IEEE
Advancing Technology for Humanity

7th IEEE International Conference on Cloud Computing Technology and Science

Vancouver, BC, Canada

30 November – 3 December, 2015

IEEE CloudCom 2015 Program At A Glance

Time	MONDAY, NOVEMBER 30		TUEDAY, DECEMBER 1			WEDNESDAY, DECEMBER 2		THURSDAY, DECEMBER 3	
8:15 - 9:00	REGISTRATION								
9:00 - 10:30	Enterprise Security Workshop Session 1 C400	TUTORIAL: Mobile Computing & Cloudlets HSBC Hall	PLENARY SESSION 1: Keynote Presentations Theatre			PLENARY SESSION 2: Keynote Presentations Theatre		TUTORIAL: Big Data and Hadoop Theatre	PhD CONSORTIUM C400
10:30 - 11:00	COFFEE BREAK							COFFEE BREAK & POSTER SESSION	
11:00 - 12:30	Enterprise Security Workshop Session 2 C400	Data Teaching Workshop HSBC Hall	Session 1A: Big Data & HPC Theatre	Session 1B: Security & Privacy I C400	Session 1C: Resource Management I HSBC Hall	Session 3A: Multimedia, Social Media & Gaming Applications HSBC Hall	Session 3B: Virtualization & Synchronization Theatre	Session 5A: Cloud Computing Operations Management Theatre	Session 5B: Security & Privacy II C400
12:30 - 13:30	LUNCH							LUNCH & POSTER SESSION	
13:30 - 15:00	Enterprise Security Workshop Session 3 C400	Quality of Service Assurance Workshop Session 1 HSBC Hall	PANEL 1 Theatre			PANEL 2 Theatre		Session 6A: Resource Management II Theatre	Session 6B: Short Papers II C400
15:00 - 15:30	COFFEE BREAK							CLOSING CEREMONY Theatre	
15:30 - 17:00	Enterprise Security Workshop Session 4 C400	Quality of Service Assurance Workshop Session 2 HSBC Hall	Session 2A: Performance Evaluation HSBC Hall	Session 2B: Cloud Computing and IoT Theatre	Session 2C: Short Papers I C400	Session 4A: Energy Efficiency & Fault Tolerance Theatre	Session 4B: Pricing & Fairness HSBC Hall		
18:00 - 20:00	RECEPTION TELUS Innovation Centre 5th Floor, TELUS Garden 510 West Georgia Street					CONFERENCE BANQUET Cloud 9 Revolving Restaurant 42/ F, Empire Landmark Hotel 1400 Robson Street			

7th IEEE International Conference on Cloud Computing Technology and Science

IEEE CloudCom 2015

30 November – 3 December, 2015
Vancouver, Canada

Conference Program

Table of Contents

Message from the General Chairs 2
Message from the Program Chairs 3
Message from the Cloud Computing Association 4
Organizing Committee 5
Program Committee 7
Keynote Speaker: Dr. Mazin Yousif 13
Keynote Speaker: Prof. Jiannong Cao 14
Keynote Speaker: Dr. Greg Newby 15
Keynote Speaker: Mr. Peter Ashwood-Smith 16
Tutorials 17
Panels 19
Technical Program 20
The Second International Workshop on Enterprise Security 25
2nd IEEE STC CC and RDA Workshop on Curricula and Teaching Methods in Cloud Computing, Big Data, and Data Science 28
The First International Workshop on Quality of Service Assurance in the Cloud 30
Workshop on Delay-Sensitive Video Computing in the Cloud 32
Practical Information 34
Plan of Meeting Rooms 35
Map of Venues 36

Message from the General Chairs

Welcome to the 7th IEEE International Conference on Cloud Computing Technology and Science! CloudCom 2015 will be held in Vancouver, Canada from 30 November to 3 December, 2015 at the Robson Square Campus of the University of British Columbia in downtown Vancouver. One of the premier conferences on cloud computing, CloudCom 2015 is sponsored by the Technical Committee on Scalable Computing (TCSC) and the Special Technical Community on Cloud Computing of the IEEE Computer Society, the IEEE Vancouver Section, the IEEE Cloud Computing Initiative, and the Cloud Computing Association, in cooperation with Compute Canada. We extend a warm welcome to delegates from industry and academia to join us for four exciting days of new ideas dissemination and technical discussions.

The Technical Program Committee under the outstanding leadership of TPC Co-chairs, Dr. Sathish Gopalakrishnan and Dr. Bingsheng He, and the respective Track Co-chairs, have put in a tremendous amount of efforts to assemble an excellent technical program, for which we show our sincere appreciation. The technical program is made possible by the high-quality submissions from the authors and the rigorous reviews by the reviewers and TPC members, for which we are truly grateful. We thank the keynote speakers, Mr. Peter Ashwood-Smith, Dr. Jiannong Cao, Dr. Greg Newby and Dr. Mazin Yousif, for contributing their valuable time to share their unique perspectives of cloud computing with us in CloudCom 2015. We anticipate informative and enlightening keynote presentations from them. The technical program is rounded out by two tutorials, two panel sessions, a poster session, and a PhD consortium, in addition to three workshops that are integrated into the conference. We thank the fellow members of the Organizing Committee, the organizers of the collocated workshops, and the student volunteers for their efforts in bringing such variety to the technical program, helping to stimulate interesting discussions in the conference, and making sure that the conference runs without a glitch. The strong support of the CloudCom Steering Committee chaired by Dr. Chunming Rong and Dr. Martin Gilje Jaatun is also very much appreciated.

Special thanks go to our Diamond Corporate Sponsor, TELUS, our Gold Corporate Sponsors, Huawei and IBM, and our Silver Corporate Sponsor, Bravolol. Their financial contributions allow us to plan an outstanding conference program. Delegates should not miss the social events, including the reception at the TELUS Innovation Centre in downtown Vancouver, and the banquet at the Cloud 9 Revolving Restaurant. We sincerely hope that you will find the conference program and the networking opportunity rewarding. Our best wishes to you and yours for a most enjoyable visit to Vancouver, ranked third among the most liveable cities in the world in 2015 by the Economist Magazine, and to the Province of British Columbia, Canada, where natural beauties and the opportunities for outdoor adventures abound.

Victor C.M. Leung, The University of British Columbia, Canada
Albert Y. Zomaya, The University of Sydney, Australia

Message from the Program Chairs

We are excited to present the Proceedings of CloudCom 2015, the 7th IEEE International Conference on Cloud Computing Technology & Science. CloudCom 2015 is sponsored by the IEEE Computer Society, the Cloud Computing Association, and the IEEE Vancouver Section.

Research in cloud computing continues to grow, and this is marked by the emergence of several related conferences and journals in the field. CloudCom 2015 received 250 submissions across the main conference, the PhD consortium, and the posters & demonstrations session. 190 of these 250 submissions were for the main conference, of which 46 (24% acceptance rate) were selected by the program committee to be presented at the conference and for inclusion in the proceedings.

The program committee was organized into different tracks:

- Architecture and Virtualization
- Services and Applications
- Internet of Things and Mobile in the Cloud
- Big Data
- High Performance Computing in the Cloud
- Security and Privacy

Each track had two track chairs who, with assistance from an able track committee, drove the review process and the selection of articles for the conference. The average number of reviews per submission was (about) 3.85. The overall program committee for the main conference comprised of more than 175 scholars working on different aspects of cloud computing. We thank the track chairs and the PC members for the excellent work they did in reviewing the submissions and providing feedback to authors.

CloudCom is a great conference because of the high-quality of submissions. We thank all the authors who submitted their work to CloudCom 2015; only a fraction of them will present their work at the conference but everyone who submitted their work deserves some credit for advancing the technology and practices around cloud computing.

As Program Co-Chairs, we also want to acknowledge the support and guidance from the CloudCom Steering Committee, particularly the Steering Committee Chairs, Dr. Martin Gilje Jaatun and Prof. Chunming Rong, as well as from the General Chairs, Profs. Victor Leung and Albert Zomaya.

We hope you will find the final program for CloudCom 2015 stimulating and inspiring, and trust that the symposium will provide you with a valuable opportunity to network and discuss ideas with researchers and practitioners from around the world.

Sathish Gopalakrishnan, The University of British Columbia, Canada
Bingsheng He, Nanyang Technological University, Singapore

Message from the Cloud Computing Association – CloudCom.org

The Cloud Computing Association initiated the annual "International Conference on Cloud Computing (CloudCom)" in 2009, which since 2010 has been known as the "IEEE International Conference on Cloud Computing Technology and Science". CloudCom was successfully held in Beijing, China (2009), Indianapolis, USA (2010), Athens, Greece (2011), Taipei, Taiwan (2012), Bristol, UK (2013), and Singapore (2014). In addition, we have also organized a large number of international workshops as part of other conferences.

As the latest installment of our main conference, CloudCom 2015 has confirmed its position as one of the premier international conferences in the cloud computing space, experienced sustained interest, contributions and sponsorship from many academic and industrial research groups. We would like to thank the local organizers from the University of British Columbia for an impressive job – and the sponsors IEEE, IEEE CS, IEEE TCSC, IEEE Vancouver Section, and IEEE Cloud Computing for their support.

The number of submissions confirms the enduring interest in cloud computing from the international research community. We are immensely grateful to the contributing authors, and we offer special thanks to our technical program committee members and external reviewers who did a great job in reviewing the large amount of high-quality papers.

We also extend our thanks to the keynote speakers, tutorial speakers, panelists, and the members of the CloudCom Steering and Advisory Committees. Special thanks to those who helped promote the conference, particularly the program chairs, track chairs and workshop chairs. Academic conferences like CloudCom rely on such hard-working volunteers for their existence!

Chunming Rong, University of Stavanger, Norway
Chair, Steering Committee, CloudCom.org

Martin Gilje Jaatun , SINTEF, Norway
Vice Chair, Steering Committee, CloudCom.org

The Cloud Computing Association (www.cloudcom.org) is a global, nonprofit member organization that shall promote the development of cloud computing technology and related matters. The Cloud Computing Association is registered in Norway and was founded by a global group of experts interested in cloud computing technology. You may join us through LinkedIn (gid=1864932) and follow us on Twitter (@CloudCom_Org).

Organizing Committee

General Chairs

Victor C.M. Leung, *The University of British Columbia, Canada*
Albert Y. Zomaya, *The University of Sydney, Australia*

Steering Committee

Chunming Rong (chair), *University of Stavanger, Norway*
Martin Gilje Jaatun (vice-chair), *SINTEF, Norway*
Albert Y. Zomaya, *The University of Sydney*
Stephen L. Diamond, *IEEE Cloud Computing Initiative, USA*

Programme Chairs

Sathish Gopalakrishnan, *The University of British Columbia, Canada*
Bingsheng He, *Nanyang Technological University, Singapore*

Workshops and Tutorials Chairs

Henry Chan, *The Hong Kong Polytechnic University, China*
Abdallah Shami, *Western University, Canada*

Posters and Demo Chairs

Hui-huang Hsu, *Tamkang University, Taiwan*
F. Richard Yu, *Carleton University, Canada*

Panel Chair

Rodger Lea, *The University of British Columbia, Canada*

Student Travel Grants and PhD Forum Chairs

Yan Bai, *University of Washington Tacoma, USA*
Lin Li, *Prairie View A&M University, USA*

Publicity Chairs

Periklis Chatzimisios, *Alexander Technological Educational Institute of Thessaloniki, Greece*
Yonggang Wen, *Nanyang Technological University, Singapore*
Honggang Wang, *University of Massachusetts, Dartmouth, USA*
Jinsong Wu, *Universidad de Chile, Chile*

Sponsorship Chairs

Panos Nasiopoulos, *The University of British Columbia, Canada*
Michael Hrybyk, *BC Net, Canada*
Xiping Hu, *The University of British Columbia, Canada*

Publication Chair

Zhengguo Sheng, *University of Sussex, UK*¸

Registration Chair

Farshid Agharebparast, *The University of British Columbia, Canada*

Local Arrangement Chairs

Bob Gill, *British Columbia Institute of Technology, Canada*
Xiaofei Wang, *The University of British Columbia, Canada*
Chunsheng Zhu, *The University of British Columbia, Canada*

Financial Chair

Mahsa Pourazad, *TELUS, Canada*

Web Chair

Wei Cai, *The University of British Columbia, Canada*

Program Committee

Program Chairs

Sathish Gopalakrishnan, The University of British Columbia
Bingsheng He, Nanyang Technological University

Architecture Track

Track Chairs
Stefan Schmid, TU-Berlin
Xun Luo, Qualcomm

Program Committee Members
Hung-Chang Hsiao, National Cheng Kung University
Gabor Kecskemeti, MTA SZTAKI
Chandra Sekaran, NITK
Xiaofei Wang, Seoul National University
Craig Lee, The Aerospace Corporation
Francisco Brasileiro, UFCG
Saeid Abolfazli, University of Malaya
Syed Ali Haider, SEECS-NUST
Sheng Di, INRIA
Vineet Chadha, Nvelo R& D, Samsung
Josef Spillner, TU Dresden
Eduardo Jacob, University of the Basque Country
Gilles Fedak, INRIA, University of Lyon
Ramin Yahyapour, GWDG - University of Göttingen
Erwin Laure, KTH/PDC
Jiannong Cao, Hong Kong Polytechnic Univ.
Hong Xu, City University of Hong Kong
Hemant Mehta, Senior Member, IEEE
Xingwei Wang, Northeastern University
Chunming Hu, Beihang University
Alexandru Iosup, Delft University of Technology
Annette Bieniusa, University of Kaiserslautern
Thomas Bauschert, TU Chemnitz
Pietro Michiardi, Eurecom
Annappa B, NITK
Tyng-Yeu Liang, National Kaohsiung University of Applied Sciences
Oliver Hohlfeld, RWTH Aachen University
Bo Yang, University of Electronic Science and Technology of China
Jakub Szefer, Yale University
David Hausheer, TU Darmstadt
Rajesh Ingle, IEEE Pune Section
Wolfgang Kellerer, Technische Universität München
Tamas Lukovszki, Eötvös Loránd University, Budapest
Burkhard Stiller, University of Zurich

Lutz Schubert, OMI, University of Ulm
Rick McGeer, Communication Design Group, SAP and US Ignite
Qingjiang Tian, Qualcomm
Justin Cappos, New York University
Yvonne Coady, UVic
Patrick Stuedi, IBM Research
Holger Karl, University Paderborn
Marko Vukolic, IBM Research - Zurich
Catalin Meirosu, Ericsson Research

Big Data Track

Track Chairs
Jinjun Chen, University of Technology
Tomasz Wiktorski, University of Stavanger

Program Committee Members
Ioan Raicu, Illinois Institute of Technology
Florin Isaila, University Carlos III of Madrid
Julian Kunkel, Universität Hamburg
Shadi Ibrahim, Inria, Rennes Bretagne Atlantique Research Center
Bruce Hendrickson, Sandia National Labs
Samer Al-Kiswany, The University of British Columbia
Jesus Carretero, Universidad Carlos III de Madrid
Bogdan Nicolae, IBM Research (Ireland)
Wolfgang Nagel, ZIH, TU Dresden
Jay Lofstead, Sandia National Laboratories
Adrien Lèbre, Inria / Ecole des Mines
Domenico Talia, University of Calabria
Maria Perez, Universidad Politecnica de Madrid
Radu Prodan, University of Innsbruck
Félix Cuadrado, Queen Mary University of London
Andre Brinkmann, Johannes Gutenberg-Universität Mainz
Juan Tirado, INRIA
Javier Blas, Carlos III University
Dana Petcu, West University of Timisoara
Dries Kimpe, KCG Holdings, Inc.
Matei Ripeanu, The University of British Columbia
Ali Butt, Virginia Tech
Dan Reed, University of Iowa
Ian Foster, Argonne National Laboratory & The University of Chicago
Geoffrey Fox, Community Grids Lab, Indiana University
Yogesh Simmhan, Indian Institute of Science
Kyle Chard, Computation Institute, University of Chicago and Argonne National Lab
Yong Zhao, University of Electronic Science and Technology of China
Osamu Tatebe, University of Tsukuba
Douglas Thain, University of Notre Dame
Yong Chen, Texas Tech University

Alexandru Iosup, Delft University of Technology
Zhou Quan, Guangzhou University
Rui Pais, University of Stavanger
Rui Esteves, University of Stavanger
Raymond Hansen, Purdue University

Security and Privacy Track

Track Chairs
Wenbo He, McGill University
Mahesh Tripunitara, University of Waterloo

Program Committee Members
Wei Gong, Tsinghua University
Kui Ren, State University of New York at Buffalo
Honggang Wang, University of Massachusetts
Yuan He, HKUST
Trent Jaeger, The Pennsylvania State University
Yinqian Zhang, The Ohio State University
Cong Wang, City University of Hong Kong
Yu Hua, HUST
Alexander Pretschner, Technische Universität München
Florian Kerschbaum, SAP
Aniket Kate, MMCI, Saarland University
Chadi Assi, Concordia University
Bogdan Carbunar, Motorola Labs
Noman Mohammed, University of Manitoba
Gang Tan, Lehigh University
Danfeng Yao, Virginia Tech
William Harris, Georgia Institute of Technology
Raphael M. Reischuk, ETH Zürich
Limin Jia, Carnegie Mellon University
Karthick Jayaraman, Microsoft
Ian Molloy, IBM Research
Siddharth Garg, NYU
Rakesh B. Bobba, Oregon State University
Ninghui Li, Purdue University
Balaji Palanisamy, University of Pittsburgh
Rich Wolski, UCSB
Ryan Henry, Indiana University
Alireza Shameli, McGill University

Services and Applications Track

Track Chairs
Patrick Hung, University of Ontario Institute of Technology
Radu Prodan, University of Innsbruck

Program Committee Members

Hong-Linh Truong, Vienna University of Technology, Vienna, Austria
Simon Ostermann, University of Innsbruck
Juan J. Durillo, University of Innsbruck
Rubing Duan, IHPC
Jorge Barbosa, FEUP
Alexandru Iosup, Delft University of Technology
Vlado Stankovski, University of Ljubljana
Frederic Suter, CC IN2P3 / CNRS
Ana-Maria Oprescu, Universiteit van Amsterdam
Gabor Kecskemeti, MTA SZTAKI
Carson K. Leung, University of Manitoba, Canada
Chang Hong Lin, National Taiwan University of Science and Technology
Shih-Hao Hung, National Taiwan University
Sven Groppe, University of Lbeck
Mehdi Bahrami, University of California, Merced
Filipe Araujo, University of Coimbra
Raymond Wong, University of New South Wales
Pedro Furtado, University Coimbra / CISUC
Luis Veiga, Instituto Superior Técnico, Universidade de Lisboa / INESC-ID Lisboa
Marco Vieira, University of Coimbra
Ajay Deshpande, IBM
Nuno Laranjeiro, University of Coimbra
Suzanne Mcintosh, NYU Courant Institute, and Cloudera Inc.
Yutao Ma, Wuhan University
Victor M. Gonzalez, Instituto Tecnológico Autónomo de México
Victor Manuel Landassuri Moreno, Centro Universitario UAEM Valle de Mexico
Eleanna Kafeza, Athens University of Economics and Business
Stanislav Sobolevsky, MIT
Mutaz Beraka, King Saud University
Fang Yu, National Chengchi University
Naghmeh Ivaki, University Of Coimbra
Luis Razo, CINVESTAV Unidad Guadalajara
Jing Zhang, UC,Irvine
Luis Rodríguez, Cinvestav
Andrea Perego, European Commission - Joint Research Centre
Huang-Chia Shih, Yuan Ze University
Angel Kuri-Morales, ITAM
Dana Petcu, West University of Timisoara
Florin Pop, University Politehnica of Bucharest
Hamid Arabnejad, FEUP (Faculty of Engineering, University of Porto)
Shajulin Benedict, HPCCLoud Research Laboratory, SXCCE, Anna University
Petr Novotny, Imperial College London
Amr Alasaad, UBC
Min-Chun Hu, National Cheng Kung University
Qixin Wang, The Hong Kong Polytechnic University
Haopeng Chen, Shanghai Jiao Tong University
Wei-Feng Tung, Fu Jen Catholic University
Xiuquan Qiao, Beijing University of Posts and Telecommunications

Kelvin Tsoi, Chinese University of Hong Kong
Nikolay Kazantsev, National Research University Higher School of Economics
Paolo Trunfio, DEIS, University of Calabria
Attila Kertesz, University of Szeged
Carmela Comito, ICAR-CNR
Zsolt Nemeth, SZTAKI
Charles Shoniregun, Infonomics Society
Ruppa Thulasiram, University of Manitoba
Laura Ricci, dipartimento di informatica, Univ. di Pisa
Fabio Souza, UFPE
Richard Lomotey, University of Saskatchewan
Bo-Hao Chen, National Taipei University of Technology

HPC on Cloud Track

Track Chairs
Matei Ripeanu, University of British Columbia
Thomas Hacker, Purdue University

Program Committee Members
Ioannis Papapanagiotou, Purdue University
Paul Watson, Newcastle University
Thilo Kielmann, Vrije Universiteit
Yung-Hsiang Lu, Purdue University
Lucas Nussbaum, LORIA - ALGORILLE
Yong Zhao, University of Electronic Science and Technology of China
Alexandru Iosup, Delft University of Technology
Eric Matson, Purdue University
Gilles Fedak, INRIA, University of Lyon
Dean Hildebrand, IBM
Suzanne Shontz, University of Kansas
Huashan Yu, School of Electronic Engineering and Computer Science, Peking University
Ioan Raicu, Illinois Institute of Technology
Samer Al-Kiswany, The University of British Columbia
Heiko Schuldt, University of Basel
Brian Bockelman, University of Nebraska-Lincoln
Qing He, Institute of Computing Technology, CAS

IoT and Mobile on Clouds

Track Chairs
Jiannong Cao, Polytechnic University of Hong Kong
Yan Zhang, Simula Research Lab

Program Committee Members
Yang Song, IBM
Edith Ngai, Uppsala University
Kevin Pang, Telus

Feng Wang, The University of Mississippi
Jiangchuan Liu, Simon Fraser University
Amr Alasaad, UBC
Laurence Yang, St Francis Xavier University
Kaveh Shafiee, Huawei Technologies Canada
Melike Kantarci, Clarkson University
Enzo Mingozzi, University of Pisa
Vojislav Misic, Ryerson University
Jelena Misic, Ryerson University
Yan Bai, University of Washington Tacoma
Rong Yu, Guangdong University of Technology
Shiwen Mao, Auburn University
Hassnaa Moustafa, Intel
Sergio Rodriguez, University of Málaga
George Alexandropoulos, Huawei Technologies

General Track

Track Chairs
Bingsheng He, Nanyang Technological University

Program Committee Members
Rajdeep Bhowmik, CISCO Systems
Young Choon Lee, Macquarie University
Junyuan Zeng, The University of Texas at Dallas

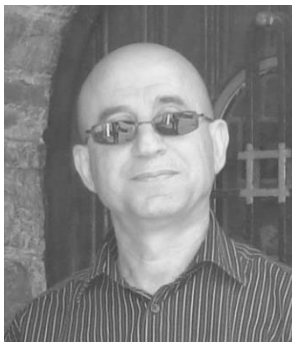
Posters/Demos Track

Track Chairs
Hui-Huang Hsu, TKU
F. Richard Yu, Carleton University

Program Committee Members
Bo Rong, CRC
Shengrong Bu, University of Glasgow
Xi Zhang, Texas A&M University
Pengbo Si, Beijing University of Technology
Chengchao Liang, Carleton University
Lei Chen, Beijing University of Posts and Telecommunications
Kan Wang, Xidian University
Gang Liu, Southwest Jiaotong University
Jie Guo, Xidian University
Bao Rong Chang, National University of Kaohsiung
Chi-Yi Lin, Tamkang University
Daniel Xiapu Luo, The Hong Kong Polytechnic University
Chao-Tung Yang, Tunghai University
Xianghan Zheng, FuZhou University

Keynote Speaker: Dr. Mazin Yousif

Managing Sprawl of Cloud Services and Data Everywhere in an Enterprise



Dr. Mazin Yousif, CTO and VP Architecture, T-Systems International
Tuesday, 1 December 2015, 9:00-9:45 am, Theatre

Abstract: We are entering an era where we are able to digitize almost everything and whatever we digitize, we are surely able to connect and analyze. At the same time, we have evolved our computing paradigms where now we have remarkable Computing/Storage/Networking power. Such capabilities are enabling us to introduce trends such as Smart Mobility, Cloud Computing, Big Data, Internet of Things and Social. They are also enabling major innovations in all industry sectors. Cloud computing is making it easier for enterprises to procure all types of services. But at the same time, it is introducing an undesirable consequence and complexity in dealing with the many types of cloud services and the many vendors delivering them. Additionally we are generating incredible amounts of data and scattering them in all over the place – Data Everywhere. This talk will provide my views on how best to approach such sprawl of cloud services and scattered data and bring all together to give an enterprise a good handle to managing them. In this talk, I will discuss the role of services/technologies such as Data-Orchestration-as-a-Service (DOaaS), Integrated Platform-as-a-Service (iPaaS) and Data Virtualization to build unified integrated end-to-end cloud services.

Biography: Dr. Yousif is the Chief Technology Officer and Vice President of Architecture for the Royal Dutch Shell Global account at T-Systems, International. Before joining T-Systems, he spent some time with IBM Canada GTS, Avirtec and Intel. He was also a Professor at Louisiana Tech University. Dr. Yousif serves as a Technology Advisor, Board Member and investor for Simudyne Corporation. He is also a Board Member for Stafford & Associates. He chairs the Advisory Board of the European Research Consortium for Informatics and Mathematics (ERCIM). He is also the Editor-in-Chief of the *IEEE Cloud Computing Magazine.* He founded the NSF Industry/University Cooperative research Center for Autonomic Computing. He was a principal leader defining the InfiniBand Architecture and co-chaired the management working group in the InfiniBand Trade Association. He was an adjunct professor in several universities including Duke, NCSU, OGI and Arizona. He has served as the General Chair or Program Chair for many conferences and serves in the editorial board of many journals. He is a frequent speaker in academic and industry conferences on topics related to cloud computing, big data and autonomic computing. He has also published extensively and was an IEEE Distinguished Visitors Program speaker from 2008 – 2013. Dr. Yousif finished his Master (Electrical Engineering) and Ph.D. (Computer Engineering) degrees from the Pennsylvania State University in 1987 and 1992, respectively.

Keynote Speaker: Prof. Jiannong Cao

Cloud Augmented Mobile Applications: Research Framework and Challenging Issues

Dr. Jiannong Cao, Chair Professor and Head of the Department of Computing at The Hong Kong Polytechnic University

Tuesday, 1 December 2015, 9:45-10:30 am, Theatre

Abstract: Mobile cloud computing (MCC) has emerged as a new paradigm of cloud computing. It offers great opportunities for mobile service industry, allowing mobile devices to access the applications and utilize the elastic resources offered by the cloud. When cloud meets mobile, there are many interesting applications and challenging issues to address. In this talk, I mainly focus on the state-of-arts and main techniques for cloud augmented mobile applications, which leverage the cloud to improve the user experiences or save energy consumption for the mobile applications. I will first describe emerging mobile applications which are made possible by using cloud resources, and present the framework for realizing such applications. I will then focus on the major research issues, including computation offloading, data/service placement and load dispatching. Finally, I will highlight the open issues and future directions in the topic areas.

Biography: Dr. Cao is currently a chair professor and head of the Department of Computing at Hong Kong Polytechnic University, Hung Hom, Hong Kong. His research interests include parallel and distributed computing, computer networks, mobile and pervasive computing, fault tolerance, and middleware. He has co-authored 3 books, co-edited 9 books, and published over 300 papers in major international journals and conference proceedings. He is a fellow of IEEE, a senior member of China Computer Federation, and a member of ACM. He was the Chair of the Technical Committee on Distributed Computing of IEEE Computer Society from 2012 - 2014. Dr. Cao has served as an associate editor and a member of the editorial boards of many international journals, including *ACM Transactions on Sensor Networks*, *IEEE Transactions on Computers*, *IEEE Transactions on Parallel and Distributed Systems*, *IEEE Networks*, *Pervasive and Mobile Computing Journal*, and *Peer-to-Peer Networking and Applications*. He has also served as a chair and member of organizing / program committees for many international conferences, including PERCOM, INFOCOM, ICDCS, IPDPS, ICPP, RTSS, DSN, ICNP, SRDS, MASS, PRDC, ICC, GLOBECOM, and WCNC. Dr. Cao received the BSc degree in computer science from Nanjing University, Nanjing, China, and the MSc and the Ph.D. degrees in computer science from Washington State University, Pullman, WA, USA.

Keynote Speaker: Dr. Greg Newby

Compute Canada: A National Cloud Computing Resource for Research Excellence

Dr. Greg Newby, CTO, Compute Canada
Wednesday, 2 December 2015, 9:00-9:45 am, Theatre

Abstract: In this presentation, Dr. Newby will share the technology deployment plans for cloud activities as Compute Canada undergoes a major technology refresh and develops national research cloud resources. Three out of the four new high performance computing systems will provide OpenStack-based partitions, meeting needs for Platform as a Service (PaaS) and other usage. At the same time, object storage will be utilized to increase data availability, reliability, multi-tenancy, and other needed features. Researchers will be able to specify the mix of resources they need such as: different storage pools, data access mechanisms, long-lived Web or database services, computing capabilities from a single virtual machine or an entire cluster, visualization and analytic services. Participants will learn how the cloud and high-performance computing resources and services are becoming more integrated, and some of the opportunities this will create for productivity and outcomes in computationally-based science and engineering.

Biography: Dr. Gregory Newby is Compute Canada's Chief Technology Officer. He has a passion for enabling diverse scientific, social and educational opportunities and has devoted his professional career to advanced research computing. Born in Montreal, Dr. Newby received his doctorate in Information Transfer from Syracuse University and most recently completed an M.B.A. in Sustainable Systems from the Bainbridge Graduate Institute of Pinchot University. Dr. Newby also obtained a Masters in Communications from University at Albany, State University of New York. Author of several books and numerous publications, Dr. Newby was a faculty member at two major US universities where he developed and taught courses in information systems, information security, and computer technology. His most recent roles include Manager of the Supercomputing Core Laboratory at King Abdullah University of Science and Technology in Saudi Arabia. Dr. Newby was Director of the Arctic Region Supercomputing Center at the University of Alaska Fairbanks, where he also served as a faculty member for 11 years.

Keynote Speaker: Mr. Peter Ashwood-Smith

5G ITS and Implications on the Wireline Network

Peter Ashwood-Smith, Technical VP-Optical, Huawei
Wednesday, 2 December 2015, 9:45-10:30 am, Theatre

Abstract: We will look at the proposed requirements and vision for 5g after which we will look at some of the implications on the wire-line network which must support the radio side. Of particular interest is the new concept of "slicing" which affects the network end to end and how cloud computing is essential to implement these capabilities.

Biography: Peter Ashwood-Smith (peter.ashwoodsmith@huawei.com) is a Huawei Senior Researcher and Technical VP-Optical with B.S and M.S. degrees in Computer Science. He has worked on the design, standardization, implementation, deployment, and large scale support of many modern transport networking protocols (for example, early proprietary label switched networks and then standards based versions such as ATM, MPLS, ASON and GMPLS). More recently Peter has been involved in the design, implementation standardization and prototyping of new Ethernet control protocols which are also being deployed in hundreds of smaller networks and data centers. Peter's recent work revolves around Transport SDN/NFV the complex traffic engineering problems and the high speed architectures required to support them. Prior to working for Huawei, Peter worked at Nortel Networks for over 20 years where he was promoted to the most senior technical position of Fellow. Peter left Nortel to join Huawei in 2009. Peter currently holds nearly 100 patents in networking and related fields including the basic design of GMPLS. Peter now leads research activities around TSDN in Huawei and was recently elected as ITU-T fixed line 5G focus group chairman.

Tutorials

Tutorial 1: Mobile Cloud Computing and Cloudlets

Monday, 30 November 2015, 9:00-10:30 am, HSBC Hall

Presenter: ***Prof. Chen-Khong Tham, Department of Electrical & Computer Engineering, National University of Singapore, Singapore***

Synopsis The basic premise of mobile cloud computing is to overcome the limitations of mobile devices by offloading processing and storage to the abundant computational and storage resources on the cloud, and/or, to a smaller extent, those of neighbouring mobile devices in the vicinity. The latter is commonly referred to as ad hoc mobile cloud computing or cloudlets. The advantages of these approaches include reduced battery usage for the originating mobile device and faster execution of computation-intensive tasks. This area has attracted a lot of research and development interest in recent years.

However, there are still challenging issues in mobile cloud computing that need to be addressed which arise from the uncertainties in the availability and quality of the wireless connections between the user's source device and the cloud and other host devices in the neighbourhood, and the availability of computational or storage resources on potential host devices. It is common for several alternative host devices or wireless connection methods with different characteristics and costs to exist. In addition, the potential host devices are sometimes owned by other users who have different degrees of willingness for their devices to execute other users' tasks.

In order to handle the scenarios mentioned above and to achieve good performance, optimization-based, stochastic programming and Markov Decision Process (MDP) methods have been proposed to perform resource management in mobile cloud computing. Game theoretic methods may also be applied to incentivize nodes to cooperate in a systematic way. This tutorial will present how these methods can be applied in mobile cloud computing systems and discuss the achievable performance and overheads involved.

Topics

1. Background and Technologies
   - Application requirements and offloading
   - Some implementation examples
2. Requirements of Mobile Cloud Computing
   - Application partitioning and VM migration
   - Wireless network configurations, intermittent connectivity
   - Infrastructure cloud vs cloudlets
3. Resource Management Methods for Mobile Cloud Computing
   - Optimization-based
   - Stochastic Programming
   - Markov Decision Process (MDP)
4. Cooperation in Mobile Cloud Computing
   - Game theoretic formulations
5. Conclusion and Future Directions

Biography Chen-Khong Tham is an Associate Professor at the Department of Electrical and Computer Engineering (ECE) of the National University of Singapore (NUS). His current research focuses on sensor network infrastructures and real-time sensor data analytics involving cyber-physical systems, wireless sensor networks, cloud computing and participatory sensing. He was an early proponent of the SensorGrid architecture. From 2007-10, he was on secondment at A*STAR Institute for Infocomm Research (I2R) Singapore and served as principal scientist and department head of the Networking Protocols Dept. From 2006-09, he was the programme manager of a multi-institution research programme on UWB-enabled Sentient Computing (UWB-SC) funded by A*STAR Singapore. He obtained his Ph.D. and M.A. degrees in Electrical and Information Sciences Engineering from the University of Cambridge, United Kingdom, and was an Edward Clarence Dyason Universitas21 Fellow at the University of Melbourne, Australia. He is an associate editor of *the IEEE Internet of Things Journal (IoT-J)* and is in the editorial board of the International Journal of Network Management. He was the general chair of IEEE SECON 2014, IEEE AINA 2011 and IEEE APSCC 2009.

Tutorial 2: Apache Hadoop System

Thursday, 3 December 2015, 9:00-10:30 am, Theatre

Presenter: ***Dr. Hong Li, Senior Software Engineer-Big Data, Conviva Inc. USA***

Synopsis This tutorial will walk you through many aspects of the Apache Hadoop system. The goal of the tutorial is to help you understand the scope of problems applicable to Hadoop and understand how Hadoop addresses these problems differently from other distributed systems.

Topics

- What is Big Data?
- Problem Scope
- Solving the problem with Hadoop
- Introduction to Hadoop
- Hadoop Eco-system
- Hadoop Core Components
- HDFS Architecture
- MapReduce Job execution
- Hadoop 2.0 (YARN or MRv2) Architecture

Biography Dr. Hong Li obtained her Ph.D. degree from the Electrical and Computer Engineering Department of McGill University in Canada. Her current research focuses are on big data systems design and big data analytics using Hadoop and Spark. From 2004 to 2009, Dr. Li was a Ph.D. researcher at McGill University, where her research focused on adaptive, scalable and quality-of-service routing for Voice- over-IP in dynamic networks using reinforcement learning algorithms. The improvement in VoIP quality obtained by her novel learning algorithms is quite significant and a report of invention has been filed for that. Dr. Li has worked on different aspects of distributed system R&D after getting her PhD. She has worked on Hadoop systems on large hadoop clusters with thousands of nodes in eBay where she also contributed to the open source Hadoop project. She is now a Senior Software engineer working on R&D in big data systems at Conviva inc., a startup focusing on big data analytics for video streaming quality and video streaming quality intelligent control, founded by Professor Hui Zhang of CMU and Professor Ion Stoica of UC Berkeley.

Panels

Panel 1: IoT, SDN and 4G/5G + Cloud: Economic Potentials vs. Security & Privacy Concerns

Tuesday, 1 December 2015, 1:30 – 3:00 pm, Theatre

Synopsis Developments in 5G, IoT and SDN all seem to involve the cloud, but individuals and organisations remain wary of putting sensitive data in the cloud. This leads to various hybrid cloud solutions which rely on data classification and segregation to keep some data in-house. Is this development breaking the vision of the cloud? Alternatively, is it possible to build an accountable public cloud that can be entrusted with our deepest secrets? How can this be done now that Safe Harbour is dead?

Moderator: ***Dr. Martin Gilje Jaatun, SINTEF***

Panelists: ***Mr. Peter Ashwood-Smith, Huawei***

Prof. Jiannong Cao, Hong Kong Polytechnic University

Prof. Thomas J Hacker, Purdue University

Dr. Greg Newby, Compute Canada

Prof. Chunming Rong, UiS / IEEE Cloud Computing

Panel 2: Opportunities and Challenges of Globally Networked Sensors and Cameras

Wednesday, 2 December 2015, 1:30 – 3:00 pm, Theatre

Synopsis The panel will focus on the opportunities and challenges posed by the emergence of globally networked sensors and cameras. The data generated by these instruments must be collected, stored, and analyzed to extract knowledge from these data. The underlying characteristics of the Internet pose a significant challenge in developing and deploying the distributed cloud computing environment needed to process these data. Factors such as available bandwidth, network latency between sensors and processing, and security all pose significant barriers to fully realizing the potential value from these sensors.

Moderator: ***Prof. Thomas J Hacker, Purdue University***

Panelists: ***Prof. Nirwan Ansari, New Jersey Institute of Technology***

Dr. Rodger Lea, University of British Columbia

Prof. Yung-Hsiang Lu, Purdue University

Prof. Edith Ngai, Uppsala University

Prof. Chen-Khong Tham, National University of Singapore

Technical Program

Tuesday, 1 December, 2015, 11:00 am – 12:30 pm

Session 1A: Big Data and HPC (Theatre, Chair: Edith Ngai)

1. SmartFetch: Efficient Support for Selective Queries. *Manuel Ferreira, João Paiva, Manuel Bravo, and Luís Rodrigues*

2. Record-Aware Two-Level Compression for Big Textual Data Analysis Acceleration. *Dapeng Dong and John Herbert*

3. Adaptive Cloud Resource Allocation for Analysing Many Video Streams. *Wenyi Chen, Yung-Hsiang Lu, and Thomas J. Hacker*

4. HPCCloud: A Cloud/Web-Based Simulation Environment. *Patrick O'Leary, Mark Christon, Sébastien Jourdain, Chris Harris, Markus Berndt, and Andrew Bauer*

Session 1B: Security and Privacy I (C400, Chair: Martin Gilje Jaatun)

1. Security Compliance Auditing of Identity and Access Management in the Cloud: Application to OpenStack. *Suryadipta Majumdar, Taous Madi, Yushun Wang, Yosr Jarraya, Makan Pourzandi, Lingyu Wang, and Mourad Debbabi*

2. VISO: Characterizing Malicious Behaviors of Virtual Machines with Unsupervised Clustering. *Yen-Han Li, Yeu-Ruey Tzeng, and Fang Yu*

3. Friend or Foe? Detecting and Isolating Malicious Nodes in Mobile Edge Computing Platforms. *Abderrahmen Mtibaa, Khaled Harras, and Hussein Alnuweiri*

4. Security-as-a-Service for Microservices-Based Cloud Applications. *Yuqiong Sun, Susanta Nanda, and Trent Jaeger*

Session 1C: Architecture I (Resource Management)
(HSBC Hall, Chair: Farshid Agharebparast)

1. Gemini: An Adaptive Performance-Fairness Scheduler for Data-Intensive Cluster Computing. *Zhaojie Niu, Shanjiang Tang, and Bingsheng He*

2. Prediction-Based Admission Control for IaaS Clouds with Multiple Service Classes. *Marcus Carvalho, Daniel Menascé, and Francisco Brasileiro*

3. Traffic-Aware Resource Controller for IaaS Clouds. *Koichi Onoue and Naoki Matsuoka*

4. Fast and QoS-Aware Heterogeneous Data Center Scheduling Using Locality Sensitive Hashing. *Mohammad Shahedul Islam, Matt Gibson, and Abdullah Muzahid*

Tuesday, 1 December, 2015, 3:30 – 5:00 pm

Session 2A: Services and Applications I (Performance Evaluation)
(HSBC Hall, Chair: Ali Kanso)

1. Let Latency Guide You: Towards Characterization of Cloud Application Performance. *Hamed Saljooghinejad, Felix Cuadrado, and Steve Uhlig*

2. An Evaluation Model for Selecting Cloud Services from Commercially Available Cloud Providers. *Shyam S. Wagle, Mateusz Guzek, Pascal Bouvry, and Raymond Bisdorff*
3. An Empirical Study for Evaluating the Performance of *jclouds. Marcelo Alexandre da Cruz Ismael, Cesar Alberto da Silva, Gabriel Costa Silva, and Reginaldo Ré*
4. A Classifier for the Latency-CPU Behaviors of Serving Jobs in Distributed Environments. *Christophe Restif, Natalia Ponomareva, and Krzysztof Ostrowski*

Session 2B: Cloud Computing and IoT (Theatre, Chair: Tomasz Wiktorski)

1. Governing Elastic IoT Cloud Systems under Uncertainty. *Stefan Nastic, Georgiana Copil, Hong-Linh Truong, and Schahram Dustdar*
2. Green Energy Aware Avatar Migration Strategy in Green Cloudlet Networks. *Xiang Sun, Nirwan Ansari, and Qiang Fan*
3. D-C LOC: A Delay Tolerant Cloud Formation Using Context-Aware Mobile Crowdsourcing. *Shahid Al Noor and Ragib Hasan*
4. Energy Efficiency as an Orchestration Service for Mobile Internet of Things. *Peramanathan Sathyamoorthy, Edith C.-H. Ngai, Xiping Hu, and Victor C. M. Leung*

Session 2C: Short Papers I (C400, Chair: Peter Van Roy)

1. Scheduling Data-Driven Workflows in Multi-cloud Environment. *Nafise Sooezi, Saeid Abrishami, and Majid Lotfian*
2. Dynamic Pricing Scheme: Towards Cloud Revenue Maximization. *Fadi Alzhouri and Anjali Agarwal*
3. A Middleware-Centric Optimization Approach for the Automated Provisioning of Services in the Cloud. *Karolina Vukojevic-Haupt, Santiago Gómez Sáez, Florian Haupt, Dimka Karastoyanova, and Frank Leymann*
4. Value and Energy Optimizing Dynamic Resource Allocation in Many-Core HPC Systems. *Amit Kumar Singh, Piotr Dziurzanski, and Leandro Soares Indrusiak*
5. The Ignite Distributed Collaborative Scientific Visualization System. *Sushil Bhojwani, Matthew Hemmings, Daniel Ingalls, Jens Lincke, Robert Krahn, David Lary, Patrick McGeer, Glenn Ricart, Marko Roeder, Yvonne Coady, and Ulrike Stege*
6. Prototyping Decomposed Cloud Software: A Case Study on 3D Skeletal Game Engine. *Minchen Li, Wei Cai, Ke Wang, Ji Hong, and Victor C. M. Leung*

Wednesday, 2 December, 2015, 11:00 am – 12:30 pm

Session 3A: Media, Social Media, and Gaming Applications
(HSBC Hall, Chair: Thomas Hacker)

1. Gaussian Mixture Model Based Interest Prediction In Social Networks. *Dongyun An, Xianghan Zheng, Chunming Rong, Tahar Kechadi, and Chong Cheng Chen*
2. Integration of an Assisted P2P Live Streaming Service in Community Network Clouds. *Mennan Selimi, Nuno Apolónia, Ferran Olid, Felix Freitag, Leandro Navarro, Agustí Moll, Roger Pueyo, and Luís Veiga*
3. Minimizing Resource Cost for Camera Stream Scheduling in Video Data Center. *Yihong Gao, Huadong Ma, Haitao Zhang, Xianda Yang, and Ning Cao*

4. DCRA: Decentralized Cognitive Resource Allocation Model for Game as a Service. *Nabil M. Al-Rousan, Wei Cai, Hong Ji, and Victor C. M. Leung*

Session 3B: Architecture II (Virtualization and Synchronization)
(Theatre, Chair: Fang Yu)

1. Diagnosing Virtualization Overhead for Multi-threaded Computation on Multicore Platforms. *Xiaoning Ding and Jianchen Shan*
2. vINT: Hardware-Assisted Virtual Interrupt Remapping for SMP VM with Scheduling Awareness. *Jian Li, Ruhui Ma, HaiBing Guan, and David S. L. Wei*
3. APLE: Addressing Lock Holder Preemption Problem with High Efficiency. *Jianchen Shan, Xiaoning Ding, and Narain Gehani*
4. IncludeOS: A Minimal, Resource Efficient Unikernel for Cloud Services. *Alfred Bratterud, Alf-Andre Walla, Hårek Haugerud, Paal E. Engelstad, and Kyrre Begnum*

Wednesday, 2 December, 2015, 3:30 – 5:00 pm

Session 4A: Architecture III (Energy Management and Fault Tolerance)
(Theatre, Chair: Yan Bai)

1. A Dual Delay Timer Strategy for Optimizing Server Farm Energy. *Fan Yao, Jingxin Wu, Guru Venkataramani, and Suresh Subramaniam*
2. Crowdware: A Framework for GPU-Based Public-Resource Computing with Energy-Aware Incentive Mechanism. *Zhongli Dong, Young Choon Lee, and Albert Y. Zomaya*
3. A QoS-Aware Data Reconstruction Strategy for a Data Fault-Tolerant Storage System. *Hsin-Wen Wei, Tseng-Yi Chen, Shuo-Han Chen, Nai-Yuan Jhang, Li-Zheng Liang, Chih-Ching Kuo, Tsan-sheng Hsu, and Wei-Kuan Shih*
4. Conflict-Free Partially Replicated Data Types. *Iwan Briquemont, Manuel Bravo, Zhongmiao Li, and Peter Van Roy*

Session 4B: Architecture V (Pricing-Based Schemes)
(HSBC Hall, Chair: Vladimir Vlassov)

1. On a Feedback Control-Based Mechanism of Bidding for Cloud Spot Service. *Zheng Li, Maria Kihl, and Anders Robertsson*
2. A Privacy and Price-Aware Inter-Cloud System. *Yuanfang Chi, Wei Cai, Zhen Hong, Henry C. B. Chan, and Victor C. M. Leung*
3. Providing Fairer Resource Allocation for Multi-tenant Cloud-Based Systems. *Jia Ru, John Grundy, Yun Yang, Jacky Keung, and Li Hao*
4. WAIO: Improving Virtual Machine Live Storage Migration for the Cloud by Workload-Aware IO Outsourcing. *Yaodong Yang, Hong Jiang, Bo Mao, Lei Tian, Yuekun Yang, and Junjie Qian*

Thursday, 3 December, 2015, 11:00 am – 12:30 pm

Session 5A: Services and Applications III (Cloud Computing Operations Management)
(Theatre, Chair: Enrica Zola)

1. Operation Changes Recommendation Method Using Histories of Operation Changes in Cloud

Computing Environment. *Shinya Kitajima, Shinji Kikuchi, and Yasuhide Matsumotoy*

2. Service-Level Agreement Durability for Web Service Response Time. *Hiranya Jayathilaka, Chandra Krintz, and Rich Wolski*
3. Evolutionary Algorithm with AHP Decision-Making Method for Cloud Workflow Service Composition. *Miao Zhang and Li Liu*
4. An Autonomous Data Structure for Brute Force Calculations in the Cloud. *Silvia Grampone, Witold Litwin, and Thomas Schwarz S.J.*

Session 5B: Security and Privacy II (C400, Chair: Ali Dehghantanha)

1. Harbormaster: Policy Enforcement for Containers. *Mingwei Zhang, Daniel Marino, and Petros Efstathopoulos*
2. Assessing Data Breach Risk in Cloud Systems. *Yogachandran Rahulamathavan, Muttukrishnan Rajarajan, Omer F. Rana, Malik S. Awan, Pete Burnap, and Sajal K. Das*
3. ARCHISTAR: Towards Secure and Robust Cloud Based Data Sharing. *Thomas Loruenser, Andreas Happe, and Daniel Slamanig*
4. StoreSim: Optimizing Information Leakage in Multicloud Storage Services. *Hao Zhuang, Rameez Rahman, Pan Hui, and Karl Aberer*

Thursday, 3 December, 2015, 13:00– 3:00 pm

Session 6A: Architecture IV (Resource Management)
(Theatre, Chair: Sathish Gopalakrishnan)

1. Continuous Datacenter Consolidation. *Petter Svärd, Wubin Li, Eddie Wadbro, Johan Tordsson, and Erik Elmroth*
2. Enhancing Real-Time Applications by Means of Multi-tier Cloud Federations. *Vamis Xhagjika, Leandro Navarro, and Vladimir Vlassov*
3. Effective Load Balancing Mechanism for Heterogeneous Range Queriable Cloud Storage. *Xun Shao, Masahiro Jibiki, Yuuichi Teranishi, and Nozomu Nishinaga*
4. Semi-Open Trace Based Simulation for Reliable Evaluation of Job Throughput and User Productivity. *Netanel Zakay and Dror G. Feitelson*

Session 6B: Short Papers II (C400, Chair: Chen Liu)

1. Data Velocity Scaling via Dynamic Monitoring Frequency on Ultrascale Infrastructures. *Toni Masteli and Ivona Brandi*
2. FSAD: Flow Similarity Analysis for Anomaly Detection in Cloud Applications. *Senbo Fu, Hyong Kim, and Rui Prior*
3. Virtualized FPGA Accelerators for Efficient Cloud Computing. *Suhaib A Fahmy, Kizheppatt Vipin, and Shanker Shreejith*
4. Energy Efficient Virtual Machine Consolidation under Uncertain Input Parameters for Green Data Centers. *Enrica Zola and Andreas J. Kassler*
5. Renewable Energy-Aware Inter-Datacenter Virtual Machine Migration over Elastic Optical Networks. *Liang Zhang, Tao Han, and Nirwan Ansari*

6. Server-Side Efficient Parity Generation for Cluster-Wide RAID System. *Hiroki Ohtsuji and Osamu Tatebe*

7. QoS-Aware Service Composition in Mobile Cloud Networks. *Ismaeel Al Ridhawi and Yousif Al Ridhawi*

PhD Consortium (C400, Thursday, 3 December, 2015, 9:00– 10:30 am, Chair: Lin Li)

1. Design and Implementation of a Distributed Mobility Management Entity on OpenStack. *Gopika Premsankar, Kimmo Ahokas, and Sakari Luukkainen*

2. Towards Integration of Wireless Sensor Networks and Cloud Computing. *Chunsheng Zhu, Xi Li, Hong Ji, and Victor C. M. Leung*

3. A Cloud-Based Workflow Approach for Optimizing Molecular Docking Simulations of Fully-Flexible Receptor Models and Multiple Ligands. *Renata De Paris, Duncan A. D. Ruiz, and Osmar Norberto de Souza*

4. A Productive Cloud Computing Platform Research for Big Data Analytics. *Yuzhong Yan, Chao Chen, Lei Huang*

Poster Session (Thursday, 3 December, 2015, 10:30– 11:00 am, 12:30 – 1:30 pm)

1. Pricing Models for Sensor-Cloud. *Chunsheng Zhu, Victor C. M. Leung, Edith C.-H. Ngai, Laurence T. Yang, Lei Shu, and Xiuhua Li*

2. An SDN App for Hadoop Clusters. *Chi-Yi Lin and Jhen-Yu Liao*

3. Octopus: Hybrid Big Data Integration Engine. *Yanjie Chen, Chenyang Xu, Weixiong Rao, Hong Min, and Gong Su*

4. Clouds of Things Need Information Flow Control with Hardware Roots of Trust. *Thomas F. J.-M. Pasquier, Jatinder Singh, and Jean Bacon*

5. Planning Mobile Cloud Infrastructures Using Stochastic Petri Nets and Graphic Processing Units. *Francisco Airton Silva, Matheus Rodrigues, Paulo Maciel, Sokol Kosta, and Alessandro Mei*

6. A Novel Cloud-Based Crowd Sensing Approach to Context-Aware Music Mood-Mapping for Drivers. *Arun Sai Krishnan, Xiping Hu, Jun-qi Deng, Renfei Wang, Min Liang, Chunsheng Zhu, Victor C. M. Leung, and Yu-Kwong Kwok*

7. Towards a Methodology for Trade-off Analysis in a Multi-cloud Environment Considering Monitored QoS Metrics and Economic Performance Assessment Results. *Claudia-Melania Chituc*

8. Energy Efficient Resource Allocation over Cloud-RAN Based Heterogeneous Network. *Heli Zhang, Hong Ji, Xi Li, Ke Wang, and Weidong Wang*

9. A DirectShow-based Cloud Gaming Testbed. *Hamed Ahmad, Mahmoud Reza Hashemi, Shervin Shirmohammadi*

10. GPU-Accelerated Key Frame Analysis for Face Detection in Video. *Xuan Qi, Chen Liu*

11. Data Science Professional uncovered: How the EDISON Project will contribute to a widely accepted profile for Data Scientists. *Andrea Manieri, Yuri Demchenko, Tomasz Wiktorski, Steve Brewer, Ruben Riestra, Matthias Hemmje, Tiziana Ferrari and Jeremy Frey*

The Second International Workshop on Enterprise Security

Preface

Welcome to our second international workshop on Enterprise Security as part of CloudCom 2015, Vancouver, Canada, November 30-December 3, 2015. The first international workshop held in Singapore has been a major success since then we have achieved greater team activities, research, and international collaborations as the major and significant outcome of our first workshop on this topic. Enterprise Security involves all business, products, governments, organization, and their contractors. This also includes research areas of information security, software security, computer security, cloud security, IoT security, data and big data security. This workshop provides a significant contribution from experts on some of the following key research areas:

- Incident response Systems Security - This involves many organisations are outsourcing computer operations to third parties, and the next logical step is to outsource management of computer security incidents as well.
- Cloud Security Assurance Model - Defining proper measures for evaluating the effectiveness of an assurance model, which we have developed to ensure cloud security, is vital to ensure the successful implementation and continued running of the model. We need to understand that with security being such an essential component of business processes, responsibility must lie with the board.
- Cloud Security - The development of cloud computing and the vast use of its services poses significant security and privacy concerns to the people and the organizations relying on these services. Diversification and obfuscation approaches are of the most promising proactive techniques that protect computers from harmful malware, by preventing them to take advantage of the security vulnerabilities. Mission critical applications are limited in the cloud as it has various security issues. As the data size are being increased gradually and the difficulty in storing, retrieving and managing data makes the application to move into cloud.
- Cloud Forensics & Cryptanalysis and Enhancement - Password based authentication has been used extensively as a one of the most appropriate authentication techniques.
- Validating technology and BI Techniques – This is useful for organizations to understand their status with return and risk. They can evaluate their security policies and technologies regularly.
- Risk Analysis and Big Data – This is increasingly important for organizations since they deal with growing amount of data, dependency and complexity. Risk analysis can be applied to many areas related or outside cloud computing.

We are pleased to receive 24 papers from researchers of 12 different countries. After the vigorous review process and careful considerations, 11 papers have been selected, with 5 full papers and 6 short papers. We have offered two prize awards. One award is to award the best paper in the information system category. The other award is to award the best paper in the computational category. Each winner can be invited to International Journal of Information Management (IJIM) and Future Generation Computer Systems (FGCS). Anothergood news we have is that extended version of conference papers and other security/risk researchers can contribute to our Springer book scheduled to call for papers after

our workshop. We are honoured to have Dr. Konstantin Beznosov to be our keynote speaker.

Enterprise Security has been a popular topic since it includes cyber security, risk management, information security, Cloud and Forensic security, risk analysis and Big Data. It is an area that can make theory into practice and allow any organizations that adopt our recommendations to enjoy the benefits of enforced Enterprise Security. The outputs of our workshop can provide organizations with several useful recommendations, proofs-of-concepts and demonstrations to improve current security and risk practices.

We hope the second international workshop will foster collaborations of projects, research publications and funding opportunities at the international setting in Vancouver, Canada. Workshop Organizing Committee would like to thank CloudCom organizers for their fullest support.

Committee

Program Chairs

Victor Chang, *Leeds Beckett University, UK*
Muthu Ramachandran, *Leeds Beckett University, UK*
Neil N. Yen, *University of Aizu, Japan*
Robert John Walters, *University of Southampton, UK*
Gary Wills, *University of Southampton, UK*

Publicity Chairs

Mario Hoffmann, *Fraunhofer Institute for Applied and Integrated Security (AISEC), Germany*
Chung-Sheng Li, *IBM, USA*
Laurence T. Yang, *St. Francis Xavier University, Canada*
Wendy Currie, *Audencia Nantes, France*

Technical Program Committee

Mitra Arami, *American University of Middle East, Kuwait*
Reinhold Behringer, *Leeds Beckett University, UK*
Victor Chang, *Leeds Beckett University, UK* Sidney
Chapman, *Freelance, Australia*
Tzu-chun Chen, *TU Darmstadt, Germany*
Chung-Sheng Li, *IBM, USA*
Muthu Ramachandran, *Leeds Beckett University, UK*
Jose Simao, *Instituto Superior de Engenharia de Lisboa, Portugal*
Robert John Walters, *University of Southampton, UK*
Gary Wills, *University of Southampton, UK*
Fara Yahya, *University of Southampton, UK*

Program (C400, Monday 30 November, 2015)

Session 1 (9:00 – 10:30 am)

1. Passing the Buck: Outsourcing Incident Response Management. *Alfredo Ramiro Reyes Zúñiga and Martin Gilje Jaatun SINTEF ICT, Norway*
2. Validating Technology Acceptance Model (TAM) during IT adoption in Organisations. *Osden Jokonya, North-West University, South Africa*
3. Panel Discussions

Break

Session 2 (11:00 am – 12:30 pm)

1. The Importance of Proper Measurement for a Cloud Security Assurance Model. *Bob Duncan and Mark Whittington, University of Aberdeen, UK*
2. Information Security in the Cloud: Should We be Using a Different Approach? *Bob Duncan and Mark Whittington, University of Aberdeen, UK*
3. Keynote Presentation: Human and Organizational Aspects of Enterprise Security Management. *Konstantin (Kosta) Beznosov, The University of British Columbia, Canada*

Lunch

Session 3 (1:30 – 3:00 pm)

1. Security and Privacy in Cloud Computing via Obfuscation and Diversification: a Survey. *Shohreh Hosseinzadeh, Sami Hyrynsalmi and Ville Leppänen, University of Turku, Finland and Mauro Conti, University of Padova, Italy*
2. Cloud Storage Forensic: hubiC as a Case-Study. *Ben Blakeley, Chris Cooney, Ali Dehghantanha, University of Salford, UK*
3. Risk Management Using Big Real Time Data. *Jie Cheng, Chunming Rong，Huijuan Ye, University of Stavanger, Norway and Zheng Xianghan, Fuzhou University, China*
4. Cryptanalysis and Enhancement of a Password-Based Authentication Scheme. *Mohamed Eldefrawy and Jalal Al-Muhtadi, King Saud University, Saudi Arabia*

Break

Session 4 (3:30 – 5:00 pm)

1. An Efficient Framework and Access control scheme for cloud health care. *Saravana Kumar N, VIT University, India and Rajya Lakshmi G.V, California State University, USA*
2. Risk Analysis of Business Intelligence. *Raed Alsufyani , Victor Chang, Leeds Beckett University, UK*
3. Security decisions in a cloud HPC environment. *Morgan Eldred, Alice Good and Carl Adams, University of Portsmouth, UK*
4. Wrap-up, award ceremony and photographic session

2nd IEEE STC CC and RDA Workshop on Curricula and Teaching Methods in Cloud Computing, Big Data, and Data Science

Preface

Welcome to the 2015 Data Teaching Workshop – 2nd IEEE STC CC and RDA Workshop on Curricula and Teaching Methods in Cloud Computing, Big Data, and Data Science held as part of CloudCom 2015 in Vancouver, Nov 30-Dec 3, 2015.

The emergence of Cloud Computing, Big Data, and Data (Intensive) Science as specialized fields in computing is motivating development of new books and courses to provide education in the techniques and technologies needed to extract knowledge from large datasets in virtualized environment. This workshop will bring together a wide community of scientists, researchers and practitioners and will serve as a meeting point for all working on or interested in this area.

The workshop was organizationally sponsored by the Horizon2020 project EDISON funded by European Community to coordinate Data Science curricula development in Europe and international harmonization.

The call for papers attracted a lot of attention from the community and high quality submissions were received. Considering that this concept is still in its infancy stage, the program committee decided to accept a small number of papers and reserved more time during the workshop for extended presentations, including tutorial elements, and a forum discussion to debate the future directions of curricula and teaching methods in Cloud Computing, Big Data, and Data Science.

We hope that you will find the workshop interesting and fun. We also hope that this forum will become a platform for dialogue and interaction, an exchanging of ideas, all moving this discipline to the next level. After all, our goal is to help distribute the latest achievements within this field to a broader audience, all while expanding professional relationships.

Committee

Program Chairs
Tomasz Wiktorski, University of Stavanger, Norway
Thomas J. Hacker, Purdue University, USA
Yuri Demchenko, University of Amsterdam, The Netherlands

Technical Program Committee
Gregory Rodgers, AMD Research, USA
Reidar Lyng, NTNU, Norway
Raymond Hansen, Purdue University, USA
Chunming Rong, University of Stavanger, Norway
Martin Gilje Jaatun, SINTEF, Norway
Aleksandra Krolak, Lodz University of Technology, Poland
Holger Brocks, FTK, Germany
Wouter Los, University of Amsterdam, Netherlands
Steve Brewer, University of Southampton, UK

Andrea Manieri, Engineering, Italy
Christopher Jung, Karlsruhe Institute of Technology, Germany
Laura Molloy, Digital Curation Centre / HATII, University of Glasgow
Lukasz Bolikowski, ICM, University of Warsaw, Poland
Ana Lucia Varbanescu, University of Amsterdam, Netherlands
Lars Nagel, Johannes Gutenberg-Universität Mainz, Germany

Program (HSBC Hall, Monday 30 November, 2015, 11:00 am – 12: 30 pm)

1. Teaching domain-driven Data Science: public-private co-creation of market-driven Certificate. *Andrea Manieri, Francesco Saverio Nucci, Mauro Femminella and Gianluca Reali*

2. Data Science and Online Education. *Geoffrey C. Fox, Sidd Maini, David Wild and Howard Rosenbaum*

3. Teaching Programing on Cloud : A Perspective Beyond Programing. *Yan Liu*

4. Experience with Problem-based Learning in a Hybrid Classroom. *Tomasz Wiktorski, Tom Hacker, Raymond Hansen and Gregory Rodgers*

5. Data Science Professional uncovered: How the EDISON Project will contribute to a widely accepted profile for Data Scientists. *Andrea Manieri, Yuri Demchenko, Tomasz Wiktorski, Steve Brewer, Ruben Riestra, Matthias Hemmje, Tiziana Ferrari and Jeremy Frey* (also presented as a poster in the Poster Session)

The First International Workshop on Quality of Service Assurance in the Cloud

Preface

Cloud computing offers a computational model where network, storage, and compute domains can be abstracted into virtual resources offered on demand. While these abstractions offer opportunities to significantly simplify the management and optimize the use of resources, they impose additional challenges on assuring the quality of service (QoS).

In the context of multi-tenancy, the same physical resources are shared by different users that do not necessarily share the same service level agreements; hence the QoS distinction has to be enforced at a finer grain. Moreover, certain attributes of the QoS may contradict with others, for instance, high availability favors replication and distributed redundancy while energy efficiency favors de-duplication and consolidation. The multi-layered architecture of the distributed cloud requires not only a thorough orchestration between layers to ensure the required QoS, but also makes the root cause analysis even more complicated in case of the SLA violation. Continuous changes and migrations of the resources allocated at all layers of abstraction pose further challenges to detecting problems, identifying their location and reasoning about causality.

The aim of this workshop is to raise awareness of the challenges of the QoS assurance in the cloud, and bring together practitioners and researchers to discuss potential solutions.

Committee

Program Chairs
Ali Kanso, Ericsson Research, Canada
Catalin Meirosu, Ericsson Research, Sweden

Technical Program Committee
Seetharami R. Seelam, IBM T. J. Watson Research Center, USA
Michela D'Errico, Hewlett-Packard Laboratories, UK
Khoder Shamy, BlackBerry Limited, Canada
Ewa Deelman, University of Southern California, USA
Renato Figueiredo, University of Florida, USA
Georges Khalil, Google Inc., Canada
Rolf Stadler, KTH Royal Institute of Technology, Sweden
Radu Prodan, University of Innsbruck, Austria
Mohamed Cheriet, Ecole de Technology Superieure, Canada
Sanjeev Mehrotra, Microsoft Research, USA
Gunter Mussbacher, McGill University, Canada
Pietro Colombo, Insubria University, Italy
Andreas Johnsson, Ericsson Research, Sweden
Ferhat Khendek, Concordia University, Canada
Devin Parrish, Mirantis, USA
Daniel Migault, Ericsson Research, Canada
Erik Elmroth, Umeå University, Sweden

Stephan Schmid, Technical University of Berlin, Germany
Abdelouahed Gherbi, Ecole de Technology Superieure, Canada
Rami Bahsoon, Birmingham University, United Kingdom
Simin Nadjm-Tehrani, University of Linköping, Sweden
Geoffrey Lefebvre, Coho Data, Canada
Tereza Carvalho, University of Sao Paulo, Brazil

Program (HSBC Hall, Monday 30 November, 2015)

Session 1 (1:30 – 3:00 pm)

1. Keynote Presentation: The IBM Container Cloud: Principles and Practices in Assuring the Quality of Service. *Seetharami R. Seelam, IBM T. J.Watson, New York*
2. Minimizing Latency of Real-Time Container Cloud for Software Radio Access Networks. *Chen-Ning Mao, Mu-Han Huang, Satyajit Padhy, Shu-Ting Wang, Wu-Chun Chung, Yeh-Ching Chung, and Cheng-Hsin Hsu*
3. Simulating High Availability Scenarios in Cloud Data Centers: A Closer Look. *Mohamed Abu Sharkh, Abdallah Shami, , Abdelkader Ouda, Peter Ohlen and Ali Kanso*

Break

Session 2 (3:30 – 5:00 pm)

1. A Dynamic Bandwidth Prediction & Provisioning Scheme in Cloud Networks. *Abiola Adegboyega*
2. A Formal Approach for QoS Assurance in the Cloud. *Parisa Heidari, Hanifa Boucheneb and Abdallah Shami*
3. Temperature Distribution Prediction in Data Centers for Decreasing Power Consumption by Machine Learning. *Yuya Tarutani, Kazuyuki Hashimoto, Go Hasegawa, Yutaka Nakamura, Takumi Tamura, Kazuhiro Matsuda, and Morito Matsuoka*
4. Workshop closing notes

Workshop on Delay-Sensitive Video Computing in the Cloud

Preface

Video applications are now among the most widely used and a daily fact of life for the great majority of Internet users. In 2013, video data accounted for 78% of all Internet traffic in the USA and 66% of all Internet traffic in the world, which by 2018 will grow to 84% in the USA and 79% in the world. While presentational video services such as those provided by YouTube and NetFlix dominate this video data, conversational video services such as video conferencing, video gaming, telepresence, tele-learning, collaborative shared environments, and screencasting also have significant usage. At the same time, with the advent of both mobile networks and cloud computing, we are seeing a paradigm shift, where the computationally-intensive components of these conversational video services are moving to the cloud, and the end user's mobile device is used as an interface to access the service. By doing so, even mobile devices without high-end graphical and computational capabilities can access a high fidelity application with high end graphics, because all the processing and rendering is done in the cloud, and the result is sent to the user via video, which any mobile device today can display. A practical example of this is Cloud Gaming, where the game events are processed and the game scene in rendered the cloud, with the resulting video streamed to the players.

What distinguishes these cloud-based conversational video systems from other video systems is the fact that they are highly delay sensitive. While buffering and interruptions of even a few seconds are tolerated by users in presentational video applications, conversational video applications require a much tighter end-to-end delay, usually in the range of 150 to 250 milliseconds. Otherwise the conversational applications will "fail" since it is not responding to user interactions fast enough. There has been many recent proposals for cloud-based encoding of video, with the great majority focusing on video-on-demand applications, and mostly using the well-known Hadoop and Map/Reduce technologies to break the video into multiple chunks, encoding or transcoding each chunk on a worker node, resulting in parallel and therefore faster encoding of the video as a whole. But this will not work in a "live" video scenario, since we do not have sufficient time for such operations: the video must be processed live as it's coming in and delivered to the user without violating delay thresholds. The fact that the cloud is used as a central node potentially adds a bottleneck and possibly further delays. Delay-sensitive processing and rendering of video in the cloud has therefore become an emerging area of interest.

When running conversational video applications in the cloud, the cloud not only processes the application logic, but also the video rendering. The resulting video is then streamed to clients as video. But, there are challenges: First, video requires high bandwidth, especially if the scene must be sent to multiple users, such as video conferencing, cloud gaming, and telepresence. For example, Cloud Gaming requires a connection with no less than 5Mbps constant bandwidth per player to provide interactive gaming services with a resolution of 720p at 30fps. Second, conversational video is sensitive to network latencies that impair the interactive experience of the application. Third, the mobility of today's users poses another set of challenges. Due to the heterogeneity of end users' devices, the cloud has to adapt the video content to the characteristics and limitations of the client's underlying network or end device. These include limitations in the available network bandwidth, or limitations in the client device's processing power, memory, display size, battery life, or the user's download limits as per his/her mobile subscription plan. While some of these restrictions are becoming less problematic due to rapid progress in mobile hardware technologies, battery life in particular and download limit to some extent are still problems that must be seriously considered. Also, consuming more bandwidth or computational power, even if available, means consuming more battery.

Committee

Program Chairs

Shervin Shirmohammadi	University of Ottawa, Ottawa, Canada
Maha Abdallah	Pierre & Marie Curie University, Paris, France
Dewan T. Ahmed	University of North Carolina, Charlotte, USA
Sheng-Wei "Kuan-Ta" Chen	Academia Sinica, Taiwan

Technical Program Committee

Abbas Javadtalab, Ericsson
Bernard Wong, University of Waterloo, Canada
Chau Yuen, Singapore University of Technology and Design, Singapore
Cheng-Hsin Hsu, National Hsing Hua University of Taiwan, Taiwan
Chun-Ying, Huang National Taiwan Ocean University, Taiwan
Di Wu, Sun Yat-Sen University, China
JongWon Kim, Gwangju Institute of Science and Technology, South Korea
Mehdi Semsarzadeh, Magor Corp.
Mirko Sužnjević, University of Zagreb, Croatia
Mohamed Hefeeda, Simon Fraser University, Canada
Mohammad Kazemi, University of Isfahan, Iran
Ngai-Man Cheung, Singapore University of Technology and Design, Singapore
Pål Halvorsen, University of Oslo, Norway
Razib Iqbal, Missouri State University, USA
Stefano Ferretti, University of Bologna, Italy
Surendar Chandra, Datrium Inc.
Wei Tsang Ooi, National University of Singapore, Singapore
Wu-chi Feng, Portland State University, USA
Yan Lu, Microsoft Research, China
Yao Liu, State University of New York at Binghamton, USA
Zhenyun Zhuang, LinkedIn

Program

In this workshop, we asked for papers that propose new approaches, methods, systems, and solutions that overcome the above shortcomings. After the review process, the following papers were accepted and will be presented during the Poster Session on 3 December, 2015:

1. GPU-Accelerated Key Frame Analysis for Face Detection in Video. *Xuan Qi and Chen Liu*

2. A DirectShow-Based Cloud Gaming Testbed. *Hamed Ahmadi, Mahmoud Reza Hashemi, and Shervin Shirmohammadi*

We thank all the reviewers, conference organizers, and the authors who submitted their papers to our workshop.

Practical Information

Registration Desk

The registration desk, located in the lobby between the meeting rooms, will be open for pick-up of registration materials and inquiries during the following hours.

Monday	30 November 2015	8:15 am – 5:30 pm
Tuesday	1 December 2015	8:15 am – 5:00 pm
Wednesday	2 December 2015	8:15 am – 5:00 pm
Thursday	3 December 2015	8:30 am – 2:30 pm

Conference Proceedings

The conference proceedings are published on the web; URL:
http://conferences.computer.org/cloudcom/2015
The login and password for the web site are provided in the registration package. Papers presented at the conference will be submitted to IEEE Xplore® for archiving after the conference.

WiFi Access

UBC Robson Square provides free WiFi access to all conference attendees (SSID: UBCvisitor). If your home institution is on the Eduroam network, you can access Eduroam using your home credential.

Nourishments and Social Events

1. Food and refreshments will be provided during morning registration, breaks and lunch hours.

2. **Reception**

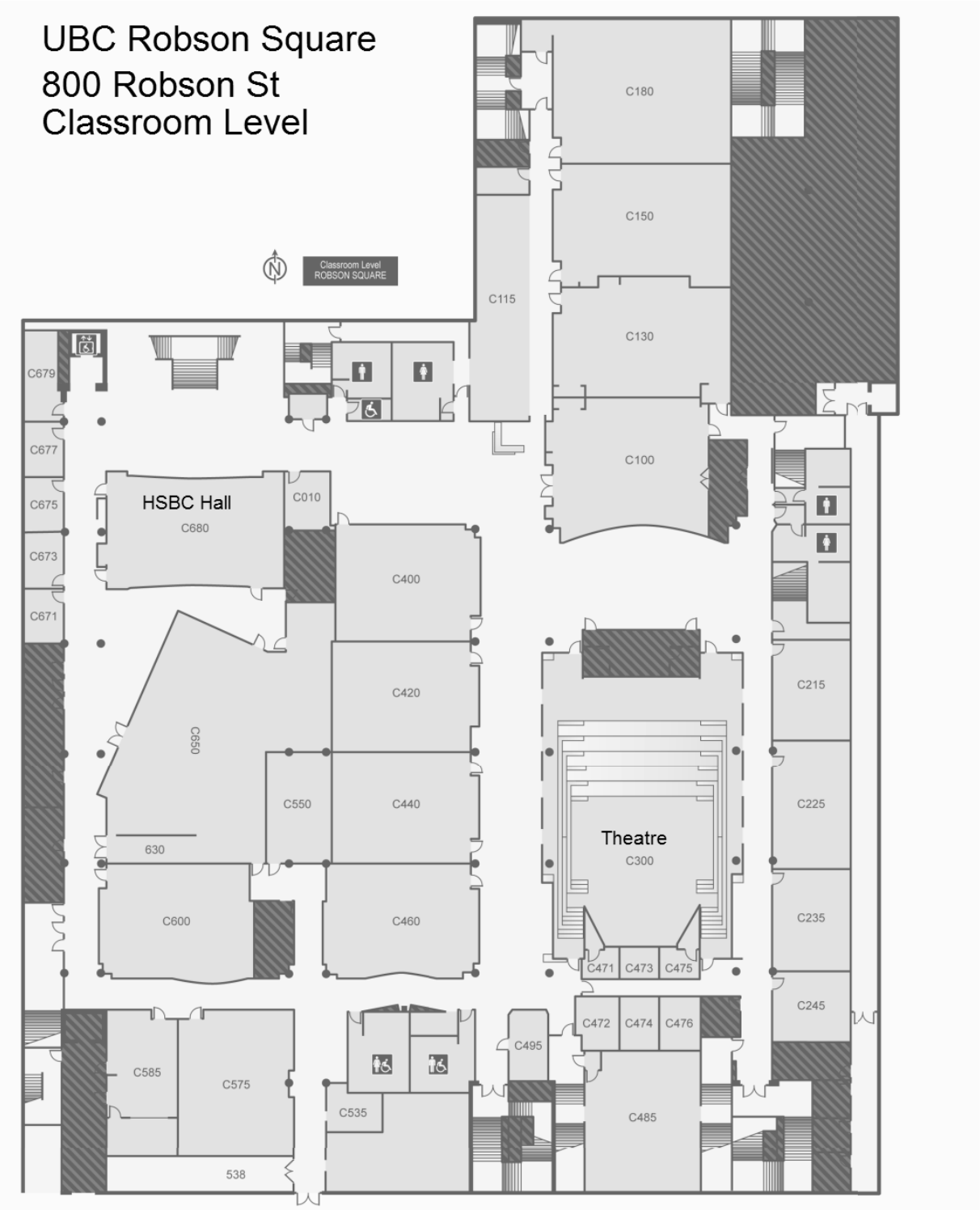
   Time: 18:00 – 20:00 on Monday, 30 November, 2015
   Venue: TELUS Innovation Centre, 5th Floor, TELUS Garden, 510 West Georgia Street.
   Show your CloudCom 2015 conference badge to gain admission to this event.

3. **Banquet**

   Time: 18:00 – 21:00 on Wednesday, 2 December, 2015
   Venue: Cloud 9 Revolving Restaurant & Lounge, 42nd Floor, The Empire Landmark Hotel, 1400 Robson Street.
   Door opens at 18:00, banquet starts at 18:30. Bring your banquet ticket for admission.

Notes on drink tickets: Four alcoholic drink tickets are provided with your registration package; each one can be exchanged for a glass of wine or a beer at either of the above events. If you would like to have juice or soft drinks instead of alcoholic drinks, please exchange one alcoholic drink ticket for two refreshment tickets at the conference registration desk ahead of the social events.

Plan of Meeting Rooms



Map of Venues

Walking Distances

UBC Robson Square to TELUS Garden:
Robson Street to Granville Street to W. Georgia Street, 500 m, 8 minutes

UBC Robson Square to Empire Landmark Hotel: along Robson Street, 1 Km, 15 minutes

UBC Robson Square to Westin Grand Hotel: along Robson Street, 400 m, 6 minutes

cloudcom 2015

Hosted by:

UBC

Sponsors:

IEEE computer society

STC CLOUD COMPUTING

1911–2011 IEEE VANCOUVER SECTION

TCSC IEEE

Cloud Computing Association

IEEE CLOUD COMPUTING

Diamond Patron:

TELUS

In Cooperation with:

compute canada | calcul canada

Gold Patrons:

IBM

HUAWEI

Silver Patron:

Bravolol