

## PAVAN BALAJI

Mathematics and Computer Science (MCS) Division, Argonne National Laboratory (ANL)

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### EDUCATION

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<b>Ph.D.</b> , Computer Science and Engg., Ohio State University	06/2006
<b>M.S.</b> , Computer Science and Engg., Ohio State University	06/2003
<b>B.Tech.</b> , Computer Science and Engg., Indian Institute of Technology (IIT), Madras	08/2001

### EMPLOYMENT

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#### Argonne National Laboratory, Argonne, IL

Assistant Computer Scientist	Aug '08 to present
Post-doctoral Researcher	Aug '06 to July '08

#### University of Chicago, Chicago, IL

Research Fellow	Mar '07 to present
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### RESEARCH INTERESTS

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My research broadly falls into the general areas of parallel and distributed computing. Specifically, I focus on three areas: (i) network-based parallel and distributed computing including high-speed interconnects (InfiniBand, 10-Gigabit Ethernet, Myrinet) and protocols (iWARP, TCP/IP, UDP/IP); (ii) parallel programming models and other middleware (MPI, sockets, file-systems, web-based data-center middleware); (iii) job scheduling and resource management (QoS, parameter sweep applications).

### AWARDS AND ACCOMPLISHMENTS

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1. *Outstanding Paper Award*. European PVM/MPI Users' Group Conference (EuroPVM/MPI), Espoo, Finland, 2009.
2. *Best Paper Award*. International Supercomputing Conference (ISC), Hamburg, Germany, 2009.
3. *Best Paper Award*. IEEE International Conference on Cluster Computing (Cluster), Tsukuba, Japan, 2008.
4. *Outstanding Paper Award*. European PVM/MPI Users' Group Conference (EuroPVM/MPI), Dublin, Ireland, 2008.
5. *Outstanding Paper Award*. International Supercomputing Conference (ISC), Dresden, Germany, 2008.
6. *Storage Challenge Award (Large Systems Category)*. IEEE/ACM International Conference for High-Performance Computing, Networking, Storage and Analysis (SC), Reno, Nevada, 2007.
7. *Los Alamos Director's Technical Achievement Award*, Los Alamos National Laboratory, 2005.
8. *Outstanding Research Award of Excellence*, Computer Science and Engineering, Ohio State University, 2005.

### RESEARCH GRANTS, DONATIONS AND LOANERS

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1. **Co-PI** (PI: W. Gropp, Argonne National Laboratory): *Analyzing and Profiling Asymmetric MPI Collective Communication on BGW*. Supercomputing time on the 40,960 processor Blue Gene Watson (BGW) system. Period: 11/01/2007.

2. **PI:** *Designing MPICH2 over Qlogic InfiniBand*. Equipment loaner from Qlogic Corporation. Period: 09/2007 to present. Total equipment cost: \$30,000.
3. **Co-PI (PI: D. K. Panda, Ohio State University):** *Designing Next Generation Communication and I/O Subsystems with Multicore Architectures*. National Science Foundation (NSF) Computing Processes and Artifacts (CPA) program. Period: 07/01/07 to 06/30/10. Total funding: \$462,512; Funding share: \$87,512.
4. **PI:** *10-Gigabit Ethernet Evaluation with MPI and PVFS*. Equipment loaner from Fulcrum Microsystems. Period: 12/2006 to present. Total equipment cost: \$15,000.
5. **PI:** *Designing Efficient System Software Services for iWARP-enabled Clusters*. Equipment loaner from NetEffect Inc. Period: 10/2006 to 02/2008. Total equipment cost: \$30,000.

## SELECTED PUBLICATIONS

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### Book Chapters

1. D. K. Panda, **P. Balaji**, S. Sur and M. Koop. *Attaining High Performance Communication: A Vertical Approach*. Chapter on *Commodity High Performance Interconnects*; CRC Press, 2009.
2. W. Feng and **P. Balaji**. *Attaining High Performance Communication: A Vertical Approach*. Chapter on *Ethernet vs. Ethernet*; CRC Press, 2009.
3. **P. Balaji**, P. Sadayappan and M. Islam. *Market-Oriented Grid and Utility Computing*. Chapter on *Techniques on Providing Hard Quality of Service Guarantees in Job Scheduling*; Wiley Publishers, 2008.

### Refereed Journal Articles

4. **P. Balaji**, A. Chan, W. Gropp, R. Thakur and E. Lusk. *The Importance of Non-Data-Communication Overheads in MPI*. Accepted for publication at the International Journal of High Performance Computing Applications (IJHPCA), 2009.
5. **P. Balaji**, D. Buntinas, D. Goodell, W. Gropp and R. Thakur. *Fine-Grained Multithreading Support for Hybrid Threaded MPI Programming*. Accepted for publication at the International Journal of High Performance Computing Applications (IJHPCA), 2009.
6. J. L. Träff, A. Ripke, C. Siebert, **P. Balaji**, R. Thakur and W. Gropp. *A Pipelined Algorithm for Large, Irregular All-gather Problems*. Accepted for publication at the International Journal of High Performance Computing Applications (IJHPCA), 2009.
7. **P. Balaji**, A. Chan, R. Thakur, W. Gropp and E. Lusk. *Toward Message Passing for a Million Processes: Characterizing MPI on a Massive Scale Blue Gene/P*. Accepted for publication at the special edition of the Springer Journal of Computer Science on Research and Development (presented at the International Supercomputing Conference (ISC)), 2009. **Best Paper Award** at ISC.
8. P. Lai, **P. Balaji**, R. Thakur and D. K. Panda. *ProOnE: A General Purpose Protocol Onload Engine for Multi- and Many-Core Architectures*. Accepted for publication at the special edition of the Springer Journal of Computer Science on Research and Development (presented at the International Supercomputing Conference (ISC)), 2009.
9. **P. Balaji**, W. Feng and D. K. Panda. *Bridging the Ethernet-Ethernet Performance Gap*. IEEE Micro Journal; Special Issue on High-Performance Interconnects, pp. 24-40, Vol. 26, Issue 3, 2006.
10. H. -W. Jin, **P. Balaji**, C. Yoo, J. -Y. Choi and D. K. Panda. *Exploiting NIC Architectural Support for Enhancing IP based Protocols on High Performance Networks*. Special Issue of the Journal of Parallel and Distributed Computing (JPDC) on Design and Performance of Networks for Super-, Cluster- and Grid-Computing, pp. 1348-1365, Vol. 65, Issue 11, 2005.
11. M. Islam, **P. Balaji**, P. Sadayappan and D. K. Panda. *QoPS: A QoS based scheme for Parallel Job Scheduling (extended journal version)*. IEEE Springer LNCS Journal Series, pp. 252-268, Vol. 2862, 2003.

## Refereed Conference Publications

12. A. Singh, **P. Balaji** and W. Feng. *GePSeA: A General-Purpose Software Acceleration Framework for Lightweight Task Offloading*. International Conference on Parallel Processing (ICPP). Sep. 22-25, 2009, Vienna, Austria.
13. N. Desai, D. Buntinas, D. Buettner, **P. Balaji** and A. Chan. *Improving Resource Availability by Relaxing Network Allocation Constraints on the Blue Gene/P*. International Conference on Parallel Processing (ICPP). Sep. 22-25, 2009, Vienna, Austria.
14. **P. Balaji**, D. Buntinas, D. Goodell, W. Gropp, S. Kumar, E. Lusk, R. Thakur and J. L. Träff. *MPI on a Million Processors*. The Euro PVM/MPI Users' Group Conference (EuroPVM/MPI). **Outstanding Paper Award**. Sep. 7-10, 2009, Espoo, Finland.
15. G. Santhanaraman, **P. Balaji**, K. Gopalakrishnan, R. Thakur, W. Gropp and D. K. Panda. *Natively Supporting True One-sided Communication in MPI on Multi-core Systems with InfiniBand*. IEEE International Symposium on Cluster Computing and the Grid (CCGrid). May 18-21, 2009, Shanghai, China.
16. **P. Balaji**, S. Bhagvat, R. Thakur and D. K. Panda. *Sockets Direct Protocol for Hybrid Network Stacks: A Case Study with iWARP over 10G Ethernet*. International Conference on High Performance Computing (HiPC). Dec. 17-20, 2008, Bangalore, India.
17. A. Chan, **P. Balaji**, W. Gropp and R. Thakur. *Communication Analysis of Parallel 3D FFT for Flat Cartesian Meshes on Large Blue Gene Systems*. International Conference on High Performance Computing (HiPC). Dec. 17-20, 2008, Bangalore, India.
18. M. Kumar, V. Chaube, **P. Balaji**, W. Feng and H.-W. Jin. *Making a Case for Proactive Flow Control in Optical Circuit-Switched Networks*. International Conference on High Performance Computing (HiPC). Dec. 17-20, 2008, Bangalore, India.
19. H. Lin, **P. Balaji**, R. Poole, C. Sosa, X. Ma and W. Feng. *Massively Parallel Genomic Sequence Search on the Blue Gene/P Architecture*. IEEE/ACM International Conference for High Performance Computing, Networking, Storage and Analysis (SC). Nov. 15-21, 2008, Austin, Texas.
20. T. Scogland, G. Narayanaswamy, **P. Balaji** and W. Feng. *Asymmetric Interactions in Symmetric Multi-core Systems: Analysis, Enhancements and Evaluation*. IEEE/ACM International Conference for High Performance Computing, Networking, Storage and Analysis (SC). Nov. 15-21, 2008, Austin, Texas.
21. N. Desai, **P. Balaji**, P. Sadayappan and M. Islam. *Are Non-Blocking Networks Really Needed for High-End-Computing Workloads?* IEEE International Conference on Cluster Computing (Cluster), **Best Paper Award**, Sep. 29 - Oct. 1st, 2008, Tsukuba, Japan.
22. **P. Balaji**, A. Chan, W. Gropp, R. Thakur and E. Lusk. *Non-Data-Communication Overheads in MPI: Analysis on Blue Gene/P*. The Euro PVM/MPI Users' Group Conference (EuroPVM/MPI), **Outstanding Paper Award**, Sep. 7-10, 2008, Dublin, Ireland.
23. **P. Balaji**, D. Buntinas, D. Goodell, W. Gropp and R. Thakur. *Toward Efficient Support for Multithreaded MPI Communication*. The Euro PVM/MPI Users' Group Conference (EuroPVM/MPI), Sep. 7-10, 2008, Dublin, Ireland.
24. J. L. Träff, A. Ripke, C. Siebert, **P. Balaji**, R. Thakur and W. Gropp. *A Simple, Pipelined Algorithm for Large, Irregular All-gather Problems*. The Euro PVM/MPI Users' Group Conference (EuroPVM/MPI), Sep. 7-10, 2008, Dublin, Ireland.
25. G. Narayanaswamy, **P. Balaji** and W. Feng. *Impact of Network Sharing in Multi-core Architectures*. IEEE International Conference on Computer Communication and Networks (ICCCN), Aug. 3-7, 2008, St. Thomas, U.S. Virgin Islands.
26. **P. Balaji**, W. Feng and H. Lin. *Semantics-based Distributed I/O with the ParaMEDIC Framework*. ACM/IEEE International Symposium on High Performance Distributed Computing (HPDC), Jun. 23-27, 2008, Boston, Massachusetts.

27. **P. Balaji**, W. Feng, H. Lin, J. Archuleta, S. Matsuoka, A. Warren, J. Setubal, E. Lusk, R. Thakur, I. Foster, D. S. Katz, S. Jha, K. Shinpaugh, S. Coghlan and D. Reed. *Distributed I/O with ParaMEDIC: Experiences with a Worldwide Supercomputer*. International Supercomputing Conference (ISC). **Outstanding Paper Award**. Jun. 17-20, 2008, Dresden, Germany.
28. **P. Balaji**, W. Feng, J. Archuleta, H. Lin, R. Kettimuthu, R. Thakur and X. Ma. *Semantics-based Distributed I/O for mpiBLAST*. Short paper. ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming (PPoPP), Feb. 20-23, 2008, Salt Lake City, Utah.
29. **P. Balaji**, W. Feng, S. Bhagvat, D. K. Panda, R. Thakur and W. Gropp. *Analyzing the Impact of Supporting Out-of-Order Communication on In-order Performance with iWARP*. IEEE/ACM International Conference for High Performance Computing, Networking, Storage and Analysis (SC), Nov. 10-16, 2007, Reno, Nevada.
30. **P. Balaji**, W. Feng, J. Archuleta and H. Lin. *ParaMEDIC: Parallel Metadata Environment for Distributed I/O and Computing*. IEEE/ACM International Conference for High Performance Computing, Networking, Storage and Analysis (SC). **Storage Challenge Award**. Nov. 10-16, 2007, Reno, Nevada.
31. G. Narayanaswamy, **P. Balaji** and W. Feng. *An Analysis of 10-Gigabit Ethernet Protocol Stacks in Multicore Environments*. IEEE International Symposium on High-Performance Interconnects (HotI), Aug. 22-24, 2007, Palo Alto, California.
32. **P. Balaji**, S. Bhagvat, D. K. Panda, R. Thakur and W. Gropp. *Advanced Flow-control Mechanisms for the Sockets Direct Protocol over InfiniBand*. IEEE International Conference on Parallel Processing (ICPP), Sep. 10-14, 2007, Xi'an, China.
33. M. Islam, **P. Balaji**, G. Sabin and P. Sadayappan. *Analyzing and Minimizing the Impact of Opportunity Cost in QoS-aware Job Scheduling*. IEEE International Conference on Parallel Processing (ICPP), Sep. 10-14, 2007, Xi'an, China.
34. **P. Balaji**, D. Buntinas, S. Balay, B. Smith, R. Thakur and W. Gropp. *Nonuniformly Communicating Noncontiguous Data: A Case Study with PETSc and MPI*. IEEE International Parallel and Distributed Processing Symposium (IPDPS), Mar. 26-30, 2007, Long Beach, California.
35. **P. Balaji**, W. Feng, Q. Gao, R. Noronha, W. Yu and D.K. Panda. *Head-to-TOE Comparison for High Performance Sockets over Protocol Offload Engines*. IEEE International Conference on Cluster Computing (Cluster), Sep. 26-30, 2005, Boston, Massachusetts.
36. W. Feng, **P. Balaji**, C. Baron, L. N. Bhuyan and D. K. Panda. *Performance Characterization of a 10-Gigabit Ethernet TOE*. IEEE International Symposium on High Performance Interconnects (HotI), Aug. 17-19, 2005, Palo Alto, California.
37. S. Narravula, **P. Balaji**, K. Vaidyanathan, H. -W. Jin and D. K. Panda. *Architecture for Caching Responses with Multiple Dynamic Dependencies in Multi-Tier Data-Centers over InfiniBand*. IEEE/ACM International Symposium on Cluster Computing and the Grid (CCGrid), May 9-12, 2005, Cardiff, UK
38. **P. Balaji**, K. Vaidyanathan, S. Narravula, H. -W. Jin and D. K. Panda. *On the Provision of Prioritization and Soft QoS in Dynamically Reconfigurable Shared Data-Centers over InfiniBand*. IEEE International Symposium on Performance Analysis of Systems and Software (ISPASS), Mar. 20-22, 2005, Austin, Texas.
39. M. Islam, **P. Balaji**, P. Sadayappan and D. K. Panda. *Towards Provision of Quality of Service Guarantees in Job Scheduling*. IEEE International Conference on Cluster Computing (Cluster), Sep. 20-23, 2004, San Diego, California.
40. **P. Balaji**, S. Narravula, K. Vaidyanathan, S. Krishnamoorthy, J. Wu and D. K. Panda. *Sockets Direct Protocol over InfiniBand in Clusters: Is it Beneficial?.* IEEE International Symposium on Performance Analysis of Systems and Software (ISPASS), Mar. 10-12, 2004, Austin, Texas.
41. R. Kurian, **P. Balaji** and P. Sadayappan. *Opportune Job Shredding: An Efficient Approach for Scheduling Parameter Sweep Applications*. Los Alamos Computer Science Institute (LACSI) Symposium, Oct. 12-14, 2003, Santa Fe, New Mexico.

42. **P. Balaji**, J. Wu, T. Kurc, U. Catalyurek, D. K. Panda and J. Saltz. *Impact of High Performance Sockets on Data Intensive Applications*. IEEE International Symposium on High Performance Distributed Computing (HPDC), Jun. 22-24, 2003, Seattle, Washington.
43. R. Gupta, **P. Balaji**, J. Nieplocha and D. K. Panda. *Efficient Collective Operations using Remote Memory Operations on VIA-based Clusters*. IEEE International Parallel and Distributed Processing Symposium (IPDPS), Apr. 22-26, 2003, Nice, France.
44. **P. Balaji**, P. Shivam, P. Wyckoff and D. K. Panda. *High Performance User-level Sockets over Gigabit Ethernet*. IEEE International Conference on Cluster Computing (Cluster), Sep. 23-26, 2002, Chicago, Illinois.

## Refereed Workshop Publications

45. **P. Balaji**, S. Bhagvat, H. -W. Jin and D. K. Panda. *Asynchronous Zero-copy Communication for Synchronous Sockets in the Sockets Direct Protocol (SDP) over InfiniBand*. Workshop on Communication Architecture for Clusters (CAC); in conjunction with the IEEE International Parallel and Distributed Processing Symposium (IPDPS), Apr. 25th, 2006, Rhodes Island, Greece.
46. V. Viswanathan, **P. Balaji**, W. Feng, J. Leigh, D. K. Panda. *A Case for UDP Offload Engines in LambdaGrids*. Workshop on Protocols for Fast Long-Distance Networks (PFLDnet), Feb. 2-3, 2006, Nara, Japan.
47. **P. Balaji**, H. -W. Jin, K. Vaidyanathan and D. K. Panda. *Supporting iWARP Compatibility and Features for Regular Network Adapters*. Workshop on Remote Direct Memory Access (RDMA): Applications, Implementations and Techniques (RAIT); in conjunction with IEEE International conference on Cluster Computing (Cluster), Sep. 26th, 2005, Boston, Massachusetts.
48. H. -W. Jin, S. Narravula, G. Brown, K. Vaidyanathan, **P. Balaji** and D. K. Panda. *Performance Evaluation of RDMA over IP Networks: A Study with the Ammasso Gigabit Ethernet NIC*. Workshop on High Performance Interconnects for Distributed Computing (HPI-DC); in conjunction with IEEE International Symposium on High Performance Distributed Computing (HPDC), Jul. 24th, 2005, Research Triangle Park, North Carolina.
49. K. Vaidyanathan, **P. Balaji**, H. -W. Jin and D. K. Panda. *Workload driven analysis of File Systems in Shared Multi-Tier Data-Centers over InfiniBand*. Workshop on Computer Architecture Evaluation using Commercial Workloads (CAECW); in conjunction with IEEE International Symposium on High Performance Computer Architecture (HPCA), Feb. 12th, 2005, San Francisco, California.
50. **P. Balaji**, H. V. Shah and D. K. Panda. *Sockets vs. RDMA Interface over 10-Gigabit Networks: An In depth Analysis of the Memory Traffic Bottleneck*. Workshop on Remote Direct Memory Access (RDMA): Applications, Implementations and Technologies (RAIT); in conjunction with IEEE International Conference on Cluster Computing (Cluster), Sep. 20th, 2004, San Diego, California.
51. **P. Balaji**, K. Vaidyanathan, S. Narravula, S. Krishnamoorthy, H. -W. Jin and D. K. Panda. *Exploiting Remote Memory Operations to Design Efficient Reconfiguration for Shared Data-Centers over InfiniBand*. Workshop on Remote Direct Memory Access (RDMA): Applications, Implementations and Technologies (RAIT); in conjunction with IEEE International Conference on Cluster Computing (Cluster), Sep. 20th, 2004, San Diego, California.
52. S. Narravula, **P. Balaji**, K. Vaidyanathan, S. Krishnamoorthy, J. Wu and D. K. Panda. *Supporting Strong Coherency for Active Caches in Multi-Tier Data-Centers over InfiniBand*. Workshop on System Area Networks (SAN); in conjunction with IEEE International Symposium on High Performance Computer Architecture (HPCA), Feb. 14th, 2004, Madrid, Spain.
53. M. Islam, **P. Balaji**, P. Sadayappan and D. K. Panda. *QoPS: A QoS based scheme for Parallel Job Scheduling*. Job Scheduling Strategies for Parallel Processing (JSSPP) workshop; in conjunction with IEEE International Symposium on High Performance Distributed Computing (HPDC), Jun. 24th, 2003, Seattle, Washington.

## Invited Papers

54. W. Feng, **P. Balaji** and A. Singh. *Network Interface Cards as First-Class Citizens*. Workshop on The Influence of I/O on Microprocessor Architecture (IOM); in conjunction with the IEEE International Symposium on High Performance Computer Architecture (HPCA), Feb. 15th, 2009, Raleigh, North Carolina.

55. K. Vaidyanathan, S. Narravula, **P. Balaji** and D. K. Panda. *Designing Efficient Systems Services and Primitives for Next-Generation Data-Centers*. Workshop on the National Science Foundation Next Generation Software (NSFNGS) Program; in conjunction with the IEEE International Parallel and Distributed Processing Symposium (IPDPS), Mar. 26th, 2007, Long Island, California.
56. **P. Balaji**, K. Vaidyanathan, S. Narravula, H. -W. Jin and D. K. Panda. *Designing Next Generation Data-centers with Advanced Communication Protocols and Systems Services*. Workshop on the National Science Foundation Next Generation Software (NSFNGS) Program; in conjunction with the IEEE International Parallel and Distributed Processing Symposium (IPDPS), Apr. 25th, 2006, Rhodes Island, Greece.

## Technical Reports

57. K. Vaidyanathan, S. Bhagvat, **P. Balaji** and D. K. Panda. *Understanding the Significance of Network Performance in End Applications: A Case Study with EtherFabric and InfiniBand*. Technical Report, OSU-CISRC-2/06-TR19, Ohio State University, Feb, 2006.
58. K. Vaidyanathan, **P. Balaji**, J. Wu, H. -W. Jin and D. K. Panda. *An Architectural Study of Cluster-based Multi-tier Data-Centers*. Technical Report, OSU-CISRC-5/04-TR25, Ohio State University, May, 2004.
59. S. Krishnamoorthy, **P. Balaji**, K. Vaidyanathan, H. -W. Jin and D. K. Panda. *Dynamic Reconfigurability Support for providing Soft Quality of Service Guarantees in Multi-Tier Data-Centers over InfiniBand*. Technical Report, OSU-CISRC-2/04-TR10, Ohio State University, Feb, 2004.

## Dissertation/Thesis

60. **P. Balaji**. *High Performance Communication Support for Sockets-based Applications over High-speed Networks*. Ph.D. Dissertation, Ohio State University, June, 2006.
61. **P. Balaji**. *Java Animated Text Rendering for Indian Language Scripts*. B.Tech. Thesis, Indian Institute of Technology, Madras, May, 2001.

## PRESENTATIONS

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### Invited Talks

1. *Message Passing for a Million Processes*. Ohio State University (OSU), May 15th, 2009, Columbus, Ohio.
2. *And You Thought Threads Could Work in Parallel?* University of New Mexico (UNM), Oct 13th, 2008, Albuquerque, New Mexico.
3. *Interfacing Multicores and High-speed Networks Towards Large-scale Computing Systems*. Virginia Tech (VT), Dec 11th, 2007, Blacksburg, Virginia.
4. *Designing High-end Computing Systems with InfiniBand*. Illinois Institute of Technology (IIT), Jun 21st, 2007, Chicago, Illinois.
5. *High Performance Messaging over High-speed Networks*. University of Chicago (over Access Grid), Nov 2nd, 2006, Argonne, Illinois.
6. *SDP and Extended Sockets: A TOE and iWARP Perspective*. NetEffect Inc., June 19th, 2006, Austin, Texas.
7. *TCP and iWARP Offload Engines: Challenges and Pitfalls*. NetEffect Inc., June 19th, 2006, Austin, Texas.
8. *Designing High-performance Communication Support for Sockets-based Applications*. Hewlett-Packard (HP), May 23rd, 2006, Palo Alto, California.
9. *Enhancing the Performance and Compatibility of Sockets over High-Speed Networks*. QLogic Corporation (formerly Pathscale Incorporation), May 5th, 2006, Mountain View, California.
10. *Designing High Performance Communication Support for Sockets-based Applications over System-area and Wide-area Networks*. Argonne National Laboratory (ANL), Mar 24th, 2006, Argonne, Illinois.

## Tutorials

11. *Designing High-End Computing Systems with InfiniBand and 10-Gigabit Ethernet*. Half-day tutorial, jointly with D. K. Panda and M. Koop. IEEE/ACM International Conference for High Performance Computing, Networking, Storage and Analysis (SC), Nov. 15, 2009, Portland, Oregon.
12. *InfiniBand and 10-Gigabit Ethernet for Dummies*. Half-day tutorial, jointly with D. K. Panda and M. Koop. IEEE/ACM International Conference for High Performance Computing, Networking, Storage and Analysis (SC), Nov. 15, 2009, Portland, Oregon.
13. *Designing High-End Computing Systems with InfiniBand and 10-Gigabit Ethernet*. Half-day tutorial, jointly with D. K. Panda and M. Koop. IEEE International Conference on Cluster Computing (Cluster), Sep. 4th, 2009, New Orleans, Louisiana.
14. *Designing High-End Computing Systems with InfiniBand and 10-Gigabit Ethernet*. Half-day tutorial, jointly with D. K. Panda and M. Koop. IEEE International Conference on High Performance Interconnects (HotI), Aug. 25th, 2009, New York, New York.
15. *InfiniBand and 10-Gigabit Ethernet for Dummies*. Half-day tutorial, jointly with D. K. Panda and M. Koop. IEEE International Conference on High Performance Interconnects (HotI), Aug. 25th, 2009, New York, New York.
16. *InfiniBand and 10-Gigabit Ethernet Architectures for Emerging HPC Clusters and Enterprise Datacenters*. Half-day tutorial, jointly with D. K. Panda. IEEE International Symposium on High Performance Computer Architecture (HPCA), Feb. 14, 2009, Raleigh, North Carolina.
17. *InfiniBand and 10-Gigabit Ethernet for Dummies*. Half-day tutorial, jointly with D. K. Panda and M. Koop. IEEE/ACM International Conference for High Performance Computing, Networking, Storage and Analysis (SC), Nov. 16, 2008, Austin, Texas.
18. *Designing High-End Computing Systems with InfiniBand and 10-Gigabit Ethernet*. Half-day tutorial, jointly with D. K. Panda and M. Koop. IEEE/ACM International Conference for High Performance Computing, Networking, Storage and Analysis (SC), Nov. 16, 2008, Austin, Texas.
19. *Designing HPC Clusters and Enterprise Datacenters: The InfiniBand and 10GE Way*. Half-day tutorial, jointly with D. K. Panda. IEEE Symposium on High-Performance Interconnects (HotI), Aug. 26, 2008, Palo Alto, California.
20. *High-Speed Network Architectures for Clusters: Designs and Trends*. Half-day tutorial, jointly with D. K. Panda. International Symposium on High-Performance Computer Architecture (HPCA), Feb. 16, 2008, Salt Lake City, Utah.
21. *Designing High-End Computing Systems with InfiniBand and iWARP Standards*. Full-day tutorial, jointly with D. K. Panda and S. Sur. IEEE/ACM International Conference for High Performance Computing, Networking, Storage and Analysis (SC), Nov. 10, 2007, Reno, Nevada.
22. *Designing High-End Computing Systems with InfiniBand and 10-Gigabit Ethernet*. Half-day tutorial, jointly with D. K. Panda. IEEE International Conference on Cluster Computing (Cluster), Sep. 17, 2007, Austin, Texas.
23. *Designing Clusters and Distributed Grid Computing Systems with InfiniBand and iWARP*. Half-day tutorial, jointly with D. K. Panda. IEEE International Symposium on Cluster Computing and the Grid (CCGrid), May 14, 2007, Rio de Janeiro, Brazil.
24. *State of InfiniBand in Designing HPC Clusters, Storage/File Systems, and Datacenters*. Full-day tutorial, jointly with D. K. Panda and S. Sur. IEEE/ACM International Conference for High Performance Computing, Networking, Storage and Analysis (SC), Nov. 13, 2005, Seattle, Washington.

## Panels

25. *MPICH2 on DCMF*. Deep Computing Messaging Framework Birds-of-a-Feather Panel. IEEE/ACM International Conference for High Performance Computing, Networking, Storage and Analysis (SC), 18th Nov, 2008, Austin, Texas.

## Conference and Workshop Presentations

26. *Toward Message Passing for a Million Processes: Characterizing MPI on a Massive Scale Blue Gene/P*. International Supercomputing Conference (ISC), Jun. 23, 2009, Hamburg, Germany.

27. *ProOnE: A General Purpose Protocol Onload Engine for Multi- and Many-Core Architectures*. International Supercomputing Conference (ISC), Jun. 23, 2009, Hamburg, Germany.
28. *Natively Supporting True One-sided Communication in MPI on Multi-core Systems with InfiniBand*. IEEE International Symposium on Cluster Computing and the Grid (CCGrid), May 18-21, 2009, Shanghai, China.
29. *Making a Case for Proactive Flow Control in Optical Circuit-Switched Networks*. IEEE/ACM International Conference on High Performance Computing (HiPC), Dec. 20th, 2008, Bangalore, India.
30. *Sockets Direct Protocol for Hybrid Network Stacks: A Case Study with iWARP over 10G Ethernet*. IEEE/ACM International Conference on High Performance Computing (HiPC), Dec. 20th, 2008, Bangalore, India.
31. *Communication Analysis of Parallel 3D FFT for Flat Cartesian Meshes on Large Blue Gene Systems*. IEEE/ACM International Conference on High Performance Computing (HiPC), Dec. 19th, 2008, Bangalore, India.
32. *Non-Data-Communication Overheads in MPI: Analysis on Blue Gene/P*. The Euro PVM/MPI Users' Group Conference (EuroPVM/MPI), Sep. 8th, 2008, Dublin, Ireland.
33. *Impact of Network Sharing in Multi-core Architectures*. IEEE International Conference on Computer Communication and Networks (ICCCN), Aug. 4th, 2008, St. Thomas, U.S. Virgin Islands.
34. *Semantics-based Distributed I/O with the ParaMEDIC Framework*. ACM/IEEE International Symposium on High Performance Distributed Computing (HPDC), Jun. 27th, 2008, Boston, Massachusetts.
35. *Distributed I/O with ParaMEDIC: Experiences with a Worldwide Supercomputer*. International Supercomputing Conference (ISC), Jun. 17th, 2008, Dresden, Germany.
36. *Analyzing the Impact of Supporting Out-of-Order Communication on In-order Performance with iWARP*. IEEE/ACM International Conference for High Performance Computing, Networking, Storage and Analysis (SC), Nov. 14th, 2007, Reno, Nevada.
37. *Advanced Flow-control Mechanisms for the Sockets Direct Protocol over InfiniBand*. IEEE International Conference on Parallel Processing (ICPP), Sep. 13th, 2007, Xi'an, China.
38. *Analyzing and Minimizing the Impact of Opportunity Cost in QoS-aware Job Scheduling*. IEEE International Conference on Parallel Processing (ICPP), Sep. 12th, 2007, Xi'an, China.
39. *Designing NFS With RDMA For Security, Performance and Scalability*. IEEE International Conference on Parallel Processing (ICPP), Sep. 12th, 2007, Xi'an, China.
40. *High Performance MPI over iWARP: Early Experiences*. IEEE International Conference on Parallel Processing (ICPP), Sep. 12th, 2007, Xi'an, China.
41. *An Analysis of 10-Gigabit Ethernet Protocol Stacks in Multicore Environments*. IEEE International Symposium on High-Performance Interconnects (HotI), Aug. 23rd, 2007, Palo Alto, California.
42. *Nonuniformly Communicating Noncontiguous Data: A Case Study with PETSc and MPI*. IEEE International Parallel and Distributed Processing Symposium (IPDPS), Mar. 27th, 2007, Long Beach, California.
43. *Asynchronous Zero-copy Communication for Synchronous Sockets in the Sockets Direct Protocol (SDP) over InfiniBand*. Workshop on Communication Architecture for Clusters (CAC); held in conjunction with the IEEE International Parallel and Distributed Processing Symposium (IPDPS), Apr. 25th, 2006, Rhodes Island, Greece.
44. *Benefits of High Speed Interconnects to Cluster File Systems: A Case Study with Lustre*. Workshop on Communication Architecture for Clusters (CAC); held in conjunction with the IEEE International Parallel and Distributed Processing Symposium (IPDPS), Apr. 25th, 2006, Rhodes Island, Greece.
45. *Making a Case for a Green500 List*. Workshop on High-Performance, Power Aware Computing (HP-PAC); held in conjunction with the IEEE International Parallel and Distributed Processing Symposium (IPDPS), Apr. 25th, 2006, Rhodes Island, Greece.

46. *Head-to-TOE Comparison for High Performance Sockets over Protocol Offload Engines*. IEEE International Conference on Cluster Computing (Cluster), Sep. 29th, 2005, Boston, Massachusetts.
47. *Supporting RDMA Capable Network Compatibility and Features for Regular Network Adapters*. Workshop on Remote Direct Memory Access (RDMA): Applications, Implementations and Techniques (RAIT); held in conjunction with the IEEE International conference on Cluster Computing (Cluster), Sep. 26th, 2005, Boston, Massachusetts.
48. *Performance Characterization of a 10-Gigabit Ethernet TOE*. IEEE International Symposium on High Performance Interconnects (HotI), Aug. 18th, 2005, Palo Alto, California.
49. *Sockets vs. RDMA Interface over 10-Gigabit Networks: An In depth Analysis of the Memory Traffic Bottleneck*. Workshop on Remote Direct Memory Access (RDMA): Applications, Implementations and Technologies (RAIT); held in conjunction with the IEEE International Conference on Cluster Computing (Cluster), Sep. 20th, 2004, San Diego, California.
50. *Exploiting Remote Memory Operations to Design Efficient Reconfiguration for Shared Data-Centers over InfiniBand*. Workshop on Remote Direct Memory Access (RDMA): Applications, Implementations and Technologies (RAIT); held in conjunction with the IEEE International Conference on Cluster Computing (Cluster), Sep. 20th, 2004, San Diego, California.
51. *Towards Provision of Quality of Service Guarantees in Job Scheduling*. IEEE International Conference on Cluster Computing (Cluster), Sep. 22nd, 2004, San Diego, California.
52. *Sockets Direct Protocol over InfiniBand in Clusters: Is it Beneficial?*. IEEE International Symposium on Performance Analysis of Systems and Software (ISPASS), Mar. 10th, 2004, Austin, Texas.
53. *Impact of High Performance Sockets on Data Intensive Applications*. IEEE International Symposium on High Performance Distributed Computing (HPDC), Jun. 22nd, 2003, Seattle, Washington.
54. *Efficient Collective Operations using Remote Memory Operations on VIA-based Clusters*. IEEE International Parallel and Distributed Processing Symposium (IPDPS), Apr. 24th, 2003, Nice, France.
55. *High Performance User-level Sockets over Gigabit Ethernet*. IEEE International Conference on Cluster Computing, Sep. 25th, 2002, Chicago, Illinois.

## Instructional Seminars

56. *Message Passing for Dummies: Introduction to MPI*. Student Lecture Series, Argonne National Laboratory, Jun 9th, 2008, Argonne, Illinois.

## Demo/Project Showcase

57. *ParaMEDIC: Parallel Metadata Environment for Distributed I/O and Computing*. IEEE/ACM International Conference for High Performance Computing, Networking, Storage and Analysis (SC), Nov 13th to 15th, 2007, Reno, Nevada.
58. *High-performance Message Passing with MPICH2*. Argonne National Laboratory exhibition booth at the IEEE International conference on Supercomputing (SC), Nov 14th to 16th, 2006, Tampa, Florida.
59. *mpiBLAST on the GreenGene Distributed Supercomputer: Sequencing the NT database against the NT database (An NT-complete problem)*. In conjunction with the Los Alamos National Laboratory at the IEEE International conference on Supercomputing (SC), Nov 14th to 17th, 2005, Seattle, Washington.
60. *InfiniBand: Performance and Implications on Next Generation Applications*. Exhibition Demo at the 10th Annual Coalition for National Science Funding Science Exhibition and Reception, Jun 23rd, 2003, Capitol Hill, Washington DC.

## Poster Presentations

61. *Semantics-based Distributed I/O for mpiBLAST*. ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming (PPoPP), Feb. 20-23, 2008, Salt Lake City, Utah.

## Miscellaneous Presentations and Seminars

62. *Analyzing, Optimizing and Evaluating PETSc over MPI*. IEEE International conference on Supercomputing (SC), Argonne National Laboratory Exhibition Booth, Nov 14th, 2006, Tampa, Florida.
63. *High-performance Communication Support for Sockets-based Applications*. Ohio State University (OSU), June 15th, 2006, Columbus, Ohio.
64. *Comparing 10-Gigabit Ethernet with InfiniBand and Myrinet for High Performance Sockets over Protocol Offload Engines*. IEEE International conference on Supercomputing (SC), ASC Exhibition Booth, Nov 16th, 2005, Seattle, Washington.
65. *A Case for UDP Offload Engines in Lambda Grids*. Ohio State University (OSU), Nov 4th, 2005, Columbus, Ohio.
66. *Analyzing the Memory Traffic Bottleneck in TCP/IP over 10-Gigabit Ethernet*. Ohio State University (OSU), Sep 12th, 2002, Columbus, Ohio.
67. *Software iWARP: Design and Implementation in FreeBSD*. Ohio State University (OSU), Sep 13th, 2002, Columbus, Ohio.
68. *Java Animated Text Rendering for Indian Language Scripts*. Indian Institute of Technology (IIT), May 11th, 2001, Madras, India.

## PROFESSIONAL ACTIVITIES

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### Chairmanships and Editorships

1. Posters Chair: *IEEE International Conference on Cluster, Cloud and Grid Computing (CCGrid)*, 2010.
2. Journal Special Issue Co-editor (with Dr. Abhinav Vishnu): *Programming Models and Systems Software Support for High-End Computing Applications*, Special Issue of the International Journal of High Performance Computing Applications (IJHPCA), 2009.
3. Program Co-chair (with Dr. Ada Gavrilovska): *International Workshop on High Performance Interconnects for Distributed Computing (HPI-DC)*, 2009.
4. Tutorials Chair: *IEEE International Conference on High Performance Interconnects (HotI)*, 2009.
5. Journal Special Issue Co-editor (with Dr. Wu-chun Feng): *Tools and Environments for Multi- and Many-Core Architectures*, Special Issue of IEEE Computer, 2009.
6. Program Co-chair (with Dr. Abhinav Vishnu): *International Workshop on Parallel Programming Models and Systems Software for High-end Computing (P2S2)*, 2009.
7. Track Co-chair (with Dr. Li Xiao): *IEEE International Conference on Computer Communications and Networks (ICCCN)*, Pervasive Computing and Grid Networking Track, 2009.
8. Program Co-chair (with Dr. Sayantan Sur): *International Workshop on Parallel Programming Models and Systems Software for High-end Computing (P2S2)*, 2008.

### Technical Committees

1. **Program Committee for International Conferences and Workshops:**
  - (a) IEEE International Conference on Cluster Computing (Cluster): 2009.
  - (b) International Workshop on The Influence of I/O on Microprocessor Architecture (IOM): 2009.
  - (c) International Workshop on Communication Architecture for Clusters (CAC): 2009.
  - (d) IEEE International Symposium on High-Performance Interconnects (HotI): 2008, 2009.

- (e) International Conference on Parallel Processing (ICPP): 2008, 2009.
- (f) International Workshop on Scheduling and Resource Management for Parallel and Distributed Systems (SRM-PDS): 2007, 2008, 2009.
- (g) IEEE International Conference on High Performance Computing (HiPC): 2007, 2008, 2009.
- (h) IEEE International Conference on Computer Communications and Networks (ICCCN): 2006, 2007, 2008, 2009.

## 2. *Other Committees:*

- (a) Student Research Symposium Committee: IEEE International Conference on High Performance Computing (HiPC): 2009.
- (b) Tutorial Committee: IEEE/ACM International Conference for High Performance Computing, Networking, Storage and Analysis (SC): 2009.
- (c) Posters Committee: IEEE International Conference on Cluster Computing (Cluster): 2009.

## 3. *Technical Review Committee for International Journals and Magazines:*

- (a) Journal of Concurrency and Computation: Practice and Experience: 2009.
- (b) Computer Networks Journal: 2009.
- (c) IBM Systems Journal: 2008.
- (d) IEEE Micro: 2007.
- (e) IEEE Transactions on Parallel and Distributed Systems (TPDS): 2006, 2007, 2008, 2009.
- (f) IEEE Transactions on Computers (TC): 2006, 2007, 2008.
- (g) Electronics and Telecommunications Research Institute Journal (ETRI): 2006.
- (h) Journal of Grid Computing (Grid): 2005.
- (i) Journal of Parallel and Distributed Computing (JPDC): 2004, 2005, 2006, 2007, 2008, 2009.

## 4. *Organizational Positions:*

- (a) Session Chair: IEEE International Conference on High Performance Computing (HiPC): 2008.
- (b) Publicity Chair: Workshop on High-Performance, Power-Aware Computing (HP-PAC): 2008.
- (c) Session Chair: IEEE/ACM International Conference for High Performance Computing, Networking, Storage and Analysis (SC): 2007.
- (d) Session Chair: International Conference on Parallel Processing (ICPP): 2007.
- (e) Session Chair: Workshop on Performance Optimization for High-Level Languages and Libraries (POHLL): 2007.
- (f) Session Chair: Workshop on Communication Architecture for Clusters (CAC): 2007, 2008.
- (g) Session Chair: IEEE International Conference on Computer Communications and Networks (ICCCN): 2006, 2008.

## 5. *Additional Reviewer for Conferences and Workshops:*

- (a) IEEE International Conference on Computer Communications (INFOCOM): 2009.
- (b) IEEE International Symposium on High-Performance Interconnects (HotI): 2007.
- (c) ACM International Conference on Supercomputing (ICS): 2007.
- (d) IEEE International Conference on Autonomic and Trusted Computing (ATC): 2007.
- (e) IEEE/ACM International Conference for High Performance Computing, Networking, Storage and Analysis (SC): 2005, 2007, 2008.
- (f) IEEE International Symposium on Performance Analysis of Systems and Software (ISPASS): 2005.
- (g) IEEE Symposium on High-Performance Computer Architecture (HPCA): 2005.
- (h) IEEE Symposium on High Performance Distributed Computing (HPDC): 2004, 2005, 2007, 2008.

- (i) IEEE International Parallel and Distributed Processing Symposium (IPDPS): 2004, 2005, 2006.
- (j) International Workshop on RDMA: Applications, Implementations and Technologies (RAIT): 2004, 2005.
- (k) IEEE International Conference on Cluster Computing: 2003, 2004, 2005.
- (l) International Workshop on Communication Architecture for Clusters (CAC): 2003, 2004, 2005.

### Panel Moderator

1. *Software for the ExaFlop Era: The Demons & The Dementors*. First International Workshop on Parallel Programming Models and Systems Software for High-End Computing (P2S2), 2008.

### Internship Advisees

1. James Dinan. *Analyzing Hybrid MPI-UPC Programming*. 4th year Ph.D. student, Dept. of Computer Science and Engineering, Ohio State University, 2009.
2. Gopalakrishnan Santhanaraman. *Truly One-sided RMA Operations in MPI*. 7th year Ph.D. student, Dept. of Computer Science and Engineering, Ohio State University, 2008.
3. Ping Lai. *ProOnE: A General Purpose Protocol Onload Engine*. 2nd year Ph.D. student, Dept. of Computer Science and Engineering, Ohio State University, 2008.
4. Rajesh Sudarsan. *A Component-based Process Manager for MPICH2*. 4th year Ph.D. student, Dept. of Computer Science, Virginia Tech., 2008.
5. Thomas Scogland. *Efficient Boot-strap Capabilities for MPI Processes*. 1st year Ph.D. student, Dept. of Computer Science, Virginia Tech., 2008.
6. Ganesh Narayanaswamy. *MPICH2 over Qlogic PSM*. 1st year M.S. student, Dept. of Computer Science, Virginia Tech., 2007.

### Thesis Committees

1. Gopalakrishnan Santhanaraman. *Designing Scalable and High-Performance One Sided Communication Middleware for Modern Interconnects*, Ohio State University, Ph.D., 2009.
2. Ganesh Narayanaswamy. *On the Interaction of High-Performance Network Protocol Stacks with Multicore Architectures*, Virginia Tech., M.S., 2008.

### Other Committees

1. Book Proposal Review Committee, Taylor and Francis Group, 2007.
2. Departmental Awards Committee, Computer Science and Engineering, Ohio State University, 2006.

### Professional Memberships

1. Member, IEEE Computer Society
2. Member, ACM Computer Society

### REFERENCES

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Available on Request