

Cloud Computing and Distributed Systems Laboratory and the Cloudbus Project



Annual Report - 2011



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 2011, 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 2011 are:

- The Lab successfully carried out three ARC research projects; one of them was carried out with Microsoft as an ARC Linkage Project and it was successfully concluded.
- The Lab successfully assisted its spin-off company, Manjrasoft, which has released a new version of Aneka Cloud Application Platform.
- Members of CLOUDS Lab have authored 40 publications, which include 9 journal papers, and 15 conference papers. An edited book on "Cloud Computing: Principles and Paradigms" has been published by Wiley, USA.
- The Lab's flagship Cloudbus Project has released "open source" CloudSim 2.1 Toolkit, which is used by several researchers in academia and industries around the world.
- Members have presented over 12 invited talks that include 6 keynotes delivered at international conferences held in India, China, Saudi Arabia, and Malaysia.
- The Lab successfully hosted research activities of over 20 scholars: 9 PhD students, 7 Research Fellows (5 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 awards such as "**4th IEEE International Scalable Computing Challenge (SCALE 2011) Award**", "Google Australia Eureka Prize for Innovation in Computer Science: 2011 Finalist", and "**2011 Telstra Innovation Challenge, People's Choice Award**".
- Received "**Best Paper Award**" from the 4th IEEE/ACM International Conference on Utility and Cloud Computing (UCC 2011), December 5-7, 2011, Melbourne, Australia.
- The Lab housed several (short and long term) international visitors (academic and PhD students) from Canada, Malaysia, China, and India.
- The Lab attracted two ARC grants in the area of "Internet of Things (IoT) and Cloud Computing" for Smart Cities.
- Members of the Lab have led community efforts by (a) involving in the organisation of conferences (e.g., CCGrid 2011 in Los Angeles, UCC 2011 in Melbourne), (b) served on the Steering Committee of 5 international conferences and (c) served as the Chair of the Advisory Board of the IEEE Technical Committee on Scalable 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!

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. Christian Vecchiola
- Dr. Javadi Bahman
- Dr. Rodrigo N. Calheiros
- Mr. Dileban Karunamoorthy
- Ms. Jessie Yi Wei
- Dr. Saurabh Garg
- Dr. Suraj Pandey

PhD Students

- Mr. Michael Mattess
- Mr. William Voorsluys
- Mr. Mohsen Amini
- Mr. Anton Beloglazov
- Mr. Amir Vahid
- Ms. Linlin Wu
- Mr. Adel Toosi
- Mr. Sivaram Yoganathan
- Mr. Deepak Poola

Masters by Research Students

- Ms. Maria Alejandra Rodriguez Sossa
- Mr. Mohammed Alrokayan

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

Australian Research Council (ARC)

- R. Buyya, Service Level Agreement (SLA) oriented Resource Allocation for Data Centers and Cloud Computing Systems, Linkage Project, Australian Research Council (ARC), Australia and CA (Computer Associates), Australia, 2009-2011. Amount: \$273,000 (ARC: \$195,000 and CA: \$78,000).
- R. Buyya, Megha: Utility Oriented Federation of Cloud Computing Environments for Scaling of Application Services, Discovery Project, ARC, 2010-2012. Amount: \$280,000.

Industry and Melbourne University Grants

- R. Buyya and S. Pandey, "Access to Amazon EC2 and S3 Public Cloud", Academic Research Grant—Equipment Access, Amazon Inc., Seattle, USA, 2010-2011. Amount Equivalent: US\$6,000.
 - R. Buyya, "Desktop Virtualisation and Cloud Computing", Academic Research Grant--Equipments, IBM, Melbourne, Australia, 2010-2011. Amount Equivalent: A\$12,000.
 - A. Melatos, G. Taylor, R. Buyya, R. Kotagiri, P. Farrell, W. Moran, P. Hall, and A. Delaigle, "Designing the LIGO Australia Data Centre", SRE Implementation Fund, The University of Melbourne, 2011. Amount: \$95,000.
 - 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.
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4. Publications

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

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

Books Edited

1. Rajkumar Buyya, James Broberg, and Andrzej Goscinski (eds), [Cloud Computing: Principles and Paradigms](#), 644 pages, ISBN-13: 978-0470887998, Wiley Press, New York, USA, February 2011.

Book Chapters

2. William Voorsluys, James Broberg, and Rajkumar Buyya, [Introduction to Cloud Computing](#), [Cloud Computing: Principles and Paradigms](#), 1-41pp, R. Buyya, J. Broberg, A.Goscinski (eds), ISBN-13: 978-0470887998, Wiley Press, New York, USA, February 2011.
3. Christian Vecchiola, Xingchen Chu, Michael Mattess, and Rajkumar Buyya, [Aneka - Integration of Private and Public Clouds](#), [Cloud Computing: Principles and Paradigms](#), 249-274pp, R. Buyya, J. Broberg, A.Goscinski (eds), ISBN-13: 978-0470887998, Wiley Press, New York, USA, February 2011.
4. Suraj Pandey, Dileban Karunamoorthy and Rajkumar Buyya, [Workflow Engine for Clouds](#), [Cloud Computing: Principles and Paradigms](#), 321-344pp, R. Buyya, J. Broberg, A.Goscinski (eds), ISBN-13: 978-0470887998, Wiley Press, New York, USA, February 2011.
5. Anton Beloglazov, Rajkumar Buyya, Young Choon Lee, and Albert Zomaya, [A Taxonomy and Survey of Energy-Efficient Data Centers and Cloud Computing Systems](#), Advances in Computers, Volume 82, 47-111pp, M. Zelkowitz (editor), ISBN: 978-0-12-385512-1, Elsevier, Amsterdam, The Netherlands, March 2011.
6. Linlin Wu and Rajkumar Buyya, [Service Level Agreement \(SLA\) in Utility Computing Systems](#), Performance and Dependability in Service Computing: Concepts, Techniques and Research Directions, 1-25pp, V. Cardellini et. al. (eds), ISBN: 978-1-60-960794-4, IGI Global, Hershey, PA, USA, July 2011.
7. Saurabh Kumar Garg and Rajkumar Buyya, [Market-Oriented Resource Management and Scheduling: A Taxonomy and Survey](#), Cooperative Networking, 277-306pp, M. S. Obaidat and S. Misra (eds), ISBN: 978-0-470-74915-9, Wiley Press, New York, USA, August 2011.
8. Mustafizur Rahman, Rajiv Ranjan, and Rajkumar Buyya, [Decentralization in Distributed Systems: Challenges, Technologies, and Opportunities](#), Advancements in Distributed Computing and Internet Technologies: Trends and Issues, 386-399pp, A. K. Pathan, M. Pathan, and H. Y. Lee (eds), ISBN13: 9781613501108, IGI Global, Hershey, PA, USA, August 2011.

9. Michael Mattess, Christian Vecchiola, Saurabh Kumar Garg, and Rajkumar Buyya, Cloud Bursting: Managing Peak Loads by Leasing Public Cloud Services, Cloud Computing: Methodology, Systems, and Applications, L. Wang, R. Ranjan, J. Chen, and B. Benatallah (eds), ISBN: 9781439856413, CRC Press, Boca Raton, FL, USA, October 2011.
10. Amir Vahid Dastjerdi and Rajkumar Buyya, [A Taxonomy of QoS Management and Service Selection Methodologies for Cloud Computing](#), Cloud Computing: Methodology, Systems, and Applications, L. Wang, R. Ranjan, J. Chen, and B. Benatallah (eds), ISBN: 9781439856413, CRC Press, Boca Raton, FL, USA, October 2011.
11. Yi Wei, Karthik Sukumar, Christian Vecchiola, Dileban Karunamoorthy and Rajkumar Buyya, [Aneka Cloud Application Platform and Its Integration with Windows Azure](#), Cloud Computing: Methodology, Systems, and Applications, L. Wang, R. Ranjan, J. Chen, and B. Benatallah (eds), ISBN: 9781439856413, CRC Press, Boca Raton, FL, USA, October 2011.
12. K. Hwang et. al., R. Buyya et. al, Design of Cloud Computing Platforms, Chapter 4, [Distributed and Cloud Computing: From Parallel Processing to the Internet of Things](#), Kai Hwang, Jack Dongarra and Geoffrey Fox (authors), ISBN: 978-0-12-385880-1, Morgan Kaufmann, San Francisco, USA, October 2011.
13. K. Hwang et. al., R. Buyya et. al, Cloud Programming and Software Environments, Chapter 6, [Distributed and Cloud Computing: From Parallel Processing to the Internet of Things](#), Kai Hwang, Jack Dongarra and Geoffrey Fox (authors), ISBN: 978-0-12-385880-1, Morgan Kaufmann, San Francisco, USA, October 2011.
14. K. Hwang et. al., R. Buyya et. al, Grid Computing and Resource Management, Chapter 7, [Distributed and Cloud Computing: From Parallel Processing to the Internet of Things](#), Kai Hwang, Jack Dongarra and Geoffrey Fox (authors), ISBN: 978-0-12-385880-1, Morgan Kaufmann, San Francisco, USA, October 2011.

Proceedings Edited

15. Shantenu Jha, Nils gentschen Felde, Rajkumar Buyya, and Gilles Fedak, Proceedings of the 12th IEEE/ACM International Conference on Grid Computing (Grid 2011, Sep. 22-23, 2011, Lyon, France), ISBN-13: 978-0-7695-4572-6, IEEE CS Press, Los Alamitos, CA, USA.
16. Rajkumar Buyya, Shrideep Pallickara, and Geoffrey Fox, Proceedings of the 4th IEEE/ACM International Conference on Utility and Cloud Computing (UCC 2011, Dec. 5-7, 2011, Melbourne, Australia), ISBN-13: 978-0-7695-4592-9, IEEE CS Press, Los Alamitos, CA, USA.

Journal Papers

17. 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, Volume 41, Number 1, Pages: 23-50, ISSN: 0038-0644, Wiley Press, New York, USA, January 2011.
18. Luis M. Vaquero, Luis Rodero-Merino, and Rajkumar Buyya, [Dynamically Scaling Applications in the Cloud](#), Computer Communication Review, Volume 41, Issue 1, Pages: 45-52, ISSN: 0146-4833, ACM Press, New York, USA, January 2011.
19. Saurabh Kumar Garg, Chee Shin Yeo, Arun Anandasivam, and Rajkumar Buyya, [Environment-Conscious Scheduling of HPC Applications on Distributed Cloud-oriented Data Centers](#), Journal of Parallel and Distributed Computing (JPDC), Volume 71, Number 6, Pages: 732-749, ISSN: 0743-7315, Elsevier Press, Amsterdam, The Netherlands, June 2011.

20. Nithiapidary Muthuvelu, Ian Chai, Eswaran Chikkannan, and Rajkumar Buyya, [Batch Resizing Policies and Techniques for Fine- Grain Grid Tasks: The Nuts and Bolts](#), Journal of Information Processing Systems, Volume 7, Number 2, Pages: 299-320, ISSN: 1976-913X, Korea Information Processing Society (KIPS), Seoul, Korea, June 2011.
21. Kyong Hoon Kim, Anton Beloglazov, and Rajkumar Buyya, [Power-aware Provisioning of Virtual Machines for Real-time Cloud Services](#), Concurrency and Computation: Practice and Experience, Volume 23, Number 13, Pages: 1491-1505, ISSN: 1532-0626, Wiley Press, New York, USA, September 10, 2011.
22. Xiaofeng Wang, Chee Shin Yeo, Rajkumar Buyya, and Jinshu Su, [Optimizing the Makespan and Reliability for Workflow Applications with Reputation and a Look-Ahead Genetic Algorithm](#), Future Generation Computer Systems, Volume 27, Number 8, Pages: 1124-1134, ISSN: 0167-739X, Elsevier Science, Amsterdam, The Netherlands, October 2011.
23. Marco A. S. Netto, Christian Vecchiola, Michael Kirley, Carlos A. Varela, and Rajkumar Buyya, [Use of Run Time Predictions for Automatic Co-Allocation of Multi-Cluster Resources for Iterative Parallel Applications](#), Journal of Parallel and Distributed Computing (JPDC), Volume 71, Number 10, Pages: 1388-1399, ISSN: 0743-7315, Elsevier Press, Amsterdam, The Netherlands, October 2011.
24. Mustafizur Rahman, Rajiv Ranjan, Rajkumar Buyya and Boualem Benatallah, [A Taxonomy and Survey on Autonomic Management of Applications in Grid Computing Environments](#), Concurrency and Computation: Practice and Experience, Volume 23, Number 16, Pages: 1990-2019,, ISSN: 1532-0626, Wiley Press, New York, USA, November 2011.
25. Saurabh Kumar Garg, Pramod Konugurthi and Rajkumar Buyya, [A Linear Programming-driven Genetic Algorithm for Meta-Scheduling on Utility Grids](#), International Journal of Parallel, Emergent and Distributed Systems, Volume 26, Number 6, Pages: 493-517, ISSN: 1744-5760, Taylor & Francis Press, UK, December 2011.

Magazine Papers

26. Rajkumar Buyya and Karthik Sukumar, [Platforms for Building and Deploying Applications for Cloud Computing](#), CSI Communications, Vol.35, No. 1, Pages: 6-11, ISSN 0970-647X, Computer Society of India (CSI), Mumbai, India, May 2011.

Conference Papers

27. Mohsen Amini Salehi, Bahman Javadi, and Rajkumar Buyya, [Resource Provisioning based on Lease Preemption in InterGrid](#), Proceedings of the 34th Australasian Computer Science Conference (ACSC 2011), Australian Computer Society, January 17-20, 2011, Perth, Australia.
28. Adam Barker and Rajkumar Buyya, [Decentralised Orchestration of Service-Oriented Scientific Workflows](#), Proceedings of the 1st International Conference on Cloud Computing and Services Science (Springer-Verlag Press), Noordwijkerhout, The Netherlands, May 7-9, 2011.
29. Linlin Wu, Saurabh Kumar Garg and Rajkumar Buyya, [SLA-based Resource Allocation for a Software as a Service Provider in Cloud Computing Environments](#), Proceedings of the 11th IEEE/ACM International Symposium on Cluster, Cloud and Grid Computing (CCGrid 2011, IEEE CS Press, USA), Los Angeles, USA, May 23-26, 2011.
30. Saurabh Kumar Garg, Chee Shin Yeo, and Rajkumar Buyya, [Green Cloud Framework For Improving Carbon Efficiency of Clouds](#), Proceedings of the 17th International European Conference on Parallel and Distributed Computing (EuroPar 2011, LNCS, Springer, Germany), Bordeaux, France, August 29-September 2, 2011.
31. Adel Nadjaran Toosi, Rodrigo N. Calheiros, Ruppa K. Thulasiran, and Rajkumar Buyya, [Resource Provisioning Policies to Increase IaaS Provider's Profit in a Federated Cloud Environment](#), Proceedings of the 13th International Conference on High Performance

- and Communications (HPCC 2011, IEEE CS Press, USA), Banff, Canada, September 2-4, 2011.
32. Rodrigo Calheiros, Rajiv Ranjan and Rajkumar Buyya, [Virtual Machine Provisioning Based on Analytical Performance and QoS in Cloud Computing Environments](#), Proceedings of the 40th International Conference on Parallel Processing (ICPP 2011, IEEE CS Press, USA), Taipei, Taiwan, September 13-16, 2011.
 33. Saurabh Kumar Garg, Srinivasa K Gopalaiyengar, and Rajkumar Buyya, [SLA-based Resource Provisioning for Heterogeneous Workloads in a Virtualized Cloud Datacenter](#), Proceedings of the 11th International Conference on Algorithms and Architectures for Parallel Processing (ICA3PP 2011, LNCS 7016, Springer, Germany), Melbourne, Australia, October 24-26, 2011.
 34. Mohsen Amini Salehi, Bahman Javadi and Rajkumar Buyya, [Performance Analysis of Preemption-aware Scheduling in Multi-Cluster Grid Environments](#), Proceedings of the 11th International Conference on Algorithms and Architectures for Parallel Processing (ICA3PP 2011, LNCS 7016, Springer, Germany), Melbourne, Australia, October 24-26, 2011.
 35. William Voorsluys, Saurabh Kumar Garg and Rajkumar Buyya, [Provisioning Spot Market Cloud Resources to Create Cost-effective Virtual Clusters](#), Proceedings of the 11th International Conference on Algorithms and Architectures for Parallel Processing (ICA3PP 2011, LNCS 7016, Springer, Germany), Melbourne, Australia, October 24-26, 2011.
 36. Amir Vahid Dastjerdi, Saurabh Kumar Garg and Rajkumar Buyya, [QoS-aware Deployment of Network of Virtual Appliances across Multiple Clouds](#), Proceedings of the 3rd IEEE International Conference on Cloud Computing Technology and Science (IEEE CloudCom 2011, IEEE CS Press, USA), Athens, Greece, Nov. 29 - Dec. 1, 2011.
 37. Saurabh Kumar Garg and Rajkumar Buyya, [NetworkCloudSim: Modelling Parallel Applications in Cloud Simulations](#), Proceedings of the 4th IEEE/ACM International Conference on Utility and Cloud Computing (UCC 2011, IEEE CS Press, USA), Melbourne, Australia, December 5-7, 2011.
 38. Bahman Javadi, Ruppa Thulasiram and Rajkumar Buyya, [Statistical Modeling of Spot Instance Prices in Public Cloud Environments](#), Proceedings of the 4th IEEE/ACM International Conference on Utility and Cloud Computing (UCC 2011, IEEE CS Press, USA), Melbourne, Australia, December 5-7, 2011. - **Best Paper Award**.
 39. Saurabh Kumar Garg, Steve Versteeg and Rajkumar Buyya, [SMICloud: A Framework for Comparing and Ranking Cloud Services](#), Proceedings of the 4th IEEE/ACM International Conference on Utility and Cloud Computing (UCC 2011, IEEE CS Press, USA), Melbourne, Australia, December 5-7, 2011.
 40. Rajkumar Buyya, Saurabh Kumar Garg, and Rodrigo N. Calheiros, [SLA-Oriented Resource Provisioning for Cloud Computing: Challenges, Architecture, and Solutions](#), Proceedings of the 2011 IEEE International Conference on Cloud and Service Computing (CSC 2011, IEEE Press, USA), Hong Kong, China, December 12-14, 2011.
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5. Invited Presentations and Outreach

By the Lab Director:

Keynote Talks at International Conferences

1. Cloud Computing and Aneka Platform, 2011 International Conference on Information Technologies (KACSTIT), Sept. 18-19, 2011, Riyadh, Saudi Arabia.
2. SLA-Oriented Resource Provisioning for Cloud Computing, 2011 IEEE International Conference on Cloud and Service Computing (CSC 2011), December 12-14, 2011, Hong Kong, China.
3. Market-Oriented Cloud Computing and the Aneka Platform, International Workshop on Cloud Computing and Future Internet, December 16-17, 2011, Beijing, China.
4. Cloud Computing: A New IT Model for Delivering Sustainable Solutions, IEEE INDICON 2011 Conference: Engineering Sustainable Solutions, Dec. 18, 2011, Hyderabad, India.
5. Cloud Computing and the Aneka Platform, International Conference on Data Engineering and Communication Systems (ICDECS 2011), December 30-31, 2011, Bangalore, India.

National Conferences

1. Cloud Computing and Aneka Platform, AUSTRADE Cloud Computing Workshop, Australian Trade Commission (AUSTRADE), Australian Embassy, Jakarta, Indonesia, March 16, 2011.
2. Cloud Computing: Principles and Paradigms, 1st National Advanced Cloud Computing Workshop, Penang, Malaysia, April 11-12, 2011.
3. National Workshop on Cloud Computing, G.Pulla Reddy Engineering College, Kurnool, India, Dec. 23, 2011.
4. National Workshop on Market-Oriented Cloud Computing and the Aneka Platform, Jawaharlal Nehru Technological University (JNTU), Anantapur, India, Dec. 27, 2011.
5. National Workshop on Cloud Computing and Applications, BMS College of Engineering, Bangalore, India, Dec. 27, 2011.

Seminars - in Cloud Computing area:

1. Majan College, Muscat, Oman, March 22, 2011.
2. Qatar University, Doha, Qatar, March 27, 2011.
3. University of Southern California (USC), Los Angeles, USA, May 27, 2011.
4. King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia, Sept. 13, 2011.
5. King Saud University, Riyadh, Saudi Arabia, Sept. 17, 2011.
6. King Abdulaziz City for Science and Technology (KACST), Riyadh, Saudi Arabia, Sept. 17, 2011.
7. University of Malaya, Kuala Lumpur, Malaysia, Sept. 21, 2011.
8. International Islamic University Malaysia (IIUM), Kuala Lumpur, Malaysia, Sept. 22, 2011.
9. Australian Computer Society (ACS), Melbourne, Australia, October 4, 2011.
10. Hong Kong Polytechnic University, Hong Kong, China, Dec. 9, 2011.
11. R.V. College of Engineering (RVCE), Bangalore, India, Dec. 28, 2011.

Conference Tutorials

1. Market-Oriented Cloud Computing, 11th IEEE/ACM International Symposium on Cluster Computing and the Grid (CCGrid 2011), Newport Beach, California, USA, May 23-26, 2011.

6. Selected Community Services

By the Lab Director:

IEEE Computer Society

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

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, and CCGrid 2011, Newport Beach, USA.
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, Brazil, 2005-to date.
5. Member, IEEE/ACM International Conference on Grid Computing (GRIDxy), 2000-to date.

Conference Chair

1. General Co-Chair, Fourth International Conference on Utility and Cloud Computing (UCC 2011), December 5-7, 2011, Melbourne, Australia.

Technical Program Committee Memberships

1. 18th International Conference on High Performance Computing (HiPC 2011), December 19-22, 2011, Bengaluru, India.
2. The 12th International Conference on Web Information System Engineering (WISE 2011), October 13-14, 2011, Sydney, Australia.
3. 13th IEEE International Conference on Cluster Computing (Cluster 2011), Sept. 26-30, 2011, Austin, USA.
4. 40th International Conference on Parallel Processing (ICPP 2011), September 13-16, 2011, Taipei, Taiwan.
5. 13th IEEE High Performance Computing and Communications (HPCC 2011), Sept. 2-4, 2011, Banff, Canada.
6. 2nd Workshop on Scientific Cloud Computing (ScienceCloud 2011), co-located with ACM HPDC 2011, June 8th, 2011, San Jose, California.

7. 10th Australasian Symposium on Parallel and Distributed Computing (AusPDC 2011), Jan. 17-20, 2011, Perth, Australia.

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:

Chairs and Memberships

1. Suraj Pandey, Organizing Co-chair, 4th IEEE/ACM International Conference on Utility and Cloud Computing (UCC 2011) December 5-7, 2011, Melbourne, Australia.
2. Rodrigo N. Calheiros, Organizing Co-chair, 4th IEEE/ACM International Conference on Utility and Cloud Computing (UCC 2011) December 5-7, 2011, Melbourne, Australia.
3. Saurabh Kumar Garg, Local Organizing Committee, 4th IEEE/ACM International Conference on Utility and Cloud Computing (UCC 2011) December 5-7, 2011, Melbourne, Australia.
4. Suraj Pandey, Cyber Co-chair, 11th IEEE/ACM International Symposium on Cluster, Cloud, and the Grid (CCGrid 2011) May 23-26, 2011, Newport Beach, USA.

Technical Program Committee Memberships

1. Suraj Pandey, 2011, 11th IEEE/ACM International Symposium on Cluster, Cloud, and the Grid (CCGrid 2011), May 23-26, 2011, Newport Beach, USA.
2. Saurabh Kumar Garg, 2011, 11th IEEE/ACM International Symposium on Cluster, Cloud, and the Grid (CCGrid 2011), May 23-26, 2011, Newport Beach, USA.
3. Christian Vecchiola, 2011, 4th IEEE International Workshop on Internet and Distributed Computing Systems (IDCS 2011), October 24-26, 2011, Melbourne, Australia.
4. Rodrigo N. Calheiros, 2011, International Conference on Cloud and Green Computing (CGC 2011), December 12-14, 2011, Sydney, Australia.
5. Bahman Javadi, 2011, 3rd International Conference on Advanced Computing (ICoAC 2011), December 14-16, 2011, Chennai, India.

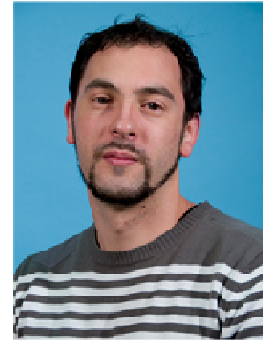
7. International Visitors

1. Dr. Srinivasa K G, MSRIT, Bangalore, India, Aug 2010-Jan 2011 - on BOYSCAST Fellowship of Govt. of India.
2. A/Prof. Dr. Ruppa (Tulsi) Thulasiram, University of Manitoba, Canada, Jan 2011-Jul 2011.
3. A/Prof. Parimala Thulasiraman, University of Manitoba, Canada, Jan 2011-Jul 2011.
4. Mr. Guofu Feng, Nanjing Audit University, China, March-Aug 2011.
5. Ms. Toktam Ghafarian Mabhoot, Feirdowsi University of Mashhad, Iran, May-Dec 2011.
6. A/Prof. Abdullah Bin Gani, University of Malaya, Malaysia, Oct 2011-Jun2012.

8. Continuing Members Profile and Activities

Member Self Profile: Dr. Christian Vecchiola

I am part of the CLOUDS Lab since 2008 when I joined as a Postdoctoral Research Fellow working on Distributed Evolutionary Computation and Global Grids. I completed my Ph.D. at the University of Genova, Italy with a thesis on “*Providing Support for Evolvable System: An Agent-based Approach*”. My research now is mostly focused on tools and technologies for Cloud Computing and development of Platform as a Service solution frameworks and solutions for distributed computing applications over the Cloud. Besides research I also taught *Distributed Systems* subject and co-lectured *Cluster and Grid Computing* subject.



Genetic algorithms are compute intensive and time consuming optimization algorithms that can be applied to different real life scenarios such as airfoil dynamic design, protein structure prediction, and virtually any problem that can be characterized by a single or multi-objective function that needs to be optimized. We supported distributed execution of evolutionary algorithms, initially on Grids and then on Clouds. I have also developed a software prototype – called Offspring – for helping research scientists in quickly prototype-distributed implementations of evolutionary algorithms. This prototype leverages Aneka.

Cloud Computing is an interesting new opportunity for companies to leverage on demand third parties for IT infrastructure, services, and applications. It allows dynamically provisioning virtual hardware, scale applications according to their needs and integrating new services to existing application. The scenario envisioned by Cloud Computing poses new interesting challenges ranging from infrastructure management, quality of service, application management and scheduling, and dynamic provisioning. Platform as a Service (PaaS) solutions provide a scalable and elastic middleware for executing applications on the Cloud, provides the right venue where to experiment many of the aspects introduced before. In particular, in 2011 we have focused in improving the dynamic provisioning infrastructure within Aneka and devising more intelligent policies for dynamic resource provisioning. Together with Prof. Buyya, I am also writing a book on High Performance Cloud Computing.

Member Self Profile: Dr. Bahman Javadi

In June 2010, I entered into my new role as a Research Fellow in the CLOUDS Lab appointed to work on the ARC Discovery Project “InterGrid: Peering Architecture and policies for Internetworking Disparate Grids”. This project aims to provide a software system that allows the creation of execution environments for various applications on top of the physical infrastructure provided by the participating Grids. The allocation of resources from multiple Grids to fulfil the requirements of the execution environments is enabled by peering arrangements established between gateways.

Since I join the CLOUDS lab, I mainly worked on the reliability issues in the InterGrid where there is ability to borrow some resources from public Cloud providers. To do so, I developed a simulation environment in GridSim with ability to simulate resource failures from Failure Trace Archive (FTA). I also developed a new package in GridSim for a workload model of cluster systems (i.e. DAS-2 system). Both packages and related documents have been released as part of GridSim 5.2 in November 2010.



Before joining the CLOUDS lab, I was a post-doctoral fellow in MESCAL team at INRIA, Grenoble, France. I have been working on following projects during 2008-2010:

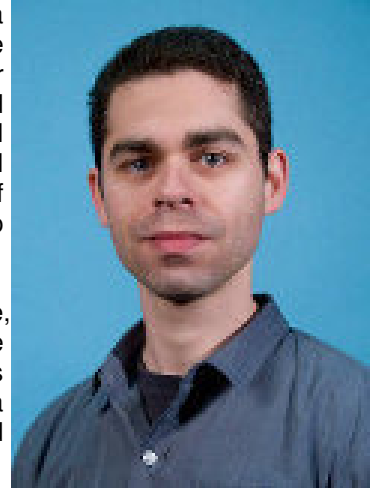
1. Clouds@home: A project funded by the national French science foundation (called ANR) for running complex services and applications over unreliable (Internet) resources. This project is in collaboration with the INRIA MOAIS, GRAAL and Grand-Large teams, and also UC Berkeley.
2. Failure Trace Archive: FTA is a centralized public repository of availability traces_of parallel and distributed systems, and tools for their analysis. The purpose of this archive is to facilitate the design, validation, and comparison of fault-tolerant models and algorithms. This effort is in collaboration with INRIA Bordeaux and TU Delft. The project is funded by an INRIA project called ALEAE. (website: <http://fta.inria.fr>)

For the list of publications and details about my past and current work, please visit my webpage: <http://people.eng.unimelb.edu.au/bahmanj>

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. My main duties are related to the InterCloud project¹, which aims at developing an architecture and system for Federation of Clouds, comprising Brokers (acting on behalf of users), Cloud providers (including IaaS, PaaS, and SaaS providers), and a Cloud Exchange which mediates interaction between parties. I've been also worked on new policies for cost-effective, deadline-aware dynamic provisioning of public Cloud resources to applications, which were incorporated to Manjarasoft's Aneka.

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 Vienna University of Technology (Austria), University of Manitoba (Canada), Pontifical Catholic University of Rio Grande do Sul (Brazil), and IBM R&D Brazil.



During 2011, I was also actively engaged in the Organization of UCC 2011, and was Assistant Lecturer for the "Distributed Systems" subject in Semester 2.

My research interest include Cloud Federation, Resource Management in Clouds and Grids, Provisioning and Scheduling in Clouds and Grids, Simulation, Emulation, and Virtualization.

Member Self Profile: Dileban Karunamoorthy

I joined CLOUDS Lab in August 2009 in the capacity of a Research Fellow contributing primarily to the on-going research and development of a platform for building cloud applications. Aneka, one of the flagship projects in the research group, 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 pursuing a Masters in Distributed Computing (MEDC) at the University of Melbourne in July 2008, I was employed at IFS R&D, an ERP software vendor, since 2000. In the fall of 2008, after finishing my first semester at University of Melbourne, I began working as a part-time Research Assistant with the CLOUDS Lab group. In August 2009 after completing my degree, I joined the group as a full-time Research Fellow.



Throughout the year 2011 I continued to work on the Aneka platform, designing and implementing a number of features. Fault-tolerance through redundancy is a key feature in any distributed computing platform. I worked on implementing a multi-master failover mechanism for Aneka that employed the Bully Election algorithm to deterministically select an active master with a group of masters in the event of failure. This design was based on the mechanism used in the popular Oracle Grid Engine. I also made a few optimizations on the platform which reduced the data transferred for tasks on the platform by an order of magnitude resulting in lower latency, increased bandwidth efficiency and overall throughput of the system. Capturing analytical data is vital in grid and cloud platforms giving useful insights on a number of aspects including the execution of applications, performance bottlenecks, failures, data transfers and resource utilization. I spent a fair amount of time implementing and integrating monitoring and reporting services in the platform which provided a means to capture such real-time data while applications were being executed.

Other areas that I worked on include securing communication within a group of Aneka containers in the network. The platform currently uses symmetric-key encryption where the key is preconfigured on all nodes that will form part of the Cloud. In future, the shared key will be exchanged at runtime using public-key cryptography. I also added support for: staging files from Amazon S3 repositories; managing and installing Aneka Daemons and Containers on Linux systems; began implementation for Share File Systems in order to better support running Aneka on clusters; certifying Aneka on HP clusters and Windows Server 2008 RC2; releasing Aneka 2.0 (a major release since Aneka 1.0 in the previous year) and engaged with customers and individuals interested in the platform. I also contributed to the following publications.

C. Vecchiola, R. N. Calheiros, D. Karunamoorthy, R. "Deadline-Driven Provisioning of Resources for Scientific Applications in Hybrid Clouds with Aneka", *Future Generation Computer Systems*, DOI: 10.1016/j.future.2011.05.008, 2011.

Suraj Pandey, Dileban Karunamoorthy and Rajkumar Buyya, *Workflow Engine for Clouds*, *Cloud Computing: Principles and Paradigms*, R. Buyya, J. Broberg, A. Goscinski (eds), ISBN-13: 978-0470887998, Wiley Press, New York, USA, 2011.

Member Self Profile: Dr. Saurabh Kumar Garg

I am currently working as Research Fellow under the supervision of Dr. Rajkumar Buyya in Cloud Computing and Distributed System (CLOUDS) Laboratory of The University of Melbourne. I completed my 5-year Integrated Master of Technology in Mathematics and Computing from the Indian Institute of Technology (IIT) Delhi, India, in 2006. After completing my post graduate degree, I joined the **IBM Indian Research** Laboratory Delhi, where I worked in the area of High Performance Computing. I designed and optimized the FFT and Random Access benchmarks for **Blue Gene/L**, which is the fastest supercomputer from IBM. Here in Melbourne University, I have been awarded with various scholarships such as MIFRS and MIRS for my PhD candidature.



In CLOUDS Laboratory, I conducted research in various research areas of Cloud computing such as utility and market principles in Grid and Cloud computing, SLA-based resource allocation, carbon- and energy-aware Scheduling, resource provisioning algorithms for SaaS, meta-scheduling etc. I developed my expertise in simulation modelling particularly in Grid Simulation Toolkits such as GridSim, CloudSim and Gridbus Broker. Currently I am working in the area of green and cloud computing to provision resources based on SLAs, virtualization, and energy consumption of infrastructure.

During year 2011, I have proposed various scheduling policies in Clouds. These works are submitted and published in to a number of peer-reviewed book chapters, International journals and conferences. My **selected publications** in 2011 are following:

1. Saurabh Kumar Garg and Rajkumar Buyya, [Market-Oriented Resource Management and Scheduling: A Taxonomy and Survey](#), Cooperative Networking, 277-306pp, M. S. Obaidat and S. Misra (eds), ISBN: 978-0-470-74915-9, Wiley Press, New York, USA, August 2011.
2. Saurabh Kumar Garg, Chee Shin Yeo, Arun Anandasivam, and Rajkumar Buyya, [Environment-Conscious Scheduling of HPC Applications on Distributed Cloud-oriented Data Centers](#), Journal of Parallel and Distributed Computing (JPDC), Volume 71, Number 6, Pages: 732-749, ISSN: 0743-7315, Elsevier Press, Amsterdam, The Netherlands, June 2011.
3. Linlin Wu, Saurabh Kumar Garg and Rajkumar Buyya, SLA-based Admission Control for a Software-as-a-Service Provider in Cloud Computing Environments, Journal of Computer and System Sciences, (accepted May 2011, in press).
4. Saurabh Kumar Garg, Steve Versteeg and Rajkumar Buyya, [SMICloud: A Framework for Comparing and Ranking Cloud Services](#), Proceedings of the 4th IEEE/ACM International Conference on Utility and Cloud Computing (UCC 2011, IEEE CS Press, USA), Melbourne, Australia, December 5-7, 2011.
5. Saurabh Kumar Garg, Chee Shin Yeo, and Rajkumar Buyya, [Green Cloud Framework For Improving Carbon Efficiency of Clouds](#), Proceedings of the 17th International European Conference on Parallel and Distributed Computing (EuroPar 2011, LNCS, Springer, Germany), Bordeaux, France, August 29-September 2, 2011.

Member Self Profile: Dr. Suraj Pandey

Research Fellow | PhD
CSIRO ICT Centre, Marsfield
Tel: +61-2-93724343
Email: suraj.pandey@csiro.au
<http://www.ict.csiro.au/staff/suraj.pandey/>



Dr Suraj Pandey is a research fellow at CSIRO. Before joining CSIRO, he worked as a post-doctoral research fellow at the Cloud Computing and Distributed Systems (CLOUDS) Laboratory at the University of Melbourne, Australia. His PhD thesis focused on scheduling data intensive application workflows on Grids and Cloud computing environments.

Dr Pandey's research spans many areas of high performance computing, including data intensive applications, workflow scheduling, resource provisioning, and accelerating scientific applications using distributed computing paradigms. He has been participating in international software competitions and has been awarded in several occasions by industry leaders such as Amazon and Microsoft.

Dr Pandey has numerous publications in ERA A* and ERA A ranked journals and conferences, including a recent research article published by the Oxford's Computer Journal.

Website: <http://www.ict.csiro.au/staff/suraj.pandey/>
Publications: <http://www.ict.csiro.au/staff/suraj.pandey/publications.php>

Member Self Profile: William Voorsluys

I joined CloudsLab in February 2008, when I started my PhD studies in the University of Melbourne.

In the past few years, before coming to Melbourne, I've been involved with aspects of grid and cloud computing, virtualization technologies and load balancing in distributed systems. This interest started back in the year 2000 during my undergraduate studies, when I developed load-balancing algorithms for heterogeneous clusters. Later, in my master's research in the University of Sao Paulo, I've studied memory-related metrics that allow a precise evaluation of a system's memory-usage, with the objective of aiding cluster load balancing policies to make better decisions.



From 2005 to 2008 I have worked as a researcher in the OurGrid project, a Brazilian grid computing initiative, which is dedicated to research and development of a peer-to-peer grid computing solution.

My PhD research aims at creating a provisioning and allocation mechanism for virtualised data centres. A key feature of my research is the concept of workload mobility. I'm taking advantage of live migration and replication of virtual machines to achieve load balancing and fault tolerance capabilities.

More specifically, my research involves devising a mechanism that uses detailed information about resource utilization in each virtual machine to intelligently consolidate and redistribute the workload in a data center. I'm also working on fault tolerant policies to allow executing high performance computing application on variable pricing cloud resource (spot market).

Member Self Profile: Anton Beloglazov

My name is Anton Beloglazov, I am from Novosibirsk, Russian Federation. I am a final year PhD candidate 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 is "Energy and Performance Efficient Dynamic Consolidation of Virtual Machines Cloud Computing Data Centers". My work is focused on the development of policies and algorithms for continuous consolidation of virtual machines in virtualized Cloud data centers in order to minimize energy consumption, while maintaining the required Quality of Service. I have contributed to the development of CloudSim, an open-source Java framework for modeling and simulation of Cloud computing infrastructures and services.

In 2011, my research work has resulted in the following publications:

1. 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 (CCPE)*, ISSN: 1532-0626, Wiley Press, New York, USA, 2011, DOI: 10.1002/cpe.1867 (in press, accepted on September 2, 2011)
2. Anton Beloglazov, Jemal Abawajy, and Rajkumar Buyya, "Energy-Aware Resource Allocation Heuristics for Efficient Management of Data Centers for Cloud Computing", *The International Journal of Grid Computing and eScience, Future Generation Computer Systems (FGCS)*, ISSN: 0167-739X, Elsevier Science, Amsterdam, The Netherlands, 2011, DOI: 10.1016/j.future.2011.04.01 (in press, accepted on April 28, 2011)
3. Anton Beloglazov, Rajkumar Buyya, Young Choon Lee, and Albert Zomaya, "A Taxonomy and Survey of Energy-Efficient Data Centers and Cloud Computing Systems", *Advances in Computers*, Marvin V. Zelkowitz (editor), Volume 82, Pages: 47-111, ISSN: 0065-2458, Elsevier, 2011, DOI: 10.1016/B978-0-12-385512-1.00003-7

For the full list of publications and details of my work, please visit my web-page: <http://beloglazov.info>

Member Self Profile: Amir Vahid Dastjerdi

I am a third year PhD student, and conducting my research on “QoS-aware Service Deployment in Federated Clouds” under supervision of Prof. Rajkumar Buyya. I have been mainly studying optimization techniques and QoS management for web service selection. The output of aforementioned research was presented in CloudCom 2011 in Athens. Recently, I have been investigating challenges involved in SLA management including negotiation for Cloud computing environment. My paper in CCGrid 2012 presents the outcome of my research on finding a solution for SLA negotiation in Cloud which can enhance reliability and profit for Cloud service users and providers respectively.

My publication in year 2011 comes below:

Conference papers:

- 1- Amir Vahid Dastjerdi, Saurabh Kumar Garg, and Rajkumar Buyya, QoS-aware Deployment of Network of Virtual Appliances across Multiple Clouds, Proceedings of the 3rd IEEE International Conference on Cloud Computing Technology and Science (IEEE CloudCom 2011, IEEE CS Press, USA), Athens, Greece, Nov. 29 - Dec. 1, 2011.
- 2- Amir Vahid Dastjerdi and Rajkumar Buyya, An Autonomous Reliability-aware Negotiation Strategy for Cloud Computing Environment, Proceedings of the 12th IEEE/ACM International Symposium on Cluster Computing and the Grid (CCGrid 2012), Ottawa, Canada, May 13-16, 2012.

Journal papers:

- 1- Vahid Dastjerdi, Sayed Gholam Hassan Tabatabaei, and Rajkumar Buyya, A Dependency-aware Ontology-based Approach for Deploying Service Level Agreement Monitoring Services in Cloud, Software: Practice and Experience, Volume ??, Number ??, Pages: ?-?, ISSN: 0038-0644, Wiley Press, New York, USA, 2012 (in press, accepted on June 5, 2011).
- 2- Amir Vahid Dastjerdi, Yoganathan Sivaram, and Rajkumar Buyya, Multi-objective Ontology-based Virtual Appliance Composition Under Fuzzy Preferences of Users in Clouds, submitted to ACM Transactions on Autonomous and Adaptive Systems (TAAS).

For more information on my research, please visit my website at
<http://ww2.cs.mu.oz.au/~amirv/>



Member Self Profile: Michael Mattess

I joined the CLOUDS lab at the beginning of 2008, when I commenced my masters by research at The University of Melbourne under the supervision of Professor Rajkumar Buyya. With this I returned to the department where I completed my undergraduate studies. During this Bachelor of Computer Science (with Honours) I investigated file systems and storage layer aspects of email systems.

Between the bachelor degree and commencing my masters I worked as a Software Engineer. In this role I develop an embedded system for the healthcare sector, which allowed for the integration of multiple systems found in hospitals. I also worked, amongst other things, on an IP based TV system.



For the most part of 2009 I was on leave-of-absence from my masters and worked as a consultant performing a diverse range of tasks, from building a virtualization cluster to reverse engineering legacy systems to writing a data migration application.

During 2010 I continued my research work, which is centered on the problems of offloading some processing of tasks to commercial cloud providers when the local infrastructure is overloaded. In late 2009 Amazon introduced 'Spot Instances', which have a varying, market driven price. Spot Instances were incorporated into my work, which was presented¹ at the HPCC 2010 conference. This work was then further extended and additional workloads were investigated.

At the end of 2010 I also converted from masters by research degree to a PhD. In 2011 I entered the third year of the PhD as a confirmed candidate.

Member Self Profile: Mohsen Amini Salehi

I am Mohsen Amini Salehi. I have a Bachelor (2003) and Master degree (2005) in Computer Science from Azad University of Mashhad and Ferdowsi University of Mashhad, Iran respectively. Currently I am a second year PhD student at the University of Melbourne, Australia. My main research interests are resource provisioning in resource sharing environments such as InterGrid and combining Grid and Cloud computing resources.



In 2004, when I was still an undergraduate, I started to get interested on research management and scheduling. In that year, I joined a new research centre on high performance computing (Simorgh), in the Computer center of the Ferdowsi University. During the period of 2003-2005, I worked with resource management and load balancing in Grid computing under supervision of Dr. Hossein Deldari. In that period I developed tools, wrote research papers, and patents. In 2005, I moved back to Azad University of Mashhad as a faculty member and lecturer. From 2005 to 2008 I was teaching in the Azad University of Mashhad in Operating System Concepts and Computer Networks. As a researcher, I was working on Text Summarization Systems during that period and I could get a research grant on that area.

In 2008, I joined CLOUDS Lab at the University of Melbourne, Australia, to pursue my PhD under supervision of Dr. Rajkumar Buyya. My research has been focused on resource provisioning in InterGrid, which extends the background of my Master degree. However, different from my previous research, at this time I am considering environments that support lease-based resource provisioning. My thesis is on preemption-based resource provisioning in resource sharing environments such as InterGrid.

During 2010 and 2011, I worked on providing resources for local users in InterGrid where there are different types of user requests. More specifically, we consider two major types of user requests namely, local users' requests and Grid users' requests. The research paper resulted from this study was accepted and published in Australian Computer Science Week 2011 Conference in Perth, Australia. I have also worked on a scheduling policy in InterGrid Gateway (IGG) level. This scheduling policy schedules user requests on different sites of a Grid in a way that the minimum number of pre-emption occurs. The research paper resulted from this study has been published in ICA3PP 2011, Melbourne and Journal of Parallel and Distributed Computing (JPDC). Another part of my research in 2011 was on admission control policies in each cluster of InterGrid, which resulted in a paper in AINA 2012. I have also worked on the impact of preemption on energy efficiency in InterGrid and implemented that in Haizea as a realistic platform.

For the list of publications and details about my past and current work, please visit my webpage: <http://www.csse.unimelb.edu.au/~mohsena>

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.



My publications of 2011 are:

- Linlin Wu and Rajkumar Buyya, Service Level Agreement (SLA) in Utility Computing Systems, Performance and Dependability in Service Computing: Concepts, Techniques and Research Directions, 1-25pp, V. Cardellini et. al. (eds), ISBN: 978-1-60-960794-4, IGI Global, Hershey, PA, USA, July 2011.
- Linlin Wu, Saurabh Kumar Garg and Rajkumar Buyya, SLA-based Resource Allocation for a Software as a Service Provider in Cloud Computing Environments, Proceedings of the 11th IEEE/ACM International Symposium on Cluster, Cloud and Grid Computing (CCGrid 2011, IEEE CS Press, USA), Los Angeles, USA, May 23-26, 2011.

Member Self Profile: Adel Toosi

I started my PhD studies under supervision of Dr. Rajkumar Buyya in the Department of Computing and Information Systems 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 systems such as fuzzy systems and genetic algorithms.

Before coming to Melbourne, I was working in Azad University of Mashhad as a lecturer. I was responsible for teaching courses like Internet Engineering, Formal Languages, and Automata Theory. During that time, I found various aspects of distributed systems fascinating so I decided to continue my education in this area. Finally, I joined the CLOUDS Lab to pursue my PhD studies. My PhD studies are funded by Melbourne International Research Scholarship (MIRS) and Melbourne International Fee Remission Scholarship (MIFRS).



Currently, I am a second year PhD student and my thesis confirmed by the committee on the subject of “Resource Provisioning Policies for Federated Cloud Computing Environments”. I study different aspects of Cloud Federation particularly economic and market oriented issues in my thesis. Last year I could publish the preliminary results of my work in the Proceeding of 2011 IEEE International Conferences on High Performance Computing and Communications:

A. N. Toosi, R. N. Calheiros, R. K. Thulasiram, and R. Buyya, “Resource Provisioning Policies to Increase IaaS Provider’s Profit in a Federated Cloud Environment”, in proceeding of The 13th IEEE International Conferences on High Performance Computing and Communications (HPCC), 2011.

I could also help Rodrigo N. Calheiros as a co-author in a journal paper on the InterCloud project. For details information about my current research and past publications, please visit my homepage:

<http://www.csse.unimelb.edu.au/~adeln>

Member Self Profile: Yoganathan Sivaram

I started my PhD studies under the supervision of Prof. Rajkumar Buyya in the Department of Computing and Information Systems at the University of Melbourne in March 2011. I received my B.Eng degree in Software Engineering in 2003 and Master of Applied Science degree in 2008 from RMIT University in Melbourne, Australia. My focus during my Masters degree is related to Internet Computing and Application Security.

Before starting my PhD studies, I worked in the industry for over 10 years as developer, technical leader, and development manager specialised in Software as a Service (SaaS) based applications. During this time I have gained valuable 'hands-on' experience in resolving challenges faced in developing and deploying SaaS applications which compliments my research interests and experience.



Currently I am working on Dynamic Scalable deployment and management of web applications in Cloud Platforms. This work particularly addresses the challenges and exploits the opportunities presented by the Cloud computing platform in order to efficiently and effectively deploys applications.

During 2011, my contributions to the research project can be summarised as follows:

1. Co-authored and submitted a journal article on "Multi-objective Ontology-based Virtual Appliance Composition Under Fuzzy Preferences of Users in Cloud"
2. Developed a strong understanding of the Aneka Cloud Application platform and worked on adding enhancements to it as well as utilising it in my research.
3. Currently I am working on my first research publication related to "Dynamic Scalable deployment and management of web applications in Cloud Platforms"

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 “QoS aware Scheduling for Streaming Application Workflows in Cloud Computing Environments”. My area of interests includes Cloud Computing, Workflows, Scheduling Algorithms, Streaming Applications and Data Warehousing.

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: Mohammed Alrokayan

In 2011, I graduated from The University of Melbourne with First Class Honours degree in Master of Information Technology.

Web and Cloud are my life, and I have done many projects in that field. Back in 2006 I have been working in a Cloud Operating System called "Swooj". 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 Gulf level competition in Mawhiba contest and the second rank in AEC's best graduate project contest.

In 2011 My M.Sc. graduation research project was Aneka Web Portal. The project has been implemented and designed as a SaaS for Aneka PaaS middleware to manage and monitor the Cloud infrastructure.

Between 2007 and 2008 I taught two subjects at King Saud University: Distrusted Systems and Information Security.

My vision is: Moving people from consumption to productivity and sharing the experience and knowledge with others. As a result, my goal is to contribute in establishing one of the top institute/organization in technology in the world.

For more information on my current and past projects please visit my website:

<http://alrokayan.com>



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 realising 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:

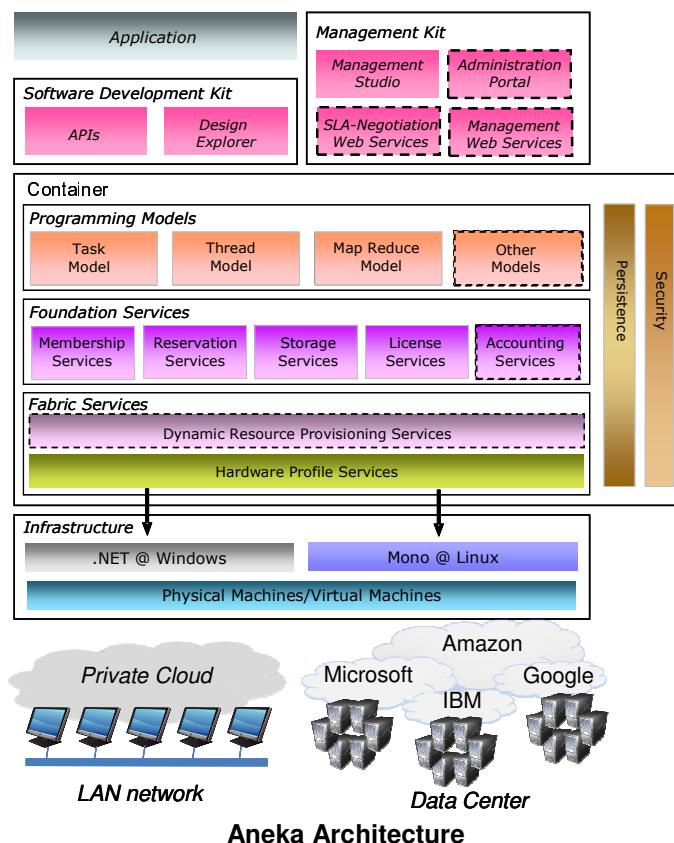
- Market Oriented Cloud Architecture
- Enterprise Cloud Application Platform (Aneka)
- Cloud Service Broker
- Cloud Workflows and Scheduling
- Service Level Agreements & Resource Allocation Systems (Libra).
- Energy-Efficient Data Centers and Clouds
- Cloud Simulation Toolkit (CloudSim).
- Application 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 Grid 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.

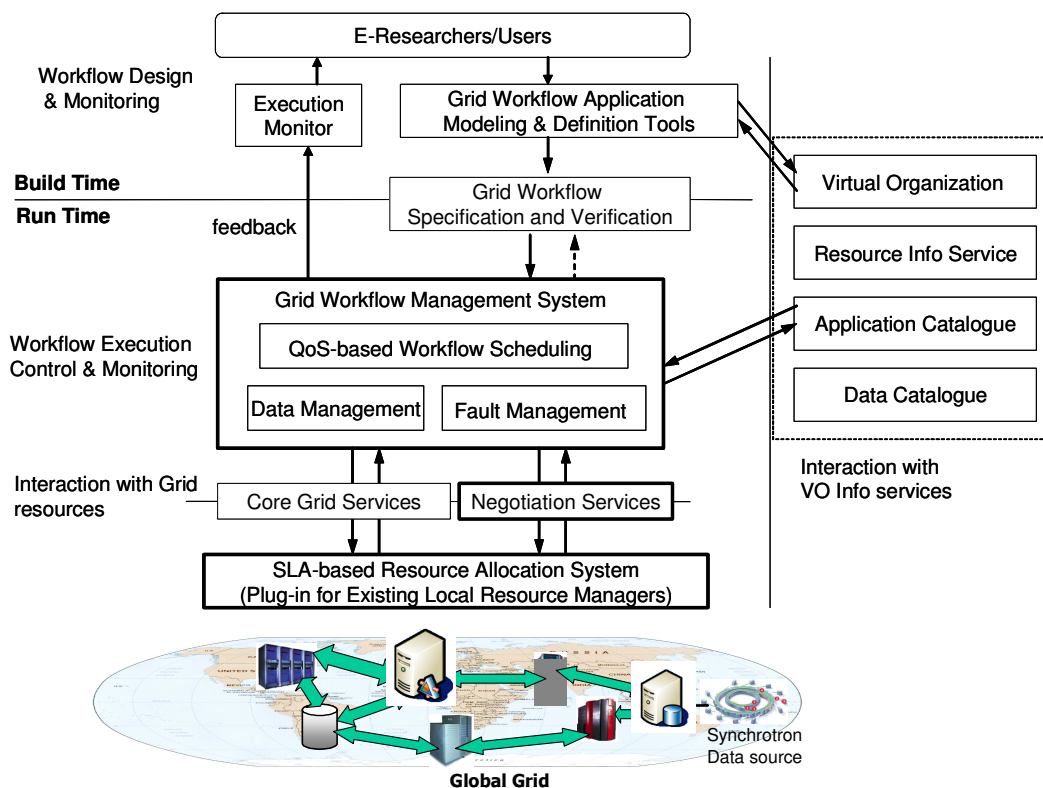


Fig. 1: Architecture of QoS-based workflow management and resource allocation system.

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, Rajkumar Buyya, Young Choon Lee, and Albert Zomaya, [A Taxonomy and Survey of Energy-Efficient Data Centers and Cloud Computing Systems](#), Advances in Computers, Volume 82, 47-111pp, M. Zelkowitz (editor), ISBN: 978-0-12-385512-1, Elsevier, Amsterdam, The Netherlands, March 2011.
- Saurabh Kumar Garg, Chee Shin Yeo, Arun Anandasivam, and Rajkumar Buyya, [Environment-Conscious Scheduling of HPC Applications on Distributed Cloud-oriented Data Centers](#), Journal of Parallel and Distributed Computing (JPDC), Volume 71, Number 6, Pages: 732-749, ISSN: 0743-7315, Elsevier Press, Amsterdam, The Netherlands, June 2011.
- Saurabh Kumar Garg, Chee Shin Yeo, and Rajkumar Buyya, [Green Cloud Framework For Improving Carbon Efficiency of Clouds](#), Proceedings of the 17th International European Conference on Parallel and Distributed Computing (EuroPar 2011, LNCS, Springer, Germany), Bordeaux, France, August 29-September 2, 2011.
- Kyong Hoon Kim, Anton Beloglazov, and Rajkumar Buyya, [Power-aware Provisioning of Virtual Machines for Real-time Cloud Services](#), Concurrency and Computation: Practice and Experience, Volume 23, Number 13, Pages: 1491-1505, ISSN: 1532-0626, Wiley Press, New York, USA, September 10, 2011.

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.

10. Software Releases

CloudSim Toolkit 2.1.1: A Framework For Modeling And Simulation Of Cloud Computing Infrastructures And Services

The Cloudbus Project at The University of Melbourne, Australia along with collaborators from the High Performance Lab (LAD) at Pontifical Catholic University of Rio Grande do Sul (PUCRS), Porto Alegre, Brazil is proud to announce the release of the new version of its Cloud simulation software, the CloudSim.

One year has passed since CloudSim beta was released. Since then, Cloud computing has gained more visibility, and a plenty of new projects, both in academia and in the industry, emerged. To help developers of such projects to evaluate new strategies and ideas before actual development, CloudSim 2.1.1 contains support for model and simulation of hot topics in Cloud computing, including green/power-aware Cloud Computing and federated Cloud Computing.

At the same time new features were added, major improvements in simulation core allowed enhanced scalability and performance of simulations and insertion and removal of simulation entities during simulation execution. It increases considerably scenarios that may be addressed in simulations, what we hope will contribute to a wider adoption of the tool by the research community.

These improvements were possible due to extensive support from the Cloud Computing research community around the world, which used CloudSim, appointed bugs, and provided us feedback on new features they would like to have in future versions the toolkit. Community is invited to keep contribution to CloudSim.

As in its previous version, all components developed as part of the CloudSim Toolkit are released as "open source" under the GPL license to encourage innovation and pass full freedom to our users.

To download the CloudSim software, please visit the Cloudbus Project web site at <http://www.cloudbus.org/cloudsim/>

The CloudSim Team
Melbourne, February 2011

Aneka 2.0.3: A Software Technology to Simplify .NET-based Enterprise Clouds

Manjrasoft Pty Ltd, Australia

Aneka is a Cloud Application Development Platform (CAP) for developing and running compute and data intensive applications. As a platform it provides users with both a runtime environment for executing applications developed using any of the three supported programming models, and a set of APIs and tools that allow you to build new applications or run existing legacy code. The purpose of this document is to help you through the process of installing and setting up an Aneka Cloud environment. This document will cover everything from helping you to understand your existing infrastructure, different deployment options, installing the Management Studio, configuring Aneka Daemons and Containers, and finally running some of the samples to test your environment.

The Aneka 2.0 distribution comes with the following features:

- Application Catalogue Service
 - Implemented Platform independent management protocol
 - Central software repository for software installation and update
 - Implemented Node gateway to control the node services
- Reservation Integration
 - Integrated Reservation services into Aneka codebase
 - Integrated the existing Allocation services into Aneka codebase
- Enterprise QoS
 - Added Cost-Optimization Job Scheduling
 - Added Time-Optimization Job Scheduling
 - Added User Modules into Design Explorer enabling selection of QoS
- Cloud Deployment
 - Full support for Amazon EC2 (static deployment and dynamic deployment)
 - Full support for Xen Virtualization
 - Static deployment via Xen VM: Dynamic deployment via Xen API
 - Full support for GoGrid (static deployment and dynamic deployment)
- Logging Service
 - Added logging service that manage the log information in each node
 - Added logging management GUI to view the log information
- Dynamic Resource Provisioning Scheduling
 - Added intelligent algorithm to dynamic provisioning service to auto scale the resources based on QoS
- Reporting Service
 - Provided service capability to report its own properties to the Aneka container
 - Implemented the Reporting service that handles queries related to various reporting activities including billing, metering, and usage
 - Enhanced GUI to provide statistics for various reporting activities
 - Configuration Utilities: Implemented customizable configuration facilities that will be used when configuring various Aneka services

Download:

<http://www.manjrasoft.com>

11. Moments with Visitors, Colleagues and International Hosts



CLOUDS Lab members (some of them) during UCC 2011 conference



Appointment of Prof. Buyya as IV-Endowed Chair Professor of Distributed Computing at Tsinghua University, Beijing, China



CLOUDS Lab members participation in SCALE 2011 and CCGrid 2011



During inauguration of ICDEDS 2011 conference in Bangalore with Chief Minister of Karnataka