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Reliable networks design and modeling (foreword)

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This Special Issue contains extended versions of selected papers from 2nd International Workshop on Reliable Networks Design and Modeling (RNDM 2010) held in Moscow, Russia on October 19–20, 2010. This very successful event was organized by Gdansk University of Technology (PL) in cooperation with University of Pittsburgh (US), and Wroclaw University of Technology (PL). The workshop was technically co-sponsored by IFIP TC6 WG6.10 and by IEEE.

RNDM 2010 was a forum for discussions between people from academia and industry. Special focus was put on network survivability, i.e. capability of a network to provide continuous transmission after failures.

All RNDM 2010 submissions were carefully reviewed by 45 members of the Technical Program Committee, and 18 external reviewers. Accepted papers written by authors from 17 countries, were organized into six technical sessions, namely: "Fault Management and Control in Survivable Networks", "Survivability of Anycast, Multicast and Overlay Networks", "Fast Service Recovery", "Methods for Measurement, Evaluation, or Validation of Survivability", "Design of Dedicated/Shared Backup Paths", and "Models and Algorithms of Survivable Networks Design and Modeling".

After the event, presented papers were carefully examined again by the Co-chairs, and authors of 14 best papers were invited to submit the extended version of their papers to this Special Issue. These extended papers were also extensively reviewed. Acceptance of final papers included in this Special Issue was conditional upon carefully addressing the reviewers' remarks. Each of the papers is briefly introduced below.

In the paper *Evaluation of Network Resilience, Survivability, and Disruption Tolerance: Analysis, Topology Generation, Simulation, and Experimentation*, James Sterbenz et al. provide a comprehensive methodology to evaluate network resilience by means of using a combination of analytical, simulation, and experimental emulation techniques. The paper by Teresa Gomes, Carlos Simões, and Luis Fernandes entitled *Resilient Routing in Optical Networks Using SRLG-disjoint Path Pairs of Min-sum Cost* introduces a new approach to find SRLG-disjoint pairs of paths necessary to provide protection of flows after failures. In the paper by Egemen K. Çetinkaya et al. entitled *Modelling Communication Network Challenges for Future Internet Resilience, Survivability, and Disruption Tolerance: A Simulation-based Approach*, the reader will find a framework to evaluate network dependability and performability. A simulation-based approach is used by the authors to analyze the effects of perturbations to normal operation of networks.

In *Evaluation and Estimation of the Availability of p-Cycle Protected Connections*, János Szigeti and Tibor Cinkler provide two interesting methods to be used to evaluate or to estimate the availability of connections protected by the p-cycle protection scheme. In particular, they show that the estimated availability is always less than the exact

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one, and define an upper bound onto the inaccuracy of the estimated unavailability.

The next paper entitled *Effective Algorithms for Finding Optimum Pairs of Link-Disjoint Paths in $\alpha + 1$ Path Protection* by Ming-Lee Gan and Soung-Yue Liew presents a new protection scheme, called "$\alpha + 1$ Path Protection", where α is the ratio of the protection bandwidth to the full bandwidth (of primary path). In their approach only critical real-time information of the primary path is protected.

In *Risk Based Resilient Network Design*, Korn Vajanapoom, David Tipper, and Sira Akavipat propose a risk-based approach to the design of resilient networks. In their paper, the term "risk" is used to measure two related quantities: the likelihood of failure or attack, and the amount of damage caused by the failure or attack.

The paper by Ahmed Haddad, Elias A. Doumith, and Maurice Gagnaire entitled *A Fast and Accurate Meta-heuristic for Failure Localization based on the Monitoring Trail Concept* refers to the issue of fast detection and localization of faults. In particular, a special meta-heuristic approach for monitoring trail assignment called MeMoTA is proposed that provides monitoring solutions close to the optimal ones, as well as ensures an acceptable scalability.

In *Three More Aspects of Resilience: Multi-Domain, Multicast, Physical Impairments*, Tibor Cinkler addresses problems that are induced by new architectures, new services, and new technologies. In particular, special focus is put on three aspects of resilience: multi-domain routing, multicast transmission, as well as physical impairments.

Eugene S. Myakotnykh et al. in the paper entitled *An Analysis of Interdomain Availability and Causes of Failures based on Active Measurements* present results of real experiments to evaluate the causes of interdomain failures. They show that the obtained end-to-end path availability is determined mainly by interdomain failures and long BGP convergence time values.

Wouter Tavernier et al. in *Packet Loss Reduction During Rerouting Using Network Traffic Analysis* model and predict network traffic passing through an IP router and define two dynamic heuristics in order to reduce the packet loss resulting from routing table updates.

Aubin Jarry in *Fast Reroute Paths Algorithms* investigates the problem of minimizing the time of service restoration. In particular, he focuses on the algorithmic aspects of computing original paths along with their backups so that they satisfy the delay constraints for single link or multiple link failure.

In *Reliable Anycast and Unicast Routing: Protection against Attacks*, Jacek Rak and Krzysztof Walkowiak propose a new approach to provide protection of anycast flows against attacks. They achieve this goal by using a new metric to find the working paths, as well as by locating the replica servers at low-degree nodes.

The issue of network re-optimization for dynamic traffic is addressed by Fernando Solano and Michał Pióro in their paper entitled *WDM Network Re-optimization Avoiding Costly Traffic Disruptions*. In particular, the authors present two procedures that collaboratively determine the best network performance without incurring on penalization fees.

The last paper by Gayan de Silva et al. entitled *On Formal Reachability Analysis in Networks with Dynamic Behavior* also refers to the case of dynamic routing. The authors introduce the formal verification process, namely, formal modeling and the reachability analysis process.

The papers included in this Special Issue were selected in hope that they show the big picture of the best ideas on network reliability presented during RNDM 2010. The editors of this Special Issue would like to express their gratitude to the Editor of TSJ for his consent to publish RNDM 2010 materials in the Journal, as well as to reviewers for delivering the detailed reviews.

Jacek Rak holds M.Sc. and Ph.D. degrees in computer science (options: computer networks, and computer communications, accordingly) received with distinction in 2003 and 2009, respectively from Gdansk University of Technology (GUT), Poland. He is currently an assistant professor at the Department of Computer Communications of the Faculty of Electronics, Telecommunications and Informatics at GUT. His main research areas include: routing, design, dimensioning and analysis of high-speed wavelength routed backbone networks with focus on survivability.

Dr. Rak was involved in many projects related to optimization of reliable computer networks. He was the TPC Co-Chair of NETWORKS 2010 Conference, Publication Chair of NETWORKS 2010 and BCFIC 2011 conferences. He also served as a TPC member/reviewer of important conferences on communications, e.g. IEEE ICC, IEEE GLOBECOM, DRCN, and journals, e.g. IEEE/ACM Transactions on Networking, or IEEE Communications Letters.

Dr. Rak is a member of IEEE (and IEEE Communications Society), and IFIP TC6 WG 6.10 (Photonic Networking Group). He is also the founder and the General Chair of the International Workshop on Reliable Networks Design and Modeling (RNDM).

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Krzysztof Walkowiak was born in 1973. He received the Ph.D. degree and the D.Sc. (habilitation) degree in computer science from the Wroclaw University of Technology, Poland, in 2000 and 2008, respectively. Currently, he is an Associate Professor at the Chair of Systems and Computer Networks, Faculty of Electronics, Wroclaw University of Technology. His research interest is mainly focused on optimization of network distributed systems like P2P systems, multicasting systems, Grid systems; network survivability; optimization of connection-oriented networks (MPLS, DWDM); application of soft-optimization techniques for design of computer networks. Prof. Walkowiak was involved in many research projects related to optimization of computer networks. Moreover, he was consulting projects for the large companies including TP SA, PZU, PKO BP, Energia Pro, Ernst and Young. Prof. Walkowiak published more than 120 scientific papers. He serves as a reviewer for many international journals including: Computer Communications, Future Generation Computer Systems, Computational Optimization and Applications, International Journal of Applied Mathematics and Computer Science, Expert Systems, Pattern Analysis and Applications, International Journal of Computer Mathematics. He is/was actively involved in many international conferences. Prof. Walkowiak is a member of IEEE and ComSoc.