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## Program at a Glance



### Program at a Glance

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### Monday, October 31

## Monday, October 31, 09:00 - 10:00

### Mini-Conference Keynote

A Modern Interface for Managing Compute, Storage and Network Platforms

*John Leung, Vice President of Alliances, DMTF Inc.*

The Distributed Management Task Force (DMTF) standards organization has hosted academic workshop on manageability for several years. These workshops were conceived to recognize and illuminate research in system, virtualization, and distributed management. At the time, one of the DMTF's key technologies, the Common Information Model (CIM), had brought forth an abundant inventory of open source tools and implementations, which researchers could select, modify and extend for their own needs. Recently, the DMTF has released Redfish™, a modern RESTful interface, for managing compute, storage and network platforms and services. The simplicity and familiar tool-chain of Redfish has driven its acceptance by the manageability ecosystem. The presentation will provide a brief overview of DMTF and its technologies, before focusing on the Redfish and the open source tools available which researchers can use to extend the interface in exploring new areas of network and service management.

## Monday, October 31, 10:30 - 12:00

### Mini-Conference Session 1

Room: A1600

Chair: Remi Badonnel (TELECOM Nancy - LORIA/INRIA, France)

#### **Reliability-Aware Service Provisioning in NFV-enabled Enterprise Datacenter Networks**

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Majid Ghaderi and Mohammad Naghibi (University of Calgary, Canada) **202**

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## Tuesday, November 1

## Tuesday, November 1, 09:00 - 10:00

### Keynote Session 1

The Zero Touch Network

**Bikash Koley (Distinguished Engineer and Director, Network Architecture, Engineering and Planning, Google Inc., USA)**

Large scale content and cloud infrastructure providers strive to offer the highest level of availability across the infrastructure stack. This however is not an easy feat given the fast pace of technology evolution, infrastructure expansion and global reach. Google's network infrastructure has been built to achieve scale, efficiency and very high reliability by following a set of key architectural principles, which we refer to as the "zero touch network". Failures do happen in any global scale network infrastructure such as Google's. By analyzing past failures, we found that a large number of them happened when a network management operation was in progress. To minimize such failures, we have built a network infrastructure where all network operations are automated, requiring no additional steps beyond the instantiation of intent. The network infrastructure is fully declarative and changes applied to individual network elements are derived by the network infrastructure from the high-level network-wide intent. Any network changes are automatically halted and automatically rolled-back by the management infrastructure if the network displays unintended behavior. Finally, the infrastructure does not allow operations which violate network policies. While it might be tempting to limit the rate at which the network evolves to minimize risk of network failures, we have internally come to the opposite conclusion. In a zero-touch-network, continuous incremental evolution results in a more robust infrastructure rather than in-frequent large changes.

## Tuesday, November 1, 10:30 - 12:00

### Technical Session 1

Room: A1600

Chair: Prosper Chemouil (Orange Labs & OLN/CNC, France)

#### ***A Connectionist Approach to Dynamic Resource Management for Virtualised Network Functions***

Rashid Mijumbi, Sidhant Hasiya, Steven Davy, Alan Davy and Brendan Jennings (Waterford Institute of Technology, Ireland); Raouf Boutaba (University of Waterloo, Canada) **1**

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Chair: Chadi Assi (Concordia University, Canada)

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**Wednesday, November 2**

**Wednesday, November 2, 09:00 - 10:00**

**Keynote Session 2**

Scaling IoT Up, Down and Out

*Prof. Henning Schulzrinne (Levi Professor of Computer Science, Columbia University, USA)*

The Internet of Things (IoT) is not all that interesting at small scale - a home thermostat consisting of a microprocessor connecting to Bluetooth or WiFi hardly requires technological breakthroughs in computer science and networking. However, the challenges become more interesting as IoT scales up to include smart phones, scales down to long-lived devices that may be energy-constrained and

scales out to tens of thousands of nodes, e.g., when instrumenting a large commercial building. For scaling up, we need to consider smartphones and similar devices as integral components of sensor-based systems, including the impact on privacy. For scaling down, energy-efficient wide-area coverage may offer new opportunities. For scaling up, securing, managing and prototyping large numbers of nodes exposes the weak points in our existing IP-based infrastructure. For example, classical techniques for managing credentials and access rights are unlikely to work well, so we have worked on inverting the standard model for device authentication. Diagnosing network conditions has to move beyond expert guidance as many of these networks are going to be managed by mechanical engineers and HVAC technicians, not system administrators writing Perl scripts querying SNMP counters. As an example, I will discuss our WiSlow diagnostic system. Scaling up also requires the ability to plan, simulate and emulate deployments before a building has been completed, motivating our current work on SECE (Sense Everything Control Everything). Finally, computation will likely move between many more locations, from the IoT device itself to opportunistically-available computational resources to traditional cloud infrastructure.

## Wednesday, November 2, 10:30 - 12:00

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Room: A1600

Chair: Filip De Turck (Ghent University - iMinds, Belgium)

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Rohit Abhishek and Shuai Zhao (University of Missouri-Kansas City, USA); Sejun Song (University of Missouri Kansas City, USA); Baek-Young Choi (University of Missouri - Kansas City, USA); Henry Zhu (Cisco, USA); Deep Medhi (University of Missouri-Kansas City, USA) **307**

Thursday, November 3

**Thursday, November 3, 09:00 - 10:00**

**Keynote Session 3**

CORD: Central Office Re-architected as a Datacenter

*Larry Peterson (Chief Architect and Board Member, ON.LAB, USA)*

CORD is a new design of a Telco Central Office that replaces closed and proprietary hardware with software running on commodity servers, switches, and access devices. It allows network operators to benefit from both the economies of scale (infrastructure constructed from a few commodity building blocks) and agility (the ability to rapidly deploy and elastically scale services) that commodity cloud providers enjoy today. This talk outlines the motivation for CORD, introduces its architecture, and describes an open reference implementation of that is available for evaluation.

**Thursday, November 3, 10:30 - 12:00**

**Technical Session 5**

Room: A1600

Chair: Lisandro Z Granville (Federal University of Rio Grande do Sul, Brazil)



***Analytic Model for SDN Controller Traffic and Switch Table Occupancy***

Christopher Metter and Michael Seufert (University of Würzburg, Germany); Florian Wamser, Thomas Zinner and Phuoc Tran-Gia (University of Wuerzburg, Germany) **109**

***Enabling Efficient Multi-Layer Repair in Elastic Optical Networks by Gradually Superimposing SDN***

Jeremias Blendin and Daniel Herrmann (TU Darmstadt, Germany); Matthias Wichtlhuber (Technische Universität Darmstadt, Germany); Matthias Gunkel (Deutsche Telekom Technik & Fixed Mobile Engineering Deutschland, Germany); Felix Wissel (Deutsche Telekom Technik, Germany); David Hausheer (TU Darmstadt, Germany) **118**

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Room: A1600

Chair: Guillaume Doyen (Troyes University of Technology, France)

***Detecting Version Number Attacks in RPL-based Networks using a Distributed Monitoring Architecture***

Anthéa Mayzaud (Inria Nancy Grand-Est, Université de Lorraine, France); Remi Badonnel (TELECOM Nancy - LORIA/INRIA, France); Isabelle Chrisment (LORIA-TELECOM Nancy, Université de Lorraine, France) **127**

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### **Distinguished Experts Panel**

# ManSDN/NFV 2016: The 3rd International Workshop on Management of SDN and NFV Systems (ManSDN/NFV 2016) - Program

## 3rd International Workshop on Management of SDN and NFV Systems

### ManSDN/NFV Keynote

Test in the new world of softwarization

*Pierre Lynch (Lead Technologist, Product Management, Ixia, Vice-Chair TST working group, ETSI NFV ISG)*

Along with multiple benefits, the softwarization of networking has multiple impacts on the organization, the operational mindset and the implementation of networking for the future. The presentation will look into how the test function will fit into a software-based networking paradigm. We will outline how test fits into the paradigm, touching on concepts like Devops and CI/CD, as well as more traditional testing models adapted to NFV and SDN. It will also discuss our experience in the differences encountered when testing in a virtual environment, and will detail concrete factors to consider with the platform, the test devices and the configuration when designing the test strategy.

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Pouya Yasrebi, Hadi Bannazadeh and Alberto Leon-Garcia (University of Toronto, Canada) **312**

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Amina Boubendir (Orange Labs & Télécom ParisTech, France); Emmanuel Bertin (Orange Labs, France); Noémie Simoni (Telecom Paristech, France) **318**

#### ***A Virtual Network Migration Approach and Analysis for Enhanced Online Virtual Network Embedding***

Mahboobeh Zangiabady and Christian Aguilar-Fuster (Cinvestav-Tamaulipas, Mexico); Javier Rubio-Loyola (Cinvestav-Tamaulipas) **324**

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Lingxia Liao (Electrical and Computer Engineering, University of British Columbia, Canada); Victor C.M. Leung (University of British Columbia, Canada) **330**

#### ***Evaluation of an End-to-End Delay Estimation in the Case of Multiple Flows in SDN Networks***

Huu-Nghi Nguyen (Ens de Lyon - LIP, France); Thomas Begin (Université de Lyon 1, France); Anthony Busson (Ecole Normale Supérieure & Laboratoire de l'Informatique du Parallélisme, France); Isabelle Guérin Lassous (Université Claude Bernard Lyon 1 - LIP, France) **336**

#### ***QoS-aware Multipathing in Datacenters Using Effective Bandwidth Estimation and SDN***

Runxin Wang (Waterford Institute of Technology, Ireland); Simone Mangiante (EMC, Ireland); Alan Davy, Lei Shi and Brendan Jennings (Waterford Institute of Technology, Ireland) **342**

### ManSDN/NFV Posters

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Abdulaziz M. Ghaleb (Qatar University, Qatar); Tarek Khalifa (University of Waterloo, Canada); Khaled Bashir Shaban (Qatar University & College of Engineering, Qatar) **359**

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Gladys Diaz (University of Paris 13 & L2TI, Institut Galilée, France); Noémie Simoni (Telecom-Paristech, France) **363**

***Dynamic Resource Allocation of Smart Home workloads in the Cloud***

Shahin Vakiliinia (Synchromedia & Synchromedia, Canada); Mohamed Cheriet (Ecole de technologie superieure (University of Quebec), Canada); Jananjoy Rajkumar (ETS, Canada) **367**

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Yoonseon Han (POSTECH, Korea); Jian Li (Pohang University of Science and Technology, Korea); Doan B Hoang (University of Technology Sydney, Australia); Jae-Hyoung Yoo (Ministry of Science, ICT and Future Planning, Korea); James W. Hong (POSTECH, Korea) **353**

**Additional Paper:**

***Energy Efficient Cloud Networks***

Leonard Nonde, Ahmde Q. Lawey, Taisir E.H. Elgorashi, and Jaafar M.H. Elmirghani **412**

# GISN 2016: International Workshop on Green ICT and Smart Networking (GISN 2016) - Program

## The International Workshop on Green ICT and Smart Networking (GISN 2016)

### GISN Keynote

#### Energy efficient cloud networks

*Prof. Jaafar Elmirghani (University of Leeds, UK)*

Cloud computing is expected to be a major factor that will dominate the future Internet service model. This talk summarizes our work on energy efficiency for cloud networks. We describe a framework for studying the energy efficiency of four cloud services in IP over WDM networks: cloud content delivery, storage as a service (StaaS), and virtual machines (VMS) placement for processing applications and infrastructure as a service (IaaS). Our approach is based on the co-optimization of both external network related factors such as whether to geographically centralize or distribute the clouds, the influence of users' demand distribution, content popularity, access frequency and renewable energy availability and internal capability factors such as the number of servers, switches and routers as well as the amount of storage demanded in each cloud. Our investigation of the different energy efficient approaches uses Mixed Integer Linear Programming (MILP) models and real time heuristics.

### GISN Session 1

#### ***Power Proportional Computing for "Green" Servers***

Earl McCune, Jr. (RF Communications Consulting & Eridan Communications, USA) **371**

#### ***A Routing Optimization Method based on Risk Prediction for Communication Services in Smart Grid***

Puyuan Zhao (Beijing University of Post and Telecommunications, P.R. China); Peng Yu, Chenchen Ji, Lei Feng and Li Wenjing (Beijing University of Posts and Telecommunications, P.R. China) **377**

#### ***The Green Sustainable Telco Cloud: Minimizing greenhouse gas emissions of server load migrations between distributed data centres***

Thomas Dandres (École Polytechnique de Montréal, Canada); Reza Farrahi Moghaddam (ETS, University of Quebec, Canada); Kim Khoa Nguyen (University of Quebec, Canada); Yves Lemieux (Ericsson Research Canada, Canada); Réjean Samson (École Polytechnique de Montréal, Canada); Mohamed Cheriet (Ecole de technologie supérieure (University of Quebec), Canada) **383**

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#### ***Driver Identification and Authentication with Active Behavior Modeling***

Angela Burton (Vanderbilt University, USA); Tapan Parikh, Shannon Mascarenhas, Jue Zhang, Jonathan Voris, Nabi Sertac Artan and Wenjia Li (New York Institute of Technology, USA) **388**

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Cody Bumgardner, Victor Marek and Caylin Hickey (University of Kentucky, USA) **400**

#### ***Monitoring and Measurement System for Green Operation of Geographically Distributed ICT Services***

Ana Carolina Riekstin (Synchromedia Lab, École de Technologie Supérieure (ETS), Canada); Thomas Dandres (École Polytechnique de Montréal, Canada); Kim Khoa Nguyen (University of Quebec, Canada); Réjean Samson (École Polytechnique de Montréal, Canada); Mohamed Cheriet (Ecole de technologie supérieure (University of Quebec), Canada) **406**

### GISN Panel Discussion

#### IEEE Green ICT initiative - roadmap

The IEEE Green ICT initiative is a three-year endeavor launched in January 2015 with the mission to develop a holistic approach to sustainability by incorporating green metrics in various IEEE fields of interest. Following a description of the initiative, this panel session will discuss the broad technology, commercial and policy challenges that must be addressed in order to fully leverage information and communication technologies (ICT) for sustainability purposes. *Panelists:* \* Mr. Pierre Boucher, Director of Research and Innovation, Ericsson, Canada \* Prof. Mohamed Cheriet, École de technologie supérieure, Canada \* Prof. Jaafar Elmirghani, University of Leeds, U.K. \* Prof. Kerry Hinton, University of Melbourne, Australia