

13th International Conference

DRCN 2017

Design of Reliable
Communication Networks

www.drcn2017.de



PROGRAM

March 8–10, 2017

Courtyard by Marriott Munich City Center

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Welcome of the Chairs

Welcome to this year's International Conference on Design of Reliable Communication Networks (DRCN), which is a forum bringing together experts from industry and academia in the field of the reliability and availability of communication networks and services. The variety of topics show once more the importance of this field for the digitalization in our society. We also observe several new trends in research, such as security-oriented design and highly reliable services in future mobile networks.

We would like to thank all the authors who submitted to DRCN 2017. A total of 16 papers have been accepted based on evaluation by at least three independent reviewers. We are delighted by the high quality, which is also indicated by the very high numeric ratings for all accepted papers.

Additionally, we thank Achim Autenrieth and Massimo Tornatore for managing the review process and setting up the technical program. As well, we are grateful to the contributors of keynote speeches, invited talks, and tutorials as well as the panel discussion.

We hope you enjoy DRCN 2017 in the capital of Bavaria!



*Dominic Schupke,
Airbus, Germany*



*Marco Hoffmann,
Nokia Bell Labs, Germany*

(GENERAL CO-CHAIRS of DRCN 2017)

Organized by

VDE

Association for Electrical, Electronics & Information Technologies

VDE is one of the largest technical and scientific associations in Europe with more than 32.000 members.

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ITG

Information Technology Society within VDE

The Information Technology Society in the VDE (ITG) promotes research, development and application of information technology in the data and communication technology, in production and communication systems, in environmental protection, medical and traffic technology.

Topics

- Reliable Network Design and Operation
- Theory and Modeling
- Resilience of Networked Services
- Telecommunication Reliability Issues for Government, Enterprises, and Society

TECHNICAL PROGRAM CO-CHAIRS



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■ Massimo Tornatore,
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- Ken-ichi Sato, Nagoya University, Japan
- Dominic Schupke, Airbus, Germany
- David Tipper, University of Pittsburgh, USA

Keynote Talks



Reliability in Optical Networks

Suresh Subramaniam (George Washington University, USA)

Free Space Optical (FSO) links are becoming increasingly popular due to their high capacity. However, their reliability remains a concern due to the strong influence of weather conditions such as fog and clouds on the availability of FSO links. In this talk, several networking approaches to improving the reliability of FSO-based mesh networks are discussed.



Multi-layer resilience schemes and their control plane support

Víctor López (Telefónica Global CTO, Spain)

Network operators design and manage IP/MPLS and optical networks on a per-layer basis, to the point that they are run as different business areas within the operator. However, there are clear CAPEX and OPEX savings that network operators can achieve by simplifying the network infrastructure. Moreover, the evolution of optical equipment and the introduction of network programmability are accelerating the adoption of multi-layer schemes in real networks. This paper revises the planning process considering resilience schemes for IP and optical networks. It also presents an evolutionary view on the control plane and SDN paradigms that enable the support of multi-layer schemes in real networks.

Invited Talks



Network Avoiding Heavy Rainfall

Hiroshi Saito (NTT Network Technology Labs., Japan)

In this talk, I present a disaster avoidance control method for use against heavy rainfall and discusses its effectiveness through actual weather data and hazard area data.

By using empirical data, I show that the proposed method reduces the probability of service disconnection to almost zero even for heavy rainfall causing landslides. In our experimental system, the proposed method was implemented through software defined network technology.



Designing a Resilient Virtual Topology in a Multi-Layer Datacenter Interconnection Network

Yuri Smirnov (Facebook, USA)

This paper describes a number of approaches to the greenfield design of a logical topology in a multi-layer datacenter interconnection (DCI) network with protection against pre-determined classes of failures. The design of the network is evaluated through a combination of key metrics including, but not limited to, latency, cost, and capacity. An aspect that adds to the complexity of the design process is the requirement to use pure shortest path IP routing instead of Traffic Engineering routing. In this paper we describe the context of this specific design problem and show how we addressed it through a combination of exhaustive search, Artificial Intelligence (AI) and Mathematical Programming (MP) techniques.



Techno-economic modelling for reliable ICT networks and Service

Sofie Verbrugge (IDLab, Belgium)

Techno-economics aims at translating technological innovation into business opportunities and challenges and can be applied in a wide range of applications domains like novel networking approaches, smart cities and smart mobility, smart energy and smart home, smart care, smart factory and smart media. It can therefore support decision makers at both public (government, regulators, cities, hospitals, etc.) and private actors (telco's, equipment vendors, data companies, etc.)

This talk will provide a state of art with respect to typical methodologies and techniques used for techno-economic research. Those include cost and revenue models, investment analysis techniques, business models and value networks, competition modeling and modeling the impact of uncertainty. Finally, the techno-economic research portal will be presented, an initiative to share standards, tools and templates amongst researchers in the techno-economics domain.



DynPaC: Leveraging SDN to provide Bandwidth on Demand services over GEANT

Eduardo Jacob, University of the Basque Country, Spain

The Bandwidth on Demand Service is a very good mechanism to get high bandwidth for specific time bounded applications over shared communication infrastructures. Traditionally, supporting this kind of services does imply a great amount of manual configuration with hinders its massive use. In this talk the approach we are following in GEANT to implement a resilient Bandwidth on Demand service over a SDN core network will be presented. DynPaC supports path computation, an advanced reservation and scheduling mechanism, fault restoration for gold services and offers interfaces to external protocols that allow for example to implement multi domain capabilities. By using SDN we can easily re-route and move flows to improve the utilization of the network and facilitate the automated management.

Tutorials



Securing Cloud-Based Programmable 5G Networks

Peter Schneider (Nokia Bell Labs, Germany)

This tutorial introduces you to the world of network security. We will have a look at the different types of cyber threats and learn about state-of-the-art protection measures, considering network types such as optical transport networks as well as cellular networks. Future 5G mobile networks are expected to be based on virtualized network functions running “in the cloud”, or more specifically, on central and distributed data centers, interconnected via software-defined transport networks. Moreover, these networks will adopt the concept of network slicing, allowing network operators to provide different virtual networks on a common infrastructure. Therefore, we will put some focus on the security aspects of network function virtualization (NFV), software defined networking (SDN) and network slicing – all hot topics in current security Research.



Designing the Next-Generation of Flexible and Reliable Optical Transport Networks

João Pedro (Instituto de Telecomunicações / Coriant Portugal)

In this tutorial you will become familiar with next-generation optical transport networks, characterized not only by their intrinsic reliability and augmented capacity but also by new degrees of flexibility. Noteworthy, these derive from advancements such as flexible-rate line interfaces, capable of fine adjustments between capacity and reach, high-capacity and modular switching platforms, improving channel fill ratio, and an optical infrastructure exploiting a flexible spectrum grid and diverse optical node architectures. Although these new features are seen as key to reduce network operators' capital expenditures (by decreasing the cost per bit transported) and provide them with the hardware flexibility that unleashes the potential of software defined networking (SDN), their efficient usage brings new challenges to network design and operation. This will be main focus of the tutorial, which will on one hand highlight the expected benefits from the new advancements, while on the other give insight on their impact in network design, planning and operation.

Panel Discussion



Reliable 5G Networks

Frank Fitzek (Deutsche Telekom Chair of Communication Networks at Technical University Dresden, Germany)

PROGRAM

Wednesday, March 8

15:00 **Opening**

15:15 **Tutorials**

Securing Cloud-Based Programmable 5G Networks

Peter Schneider (Nokia Bell Labs, Germany)

Designing the Next-Generation of Flexible and Reliable Optical Transport Networks

João Pedro (Instituto de Telecomunicações & Coriant, Portugal)

18:00 – **Welcome Reception**

21:30

Thursday, March 9

09:00 **Keynote Speech:**
“Reliability in Optical Networks”

Suresh Subramaniam (George Washington University, USA)

10:00 **Coffee Break**

10:30 **Invited Talk Session 1:**
“Designing a Resilient Virtual Topology in a Multi-Layer Datacenter Interconnection Network”
Yuri Smirnov (Facebook, USA)

Session 1 – Reliability in Transport Networks

Session Chair: João Pedro (Instituto de Telecomunicações & Coriant, Portugal)

11:00 **Comparison of Various Reliable Transport Architectures for Long-Haul Networks**

Onur Turkcu, Abishek Gopalan, Biao Lu and Parthiban Kandappan (Infinera, USA)

11:20 **A Multiple-Link Failures Enumeration Approach for Availability Analysis on Partially Disjoint Paths**

Nehuen Gonzalez-Montoro (National University of Córdoba IDIT – CONICET, Argentina); Renato Cherini (National University of Córdoba, Argentina); Jorge M Finochietto (National University of Córdoba CONICET, Argentina)

11:40 **Connection Management in a Resilient Transport Protocol**
Truc Anh N. Nguyen (The University of Kansas, USA); James P. G. Sterbenz (Lancaster University, UK & The University of Kansas, USA)

12:00 **Lunch Break**

13:00 **Invited Talk Session 2:**
“Techno-economic modelling for reliable ICT networks and Service”
Sofie Verbrugge (IDLab, Belgium)

Session 2 – Modeling and Methods for Network Reliability

Session Chair: Suresh Subramaniam (George Washington University, USA)

13:30 **Finding Minimum Node Separators: A Markov Chain Monte Carlo Method**
Joohyun Lee (The Ohio State University, USA); Jaewook Kwak (North Carolina State University, USA); Hyang-Won Lee (Konkuk University, Korea); Ness B. Shroff (The Ohio State University, USA)

13:50 **Modelling Spectrum Assignment in a Two-Service Flexi-Grid Optical Link with Imprecise Continuous-Time Markov Chains**
Cristina E.M. Rottondi (Dalle Molle Institute for Artificial Intelligence (IDSIA), Switzerland); Alexander Erreygers (Ghent University, Belgium); Giacomo Verticale (Politecnico di Milano, Italy); Jasper De Bock (Ghent University, Belgium)

14:10 **Routing Optimization for SDN Networks Based on Pivoting Rules for the Simplex Algorithm**
Fabien Geyer (Airbus Group Innovations, Germany)

14:30 **Coffee Break**

Session 3 – Security and Resilience against Network Attacks

Session Chair: James P. G. Sterbenz (Lancaster University, UK & The University of Kansas, USA)

15:00 **Towards Cloud Security Improvement with Encryption Intensity Selection**
Mortada Aman and Egemen K. Çetinkaya (Missouri University of Science and Technology, USA)

- 15:20 **Using SEIRS Epidemic Models for IoT Botnets Attacks**
M. Todd Gardner (University of Missouri, Kansas City Federal Aviation Administration, USA); Cory Beard and Deep Medhi (University of Missouri-Kansas City, USA)
- 15:40 **Spectral Analysis of Backbone Networks Against Targeted Attacks**
Tristan Shatto and Egemen K. Çetinkaya (Missouri University of Science and Technology, USA)
- 16:00 – **Improving the Robustness to Targeted Attacks in Software Defined Networks (SDN)**
16:50 *Diego F. Rueda and Eusebi Calle (University of Girona, Spain); Jose Luis Marzo (Universitat de Girona, Spain)*
- 17:00 – **Panel Discussion on “Reliable 5G Networks”**
18:30 *by Professor Frank Fitzek (Deutsche Telekom Chair of Communication Networks at Technical University Dresden, Germany)*
- 20:00 – **Conference Dinner**
23:00

Friday, March 10

- 09:00 **Keynote Speech: “Multi-layer resilience schemes and their control plane support”**
Víctor López (Telefónica Global CTO, Spain)
- 10:00 **Coffee Break**
- 10:30 **Invited Talk Session 4: “Network Avoiding Heavy Rainfall”**
Hiroshi Saito (NTT Network Technology Labs., Japan)
- Session 4 – Disaster Resiliency**
Session Chair: Deep Medhi (University of Missouri-Kansas City, USA)
- 11:00 **Analysis of Node-Resilience Strategies under Natural Disasters**
Manuel Aprile (École Polytechnique Fédérale de Lausanne, Switzerland); Natalia Castro (Universidad de la República, Uruguay); Franco Robledo (Facultad de Ingeniería, Universidad de la República, Uruguay); Pablo Gabriel Romero (Universidad de la República, Uruguay)

11:20

Determination of the Minimum Cost Pair of D-Geodiverse Paths

Amaro F. de Sousa (Institute of Telecommunications, University of Aveiro, Portugal); Dorabella Santos (Instituto de Telecomunicações - Pólo de Aveiro, Portugal); Paulo P Monteiro (Universidade de Aveiro Instituto de Telecomunicações, Portugal)

11:40

Multi-Carrier Interconnection-based Emergency Packet Transport Network Planning in Disaster Recovery

Sugang Xu (National Institute of Information and Communications Technology, Japan); Noboru Yoshikane (KDDI Research, Inc., Japan); Masaki Shiraiwa (National Institute of Information and Communications Technology, Japan); Takehiro Tsuritani (KDDI RD Laboratories, Inc., Japan); Hiroaki Harai (National Institute of Information and Communications Technology, Japan); Yoshinari Awaji (National Institute of Information and Communications Technology (NICT), Japan); Naoya Wada (NICT, Japan)

12:00

Lunch Break

13:00

Invited Talk Session 5:

“DynPaC: Leveraging SDN to provide Bandwidth on Demand services over GEANT”

Eduardo Jacob (University of the Basque Country, Spain)

Session 5 – Survivability in 5G and Programmable Networks

Session Chair: Andreas Kirstädter (University of Stuttgart, Germany)

13:30

Survivable BBU Hotel placement in a C-RAN with an Optical WDM Transport

Bahare Masood Khorsandi and Carla Raffaelli (University of Bologna, Italy); Lena Wosinska and Paolo Monti (KTH Royal Institute of Technology, Sweden); Matteo Fiorani (Ericsson Research, Sweden)

13:50

Survivability of Fixed Mobile Convergent Access Networks

Attila Mitcsenkov and Tibor Cinkler (Budapest University of Technology and Economics, Hungary); Achille Pattavina and Francesco Musumeci (Politecnico di Milano, Italy)

14:10

AI for SLA Management in Programmable Networks

Imen Grida Ben Yahia (Orange Labs, France); Jaafar Bendriss (Orange Lab, France); Prosper Chemouil (Orange Labs OLN/CNC, France); Djamel Zeghlache (Institut Mines-Telecom, Telecom SudParis UMR 5157 CNRS – Samovar, France)

14:30	DRCN Best Paper Award and Closing Ceremony
15:00	End of DRCN 2017
15:00	Coffee Break
	RECODIS Session at DRCN
15:30	Introduction
15:40	<p>The Robust Node Selection Problem aiming to Minimize the Connectivity Impact of any Set of p Node Failures</p> <p><i>Amaro de Sousa, Dorabella Santos (Institute of Telecommunications, University of Aveiro, Portugal), Deepak Mehta (United Technologies Research Centre, Ireland)</i></p>
16:00	<p>Interdependence between Power Grids and Communication Networks: A Resilience Perspective</p> <p><i>Lucia Martins (University of Coimbra & INESC-Coimbra, Portugal), Rita Girao-Silva (FCTUC, University of Coimbra & INESC-Coimbra, Portugal), Luisa Jorge (IPB & INESC Coimbra, Portugal), Alvaro Gomes (FCTUC, Portugal), Francesco Musumeci (Politecnico di Milano, Italy), and Jacek Rak (Gdansk University of Technology, Poland)</i></p>
16:20	<p>Enumerating Shared Risk Link Groups of Circular Disk Failures Hitting k Nodes</p> <p><i>Balázs Vass, János Tapolcai (Budapest University of Technology and Economics, Hungary), Erika Bérczi-Kovács (Eötvös University, Budapest, Hungary)</i></p>
16:40	<p>A repeated game formulation of network embedded coding for multicast resilience in extreme conditions</p> <p><i>Christian Esposito (University of Salerno, Italy), Aniello Castiglione (Università di Salerno, Italy), Francesco Palmieri (Università di Salerno, Italy), Florin Pop (University Politehnica of Bucharest, Romania), Jacek Rak (Gdansk University of Technology, Poland)</i></p>
17:00	END of RECODIS Session at DRCN 2017

GENERAL INFORMATION

Contact

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Website

Visit the DRCN 2017 homepage for getting the latest information related to the conference: www.drcn2017.de

Registration Desk Hours

- Wednesday, March 8, 2017,
14:00 – 17:30
- Thursday, March 9, 2017,
08:00 – 18:00
- Friday, March 10, 2017,
08:00 – 15:30

Availability by e-mail on-site: jasmin.kayadelen@vde.com

Proceedings

All papers accepted for presentation at the conference will be published at VDE Verlag and included in IEEE Xplore. The Download information with all proceedings will be handed out on-site to all participants attending the conference.

Conference Location



Courtyard Munich City Center

Schwanthalerstrasse 37
Munich, Bavaria 80336 Germany

Phone: +49-89-54 88 48 80
Fax: +49-89-54 88 48 833

Welcome Reception

18:00 – 19:40 | **Visit of BMW-Welt Munich**



BMW Welt is full of impressive facts and fascinating stories. Go on a discovery tour. This tour covers all the main points of BMW Welt: you will find out interesting background information on the building, its special architecture and how it was created. The BMW Welt Compact

Tour also provides a glimpse behind the scenes, explaining the complex logistics of automobile delivery to customers from all over the world. Look forward to experiencing the various elements of BMW Welt and hearing interesting talks.

19:40 – 21:30 | **Welcome Reception at the conference hotel (Courtyard Munich City Center)**

Conference Dinner

The dinner event takes place at Augustiner Keller Munich – an unique bavarian atmosphere style restaurant of a genuine Munich beer garden and Pub.

www.augustinerkeller.de



Munich



Munich, the capital of Bavaria, is one of Germany's most exciting travel destinations and offers variety for every visitor. The lively city consists of a mixture of visible history of almost one thousand years and modern spirit. Please visit the official website at www.munich.de for further information.

Insurance

The organizers may not be held responsible for any injury to participants or damage, theft and loss of personal belongings. Participants should therefore make their own insurance arrangements.

PROGRAM OVERVIEW

WEDNESDAY, MARCH 8

15:00	Opening
15:15	Tutorials
18:00	Welcome Reception

THURSDAY, MARCH 9

09:00	Keynote Speech: "Reliability in Optical Networks" Suresh Subramaniam (George Washington University, USA)
10:00	Coffee Break
10:30	Invited Talk Session 1: "Designing a Resilient Virtual Topology in a Multi-Layer Datacenter Interconnection Network" Yuri Smirnov (Facebook, USA)
11:00	Session 1 – Transport
12:00	Lunch Break
13:00	Invited Talk Session 2: "Techno-economic modelling for reliable ICT networks and Service" Sofie Verbrugge (IDLab, Belgium)
13:30	Session 2 – Modeling
14:30	Coffee Break
15:00	Session 3 – Security
17:00	Panel Discussion on "Reliable 5G Networks" by Frank Fitzek (Deutsche Telekom Chair of Communication Networks at Technical University Dresden, Germany)
20:00	Conference Dinner

FRIDAY, MARCH 10

09:00	Keynote Speech: "Multi-layer resilience schemes and their control plane support" Víctor López (Telefónica Global CTO, Spain)
10:00	Coffee Break
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11:00	Session 4 – Disaster
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