

# JOURNAL OF TELECOMMUNICATIONS AND INFORMATION TECHNOLOGY

## *Preface*

We present to the readers of the *Journal of Telecommunications and Information Technology* a special issue that mostly contains the papers from last year conference on Decision Support for Telecommunications and Information Society, which concerned diverse mathematical and computational techniques for supporting solutions of numerous problems in telecommunication networks, related markets and technology.

Włodzimierz Ogryczak and Paweł Ołender in the paper *On MILP Models for the OWA Optimization* consider the ordered weighted averaging (OWA) aggregation that uses the weights assigned to the ordered values (i.e., to the largest value, the second largest and so on) rather than to the specific coordinates. It allows to evaluate solutions impartially when distribution of outcomes is more important than assignments of these outcomes to the specific criteria. This applies, for example, to systems with multiple independent users or agents whose objectives correspond to the criteria. The authors concentrate on the most efficient computationally approaches to solving mixed integer linear programming OWA problems and they present several computational experiments on such problems.

Marco Caserta, Silvia Schwarze, and Stefan Voß in the paper *Developing a Ring-Based Optical Network Structure with Glass-Through Nodes* consider a security in optical transport networks (OTN), in particular the concept of 1+1 protection that requires a connection of each origin-destination(OD)-pair by at least two node-disjoint paths. On a ring topology of a network, 1+1 protection is given naturally. Moreover, the routing effort is typically decreasing on rings. These observations motivate the investigation of ring structures for OTN. While developing a ring structure for telecommunication networks, several subtasks can be identified. Rings have to be designed, OD-pairs have to be assigned to rings, communication among rings has to be defined, a proper flow routing has to be chosen, and rings have to be dimensioned regarding the flow capacity. The authors address the first two issues, namely generation of rings and assignment of OD-pairs to rings. The authors proposed an algorithm for random generation of candidate rings and a mathematical model for assigning OD-pairs to rings in such a manner that active nodes are chosen accordingly. Examples of applications and problems for future research are also discussed.

Matthias Fricke, Andrea Heckwolf, Ralf Herber, Ralf Nitsch, Silvia Schwarze, Stefan Voß, and Stefan Wevering in the paper *Requirements of 4G-Based Mobile Broadband on Future Transport Networks* consider new standards in mobile communications regarding available bandwidth resulting from future long term evolution (LTE) technologies. It is expected that users of one radio cell will share more than 100 Mbit/s in future. To take advantage of the full feature set of next generation mobile networks, transport network design has to face

new requirements, caused by the architectural changes of LTE technologies. The newly defined X2 interface especially has an impact on the transport network requirements. X2 enables direct communication between evolved base stations (eNBs) and thus, enforces local solutions. At the same time, there is a tendency to locate network elements at fewer, central sites in order to reduce operational expenditure, in particular concerning the transport layer. This leads to the question of how the direct X2 connection of eNBs on the logical layer can be accommodated with a general centralization of transport networks. The authors show that a centralized transport network is able to realize the local meshing between eNBs for LTE. However, for LTE advanced, the standards currently discussed by the 3GPP initiative could lead to enhanced the requirements on the X2 interface latency.

Rita Girão-Silva, José Craveirinha, and João Clímaco in the paper *Hierarchical Multiobjective Routing Model in MPLS Networks with Two Service Classes – A Comparison Case Study* consider a two-level hierarchical multicriteria routing model for multiprotocol label switching networks with two service classes (QoS, i.e., with quality of service requirements, and best effort services) and alternative routing. A heuristic resolution approach where non-dominated solutions are obtained throughout the heuristic run and kept in an archive for further analysis is also reviewed. An extensive analysis of the application of this procedure to two reference test networks for various traffic matrices is presented. A comparison of the results of the proposed method with a lexicographic optimization approach based on a multicommodity flow formulation using virtual networks is carried out. Finally, the results of a stochastic discrete event simulation model developed for these networks are presented in order to illustrate the effectiveness of the resolution approach and to assess the inaccuracies of the analytic results.

Piotr Rzepakowski and Szymon Jaroszewicz in the paper *Uplift Modeling in Direct Marketing* consider a precise targeting of marketing actions that can potentially result in a greater return on investment. Usually, response models are used to select good targets. They aim at achieving high prediction accuracy for the probability of purchase, based on a sample of customers, to whom a pilot campaign has been sent. However, to separate the impact of the action from other stimuli and spontaneous purchases, we should model not the response probabilities themselves, but instead, the change in those probabilities caused by the action. The problem of predicting this change is known as uplift modeling, differential response analysis, or true lift modeling. In the paper, tree-based classifiers designed for uplift modeling are applied to real marketing data and compared with traditional response models, and other uplift modeling techniques described in literature. Computational experiments show that the proposed approaches outperform existing uplift modeling algorithms and demonstrate significant advantages of uplift modeling over traditional response based targeting.

Andrzej Karbowski in the paper *Integrated Routing and Network Flow Control Embracing Two Layers of TCP/IP Networks – Methodological Issues* considers a cross-layer network optimization problem that involves network and transport layers, treating both routing and flows as decision variables. Due to the non-convexity of the capacity constraints when using Lagrangian relaxation method, a duality gap causes numerical instability. It is shown that the rescue preserving separability of the problem may be the application of the augmented Lagrangian method, together with Cohen's Auxiliary Problem Principle.

Kamil Kołtyś, Krzysztof Pieńkosz, and Eugeniusz Toczyłowski in the paper *Auction Models Supporting End-to-End Connection Trading* consider bandwidth allocation problem on the telecommunication market where there are many sellers and buyers. Sellers offer the bandwidth of telecommunication links. Buyers are interested in the purchase of the bandwidth of several links that makes up an end-to-end connection between two nodes of telecommunication network. The paper analyzes three auction models supporting such a bandwidth exchange: NSP (network second price), BCBT (model for balancing communication bandwidth trading) and BCBT-CG which is a modification of BCBT that applies column generation technique. All of these models concern divisible network resources, treat bandwidth of telecommunication links as an elementary commodity offered for sale, and allow for purchasing bandwidth along multiple paths joining two telecommunication nodes. All of them also aim at maximizing the social welfare. Considered auction models have been compared in the respect of economic and computational efficiency. Experimental studies have been performed on several test instances based on the SNDlib library data sets.

Piotr Arabas, Przemysław Jaskóła, Mariusz Kamola, and Michał Karpowicz in the paper *Analysis and Modeling of Domain Registration Process* consider the domain name reservation process for the polish .pl domain. Two models of various time scale are constructed and finally combined to build a long range high resolution model. The results of the prediction are verified by using real data.

Anna Felkner and Adam Kozakiewicz in the paper *RT<sub>+</sub><sup>T</sup> – Time Validity Constraints in RT<sup>T</sup> Language* maintain that most of the traditional access control models, such as mandatory, discretionary, and role based access control make authorization decisions based on the identity, or the role of the requester who must be known to the resource owner. Thus, they may be suitable for centralized systems but not for decentralized environments where the requester and service provider or resource owner are often unknown to each other. To overcome the shortcomings of traditional access control models, trust management models might use three different semantics (set-theoretic, operational, and logic programming) of RT<sup>T</sup> a language from the family of role-based trust management languages (RT). RT<sup>T</sup> is used for representing security policies and credentials in decentralized distributed access to control systems. A credential provides information about the privileges of users and the security policies issued by one or more trusted authorities. The core part of the paper is the introduction of time validity constraints to show how to make RT<sup>T</sup> language more realistic. The new language, named RT<sub>+</sub><sup>T</sup>, takes time validity constraints into account. The semantics for RT<sub>+</sub><sup>T</sup> language is also shown. Inference system is introduced not just for specific moment, but also for time intervals. It evaluates maximal time validity when it is possible to derive the credential from the set of available credentials. The soundness and completeness of the inference systems with time validity constraints with respect to the set-theoretic semantics of RT<sub>+</sub><sup>T</sup> language is proven.

Marcin Mincer and Ewa Niewiadomska-Szynkiewicz in the paper *Application of Social Network Analysis to the Investigation of Interpersonal Connections* present an application of social network analysis (SNA) to the investigation and analysis of social relationships of people. This application concerns data mining in the case of two social networks: Facebook and Twitter. The presented simulations illustrate how social analysis can be used to determine the interpersonal connections, importance of actors in a given social network and detect communities of people. The strengths and weaknesses of SNA techniques are discussed.

Jarosław Hurkała and Adam Hurkała in the paper *Effective Design of the Simulated Annealing Algorithm for the Flowshop Problem with Minimum Makespan Criterion* address the  $n$ -job,  $m$ -machine flowshop scheduling problem with minimum completion time (makespan) as the performance criterion. They describe an efficient design of the Simulated Annealing algorithm for solving approximately this NP-hard problem. The main difficulty in implementing the algorithm is no apparent analogy for the temperature as a parameter in the flowshop combinatorial problem. Moreover, the quality of solutions is dependent on the choice of cooling scheme, initial temperature, number of iterations, and the temperature decrease rate at each step as the annealing proceeds. The authors propose how to choose the values of all the aforementioned parameters, as well as the Boltzmann factor for the Metropolis scheme. Three perturbation techniques are tested and their impact on the solutions quality is analyzed. A heuristic and randomly generated solutions as initial seeds to the annealing optimization process are compared. Computational experiments indicate that the proposed design provides very good results – the quality of solutions of the Simulated Annealing algorithm is favorably compared with two different heuristics.

Rafał Kasprzyk in the paper *Diffusion in Networks* considers a concept of a method and its application to examine the dynamics of diffusion processes in networks. The proposed method was used as a core framework for the CARE (Creative Application to Remedy Epidemics) system.

Kamil Staszek, Jacek Kołodziej, Krzysztof Wincza, and Sławomir Gruszczyński in the paper *Compact Broadband Rat-Race Coupler in Multilayer Technology Designed with the Use of Artificial Right- and Left-Handed Transmission Lines* consider a compact broadband rat-race coupler for the first time designed and realized in a multilayer microstrip technology. To achieve both broad operational bandwidth and a compact size the 270° transmission line of a conventional rat-race, coupler has been replaced by a –90° left-handed transmission line realized with the use of a quasi-lumped element technique. Moreover, to achieve better compactness of the resulting coupler, all 90° right-handed transmission lines have been realized with the use of the same technique. It has been also proved that simple LC approximation of a left-handed transmission line can be successfully used for the design. Moreover, it has been shown that when appropriately chosen, the multilayer dielectric structure allows for realization of structures designed with the use of this simple approximation, for both right-handed and left-handed transmission lines, without losing too much of performance.

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