BalkanCom 2021
Wireless Future in the New Decade

Fourth International Balkan Conference on Communications and Networking

Novi Sad, Serbia, September 20-22, 2021

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Message from General Chairs

Dear Participants,

With great pleasure we welcome you to Novi Sad, Serbia, for the fourth edition of BalkanCom conference. BalkanCom 2021 comes during challenging times of pandemic and will take form of a hybrid conference event, with both physical and online presence. Our goal is to continue the tradition of establishing ties both within the region and with the rest of the world.

Since BalkanCom 2019, the world has changed tremendeously. New ways of work, collaboration, research and development are required and they cannot be imagined without communication technologies. The deployment of 5G is a fundamental building block for future wireless infrastructure, however, the attention of researchers has already shifted towards identification and research on novel beyond 5G technologies.

Introduction of machine learning and artificial intelligence into all aspects of communications and networking, exploration of novel wireless bands (terahertz communications) and communication paradigms (intelligent reflective surfaces), further evolution of Internet of Things and introduction of non-terrestrial network infrastructure are just part of the list of ongoing and emerging topics that will be touched upon in BalkanCom program.

We welcome all participants of BalkanCom 2021, and wish everyone a lot of interaction, communication and collaboration.

General Co-Chairs

Petar Djuric
Stony Brook University
USA
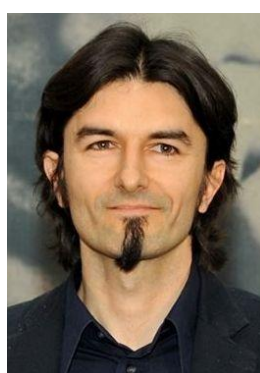
Dejan Vukobratovic
University of Novi Sad
Serbia

Message from TPC Chairs

Dear participants of the Fourth BalkanCom conference,

It is a great pleasure to warmly welcome you in the picturesque city of Novi Sad, in the north of the Balkan Peninsula, for yet another edition of the premier telecommunications and networking conference in the Balkans.

We are happy that this edition takes place this year after being cancelled last year due to Covid-19. We express our thanks to the Steering Committee, the Conference Chairs, Keynote Speakers and all individuals that invariably put their inspiration and efforts to have a successful BalkanCom 2021.

We are excited to share with you an exquisite program that combines state-of-the-art topics in the broad field of communications. We are looking forward to an open and informative time and exchange of ideas among peers from across the world. This year, authors can also participate remotely due to Covid-19 restrictions.

The umbrella topic of this year's edition is "Wireless Future in the New Decade" fitting not only for the Balkan Peninsula, but globally, heralding a new decade of innovation and groundbreaking progress in the ICT domain. This is reflected both in the conference program and the keynote speeches.

We thank our Serbian hosts, all committee members and the authors who have contributed their work and responded to our invitation. We received papers from across the world. The program covers 6 regular sessions with 21 papers and 4 special sessions with 17 papers/presentations that range from learning and communications to challenges in IoT, terahertz and multimodal communications, management and security to emerging applications and experimentation. We also have a student session that shows the potential of the future telecom researchers and professionals. In terms of number of submissions, this edition had to anticipate the Covid-19 environment. We managed to gather 184 paper authors with 43.5% from the Balkan region. Additionally, we have 3 keynotes specifically targeting novel concepts to be introduced in the new decade. We are proud to continue the successful BalkanCom's story, which is becoming a long-lasting, important event for the Balkan region.

We wish you a successful conference and look forward to welcoming you in Novi Sad either in-person or virtual!

BalkanCom'21 TPC Chairs
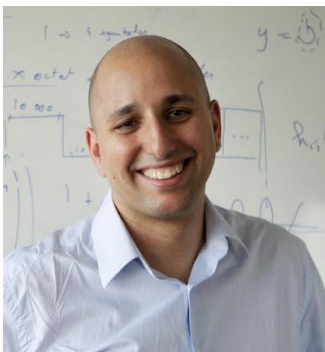
Merouane Debbah	**Octavia Dobre**	**Konstantinos Oikonomou**
CentraleSupélec and TII	Memorial University	Ionian University
France and UAE	Canada	Greece

The Age of Information: Status Updates for Real-Time Systems

Roy Yates
Professor
Rutgers University,
New Brunswick (NJ), USA

Increasingly ubiquitous network connectivity has engendered applications in which sources such as environmental sensors, video cameras, and autonomous vehicles send updates of their status to interested recipients. These applications require timely status updates at the recipients; however, this is typically constrained by limited communication and network resources. We describe an Age-of-Information (AoI) timeliness metric for the evaluation of status update systems and we characterize the AoI requirements of a range of real-time applications. We derive general methods for calculating AoI that we apply to system abstractions of sources, monitors, networks, and edge cloud processors. We identify optimal updating policies based on the bandwidth and energy constraints of the senders and system. We observe that optimal updating policies can be counter-intuitive and differ from the throughput/delay tradeoffs that typically describe low latency networking.

Aspects of Time and Space in Wireless Connectivity Beyond 5G

Petar Popovski
Professor
Aalborg University
Aalborg, Denmark

Multiantenna transmitters are commonly associated with many additional complications when it comes to hardware design. Still many antennas, by means of the law of large numbers, allow us to make a virtue out of necessity. Few or even a single power amplifier can drive all antenna elements whose data streams are digitally and independently modulated directly before or even after the antenna connector with the help of digital RF switches directly controlled by baseband circuitry. Digital-to-analog conversion, circuit matching, and mitigation of mutual antenna coupling are subject to optimization by means of real-time signal processing. Error-vector magnitudes are to be measured in terms of the electromagnetic field on air. While load modulated arrays are highly promising for massive MIMO and millimeter wave technology, new technological challenges have to be met: RF-switches must meet the speed and power requirements of modern communication systems. Spectral shaping is a serious challenge and standing waves between various antenna elements must be avoided. This keynote gives an overview of the state-of-the-art of load modulated arrays, in general, and provides partial solutions for some of the main challenges that come with this promising technology.

Ultra-Low-Latency Millimeter Wave Networking using True-Time-Delay Array Architecture

Danijela Cabric

Professor

University of California Los Angeles (UCLA)

Los Angeles (CA), USA

Future generations of millimeter wave networks (mmW-nets) will operate in the upper mmW frequency band where ≥ 10 GHz bandwidth can be used to meet the ever increasing demands. Their realization will demand addressing a completely new set of challenges including wider bandwidths, larger antenna array sizes, and higher cell density. These new system requirements demand fundamental rethinking of radio architectures, signal processing, and networking protocols. Major breakthroughs are required in radio front-end architectures to enable wideband mmW-nets, as most commonly adopted phased antenna array (PAA) based radios face many challenges in achieving fast beam acquisition, interference suppression and wideband data communication. This talk will present the potential of true-time-delay (TTD) based array architecture for wideband mmW-nets for low latency initial beam training and data communication.

Technical Program - at a glance

BalkanCom 2021

	September 20 (Mon)	September 21 (Tue)	September 22 (Wed)	
09:20 - 11:00	**Opening and Welcome** **Session 1:** Sensing, Detection and Localization	**Session 4:** Network Management and Security	**Keynote 3:** Danijela Cabric	09:20 - 10:20
			Coffee Break	10:20 - 10:40
11:00 - 11:20	**Coffee Break**	**Coffee Break**	**Session 7:** Terahertz and Millimeter-Wave Communications	10:40 - 12:20
11:20 - 12:40	**Session 2:** Learning and Communication in Smart Grids	**Session 5:** Massive IoT: Fundamentals and Applications	**Lunch Break**	12:20 - 13:20
12:40 - 13:40	**Lunch Break**	**Lunch Break**	**Session 8:** Multimodal Signal Compression, Communication and Analysis	13:20 - 14:40
13:40 - 14:40	**Keynote 1:** Roy Yates	**Keynote 2:** Petar Popovski		
14:40 - 16:00	**Session 3:** Industrial Internet of Things: Challenges and Prospects	**Session 6:** Information Processing and Learning over Networks	**Session 9:** Emerging Applications and Experimentation	14:40 - 16:00
16:00 - 16:20	**17:00:** Novi Sad Tour **18:30:** Welcome Reception	**16:15:** Tour of Sremski Karlovci Visit to a Winery	**Coffee Break**	16:00 - 16:20
16:20 - 18:00			**Student Session**	16:20 - 18:00
		18:00: Social Event Traditional Ethno House **19:30** Conference Dinner		

MONDAY

Opening Ceremony
Time: Monday, Sep. 20, 2021 - 9:20 - 10:00

Welcome by the conference General Chairs and Technical Program Committee Chairs. Welcome address by State Secretary of Ministry of Trade, Telecommunications and Tourism. Trends in mobile industry welcome presentation by the premium sponsor A1.

Session 1: Sensing, Detection and Localization
Time: Monday, Sep. 20, 2021 - 10:00 – 11:00
Chair: Petar Djuric, Stony Brook University

In-body Bionanosensor Communication and Localization for Anomaly Detection
Jennifer Simonjan (Silicon Austria Labs, Austria); Bige Deniz Unluturk (Michigan State University, USA); Ian Fuat Akyildiz (Norwegian Univ. of Science and Technology, Trondheim, Norway)

RF Backscatter-Based Sensors for Structural Health Monitoring
Milutin Stanacevic (Stony Brook University, USA); Abeer Ahmad (Stony Brook University, USA); Xiao Sha (Stony Brook University, USA); Akshay Athalye (Stony Brook University , USA); Samir R. Das (Stony Brook University, USA); Kelly Caylor (UC Santa Barbara, USA); Branko Glisic (Princeton University, USA); Petar M. Djurić (Stony Brook University, USA)

Multi-Agent Q-Learning in UAV Networks for Target Detection and Indoor Mapping
Anna Guerra (University of Bologna, Italy); Francesco Guidi (National Research Council of Italy, Italy); Davide Dardari (University of Bologna, Italy); Petar M. Djurić (Stony Brook University, USA)

Session 2: Learning and Communication in Smart Grids
Time: Monday, Sep. 20, 2020 - 11:20 – 12:40
Chair: Zoran Hadzi Velkov, Ss. Cyril and Methodius University

Private Information Inference of Households from Electricity Consumption Data
Mert Pekey, Yiğit Çelebi, Ceren Anıl and Albert Levi (Sabanci University, Turkey)

Graph Neural Network Based DC State Estimation in Electric Power Systems
Ognjen Kundacina (University of Novi Sad, Serbia); Mirsad Cosovic (University of Sarajevo, Bosnia and Herzegovina); Dejan Vukobratović (University of Novi Sad, Serbia)

Learning the Impedance Entanglement for Wireline Data Communication
Andrea M Tonello and Nunzio Letizia (University of Klagenfurt, Austria); Marco De Piante (University of Udine, Italy)

Edge Computing: System Overview and Fusion with Wireless Power Transfer
Marija Poposka and Zoran Hadzi-Velkov (Ss. Cyril and Methodius University in Skopje, N. Macedonia)

MONDAY

Keynote 1

The Age of Information: Status Updates for Real-time Systems
Roy Yates (Rutgers University, New Brunswick, NJ, USA)
Time: Monday, Sep. 20, 2021 - 13:40 – 14:40

Session 3: Industrial Internet of Things: Challenges and Prospects
Time: Monday, Sep. 20, 2021 - 14:40 – 16:00
Chair: Gordana Gardasevic, University of Banja Luka

The Impact of LoRa Transmission Parameters on Packet Delivery and Dissipation Power
Tamara Rašić (Mtel A. D.–Telekom Srpske, Bosnia and Herzegovina); Joao Lucas Eberl Simon (University of Exeter, United Kingdom); Nenad Zorić (University of Novi Sad, Serbia) and Mitar Simić (University of Novi Sad, Serbia and University of Banja Luka, Bosnia and Herzegovina)

Performance Evaluation of 6TiSCH Network with Multiple Physical Layers
Milica Lekić and Gordana Gardasevic (University of Banja Luka, Bosnia and Herzegovina)

Digital transformation in Industry 4.0 Using Vibration Sensors and Machine Learning
Dejan Drajic, Nenad Gligoric and Srdjan Krco (DunavNET, Serbia)

Internet of Things Platform Architecture for Smart Factories
Lazar Berbakov and Nikola Tomasevic (Institute Mihajlo Pupin, Serbia)

Session 4: Network Management and Security
Time: Tuesday, Sep. 21, 2021 – 09:20 – 11:00
Chair: Petar Popovski, Aalborg University

Automatic Network Slicing for Resource Allocation in Underwater Acoustic Communication Systems
Osama M. Bushnaq, Igor V. Zhilin, Giulia De Masi, Enrico Natalizio and Ian F. Akyildiz (Technology Innovation Institute, United Arab Emirates)

Constructing Budget Connected Dominating Sets in Large-Scale IoT Network Environments
Konstantinos Skiadopoulos, Athanasios Tsipis and Konstantinos Oikonomou (Ionian University, Greece)

Scalable Server Location for Distributed Interactive Applications Under Budget Constraints
Athanasios Tsipis and Vasileios Komianos (Ionian University, Greece)

Dynamics of Multi-Strain Malware Epidemics over Duty-Cycled Wireless Sensor Networks
Dmitriy Fedorov, Yrys Tabarak and Aresh Dadlani (Nazarbayev University, Kazakhstan); Muthukrishnan Senthil Kumar (PSG College of Technology, India); Vipin Kizheppatt (Birla Institute of Technology and Science Pilani, India)

Securing Internet of Things Networks with Gateways and Multi-SSID Technology
Ahmet Kasif (Bursa Technical University, Turkey); Cengiz Togay (Bursa Uludag University, Turkey); Albert Levi (Sabanci University, Turkey)

Session 5: Massive IoT: Fundamentals and Applications
Time: Tuesday, Sep. 21, 2021 – 11:20 – 12:40
Chair: Cedomir Stefanovic, Aalborg University

On Tree-Algorithms with Free Access, Multipacket Reception, and Successive Interference Cancellation
Syed Muhammad Ali (Aalborg University, Denmark); Dejan Vukobratović (University of Novi Sad, Serbia); Marko Beko (Universidade de Lisboa and Universidade Lusófona de Humanidades e Tecnologias, Portugal); Čedomir Stefanović (Aalborg University, Denmark)

Information Freshness in Random Access Channels for IoT Systems
Andrea Munari (German Aerospace Center, Germany); Elif Uysal (Middle East Technical University, Turkey)

Unsourced Random Access for the MIMO Channel
Kirill Andreev and Alexey A. Frolov (Skolkovo Institute of Science and Technology, Russia)

Two-Tier Multi-Rate Slotted ALOHA for OWC/RF-Based IoT Networks
Milica Petkovic and Dejan Vukobratović (University of Novi Sad, Serbia); Andrea Munari and Federico Clazzer (Institute of Communications and Navigation of the German Aerospace Center, Germany)

TUSEDAY

Keynote 2

Aspects of Time and Space in Wireless Connectivity beyond 5G

Petar Popovski (Alborg University, Aalborg, Denmark)
Time: Tuesday, Sep. 21, 2021 - 13:40 – 14:40

Session 6: Information Processing and Learning over Networks

Time: Tuesday, Sep. 21, 2021 – 14:40 – 16:00
Chair: Georgios Giannakis, University of Minesotta

Meta Distribution-optimal Base Station Deployment for Finite-Area Mobile Networks
Christodoulos Skouroumounis and Ioannis Krikidis (IRIDA Research Centre for Communication Technologies and University of Cyprus, Cyprus)

An efficient decentralized approach for mmWave MIMO Channel Estimation
Maria Trigka, Christos Mavrokefalidis and Kostas Berberidis (University of Patras, Greece)

Fast topology identification from smooth graph signals
Seyed Saman Saboksayr, Gonzalo Mateos and Müjdat Çetin (University of Rochester, USA)

GAN Based Data Augmentation for Indoor Localization Using Labeled and Unlabeled Data
Wafa Njima (CY Paris Université, ENSEA, CNRS, France); Marwa Chafii and Raed Shubair (New York University, United Arab Emirates)

An ensemble learning framework for distributed resource allocation in inteference channels:
The two user case
George A. Ropokis (CentraleSupélec/IETR, France)

Keynote 3

Ultra-Low-Latency Millimeter Wave Networking using True-Time-Delay Array Architecture
Danijela Cabric (University of California, Los Angeles, CA, USA)
Time: Wednesday, Sep. 22, 2021 - 09:20 – 14:40

Session 7: Terahertz and Millimeter-Wave Communications

Time: Wednesday, Sep. 22, 2021 – 10:40 – 12:20
Chair: Tolga Girici, TOBB University of Economics and Technology

Characterization of Terahertz Band Transmittance from Sea-Level to Drone Altitudes

Akhtar Saeed, Ammar Saleem and Ozgur Gurbuz (Sabanci University, Turkey); Mustafa Alper Akkaş (Bolu Abant İzzet Baysal University, Turkey)

Fading Modeling in Indoor THz Wireless Systems

Evangelos N. Papasotiriou, Alexandros-Apostolos A. Boulogeorgos and Angeliki Alexiou (University of Piraeus, Greece)

TeraHertz Channel Model for Search and Rescue Nanonetwork Applications in Debris Areas

Emre Şahin (Pamukkale University, Turkey); Orhan Dagdeviren (Ege University, Turkey); Mustafa Alper Akkaş (Bolu Abant İzzet Baysal University, Turkey)

Optimal Precoding and Deployment of Millimeter-Wave Drone Base Stations

Fatih Yurekli and Tolga Girici (TOBB University of Economics and Technology, Turkey)

On the Performance of Zero-forcing Beamforming in a Real I2V Scenario at Millimiter Wave

Mehdi Haghshenas, Mattia D'adda, Francesco Linsalata, Luca Barbieri, Monica Nicoli and Maurizio Magarini (Politecnico di Milano, Italy)

Session 8: Multimodal Signal Compression, Communication and Analysis

Time: Wednesday, Sep. 22, 2021 – 13:20 – 14:40
Chair: Milos Radosavljevic, InterDigital

Feature Selection and Extraction in Sequence Labeling for Arrhythmia Detection

Minxiang Ye (University of Strathclyde, United Kingdom and Zhejiang Lab, China); Vladimir Stankovic and Lina Stankovic (University of Strathclyde, United Kingdom); Srdjan Lulic (PanonIT, Serbia); Andras Anderla and Srdjan Sladojevic (University of Novi Sad, Serbia)

Non-Intrusive Load Monitoring for Multi-objects in Smart Building

Dandan Li (Tongji University, China); Jiangfeng Li (University of Strathclyde, United Kingdom); Xin Zeng (Tongji University, China); Vladimir Stankovic and Lina Stankovic (University of Strathclyde, United Kingdom); Qingjiang Shi (Tongji University and Shenzhen Research Institute of Big Data, China)

MARVEL: Multimodal Extreme Scale Data Analytics for Smart Cities Environments

Dragana Bajovic (University of Novi Sad, Serbia); Arian Bakhtiarnia (Aarhus University, Denmark); George Bravos (ITML, Greece); Alessio Brutti (Fondazione Bruno Kessler, Italy); Felix Burkhardt (audEERING GmbH, Germany); Daniel Cauchi (Greenroads Ltd, Malta); Antony Chazapis (FORTH-ICS, Greece); Claire Cianco (Greenroads Ltd, Malta); Nicola Dall'Asen (Fondazione Bruno Kessler, Italy); Vlado Delić (University of Novi Sad, Faculty of Technical Sciences, Serbia); Christos Dimou (ITML, Greece); Djordje Djokic (Privanova, France); Antonio Escobar-Molero (Infineon Technologies AG, Germany); Lukas Esterle (Aarhus University, Denmark); Florian Eyben (audEERING GmbH, Germany); Elisabetta Farella (Fondazione Bruno Kessler, Italy); Thomas Festi (Municipality of Trento, Italy); Artemios Geromitsos (INTRASOFT, Greece); Giannis Giakoumakis (FORTH-ICS, Greece); George Hatzivasilis (Sphynx Technology Solutions AG, Switzerland); Sotiris Ioannidis (FORTH-ICS and Technical University of Crete, Greece); Alexandros Iosifidis (Aarhus University, Denmark); Theodora Kallipolitou (ZELUS, Greece); Grigorios Kalogiannis (Sphynx Technology Solutions AG, Switzerland); Akrivi Kiousi (INTRASOFT, Greece); Despina Kopanaki (FORTH-ICS, Greece); Manolis Marazakis (FORTH-ICS, Greece); Stella Markopoulou (ZELUS, Greece); Adrian Muscat (Greenroads Ltd and University of Malta, Malta); Francesco Paissan (Fondazione Bruno Kessler, Italy); Tomas Pariente Lobo (Atos Spain SA, Spain); Dusan Pavlovic (Privanova, France); Theofanis P. Raptis (IIT-CNR, Italy); Elisa Ricci (Fondazione Bruno Kessler, Italy); Borja Saez (Infineon Technologies AG, Germany); Farhan Sahito (Privanova, France); Kenneth Scerri (Greenroads Ltd and University of Malta, Malta); Björn Schuller (audEERING GmbH and University of Augsburg, Germany); Nikola Simic (University of Novi Sad, Serbia); George Spanoudakis (Sphynx Technology Solutions AG, Switzerland); Alex Tomasi (Municipality of Trento, Italy); Andreas Triantafyllopoulos (audEERING GmbH, Germany); Lorenzo Valerio (IIT-CNR, Italy); Javier Villazán (Atos Spain SA, Spain); Yiming Wang (Fondazione Bruno Kessler, Italy); André Xuereb (Greenroads Ltd and University of Malta, Malta); Johan Zammit (Greenroads Ltd, Malta)

Compression artifacts masking by re-noising
Miloš Radosavljević, Edouard Francois (InterDigital, France) and Erik Reinhard (InterDigital R&D, France)

Session 9: Emerging Applications and Experimentation
Time: Wednesday, Sep. 22, 2021 – 14:40 – 16:00
Chair: Konstantinos Oikonomou, Ionian University

Controlling Probe Frequency with Network Traffic Dynamics: An Experience Report
Neminath Hubballi (Indian Institute of Technology Indore, India)

Tendermint Performance with Large Transactions: The Healthcare System Scenario
Jovan Karamachoski, Liljana Gavrilovska (Ss. Cyril and Methodius University in Skopje, N. Macedonia)

Design of a Computational Offloading Platform for Immersive Experiences in Digital Culture
Vasileios Komianos, Athanasios Tsipis and Katerina Kontopanagou (Ionian University, Greece)

A Refined Topology-Independent Probabilistic TDMA MAC Policy for Ad Hoc Networks
Vasileios Dragonas, Georgios Tsoumanis and Konstantinos Oikonomou (Ionian University, Greece)

Student Session
Time: Wednesday, Sep. 22, 2021 - 16:20 – 18:00
Chair: Milica Petkovic, University of Novi Sad

A Migration-Based Approach for the SDN Controller Placement Problem in Tree Topologies
Alexandros Zervopoulos and Konstantinos Oikonomou (Ionian University, Greece)

A Study on Value-of-Information and Age-of-Information in a First Responders' Health Monitoring System
Syed Muhammad Ali and Čedomir Stefanović (Aalborg University, Denmark)

On Error Probability of Massive IoT Slotted ALOHA System in Finite-Length Regime
Tijana Devaja and Dejan Vukobratović (University of Novi Sad, Serbia); Marko Beko (Universidade Lusófona de Humanidades e Tecnologias, Portugal)

A Coverage Path Planning Algorithm for Self-Organizing Drone Swarms
Konstantinos Bezas (Ionian University, Greece); Georgios Tsoumanis (University of Ioannina, Greece); Konstantinos Oikonomou (Ionian University, Greece)

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