage in the coil with a known magnetic field. Received a picture of the induced field. As a consequence of the proposed mathematical model shows characteristics when measuring variable influence magnetic field using a sensitive coil.

Keywords: electromagnetic induction, magnetic induction, alternating voltage.

28.

ANALYSIS OF THE TRANSFER OF ENERGY FROM THE MAGNETIC FIELD

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The report analyzed issues related to electromagnetic induction and transfer of energy from the magnetic field. Based on the mathematical model used is shown that at unchanging electric field and a magnetic field changing in whole the energy is transferred from the magnetic field. For a more detailed description of an example operation of the analyzed pulse transformer in the rectangular pulses. In the time interval when the input voltage is constant, the magnetic flux increases at a constant rate, and the induced electric field does not change. It is shown that the proposed expressed in previous publications are applicable to an exciter of the magnetic field. If more than one exciter based on the analysis of experimental results from previous publications are offered expressions describing the intensity of the induced electric field and the transfer of energy from the magnetic field as a function of the rate of change of the magnetic field. Expressions are given to determine the strength of the induced electric field and the density of the transmitted energy excited by an electric element

29.

CIRCUITS FOR CHARGING OF ENERGY STORAGE ELMENTS IN POWER SUPPLYING MODULE FOR COMUNICATION SYSTEM

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In this paperwork a study of circuits for charging and voltage balancing over series connected energy storage elements has been made. The proposed circuits are with CL – filter in the rectifier circuit. The studied circuits are based on Resonant Converter with Reversed Diodes (RIRD) and Resonant Converter with Reversed Diodes and Voltage

Limitation over Commutating Capacitor (RIRDVLCC). Simulation studies are made for the two circuits. Characteristics for assessing the qualities of the circuits are made, based on the simulation studies.

Adding CL – filter in the rectifier circuit of both circuits, leads to charging with constant current. Adding CL – filter does not change the working regime of RIRD and RIRDVLCC. The created characteristics can be used for quality assessment of both circuits. The characteristic for the maximum current through transistor T1 can be used for choosing of the transistors and other elements in the circuit.

Keywords: Battery, CL – filter, Resonant converter

30.

SIMPLE DIGITAL QAM-MODULATOR FOR HOBBY PROJECTS OR EDUCATIONAL PURPOSES

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The paper present the creation of a simple QAM-modulator with a low-end microcontroller which can be used for demonstrating the principles of the quadrature-amplitude modulation – its realization and a short introduction of the advantages, disadvantages and applications. Also, it is presented an algorithm based on the numerical methods, which is well suited against the hardware capabilities of the microprocessor and it's advantages are compared against the other regularly used methods.

Keywords: QAM-modulation, education, algorithms, numerical methods

31.

AVAILABILITY OF FSO SYSTEM IN THE PRESENCE OF RANDOM JITTER IN THE INITIAL LASER BEAM DIRECTION

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This paper studies the availability of FSO (free-space optics) systems in the presence of random misalignments between the laser radiation direction and the center of the receiving antenna. It utilizes a statistical model of the atmospheric visibility and a statistical model of the optical beam jitter. The simulations are performed for different conditions. The availability of a two systems is compared, one uses optimal beam divergence angle and the other uses constant beam divergence angle for all initial conditions. Results can be used either to analyze the availability of a commercial FSO system mounted in a given geographic region, or to calculate the optimal system parameters given some initial condition (such as output power of the laser diod or the link distance) so that the system will perform reliably.

Keywords: random jitter, availability, optimal system parameters, reliability

32.

ONE POSSIBILITY FOR THE INTEGRATED APPROACH FOR THE EFFECTIVE COMMUNICATIONS

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The article presents the idea for one possibility for the integrated approach for the effective communications.

Keywords: radiofrequency, posts, telecommunications, integrity.

33.

TELECOMMUNICATION SERVICES THROUGH VISIBLE LIGHT BASED ON LI FI - TECHNOLOGY

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The report presents an overview of some new publications from leading companies and researchers regarding the Li-Fi technology application and its accelerated launch on the market.