

АНОТАЦИИ

**на материалите по чл. 76 (1) от ПРАС на ПУ,
вкл. самооценка на приносите и наукометрични показатели**

на

доц. д-р Иван Ганчев Иванов

от катедра „Компютърни системи“

към Факултет по математика и информатика

на Пловдивски университет „Паисий Хилендарски“

за участие в конкурс за заемане на академичната длъжност „професор“

Област на висше образование: 4. Природни науки, математика и информатика

Професионално направление: 4.6 Информатика и компютърни науки (Компютърни мрежи и комуникации),

обявен в ДВ, бр. 46 от 9 юни 2017 г.

За участие в конкурса е селектирана представителна извадка от 111 научни труда (от общо 253) в областта на компютърните мрежи и комуникации, за които са известни 571 цитирания (от общо 884).

Анотациите на селектираните научни трудове за участие в конкурса са представени в първата част на този документ.

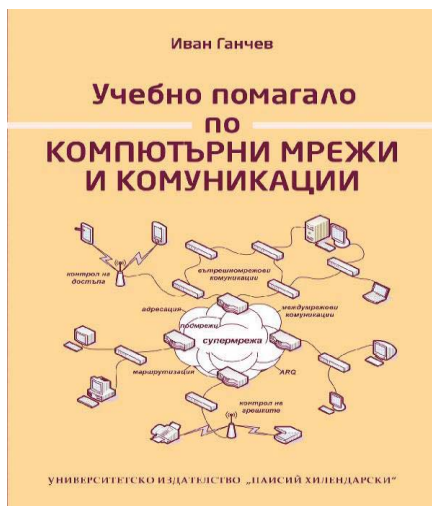
Във втората част е представена самооценка на приносите на селектираните научни трудове, разпределени по следните тематични подобласти:

- Комуникации на бъдещето;
- Интернет на нещата (*Internet of Things, IoT*);
- Интернет томография (*Internet tomography*);
- Комуникационни технологии за мобилно електронно обучение;
- Други научни изследвания.

Обобщени наукометрични показатели, генерирани от референтната база данни Scopus, са представени в трета част на документа.

АНОТАЦИИ НА НАУЧНИТЕ ТРУДОВЕ ЗА УЧАСТИЕ В КОНКУРСА

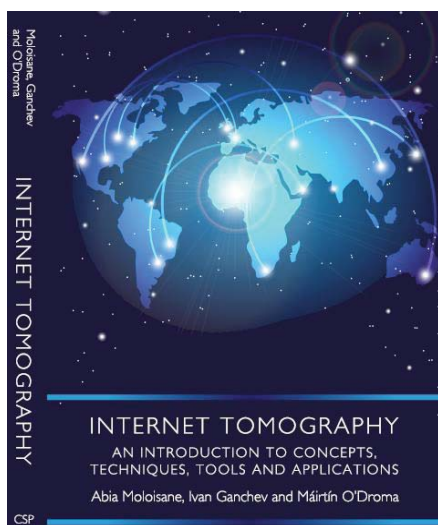
1. **И. Ганчев. Учебно помагало по компютърни мрежи и комуникации. 244 стр. Университетско издателство „Паисий Хилендарски“, гр. Пловдив. ISBN: 978-619-202-260-0. 2017 г.**



Учебното помагало има за цел да подпомогне студентите в (само)подготовката им при усвояване на учебния материал по дисциплината „Компютърни мрежи и комуникации“, водена от автора във Факултета по математика и информатика на Пловдивския университет „Паисий Хилендарски“. Помагалото е с информационно-тренировъчна насоченост. Материалът е обособен в 7 теми, като всяка от тях включва кратка теоретична част, 10 примерно решени задачи и 10 задачи за упражнение (самостоятелна работа) на студентите с цел самопроверка на знанията и самоподготовка за изпита по съответната дисциплина. Задачите във всяка тема са подредени по подтеми и степен на сложност и имат за цел не само практическо приложение на усвоените знания от страна на студентите, но и развиване на техните умения за решаване на проблемноориентирани задачи и

задълбочаване на знанията им по съответната тема. Помагалото е предназначено преди всичко за обучение на студентите от Факултета по математика и информатика на Пловдивския университет „Паисий Хилендарски“ по дисциплината „Компютърни мрежи и комуникации“ за магистърските специалности „Софтуерни технологии“ и „Бизнес информатика с английски език“ (със срок на обучение 2 години) и бакалавърските специалности „Информатика“, „Софтуерни технологии и дизайн“, „Софтуерно инженерство“, „Бизнес информационни технологии“, „Биоинформатика“, и отчасти по изборната дисциплина „Интернет на нещата“.

2. **A. Moloisane, I. Ganchev, M. O’Droma. 2013. Internet Tomography: An Introduction to Concepts, Techniques, Tools and Applications. 175 pp. ISBN(10): 1-4438-4421-7; ISBN(13): 978-1-4438-4421-5. Cambridge Scholars Publishing, UK. CSP 'BOOK of the MONTH'**



Introduced from basic principles through to techniques, tools and applications, Internet tomography – a concept used to describe the science of analysing the performance of the Internet in its various parts or as a whole by probing it through various means from the outside – is the subject of this monography. The design of an Internet Tomography Measurement System (ITMS) – a collection and operation of such means, aimed at mapping the Internet performance profile spatially and temporally over paths between probing stations – is a particular focus. ITMS design criteria addressed include: minimally-invasive or non-invasive, independent and autonomous, active or passive measurement, flexibility and scalability, capability of targeting local, regional and global Internet paths and underlying networks, compliance with the standardised performance methodologies and Quality of Service (QoS) metrics, e.g., those of the Internet Engineering Task

Force's (IETF) Internet Protocol Performance Metrics (IPPM) Working Group. The monography also features:

- The use of Internet tomography measurement in support of network simulation- and emulation modelling for network and service design and analysis, and service deployment.
- The exploration of spatial and temporal Internet performance variations by means of scenario-based analysis using real-time Internet performance data.
- Aspects of Internet tomography in Next Generation Networking (NGN) wireless architectures.
- The role of an ITMS in Service Level Agreement (SLA) design, implementation and compliance.

3. R. van der Mei, H. van den Berg, I. Ganchev, K. Tutschku, P. Leitner, P. Lassila, W. Burakowski, F. Liberal, A. Arvidsson, T. Hoßfeld, T. Maki, P. Mannersalo, K. Wac, H. Melvin, T. Grbac, Y. Haddad, P. Key. 2017. "State-of-the-Art and Research Challenges in the Area of Autonomous Control for a Reliable Internet of Services". In: *Autonomous Control for a Reliable Internet of Services: Methods, Models, Approaches, Techniques, Algorithms and Tools*. I. Ganchev, R. van der Mei, H. van den Berg (Eds.). Lecture Notes in Computer Science. Springer International Publishing, Switzerland. December. Pp. x1-x18. (accepted) SJR₂₀₁₆=0,315

The explosive growth of the Internet has fundamentally changed the global society. The emergence of concepts like service-oriented architecture (SOA), Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS) and Cloud Computing has catalyzed the migration from the information-oriented Internet into an Internet of Services (IoS). This has opened up virtually unbounded possibilities for the creation of new and innovative services that facilitate business processes and improve the quality of life. The goal of this book chapter is to first analyze the state-of-the-art in the area of autonomous control for a reliable IoS and then to identify the main scientific challenges within it. A general background and high-level description of the current state of knowledge is presented. Then, for each of the three subareas, namely the autonomous management and real-time control, methods and tools for monitoring and service prediction, and smart pricing and competition in many-domain systems, a brief general introduction and background are presented, and a list of key research topics is formulated.

4. C. Dobre, I. Ganchev, N. Garcia, R. Goleva, C. Valderrama. 2017. "Introduction to Enhanced Living Environments". In: *Enhanced Living Environments: From Models to Technologies*. R. I. Goleva, I. Ganchev, C. Dobre, N. Garcia, C. Valderrama (Eds.). The Institution of Engineering and Technology (IET), UK. October. Pp. x1-x18. ISBN: 978-1-78561-211-4. <http://www.theiet.org/resources/books/healthcare/enhliv.cfm> (in print)

This book chapter introduces the Ambient Assisted Living (AAL) and Enhanced Living Environments (ELE) in different aspects. The integration of the Information and Communications Technologies' (ICT), cloud, fog, dew, and dust computing, microelectronics, sensor networks, and many other pervasive devices, along with the use of ambient intelligence aiming to construct a safe environment around people is presented. The missing interaction of multiple stakeholders needing to collaborate for ELE supporting a multitude of AAL services is highlighted along with the barriers to innovation in the markets concerned, the governments and health care sector that do not yet take place at a relevant scale. Fundamental ELE issues, which remain open, are pointed out. The importance of social connections and societal activities is brought forward. The chapter traces the advance research in the area of ELE/AAL starting from end-users and platform definition, and ending with service personalization and implementation.

5. S. Autexier, R. Goleva, N. Garcia, R. Stainov, I. Ganchev, C. Mavromoustakis, C. Dobre, I. Chorbev, V. Trajkovik, E. Zdravevski. 2017. "End-Users AAL and ELE Service Scenarios in Smart Personal Environments". In: *Enhanced Living Environments: From Models to Technologies*. R. I. Goleva, I. Ganchev, C. Dobre, N. Garcia, C. Valderrama (Eds.). The Institution of Engineering and Technology (IET), UK. October. Pp. x1-x32. ISBN: 978-1-78561-211-4. <http://www.theiet.org/resources/books/healthcare/enhliv.cfm> (in print)

This book chapter presents results from Ambient Assisted Living (AAL) and Enhanced Living Environment (ELE) service identification and testing performed within an AAL lab. Possible end-user testing groups and scenarios of 'AAL as a Service' (AALaaS) and 'ELE as a Service' (ELEaaS) platforms are described and specified. Firstly, protocols and services classifications are presented according to the end-user specific requirements from communication and information point of view as the chapter aims to show how end-users, caregivers and service providers can be prepared for the challenges of the market. The aim of the test group is to verify and validate the platforms and services for the ELE created, integrated, described and specified. The testing is based on the platform technology and depends on the user requirements' analysis and ongoing work throughout use cases. Existing living labs experience has been used and enriched by customized information and communication services known from the ICT sector. Description of the ELEaaS is done in general terms along with the testing needed to be performed against general type of functions provided. The need for customization of the services, applicability to the needs of all stakeholders, flexibility for data exchange, integration, and interoperability between different versions and types of platforms is highlighted and justified.

6. R. Goleva, M. Pudane, S. Petrovica, E. Lavendelis, K. Kreiner, M. Drobits, I. Ganchev, N. Garcia, R. Stainov, C. Dobre, C. Mavromoustakis, I. Chorbev, V. Trajkovik, E. Zdravevski, G. Mastorakis. 2017. "AALaaS/ELEaaS Platforms". In: *Enhanced Living Environments: From Models to Technologies*. R. I. Goleva, I. Ganchev, C. Dobre, N. Garcia, C. Valderrama (Eds.). The Institution of Engineering and Technology (IET), UK. October. Pp. x1-x25. ISBN: 978-1-78561-211-4. <http://www.theiet.org/resources/books/healthcare/enhliv.cfm> (in print)

This book chapter presents a generic 'Ambient Assisted Living as a Service' (AALaaS) / 'Enhanced Living Environment as a Service' (ELEaaS) platform. Multiple platform elements are described by taking into account layered hierarchical models, horizontally and vertically planning models as well as models with planes. The main goal of the work is to identify the important platform parts, classify the existing models, and create a framework that will allow further protocols and services classification. The chapter starts with a presentation of the end-user requirements, continues with the analysis and design phases, and ends up with a possible implementation of the platform as a cloud-based one, aiming to aggregate data from multiple different access- and edge technological solutions and islands, and allowing data analysis and mining at the abstract level. This is considered as a driving force for further development of possible business solutions. The work is based on a real-life experience gained within living labs and conducted surveys on the topic.

7. I. Ganchev and M. O'Droma. 2014. "A New Techno-Business Model based on a Personal IPv6 Address for Wireless Networks of Moving Objects". In: *Wireless Networking for Moving Objects - Protocols, Architectures, Tools, Services and Applications*. I. Ganchev, M. Curado, A. Kessler (Eds.). Lecture Notes in Computer Science. Springer International Publishing, Switzerland. September. Pp. 3-13. ISBN:

978-3-319-10833-9. DOI: 10.1007/978-3-319-10834-6. SJR=0,325 (реферирана в SCOPUS)

A new techno-business model, based on a personal IPv6 (PIIPv6) address embedded in an X.509v3 digital certificate, is described in this book chapter. The new globally significant, network-independent PIPv6 address class will enable real number ownership and full anytimeanywhere-anyhow portability for future generations of wireless networks of moving objects, such as those in vehicular ad hoc networks (VANETs), mobile ad hoc networks (MANETs), and other types of ad hoc networks. The unique PIPv6 address of the network node (object) could serve as its long-term identity, and enable its advanced secure mobility and participation in the variety of evolving dynamic, fluid wireless mobile network scenarios. It can also serve enhanced authentication, authorization and accounting (AAA) functionality, through which commercially viable adhoc networking and open mesh-networking solutions are realizable. In these latter, a mobile node (object) acting as a gateway (or a relay) may offer (or facilitate) wireless Internet access services casually or persistently to other mobile nodes or objects and receive credits for this service. This solution is exactly the kind of incentivised one that is required for cooperative relaying over multiple hops, i.e., that available idle mobile nodes and objects are incentivised to operate and offer service as relay nodes for other objects which are trying to reach a gateway for access to specific or general telecommunications services, such as the Internet. The idle nodes may provide this access directly if that is possible or in a dynamic collaboration via a multi-hop link.

8. J. L. Munoz, O. Esparza, C. Ganan, J. Mata-Diaz, J. Alins, I. Ganchev. 2014. "MHT-based Mechanism for Certificate Revocation in VANETs". In: *Wireless Networking for Moving Objects - Protocols, Architectures, Tools, Services and Applications*. I. Ganchev, M. Curado, A. Kassler (Eds.). Lecture Notes in Computer Science. Springer International Publishing, Switzerland. September. Pp. 282-300. ISBN: 978-3-319-10833-9. DOI: 10.1007/978-3-319-10834-6. SJR=0,325 (реферирана в SCOPUS)

Vehicular Ad Hoc Networks (VANETs) require mechanisms to authenticate messages, identify valid vehicles, and remove misbehaving vehicles. A Public Key Infrastructure (PKI) can be utilized to provide these functionalities using digital certificates. However, if a vehicle is no longer trusted, its certificates have to be immediately revoked and this status information has to be made available to other vehicles as soon as possible. The goal of this book chapter is to introduce and describe in detail a certificate revocation mechanism based on the Merkle Hash Tree (MHT), which allows to efficiently distribute certificate revocation information in VANETs. For this, an extended-CRL is created by embedding a hash tree in each standard certificate revocation list (CRL). A node possessing an extended-CRL can respond to certificate status requests without having to send the complete CRL. Instead, the node can send a short response (less than 1 KB) that fits in a single UDP message. This means that any node possessing an extended-CRL, including Road Side Units (RSUs) or intermediate vehicles, can produce short certificate-status responses that can be easily authenticated. The main procedures involved in the proposed mechanism are described in detail. General security issues related to the mechanism are treated as well.

9. D. Meere, I. Ganchev, S. Stojanov, M. O'Droma. 2009. "Adaptation for Assimilation: The Role of Adaptable M-Learning Services in the Modern Educational Paradigm" In: *New Trends in Intelligent Technologies, International Book Series "Information Science and Computing"*, No. 14, Pp. 101-110. ITHEA, Sofia, Bulgaria. ISSN: 1313-0455.

This book chapter presents an adaptable InfoStation-based multi-agent system facilitating the mobile eLearning (mLearning) services provision within a University Campus. The network architecture is presented along with the interactions between the various components within the architecture during mLearning service provision (mLecture, mTest) are presented. System implementation approaches are also considered, with particular

attention paid to the creation of user profiles and service profiles for the personalization and contextualization of the presented services..

10. S. Stoyanov, I. Ganchev, M. O'Droma, H. Zedan, D. Meere, V. Valkanova. 2011. "Semantic Multi-Agent mLearning System". Chapter 11 in: *Semantic Agent Systems: Foundations and Applications*. Studies in Computational Intelligence (SCI), vol. 344. A. Elçi, M. T. Koné and M. A. Orgun (Eds.). Springer-Verlag Berlin Heidelberg, Germany. Pp. 243-272. ISSN: 1860-949X. E-ISSN: 1860-9503. DOI: 10.1007/978-3-642-18308-9. SJR=0,168 (реферирана в Web of Science и SCOPUS)

An agent-oriented middleware supporting context-aware mLearning service provision is presented in this book chapter. The middleware architecture developed for a distributed InfoStation-based University system is described in detail. The concept for the control and management of service sessions and communications scenarios is also presented. The utilization of semantic information in order to facilitate contextualised mLearning services is detailed.

11. S. Stoyanov, I. Ganchev, I. Popchev, M. O'Droma. 2010. "An Approach for the Development of a Context-Aware and Adaptive eLearning Middleware" In: *Intelligent Systems: From Theory to Practice*. Studies in Computational Intelligence (SCI), vol. 299. V. Sgurev, M. Hadjiski and J. Kacprzyk (Eds.). Springer-Verlag Berlin Heidelberg, Germany. Pp. 519-535. ISSN: 1860-949X. E-ISSN: 1860-9503. DOI: 10.1007/978-3-642-13428-9. SJR=0,165 (реферирана в Web of Science и SCOPUS)

This book chapter describes a generic, service-oriented and agent-based approach for the development of eLearning intelligent system architectures providing wireless access to electronic services (eServices) and electronic content (eContent) for users equipped with mobile devices, via a set of InfoStations deployed in key points around a University Campus. The approach adopts the ideas suggested by the Model Driven Architecture (MDA) specification of the Object Management Group (OMG). The architectural levels and iterations of the approach are discussed in detail and the resultant context-aware, adaptive middleware architecture is presented. The classification and models of the supporting agents are presented as well.

12. D. Meere, I. Ganchev, M. O'Droma, M. O'hAodha, S. Stojanov. 2010. "Evolution of modern library services: the progression into the mobile domain". Chapter 6 In: *M-Libraries 2: A virtual library in everyone's pocket*, M. Ally and G. Needham, Eds.: Facet Publishing, UK, May 2010.

This book chapter describes the main elements of a service architecture needed to support the expansion of existing library-based services into the mobile domain, based on a model proposed as part of the Distributed e-Learning Centre (DeLC) initiative. The enhanced DeLC architecture, detailing the underlying communications infrastructure, along with the various enhanced library-based services are discussed. The capabilities of these mobile services (m-Services) in ensuring greater dissemination and re-organisation in relation to the large volumes of administrative information which third-level institutions are required to deal with on a daily basis are considered. The utilization of various profiles in order to facilitate a more personalized and contextualized information environment for library users is detailed. Finally, an approach to the development of 'Personal Assistants' (PAs), operating within this multi-agent environment is outlined.

13. I. Ganchev, S. Stojanov, M. O'Droma, D. Meere. "Development of InfoStation-based and Context-aware mLearning System Architectures" In: *Advanced Learning*. Raquel Hijón-Neira, editor. InTech, Croatia. ISBN: 978-953-307-010-0. Pp. 115-139. October 2009.

This book chapter considers the main aspects in the development of InfoStation-based and context-aware multi-agent system architectures, which facilitate the provision of intelligent mobile eLearning (mLearning) services across a University Campus area. Generic models and approaches for the development of eLearning systems are considered, paying particular attention to the various aspects which will have a greater bearing on the adaptation and personalization of the eLearning content for the specific end user. The supporting network architecture is described both horizontally and vertically illustrating how each of the main system components collaborates in order to facilitate the delivery of mLearning services. The chosen multi-agent approach for the system implementation is justified. The approach uses some fundamental OMG-MDA ideas with additional elements, which take into account the specifics of the InfoStation network. The software architecture required to provide the needed hardware flexibility and adaptability according to the requirements of modern eLearning systems is discussed. The system architecture is being developed on three levels: scenarios level, agent-oriented middleware, and eLearning services level. The four main generic service scenarios are presented highlighting the requirements for effective distribution of service control and session management between the agents. Suitable agent-oriented system models are proposed and explained, and the interactions between agents and mLearning services in each of these models are presented. Approaches for system implementation and structuring are also considered. Particular attention is paid to the creation of user profiles and service profiles aiding the delivery of more personalised and context-aware mLearning services and their implementation through the Composite Capabilities/ Preference Profile (CC/PP) and User-Agent Profile (UAProf). The utilization of J2ME as the architecture for the development, deployment and execution of the mLearning services is outlined. The implementation of the system by means of the Java Agent DEvelopment (JADE) framework making particular use of its Light Extensible Agent Platform (LEAP) module is also discussed in detail.

14. V. Siris, I. Ganchev, M. O'Droma, B. Stiller. 2009. "Services, Optimisation and Economic Aspects", Chapter 6 in: *Traffic and QoS Management in Multimedia Wireless Networks*. Lecture Notes in Electrical Engineering 31, Pp. 267-303. Y. Koucheryavy, et al. (Eds.). Springer Science + Business Media, USA. [ISBN: 978-0-387-85572-1; e-ISBN: 978-0-387-85573-8-6; DOI: 10.1007/978-0-387-85573-8]. ISSN: 1876-1100. E-ISSN: 1876-1119. **SJR=0,125 (реферирана в Web of Science и SCOPUS)**

This book chapter deals with commercialization support mechanisms for value-added telecommunication services and the efficient use of network resources, highlighting both differences and special needs for various mobile and wireless technologies and services, but also identifying requirements of a uniform framework and architecture to provide multiple services. Section 6.2 discusses the definition and deployment of various mobile and wireless services. Section 6.3 discusses business aspects, in addition to Authentication, Authorization, Accounting, Auditing, and Charging (A4C) issues as well as billing mechanisms. Finally, Section 6.4 investigates mobile and wireless networks, based on user/application requirements and cost/revenue aspects.

15. I. Ganchev, M. O'Droma, D. Meere, M. Ó hAodha, S. Stojanov. 2008. "M-learning and m-teaching architectures and the integration of evolving multi-campus educational

support e-services” In: *M-libraries: libraries on the move to provide virtual access*. Gill Needham and Mohamed Ally (Eds.). Facet Publishing, UK. ISBN: 978-1-85604-648-0. Pp. 159-171.

This book chapter describes the establishment of an innovative collaborative project between the University of Limerick and the University of Plovdiv - the Distributed e-Learning Centre (DeLC). This Centre aims to provide a distance e-Learning and e-Teaching facility available at any place and at any time to individuals and groups of students / educators both in on-line (synchronous mode) and off-line (asynchronous mode). The current version of the DeLC aims to enhance the provision of the intelligent mobile services necessary to ensure the better organization and functioning of the entire e-Learning/e-Teaching process in a University environment. It also aims to provide discontinuous m-Learning and m-Teaching facilities by allowing electronic access from virtually any device (both stationary and/or mobile) currently in a user’s possession. This paper analyses some of the main elements of the DeLC architecture that are necessary for the support of m-Learning and m-Teaching in a third-level environment and the enormous potential this area holds in terms of future research possibilities and developments. A particular focus of the paper is on the possibilities for improving student access to on-line educational/learning resources in the library through the incorporation of advanced wireless systems such as (Bluetooth, Wi-Fi, UMTS/GPRS/GSM etc.), mobile devices (e.g. smart phones, laptops, PDAs) and those e-Learning applications that offer “anytime, anyplace, anyhow” access to library/information resources.

16. A. Moloisane, I. Ganchev, M. O’Droma. 2007. “Internet Tomography in Support of Internet and Network Simulation and Emulation Modeling”. Chapter 21 In: *Recent Advances in Modeling and Simulation Tools for Communication Networks and Services*. Springer, USA. December. Pp. 409-427. A. N. Ince and A. Bragg (Eds.). ISBN: 978-0-387-73907-6 (Print) 978-0-387-73908-3 (Online). **SJR=0,101 (реферирана в Web of Science u SCOPUS)**

Internet performance measurement data extracted through Internet Tomography techniques and metrics and how it may be used to enhance the capacity of network simulation and emulation modelling is addressed in this book chapter. The advantages of network simulation and emulation as a means to aid design and develop the component networks, which make up the Internet and are fundamental to its ongoing evolution, are highlighted. The chapter describes how measurement of empirical Internet data, obtained through Internet Tomography Measurement Systems (ITMS), can serve an important role in providing the laboratory simulation and emulation modelling tools with Internet parameterization data. The data being extracted from the Internet can be used to recreate real-world conditions within the modelling experiments. The chapter sets out how such data may be captured over extended and targeted periods of time and used in the laboratory modelling and experiments to define best-, average-, and worst-case Internet scenarios likely to be encountered by the applications or network upgrades being designed. An example of real-time one-to-many global-based Internet quality of service (QoS) measurement data sets obtained within a collaboration in the Réseaux IP Européens (RIPE) project for this purpose is presented.

17. P. Flynn, I. Ganchev, M. O’Droma. 2006. “Wireless Billboard Channels: Vehicle and Infrastructural Support for Advertisement, Discovery, and Association of UCWW Services” In: *Annual Review of Communications*, Vol. 59 (Chicago, Ill.: International Engineering Consortium), Pp. 493–504. ISBN: 978-1-931695-53-4.

This book chapter describes wireless billboard channels (WBCs) used for advertisement, discovery, and association (ADA) of wireless and mobile services in future fourth-generation wireless world (4GWW) and next-generation wireless networks, and in ubiquitous consumer wireless world (UCWW) business environments. A WBC service discovery model is proposed along with a format and ASN.1 encoding for service description (SD). Categorization of services is provided and service templates elaborated. Steps are taken to determine the best format of the data on the WBC channel and the best technology to allow mobile terminals to access the channel. Critical review and comparison of possible WBC carrier technologies is given.

18. M. O'Droma, I. Ganchev, N. Wang. 2006. "On Incoming Call Connection Service in a Ubiquitous Consumer Wireless World" In: *Next Generation Teletraffic and Wired/Wireless Advanced Networking, Lecture Notes in Computer Science (LNCS)*, vol. 4003, Springer-Verlag Berlin Heidelberg, Germany. Pp. 287-297. Y. Koucheryavy, J. Harju, V. Iversen (Eds.), XVI, ISBN: 3-540-34429-2. ISSN: 0302-9743. SJR=0,315 (реферирана в Web of Science и SCOPUS)

This book chapter proposes a new consumer-oriented incoming call connection (ICC) service provision. The architecture and implementation design of this ICC is conceived to underpin the evolution of the proposed future ubiquitous consumer wireless world (UCWW) environment, founded on the consumer-based business model (CBM). ICC design issues, architecture, core signalling flow elements for ICC setup and operation, and standardisation issues are presented and discussed.

19. N. Kubinidze, I. Ganchev, M. O'Droma. 2006. "Network Simulator NS2: Shortcomings, Potential Development and Enhancement Strategies" In: *Modeling and Simulation Tools for Emerging Telecommunications Networks*. Springer, USA. Pp. 263-277. A. N. Ince and E. Topuz (Eds.). ISBN-10: 0-387-32921-8 (HB), ISBN-13: 978-0387-32921-5 (HB). (реферирана в Web of Science и SCOPUS)

The basic concept and evolution of the network simulator (NS) is discussed. MPLS Network Simulator (MNS) and Wireless Mobile Networking are described with emphasis on conceptual model and architecture. Current NS compatibility issues and shortcomings are considered and a potential development plan is proposed. NS enhancement strategies in terms of enriching various modules with Multi-Protocol Label Switching (MPLS) and Hierarchical Mobile Internet Protocol version 6 (HMIPv6) functionalities are proposed and novel schematic embedding algorithms are shown.

20. M. O'Droma, I. Ganchev, A. Moloisane, V. Dadarlat. 2005. "Internet Tomography in 4G System Architecture - On the Role of Network Performance Infrastructures" In: *Annual Review of Communications*, Vol. 58 (Chicago, Ill.: International Engineering Consortium), Pp. 621-623. ISBN: 978-1-931695-36-7.

This book chapter traces the main directions for applying the methods and technics of the Internet tomography in fourth-generation (4G) wireless networks in order to supply relevant performance data as regards the delivery of services to consumers based on service level agreements (SLAs) in order to develop and implement a set of robust QoS measurement standards and end-to-end Internet protocol – based service level verification (IP–SLV) solutions, which can measure the complete user experience on critical paths on an ongoing basis, and effectively not only establish compliance or otherwise of SLAs but exercise an earlywarning system, which, by leading to network and resource management in various network sectors, will assist SLA compliance capability.

21. M.S. O'Droma and I. Ganchev. 2004. "Enabling an Always Best-Connected Defined 4G Wireless World" In: *Annual Review of Communications*, Vol. 57 (Chicago, Ill.: International Engineering Consortium), Pp. 1157-1170. ISBN: 0-931695-28-8.

This book chapter puts forward views on evolving wireless networks and how that evolution may be directed for the benefit of the consumer and other stakeholders. Always best connected (ABC) is the paradigm many see as defining the evolution of the next or fourth generation (4G) networks. It is argued that an infrastructural rethink on the way authentication, authorization, and accounting (AAA) service is supplied is key to this evolution. At a high level this may be described as a business plan for the supply of wireless services, especially with the wireless access service component being founded on a consumer-based structure rather than a subscriber-based structure. The consumer-based structure consists in enabling a loose dynamic (even casual) consumer-type association between users and access network providers (ANP). To support this, a pivotal role is proposed for a third-party AAA service supplier. The approach will necessitate the creation of other new support services. Included among these is a global standardized approach toward ANP service advertisement, discovery, and association through newly defined wireless billboard channels (WBC) and incoming call connection (ICC) service. Ways this approach will more positively drive wireless communications into its fourth generation with attractive benefits for all stakeholders alike are detailed. It is hypothesized also that this infrastructure can be a foundation for ad hoc networking business plan development. A novel wireless credit card system is among the new services that this consumer-based business model and network infrastructure could spawn.

22. S. T. Mirtchev, I. Ganchev. 2017. "Generalised Pollaczek-Khinchin formula for the Polya/G/1 queue". *IET Electronics Letters*, Vol. 53, No. 1, Pp. 27-29. January. Print ISSN: 0013-5194. Online ISSN: 1350-911X. DOI: 10.1049/el.2016.2876. IF₂₀₁₆=1,155 / SJR₂₀₁₆=0,442 (реферирана в Web of Science и SCOPUS)

A generalised Pollaczek–Khinchin formula for the Polya/G/1 queue, with a Polya peaked arrival process, general distributed service times, and infinite number of waiting positions, is obtained. It is shown that the peakedness of the number of arrivals and the variance of the service time lead to a significant increase in the service delay and queue length.

23. S. T. Mirtchev, R. I. Goleva, D. K. Atamian, M. J. Mirtchev, I. Ganchev, R. Stainov. 2016. "A Generalized Erlang-C Model for the Enhanced Living Environment as a Service (ELEaaS)". *Cybernetics and Information Technologies*, Vol. 16, No. 3, Pp. 104-121. August. Print ISSN: 1311-9702; Online ISSN: 1314-4081. DOI: 10.1515/cait-2016-0037. SJR=0,203 (реферирана в Web of Science и SCOPUS)

In this article, a full-access waiting multi-server queue with a statedependent arrival and departure processes is investigated and suggested for use as a generic traffic model of the novel concept of the Enhanced Living Environment as a Service (ELEaaS). The generalized arrival and service flows with nonlinear state dependence intensities are used. The idea is based on the analytical continuation of the Poisson arrival process and Bernoulli service process, and the classic M/M/n queuing system. Birth and death processes and state-dependent rates are applied. The suggested new queuing system is of a M(g)/M(g)/n/k type (in Kendal notation) with a generalized arrival and departure processes M(g). The input and output intensities depend nonlinearly on the system state with defined parameters – the so-called "peaked factors". The state probabilities of the system are obtained using the general solution of the birth and death processes. The influence of the peaked factors on the queuing behavior is evaluated showing that state-dependent arrival and service rates may change significantly the characteristics of the

queuing system. The simplicity and uniformity in representing both peaked and smooth behavior make this queuing model also attractive for future networks' analysis and synthesis.

24. Z. Ji, I. Ganchev, M. O'Droma, L. Zhao, X. Zhang. 2014. "A Cloud-Based Car Parking Middleware for IoT-based Smart Cities: Design and Implementation". *Sensors*. MDPI, Basel, Switzerland. Vol. 14, No. 12, November, Pp. 22372-22393. DOI: 10.3390/s141222372. ISSN: 1424-8220. IF= 2,245 / SJR=0,636 (реферирана в Web of Science u SCOPUS)

This paper presents the generic concept of using cloud-based intelligent car parking services in smart cities as an important application of the Internet of Things (IoT) paradigm. This type of services will become an integral part of a generic IoT operational platform for smart cities due to its pure business-oriented features. A high-level view of the proposed middleware is outlined and the corresponding operational platform is illustrated. To demonstrate the provision of car parking services, based on the proposed middleware, a cloud-based intelligent car parking system for use within a university campus is described along with details of its design, implementation, and operation. A number of software solutions, including Kafka/Storm/Hbase clusters, OSGi web applications with distributed NoSQL, a rule engine, and mobile applications, are proposed to provide 'best' car parking service experience to mobile users, following the Always Best Connected and best Served (ABC&S) paradigm.

25. Z. Ji, I. Ganchev, M. O'Droma, X. Zhang, X. Zhang. 2014. "A Cloud-based X73 Ubiquitous Mobile Healthcare System: Design and Implementation". *The Scientific World Journal*. Hindawi Publishing Corporation. Vol. 2014, Article ID 145803, March, Pp. 1-14. DOI: 10.1155/2014/145803. ISSN: 1537-744X. SJR=0,392 (реферирана в Web of Science u SCOPUS)

Based on the user-centric paradigm for next generation networks, this paper describes a ubiquitous mobile healthcare (uHealth) system based on the ISO/IEEE 11073 personal health data (PHD) standards (X73) and cloud computing techniques. A number of design issues associated with the system implementation are outlined. The system includes a middleware on the user side, providing a plug-and-play environment for heterogeneous wireless sensors and mobile terminals utilizing different communication protocols and a distributed "big data" processing subsystem in the cloud. The design and implementation of this system are envisaged as an efficient solution for the next generation of uHealth systems.

26. D. Meere, I. Ganchev, Z. Ji, M. O'Droma. 2013. "Contextualised mLearning Service Delivery through a Multi-Agent Platform". *International Journal of Computational Intelligence Studies (IJCISTUDIES)*, Inderscience Publishers, Vol. 2, No. 3/4, November, Pp. 218-240. ISSN: 1755-4977.

A multi-agent-based platform, designed to incorporate mobile devices into educational practices, is presented in this paper. The platform builds on the InfoStation paradigm. Together with the rationale behind the multi-agent approach, the operations and interactions of agents with the platform's underlying data structures are discussed. Details on the contextualisation of delivered service content together with supporting mechanisms are also presented. This contextualisation function enables system adaptation in response to the varying operating environments inherent to this type of wireless access architecture, and to the service delivery modes dictated by, or matched to, the personal context of the user. The educational opportunities thereby created such as support for

dispersed distance learning and enriched learning environments are discussed. Future directions for the development of this platform are also outlined.

27. I. Ganchev, D. Meere, Z. Ji, M. O'Droma. 2013. "An Agent-based mTest and mAssessment Service Delivery Platform". *International Journal of Digital Society (IJDS)*, Special Issue, Vol. 1, Issue 1, Pp. 826-835. Publishers: Infonomics Society, UK. ISSN: 2040 2570 (Online).

Within this paper, an InfoStation-based multiagent architecture is presented, which provides the infrastructure to support the delivery of contextualised mobile assessments in the form of mTests, which could be utilised to enhance more traditional localised educational practices or indeed to provide additional tools to support distance learning. The utilisation of a multi-agent system architecture, incorporating the personal mobile devices of learners, is described. The main architectural components within the system are discussed, detailing the functionality required in delivering effective assessments and feedback to learners. As well as this, the continuing client-side developments, including the current research geared towards the incorporation of HTML5 is detailed. Finally, the system functionality required for effective service management by educators is detailed.

28. I. Ganchev, Z. Ji, D. Meere, M. O'Droma. 2012. "A Local WBC System Operating Across a University Campus". *Cyber Journals: Multidisciplinary Journals in Science and Technology, Journal of Selected Areas in Telecommunications (JSAT)*, September Edition, Pp. 1-7. ISSN: 1925-2676 (Online).

A local wireless billboard channel (WBC) system, operating across a university campus and supporting contextualized advertisement of services to students and staff members for subsequent service discovery and association, is proposed in this paper. A description of the main wireless services available on campus is provided. Design and implementation aspects of the system's software architecture are outlined.

29. D. Meere, Z. Ji, I. Ganchev, M. O'Droma. 2012. "A Framework Design for Utilization in Facilitating Contextualised mLearning". *GSTF International Journal on Computing (JoC)*, Vol. 1, No. 4, January, Pp. 81-87. ISSN: 2010-2283. DOI: 10.5176_2010-2283_1.4.96.

This paper presents an intelligent, light-weight, distributed and Java-based framework design for the presentation of mobile services (mServices) within a mobile eLearning (mLearning) InfoStation-based environment. The framework has been developed by incorporating inversion of control (IoC) design patterns and is maintained by a light-weight HTTP container. A multi-agent system (MAS) acts as a bridge between the mService applications and mobile users. The concept for the light-weight, intelligent and distributed design of the framework is presented.

30. Z. Ji, D. Meere, I. Ganchev, M. O'Droma. 2012. "Implementation and Deployment of an Intelligent Framework for Utilization within an InfoStation Environment". *Journal of Software, Academy Publisher*, Vol. 7, No. 5, May, Pp. 935-942. ISSN: 1796-217X. DOI: 10.4304/jsw.7.5.935-942. SJR=0,196 (реферирана в SCOPUS)

This paper details the design and implementation of an intelligent, light-weight, distributed Java platform based framework for the provision of mobile services (mServices) within an InfoStation-based mLearning environment. A multi-agent system, acting as a conduit between the mService applications and the mobile users is detailed. The

deployment of this system for the integration of the supported services into a blended learning experience for system users is also outlined.

31. D. Meere, I. Ganchev, M. O’Droma, P. Noonan, S. Hayes. 2011. “Using Mobile Phones as Tools for Enhanced Blended Learning”. *Journal of International Scientific Publications: Educational Alternatives*, Vol. 9, Part 1, September, Pp. 157-175. ISSN: 1313-2571.

Developments of a context-sensitive InfoStation-based architecture, tasked with supporting the provision of mobile information services within a University domain, are outlined in this paper. These services, designed to complement the traditional educational practices, provide an enhanced blended learning experience for students, and as such aid the students assimilation of the presented information. The developments described are focused on exploitation of the greatly expanding functionality, including the multi-media capabilities of modern handheld mobile devices. It also forges experience in the greater integration, exploitation, utilization and management of these modern wireless technologies in educational environments.

32. S. Stoyanov, I. Ganchev, D. Mitev, V. Valkanov, M. O’Droma. 2011. “Service-oriented and Agent-based Architecture Supporting Adaptable, Scenario-based and Context-aware Provision of Mobile E-learning Services”. *International Journal of Computer Information Systems and Industrial Management Applications (IJCISIM)*, Vol. 3, Pp. 771-779. Dynamic Publishers, Inc., USA. ISSN: 2150-7988.

This paper describes an OMG’s MDA-based approach for the development of a service-oriented and agent-based middleware architecture supporting flexible and adaptable, scenario-based and context-aware provision of mobile e-Learning services within InfoStation wireless environments. Considering the system development as a process of iterations, the approach provides an extensive ability to examine different development aspects and extend the system architecture step by step. The first two iterations, namely the base middleware architecture and the scenario-based management, are described in detail. A simulation environment used for testing the architecture is also presented.

33. L. Merwick, I. Ganchev, M. O’Droma. 2010. “Intelligent Messaging Service in an InfoStation-based University Network”. *International Journal of Computer Science & Emerging Technologies (IJCSET)*, Vol. 1, Issue 4, December, Pp. 287-298. E-ISSN: 2044-6004.

This paper shows how a communication infrastructure consisting of mobile devices, InfoStations and an intelligent gateway can be combined to create a messaging service for a campus sized area. It allows for fast and efficient delivery of messages to a group of users through the provision of two-tier address space architecture. A particularly novel part is the creation of an intelligent central message processing agent which decides which device, and in what format, the message should be forwarded based on a user’s preferences and the presence (or not) of their registered devices on the network. The benefit of this ‘Intelligent Assistant’ is the delivery of messages to a user on the device they are most likely to be able to access at any moment in time and thus deliver messages in a timely manner. A system was successfully prototyped which could deliver messages in SMS and email format and was designed so that further message formats could easily be integrated.

34. S. Stoyanov, I. Ganchev, I. Popchev, I. Dimitrov. 2010. "Request Globalization in an InfoStation Network". *Comptes rendus de l'Académie bulgare des Sciences*, Tome 63, No. 6, Pp. 901-908. ISSN: 1310-1331. IF= 0,219 / SJR=0,215 (реферирана в Web of Science u SCOPUS)

This paper considers the problem of finding an optimal deployment of information resources on an InfoStation network in order to minimize the overhead and reduce the time needed to satisfy user requests for resources. Two formal models are developed for formalizing the problem – a static model and a dynamic model. Ideas of how to use these models for solving the problem of optimal deployment of resources are presented.

35. D. Brogan, I. Ganchev, M. O'Droma. 2009. "A-WING: an ad hoc wireless inter-network gateway". *International Journal of Network Management*, John Wiley & Sons, Vol. 19, Issue 4, July/August, Pp. 253-269. ISSN: 1055-7148. E-ISSN: 1099-1190. DOI: 10.1002/nem.701. SJR=0,313 (реферирана в Web of Science u SCOPUS)

This paper presents a design and implementation of a novel ad hoc wireless inter-network gateway and research platform (A-WING) which supports heterogeneous wireless and wired networking infrastructures and ad hoc wireless protocols. The driving goal is to explore and realize ways of increasing the 'always best connected' options for mobile wireless devices. The platform currently supports IEEE 802.11 (Wi-Fi), IEEE 802.3 (Ethernet), Bluetooth, IPv4, IPv6, broadcasting and multicasting, stream and datagram transport protocols. The gateway can be readily expanded by the addition of new functionality or support for other networking hardware. This functional variety and inbuilt extensibility ensures that A-WING can facilitate research into multi-mode multi-protocol wireless networking. The A-WING design is based on a new generic description of link layer services called the '9Cs' and includes a new method for the hierarchical description of networks incorporating nodes with multiple interfaces together with the development of a new XML schema for network, node and interface descriptive inter-nodal messaging.

36. S. Stoyanov, I. Ganchev, I. Popchev, M. O'Droma. 2008. "An Approach to the Development of InfoStation-Based eLearning Architectures". *Comptes rendus de l'Académie bulgare des Sciences*, Tome 61, No. 9, Pp. 1189-1198. ISSN: 1310-1331. IF= 0,152 / SJR=0,193 (реферирана в Web of Science u SCOPUS)

The paper provides a general description of an approach for the development of InfoStation-based eLearning architectures. The approach adopts the ideas suggested in the MDA specification of OMG. The three levels of the prototype system architecture, developed by following this approach, are discussed in detail. The resultant InfoStation-based network architecture provides mobile access to electronic services (eServices) and electronic content (eContent), for users equipped with mobile wireless devices, via a set of InfoStations deployed in key points around a university campus.

37. I. Ganchev, M. O'Droma, D. Meere. 2008. "Intelligent Car Parking Locator Service". *International Journal "Information Technologies and Knowledge" (IJ ITK)*, Vol. 2, No. 10, Pp. 166-173. ISSN: 1313 -0455_printed, -048X_online, -0501_CD/DVD.

This paper presents an InfoStation-based multi-agent system facilitating a Car Parking Locator service provision within a University Campus. The system network architecture is outlined, illustrating its functioning during the

service provision. A detailed description of the Car Parking Locator service is given and the system entities' interaction is described. System implementation approaches are also considered.

38. I. Ganchev, S. Stojanov, M. O'Droma, D. Meere. 2008. "InfoStation-based Adaptable Provision of m-Learning Services: Main Scenarios". *International Journal "Information Technologies and Knowledge" (IJ ITK)*, Vol. 2, No. 5, Pp. 475-482. ISSN: 1313 -0455printed, -048X_online, -0501_CD/DVD.

This paper presents an adaptable InfoStation-based multi-agent system facilitating the mobile eLearning (mLearning) service provision within a University Campus. A horizontal view of the network architecture is presented. Main communications scenarios are considered by describing the detailed interaction of the system entities involved in the mLearning service provision. The mTest service is explored as a practical example. System implementation approaches are also considered.

39. I. Ganchev, S. Stojanov, M. O'Droma, D. Meere. 2007. "An InfoStation-Based Multi-Agent System Supporting Intelligent Mobile Services Across a University Campus". *Journal of Computers*, Vol. 2, Issue 3, Academy Publisher, May, Pp. 21-33. ISSN: 1796-203X. SJR=0,112 (реферирана в SCOPUS)

This paper presents an InfoStation-based multi-agent system, which provides mobile services (mServices) across a University Campus. A description of some of the mServices along with sample interactions among entities is provided. Technologies for delivering of these services are discussed and approaches for the system implementation and structuring are considered.

40. M. O'Droma, I. Ganchev, H. Chaouchi, H. Aghvami, V. Friderikos. 2006. "Always Best Connected and Served` Vision for a Future Wireless World". *Journal of Information Technologies and Control*, Year IV, No 3-4/2006, Pp. 25-37+42. ISSN: 1312-2622.

The evolution of a fully 'Always Best Connected and Served' (ABC&S) enabled future wireless world paradigm is addressed in this paper. The goal is to propose aspects of a novel vision together with the consequential strategic requirements and potential solutions for system architectural and protocol development. Subjective and objective aspects of the ABC&S concept from the viewpoints of the various wireless network 'players' – user, access network provider (ANP), teleservice provider (TSP), and terminal manufacturer – are delved into. As primarily ABC&S is an end-user's issue this perspective is given priority. The important roles and influence on ABC&S realization of ANPs and TSPs is also considered. An illustrative hypothetical ABC&S action scenario is presented. Proposals for an ABC&S communication cross-layer protocol reference model, network architectural components and management protocol are set out, together with a schematic outline of an operational user-friendly ABC&S terminal. These are largely in line with a subscriber-based business model. Aspects in line with a consumer-based business model are also treated. These include approaches towards the servicing of ABC&S needs by means of an open multi-access wireless networks environment with open standards on some key issues such as advertising net-work presence and various profiles on standardized 'wireless billboard channels' (WBC), and third-party management of Authentication, Authorization and Accounting (3P-AAA) functionality.

41. H. Chaouchi, I. Armuelles, I. Ganchev, M. O'Droma, N. Kubinidze. 2006. "Signalling Analysis in Integrated 4G Networks". *International Journal of Network Management*, Vol. 16, Issue 1, January/February, Pp. 59-78, John Wiley & Sons, Ltd., ISSN: 1055-

7148. E-ISSN: 1099-1190. DOI: 10.1002/nem.589. SJR=0,355 (реферирана в SCOPUS)

In the emerging integrated 4G networks one of the issues is the signalling of information related to different control purposes such as QoS, mobility and security signalling. In fact, some questions such as which are the candidate signalling protocols, and which approach of integrated signalling to be adopted (unified versus non-unified) need to be considered in the context of the emerging 4G integrated network. This is precisely the scope of this paper. We first identify the requirements related to mobility, security/AAA and QoS signalling, then we consider candidate signalling protocols and we propose possible approaches in the integration of signalling in the context of 4G networks.

42. I. Ganchev, M. S. O'Droma, M. Siebert, F. Bader, H. Chaouchi, I. Armuelles, I. Demeure, F. McEvoy. 2006. "A 4G Generic ANWIRE System and Service Integration Architecture". *ACM SIGMOBILE Mobile Computing and Communications Review*, Vol. 10, No. 1, January, Pp. 13-30.

This paper proposes a 4G 'Generic ANWIRE system and service Integration Architecture' (GAIA). The relationship between the different GAIA domains is explained and interaction between their functional entities is shown in order to explore various GAIA properties. An overview of the relevant topics related to the GAIA architecture and its respective elements is given. A well-based summary on system integration efforts of previous projects is provided as a basis for deriving of various requirements for GAIA. New two-phase business model to accommodate the 4G development is proposed and justified. Finally, a new reference communication model of a future 4G wireless system is proposed and GAIA interdomain signalling issues are discussed.

43. S. Stoyanov, I. Ganchev, I. Popchev, M. O'Droma. 2005. "From CBT to e-Learning". *Journal of Information Technologies and Control*, Year III, No. 4/2005, Pp. 2-10, ISSN: 1312-2622.

Two basic concepts, significant for the development of software in support of the learning process, are formally presented, distinguished and compared. The first, Computer Based Training (CBT), is used as a starting point for the development of a means for learning support. The second, eLearning, is used as a reference point for long-term research and development of education and learning using the full potential of electronic media and technology. The paper includes a demonstration of an approach for the development of information systems for education, based on clear differentiation between these two concepts.

44. F. McEvoy, I. Ganchev, M. O'Droma. 2005. "New Third-Party AAA Architecture and Diameter Application for 4GWW". *Proc. of the 16th Annual IEEE International Symposium on Personal Indoor and Mobile Radio Communications (IEEE PIMRC 2005)*, Vol. 3, Pp. 1984-1988, 11-14 September, Berlin, Germany. ISBN: 978-3-8007-2909-8. SJR=0,312 (реферирана в SCOPUS)

This paper' proposes a new third-party AAA (3P-AAA) supporting architecture, with which to serve a more Consumer-based Business Model (CBM) for fourth generation wireless world (4GWW). A new Diameter 3P-AAA application is suggested as a base signaling protocol solution option to serve this architecture. The command and response messages necessary for this application are identified and elaborated.

45. N. Kubinidze, M. O'Droma, I. Ganchev. 2004. "Intersystem End-to-End QoS Provision in 4G Heterogeneous Networks". *Transactions on Computers, WSEAS*, Issue 5, Vol. 3, November, Pp. 1355-1360. ISSN: 1109-2750.

The paper presents an IP-based multi-service approach for end-to-end (E2E) Quality of Service (QoS) provision and discusses it in the context and perspective of the fourth generation (4G) networks. Particular emphasis is placed on distribution of functionalities between core, edge, multi-access networks and mobile host. Existing QoS mechanisms are briefly discussed and possible QoS mapping techniques between various wireless and fixed protocols, namely GPRS/UMTS and MPLS/DiffServ are proposed and evaluated. Intersystem E2E QoS support model provided across different network parts and suitable for deployment in 4G heterogeneous network environment is presented. Two options for E2E QoS provision are specified and consequent shifting of functionalities of the core, edge and multi-access networks are demonstrated and justified.

46. H. Zhang, I. Ganchev, N.S. Nikolov, M. O'Droma. 2017. "Weighted Item Ranking for Pairwise Matrix Factorization". *Proc. of 2nd International South-East European Design Automation, Computer Engineering, Computer Networks and Social Media Conference (SEEDA-CECNSM 2017)*. Pp. x1-x5. 23-25 September, Kastoria, Greece. (accepted)

Recommendation systems employed on the Internet aim to serve users by recommending items which will likely be of interest to them. The recommendation problem could be cast as either a rating estimation problem which aims to predict as accurately as possible for a user the rating values of items which are yet unrated by that user, or as a ranking problem which aims to find the top-k ranked items that would be of most interest to a user, which s/he has not ranked yet. In contexts where explicit item ratings of other users may not be available, the ranking prediction could be more important than the rating prediction. Most of the existing ranking-based prediction approaches consider items as having equal weights which is not always the case. Different weights of items could be regarded as a reflection of items' importance, or desirability, to users. In this paper, we propose to integrate variable item weights with a ranking-based matrix factorization model, where learning is driven by Bayesian Personalized Ranking (BPR). Two ranking-based models utilizing different-weight learning methods are proposed and the performance of both models is confirmed as being better than the standard BPR method.

47. R. Goleva, R. Stainov, N. Kletnikov, J. Achkoski, S. Mirtchev, I. Ganchev. 2017. "Performance Analysis of End-to-End Sensor-to-Cloud Personal Living Platform". *Proc. of International Workshop on IoT, M2M and Healthcare (IMH 2017)*. Pp. x1-x7. 18-20 September, Lund, Sweden. (accepted)

This paper presents a performance analysis of the end-to-end sensor-to-cloud personal living platform. The analysis is based on a typical architecture starting from a single sensor and actuator and continuing to the virtualized services at smart dust, dew, fog and cloud level. The system is diverse and allows interconnection of different sensors/actuators technologies directly or throughout gateways. The experiments in a living lab presented use energy harvesters and ZigBee PRO sensors. The results from sensor network are applicable for non-real-time and non-critical data connection. As a final conclusion, it is claimed that for critical and non-critical measurements that need to be supported in a typical living environment there is a necessity to use different priorities of the services and different sensors as well.

48. H. Zhang, I. Ganchev, N.S. Nikolov, Z. Ji, M. O'Droma. 2017. "Weighted Matrix Factorization with Bayesian Personalized Ranking". Proc. of 2017 SAI Computing Conference. Pp. 307-311. 18-20 July, London, UK. ISBN: 978-1-5090-5443-5/17.

This paper proposes an improvement to item recommendation systems based on collaborative filtering (CF) with implicit feedback data. Combined with the Bayesian Personalized Ranking (BPR) optimization approach, recommended for implicit-only feedback contexts, CF has been shown to be effective in generating accurate recommendations. The method, based on the assumption that a user prefers a consumed item to an unconsumed item, aims to maximize the difference of predicted scores between these items for each user. In most of the existing CF recommendation methods, all items are assigned the same weight, which of course is not the case in reality. In this paper, a new improved matrix factorization (MF) approach is proposed where the weights of items are allowed to vary and be reflective of items' importance or their desirability to a user. The scheme integrates these item weights as appropriate and utilizes a dynamic learning model where learning is driven by BPR. The performance of the proposed method is tested against the traditional MF. Tests confirm that better accuracy can be indeed achieved by the proposed method.

49. I. Ganchev, Z. Ji, M. O'Droma. 2017. "An IoT-based Smart Electric Heating Control System: Design and Implementation". Proc. 9th International Conference on Ubiquitous and Future Networks (ICUFN 2017), Pp. 760-762. 4-7 July. Milan, Italy. ISBN: 978-1-5090-4749-9/17. ISSN: 2165-8528. SJR₂₀₁₆=0,176 (реферирана в SCOPUS)

This paper presents the design and realization of an IoT-based smart electric heating control system for homes, offices, schools, community centres, and the like. The architecture proposed provides a gateway to the IoT cloud for the control system through a Data Transfer Unit (DTU) which sends the sensor data to an IoT centre via a TCP server over a GPRS/Wi-Fi wireless interface and receives energy telecommands for the controllers, which thus switch off, on or adjust electric heating operation. The hardware and software descriptions set out here are from a small pilot system which was successfully designed and implemented.

50. H. Zhang, I. Ganchev, N.S. Nikolov, Z. Ji, M. O'Droma. 2017. "Hybrid Recommendation for Sparse Rating Matrix: A Heterogeneous Information Network Approach". Proc. of 2017 IEEE 2nd Advanced Information Technology, Electronic and Automation Control Conference (IEEE IAEC 2017). Pp. 740-744. 25-26 March, Chongqing, China. ISBN: 978-1-4673-8979-2/17. BEST PAPER AWARD

Exploiting additional item meta-data is proposed in this paper for solving data sparsity and cold start problems found in item-based collaborative filtering (CF) techniques, which are employed in recommendation systems. Additional item meta-data provides the foundation for generating a heterogeneous information network (HIN). The proposed approach is to enrich the item-based CF with diverse types of relationships existing between items in the HIN, to overcome the sparsity issue from implicit user feedback. Bayesian personalized ranking optimization technique is used for estimation and its performance is evaluated by comparing the results with the traditional item-based CF. The experimental tests prove that the proposed approach achieves better accuracy.

51. I. Ganchev, Z. Ji, M. O'Droma. 2017. "Designing an IoT Wireless-based Air Quality Index Monitoring and Publishing System". Royal Irish Academy 18th URSI Research

Colloquium “Communications and Radio Science for a Smarter World”, Pp. 16-19. 8-9 March. RIA, Dublin, Ireland. Proceedings Book (©RIA; ISBN: 978-1-908997-60-9).

This paper presents the design and realization of a wireless-based Air Quality Index (AQI) monitoring and publishing system for daily or live reporting of geo-grid resolved air quality. Each geo-grid point includes a variety of pollution sensors connected with an ultra-low-power geo-grid identified Data Transfer Unit (DTU) via a digital serial port or an analog current port. The DTU sends the sensor data to a Hadoop cluster through a data-to-data (D2D) transparent Transmission Control Protocol (TCP) server via a GPRS/Wi-Fi wireless interface. A full pilot AQI system was successfully implemented and tested, and its use demonstrated.

52. I. Ganchev, Z. Ji, M. O'Droma. 2016. “Designing a Low-Cost Data Transfer Unit for Use in IoT Applications”. Proc. of the 8th International Congress on Ultra Modern Telecommunications and Control Systems (ICUMT 2016). Pp. 11-14. 18-20 October, Lisbon, Portugal. ISBN: 978-1-4673-8817-7/16. DOI: 10.1109/ICUMT.2016.7765337. (реферирана в Web of Science и SCOPUS)

This paper presents the design and realization of a small, robust, low-cost and easily accessible data transfer unit (DTU), acting as a gateway between a wireless sensor network (WSN) and a corresponding information center (server) operating on the Internet. The unit consists of an Advanced RISC Machine (ARM) microcontroller unit (MCU), a General Packet Radio Service (GPRS) module, and a power supply module. The DTU was successfully tested and its use demonstrated.

53. A. Mauthe, D. Hutchison, E. K. Cetinkayay, I. Ganchev, J. Rak, J. P.G. Sterbenz, M. Gunkel, P. Smith, T. Gomes. 2016. “Disaster-Resilient Communication Networks: Principles and Best Practices”. Proc. of the 8th International Workshop on Resilient Networks Design and Modeling (RNDM 2016). Pp. 1-10. 13-15 September, Halmstad, Sweden. ISBN: 978-1-4673-9023-1/16. DOI: 10.1109/RNDM.2016.7608262. SJR=0,113 (реферирана в Web of Science и SCOPUS)

Communication network failures that are caused by disasters, such as hurricanes, earthquakes and cyber-attacks, can have significant economic and societal impact. To address this problem, the research community has been investigating approaches to network resilience for several years. However, aside from well-established techniques, many of these solutions have not found their way into operational environments. The RECODIS COST Action aims to address this shortcoming by providing solutions that are tailored to specific types of challenge, whilst considering the wider socio-economic issues that are associated with their deployment. To support this goal, this paper presents an overview of some of the foundational related work on network resilience, covering topics such as measuring resilience and resilient network architectures, amongst others. In addition, it provides insights into current operational best practices for ensuring the resilience of carrier-grade communication networks.

54. H. Zhang, I. Ganchev, N. S. Nikolov, M. O'Droma. 2016. “A Trust-Enriched Approach for Item-Based Collaborative Filtering Recommendations”. Proc. of the IEEE 12th International Conference on Intelligent Computer Communication and Processing (2016 IEEE ICCP). Pp. 65-68. 8-10 September, Cluj-Napoca, Romania. ISBN: 978-1-5090-3899-2/16. DOI: 10.1109/ICCP.2016.7737124. SJR=0,126 (реферирана в Web of Science и SCOPUS)

The item-based collaborative filtering (CF) is one of the most successful approaches utilized by the recommendation systems. The basic concept behind it is to recommend those items to users which are similar to other items that these users have been interested in recently. This paper proposes a hybrid method that integrates user trust relations with item-based CF. This is achieved by incorporating user social similarities into the computation of item similarities. Performance evaluation of the proposed method is done by comparing the results with the traditional item-based CF. The experiment results demonstrate that the proposed approach achieves better accuracy.

55. I. Ganchev, Z. Ji, M. O'Droma. 2016. "A Conceptual Framework for Building a Mobile Services' Recommendation Engine". Proc. of the IEEE 8th International Conference 'Intelligent Systems' (IEEE IS 2016). Pp. 285-289. 4-6 September, Sofia, Bulgaria. ISBN: 978-1-5090-1353-1/16. DOI: 10.1109/IS.2016.7737435. SJR₂₀₁₅=0,120 (реферирана в Web of Science и SCOPUS)

This paper presents a conceptual framework for building a recommendation engine for use in the ubiquitous consumer wireless world (UCWW). The framework is based on the Lambda Architecture and as such provides real-time recommendations at the speed layer and off-time analytical operations at the batch layer. Moreover, at the speed layer, a root server is used for updating the real-time recommendation algorithms and dispatching the processing of users' information to different recommendation servers for load balancing with a consistent hash algorithm. At the batch layer, a number of off-line machine learning algorithms are utilized for items analyzing, user profiling based on raw data, and sending the results to the serving layer. At the end, a decision server formats recommendations for 'best' service instances, which are sent back to users for effecting an always best connected and best served (ABC&S) experience.

56. I. Ganchev, Z. Ji, M. O'Droma. 2016. "The Creation of a Data Management Platform for Use in the UCWW". Proc. of 2016 SAI Computing Conference. Pp. 585-588. 13-15 July, London, UK. ISBN: 978-1-4673-8460-5/16. DOI: 10.1109/SAI.2016.7556040. (реферирана в Web of Science и SCOPUS)

This paper presents a cloud-based Data Management Platform (DMP) for use in the Ubiquitous Consumer Wireless World (UCWW) environment for the management of raw data, i.e., for turning 'big data' logs of consumers' mobile services activities into actionable analytic dataset, supporting an enhanced Always Best Connected and best Served (ABC&S) access to mobile services. It facilitates the provision of enriched consumer profiling to the real-time service recommendation system utilized within the UCWW. Details of the DMP design and implementation are provided.

57. I. Ganchev, Z. Ji, M. O'Droma. 2015. "A Distributed Cloud-based Service Recommendation System". Proc. of the 2015 International Conference on Computing and Network Communications (CoCoNet'15). Pp. 212-215. 16-19 December, Trivandrum, India. ISBN: 978-1-4673-7309-8/15. DOI: 10.1109/CoCoNet.2015.7411189. Library of Congress: CFP15C74-USB. (реферирана в Web of Science и SCOPUS)

A distributed cloud-based service recommendation system, used to discover and suggest to mobile users (consumers) the 'best' mobile services in the emerging ubiquitous consumer wireless world (UCWW), is described. The system - built with Hadoop, Storm, and Kafka - will allow consumers to receive timely recommendations about the 'best' instances of mobile services, they are interested in, anywhere-anytime-anyhow.

58. H. Zhang, N. S. Nikolov, I. Ganchev. 2015. "UCWW Semantic-Based Service Recommendation Framework". Proc. of the 2015 IEEE International Symposium on Technology in Society (IEEE ISTAS 2015). Pp. x1-x6, 11-12 November, Dublin, Ireland. ISBN: 978-1-4799-8283-7. DOI: 10.1109/ISTAS.2015.7439435 (реферирана в Web of Science и SCOPUS)

Context-aware recommendation systems make recommendations by adapting to user's specific situation, and thus by exploring both the user preferences and the environment. This paper proposes a context-aware service recommendation framework utilising semantic knowledge in the Ubiquitous Consumer Wireless World (UCWW). The main objective of the framework is to provide users with the 'best' service instances that match their dynamic, contextualised and personalised requirements and expectations, thereby aligning to the always best connected and best served (ABC&S) paradigm. In the proposed framework, services and their related attributes are modeled dynamically as a heterogeneous network, based on a given network schema. Then, profile kernels – referring to the minimal set of features describing the user preferences – are extracted to model the user profiles. Subsequently, a recommendation engine, considering both the user profiles and current context, is applied to recommend 'best' service instances to users.

59. I. Ganchev, Z. Ji, M. O'Droma. 2015. "Making the UCWW a Reality". Proc. of the 2015 IEEE International Symposium on Technology in Society (IEEE ISTAS 2015). Pp. x1-x4, 11-12 November, Dublin, Ireland. ISBN: 978-1-4799-8283-7. DOI: 10.1109/ISTAS.2015.7439435 (реферирана в Web of Science и SCOPUS)

This paper reports on the development of a novel cloud-based next generation networking (NGN) system prototype, built on the revolutionary concept for the realization of the next phase of a NGN-based consumer-oriented wireless networking, founded on the key attributes of the Ubiquitous Consumer Wireless World (UCWW). Design aspects and potential societal impact are presented.

60. I. Ganchev, Z. Ji, M. O'Droma, C. Dai. 2015. "A CIM System for Use in the UCWW". Proc. of the 2015 International Conference on Cyber-Enabled Distributed Computing and Knowledge Discovery (CyberC 2015). Pp. 72-75, 17-19 September, Xi'an, China. ISBN: 978-1-4673-9200-6/15. DOI: 10.1109/CyberC.2015.63. SJR=0,128 (реферирана в Web of Science и SCOPUS)

This paper describes the design and development of a Consumer Identity Module (CIM) system for use in the emerging ubiquitous consumer wireless world (UCWW). The CIM system includes a smart-card, a client application, and a server application. Inserted into an intelligent mobile terminal, the CIM card provides a trusted execution environment for mobile applications. The smart-card application maintains the user identification, user profile, credit card information, terminal's IPv6 address, 3P-AAA data, X.509 certification, etc. After being successfully authenticated by the CIM system, the mobile user is able to receive the 'best' service instances from the UCWW cloud under the always best connected and best served (ABC&S) paradigm.

61. Z. Ji, I. Ganchev, M. O'Droma, T. Ding. 2014. "A Distributed Redis Framework for Use in the UCWW". Proc. of the IEEE International Conference on Cyber-Enabled Distributed Computing and Knowledge Discovery (IEEE CyberC 2014). Pp. 241-244,

10-12 October, Shanghai, China. ISBN: 978-1-4799-6236-5/14. DOI: 10.1109/CyberC.2014.50. SJR=0,102 (реферирана в Web of Science и SCOPUS)

The performance of data access plays an important role for the applications of the emerging ubiquitous consumer wireless world (UCWW). As a 'Not only SQL' (NoSQL) database, Redis has been deployed in the UCWW cloud as an open-source key value store acting as the key component in the system. Given the limited performance of a single Redis node, to improve the system's performance and handle large amounts of requests from the web applications in the UCWW system, a distributed Redis framework has been designed and is proposed in this paper. Considering the complex management of the Redis cluster, in the distributed Redis framework the ZooKeeper is used to manage the Redis nodes at the database layer and service governance is utilized at the service layer. With this layered design, the resultant framework is flexible and scalable, and could be easily integrated into the UCWW cloud.

62. Z. Ji, I. Ganchev, M. O'Droma. 2014. "An InfoStation-based Distributed mLearning System". Proc. of the 8th International Conference on Next Generation Mobile Apps, Services and Technologies (NGMAST 2014). Pp. 137-140, 10-12 September, University of Oxford, Oxford, UK. ISBN: 978-1-4799-5073-7/14. DOI: 10.1109/NGMAST.2014.22. SJR=0,242 (реферирана в Web of Science и SCOPUS)

Within this paper, a client-server mobile e-Learning (mLearning) system is presented, which operates within an InfoStation-based networking environment for the provision of mobile services to users under the always best connected and best served (ABC&S) paradigm. A light-weight distributed framework is utilized for service governance on the server side, along with a generic Android mobile application operating on the client side. This distributed design helps improve the system's reliability and performance as it allows mLearning services to be deployed on multiple machines located in different areas.

63. Z. Ji, I. Ganchev, M. O'Droma, X. Zhang. 2014. "A Cloud-Based Intelligent Car Parking Service for Smart Cities". Proc. of the 31st URSI General Assembly and Scientific Symposium of the International Union of Radio Science (URSI GASS 2014), Pp. 1-4, 16-23 August, Beijing, China. ISBN: 978-1-4673-5225-3/14. DOI: 10.1109/URSIGASS.2014.6929280. SJR=0,138 (реферирана в Web of Science и SCOPUS)

This paper presents the generic concept of using cloud-based intelligent car parking services in smart cities, as an important application deployed on the Internet of Things (IoT) paradigm. The corresponding IoT sub-system includes sensor layer, communication layer, and application layer. A high-level view of the system architecture is outlined. To demonstrate the provision of car parking services with the proposed platform, a cloud-based intelligent car parking system for use within a University campus is described along with details of its design and implementation.

64. I. Ganchev, Z. Ji, M. O'Droma. 2014. "A Generic IoT Architecture for Smart Cities". Proc. of the 25th IET Irish Signals & Systems Conference 2014 and 2014 China-Ireland International Conference on Information and Communications Technologies (ISSC 2014/CICT 2014), Pp. 196-199, 26-27 June, Limerick, Ireland. ISBN: 978-1-84919-924-7. DOI: 10.1049/cp.2014.0684. (реферирана в SCOPUS)

In the Cluster of European Research Projects (CERP) report, the Internet of Things (IoT) is defined as an integrated part of the future Internet, which ensures that ‘things’ with identities can communicate with each other. IoT will be applied in different areas, e.g. smart cities, agriculture, energy, environment protection, health, home automation, etc. However, if different IoT applications are based on different architectures, this will prevent the IoT co-building, convergence, and openness. To reduce investments in the IoT area, a top-down architectural principles need to be followed to unify the design. This paper provides classification of the IoT platforms and proposes a top-level generic IoT architecture particularly suited for the creation of smart cities.

65. I. Ganchev, S. Stoyanov, D. Meere, I. Dimitrov, M. O’Droma. 2014. “The InfoStation Paradigm – Past, Present and Future Developments”. Proc. of the International Conference “From DeLC to VelSpace”, Pp. 83-94. 26-28 March, Plovdiv, Bulgaria. Third Millennium Media Publications. ISBN: 0-9545660-2-5.

This paper details the InfoStation paradigm, upon which modern mLearning systems could be successfully built. The origins of this paradigm are discussed by identifying the reasons for the paradigm’s inception and how this design approach was intended to aid the delivery of wireless data services. The state-of-the-art of the InfoStation-based infrastructures, designed to facilitate the delivery of mobile services (mServices) within an educational institution area is then presented. The InfoStation network architecture is described detailing each of the components which comprise the three tiers. Also discussed is a high-level view of the process through which each of the main system components collaborates in order to facilitate the delivery of various mServices. Future directions for research and development in this area are set up at the end.

66. D. Meere, I. Ganchev, M. O’Droma. 2014. “The Evolution of mLearning and Leveraging Technology into Educational Practices”. Proc. of the International Conference “From DeLC to VelSpace”, Pp. 199-206. 26-28 March, Plovdiv, Bulgaria. Third Millennium Media Publications. ISBN: 0-9545660-2-5.

This paper presents an overview of a multi-agent platform designed to facilitate the effective incorporation of mobile devices into educational practices, through the delivery of contextualized and personalized services. Details on the contextualisation of delivered service content together with supporting mechanisms are presented. This contextualization functionality enables the system to adapt in response to varying operating environments, and to the service delivery modes dictated by, or matched to, the personal context of the user.

67. Z. Ji, Y. An, I. Ganchev, M. O’Droma. 2013. “The mServices GUI Architectures Design for the mLearning System”. Proc. of the IEEE International Conference on Cyber-Enabled Distributed Computing and Knowledge Discovery (IEEE CyberC 2013), Pp. 243-246. 10-13 October, Beijing, China. ISBN: 978-0-7695-5106-7/13. DOI: 10.1109/CyberC.2013.47. SJR=0,108 (реферирана в Web of Science и SCOPUS)

The design of a mobile services (mServices) Graphical User Interface (GUI) architecture for use in mobile eLearning (mLearning) systems is presented in this paper. The architecture is developed based on the Google Web Toolkit (GWT) - a development toolkit for building and optimizing complex multi-platform web-based applications. It is well suited for developing different mService applications, i.e., mTest, mLecture, mLibrary, etc. The architecture is implemented with the Observer and the Model View Controller (MVC) design patterns. Together with the Twitter’s bootstrap Cascading Style Sheets level three (CSS3), the created mService applications can run in the modern browsers, i.e., Chrome, Firefox, Internet Explorer, Opera, and Safari.

68. Z. Ji, X. Zhang, I. Ganchev, M. O'Droma. 2013. "Development of a Sencha-Touch mTest Mobile App for a mLearning System". Proc. of the 13th IEEE International Conference on Advanced Learning Technologies (IEEE ICALT 2013), Pp. 210-211. 15-18 July, Beijing, China. ISBN: 978-0-7695-5009-1/13. DOI: 10.1109/ICALT.2013.64. SJR=0,123 (реферирана в Web of Science и SCOPUS)

This paper presents an HTML5 mobile test (mTest) application for use in an agent-based mobile eLearning (mLearning) system. The application was developed based on the Sencha Touch framework. The mTest application receives XML data from a personal assistant agent on the client side and can work in different mobile operating system environments, such as iOS, Android, BlackBerry, Windows Phone, etc. The application is designed by means of the Model View Controller (MVC) design pattern, and is easy to maintain, test, and extend. Moreover, the mTest session is stored on the mLearning server side, which facilitates the handover from one user device to another during the service session, and enables an always best connected and best served (ABC&S) communication mode.

69. Z. Ji, X. Zhang, I. Ganchev, M. O'Droma. 2012. "A Personalized Middleware for Ubiquitous mHealth Services". Proc. of the 14th IEEE International Conference on e-Health Networking, Applications and Services (IEEE Healthcom 2012), Pp. 474-476. 10-13 October, Beijing, China. ISBN: 978-1-4577-2038-3. SJR=0,151 (реферирана в SCOPUS)

This paper presents a personalized middleware for mobile eHealth (mHealth) services for use in the Ubiquitous Consumer Wireless World (UCWW). The middleware was developed based on the ISO/IEEE 11073 personal health data (PHD) standards. It works as a multi-agent system (MAS) to provide intelligent collection of physiological data from medical sensors attached to human body, and subsequent sending of gathered data to a log data node by utilizing the Always Best Connected and best Served (ABC&S) communication paradigm. A number of design issues associated with the middleware implementation are outlined.

70. Z. Ji, X. Zhang, I. Ganchev, M. O'Droma. 2012. "A Content Adaptation Middleware for Use in a mHealth System". Proc. of the 14th IEEE International Conference on e-Health Networking, Applications and Services (IEEE Healthcom 2012), Pp. 455-457. 10-13 October, Beijing, China. ISBN: 978-1-4577-2038-3/12. SJR=0,151 (реферирана в SCOPUS)

This paper presents an agent-based content adaptation middleware for use in a mobile eHealth (mHealth) system. The middleware was developed by utilizing an object-oriented database version of the Wireless Universal Resource File (WURFL) Application Programming Interface (API) and integrated into a cloud system as means for facilitating an Always Best Connected and best Served (ABC&S) communication mode. A pure Java Wireless Abstraction Library (Java-WALL) tag and a lightweight Multi-Agent System (MAS) are presented. A number of design aspects associated with the middleware implementation are also highlighted.

71. D. Meere, I. Ganchev, M. O'Droma. 2012. "Utilising a Multi-Agent System to Support the Deployment of Contextualised mLearning Services". Proc. of the 6th IEEE International Conference on Intelligent Systems (IEEE IS'12), Pp. 88-94. 6-8 September, Sofia, Bulgaria. IEEE Catalogue Number: CFP12802-CDR. ISBN: 978-1-4673-2278-2/12. BEST PAPER AWARD. SJR=0,121 (реферирана в SCOPUS)

Enhancement of an InfoStation-based multi-agent architecture is presented. The focus of the enhancement is the system's capability to facilitate the contextualisation of delivered service content. It adapts to varying operating environments inherent to this type of wireless access architecture, and to service delivery modes dictated by, or matched to, the personal context of the user. The educational opportunities thereby created such as support for dispersed distance learning and enriched learning environment are discussed.

72.D. Meere, I. Ganchev, M. O'Droma. 2012. "Development of an Agent-based mLearning and mAssessment Delivery Platform". Proc. of the International Conference on Information Society (i-Society 2012), Pp. 519-524. 25-28 June, London, UK. ISBN: 978-1-908320-05-6. SJR=0,115 (реферирана в SCOPUS)

Within this paper, an InfoStation-based multi-agent architecture is presented, which provides the infrastructure to support the delivery of contextualised assessment in the form of mTests. These mTests can be utilised to enhance more traditional localised educational practices, or indeed to provide additional tools to support distance learning. The utilisation of a multi-agent system architecture, incorporating the personal mobile devices of learners, is presented, building on the previous work. The main architectural components within the system are discussed, detailing the functionality required in delivering effective assessments and feedback to learners. Finally, the system functionality required for effective service management by educators is detailed.

73.I. Ganchev, Z. Ji, M. O'Droma. 2012. "A Realization of Cognitive Pilot Channels through Wireless Billboard Channel Infrastructure for Cognitive Radio". Proc. of the 2nd Baltic Congress on Future Internet Communications (BCFIC 2012), Pp. 19-25, 25-27 April, Vilnius, Lithuania. IEEE catalog number: CFP1206L-CDR. ISBN: 978-1-4673-1671-2/12. SJR=0,119 (реферирана в SCOPUS)

This paper proposes an out-band cognitive pilot channel (CPC) solution for cognitive radio systems and networks. The solution exploits wireless billboard channel (WBC) technology which was originated to play a key role in a ubiquitous consumer wireless world (UCWW) environment. The paper shows how the WBC technology and variety of potential WBC downlink platforms match the requirements of the CPC scheme, with their main goal of enabling the transfer to mobile terminals (MTs) of available knowledge of the wireless operational and geographical environment, established policies and internal state of any usable and accessible 'cognitive spectrum'. The paper sets out the three-layer WBC/CPC system architecture, with specific emphasis on the top service layer and the CPC 'service descriptions', and includes also details on the link and physical layers for a 'WBC/CPC over DVB-H' platform.

74.D. Tairov, I. Ganchev, M. O'Droma. 2011. "Third-Party AAA Framework and Signaling in UCWW". Proc. of the 7th International Conference on Wireless Communications, Networking and Mobile Computing (WiCOM 2011), Pp. x1-x5, 23-25 September, Wuhan, China. ISBN: 978-1-4244-6252-0/11. DOI: 10.1109/wicom.2011.6040462. SJR=0,104 (реферирана в Web of Science и SCOPUS)

This paper treats the signaling needs which will satisfy the requirements of the novel Third-Party Authentication, Authorization and Accounting (3P-AAA) framework. The main 3P-AAA interfaces and candidate signaling protocols are described. Some aspects of the integration of the proposed 3P-AAA framework with the currently existent 3GPP IP multimedia subsystems (IMS) are also considered.

75. D. Meere, I. Ganchev, M. O'Droma. 2011. "Mobile Phones as Learning Instruments: mLearning Service Provision within an InfoStation-based Multi-Agent Environment". Proc. of the International Conference on Telecommunication Technology and Applications (ICTTA 2011), Pp. 1-6, 2-4 May 2011, Sydney, Australia. ISBN: 978-981-08-8636-3. (Proc. of CSIT vol. 5 (2011) © IACSIT Press, Singapore). (реферирана в Web of Science)

The system presented in this paper seeks to incorporate mobile devices into the spheres of learning, and utilize the assimilated tacit knowledge of students. The ongoing development of a context-sensitive InfoStation-based architecture, tasked with supporting the provision of mobile information services within a University domain, is outlined. These services are designed to complement the traditional educational paradigm, providing an enhanced blended learning experience for students.

76. I. Ganchev, S. Stoyanov, M. O'Droma, V. Valkanova, D. Meere. 2010. "Pervasive InfoStation-based mLearning System". Proc. of the IARIA 5th International Conference on Systems and Networks Communications (ICSNC 2010), Pp. 320-325, 22-27 August, Nice, France. ISBN: 978-0-7695-4145-7. DOI: 10.1109/ICSNC.2010.57. SJR=0,107 (реферирана в SCOPUS)

An agent-oriented pervasive system supporting a context-aware and personalized mLearning services provision within an InfoStation-based University network is presented. The InfoStation's middleware architecture facilitating the users' mobile access to services is described along with the interaction between agents. An extended system architecture supporting the service personalization is proposed.

77. S. Stoyanov, I. Ganchev, I. Popchev, M. O'Droma, V. Valkanova, 2010. "Agent-Oriented Middleware for InfoStation-based mLearning Intelligent Systems". Proc. of the 5th IEEE International Conference on Intelligent Systems (IEEE IS'10), Pp. 91-95, 7-9 July, London, UK. ISBN: 978-1-4244-5164-7/10. SJR=0,165 (реферирана в SCOPUS)

An agent-oriented middleware supporting context-aware and adaptable mLearning service provision within an InfoStation-based University network is presented. The InfoStation's middleware architecture facilitating the users' mobile (Wi-Fi) access to services is described. The agents' interaction is explained in detail.

78. I. Ganchev, S. Stoyanov, V. Valkanova, M. O'Droma. 2010. "Service-oriented and Agent-based Architecture Supporting Adaptable Context-Aware Provision of Mobile E-Learning Services". Proc. of the IADIS International Conference on E-Learning 2010 (EL 2010), Pp. 97-104, 26-31 July, Freiburg, Germany. ISBN: 978-972-8939-17-5. SJR=0,111 (реферирана в SCOPUS)

This paper describes an OMG's MDA-based approach for the development of a service-oriented and agent-based middleware architecture supporting flexible and adaptable, scenario-based and context-aware provision of mobile e-Learning services within InfoStation wireless environments. Considering the system development as a process of iterations, the approach provides an extensive ability to examine different development aspects and extend the system architecture step by step. The first two iterations, namely the base middleware architecture and the scenario-based management, are presented in detail.

79. S. Stoyanov, I. Ganchev, V. Valkanova, M. O'Droma. 2010. "Scenario-oriented and Context-aware mLearning System Architecture". Proc. of the IADIS International Conference on Mobile Learning 2010 (ML 2010), Pp. 250-254, 19-21 March, Porto, Portugal. ISBN: 978-972-8924-99-7. (реферирана в SCOPUS)

This paper describes an OMG's MDA-based approach for the development of service-oriented and agent-based middleware architectures supporting flexible and adaptable, scenario-oriented and context-aware provision of mLearning services within InfoStation wireless environments. Considering the system development as a process of iterations, the approach provides an extensive ability to examine different development aspects and extend the system architecture step by step. One of these iterations, namely the time-based scenario management, is presented in detail.

80. S. Stoyanov, V. Valkanova, I. Ganchev, M. O'Droma. 2010. "An Approach and Architecture Supporting Context-Aware Provision of mLearning Services". Proc. of the IARIA 2nd International Conference on Mobile, Hybrid, and On-line Learning (eL&mL2010), Pp. 11-16, 10-16 February, St. Maarten, Netherlands Antilles. ISBN: 978-0-7695-3955-3/10. DOI: 10.1109/eLmL.2010.14. SJR=0,108 (реферирана в Web of Science и SCOPUS)

This paper describes an extended approach for the development of a flexible, context-aware and adaptable, service-oriented and agent-based software architecture for use in on-line eLearning systems employing an InfoStation infrastructure. The extended approach is built on the top of a previously used basic approach which has shown some imperfections. Considering the system development as a process of iterations, the new approach provides an extensive ability to examine different development aspects and extend the system architecture step by step. The lower-level types of iterations are presented in detail.

81. S. Stoyanov, I. Ganchev, M. O'Droma, H. Zedan, V. Valkanova. 2009. "Agent-Oriented Middleware for Mobile eLearning Services". Proc. of the 33rd Annual IEEE International Computer Software and Applications Conference (IEEE COMPSAC 2009). Pp. 62-66, 20-24 July, Seattle, WA, USA. ISBN: 0730-3157/09. ISSN: 0730-3157. ISSN: 0730-6512. DOI: 10.1109/COMPSAC.2009.116. SJR=0,177 (реферирана в Web of Science и SCOPUS)

An agent-oriented middleware supporting context-aware mobile eLearning services provision is presented. The middleware architecture developed for a distributed InfoStation-based network established within a University Campus is described in detail. A concept for the control and management of service sessions and communications scenarios is also presented. Implementation issues encountered during the MailChecker development and testing are described, which provides a valuable insight for the successful development of other Bluetooth-based service applications.

82. I. Ganchev, S. Stoyanov, M. O'Droma, V. Valkanova. 2009. "Context-Aware mLearning Service Execution in an InfoStations Environment". Proc. of the 4th IARIA International Conference on Internet and Web Applications and Services (ICIW 2009), Pp. 632-637, 24-28 May, Venice, Italy. ISBN: 978-0-7695-3613-2/09. DOI: 10.1109/ICIW.2009.101. SJR=0,228 (реферирана в Web of Science и SCOPUS)

A software system architecture for context-aware mLearning service execution in an InfoStations environment established within a University Campus is presented. The main user scenarios affecting the context-aware service execution are described. The multi-agent nature of the InfoStation's architecture receives particular attention.

83. I. Ganchev, M. O'Droma, D. Meere. 2008. "Profile Implementation and Service Adaptation within an InfoStation-based mLearning Environment". Proc. of 2008 International Conference on Computer Science and Software Engineering (CSSE2008), Pp. 863-866, 12-14 December, Wuhan, China. ISBN: 978-0-7695-3336-0/08. DOI: 10.1109/CSSE.2008.307. SJR=0,104 (реферирана в SCOPUS)

This paper deals with the creation and utilization of user profiles and user service profiles within an InfoStation-based

mobile eLearning (mLearning) environment. The underlying technologies are paid particular attention. A description of a generic mLearning service along with sample interactions among the involved system entities is provided. Various profile attributes affecting the service adaptation for different operating environments are also examined.

84. S. Stoyanov, I. Ganchev, M. O'Droma, D. Mitev, I. Minov. 2008. "Multi-Agent Architecture for Context-Aware mLearning Provision via InfoStations". Proc. of the 5th International Conference on Soft Computing as Transdisciplinary Science and Technology (CSTST 2008), Pp. 549-552, 27-31 October, Cergy-Pontoise, Paris, France. ACM. ISBN: 978-1-60558-046-3. DOI: 10.1145/1456223.1456334. SJR=0,125 (реферирана в SCOPUS)

A software architecture for context-aware mLearning provision via InfoStations within a University Campus is presented. The multi-agent nature of the proposed architecture receives particular attention with a special focus on agents involved in the initiation, management, and maintenance of a Bluetooth communication between an InfoStation and a mobile device.

85. S. Stoyanov, I. Ganchev, I. Popchev, M. O'Droma. 2008. "Service-oriented and Agent-based Approach for the Development of InfoStation eLearning Intelligent System Architectures". Proc. of the 4th International IEEE Conference "Intelligent Systems" (IEEE IS'08), Pp. 6-20-6-25, 6-8 September, Varna, Bulgaria. ISBN: 978-1-4244-1739-1/08. DOI: 10.1109/IS.2008.4670434. SJR=0,115 (реферирана в Web of Science и SCOPUS)

The paper describes a generic service-oriented and agent-based approach for the development of eLearning intelligent system architectures providing mobile access to electronic services (eServices) and electronic content (eContent) for users equipped with wireless devices, via a set of InfoStations deployed in key points around a University Campus. The approach adopts the ideas suggested by the MDA specification of OMG. The agent level and service level of the resultant system architecture are discussed in detail. A classification and models of supporting agents are presented as well.

86. I. Ganchev, S. Stojanov, D. Meere, M. O'Droma. 2008. "InfoStation-based mLearning System Architectures: Some Development Aspects". Proc. of the 8th IEEE

International Conference on Advanced Learning Technologies (IEEE ICALT'08), Pp. 504-505, 1-5 July, Santander, Spain. ISBN: 978-0-7695-3167-0/08. SJR=0,126 (реферирана в Web of Science и SCOPUS)

This paper focuses on the development of InfoStation multi-agent system architectures facilitating the provision of mobile eLearning (mLearning) services across a University Campus area. Generic models and development approaches are considered. Particular attention is paid to the eContent generation and interpretation, as well as to the specification of the system architecture required to provide the needed flexibility and adaptability according to the requirements of modern mLearning systems. The multiagent approach for the system implementation is also justified.

87. I. Ganchev, D. Meere, S. Stojanov, M. Ó hAodha, M. O'Droma. 2008. "On InfoStation-Based Mobile Services Support for Library Information Systems". Proc. of the 8th IEEE International Conference on Advanced Learning Technologies (IEEE ICALT'08), Pp. 679-681, 1-5 July, Santander, Spain. ISBN: 978-0-7695-3167-0. SJR=0,126 (реферирана в Web of Science и SCOPUS)

An InfoStation-based information system design for the provision of mobile services (mServices) within a Library domain is presented. The main Library mServices developed, along with sample interactions among entities, is described. The creation, management and implementation of user profiles and user service profiles receive particular attention.

88. Z. Ji, I. Ganchev, M. O'Droma, R. Sadlier. 2007. "A HTTP-based Medical Image Server Compatible with Evolving Wireless Communications Infrastructures". Proc. of the IET China-Ireland International Conference on Information and Communications Technologies (CICT07), Pp. 914-921, 28-29 August, Dublin City University, Ireland. ISBN: 978-0-8634-1829-7. DOI: 10.1049/cp:20070795. (реферирана в SCOPUS)

This paper proposes a HTTP-based medical image server for the analysis, processing and transmission of medical images (e.g. DICOM, ANALYZES, CTC) realized on the server side, and displaying the results on the client side (handheld terminals, laptops), using the existing or upcoming wireless/wired Internet/Intranet telecommunications infrastructures. The medical image server runs on a lightweight 3-tier J2EE architecture. In the persistence tier, a number of image archives, a relational database and an index database are used for saving the medical images, user profiles and index data respectively. In the application tier, a set of APIs supports medical images loading, analysis and processing, helped by an intelligent business-logic API acting as a bridge between the persistence tier and the web tier. In the web tier, an Applet/Xlet, running on a laptop/handheld terminal, communicates with the server side using the HTTP protocol. With this HTTP-based medical image server, users can upload, retrieve, analyze, and process medical images behind firewalls in an effective and secure way.

89. I. Ganchev, S. Stojanov, M. O'Droma, D. Meere. 2007. "Adaptable InfoStation-based mLecture Service Provision within a University Campus". Proc. of the 7th IEEE International Conference on Advanced Learning Technologies (IEEE ICALT'07), Pp. 165-169, 18-20 July, Niigata, Japan. ISBN: 0-7695-2916-X/07. SJR=0,146 (реферирана в SCOPUS)

This paper presents an InfoStation-based multi-agent system, which provides intelligent mobile eLearning (mLearning) services in a University Campus area. The network architecture is outlined. A description of the adaptable mLecture service as well as a sample entity interaction is provided. Approaches to the implementation of this system are considered.

90. I. Ganchev, M. O'Droma. 2007. "New personal IPv6 address scheme and universal CIM card for UCWW". Proc. of the 7th International Conference on Intelligent Transport Systems Telecommunications (ITST 2007), Pp. 381-386, 6-8 June, Sophia Antipolis, France. IEEE Catalog No: 07EX1765. Library of Congress: 2007923401. ISBN: 1-4244-1178-5/07. SJR=0,105 (реферирана в Web of Science и SCOPUS)

This paper proposes a new personal IPv6 address scheme and universal Consumer Identity Module (CIM) card for future ubiquitous consumer wireless world (UCWW) established on the Consumer-based Business Model (CBM). The new person-centric, network-independent, IPv6 address class will enable real consumer number ownership and full anytime-anywhere-anyhow portability for future generations of mobile users empowered to opt out of their long-term subscriptions with access network providers (ANPs), and use advertised communication services from any consumer-centric wireless access network present to them. The new proposed universal CIM card will enable users to use their personal IPv6 number with whatever terminal they choose thus facilitating advanced user mobility.

91. N. Wang, I. Ganchev, M. O'Droma. 2007. "An Architecture for the Provision of Incoming Call Connection Service in UCWW". Proc. of the IEEE 65th Vehicular Technology Conference (VTC2007-Spring) on "Truly Ubiquitous Wireless Systems", Pp. 649-653, 22-25 April, Dublin, Ireland. ISBN: 1550-2252. ISSN: 1550-2252. IEEE Catalog 07CH37784C. SJR=0,337 (реферирана в Web of Science и SCOPUS)

This paper proposes an architecture for a consumer-oriented Incoming Call Connection (ICC) service provision, which will be an integral element of the recently proposed future Ubiquitous Consumer Wireless World (UCWW). The main components and interfaces of the ICC service architecture are described and protocol candidates are suggested. A typical illustrative ICC service scenario is elaborated and an outline proposal for an experimental proof-of-concept testbed is set out.

92. I. Ganchev, S. Stojanov, M. O'Droma, D. Meere. 2006. "An InfoStation-Based Multi-Agent System for the Provision of Intelligent Mobile Services in a University Campus Area". Proc. of the 3rd International IEEE Conference "Intelligent Systems" (IEEE IS'06), Pp. 426-431, 4-6 September, London, UK. ISBN: 1-4244-0195-X/06. ISSN: 1541-1672. SJR=0,141 (реферирана в Web of Science и SCOPUS)

This paper presents an InfoStation-based multiagent system, which provides intelligent mobile services in a University campus area. The corresponding network architecture (both horizontally and vertically) is presented. A description of some of the intelligent mobile services along with interaction among sample entities is provided. Technologies for delivering of these services are discussed, and approaches for the system implementation and structuring are considered.

93. I. Ganchev, M. O'Droma, S. Stojanov, M. Ó hAodha. 2006. "M-Learning and M-teaching Architectures and the Integration of E-Services for Educational Support".

Proc. of the IADIS International Conference on Mobile Learning 2006, Pp. 19-25, 14–16 July, Dublin, Ireland. ISBN: 927-8924-15-1.

This paper describes the main elements of the service architecture needed to support mobile teaching (m-teaching) and mobile learning (m-learning) within a Distributed e-Learning Center (DeLC). The paper outlines an enhanced DeLC network model along with its supporting communications infrastructure and explains the manner in which such a model can be used to provide intelligent mobile services for library users and information seekers across a University campus. Models for the classification and addressing of DeLC services are proposed. The main types of the DeLC mobile services are considered as they function within the environment of a campus-wide information network and examples of them are described. Finally a re-engineering approach for developing the second enhanced version of DeLC is proposed. This enhanced version allows improved mobile learning facilities in the library/information environment and at other key access points across the University campus, which facilitates mobile and interactive developments for both students and staff.

94. I. Ganchev, S. Stojanov, M. O'Droma, D. Meere. 2006. "An InfoStation-Based University Campus System for the Provision of mLearning Services". Proc. of the 6th IEEE International Conference on Advanced Learning Technologies (IEEE ICALT'06), Pp. 195-199, 5–7 July, Kerkrade, the Netherlands. ISBN: 0-7695-2632-2/06. SJR=0,116 (реферирана в SCOPUS)

This paper presents an InfoStation-based multiagent system, which provides mobile eLearning (mLearning) services in a University Campus area. A description of some of the mLearning services along with sample entities' interaction is provided. Technologies for delivering of these services are discussed, and approaches for the system implementation and structuring are considered.

95. F. McEvoy, I. Ganchev, M' O'Droma. 2006. "Building a Testbed with New Security Features for UCWW Research". Proc. of the 10th IEEE International Symposium on Consumer Electronics (IEEE ISCE 2006), Pp. 581-586, 29 June – 1 July, St. Petersburg, Russia. ISBN: 1-4244-0216-6/06. SJR=0,167 (реферирана в Web of Science u SCOPUS)

The consumer-based techno-business model (CBM) serves as a basis for the new emerging ubiquitous consumer wireless world (UCWW). For it all authentication, authorization and accounting (AAA) is handled by third-party AAA service providers (3P-AAA SPs). A possible architecture, a candidate signalling protocol and a functional model for 3P-AAA are considered in this paper. A testbed proposal for 3P-AAA, which contains embedded new security features, is set out. The approach towards simulation and development of this testbed so as to create a 3P-AAA prototype system is elaborated.

96. N. Kubinidze, M' O'Droma, I. Ganchev. 2006. "UMTS CoS Support in MPLS-enabled IP Backbones". Proc. of the 10th IEEE International Symposium on Consumer Electronics (IEEE ISCE 2006), Pp. 322-326, 29 June – 1 July, St. Petersburg, Russia. ISBN: 1-4244-0216-6/06. SJR=0,167 (реферирана в Web of Science u SCOPUS)

Novel schemes for UTRAN-specific UMTS QoS parameters mapping onto MPLS shim header fields for the traffic originating in UMTS access network and traversing MPLS/DiffServ enabled IP-backbone network core are proposed

in this paper. The heterogeneous network implementation context and the conformity of class of service (CoS) parameters support of each of the technologies is highlighted.

97. I. Ganchev, S. Stojanov, M. O'Droma. 2005. "Consumer-oriented DeLC Service Architecture". Proc. of the 3rd International Conference on Education and Information Systems: Technologies and Applications (EISTA'05), vol. II, Pp. 213-218, 14-17 July, Orlando, Florida, USA. ISBN: 980-6560-34-5. SJR=0,100 (реферирана в Web of Science u SCOPUS)

This paper describes the main elements of a consumer-oriented service architecture of a Distributed e-Learning Center (DeLC). The main aspects of the DeLC development are discussed. The DeLC network model needed for the support of m-Learning/m-Teaching process is considered along with the corresponding communication infrastructure. Models for DeLC services and nodes are proposed and explained. The main types of the DeLC mobile services are considered and pilot examples are described. Finally a re-engineering approach for developing the second enhanced version of DeLC is proposed.

98. I. Ganchev, S. Stojanov, M. O'Droma. 2005. "Mobile Distributed e-Learning Center". Proc. of the 5th IEEE International Conference on Advanced Learning Technologies (IEEE ICALT'05), Pp. 593-594, 5-8 July, Kaohsiung, Taiwan. ISBN: 0-7695-2338-2/05. DOI: 10.1109/ICALT.2005.199. SJR=0,138 (реферирана в Web of Science u SCOPUS)

The development of a mobile Distributed e-Learning Center (DeLC) with enhanced functionality, including two pilot mobile services, is described. Some DeLC re-engineering approaches to enhance the m-Learning/m-Teaching facilities available in a University campus are considered.

99. S. Stojanov, I. Ganchev, I. Popchev, M. O'Droma, E. Doychev. 2005. "An Approach for the Development of Agent-Oriented Distributed eLearning Center". Proc. of the International Conference on Computer Systems and Technologies (CompSysTech'05), Pp. IV.13-1 - IV.13-7, 16-17 June, Varna, Bulgaria. ISBN: 954-9641-38-4.

The paper presents the approach for the development of the agent-oriented version of DeLC (Distributed eLearning Center). A re-engineering process supported the transition from the object-component to the agent-oriented version is described. The communication between the agents and eServices will be based on the DAML-S (OWL-S) protocol.

100. I. Armuelles, T. Robles, H. Chaouchi, I. Ganchev, M. O'Droma, M. Siebert. 2004. "On Ad Hoc Networks in the 4G Integration Process". Proc. of the 3rd Annual Mediterranean Ad Hoc Networking Workshop (Med-Hoc-Net 2004), Pp. 45-56, June 27-30, 2004, Bodrum, Turkey. ISBN: 975-98840-1-1.

The imminent combination of different wireless technologies will provide a very flexible and powerful platform to support requirements for future services and applications, which will be part of mobile communications beyond 3G. The main goal of this paper is to present the preliminary results of the ongoing research in the project ANWIRE (Academic Network on Wireless Internet Research in Europe) with respect to the system integration process for an envisioned environment of heterogeneous integrated networks. Specially, this paper is focused on the ad hoc

network integration with fixed and wireless mobile networks in order to fulfill requirements imposed by mobile users with the expected “anytime, anywhere with anybody” type of communication. Besides the ad hoc networks introduction, the implications of ad hoc networks in the 4G integration process are also elaborated. The requirements for this integration are identified. A special focus thereby was put on the evolution of business models and their long sight to consider ad hoc related properties. Finally, a proposed Generic ANWIRE system and service Integration framework Architecture (GAIA) is described.

101. I. Ganchev, S. Stojanov, M. O’Droma, I. Popchev. 2004. “Enhancement of DeLC for the Provision of Intelligent Mobile Services”. Proc. of the 2nd IEEE International Conference on Intelligent Systems (IS’04), vol. 1, Pp. 359-364, 22-24 June, Varna, Bulgaria. IEEE Cat. No. 04EX791. ISBN: 0-7803-8278-1/04. Library of Congress 2003115853. SJR=0,122 (реферирана в Web of Science и SCOPUS)

This paper presents a new enhanced version of the Distributed eLearning Center (DeLC), providing intelligent mobile services for users in a University Campus. The main enhancements are related to the extension of the DeLC network model to a 3-tier structure and introduction of new intelligent elements into it. A re-engineering approach for the realization of required changes in the DeLC system architecture is proposed, which allows re-use of services already deployed in the existing version of DeLC and development of new mobile services based on intelligent agents used as personal helpers for DeLC users. A description of some of the mobile services along with the supporting communication infrastructure is also provided.

102. I. Ganchev, M. O’Droma, H. Chaouchi, I. Armuelles, M. Siebert, N. Houssos. 2004. “Requirements for an Integrated System and Service 4G Architecture”. Proc. of the IEEE 59th Vehicular Technology Conference (VTC2004-Spring), Pp. 3029-3034, 17-19 May, Milan, Italy. IEEE-04CH37514. ISBN: 0-7803-8255-2/04. ISSN: 1550-2252. SJR=0,487 (реферирана в Web of Science и SCOPUS)

The emerging 4G networks intend to provide a variety of adaptable services to mobile and nomadic users by using integrated heterogeneous network infrastructure. In this paper, the commonalities and differences among the various approaches in the integration of 4G systems and services are identified on the basis of an analysis of the research done by well-known international projects. Building on this and other ideas, the requirements for an integrated system and service 4G architecture are defined. Considerations and ideas discussed include AAA functions, network system management, end-to-end QoS negotiation and support, mobility management, adaptability and reconfigurability, support for multiple communication modes, ABC&S, service and access network advertisement, discovery and association, wireless billboard channel, and security and privacy challenges.

103. H. Chaouchi, G. Pujolle, I. Armuelles, M. Siebert, C. Bader, I. Ganchev, M. O’Droma, N. Houssos. 2004. “Policy Based Networking in the Integration Effort of 4G Networks and Services”. Proc. of the IEEE 59th Vehicular Technology Conference (VTC2004-Spring), Pp. 2977-2981, 17-19 May, Milan, Italy. IEEE-04CH37514. ISBN: 0-7803-8255-2/04. ISSN: 1550-2252. SJR=0,487 (реферирана в Web of Science и SCOPUS)

4G wireless and mobile communication networks have the ambition to integrate heterogeneous wireless access network technologies combining mutual advantages and thus offering a variety of services to the users, maximizing their satisfaction on the one hand and maximizing the network and service providers' profits on the other hand.

However, this integration is not achievable without challenges. This paper presents related system integration requirements and provides a new framework to support the integration of 4G networks and services. This framework uses a policy based networking concept in order to provide the unified control in the oncoming 4G networks and services. The paper also provides an analysis of the candidate signaling protocols in this framework. Two approaches are described: i) The unified QoS, mobility, and security signaling; and ii) the heterogeneous QoS, mobility, and security signaling. In addition, the paper introduces user, terminal, network and service profiles and management in order to provide a user-centric approach and consider different user, terminal, network, and service constraints in order to better adapt the user service as well as the network configuration to these constraints. Finally, an estimation on the composition of exchanged signaling data with respect to the aspired level of integration is provided.

104. M. O'Droma and I. Ganchev. 2004. "New Access Network Techno-Business Model for 4GWW". Proc. of 4th ANWIRE International Workshop on Wireless Internet and Reconfigurability (held in conjunction with the 3rd IFIP-TC6 Networking Conference), Pp. 75-81, 14 May, Athens, Greece.

This paper puts forward views on evolving fourth generation wireless world (4GWW) and how that evolution may be directed for the benefit of the consumer and other stakeholders. It is argued that an infrastructural re-think on the way Authentication, Authorization and Accounting (AAA) service is supplied is key to this evolution. At a high level this may be described as a business plan for the supply of wireless services, especially with the wireless access service component being founded on a consumer-based structure rather than a subscriber-based structure. The consumer-based techno-business model (CBM) will enable a loose dynamic (even casual) consumer-type association between mobile users (MUs) and access network providers (ANPs). Innovations required to support this include a pivotal role for a third-party AAA service provider entity. The approach will necessitate the creation of other new technological support services. Among these would be a global standardized approach towards ANP service advertisement, discovery and association. It is proposed here that this service would best be realized through newly defined wireless billboard channels (WBC) and a new incoming caller connection (ICC) service implementation technology. Ways this approach will more positively drive wireless communications into its fourth generation with attractive benefits for all stakeholders alike are detailed. Further the reasoning behind a hypothesis that the CBM infrastructure can be a foundation for Ad Hoc networking business plan development are also presented.

105. N. Kubinidze, M. O'Droma, I. Ganchev. 2004. "Integrated Algorithm of HMIPv6 & MPLS for NS to Support Next Generation Wireless Networks". Proc. of the IEE Conference on Telecommunications Quality of Service: The Business of Success (IEE QoS 2004), Pp. 156-159, 2-3 March, The IEE, Savoy Place, London, UK. ISSN: 0537-9989. SJR=0,127 (реферирана в SCOPUS)

The paper highlights advantages of HMIPv6 and MPLS integration in the aspect of guaranteed and efficient end-to-end QoS provision in multi-domain wireless networks. Multiple domain scenario of radio access networks is considered and focus on traffic transmission from/to Mobile Host (MH) and a Correspondent Node (CN) is made. Agent advertisement, MH registration, Label Switched Path establishment and maintenance, and data transfer procedures are described. Intra-domain and inter-domain soft handover is discussed in the context of multiple domain wireless access networks. A novel network simulator algorithm, suitable for the NS2, which integrates the functionalities of two technologies (HMIPv6 and MPLS) is proposed and the structural parts of the block diagram are explained in detail.

106. N. Alonistioti, N. Passas, A. Kaloxylos, H. Chaouchi, M. Siebert, M. O'Droma, I. Ganchev, C. Bader Faouzi. 2004. "Business Model and Generic Architecture for Integrated Systems and Services: The ANWIRE Approach" (white paper). Proc. of the WWRF 8bis meeting, 8 pp., 26-27 February, Beijing, China.

The evolution of mobile communication systems to 3G and beyond introduces a new era in advanced multimedia service provision to mobile users. The success of next generation networks is highly dependent on the availability of a plethora of applications, accessible via a variety of network infrastructures and terminals. This vision can be realized only through the co-operation of various business players (e.g., application developers, content providers), in addition to the mobile operators. The specification by major standardization organizations of open APIs for network access by third parties is a significant step towards this direction. However, the road to a dynamic, open environment includes major further challenges like taming the unprecedented complexity of service provision and management that spans multiple domains and the introduction of network and systems that are dynamically reconfigurable and adaptive in order to accommodate service delivery over highly diverse contexts.

107. M. Siebert, H. Chaouchi, I. Armuelles, N. Passas, I. Ganchev, M. O'Droma. 2004. "System and Service Integration in Heterogeneous Networks by a Policy Based Network Architecture". Proc. of the 5th European Wireless Conference on Mobile and Wireless Systems beyond 3G (EW04), Pp. 202-208, 24-27 February, Barcelona, Spain. ISBN: 84-7653-847-2.

Within this paper, the Academic Network for Wireless Internet Research in Europe (ANWIRE) presents a new policy based architecture for system and service integration in future heterogeneous wireless mobile networks. The proposed generic framework is based on a detailed review and comparative analysis of ongoing research work in the field of system and service integration followed by a respective classification, which is used as a basis to derive requirements of a new integrated architecture. The presented architecture facilitates interworking of heterogeneous systems by considering key enabling technologies like 'Wireless Internet' and 'Reconfigurability' as envisaged by ANWIRE.

108. S. Stojanov, I. Ganchev, M. O'Droma. 2003. "An Adaptation of the DeLC Architecture to the 'SCORM' Standard". Proc. of the 4th International Conference on Informatics and Information Technology (CiiT 2003), Pp. 171-177, 11-14 December, Bitola, Macedonia. ISBN: 9989-668-45-0.

A services-oriented education system, Distributed eLearning Center - DeLC, is presented in this paper. An essential disadvantage of the current version of the DeLC is that the system doesn't support some of the existing eLearning standards. The emerging standard SCORM has been chosen for the implementation of the next version of the center. We present our first vision for adaptation of the DeLC architecture to the SCORM standard as regards the implementation of eLearning services, the model used for overall control and management, and the process of eServices integration. As necessary action we consider also changing the structure of the meta-level and the profiles-supporting system.

109. I. Ganchev, M. O'Droma, F. McDonnell. 2002. "Component-Based Platform for a Virtual University Information System". Proc. of 6th WSEAS International

Multiconference CSCC, D2, Pp. 7571-7576, 7-14 July. Crete, Greece. ISBN: 960-8052-63-7.

Design ideas for a Virtual University Information System, VUIS, are presented. The design is an interface-centric component-based architecture. Basic services are decomposed into sets of monadic services, each of which is implemented as a reusable Enterprise Java Beans (EJB) software component. The interaction patterns and communication interfaces between components to realise foreseen and un-foreseen basic services are described. Considerations of scalability, security, latency, user interface design issues (e.g. acceptable response time, and speed) are addressed. The paper includes an EJB application example showing this approach towards modelling and how it benefits the design of the VUIS.

110. I. Ganchev, M. O'Droma, R. Andreev. 2007. "Functionality and SCORM-compliance Evaluation of eLearning Tools". Proc. of the 7th IEEE International Conference on Advanced Learning Technologies (IEEE ICALT'07), Pp. 467-469, 18-20 July, Niigata, Japan. ISBN: 0-7695-2916-X/07. SJR=0,146 (реферирана в Web of Science и SCOPUS)

A comparative analysis of the functional design and standards' compliance of eLearning authoring/assembling tools and Learning Content Management Systems (LCMSs) is presented with a view of assessing how their functionality meets the requirements for robust development of eLearning content that complies with the existing eLearning standards and specifications. The standard reference model used as a basis for the comparative analysis is the Sharable Content Object Reference Model (SCORM) of the Advanced Distributed Learning (ADL) Initiative. The results show up the strengths but also the inadequacies of existing products. The exercise is useful also in that it implicitly draws out, in a fairly systematic and detailed way, a range of strengths and attributes one would like to see in the functional design of a minimal comprehensive eLearning authoring/assembling tool and LCMS.

111. R. Andreev, I. Ganchev, M. O'Droma. 2005. "Content Metadata Application and Packaging Service (CMAPS) – Innovative Framework for Producing SCORM-compliant e-Learning Content". Proc. of the 5th IEEE International Conference on Advanced Learning Technologies (IEEE ICALT'05), Pp. 274-278, 5-8 July, Kaohsiung, Taiwan. ISBN: 0-7695-2338-2/05. DOI: 10.1109/ICALT.2005.93. SJR=0,138 (реферирана в Web of Science и SCOPUS)

This paper discusses the application of metadata to SCORM-compliant e-Learning content in the broader context of the proposed Content Metadata Application and Packaging Service (CMAPS) framework. The CMAPS framework is developed on the basis of a process model, for producing high-quality e-Learning content, proposed by the Learning Systems Architecture Lab (LSAL) at Carnegie Mellon University. The original LSAL model is expanded by introducing a new substage needed for the better identification of assets comprising educational resources and easy creation of asset metadata. For the needs of CMAPS, two new IEEE LOM metadata application profiles are created and their elements explained. Finally, the proposed CMAPS framework is described and a brief overview of the expected functionality of its modules is present.

САМООЦЕНКА НА ПРИНОСИТЕ ПО ТЕМАТИЧНИ ПОДОБЛАСТИ

КОМУНИКАЦИИ НА БЪДЕЩЕТО

Основните приноси в тази подобласт са свързани с разработената **нова телекомуникационна парадигма** за т.нар. **повсеместен потребителски безжичен свят** (*Ubiquitous Consumer Wireless World, UCWW*), получила широк международен отзвук във вид на публикации и цитирания в списания, сборници на научни конференции и книги. Чрез предлагането (като част от нея) на нов перспективен техно-бизнес модел за развитието на бъдещите безжични комуникационни технологии е проправен път за истинска революция в областта на телекомуникациите. Новаторските идеи тук включват предложени иновативни инфраструктурни и технологични промени в структурата на безжичните мрежови архитектури с цел постигане (и предлагане на потребителите) на по-голяма свобода, необвързаност и по-голям избор на услуги заедно с по-големи възможности за (и гъвкавост при) тяхното управление (спрямо конкретните нужди на всеки един потребител), пълна свобода за преносимост на номерà, адреси и услуги с цел подобряване на интегралния показател 'цена/качество', *технологична* предпоставка за премахване на таксите за роуминг, създаване на нови и отворени бизнес среди в областта на безжичните комуникации, по-голяма отвореност на (и улеснено навлизане в) пазара за мобилни мрежи и услуги, и като цяло засилена конкуренция между мрежовите доставчици и доставчиците на услуги, което пък ще доведе до по-големи икономически ползи за потребителите. Аспекти от дизайна на UCWW системен прототип, базиран на използването на облачни технологии [61] и NGN принципи, е представен в [59] заедно с потенциалното му въздействие върху бъдещото общество. Приносът на [61] е предимно в създадената разпределена многослойна Redis рамка, използваща ZooKeeper за управление на Redis възлите, с необходимата гъвкавост и мащабируемост за лесно интегриране в UCWW облака.

По-конкретно приносите на кандидата в тази подобласт могат да се обобщят както следва:

- **Доразвиване и разширяване на класическата комуникационна парадигма за винаги най-добра свързаност** (*always best connected, ABC*) [21] в напълно потребителски ориентирана версия с допълнителен елемент за винаги най-добро обслужване (*always best connected and best served, ABC&S*) [104]. В [40] са разгледани различни аспекти на тази нова визия заедно с необходимите стратегически изисквания и възможни решения за разработване на необходимите системни архитектури и комуникационни протоколи, като са отчетени обективните и субективните страни от гледна точка на различните участници: потребители, мрежови доставчици, доставчици на услуги и производители на мобилни устройства. Освен това е предложен ABC&S референтен комуникационен модел (с възможност за пряка комуникация между несъседни слоеве) заедно със съответни мрежови архитектурни компоненти и протоколи за управление, като е представена и схематична структура на потребителски ABC&S терминал;
- Предлагане и разработване на **новаторски техно-бизнес модел, ориентиран към потребителя** (*consumer-centric techno-business model, CBM*) [14, 21, 42, 106], като алтернатива и замяна на съществуващия старомоден и затормозяващ абонатен модел (*subscriber-based techno-business model, SBM*), тъй като не обвързва (за дълго време) потребителя към един-единствен мрежов доставчик, а му дава свобода за избор (във всеки един момент) на най-добрия (за използването на определена мобилна услуга) мрежов доставчик, превръщайки по този начин потребителя в **консуматор**, а не просто абонат на услуги. Мотивиране на хипотезата, че CBM може да послужи и като бизнес основа за усъвършенствано развитие на ad-нос мрежи, е представено в [104];
- Предлагане и разработване на **концепция за безжични билбордни канали** (*wireless billboard channels, WBC*) [21, 104], използвани за рекламиране и автоматично откриване на предлагани

(мобилни) услуги и последващо асоцииране (*advertisement, discovery, and association, ADA*) на потребителите с тях. В тази връзка в [17] е предложен модел за автоматично откриване на услуги заедно с подходящи шаблони (в ASN.1 формат) за тяхното описание чрез категоризиране в групи и подгрупи. Освен това е определена подходяща структура за предаване на данните по WBC и е направен критичен анализ (и сравнение за използване) на съществуващите безжични разпръскващи технологии за реализация на WBC канали [17]. В [28] е предложена система, работеща в рамките на университетско градче и базирана на локален WBC канал за рекламиране на (предимно образователни) услуги за студенти, преподаватели и членове на персонала. [73] предлага реализация на когнитивни пилотни канали (*cognitive pilot channel, CPC*) чрез WBC инфраструктура, като за целта дефинира трислойна интегрална WBC/CPC системна архитектура, базирана на DVB-H технология за пренос, и представя експериментално получени резултати за функционирането ѝ;

- Разработване на ефективни **методи и модели за откриване и препоръчване на най-подходящи (мобилни) услуги** за конкретния потребител. За целта в [58] е предложена концептуална контекстно-съобразена рамка, използваща семантично знание и отчитаща както предпочитанията на потребителите, съдържащи се в генерираните им профили, така и текущия контекст, като услугите и техните атрибути са моделирани динамично във вид на хетерогенна информационна мрежа. Тази рамка след това е детайлизирана в [55] на базата на Lambda архитектура с допълнителна функционалност за офлайн анализиране на събраните данни чрез алгоритми за машинно обучение (*machine learning*) и последващо препоръчване на най-подходящите (за даден потребител според текущия контекст) услуги (в реално време) в съответствие с ABC&S парадигмата. [56] представя разработената облачно-базирана платформа за мениджмънт на данни (*Data Management Platform, DMP*) с цел превръщане на големи масиви от данни, събрани въз основа на мрежовата активност на потребителите и дейностите им, свързани с използването на мобилни услуги, в действително множество от данни (*dataset*), подходящо за аналитична обработка. Приносът на [57] е в реализираната (с помощта на Hadoop, Storm, и Kafka софтуерни технологии) разпределена облачно-базирана система, позволяваща на потребителите да получават навремени препоръки за най-подходящите за тях (мобилни) услуги ‘навсякъде, по всяко време и по всеки възможен начин’ (*anywhere/anytime/anyhow*).

По отношение на алгоритмите за обработка на данните също е извършена съществена работа. Така например [50] предлага използването на мета-данни (различни видове отношения, съществуващи между елементите в една хетерогенна информационна мрежа) за решаването на проблеми, свързани с наличието на недостатъчни (оскъдни) данни и ‘студен старт’ (*cold start*), характерни за техниките за съвместно филтриране (в сътрудничество с други потребители), използвани в системи за препоръчване, за което е доказано (чрез експериментално тестване), че води до по-добри резултати. Приносът на [48] е в предложеното подобрене, постигащо по-голяма акуратност (доказана експериментално) на метода за препоръчване, базиран на съвместно филтриране на косвени данни, основано на предположението, че потребителите предпочитат вече използвани услуги (консумирани стоки) пред неизползвани (неконсумирани). [46] предлага използването и интегрирането на различни тегла на услугите (стоките, елементите) в рангов модел с умножение на матрици, при който обучението се извършва чрез Бейс персонализирано класиране (*Bayesian Personalized Ranking, BPR*), като са предложени два модела, за които чрез експерименти е потвърдено, че са по-добри от стандартния BPR метод. [54] предлага хибриден метод, който интегрира съществуващи потребителски доверителни отношения (напр. социални прилики) в техники за препоръчване, базирани на съвместно филтриране, чрез което се постига по-добра точност;

- Предлагане и разработване на **концепция** за нов вид глобално-значим и мрежово-независим адрес (адресен клас) – **персонален IPv6 адрес (PIPV6)** [7, 14], която позволява реалното му владение от страна на потребителя и пълната му преносимост. Вграден в цифров (X.509v3) сертификат този уникален PIPv6 адрес [90] може да служи като дългосрочна идентификация на мрежов възел (обект), позволяващ му разширена (и сигурна) мобилност и участието му в различни комуникационни сценарии [7], както и подобрена автентикация, оторизация и отчетност (*authentication, authorization and accounting, AAA*) в различни видове мрежи, в това число комуникационни мрежи на моторни превозни средства (Vehicular Ad Hoc Networks, VANETs). В тази връзка основният принос на [8] се състои в разработването на механизъм за анулиране на цифрови сертификати, основан на Merkle Hash Tree (МНТ), който дава възможност за ефективно и своевременно разпространение на съответната информация в VANET мрежи;
- Предлагане и разработване на **концепция за автентикация, оторизация и отчетност, предоставяни от трети страни** при осъществяването на комуникации (*third-party AAA, 3P-AAA*) [14, 104] като крайъгълен камък за реструктуриране на пазара и на бизнес-плана за предоставяне на безжични комуникационни услуги. За целта е създадена 3P-AAA рамка за стратегическо развитие на инфраструктура и протоколи за независимо и автономно предоставяне на AAA услуги от трети страни, които не са мрежови доставчици [21, 44]. Въпросите за сигнализация са третирани в [74], където са описани основните 3P-AAA интерфейси и кандидат-протоколи за сигнализация заедно с някои аспекти на интеграцията на предложената рамка с 3GPP IMS спецификацията. Ново Diameter-базирано 3P-AAA приложение е предложено в [44], като за него са разработени основните съобщения, необходими за изпращане на команди и отговори. Възможна архитектура и функционален модел за 3P-AAA са предложени в [95], заедно с експериментална установка за тестване;
- Предлагане и разработване на **концепция за универсална смарт-карта за самоличност на потребителя** (*consumer identity module, CIM*) [14, 60, 90], която да замести използваната в момента (U)SIM карта в мобилните устройства. CIM картата поддържа идентифициране на потребителя, потребителски профил, информация за кредитни карти, (персонални) IP адреси, 3P-AAA данни, X.509 сертификати и др. Чрез нея всяка такса (цена за използване от страна на потребителя) на комуникационна услуга се заплаща (автоматично) на доставчика и индиректно през трета 3P-AAA страна [21]. Допълнително CIM картата може да послужи за основа при разработването на предложената в [21] 'безжична кредитна карта', която може да се използва за заплащане и на други услуги/стоки, ползвани/закупени от потребителя, напр. чрез NFC технологията. Разработената впоследствие цялостна CIM система от вида 'клиент/сървър' е описана в [60];
- Предлагане и разработване на **нова версия** (ориентирана към потребителя) на класическата, но недостатъчно гъвкава при едновременно използване на хетерогенни мрежи за достъп, телекомуникационна **услуга за осъществяване на входящи повиквания** (*incoming call connection, ICC*) [14, 21, 104]. Тази нова версия на услугата осигурява механизъм за автономен контрол и мобилност, (частично) контролиран от потребителя, позволяващ му истински *multihoming* и динамична едновременна асоциация с различни (налични) мрежи за достъп и избор на 'най-добрата' от тях за всеки конкретен тип входящо повикване според текущия контекст и в съответствие със субективните ABC&S изисквания. Въпроси, свързани с дизайна, архитектурата и основните сигнализационни елементи за настройка и функциониране на новата потребителски-ориентирана ICC версия, са представени и обсъдени в [18] заедно с някои въпроси по нейното стандартизиране. [91] представя разработената потребителски ориентирана ICC архитектура, като описва нейните основни компоненти и интерфейси заедно с илюстративен сигнализационен

сценарий, предлага подходящи кандидат-протоколи за нейната реализация, и представя експериментална установка за проверка на концепцията;

- Предлагане и разработване на **концепция за гореща смяна на мрежовия достъп** (*hot access network change, HAC*) [40] без прекъсване на текущата/ите комуникационна/и сесия/и, като доразвитие на класическото (базирано на силата на сигнала) препредаване (handover) от една мрежа / базова станция / точка за достъп към друга такава, но с отчитане преди всичко на показателите за качество (QoS) и цената на обслужване;
- Предлагане на **концепция за интегрирано хетерогенно мрежовиране** (*Integrated Heterogeneous Networking, IHN*), което се осъществява не под егидата на мрежите (мрежовите доставчици), а се задвижва, управлява и контролира от потребителите (подпомагани от доставчиците на мобилни услуги) и е прозрачно за мрежите (за достъп) [14, 18]. По този начин интелигентността се измества от центъра към периферията на мрежите, т.е. към потребителските устройства и сървърни структури (в това число облачни), което предлага и по-големи бизнес възможности за производителите на хардуер и софтуер.

Друго перспективно направление в тази подобласт е свързано със замяната на парадигмата на информационно-ориентирания Интернет с т.нар. **Интернет на услугите** (*Internet of Services, IoS*) – глобална система, в която новите услуги се създават и предлагат като верижни структури, получени чрез комбиниране и интегриране на функционалността на голям брой (от стотици до хиляди) други (съществуващи) услуги, предлагани от различни трети страни, включвайки в това число облачни услуги. В този смисъл качеството на обслужване (QoS) и оценката му след използване от страна на потребителя (Quality of Experience, QoE) придобиват съществено значение, тъй като обичайният *ad-hoc* базиран контрол работи добре само за верижни структури с малък размер. В тази връзка приносът на [3] е в извършения анализ на състоянието на научните изследвания в областта на автономния контрол за надежден IoS и идентифицирането на основните научни предизвикателства във всяко едно от трите поднаправления: автономно управление и контрол в реално време, методи и средства за мониторинг и прогнозиране (на състояние/функционалност/производителност) на услуги, и интелигентно ценообразуване и конкурентноспособност при наличие на множество домейни.

ИНТЕРНЕТ НА НЕЩАТА (*INTERNET OF THINGS, IoT*)

Едно от важните направления в тази подобласт е насочено към създаването на **интелигентни градове** (*smart cities*). В тази връзка първоначално в [37] е развита идеята за ‘интелигентно паркиране’ в рамките на университетско градче чрез използване на InfoStation-базирана мулти-агентна система. Приносът на [24, 63] се състои в доразвиване на тази първоначална концепция чрез използване на облачно-базирани компютърни технологии, като неразделна част от разработената архитектура за интелигентни градове с общо предназначение, представена в [64], заедно с пилотна система (и съпътстващ мидълуер) за паркиране на моторни превозни средства (МПС), използваща подходящи софтуерни решения като Kafka/Storm/Hbase клъстери, OSGi уеб приложения, разпределена NoSQL база данни и разработените мобилни приложения за откриване, резервиране и предоставяне на най-подходящото (за всеки поребител/шофьор) паркомясто в съответствие с ABC&S комуникационната парадигма. Друго поднаправление е свързано с решаване на проблема за контрола на качеството на въздуха особено в големите градове. За целта [51] представя проектираната и реализирана пилотна GPRS/Wi-Fi-базирана система за мониторинг на индекса на качество на въздуха (Air Quality Index, AQI) и за ежедневното му отчитане (‘на живо’) с последваща статистическа обработка и визуализация на резултатите на уеб сайт. Трето поднаправление е насочено към ефективното

използване на електрическа енергия (smart grid). В тази връзка приносът на [49] е в реализираната IoT прототипна система за контрол на електрическо отопление на домове, офиси, училища, читалища и т.н., базирана на вземането на интелигентни решения, свързани с управлението на съответните контролери, в поддържаща облачна структура. [52] представя проектирания и успешно тестван електронен модул за пренос на данни (data transfer unit, DTU) с предвидено широко приложение в различни IoT-базирани системи (в частност [49, 51]), действащ като комуникационен шлюз между безжична сензорна мрежа (wireless sensor network, WSN) и съответен информационен център (сървър, облак), достъпен през Интернет.

Друго направление, по което е работено в тази подобласт от кандидата, е свързано с **интелигентното здравеопазване** в различни негови форми – електронно (eHealth) [88], мобилно (mHealth) [69, 70], повсеместно (uHealth) [25]. По-специално [88] представя разработения HTTP-базиран сървър за анализ, обработка и предаване на медицински изображения, базиран на олекотена J2EE трислойна архитектура и съвместим със съществуващи и нововъзникващи телекомуникационни инфраструктури. [69] представя персонализиран мидълуер (middleware) за mHealth услуги, разработен на базата на ISO/IEEE 11073 PHD стандарти, работещ като мулти-агентна система с цел събиране на физиологични данни от медицински сензори, прикрепени към човешкото тяло, с последващото им изпращане към облачна структура за обработка и предприемане на съответни действия. Специфичната функционалност на този мидълуер, свързана с адаптация към съдържанието на предлаганите mHealth услуги, разработена с помощта на WURFL и JAVA-WALL софтуерни средства, е разгледана в [70]. Основавайки се на потребителски центрираната парадигма за мрежите от следващо поколение, [25] описва uHealth система, поддържаща различни комуникационни протоколи, включваща мидълуер за осигуряване на plug-and-play среда за хетерогенни безжични сензори и мобилни устройства, и разпределена подсистема за обработка на големи масиви от данни (big data) в облака.

Към тази подобласт спадат и новите поднаправления за **съществуване/живеене, подпомагано от околния свят (Ambient Assisted Living, AAL)** и **подобриени среди за живот (Enhanced Living Environments, ELE)**, включващи интеграция на информационни и комуникационни технологии (ИКТ), облачни компютърни технологии, микроелектроника, сензорни мрежи и мобилни устройства с цел изграждането на безопасна среда около хора, изискващи асистиране като: застаряващи хора, деца, болни, хора с физически и/или умствени увреждания и др. В тази връзка приносът на [4] е в направения анализ на основната научноизследователска дейност, извършена до момента, и идентифицирането на основните проблеми, оставащи (все още) за разрешаване. [5] представя някои резултати, свързани с тестването на AAL/ELE услуги и сценарии, извършени в лабораторни условия с цел верификация и валидация на използваната платформа. Приносът на [6] се заключава в описаната разработена платформа с общо предназначение за 'AAL as a Service' (AALaaS) / 'ELE as a Service' (ELEaaS) и предложената за използване рамка с цел по-нататъшно класифициране на комуникационни протоколи и услуги по тези две направления. [47] представя анализ на производителността на ELE персонализирана платформа, базирана на сензорни и облачни технологии, основаващ се на експерименти, проведени в лаборатория за живеене.

ИНТЕРНЕТ ТОМОГРАФИЯ (*INTERNET TOMOGRAPHY*)

Основен научен труд, представен в тази подобласт, е монографията [2], която третира детайлно проблема за изследване на пространствените и времевите вариации на функционирането на глобалната мрежа Интернет чрез използване на (базиран на сценарии) анализ на данни, получени/измерени в реално време чрез сондиране. Представени са основните принципи, техники, средства и приложения на това перспективно

научно направление. Разгледано е използването на Интернет томографични данни за извършване на симулационно и/или емуляционно моделиране на комуникационни (в частност компютърни) мрежи, както и за дизайн, анализ и разполагане на мрежови услуги. Монографията включва и аспекти на използването на Интернет томографията в безжични архитектури на комуникационни мрежи от следващо поколение (NGN), както и ролята ѝ в процеса на проектиране, изпълнение и спазване на различни видове споразумения на ниво обслужване (Service Level Agreement, SLA). Представени са основните критерии за проектиране на автоматизирана измервателна система за Интернет томография (Internet Tomography Measurement System, ITMS), целяща пространствено и времево картографиране на Интернет чрез създаване (и непрекъснато актуализиране) на производителни профили на комуникационни трасета между сондиращите станции, в съответствие със стандартизираните методологии и утвърдените показатели за качеството на обслужване (QoS). Основните приноси на монографията се заключават в следното: приведена е таксономия на основните средства, използвани за измерване на производителността на Интернет, категоризирани по базисни комуникационни протоколи и слоеве; извършен е сравнителен анализ на съществуващи (към момента) проекти и инициативи в областта на Интернет томографията, като са идентифицирани двата най-значими от тях; демонстрирана е връзката и е доказано значението на Интернет томографията за постигането и гарантирането на добри показатели за качеството на обслужване, за успешното прилагане на практика на трафичното инженерство (traffic engineering, TE) и за цялостното управление на комуникационни мрежи (в частност Интернет) и услуги; разработена е методика за извършване на цялостен анализ на функционирането/производителността на Интернет трасета, която е приложена успешно спрямо целева група, като са приведени и анализирани подробни статистически данни за продължителен период от време; въведен е (и за първи път е използван) **нов комуникационен термин Congestion Level Index (CLI)** за оценка на съществуващи задръствания на Интернет трасета, като експериментално са получени CLI показателите на целева група държави; показано е нагледно използването на експериментално измерените и обработени чрез предложената методика данни за SLA верификация и мениджмънт, както и за стратегическо разполагане на различни категории услуги (и приложения) с цел гарантиране на максимално задоволяване на потребителите (QoE); извършен е (и е представен в подходящ графичен и табулиран вид) подробен времеви анализ на наблюдаваните вариации в Интернет функционирането/производителността въз основа на събраните (на годишна база) данни за целевите комуникационни трасета, съчетан със съпоставката им спрямо постигането на зададените SLA цели, поддръжката и надграждането на комуникационни ресурси (там, където е необходимо), и планирането и управлението на събития в комуникационните мрежи от страна на техните доставчици; демонстрирано е използването на принципите на Интернет томографията за повишаване възможностите на симулационното и/или емуляционното моделиране на комуникационни (в частност компютърни) мрежи и услуги, и за провеждането на мрежови експерименти; показана е връзката на ITMS с инфраструктури за оценка на функционирането на (безжични NGN) комуникационни мрежи (Network Performance Infrastructures, NPIs), като за целта е направен анализ на съществуващи NPI средства и е представено значението на използването на напреднали/модерни NPI-ITMS инфраструктурни решения от страна на мрежовите доставчици и доставчиците на услуги за повишаване на тяхната ефективност и по-пълно задоволяване потребностите на потребителите.

Прилагането на експериментално получените данни за функционирането на Интернет, извлечени чрез използването на Интернет томографични техники и метрики, за увеличаване капацитета и ефикасността на симулационното и/или емуляционното моделиране като основни средства за дизайн и разработване на компонентни мрежи, съставляващи Интернет, е разгледано и в [16]. Показано е, че емпиричните данни, извлечени в течение на продължителни (и целенасочени) периоди от време и предоставени от Интернет томографични измервателни системи, могат да се използват за пресъздаване на реални условия в рамките на моделираните лабораторни експерименти с цел определянето на най-добри, умерени и най-лоши

комуникационни сценарии, в които могат да бъдат въвлечени потребителите (приложенията), или за планиране и провеждане на мрежови надграждания (увеличаване на мрежовия капацитет).

[20] чертае основните насоки за прилагане на методите и техниките на Интернет томографията в безжичните мрежи от четвърто поколение (4G) с цел осигуряване на реално измерени данни по отношение на доставката на услуги към потребителите въз основа на споразумения на ниво на обслужване (SLAs), разработване на набор от стандарти за измерване на качеството на обслужване (QoS) и прилагане на решения (от край до край) за IP верификация на ниво обслужване (IP-SLV), които да могат да се използват за оценка на опита (при използване на съответната услуга) на потребителя (QoE) и за установяване (или не) на SLA съответствие, с възможности за вграждане в системи за ранно предупреждение за по-ефективно управление на мрежови ресурси.

КОМУНИКАЦИОННИ ТЕХНОЛОГИИ ЗА МОБИЛНО ЕЛЕКТРОННО ОБУЧЕНИЕ

Основните приноси на кандидата в тази подобласт са свързани с **усъвършенстване на InfoStation парадигмата** [65] за доставка на силно персонализирани [76] и контекстуализирани [71] мобилни услуги към потребителите – **навсякъде, по всяко време и по всеки възможен начин (*anywhere/anytime/anyhow*)**, което представлява значителна доработка и крачка напред в сравнение с оригиналната InfoStation идея за *many-time/many-where* обслужване. Множеството публикувани статии в тази подобласт са насочени към интегрирането на тази нова технология в учебния процес и в образователните практики на академичните институции. Първоначални идеи за реализация са дадени в [43], а подходящи модели и подходи са разгледани в [86], които по-късно са доразвити, напр. в [76]. В [39] е предложена доработка (и е представена реализация) на архитектура за доставка на мобилни услуги в InfoStation среда, съобразена с възможностите на мобилните устройства и с предпочитанията на потребителите. Основният принос на [10, 76, 77] се заключава в предложението (специално за разпределената InfoStation архитектура) агентно-ориентиран мидълуер за контекстно-съобразена доставка на услуги [82], базирана на използването на семантична информация с оглед улесняване контекстуализирането на услугите (като взаимодействията на агентите с тях са описани с помощта на OWL-S онтологии [9]) и в разработената концепция за контрол и управление на сесии и комуникационни сценарии. Времевият аспект на това управление (time-based scenario management) е разгледан в [79], а основните сценарии са описани детайлно в [38]. [11, 13, 32, 36, 85] представят използването на агентно-базиран подход, ориентиран към услугите, за разработването на интелигентни системи за мобилно обучение, базирани на InfoStation архитектурата, чрез използването на идеи от OMG спецификацията Model Driven Architecture (MDA), като за целта е разработена класификация и са предложени модели на поддържащите софтуерни агенти. Допълнително [32, 78, 80], разглеждайки системната разработка като итерационен процес, предлагат подход за поетапно развитие и разширяване на системната архитектура стъпка по стъпка. [62] се фокусира върху разработването на нова облачно-базирана версия на системата чрез използване на PSP (personal software process) методология. [13, 83, 87] отделят специално внимание на реализирането (с помощта на спецификациите CC/PP и UAProf) на потребителски профили [9, 66] и профили на услуги [10]. Прилагането на J2ME, JADE и LEAP технологии за разработване на услугите е разгледано в [71] и е демонстрирано в [39]. Приносът на [12] се състои предимно в предложението за разработване на лични асистенти (personal assistants), функциониращи в мулти-агентна InfoStation-базирана среда и подпомагащи доставката на персонализирани и контекстуализирани мобилни услуги към потребителите. [67] предлага съответна архитектура за графичен потребителски интерфейс (GUI), разработена с помощта на Google Web Toolkit (GWT), Asynchronous JavaScript and XML (AJAX) и Twitter's bootstrap Cascading Style Sheets level three (CSS3). [26] представя подробно разработената мулти-агентна

платформа, основаваща се на усъвършенстваната InfoStation парадигма, заедно с операциите по взаимодействие между агентите (също и в [66]) и с основните структури от данни. Реализираната контекстуализираща функция позволява адаптация на системата в отговор на промените в оперативната среда [82], присъщи за този тип архитектури, базирани на безжичен комуникационен достъп. Целта е да се постигне доставка на услуги, съобразена с текущия контекст (на потребителите, услугите и използвания безжичен достъп, напр. от тип Wi-Fi [76, 77] или Bluetooth [84]). [27] обръща по-специално внимание на (агентно-базираната) доставка на образователни услуги тип 'мобилен тест' (mTest) и 'мобилен оценяване' (mAssessment), чието администриране е разгледано в [72]. В тази връзка [68] представя прототипно HTML5 mTest мобилно приложение, разработено на базата на рамката Sencha Touch, което може да функционира на различни платформи (iOS, Android, BlackBerry, Windows Phone). Услугата 'мобилен лекция' (mLecture) също е разработена, напр. в [9, 71, 89]. Други видове разработени услуги са разгледани в [94]. 4D класификация на услугите е представена в [93]. Приносът на [29, 30] се състои в разработената (за използване в InfoStation среда) интелигентна, олекотена, разпределена и Java-базирана рамка за представяне на мобилни услуги, която е базирана на платформата Drools, inversion of control (IoC) дизайнерски модели и олекотен HTTP контейнер, като се отчита необходимостта от олекотяване на JADE чрез ре-дизайн и се предлага използването на WURFL за контекстно известяване при доставката на услугите [66, 71]. Фокусът на [31, 75] е върху използването на значително разширената функционалност (вкл. мултимедийни възможности) на съвременните преносими мобилни устройства и тяхната по-пълна интеграция в учебния процес на базата на модерните безжични технологии, както и върху разработването на някои допълнителни услуги, напр. предложени и описани в [39, 92], предоставяни от InfoStation-базирана система в допълнение на традиционните образователни практики. В тази връзка приносът на [33] се състои в разработването на прототип на интелигентна услуга за бърза и ефективна доставка на съобщения до (група от) потребители в InfoStation среда чрез използване на двустепенно адресно пространство, централен производствен агент и интелигентен помощник, гарантиращи доставка в съответствие с ABC&S комуникационната парадигма. [81] разглежда реализацията на услугата MailChecker за проверка на електронна поща, като описва основните (срещнати по време на реализацията и тестването) проблеми, с което осигурява ценна информация за успешната разработка на други Bluetooth-базирани услуги. [34] разглежда проблема за оптимално разполагане на информационни ресурси в InfoStation мрежа с цел намаляване на режийните разноски и съкращаване на времето, необходимо за удовлетворяване на потребителските заявки, като за целта са разработени два модела за формализиране на проблема и са представени идеи за тяхното прилагане на практика. [15, 97] анализират някои от основните елементи на Distributed e-Learning Centre (DeLC) архитектура за поддръжка на мобилно обучение и преподаване [93], като особено акцентират върху възможностите за подобряване на достъпа на обучаемите до online информационни (вкл. библиотечни [12, 87]) ресурси чрез използването на модерни безжични комуникационни стандарти [76, 77, 84], интелигентни мобилни устройства [31, 75], мобилни приложения [68] и услуги [98, 101], които предлагат обучение 'навсякъде, по всяко време и по всеки възможен начин'. [99] предлага агентно-ориентиран вариант на DeLC, базиран на използването на 'тънки' и 'дебели' софтуерни агенти. Адресен модел на мобилните услуги в DeLC е разработен в [101]. Адаптиране на DeLC архитектурата към SCORM стандарта е предложено в [108]. Дизайнерски идеи за изграждане на информационна система за виртуален университет (Virtual University Information System, VUIS), в която услугите са реализирани като EJB софтуерни компоненти, са представени в [109] заедно с модели за взаимодействие и комуникационни интерфейси между компонентите. Сравнителен анализ на съществуващи средства за създаване на съдържание за електронно обучение (authoring/assembling tools) и системи за неговото управление (Learning Content Management Systems, LCMs) е представен в [110] с оглед оценка на степента на съответствие на тяхната функционалност към изискванията на стандартите SCORM и ADL. Резултатите от анализа са полезни с това, че систематично и подробно идентифицират набор от атрибути, необходими за функционалното

проектиране на подобни средства. [111] разглежда приложението на мета-данни в SCORM-съвместимо съдържание за електронно обучение през призмата на рамката CMAPS, като за целта предлага нови подетапи за по-добро идентифициране на активи (assets) на образователни ресурси и по-лесно създаване на мета-данни за тях; в тази връзка са създадени два нови IEEE LOM профили за мета-данни.

ДРУГИ НАУЧНИ ИЗСЛЕДВАНИЯ

[1] представлява учебно помагало, имащо за цел подпомагане на студентите в (само)подготовката им при усвояване на учебния материал по дисциплината „Компютърни мрежи и комуникации“, по-специално по 7 основни теми, по които обикновено студентите изпитват най-големи затруднения. За целта всяка глава включва кратка теоретична част и разработен комплект от 10 примерно решени задачи и 10 задачи за упражнение (самостоятелна работа) на студентите, подредени по подтеми и степен на сложност, чието последователно изпълнение гарантира усвояването на учебния материал. Помагалото дава възможност не само за практическо приложение на усвоените знания от страна на студентите, но и за развиване на техните умения за решаване на проблемноориентирани задачи и задълбочаване на знанията им по разгледаните теми.

[35] представя разработения шлюз A-WING за безжично ad-hoc взаимно свързване на хетерогенни мрежи, чийто дизайн се базира на предложената новаторска 9Cs класификация на комуникационни услуги на каналния слой и включва нов метод за йерархично описание на комуникационни мрежи, подпомогнат от разработената новаторска XML схема за описание на мрежови възли, техните комуникационни интерфейси и обкръжението им.

В областта на безжичните комуникационни мрежи от 4. поколение (4G) от кандидата е извършена научноизследователска работа по интегриране на хетерогенни мрежови технологии за безжичен достъп с цел комбиниране на предимствата им, предлагане на по-богато разнообразие от услуги на потребителите и максимизиране печалбите на мрежовите доставчици и доставчиците на услуги. В тази връзка [103, 107] представят разработената нова рамка, базирана на политики, за подпомагане на интеграцията на мрежи и услуги в 4G, с цел осигуряване на единен контрол, като са описани два основни подхода. В допълнение е въведено управлението на различни видове профили с цел постигане на по-добро адаптиране на услугите към потребителите и оптимална мрежова конфигурация. На базата на тази рамка в [42, 100, 106] е предложена 4G системна архитектура за интеграция на мрежи и услуги (GAIA), като са разгледани въпроси, свързани със сигнализацията между различните й домейни и с взаимодействието на основните й функционални компоненти, като изискванията към нея са разгледани преди това в [102]. [107] допълнително разглежда интеграцията на ad-hoc мрежи и необходимото за това адаптиране на GAIA, а [100] обръща внимание и на развитието на поддържащи техно-бизнес модели. Проблеми, свързани със сигнализирането на информация, необходима за постигане на различни контролни цели (QoS, мобилност, сигурност, AAA), и възможните кандидат-протоколи и подходи за сигнализация са разгледани в [41]. Допълнително [45] представя IP-базиран подход за осигуряване качеството на обслужване (QoS) в 4G мрежи (от край до край) въз основа на GPRS, UMTS, MPLS и DiffServ техники, и предлага съответен QoS модел, подходящ за използване в 4G хетерогенна мрежова среда. [96] предлага нови разработени схеми за използване на UTRAN-специфични UMTS QoS параметри в заглавните части на MPLS протоколни единици и приложение на предложения метод спрямо трафик, генериран в UMTS мрежи и преминаващ през MPLS/DiffServ-базирана IP опорна мрежа. [105] подчертава предимствата на интеграцията на HMIPv6 с MPLS с цел гарантиране

качеството на обслужване (от край до край) в мулти-домейни безжични комуникационни мрежи и разглежда въпроса за 'меко препредаване' (soft handover) от една мрежа към друга както в рамките на един домейн, така и между различните домейни. Освен това е предложен и алгоритъм за мрежовия симулатор NS2, интегриращ функционалностите на двете технологии (HMIPv6 и MPLS). [19] продължава работата по темата за NS2, като посочва някои негови недостатъци и предлага начини за неговото развитие и стратегии за усъвършенстване чрез добавяне на HMIPv6 и MPLS функционалности към определени негови модули, и представя схематични алгоритми за вграждането им.

Кандидатът е извършил научни изследвания и в областта на телетрафичното инженерство. Приносът на [22] е в изведената обобщена Pollaczek–Khinchin формула за средната дължина на опашката и средното време на изчакване в буферите на мрежи с пакетна комутация, описвани чрез едносървърна Poisson/G/1 система с неравномерен Poisson процес на пристигане на пакетите, произволно разпределение на времето им на обслужване и безкрайна опашка за изчакване, като е показано как пиковите на входящия поток от пристигащи пакети и варирането на времето им на обслужване влияят на времето на обслужване и на дължината на опашката в системата. Практическото значение на предложената обобщена формула се състои в способността ѝ да описва пиково поведение на телетрафични потоци в модерните телекомуникационни мрежи. В [23] е изследвана мулти-сървърна опашка за изчакване със зависещи от състоянието процеси на пристигане и изпращане на пакетите, която е предложена за използване като основен телетрафичен модел от $M(g)/M(g)/n/k$ тип на новата концепция за 'подобрани среди за живот като услуга' (ELEaaS).

[53] представя обзор на някои фундаментални принципи, техники и тенденции в областта на мрежовата издръжливост (network resilience) в отговор на природни бедствия (урагани, земетресения, наводнения и т.н.) или вследствие на неправилни (неволни) човешки действия и/или кибер-атаки, като за целта са разгледани съвременните 'най-добри' оперативни практики за осигуряване на издръжливост на преносни комуникационни мрежи. В тази връзка основният принос на кандидата е свързан с въведената нова дефиниция за мрежова издръжливост, включваща новаторски аспекти за необходимостта от количественото ѝ измерване и отчитане ефективността на разходите за нейното постигане.

НАУКОМЕТРИЧНИ ПОКАЗАТЕЛИ

Селектираните за участие в конкурса 111 научни труда в областта на компютърните мрежи и комуникации са част от публикуваните до момента 253 научни труда на кандидата, от които 124 са реферирани в Scopus:

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За научните трудове на кандидата, селектирани за участие в конкурса, са известни 571 цитирания¹ – от общо 884 цитирания, от които 218 са реферирани в Scopus. Индексът на Хирш (*h*-индекс) на кандидата в Scopus е $h_i=9$:

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Ganchev, Ivan Back to author details page
Plovdiv University Paisii Hiledarski, Plovdiv, Bulgaria
Author ID:56962772500

Documents (124) **h-index (9)** Citations (218) Co-authors (93)

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Documents	Citations	Title
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This author's h-index is 9
The h-index is based upon the number of documents and number of citations.

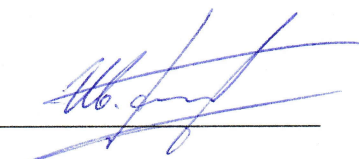
Детайлна информация по отношение както на специфичните, така и на съществените (но не задължителни), изисквания на Факултета по математика и информатика (ФМИ) на Пловдивския университет „Паисий Хилендарски“ (ПУ), т.е. за активна аудиторна и извънаудиторна заетост, в това число: научно ръководство на 5 успешно защитили докторанта (от които 3 в чуждестранен университет), 2 отчислени докторанта (от които 1 в чуждестранен университет), 3 текущи докторанта (от които 1 в чуждестранен университет), 1 докторант (в чуждестранен университет), прехвърлен към друг департамент, и 1 пост-докторант в чуждестранен университет; научно ръководство на 15 успешно завършили дипломанти (от бакалавърски и магистърски програми) към ФМИ на ПУ, както и на 8 успешно завършили магистри (по научноизследователски програми), 6 успешно завършили магистри (по учебни програми) и над 71 успешно завършили бакалаври в

¹ От приведената статистика на цитиранията са изключени самоцитирания (преки или косвени)!

чуждестранен университет; 78 изнесени доклада на научни форуми; участие в 34 научноизследователски проекта със (съ)ръководство на 16 от тях; участие в 203 програмни, технически, организационни и др. комитети на научни мероприятия; ръководство на 15 други научни мероприятия; членство в 8 авторитетни професионални организации в научната област; участие в 19 редколегии на научни издания; експертна дейност в 1 международна и 1 национална организации; разработени лекционни курсове за студентите в 3 университета (от които един чуждестранен); изготвени рецензии на 462 научни труда за 173 научни издания/мероприятия; 4 получени награди и 1 номинация за награда; и т.н., е приложена в допълнителните документи.

05.09.2017 г.

Изготвил:



(доц. д-р Иван Ганчев)