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8 – 10 November 2021**



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Monday, November 8

Monday, November 8 8:45 - 9:00 (America/Chicago)

Opening Session

Chair: Susmit Shannigrahi

Monday, November 8 9:00 - 10:15 (America/Chicago)

S1: Edge Computing

Session Chair - Spyridon Mastorakis, smastorakis@unomaha.edu

S1.1 9:00 (Short Paper) DFaaS: Decentralized Function-as-a-Service for Federated Edge Computing

Michele Ciavotta, Davide Motterlini, Marco Savi and Alessandro Tundo
pp. 1-4

S1.2 9:25 Enabling Delay-Sensitive IoT Application by Programmable Local 5G Edge

Koichiro Amemiya and Akihiro Nakao
pp. 5-10

S1.3 9:50 A Global Orchestration Matching Framework for Energy-Efficient Multi-Access Edge Computing

Tobias Mahn and Anja Klein
pp. 11-18

Monday, November 8 10:15 - 10:30 (America/Chicago)

Break/Networking

Monday, November 8 10:30 - 12:00 (America/Chicago)

S2: Machine Learning for Cloud Computing

S2.1 10:30 Leveraging Partial Model Extractions using Uncertainty Quantification

Arne Aarts, Wil Michiels and Peter Roelse
pp. 19-25

S2.2 11:00 A Machine Learning Approach for Service Function Chain Embedding in Cloud Datacenter Networks

Tom Jenno Wassing, Danny De Vleeschauwer and Chrysa Papagianni
pp. 26-32

S2.3 11:30 *Using Machine Learning and In-band Network Telemetry for Service Metrics Estimation*

Leandro Almeida, Rafael Pasquini and Fábio Luciano Verdi

pp. 33-39

Monday, November 8 12:00 - 12:45 (America/Chicago)

Break/Networking

Monday, November 8 12:45 - 1:45 (America/Chicago)

Panel

Monday, November 8 2:00 - 2:45 (America/Chicago)

Keynote - Craig Partridge

Chair: Susmit Shannigrahi

Monday, November 8 2:45 - 3:00 (America/Chicago)

Break

Monday, November 8 3:00 - 4:00 (America/Chicago)

Keynote: Neoteric Frontiers in Cloud and Edge Computing

Prof. Rajkumar Buyaa (The University of Melbourne, Australia)

Chair: Chrysa Papagianni

ABSTRACT

Computing is being transformed to a model consisting of services that are delivered in a manner similar to utilities such as water, electricity, gas, and telephony. In such a model, users access services based on their requirements without regard to where the services are hosted or how they are delivered. Cloud computing paradigm has turned this vision of "computing utilities" into a reality. It offers infrastructure, platform, and software as services, which are made available to consumers as subscription-oriented services. Cloud application platforms need to offer (1) APIs and tools for rapid creation of elastic applications and (2) a runtime system for deployment of applications on geographically distributed computing infrastructure in a seamless manner.

The Internet of Things (IoT) paradigm enables seamless integration of cyber-and-physical worlds and opening up opportunities for creating new class of applications for domains such as smart cities and smart healthcare. The emerging Fog/Edge computing paradigm is extends Cloud computing model to edge resources for latency sensitive IoT applications with a seamless integration of network-wide resources all the way from edge to the Cloud.

This keynote presentation will cover (a) 21st century vision of computing and identifies various IT paradigms promising to deliver the vision of computing utilities; (b) innovative architecture for creating elastic Clouds integrating edge resources and managed Clouds, (c) Aneka 5G, a Cloud Application Platform, for rapid development of Cloud/Big Data applications and their deployment on private/public Clouds with resource provisioning driven by SLAs, (d) a novel FogBus software framework with Blockchain-based data-integrity management for facilitating end-to-end IoT-Fog/Edge-Cloud integration for execution of sensitive IoT applications, (e) experimental results on deploying Cloud and Big Data/ IoT applications in engineering, and health care (e.g., COVID-19), deep learning/Artificial intelligence (AI), satellite image processing, natural language processing (mining COVID-19 research literature for new insights) and smart cities on elastic Clouds; and (f) directions for delivering our 21st century vision along with pathways for future research in Cloud and Edge/Fog computing.

Tuesday, November 9

Tuesday, November 9 9:00 - 10:00 (America/Chicago)

S3: Efficient Resource Allocation

Chair: Venkatesh Tamarapalli

9:00 *Using Distributed Tracing to Identify Inefficient Resources Composition in Cloud Applications*

Clément Cassé, Pascal Berthou, Philippe Owezarski and Sébastien Josset
pp. 40-47

9:30 *Profit-aware placement of multi-flavoured VNF chains*

Federica Paganelli, Paola Cappanera, Antonio Brogi and Riccardo Falco

Presenter bio: Federica Paganelli graduated in telecommunications engineering in 2000 and received the Ph.D. degree in telematics and information society from the University of Florence, Italy, in 2004. She is currently an Associate Professor at the Department of Computer Science, University of Pisa, Italy. Her recent research interests include resource orchestration in software-defined infrastructures, network virtualization, protocols and services for the Internet of Things.

pp. 48-55

Tuesday, November 9 10:00 - 10:30 (America/Chicago)

Break/Networking

Tuesday, November 9 10:30 - 12:00 (America/Chicago)

S4: Telemetry and Benchmarking

S4.1 10:30 *Understanding and Leveraging Cluster Heterogeneity for Efficient Execution of Cloud Services*

Sambit K Shukla, Dipak Ghosal and Matthew Farrens

pp. 56-64

S4.2 11:00 *Estimating Function Completion Time Distribution in Open Source FaaS*

Dávid Balla, Markosz Maliosz and Csaba Simon

pp. 65-71

S4.3 11:30 *Data Analytics Using Two-Stage Intelligent Model Pipelining for Virtual Network Functions*

Takaya Miyazawa, Ved P. Kafle and Hitoshi Asaeda

Presenter bio: Takaya Miyazawa received a Ph.D. in Information and Computer Science from Keio University, Japan, in 2006. He is currently a senior researcher at National Institute of Information and Communications Technology (NICT), Tokyo, Japan. His research interests include network control, management and virtualization technologies.

pp. 72-80

Tuesday, November 9 12:00 - 1:00 (America/Chicago)

Break/Networking

Tuesday, November 9 1:00 - 2:00 (America/Chicago)

Student Mentoring Panel

Chair: Abhishek Mahesh Appaji

Tuesday, November 9 2:15 - 4:00 (America/Chicago)

S5: Cloud Networking

Chairs: Valerio Formicola, Susmit Shannigrahi

S5.1 2:15 *Longer Stay Less Priority: Flow Length Approximation Used In Information-Agnostic Traffic Scheduling In Data Center Networks*

Muhammad Shahid Iqbal and Chien Chen

Presenter bio: He is currently studying PhD student at National Chiao Tung University. He got His master degree from COMSATS institute of Information Technology, Pakistan. His research interests include Software Defined Networks, P4.

pp. 81-86

S5.2 2:41 (Short Paper) *Where is the Light(ning) in the Taproot Dawn? Unveiling the Bitcoin Lightning (IP) Network*

Pedro Casas, Matteo Romiti, Peter Holzer, Sami Ben Mariem, Benoit Donnet and Bernhard Haslhofer

Presenter bio: Dr. Pedro Casas is Senior Scientist at the Austrian Institute of Technology (AIT) in Vienna. He received an Electrical Engineering degree from Universidad de la República (UdelaR), Uruguay in 2005, a Ph.D. degree in Computer Science from Institut Mines-Telecom, Telecom Bretagne, France in 2010, and a Ph.D. degree in Electrical Engineering from UdelaR in 2013. He held a Research and Teaching Assistant position at UdelaR between 2001 and 2012, and was a Postdoctoral Research Fellow at LAAS-CNRS in Toulouse in 2010/2011. Between 2011 and 2015 he was Senior Researcher at the Telecommunications Research Center Vienna (FTW). His research areas span AI/ML approaches for Networking, big data analytics and platforms, Internet network measurements, network security and anomaly detection, as well as QoE monitoring and assessment. Dr. Casas has published more than 180 networking research papers in major international conferences and journals, receiving 14 awards for his work.

pp. 87-90

S5.3 3:07 *Throughput Distribution and Stabilization on TCP BBR Connections*

Kohei Ogawa, Kouto Miyazawa, Saneyasu Yamaguchi and Aki Kobayashi

pp. 91-96

S5.4 3:33 *Characterizing network performance of single-node large-scale container deployments*

Conrado Santos Boeira, Miguel Neves, Tiago Ferreto and Israat Haque

pp. 97-103

Wednesday, November 10

Wednesday, November 10 9:00 - 10:00 (America/Chicago)

Keynote: Self-Adjusting Networks: The Power of Choices in Datacenter Topology Design

Prof. Stefan Schmid (Technical University of Berlin, Germany)

Datacenter network traffic is growing explosively, and next-generation workloads, e.g., related to machine learning and artificial intelligence, are likely to further push networks towards their capacity limits. While over the last years, several interesting new datacenter network architectures have been proposed to improve the efficiency and performance of datacenter networks, these networks typically

have in common that their topology is fixed and cannot be reconfigured to the traffic demand they serve.

In this talk, I will discuss a different approach to operate networks: reconfigurable "self-adjusting" networks whose topology adjusts to the workload in an online manner. Reconfigurable networks are enabled by emerging optical technologies, allowing to quickly change the physical topology at runtime. This technology also introduces a vision of demand-aware networks which tap a new optimization opportunity: empirical and measurement studies show that traffic workloads feature spatial and temporal structure, which in principle could be exploited by reconfigurable networks. However, while the technology of such reconfigurable networks is evolving at a fast pace, these networks lack theoretical foundations: models, metrics, and algorithms - we have fallen behind the curve. The objective of this talk is to help bridge this gap, and introduce to the IEEE CloudNet community a rich and potentially impactful research area. We first discuss technological enablers and report on motivating empirical studies. Our main focus then is on the new models and algorithmic and practical challenges introduced by this field. In particular, we will review existing algorithms and complexity results, report on early prototypes, and highlight future research directions.

Wednesday, November 10 10:00 - 10:30 (America/Chicago)

Break/Networking

Wednesday, November 10 10:30 - 12:00 (America/Chicago)

S6: Video Streaming

Chair: Venkatesh Tamarapalli

S6.1 10:30 *Super-resolution on Edge Computing for Improved Adaptive HTTP Live Streaming Delivery*

João da Mata Libório, Filho, Maiara de S. Coelho and Cesar A. V. Melo
pp. 104-110

S6.2 11:00 *An Edge Video Analysis Solution For Intelligent Real-Time Video Surveillance Systems*

Alessandro Souza Silva, Michel S. Bonfim and Paulo A. L. Rego
pp. 111-117

S6.3 11:30 *Invited Paper - Cloud for Holography and Augmented Reality*

Abderrahmane Boudi, Massimo Coppola, Luis Cordeiro, Massimiliano Corsini, Patrizio Dazzi, Ferran Diego, Yago Gonzalez Rozas, Manos Kamarianakis, Maria Pateraki, Antonis Protopsaltis, Thu Le Pham, Aravindh Raman, Alessandro Romussi, Luis Rosa, Elena Spatafora, Tarik Taleb, Theodoros Theodoropoulos, Konstantinos

Wednesday, November 10 12:00 - 1:00 (America/Chicago)

Break/Networking

Wednesday, November 10 1:00 - 2:30 (America/Chicago)

S7: Testbeds and Security

S7.1 1:00 Secured Distributed Storage Resource Allocation on Cloud-Edge Infrastructures

Konstantinos Kontodimas, Polyzois Soumplis, Aristotelis Kretsis, Panagiotis Kokkinos and Emmanouel Varvarigos
pp. 127-132

S7.2 1:30 Mitigation of DNS Water Torture Attacks within the Data Plane via XDP-Based Naive Bayes Classifiers

Nikos Kostopoulos, Stavros Korentis, Dimitris Kalogeras and Vasilis Maglaris

Presenter bio: Nikos holds a diploma in Electrical & Computer Engineering from the National Technical University of Athens (NTUA) in Greece. He is currently a Ph.D. Student at NTUA. His research focuses on network security tailored to DNS.

pp. 133-139

S7.3 2:00 Invited paper - The Open Cloud Testbed (OCT): A Platform for Research into new Cloud Technologies

Michael Zink, David Irwin, Emmanuel Cecchet, Hakan Saplakoglu, Orran Krieger, Martin Herbordt, Michael Daitzman, Peter Desnoyers, Miriam Leeser and Suranga Handagala

Presenter bio: Michael Zink is currently an Associate Professor in the Electrical and Computer Engineering Department at the University of Massachusetts Amherst. His research interests are in cyber-physical systems, multimedia distribution, and Future Internet Architectures. In the area of multimedia streaming his work has focused on Available Bitrate Streaming and Quality of Experience. He is Co-Director of the NSF Engineering Research Center for Collaborative Adaptive Sensing of the Atmosphere, where his research focuses on closed-loop sensing system for severe weather detection and warning. As PI for several GENI projects he contributed to the creation of one of the largest "at-scale" Future Internet testbed. Prof. Zink is a Senior Member of the IEEE, a recipient of an NSF CAREER Award, and received the DASH-IF Excellence in DASH Award for his work on quality adaptation for DASH. He received his M.S. and Ph.D. in Electrical Engineering from Darmstadt University of Technology.

pp. 140-147

Wednesday, November 10 2:30 - 2:45 (America/Chicago)

Break

Wednesday, November 10 2:45 - 3:45 (America/Chicago)

S8: Scheduling

S8.1 2:45 *GDSim: Benchmarking Geo-Distributed Data Center Schedulers*

Daniel Alves, Katia Obraczka and Abdul Kabbani

pp. 148-156

S8.2 3:15 *Efficient Batch Scheduling of Large Numbers of Cloud Benchmarks*

Derek Phanekham, Troy Walker, Suku Nair, Mike Truty, Manasa Chalasani and Rick Jones

pp. 157-163

Wednesday, November 10 3:45 - 4:00 (America/Chicago)

Closing Session