

**Cloud Computing and Distributed Systems Laboratory
and the Cloudbus Project**



Annual Report - 2013



Department of Computing and Information Systems

Melbourne School of Engineering

The University of Melbourne, Australia

1. Director's Message

I am pleased to report on the key activities and outcomes of **Cloud Computing and Distributed Systems (CLOUDS) Laboratory** at the University of Melbourne, Australia during the academic year 2013, which has been another extraordinary year in terms of research quality and international recognition of its members. The Lab has consolidated its position as one of the world-leaders in developing innovative solutions for Cloud Computing. The highlights of research activities and outcomes in 2013 are:



- The Lab successfully carried out three ARC research projects: Future Fellowship programme, Discovery Project, and Industry Linkage Project.
- Members of the CLOUDS Lab have authored 31 publications, which include 17 journal papers and 2 books.
- One of our books "*Mastering Cloud Computing*" is published as international edition by Morgan Kaufmann in USA and Asian edition by McGraw Hill in India.
- The Lab's flagship Cloudbus Project has released various new modules for Aneka and CloudSim. CloudSim 3.0 Toolkit now contains modules for DVFS, web modelling and MapReduce application modelling. It has been used by several researchers in academia and industries around the world.
- Members have presented over 35 invited talks that include 7 keynotes delivered at international conferences held in Mexico, India, Canada, and the Netherlands.
- The Lab successfully hosted research activities of over 20 scholars: 14 PhD students, 4 Research Fellows (2 at PostDoc level and 2 Software Engineers), and couple of Masters/honours students.
- Lab members have been recognised for their outstanding contribution to the field of distributed computing by listings such as "*ISI Highly Cited Author*" (Dec. 2012 listing).
- In 2013 alone, our papers have attracted over 5500 citations (ref: Google Scholar) and we hope this trend will continue!
- The Lab housed several (short and long term) international visitors (academic and PhD students) from Slovenia, China, Brazil, USA, and Canada.
- The Lab attracted four new grants in the area of Cloud computing. One ARC Linkage with CA, others were from Australian Dept of Innovation (Australia India Strategic Research), Melbourne-Chindia Research Network in Cloud Computing, and Samsung.
- Members of the Lab have led community efforts such as (a) the organisation of conferences (e.g., UCC 2013 in Germany), (b) membership in Steering Committee of 5 international conferences, (c) Advisory Board of the IEEE Technical Committee on Scalable Computing, and (d) Editor-In-Chief of IEEE Transactions on Cloud Computing.

The Lab is always looking for talented, motivated, and dedicated "young" students and researchers to join its team. Please feel free to contact me with your ideas!

Sincerely yours,

A handwritten signature in black ink, appearing to read 'Rajkumar Buyya'.

Professor Rajkumar Buyya, PhD
Director, Cloud Computing and Distributed Systems (CLOUDS) Laboratory
Department of Computing and Information Systems
The University of Melbourne, Australia
Web: www.cloudbus.org

2. The Team

Director:

- Professor Rajkumar Buyya

Research Staff:

- Dr. Rodrigo N. Calheiros
- Dr. Amir Vahid
- Mr. Enayat M. Moghaddam
- Ms. Rekha Garg

PhD Students

- Mr. Anton Beloglazov
- Ms. Linlin Wu
- Mr. Adel Toosi
- Mr. Deepak Poola
- Mr. Mohammed Alrokayan
- Ms. Atefeh Khosravi
- Mr. Nikolay Grozev
- Ms. Sareh Fotuhi
- Mr. Yaser Mansouri
- Mr. Roland Padilla
- Ms. Maria Rodriguez
- Mr. Chenhao Qu
- Mr. Le Tan Chanh Nguyen
- Ms. Yali Zhao
- Mr. Jungmin Jay Son
- Mr. Farzad Khodadadi
- Mr. Bowen Zhou

Collaborators

- Colleagues holding research grants with the Director
 - International Visitors
 - Many collaborators involved in extending and using the Cloudbus software.
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3. Competitive Grants Funded Projects and Programs - Active

Australian Research Council (ARC)

- R. Buyya, Dynamic resource provisioning for autonomic management of cloud computing environments, Future Fellowship, ARC, 2012-2016. Amount: \$786,168.
- M. Palaniswami and R. Buyya, Creating a Smart City Through Internet of Things, Linkage Project, ARC, 2012-2014. Amount: \$350,000.
- R. Buyya, A. Lachlan, and A. Wierman, Resource management algorithms and software systems for green cloud computing, Discovery Project, ARC, 2013-2015. Amount: \$315,000.
- R. Kotagiri, R. Buyya, C. Leckie, and S. Versteeg, Business goals and analytics driven management of cloud computing based information technology infrastructure, Linkage Project, ARC, 2013-2016. Amount: \$280,000.

Other National Grants

- R. Ranjan, R. Buyya, R. Shyamasundar, A. Zaslavsky, S. Nepal, R. Calheiros, S. Chen, R. Ghosh, A. Haller, and O. Dabeer, "Innovative Solutions for Deployment of BigData and Disaster Management Applications on Clouds", Australia-India Strategic Research Fund (AISRF Round 7), Australian Department of Industry, 2013-2016. Amount: \$400,000.
 - Indian partners received direct funding from Dept. of Science and Technology (DST), Govt. Of India. Amount: INR 10,200,000
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Industry and Melbourne University Grants

- R. Buyya and Aneka Team, "Scaling e-Science Applications using Azure Public Cloud", Academic Research Grant—Equipment Access, Microsoft, Seattle, USA, 2010-2013. Amount Equivalent: Approx. US\$180,000.
 - R. Buyya, Z. Xiao, Y. Cui, Y. Wu, J. Cao, U. Bellur, R. K. Shyamasundar, R. K. Pisipati, B. Sinha, S. K. Nandy, J. Lakshmi, and T. V. Prabhakar, "Melbourne-Chindia Cloud Computing (MC3) Research Network", International Research and Research Training Fund (IRRTF), The University of Melbourne, 2013-2016. Amount: \$150,000.
 - R. Buyya and R. Calheiros, "A Platform for Green Cloud Computing", Global Research Outreach (GRO) Program, Samsung, South Korea, 2013-2014. Amount: \$100,000.
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4. Publications

- The Lab publication record since its inception in 2002 highlighted in the Table below:

Year Publication Type	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Books/Proceedings Edited	1	1	1	1	5	4	3	5	2	3	2	2
Journal Papers	6	1	4	5	6	4	10	13	8	9	15	17
Book Chapters	1	0	0	4	4	2	4	11	3	13	3	1
Conference Papers	4	7	9	16	15	24	22	27	15	14	12	6
Magazine/Other Articles	0	0	1	2	4	2	0	1	2	1	0	5
<i>Total</i>	12	9	15	28	34	36	39	57	30	40	32	31

Books

- Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, Mastering Cloud Computing, International Edition: Morgan Kaufmann, ISBN: 978-0-12-411454-8, Burlington, Massachusetts, USA, May 2013; and Indian Edition: Tata McGraw Hill, ISBN-13: 978-1-25-902995-0, New Delhi, India, Feb 2013.
- K. R. Venugopal and Rajkumar Buyya, Mastering C++, 883, pages, 2nd Edition, ISBN-13: 978-1-25-902994-3, McGraw Hill Education, New Delhi, India, 2013.

Book chapters

- Rajkumar Buyya, Suraj Pandey, and Christian Vecchiola, Market-Oriented Cloud Computing and the Cloudbus Toolkit, Large Scale Network-Centric Distributed Systems, 319-358pp, H. Sarbazi-Azad and A. Y. Zomaya (eds), ISBN: 978-0-4709-3688-7, Wiley Press, Hoboken, NJ, USA, October 2013.

Journal Editorials

- Rajkumar Buyya, Introduction to the IEEE Transactions on Cloud Computing, IEEE Transactions on Cloud Computing, Volume 1, No. 1, Pages: 3-21, IEEE CS Press, USA, Jan-June 2013.
- Vojislav B. Misic, Rajkumar Buyya, Yong Cui, and Dejan Milojcic, Special Issue on Cloud Computing, IEEE Transactions on Parallel and Distributed Systems (TPDS), Volume 24, No. 6, Pages: 1062-1065, ISSN: 1045-9219, IEEE CS Press, USA, June 2013.
- Rajiv Ranjan, Rajkumar Buyya, and Surya Nepal, Model-driven provisioning of application services in hybrid computing environments, Future Generation Computer Systems, Volume 29, No. 5, Pages: 1211-1215, ISSN: 0167-739X, Elsevier Press, Amsterdam, The Netherlands, July 2013.
- Luis Miguel Vaquero, Luis Rodero-Merino, and Rajkumar Buyya, Cloud Scalability: Building the Millennium Falcon, Concurrency and Computation: Practice and Experience, Volume 25, No. 12, Pages: 1623-1627, Wiley Press, New York, USA, August 2013.
- Pavan Balaji and Rajkumar Buyya, Guest editors' introduction: Special issue on Cluster, Grid, and Cloud Computing, Future Generation Computer Systems, Volume 29, No. 8, Pages: 2220-2221, ISSN: 0167-739X, Elsevier Press, Amsterdam, The Netherlands, Oct. 2013.

Journal Papers

9. Nithiapidary Muthuvelu, Christian Vecchiola, Ian Chai, Eswaran Chikkannan, and Rajkumar Buyya, Task Granularity Policies for Deploying Bag-of-Task Applications on Global Grids, *Future Generation Computer Systems*, Volume 29, No. 1, Pages: 170-181, ISSN: 0167-739X, Elsevier Science, Amsterdam, The Netherlands, January 2013.
10. Bahman Javadi, Parimala Thulasiraman, and Rajkumar Buyya, Enhancing Performance of Failure-prone Clusters by Adaptive Provisioning of Cloud Resources, *Journal of Supercomputing*, Volume 63, No. 2, Pages: 467-489, ISSN: 0920-8542, Springer, Netherlands, February 2013.
11. Saurabh Kumar Garg, Srikumar Venugopal, James Broberg, and Rajkumar Buyya, Double Auction-Inspired Meta-Scheduling of Parallel Applications on Global Grids, *Journal of Parallel and Distributed Computing (JPDC)*, Volume 73, Number 4, Pages: 450-464, ISSN: 0743-7315, Elsevier Press, Amsterdam, The Netherlands, April 2013.
12. Rodrigo N. Calheiros, Marco A. S. Netto, Cesar A. F. De Rose, and Rajkumar Buyya, EMUSIM: An Integrated Emulation and Simulation Environment for Modeling, Evaluation, and Validation of Performance of Cloud Computing Applications, *Software: Practice and Experience*, Volume 43, Number 5, Pages: 595-612, ISSN: 0038-0644, Wiley Press, New York, USA, May 2013.
13. Rafah M. Almuttairi, Rajeev Wankar, Atul Negi, C.R. Rao, Arun Agrawal, and Rajkumar Buyya, A Two Phased Service Oriented Broker for Replica Selection in Data Grids, *Future Generation Computer Systems*, Volume 29, No. 4, Pages: 953-972, ISSN: 0167-739X, Elsevier Science, Amsterdam, The Netherlands, June 2013.
14. Bahman Javadi, Ruppa Thulasiram and Rajkumar Buyya, Characterizing Spot Price Dynamics in Public Cloud Environments, *Future Generation Computer Systems*, Volume 29, No. 4, Pages: 988-999, ISSN: 0167-739X, Elsevier Science, Amsterdam, The Netherlands, June 2013.
15. Saurabh Kumar Garg, Steve Versteeg, and Rajkumar Buyya, A Framework for Ranking of Cloud Computing Services, *Future Generation Computer Systems*, Volume 29, No. 4, Pages: 1012-1023, ISSN: 0167-739X, Elsevier Science, Amsterdam, The Netherlands, June 2013.
16. Saurabh Kumar Garg, Christian Vecchiola, and Rajkumar Buyya, Mandi: A Market Exchange for Trading Utility and Cloud Computing Services, *The Journal of Supercomputing*, Volume 64, No. 3, Pages: 1153-1174, ISSN: 0920-8542, Springer Science+Business Media, Berlin, Germany, June 2013.
17. Anton Beloglazov and Rajkumar Buyya, Managing Overloaded Hosts for Dynamic Consolidation of Virtual Machines in Cloud Data Centers Under Quality of Service Constraints, *IEEE Transactions on Parallel and Distributed Systems (TPDS)*, Volume 24, No. 7, Pages: 1366-1379, ISSN: 1045-9219, IEEE CS Press, Los Alamitos, CA, USA, July 2013.
18. Toktam Ghafarian, Hossein Deldari, Bahman Javadi, Mohammad Yaghmaee, and Rajkumar Buyya, CycloidGrid: A Proximity-Aware P2P-based Resource Discovery Architecture in Volunteer Computing Systems, *Future Generation Computer Systems*, Volume 29, No. 6, Pages: 1583-1595, ISSN: 0167-739X, Elsevier Science, Amsterdam, The Netherlands, August 2013.
19. Toktam Ghafarian, Hossein Deldari, Bahman Javadi, and Rajkumar Buyya, A Proximity-aware Load Balancing in Peer-to-Peer based Volunteer Computing Systems, *Journal of Supercomputing*, Volume 65, No. 2, Pages: 797-822, ISSN: 0920-8542, Springer, Netherlands, August 2013.
20. Jayavardhana Gubbi, Rajkumar Buyya, Slaven Marusic, and Marimuthu Palaniswami, Internet of Things (IoT): A Vision, Architectural Elements, and Future Directions, *Future Generation Computer Systems*, Volume 29, No. 7, Pages: 1645-1660, ISSN: 0167-739X, Elsevier Science, Amsterdam, The Netherlands, September 2013.
21. Mustafizur Rahman, Md Rafiul Hassan, Rajiv Ranjan, and Rajkumar Buyya, Adaptive Workflow Scheduling for Dynamic Grid and Cloud Computing Environment, *Concurrency*

- and Computation: Practice and Experience, Volume 25, No. 13, Pages: 1816-1842, ISSN: 1532-0626, Wiley Press, New York, USA, September 2013.
22. Mustafa Kaiiali, Rajeev Wankar, C.R. Rao, Arun Agarwal, and Rajkumar Buyya, Grid Authorization Graph, Future Generation Computer Systems, Volume 29, No. 8, Pages: 1909-1918, ISSN: 0167-739X, Elsevier Science, Amsterdam, The Netherlands, October 2013.
 23. Muhammad Shiraz, Abdullah Gani, Rashid Hafeez Khokar, and Rajkumar Buyya, A Review on Application Processing Frameworks in Mobile Devices for Mobile Cloud Computing, IEEE Communications Surveys and Tutorials, Volume 15, No. 3, Pages: 1294-1313, ISSN: 1553-877X, IEEE Communications Society Press, USA, October 2013.
 24. Tom Guérout, Thierry Monteil, Georges Da Costa, Rodrigo Neves Calheiros, Rajkumar Buyya, Mihai Alexandru, Energy-aware Simulation with DVFS, Simulation Modelling Practice and Theory, Volume 39, No. 1, Pages: 76-91, ISSN: 1569-190X, Elsevier Science, Amsterdam, The Netherlands, November 2013.
 25. Saurabh Kumar Garg and Rajkumar Buyya, An Environment for Modelling and Simulation of Message-Passing Parallel Applications for Cloud Computing, Software: Practice and Experience, Volume 43, No. 11, Pages: 1359-1375, ISSN: 0038-0644, Wiley Press, New York, USA, November 2013.

Conference Papers

26. Mohammed Alokayan and Rajkumar Buyya, A Web Portal for Management of Aneka-Based MultiCloud Environments, Proceedings of the 11th Australasian Symposium on Parallel and Distributed Computing (AusPDC 2013), Adelaide, South Australia, January-February 2013.
 27. Michael Mattess, Rodrigo N. Calheiros, and Rajkumar Buyya, Scaling MapReduce Applications across Hybrid Clouds to Meet Soft Deadlines, Proceedings of the 27th IEEE International Conference on Advanced Information Networking and Applications (AINA 2013, IEEE CS Press, USA), Barcelona, Spain, March 25-28, 2013.
 28. Linlin Wu, Saurabh Kumar Garg, Rajkumar Buyya, Chao Chen, and Steve Versteeg, Automated SLA Negotiation Framework for Cloud Computing, Proceedings of the 13th IEEE/ACM International Symposium on Cluster, Cloud, and Grid Computing (CCGrid 2013, IEEE CS Press, Los Alamitos, CA, USA), Delft, the Netherlands, May 13-16, 2013.
 29. Long Wang, Rubing Duan, Xiaorong Li, Sifei Lu, Terence Hung, Rodrigo Calheiros, and Rajkumar Buyya, An Iterative Optimization Framework for Adaptive Workflow Management in Computational Clouds, Proceedings of the 11th IEEE International Symposium on Parallel and Distributed Processing with Applications (ISPA 2013, IEEE CS Press, Los Alamitos, CA, USA), Melbourne, Australia, July 16-18, 2013.
 30. Atefeh Khosravi, Saurabh Kumar Garg, and Rajkumar Buyya, Energy and Carbon-Efficient Placement of Virtual Machines in Distributed Cloud Data Centers, Proceedings of the 19th International European Conference on Parallel and Distributed Computing (Euro-Par 2013, Springer, Berlin, Germany), Aachen, Germany, August 26-30, 2013.
 31. Yaser Mansouri, Adel Nadjaran Toosi and Rajkumar Buyya, Brokering Algorithms for Optimizing the Availability and Cost of Cloud Storage Services, Proceedings of the 5th IEEE International Conference on Cloud Computing Technology and Science (IEEE CloudCom 2013, IEEE CS Press, USA), Bristol, UK, Dec. 2-5, 2013.
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5. Invited Presentations and Outreach

By the Lab Director:

Keynote Talks at International Conferences

1. Market-Oriented Cloud Computing and the Aneka Platform, 4th International Supercomputing Conference in Mexico (ISUM 2013), March 5-8, 2013, Manzanillo, Colima, Mexico.
2. InterCloud: Resource Provisioning and Scheduling for Scalable (Internet of Things) Applications, CCGrid 2013 Second International Workshop on Data-Intensive Process Management in Large-Scale Sensor Systems, May 13, 2013, Delft, The Netherlands.
3. Market-Oriented Cloud Computing, 2013 International Conference on Advances in Computing, Communications and Informatics (ICACCI-2013), Mysore, India, Aug 22-25, 2013.
4. Market-Oriented Cloud Computing, The 17th IEEE International Enterprise Distributed Object Computing Conference (EDOC 2013), September 9- 13, 2013, Vancouver, Canada.
5. Market-Oriented Cloud Computing and the Aneka Platform, IEEE International Conference on Cloud Computing for Emerging Markets (CCEM 2013), Oct. 16-18, 2013, Bangalore, India.
6. Market-Oriented Cloud Computing and the Aneka Platform, 2013 International Conference on Cloud Computing and Big Data (CloudCom-Asia 2013), Dec 16-19, 2013, FuZhou, China.
7. Market-Oriented Cloud Computing and the Aneka Platform, 2013 World Ubiquitous Science Congress (U-Science2013), December 21-22, 2013, Chengdu, Sichuan, China

National Conferences

1. Cloud Computing with Aneka, International Workshop on Cloud Computing, Anna University, Chennai, India, Aug. 20, 2013.
2. Market-Oriented Cloud Computing, Compute-2013: The 6th ACM India Computing Conference, Vellore, India, Aug. 22-24, 2013.
3. Cloud Computing with the Aneka Platform, TEQIP Karnataka Workshop on Cloud Computing, Bangalore, India, Oct. 10, 2013.
4. Cloud Research Challenges, International Workshop on Cloud Computing, Cochin, India, Oct. 19, 2013.
5. Cloud Computing, Information Security and Forensic Analysis Workshop, VJIT, Mumbai, India, Oct. 21, 2013.

Seminars - in Cloud Computing area:

1. George Washington University, Washington DC, USA, March 1, 2013.
2. University of Derby, Derby, UK, May 20, 2013.
3. University of Oxford, Oxford, UK, May 23, 2013.
4. Imperial College London, UK, May 24, 2013.
5. Tsinghua University, Beijing, China, May 27, 2013.
6. Huawei, Beijing, China, May 28, 2013.
7. Peking University, Beijing, China, May 28, 2013.
8. Beijing Jiaotong University, Beijing, China, May 29, 2013.
9. Beihang University, Beijing, China, May 30, 2013.
10. Università di Roma @ Tor Vergata, Rome, Italy, July 15, 2013.
11. Second University of Naples, Aversa, Italy, July 16-18, 2013.
12. Jawaharlal Nehru University (JNU), Delhi, India, Aug. 19, 2013.
13. Indian Institute of Technology Delhi (IITD), Delhi, India, Aug. 19, 2013.

14. VIT University Chennai, Chennai, India, Aug. 21, 2013.
15. SSN College of Engineering, Chennai, India, Aug. 21, 2013.
16. Cloud Computing Innovation Council for India, Bangalore, India, Aug. 23, 2013.
17. The University of British Columbia (UBC), Vancouver, Canada, Sept. 10, 2013.
18. Nanyang Technological University (NTU), Singapore, Oct. 9, 2013.
19. The National Institute of Engineering (NIE), Mysore, India, Oct. 11, 2013.
20. Maharaja Institute of Technology (MIT), Mysore, India, Oct. 15, 2013.
21. University of Tartu, Tartu, Estonia, Dec. 4-6, 2013.

Conference Tutorials

1. Market-Oriented Cloud Computing, 13th IEEE/ACM International Symposium on Cluster Computing and the Grid (CCGrid 2013), Delft, The Netherlands, May 13, 2013.
 2. Market-Oriented Cloud Computing and the Aneka Platform, 6th IEEE/ACM International Conference on Utility and Cloud Computing, December 9-12, 2013, Dresden, Germany.
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6. Selected Community Services

By the Lab Director:

IEEE Computer Society

1. Chair of Advisory Board, IEEE Technical Committee on Scalable Computing

IEEE Transactions on Cloud Computing

1. Editor in Chief (EiC), 2013-to date.

Journal Editorials

1. Editorial Board Member, *Future Generation Computer Systems (FGCS)* -- The International Journal of Grid Computing: Theory, Methods and Applications, ISSN: 0167-739X, Elsevier Press, Amsterdam, The Netherlands.
2. Editorial Board Member, *International Journal of Parallel, Emergent and Distributed Systems* (IJPEDS), ISSN: 1744-5760, Taylor & Francis Group, UK.
3. Editorial Board Member, *Multiagent and Grid Systems: An International Journal*, ISSN: 1574-1702, IOS Press, Amsterdam, The Netherlands, 2005 onwards.
4. Editorial Board Member, *Software: Practice and Experience*, ISSN: 0038-0644, Wiley Press, New York, USA, 2009-to date.

Conference Steering Committee

1. Chair, CCGrid conference series: IEEE/ACM International Symposium on Cluster Computing and the Grid (CCGrid): CCGrid 2001, Brisbane, Australia; CCGrid 2002, Berlin, Germany; CCGrid 2003, Tokyo, Japan; CCGrid 2004 in Chicago, USA; CCGrid 2005, UK; CCGrid 2006, Singapore; CCGrid 2007, Brazil; CCGrid 2008, Lyon, France, CCGrid 2009, Shanghai, China, CCGrid 2010, Melbourne, Australia, CCGrid 2011, Newport Beach, USA, CCGrid 2012, Ottawa, Canada, and CCGrid 2013, Delft, The Netherlands.
2. Co-Chair, International Conference on e-Science(e-Science) series, 2005- to date.
3. Member, IEEE International Conference on Cluster Computing (ClusterXY), 1999-to date.
4. Member, International Symposium on Computer Architecture and High Performance Computing, 2005-to date.
5. Chair, IEEE/ACM International Conference on Utility and Cloud Computing (UCCxy), 2010-to date.

Technical Program Committee Memberships

1. 8th International Symposium on Software Engineering for Adaptive and Self-Managing Systems (SEAMS 2013), May 20-21, San Francisco, USA.
2. 11th IEEE International Symposium on Parallel and Distributed Processing with Applications (ISPA 2013, IEEE CS Press, Los Alamitos, CA, USA), July 16-18, 2013, Melbourne, Australia.
3. 42nd International Conference on Parallel Processing (ICPP 2013), October 1-4, 2013, Lyon, France.
4. 15th International Conference on High Performance and Communications (HPCC 2013), Zhangjiajie, China, November 13-15, 2013.

5. 14th ACM/IFIP/USENIX International Conference on Middleware, Dec. 9-13, 2013, Beijing, India.
6. 19th IEEE International Conference on Parallel and Distributed Systems (ICPADS 2013), Dec. 15-18, 2013, Seoul, Korea.

Community Information Sources

- Maintained a Grid Computing Information Centre at: <http://www.gridcomputing.com>, whose newsletter mailing list has over 2500 members. This website is often ranked as #2 source for grid computing by Google search engine.
- Maintained a Cluster Computing Information Centre at: <http://www.buyya.com/cluster>
- Co-Moderator for Computing Research Repository (CoRR, <http://arxiv.org/corr/>)'s subject on "Distributed, Parallel, and Cluster Computing".

By Other Members:

Technical Program Committee Memberships

1. Rodrigo N. Calheiros, 28th Symposium On Applied Computing (ACM SAC 2013) – Operating Systems Track, March 18-22, 2013, Coimbra, Portugal.
2. Rodrigo N. Calheiros, 2nd International Conference on Smart Grids and Green IT Systems (SMARTGREENS 2013), May 9-10, 2013, Aachen, Germany.

7. International Visitors

1. Ms. Ling Ding, Heifei University of Technology, China, Oct 2012-Oct 2014.
 2. A/Prof. Lu Liu, University of Science and Technology Beijing, China, Nov 2012-Oct 2013.
 3. Mr. Mehran Garmehi, Iran University of Science and Technology, Tehran, Iran: March-Aug 2013.
 4. Mr. Robert Dukaric, University of Ljubljana, Slovenia: June-Aug. 2013.
 5. Ms. Deborah Magalhães, Federal University of Ceará, Brazil: July 2013-2014.
 6. Mr. Guilherme da Cunha rodrigues, Federal University of Rio Grande do Sul (UFRGS), Brazil: Nov. 2013-July-2014.
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8. Continuing Members Profile and Activities

Member Self Profile: Rodrigo N. Calheiros

I joined the CLOUDS Lab as a Research Fellow in June 2010, after being a research visitor between 2008 and 2009.

During 2013, I was Associate Lecturer for one subject: Distributed Systems (Sem. 2).

As a Research Fellow for ARC Discovery Project, I focused on Energy efficiency in Clouds, where I've been researching methods for reducing power consumption of VMs executing Bag of Tasks applications. I am also involved in the investigation of methods for reducing energy consumption of Clouds subject to workloads similar to Google cluster. This project is being carried by Ms. Sareh Fotuhi Piraghaj, which I am co-supervising her PhD. The results we achieved so far are very promising, and we expected that publications describing early results of this project will start to appear in the beginning of next year.



During 2013, I was also involved in a project with Evado Pty Ltd, which was sponsored by the Department of Business and Innovation from the Victorian government. This gave me the opportunity to work with a company offering SaaS products in the area of clinical trials.

During this year I've been actively involved in attracting new grants for the Lab. I am a co-CI in two successful grant applications, and contributed towards the other grants the Lab attracted this year.

I'm also one of the original designers and developers of CloudSim. Therefore, I'm still collaborating in the support for the tool whenever users from these tools contact us. I've been also involved in collaborations with researchers from iHPC (Singapore), University of Ceara (Brazil), and CSIRO (Australia).

Other activities I was involved in 2013 were program committee memberships, and supervision of Master and PhD students.

Member Self Profile: Amir Vahid Dastjerdi

In March 2013, I have submitted my thesis which presents a toolkit that simplifies cross-Cloud deployment and facilitates service discovery, composition, and negotiation. My thesis was nominated for the best thesis award and accepted without amendments by examiners. After



completed my PhD I

have worked in industry for a period of 6 months, and then joined Clouds Lab in Aug 2013 as a research fellow. My current research interests include Cloud service coordination, scheduling, and resource provisioning using optimization, machine learning, and artificial intelligence techniques. Links to my thesis and recent publications comes below:

Thesis:

Amir Vahid Dastjerdi, QoS-aware and Semantic-based Service Coordination for Multi-Cloud Environments, Ph.D. Thesis, The University of Melbourne, Australia, March 2013.

Journal papers:

Amir Vahid Dastjerdi and Rajkumar Buyya, Compatibility-aware Cloud Service Composition Under Fuzzy Preferences, IEEE Transactions on Cloud Computing, IEEE Computer Society Press, USA, 2014 (in press).

Member Self Profile: Enayat M. Moghaddam

My service as a research assistant has commenced in mid-2012. During my Master program on Distributed Systems, I was vigorously following the ongoing activities in CLOUDS Lab; and after being graduated, I officially joined the group.

During this short period, I mostly was involved in the design and implementation of a dynamic VM provisioning system which is a collaboration project with CSIRO.

Enhancement and support of Aneka platform, automatic Aneka infrastructure deployment and configuration, and adding support for variety of public Cloud providers were in my duty list.



Member Self Profile: Rekha Garg

I began my journey at CLOUDS Lab as a Research Fellow in January 2013, where I was responsible for development of a platform for building cloud applications like Aneka. Aneka is an infrastructure for developing cloud-based applications capable of utilizing resources on the desktop, clusters, and on-demand resources from infrastructure-as-a-service providers.

Prior to joining the University of Melbourne in January 2013, I was employed at Mindtree Ltd, Bangalore, India as a Sr. Software Engineer, where I was mostly involved in designing and implementation of multiple projects involving .Net technology. My thrust to work on newer technologies and expanding my knowledge brought me in contact with Dr. Buyya, who acknowledged my previous experience and gave me an opportunity to learn and explore a completely new and different dimension of the software technology i.e. cloud computing.



In CLOUDS Laboratory, I was actively involved in enhancing Aneka application. I researched and developed Aneka application for dynamic provisioning of multiple providers like Amazon and Azure etc. I also completed migration of Aneka application from 2.0 to 3.5 .Net Framework. Additionally, I explored integration of Aneka and Azure provider using infrastructure as service.

Member Self Profile: Anton Beloglazov

My name is Anton Beloglazov, I am from Novosibirsk, Russian Federation. I have completed my PhD in February 2013 under the supervision of Prof. Rajkumar Buyya at the Cloud Computing and Distributed Systems (CLOUDS) Laboratory within the Department of Computing and Information Systems, The University of Melbourne, Australia. I have joined the CLOUDS Lab in 2009 to pursue my PhD studies funded by Endeavour International Postgraduate Research Scholarship and Melbourne International Research Scholarship. Prior to my PhD, I have graduated from Novosibirsk State Technical University in 2006 with Bachelor's degree followed by Master's degree in 2008 in Computer Science and Engineering.



My PhD research topic was "Energy-Efficient Management of Virtual Machines in Data Centers for Cloud Computing". My work focused on the development of novel techniques, models, algorithms, and software for dynamic consolidation of virtual machines in Cloud data centers to improve the utilization of physical resources and reduce energy consumption under quality of service constraints. I have contributed to the development of CloudSim, an open-source Java framework for modeling and simulation of Cloud computing infrastructures and services: <https://code.google.com/p/cloudsim/>. I have also designed and implemented OpenStack Neat, an open-source framework for distributed dynamic consolidation of virtual machines in OpenStack Clouds: <http://openstack-neat.org/>

In 2013, my PhD thesis has been published:

Anton Beloglazov, "Energy-Efficient Management of Virtual Machines in Data Centers for Cloud Computing", PhD thesis, Department of Computing and Information Systems, The University of Melbourne, 2013.

My PhD thesis, full list of publications, and other information are available on my web-page: <http://beloglazov.info/>

Member Self Profile: Linlin Wu

Linlin Wu is a PhD candidate under the supervision of Professor Rajkumar Buyya in the CLOUDS Laboratory at the University of Melbourne, Australia. She received Master of Information Technology from the University of Melbourne and then worked for CA (Computer Associates Pty Ltd) as Quality Assurance Engineer. Then she joined National Australia Bank (NAB) as a Knowledge Optimization Officer. Here in Melbourne University, she has been awarded with APA scholarship supporting PhD studies. She received the Best Paper Award from AINA 2010 conference for her first publication. Her current re-search interests including: Service Level Agreement, QoS measurement, Resource Allocation, and Market-oriented Cloud computing. She is the Vice Chair of IEEE committee at the University of Melbourne organizing industry and social activities for IEEE members.



Member Self Profile: Adel Toosi

I started my PhD studies under supervision of Dr. Rajkumar Buyya in the Department of Computer Science and Software engineering at the University of Melbourne in July 2010. I received my B.Sc. degree in 2003 and M.Sc. degree in 2006 both in Computer Software Engineering from Ferdowsi University of Mashhad, Iran. Throughout my master degree, I mainly focused on the areas of network security, especially intrusion detection systems, and soft computing system such as fuzzy systems and genetic algorithms.

Currently, I am the last year PhD student and my thesis confirmed by the committee on the subject of "Resource Provisioning Policies for Federated Cloud Computing Environments". I study pricing and market aspects of Cloud and Cloud Federation in my thesis. Last year, I was able to publish following papers as a co-author:



1. Yaser Mansouri, Adel Nadjaran Toosi and Rajkumar Buyya, "Brokering Algorithms for Optimizing the Availability and Cost of Cloud Storage Services", To be presented in proceedings of the IEEE International Conference on Cloud Computing Technology and Science (CloudCom'13), Dec. 2013, Bristol, UK.
2. Mohsen Amini Salehi, Adel Nadjaran Toosi, Rajkumar Buyya, "Contention Management in Federated Virtualized Distributed Systems: Implementation and Evaluation", To be presented in Journal of Software: Practice and Experiences, DOI: 10.1002/spe.2221, 2014.

and I also submitted the following journal papers which are under review:

1. Adel Nadjaran Toosi, Member, Kurt Vanmechelen and Rajkumar Buyya "An Auction Mechanism for Cloud Spot Market" submitted to IEEE transaction on Parallel and Distributed Systems (Second round of revision).
2. Adel Nadjaran Toosi, Rodrigo N. Calheiros, Rajkumar Buyaa, "Interconnected Cloud Computing Environments: Challenges, Taxonomy and Survey", Submitted to Journal of ACM computing Surveys (ACM CSUR) (Second round of revision).
3. Saurabh Kumar Garg, Srinivasa K. Gopalaiyengar, Adel Nadjaran Toosi, Rajkumar Buyya "SLA-based Virtual Machine Management for Heterogeneous Workloads in a Cloud Datacenter", Journal of Network and Computer Applications, (Second round of revision).

For detail information about my current research and past publications, please visit my homepage: <http://www.csse.unimelb.edu.au/~adeln>

Member Self Profile: Deepak C Poola

I joined Cloudbus lab in July 2011 as a PhD Student under the supervision of Prof Rajkumar Buyya and Prof Rao Kotagiri. My chosen area of research is "Robust and Fault-Tolerant Scheduling for Scientific Workflows in Cloud Computing Environments". My area of interests includes Cloud Computing, Workflows, Scheduling Algorithms, Streaming Applications and Data Warehousing.

As a part of my research, I am investigating into scientific workflow scheduling focusing on robust and fault-tolerant schedules. My research is primarily focussed on Cloud computing environments. I am investigating on workflow scheduling with heterogeneous Cloud resources also working considering different Cloud pricing models (i.e spot and on-demand). As a part of research I have developed two heuristics so far, which have resulted in two papers, which are currently under review.

Prior to Joining Cloudbus Lab, I was working as an Application Developer in J P Morgan Chase, India. I have worked in Java, Spring, Struts, UNIX and web services as a part of my job profile. I have been in J P Morgan for two years from 2009 to 2011.

I have also worked as an Intern in Citrix R&D, Bangalore from Jan 2009 to Jun 2009. During which I worked on the implementation to WBXML parser for their home product Net scalar. Citrix gave me exposure and knowledge of working in a networking company.

I am a proud Alumina of BITS-Pilani, India. I have completed my M.E Computer Science from BITS-Pilani. Prior to which I completed my graduation in B.E Computer science from VISVESWARAIAH TECHNOLOGICAL UNIVERSITY, Karnataka.

Apart from this I nourish interests in Poetry, Philosophy and Sports.



Member Self Profile: Atefeh Khosravi

I joined CLOUDS Lab in March 2012 to pursue my PhD studies under the supervision of Prof. Rajkumar Buyya at the University of Melbourne. My PhD studies are funded by the Endeavour International Postgraduate Research Scholarship (IPRS) and Australian Postgraduate Award (APA).

Before entering the University of Melbourne, I received my M.Sc. degree of Computer Engineering in 2011 and my B.Sc. degree of Information Technology Engineering in 2008, both from the Amirkabir University of Technology. During my master studies, I have worked as a researcher and consultant on Iran National IP/MPLS Core Network project at Iran Telecommunication Research Center (ITRC).

Currently, I am a second year PhD student and my confirmed thesis subject by the committee is “Energy and Carbon-Efficient Resource Management in Distributed Cloud Data Centers”. It is mainly focused on the development of policies and algorithms for placement of virtual machines by considering data centers’ energy sources, carbon footprint, power consumption, and network distance, while meeting the required quality of service for Cloud users. The outcome of my first work has resulted in the following publication:

- Atefeh Khosravi, Saurabh Kumar Garg, and Rajkumar Buyya, “Energy and Carbon-Efficient Placement of Virtual Machines in Distributed Cloud Data Centers”, Proceedings of the 19th International European Conference on Parallel and Distributed Computing (Euro-Par 2013, Springer, Berlin, Germany), Aachen, Germany, August 26-30, 2013.

For detail information, please visit my homepage: <http://ww2.cs.mu.oz.au/~atefeh/>



Member Self Profile: Mohammed Alokayan

I joined CLOUDS Lab in 2011 during my Master study. I was researching Aneka Cloud Platform and developing Cloud Web Portal (CWP) as part of my Master Thesis at the lab. CWP has been implemented and designed as a SaaS for Aneka middleware to manage and monitor cloud infrastructure.

By the end of 2011 I have graduated from The University of Melbourne with First Class Honours degree in Master of Information Technology. Then, in early 2012 I become a PhD student at The University of Melbourne.

Also, I'm a faculty member at the College of Computer and Information Science (CCIS), King Saud University (KSU), Riyadh, Saudi Arabia since 2007. I taught Distrusted Systems and Information Security for B.Sc. students.

Back in 2006 I have been working in a Cloud Operating System called "Swooj". Part of Swooj was my B.Sc. graduation project, which was a Cloud Operating System that combines three concepts: Thin Clients, Remote Desktop Services and Web 2.0. Swooj won the first rank in Mawhiba contest (Gulf region wide) and the second rank in AEC's best graduate project contest (Saudi Arabia wide).

For more information on my current and past projects please visit my website: <http://alokayan.com>

My publications are:

- Mohammed Alokayan and Rajkumar Buyya, A Web Portal for Management of Aneka-Based MultiCloud Environments, Proceedings of the 11th Australasian Symposium on Parallel and Distributed Computing (AusPDC 2013), Adelaide, South Australia, January-February 2013.
- Anton Beloglazov, Sareh Fotuhi Piraghaj, Mohammed Alokayan, and Rajkumar Buyya, Deploying OpenStack on CentOS Using the KVM Hypervisor and GlusterFS Distributed File System, Technical Report CLOUDS-TR-2012-3, Cloud Computing and Distributed Systems Laboratory, The University of Melbourne, August 14, 2012.



Member Self Profile: Sareh Fotuhi Piraghaj

I joined CLOUDS Lab at the beginning of 2012. I am conducting my research on 'Autonomic Energy Efficient Resource Management in Cloud data centres'. During my research I participated in deploying OpenStack on the available hardware using the KVM Hypervisor. This results in a technical report 1 as a step by step installation guide for OpenStack. During 2013, I have been working on workload characterisation of Google workloads and the impact of efficient resource allocations on energy consumption of a data center.

During my master's degree in Iran University of Science and Technology, I have been working on image processing techniques on Synthetic Aperture Radar images which results in a number of publications.



My experiences before joining The University of Melbourne are as follows:

- Tutor, Teaching mathematics and physics for high school students, 2007-2012
- Teacher, Teaching mathematics and physics
- Counsellor, Ghalamchi Institute, 2008(for six months)
- University Lecturer (Digital Systems and Designs)
- Programmer (Working on Image Processing and Tracking techniques)
- Laboratory teacher

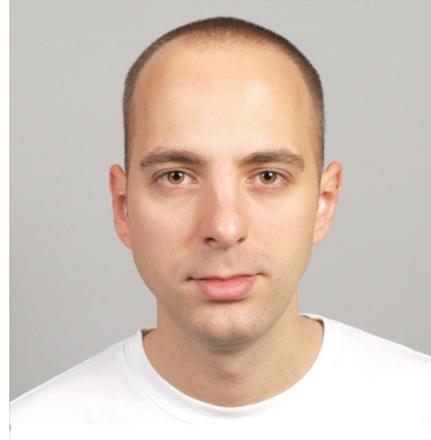
Member Self Profile: Nikolay Grozev

I joined CloudsLab in March 2012, when I enrolled as a PhD student at the University of Melbourne under the supervision of Prof. Rajkumar Buyya.

Previously I have graduated from the University of Sofia "St. Kliment Ohridski" with a bachelor's degree in Informatics and a master's degree in Software Engineering. I have also specialised at the Mälardalen University, Sweden, where I worked on my master's thesis. My professional experience includes working as a Software Engineer at various companies participating in projects ranging from large scale enterprise systems to research products.

In my PhD research I investigate how to architect 3-tier applications so that they can utilise multiple Cloud data centres. This will allow for building applications which are more resilient to data centre outages and provide end users worldwide with high Quality of Experience (QoE) by minimising network latency. Moreover, it will allow for building cost efficient systems that are legislation compliant in multiple regulatory regions.

A complementary direction in my research is the modelling and simulation of interactive distributed systems. I research analytical performance models and simulation environments that facilitate quick performance analysis and evaluation of provisioning and scheduling approaches for such applications.



Member Self Profile: Maria Alejandra Rodriguez

My name is Maria Alejandra Rodriguez and I am from Bogota, Colombia. I came to Melbourne on February 2010 to start my master's degree, Master of Engineering in Distributed Computing, at the University of Melbourne. I completed the degree on December 2011 with first class honours. In October 2012 I decided to pursue my PhD and joined the Cloud Computing and Distributed Systems (CLOUDS) Laboratory at The University of Melbourne where I am currently a PhD candidate under the supervision of Prof. Rajkumar Buyya.



Before coming to Australia, I finished my Bachelor's degree in Computing and Systems Engineering at Los Andes University in Bogota, Colombia. I worked as a software engineer in a small company for over two years and then headed to Bangalore, India to work for Tata Consultancy Services, an Indian multinational. As much as I enjoyed and learnt from my years in the industry, I've always had a passion for learning and studying and hence decided to go 'back to school' after spending a year as a developer in India.

During my master's research project, I investigated the execution of scientific workflows on distributed environments, specifically on grids and clouds. I am now expanding on this topic and my knowledge of Cloud Computing. I am researching resource provisioning and scheduling algorithms for large-scale scientific workflows on Clouds. I have developed a heuristic that targets IaaS Clouds and its pricing model while taking advantage of some of their more promising characteristics: elasticity, heterogeneity and auto-scaling. Another of my research interests is energy efficiency in Cloud data centers and how this concept can be incorporated into workflow management systems and scheduling algorithms.

Member Self Profile: Yasser Mansouri

I am a Ph.D. student under supervision of Prof. Rajkumar Buyya in the Department of Computing and Information, University of Melbourne. I joined Cloud Computing and Distributed Systems (CLOUDS) laboratory in August 2012. I received the B.Eng. and M.Sc. degrees from Shahid Beheshti University and Ferdowsi University of Iran, respectively.

My research interests cover the broad area of Distributed Systems, with special emphasis on data replication and management in data grids and data cloud systems. Specifically, I am interested in designing new data placement algorithms and analysing their performances. My recent publications are as follows:

[1] Yaser Mansouri, Adel Nadjaran Toosi and Rajkumar Buyya, Brokering Algorithms for Optimizing the Availability and Cost of Cloud Storage Services, Proceedings of the 5th IEEE International Conference on Cloud Computing Technology and Science (IEEE CloudCom 2013, IEEE CS Press, USA), Bristol, UK, Dec. 2-5, 2013.

[2] Yaser Mansouri, Minimizing Cost of K-Replica in Hierarchical Data Grid Environment, Proceedings of the 28th IEEE International Conference on Advanced Information Networking and Applications (AINA-2014), Victoria, Canada, May 13-16, 2014 (to appear).



Member Self Profile: Chenhao Qu

I joined the CLOUDS lab in Feb 2013 under the supervision of Professor Rajkumar Buyya and Dr Rodrigo N. Calheiros. Before came to Australia, I just graduated from Fudan University, China in 2012 with a bachelor degree on Software Engineering.

In my research, I investigate how to deploy and manage applications on multi-clouds, which involves service discovery and selection, application monitoring, auto scaling, and SLA management. The aim of the research is to facilitate cost-efficient usage of cloud resources and in the meantime ensure high quality of service for application end users.



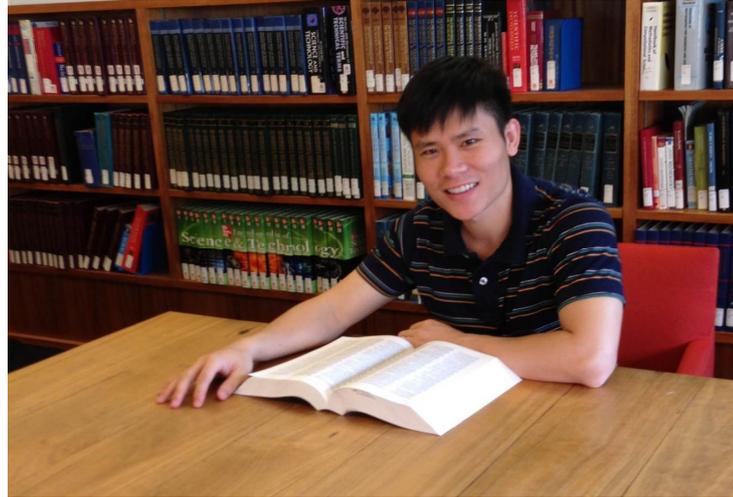
Member Self Profile: Le Tan Chanh Nguyen

I joined Clouds lab in June 2013 when I started my PhD program under the supervision of Professor Rajkumar Buyya and Dr Rodrigo N. Calheiros at University of Melbourne.

Before arriving at university of Melbourne, I have completed my master degree with the first class honour in Computer Science at Tsinghua University, Peking, China in June 2012 with the research project related to data mining and deep web. Previously, I received my bachelor degree in Software engineering at HCM

university of Technology, Viet Nam in 2009. Beside the academic experience, I have also worked in industry for one year after receiving bachelor degree. In during that time, I worked for a USA outsourcing company located at Ho Chi Minh city, Viet Nam in some projects related to business web services.

After investigating in Cloud computing research area in few months, I pursue my idea utilizing data mining techniques developing approaches aim at predicting future resource demand and anomaly detection in Cloud. Currently, I'm working on the combination approach in which the classification technique cooperates with machine learning algorithms modelling efficiently short-term host load predicting in Cloud infrastructure.



Member Self Profile: Yali Zhao

I joined Clouds lab in December 2013 to pursue my PhD studies under Dr. Rajkumar Buyya's supervision. My current research interests are Big Data Computing, Workflow Scheduling, SLA-based Resource Allocation, Service Composition, etc. My PhD studies are funded by Melbourne International Research Scholarship (MIRS) and Melbourne International Fee Remission Scholarship (MIFRS).

I obtained my bachelor degree of Software Engineering from Harbin Institute of Technology (HIT) in July 2011. I joined the international master program between HIT and University of Bordeaux 1 (UB1) and obtained my master degree of Software Engineering from HIT and master degree of Enterprise Computing and Engineering (Master Productique International) from UB1 in October 2013.

I joined the Research Center of Intelligent Computing for Enterprise & Service (ICES) in my first master year at HIT. I participated in the Intelligent Home Service System (IHSS) Project and accomplished the design and implementation of the subproject Health Service System (HSS). I conducted research topic, at UB1, on Service Brokering Mechanism which based on the wisdom of Service Composition. During my second master year, I undertook half year internship at Distributed System Group in Vienna University of Technology (TUWIEN) and derived my master thesis on "Design and Implementation of Workflow Scheduling Mechanism based on Resource Allocation".



Member Self Profile: Roland Padilla

Roland Padilla is uniquely positioned as an information systems (IS) practitioner-academic. As an IS professional he had worked for global organisations representing systems integration (SI), information technology (IT) consulting, and business process outsourcing (BPO). Most recently, he is recognised by the Australian Computer Society (ACS) as a senior ACS certified professional or MACS (Snr) CP, someone in professional practice for at least 10 years and has been in a senior ICT management position for at least 5 years.



He rose from the ranks as a PABX (Private Automatic Branch Exchange) Engineer involved in patching cables to a General Manager responsible for global operations. Roland has demonstrated success and proven an ability to lead people and manage numerous functions, consisting data networking from CISCO Systems (Engineer), IT systems integration from FUJITSU (Manager), resource management from Headstrong (Manager), IT service management from Netmarks (General Manager), and project management from NEC (Team Leader). These senior leadership and management functions from multi-national corporations provided an opportunity to engage in diverse industry segments, comprising telecommunications, semiconductor, automotive, banking, government, and utilities. Additionally, Roland has demonstrated global experiences, having undertaken projects, collaborations, and skills trainings in several countries such as Japan, US, Philippines, Hong Kong, Singapore, and UK.

Apart from real world and broad industry perspectives, Roland is deepening his viewpoint within the academic world. In 2010, he earned his master's degree in IS, and obtained a First-Class Honours (H1) or High Distinction (HD) equivalent. He had the honour and privilege to deliver the valedictory address on Graduation Day. In less than a month, he joined CISCO Systems in Sydney, and won 1st Place in its Asia-Pacific and Japan internship competition. Currently, Roland is finishing his doctoral dissertation, exploring how to measure service value in business-to-business cloud computing. Economies are increasingly dominated by the service sector. More than ever, research is needed to address approaches that measure and optimise service. His research journey examines service value within an interdisciplinary context, and focuses on the effective use of computing and information technologies by organisations. His thesis seeks to address the essential research question of how service value, as a higher-order formative measure, is investigated within the business-to-business context of cloud computing. The research project argues that a reliable conceptualisation of the service value construct is of critical relevance in the optimisation and measurement of the cloud computing phenomena.

In transitioning from Masters to PhD, Roland was awarded an Australian Postgraduate Award (APA), a scholarship awarded to local students with exceptional research potential and proven academic excellence. This scholarship supports him via fee remission and living allowance throughout this worthwhile intellectual journey. Apart from this scholarly pursuit, Roland is occupied as a Convenor of the cloud computing special interest group (SIG) of the ACS, and a Board Member of the ACS Victorian Branch.

For more information, please visit <http://linkedin.com/in/rolandpadilla>

Member Self Profile: Jing Ding

I'm Jing Ding, from Anhui Province of China. From October 2012, I became a visiting student supervised by Rajkumar Buyya in Cloud Computing and Distributed Systems (CLOUD) Laboratory at University of Melbourne. My visit is sponsored by Chinese Scholarship Council (CSC).

I am a second year PhD student at Hefei University of Technology in China. Before I came to University of Melbourne, I participated in projects on Cloud Computing, exploring decision making process and information service system architecture in Cloud Computing environment.

My current research focuses on Cloud services, in order to provide better infrastructure, platform and software services in Cloud Computing environment.

I wish to have vibrant and enjoyable study life in Melbourne.



Member Self Profile: Deborah Maria Vieira Magalhães

I am a second year PhD student in the Department of Teleinformatics Engineering at the Federal University of Ceará, Brazil. I joined CloudsLab in July 2013 supervised by Rajkumar Buyya as a visitor student at the University of Melbourne, sponsored by the Brazilian agency CNPq through the project Medical Applications Assisted by Scientific Computing (MAAC). Since then I have worked with modeling and characterization of applications for analysis and simulation of cloud computing environments, providing an opportunity for the development of policies of management and capacity planning of the physical resources according to the profile of resource usage and users behavior.



I am part in the Group of Computer Networks, Software Engineering and Systems (GREat) where I worked with cloud tasks scheduling through hierarchical and nonhierarchical clustering statistical methods considering the metrics throughput and response time and I also developed strategies for dynamic resource allocation in virtualized computing environments in order to reduce energy consumption without compromising performance requirements concerning availability and SLA violation during my master degree.

Before my master degree, I work in a project that provides latency tests in order to contribute to the operation of an advanced computational infrastructure to attend the academic, business and government through the development of simulations and data processing in areas such as meteorology, petroleum, automotive industry and Bioinformatics. This project has the collaboration of several universities throughout Brazil.

Apart from academic life, my personal interests include films, travelling, music and dance that inspire a virtuous life.

Member Self Profile: Guilherme da Cunha Rodrigues

I joined CLOUDS Lab in November 2013 to accomplish my partial doctoral under the supervision of Prof. Rajkumar Buyya and Dr. Rodrigo Calheiros at the University of Melbourne.

Before join the CLOUDS Lab, I received my MSc degree in Computer Science in 2008 from Pontifical University Catholic of Rio Grande do Sul (PUCRS). Currently, I'm PhD candidate at Federal University of Rio Grande do Sul (UFRGS) Brazil, under the supervision of Prof. Lisandro Granville at Computer Networks Group. Moreover, I'm professor at Federal Institute of Education, Science and Technology Sul Rio Grandense (IFSUL). I have worked in computer networks, network management and distributed systems.



My PhD research is on Cloud Monitoring, more specifically about the relationship among several cloud monitoring requirements such as scalability, accuracy, adaptability, and timeliness. In addition, I have contributed in research from other PhD candidates at UFRGS. My publication since 2012 comes below.

- Márcio Barbosa de Carvalho ; Rafael Pereira Esteves ; Guilherme da Cunha Rodrigues ; Lisandro Granville ; Liane Tarouco . A Cloud Monitoring Framework for Self-Configured Monitoring Slices Based on Multiple Tools. In: 9th International Conference on Network and Service Management - CNSM, 2013, Zurich. 9th CNSM and Workshops - Short Papers, 2013. p. 180-184.
- Guilherme da Cunha Rodrigues ; Vinicius Guimaraes ; Glederson Santos ; Lisandro Granville ; Liane Tarouco . Network and Services Monitoring: A Survey in Cloud Computing Environments. In: The Eleventh International Conference on Networks, 2012, Saint Gilles, Reunion. ICN-1 - Network Management Scheduling and Policy, 2012. v. 1. p. 7-13.

Member Self Profile: Jungmin Son (Jay)

I started the Master of Information Technology degree at the University of Melbourne in 2012. In this year, my master's thesis was conducted under the supervision of Professor Buyya and Dr Calheiros, which led me to start my PhD study in CLOUDS lab from 2014. In my master's thesis, I designed and implemented an automated decision system to efficiently select and allocate resources for multiple cloud providers.

Previously, I completed my bachelor degree in Information and Computer Engineering at Ajou University, South Korea. Two papers were published in domestic conference while I was working as a research intern at the university lab.

After completing my bachelor's degree in 2006, I had worked in Samsung Electronics as a software engineer for 4 years. I had contributed to develop software for various Samsung mobile phones mainly released in European market.



9. Selected Projects/Programs

Cloudbus: A Toolkit for Market-Oriented Cloud Computing

Web: <http://www.cloudbus.org/>

The Cloud Computing and Distributed Systems (CLOUDS) Laboratory is a software research and innovation group at the University of Melbourne, Australia. The Lab is actively engaged in design and development of next-generation computing systems and applications that aggregate by dynamically leasing services of distributed resources depending on their availability, capability, performance, cost, and users' QoS requirements. The lab is working towards realizing this vision through its two flagship projects: Gridbus and Cloudbus.

The Cloudbus project, an initiative that started in 2008 by the CLOUDS lab at the University of Melbourne, facilitates the realization of the above vision. The project developed innovative solutions for market-oriented Cloud computing. The current innovative developments include: (i) Aneka, a platform for developing and managing Cloud computing applications from market-oriented perspective; (ii) InterCloud, a framework for internetworking of Cloud service providers, dynamically creating federated computing environments, and scaling of distributed applications; (iii) CloudSim, a simulation framework that allows researchers to control every aspect of a Cloud environment: algorithms, platforms, and infrastructure; and (iv) Workflow Engine, a management platform that facilitates the creation, deployment and monitoring of complex applications modeled in a systematic and orderly manner in Cloud computing environments.

The Cloudbus project

The Cloudbus project is engaged in the creation of open-source specifications, architecture and a reference Cloud toolkit implementation of market-oriented cloud computing. Some of our technologies serve as foundation for industrial solutions offered by Manjrasoft to its customers worldwide.

The research probes include:

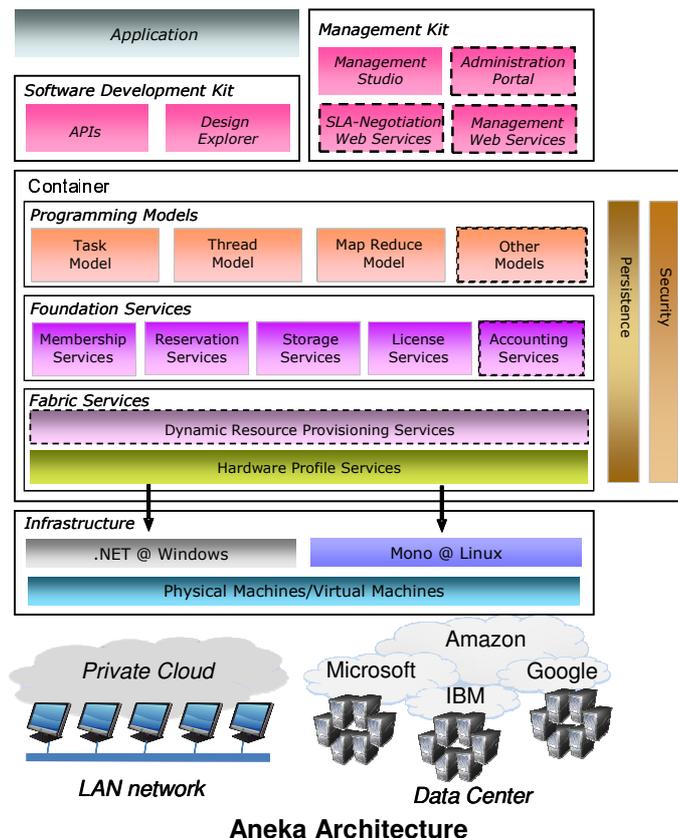
- Market Oriented Cloud Architecture
- Enterprise Cloud Application Platform (Aneka)
- Cloud Service Broker
- Cloud Workflows and Scheduling
- Service Level Agreements & Resource Allocation Systems (Libra).
- Energy-Efficient Data Centers and Clouds
- Cloud Simulation Toolkit (CloudSim).
- Application Development Environments
- Application Targets include: ECG Monitoring and Analysis, Data Mining and Business Analytics, Brain Imaging (Dartmouth Medical School), and Geophysics (*Intrepid*).
- Open SensorWeb Architecture
- InterCloud – Peering and Federation of Clouds
- Content Delivery Networks

Aneka: .NET-based Cloud Computing

Web: <http://www.manjrsoft.com>

ANEKA provides a set of services that make construction and development of Clouds and their applications as easy as possible without sacrificing flexibility, scalability, reliability and extensibility. It is now commercialized through Manjrsoft, a startup company of the University of Melbourne. The key features supported by ANEKA are:

- A configurable and flexible execution platform (container) enabling -
 - Pluggable services;
 - Security implementations - multiple authentication / authorization mechanisms such as role-based security and Windows domain-based authentication;
 - Multiple persistence options including RDBMS, SQL Express, MySQL and flat files;
- SDK (Software Development Kit) supporting multiple programming models including –
 - Object oriented thread model,
 - Task model for legacy applications
 - Map Reduce model for data-intensive applications
 - Custom tools such as Design Explorer for parameter sweep studies
- Easy to use management tool for SLA and QoS negotiation and resource allocation.



QoS-Oriented Cloud Workflow Engine

Web: <http://www.cloudbus.org/workflow>

The emerging e-Research paradigm enables researchers from different disciplines and organisations to engage in collaborative scientific investigation. They need to share geographically distributed resources owned by different organisations. e-Research applications need to negotiate with resource providers for guarantees on access time, duration and level of quality of service (QoS). To meet QoS requirements of e-Research application workflows, this project aims to develop Grid technologies that support (a) QoS-based scheduling of e-Research application workflows on distributed resources, (b) mechanisms for formulating, negotiating and establishing service level agreements (SLA) with resource providers and (c) SLA-based allocation and management of resources. Specifically, the project aims to:

- Define an architectural framework and principles for the development of QoS-based workflow management and SLA-based resource allocation systems,
- Develop QoS-based algorithms for scheduling e-Research workflow applications,
- Develop SLA-based negotiation protocols and resource allocation algorithms,
- Implement a prototype system by incorporating the algorithms and policies developed above, and
- Develop real world demonstrators in various scientific domains such as life sciences.

Key Reference: [1] Jia Yu and Rajkumar Buyya, Scheduling Scientific Workflow Applications with Deadline and Budget Constraints using Genetic Algorithms, *Scientific Programming Journal*, Volume 14, Issue 3-4, ISSN: 1058-9244, IOS Press, Amsterdam, The Netherlands, Nov. 2006.

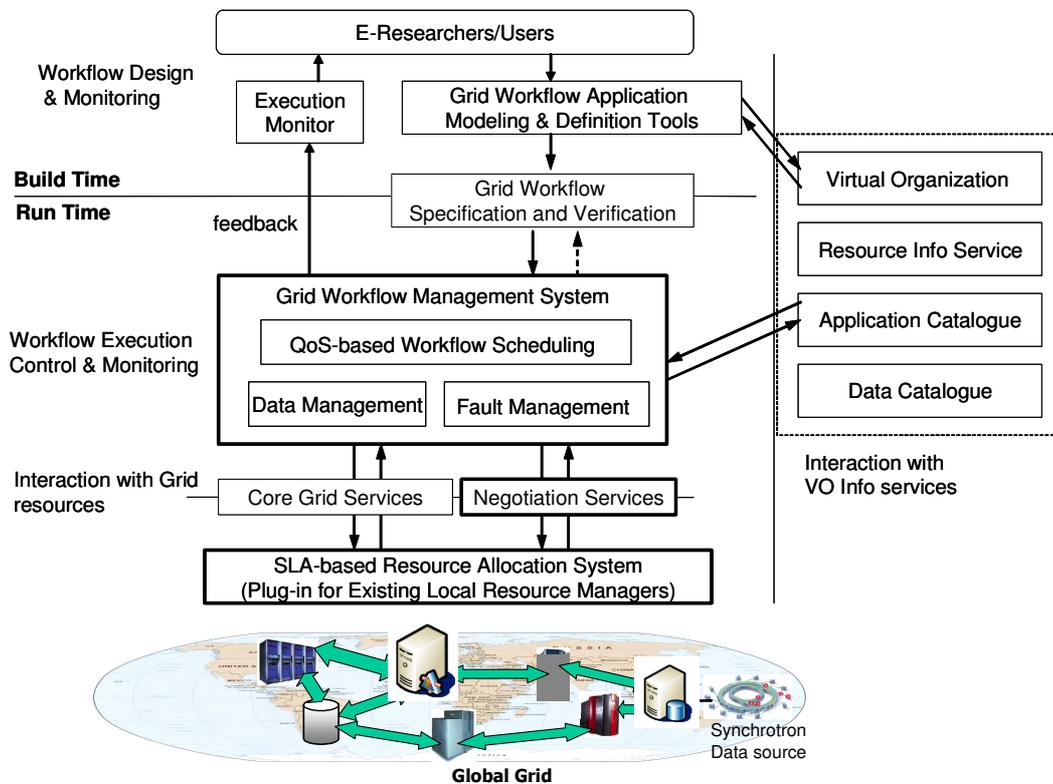


Fig. 1: Architecture of QoS-based workflow management and resource allocation system.

The Green Cloud Project: Innovative Solutions for Energy-Efficient Cloud Computing

Web: <http://www.cloudbus.org/greencloud>

Traditionally, high-performance computing (HPC) community has focused on performance (speed). Since early 2000, several companies have started building Data Centers inspired by commodity HPC (cluster computing) systems-architecture for hosting/powering industrial applications including search engines such as Google. At the same time microprocessor vendors have not only doubled the number of transistors (and speed) every 18-24 months, but they have also doubled the power densities. That is, the tremendous increase in computer performance has come with an even greater increase in power usage. As a result operational cost of HPC systems including industrial Data Centre is rapidly growing. This is reflected from a statement by CEO of Google (Eric Schmit): "what matter most to Google is not speed but power, because data centers can consume as much electricity as a city."

The aim of Green Cloud Project is to develop high-end computing systems such as Clusters, Data Centers, and Clouds that allocate resources to applications hosting Internet services (e-Services) to meet not only users' quality of service requirements, but also minimise consumption of electric power. That is to, to improve power management and consumption by dynamically managing and configuring power-aware ability of system devices, such as processors, disks, and communication links.

Selected Publications:

- Anton Beloglazov, Jemal Abawajy, and Rajkumar Buyya, Energy-Aware Resource Allocation Heuristics for Efficient Management of Data Centers for Cloud Computing, *Future Generation Computer Systems*, Volume 28, No. 5, Pages: 755-768, ISSN: 0167-739X, Elsevier Science, Amsterdam, The Netherlands, May 2012.
- Anton Beloglazov and Rajkumar Buyya, Optimal Online Deterministic Algorithms and Adaptive Heuristics for Energy and Performance Efficient Dynamic Consolidation of Virtual Machines in Cloud Data Centers, *Concurrency and Computation: Practice and Experience*, Volume 24, No. 13, Pages: 1397-1420, ISSN: 1532-0626, Wiley Press, New York, USA, September 10, 2012.
- Saurabh Garg and Rajkumar Buyya, Green Cloud Computing and Environmental Sustainability, *Harnessing Green IT: Principles and Practices*, 315-340pp, S. Murugesan and G. Gangadharan (eds), ISBN: 978-1-1199-7005-7, Wiley Press, UK, October 2012.
- Anton Beloglazov and Rajkumar Buyya, Managing Overloaded Hosts for Dynamic Consolidation of Virtual Machines in Cloud Data Centers Under Quality of Service Constraints, *IEEE Transactions on Parallel and Distributed Systems (TPDS)*, Volume 24, No. 7, Pages: 1366-1379, ISSN: 1045-9219, IEEE CS Press, Los Alamitos, CA, USA, July 2013.
- Atefeh Khosravi, Saurabh Kumar Garg, and Rajkumar Buyya, Energy and Carbon-Efficient Placement of Virtual Machines in Distributed Cloud Data Centers, *Proceedings of the 19th International European Conference on Parallel and Distributed Computing (Euro-Par 2013)*, Springer, Berlin, Germany), Aachen, Germany, August 26-30, 2013.
- Tom Guerout, Thierry Monteil, Georges Da Costa, Rodrigo Neves Calheiros, Rajkumar Buyya, Mihai Alexandru, Energy-aware simulation with DVFS, *Simulation Modelling Practice and Theory*, ISSN: 1569-190X, Elsevier Science, Amsterdam, The Netherlands, 2013. (in press, accepted on April 30, 2013).

CloudSim: A Framework for Modeling and Simulation of Cloud Computing Infrastructures and Services

Web: <http://www.cloudbus.org/cloudsim>

Recently, cloud computing emerged as the leading technology for delivering reliable, secure, fault-tolerant, sustainable, and scalable computational services, which are presented as Software, Infrastructure, or Platform as services (SaaS, IaaS, PaaS). Moreover, these services may be offered in private data centers (private clouds), may be commercially offered for clients (public clouds), or yet it is possible that both public and private clouds are combined in hybrid clouds.

These already wide ecosystem of cloud architectures, along with the increasing demand for energy-efficient IT technologies, demand timely, repeatable, and controllable methodologies for evaluation of algorithms, applications, and policies before actual development of cloud products. Because utilization of real testbeds limits the experiments to the scale of the testbed and makes the reproduction of results an extremely difficult undertaking, alternative approaches for testing and experimentation leverage development of new Cloud technologies.

A suitable alternative is the utilization of simulations tools, which open the possibility of evaluating the hypothesis prior to software development in an environment where one can reproduce tests. Specifically in the case of Cloud computing, where access to the infrastructure incurs payments in real currency, simulation-based approaches offer significant benefits, as it allows Cloud customers to test their services in repeatable and controllable environment free of cost, and to tune the performance bottlenecks before deploying on real Clouds. At the provider side, simulation environments allow evaluation of different kinds of resource leasing scenarios under varying load and pricing distributions. Such studies could aid the providers in optimizing the resource access cost with focus on improving profits. In the absence of such simulation platforms, Cloud customers and providers have to rely either on theoretical and imprecise evaluations, or on try-and-error approaches that lead to inefficient service performance and revenue generation.

The primary objective of this project is to provide a generalized and extensible simulation framework that enables seamless modeling, simulation, and experimentation of emerging Cloud computing infrastructures and application services. By using CloudSim, researchers and industry-based developers can focus on specific system design issues that they want to investigate, without getting concerned about the low level details related to Cloud-based infrastructures and services.

CloudSim is powered by jProfiler.

Main reference: Rodrigo N. Calheiros, Rajiv Ranjan, Anton Beloglazov, Cesar A. F. De Rose, and Rajkumar Buyya, CloudSim: A Toolkit for Modeling and Simulation of Cloud Computing Environments and Evaluation of Resource Provisioning Algorithms, Software: Practice and Experience (SPE), Volume 41, Number 1, Pages: 23-50, ISSN: 0038-0644, Wiley Press, New York, USA, January, 2011.

11. Moments with Visitors, Colleagues and International Hosts



Prof. Buyya presenting inaugural address for Compute-2013: The 6th ACM India Computing Conference, Vellore, India, Aug. 22-24, 2013.



A panel on Cloud Challenges at 13th IEEE/ACM International Symposium on Cluster Computing and the Grid (CCGrid 2013), Delft, The Netherlands, May 13, 2013.



A 3-day Seminar series at the Second University of Naples, Aversa, Italy, July 16-18, 2013.



A visit to Infosys, Mysore Campus in Aug 2013 – with Dr. B.M Subraya (Associate Vice President for Education and Research) and Madhan Kumar Srinivasan.



With Dr. K.Chidananda Gowda (former Vice Chancellor of Kuvempu University) in his residence in Mysore (Kuvempu's house "Udayaravi" in Mysore)



With Dr. Steve Diamond, Chair of IEEE Initiative in Cloud Computing at the IEEE International Conference on Cloud Computing for Emerging Markets (CCEM 2013), Oct. 16-18, 2013, Bangalore, India.



With Professor Vijay K Bhargava (President of the IEEE Communications Society for the year 2012 and 2013) during my seminar at the University of British Columbia, Sept 2013.



Four Elected Chairs of IEEE Technical Committee on Scalable Computing (TCSC) since its foundation (from 2005-2015) at 2013 World Ubiquitous Science Congress (U-Science2013), December 21-22, 2013, Chengdu, Sichuan, China.