

# Michael LeBeane

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Computer architecture Ph.D. with 4+ years combined industry experience.

## EDUCATION

### University of Texas at Austin

**GPA 3.97/4.0**

Ph.D. in Electrical and Computer Engineering

M.S. in Electrical and Computer Engineering

Graduation: August 2018

### Washington University in St. Louis

**GPA 3.95/4.0** (*Summa Cum Laude*)

Bachelor of Science in Computer Engineering

Bachelor of Science in Computer Science

Graduation: May 2012

### Ph.D. Dissertation

*Optimizing Communication in GPU Clusters*

With the impending end of Dennard scaling, high performance computing has turned to accelerators to continue pushing the performance and power trends of the last 50 years. Chief among proposed accelerator architectures are GPUs, which have already found a comfortable home in datacenter and HPC ecosystems. However, despite rapid adoption, communication between networks of GPUs remains cumbersome, requiring tight coordination with a host CPU to communicate with other systems.

My dissertation describes many techniques to optimize GPU networking in a distributed memory environment. I evaluate hardware and software modifications to both network interface controllers and GPUs to allow end-to-end, user-space communication between networks of GPUs, avoiding critical path CPU interference when possible. These strategies are evaluated across many important multi-node primitives and critical emerging workloads, such as machine learning.

## WORK AND RESEARCH EXPERIENCE

### Advanced Micro Devices, Inc.

*Austin, Texas*

*Senior Design Engineer (Summer 2014, Summer 2015 - Current)*

- Researching novel, RDMA-based communications hardware for GPUs
- Prototyping and evaluating APIs, runtimes, and programming models for efficient and performant GPU/NIC interaction with minimal host CPU involvement
- Outlining high performance networking strategies for AMD GPUs as a part of the US Department of Energy's PathForward program
- Driving networking insights gained through research into AMD's product roadmap and ROCm software stack
- Contributing new features and performance optimizations to AMD's event-driven, cycle-level CPU/GPU simulator

*Graduate Intern (Summer 2013)*

- Contributed custom code and debugged in-house, trace-driven SoC simulator
- Developed and documented work-flow to collect HyperTransport memory bus traces
- Conducted GPU/CPU sensitivity studies on strategically important OpenCL applications

### University of Texas at Austin

*Austin, Texas*

*Graduate Research Assistant (Advisor: Lizy K. John) (Fall 2013 – Summer 2015)*

- Worked on graph partitioning algorithms for heterogeneous data centers using GraphLab
- Explored the use of McPAT for modeling modern microprocessors using performance counters
- Performed performance evaluation on Hadoop Map/Reduce framework
- Prototyped microarchitecture changes on several research simulation platforms

## **Intel Corporation**

### ***Hillsboro, Oregon***

#### ***Graduate Intern (Summer 2012)***

- Designed and verified architecture and RTL for prototype hardware to be included in future Intel chipsets
- Assisted software development team with debugging of prototype Linux driver

#### ***Undergraduate Intern (Summer 2011)***

- Delivered key insights into SAN caching techniques and optimizations
- Provided quantitative measurements detailing strengths and weaknesses of SAN topologies

## **Washington University in St. Louis**

### ***St. Louis, Missouri***

#### ***Network Security Analyst (Spring 2011)***

- Prototyped Snort open-source packet-analyzer for deployment on live networks
- Wrote PHP and Bash scripts for automation of network maintenance tasks

## **Announce Media**

### ***St. Louis, Missouri***

#### ***Operations Intern (Summer 2010)***

- Designed and implemented automated solutions for backing up critical company resources to cloud storage
- Engineered automated deployment process of company resources to new machines

## ***TECHNICAL SKILLS***

Knowledgeable of modern CPU and GPU microarchitectures

Knowledgeable of the fundamentals of systems software and operating systems

Experience with MPI, PGAS languages, and high performance RDMA networking stacks

Experience with workload characterization and hardware/software performance analysis

Proficient with C++, C, and OpenCL programming languages

Proficient with Bash and Python for scripting

Proficient with event-driven architectural simulators

## ***LEADERSHIP AND TEACHING***

## **Washington University in St. Louis**

### ***Computer Science Student Advisory Board (2008 - 2012)***

- Advised on proposed computer science curriculum changes
- Provided conduit for students to voice suggestions and concerns to department leadership

### ***Computer Science Teaching Assistant (Spring 2010)***

- Aided students with understanding of Java and basic object-oriented design principles
- Held office hours and private tutoring sessions for students

## ***HONORS AND AWARDS***

Microelectronics and Computer Development Fellow (2012 - 2016)

Outstanding Undergraduate Student Award (2012)

## ***PUBLICATIONS***

### **ComP-Net: Command Processor Networking for Efficient Intra-Kernel Communications on GPUs**

Michael LeBeane, Khaled Hamidouche, Brad Benton, Mauricio Breternitz, Steven K. Reinhardt, Lizy K. John

International Conference on Parallel Architectures and Compilation Techniques (PACT). November 2018.

### **Neighborhood-Aware Address Translation for Irregular GPU Applications**

Seunghee Shin, Michael LeBeane, Yan Solihin, Arkaprava Basu

International Symposium on Microarchitecture (MICRO). October 2018.

### **Lost in Abstraction: Pitfalls of Analyzing GPUs at the Intermediate Language Level**

Anthony Gutierrez, Bradford M Beckmann, Alexandru Dutu, Joseph Gross, Michael LeBeane, John Kalamatianos, Onur Kayiran, Matthew Poremba, Brandon Potter, Sooraj Puthoor, Matthew D Sinclair, Mark Wyse, Jieming Yin, Xianwei Zhang, Akshay Jain, Timothy Rogers  
International Symposium on High Performance Computer Architecture (HPCA). Industrial Session. February 2018.

### **GPU Triggered Networking for Intra-Kernel Communications**

Michael LeBeane, Khaled Hamidouche, Brad Benton, Mauricio Breternitz, Steven K. Reinhardt, Lizy K. John  
International Conference for High Performance Computing, Networking, Storage, and Analysis (SC). November 2017.

### **Extended Task Queuing: Active Messages for Heterogeneous Systems**

Michael LeBeane, Brandon Potter, Abhisek Pan, Alexandru Dutu, Vinay Agarwala, Wonchan Lee, Deepak Majeti, Bibek Ghimire, Eric Van Tassell, Samuel Wasmundt, Brad Benton, Mauricio Breternitz, Michael L. Chu, Mithuna Thottethodi, Lizy K. John, and Steven K. Reinhardt.  
International Conference for High Performance Computing, Networking, Storage, and Analysis (SC). November 2016.

### **Proxy-Guided Load Balancing of Graph Processing Workloads on Heterogeneous Clusters**

Shuang Song, Meng Li, Xinnian Zheng, Jee Ho Ryoo, Reena Panda, Michael LeBeane, Andreas Gerstlauer, and Lizy K. John.  
International Conference on Parallel Processing (ICPP). August 2016.

### **Genesys: Automatically Generating Representative Training-sets**

Reena Panda, Xinnian Zheng, Jee Ho Ryoo, Michael LeBeane, Shuang Song, Andreas Gerstlauer, and Lizy K. John.  
International Conference on Embedded Computer Systems: Architectures, Modeling, and Simulation (SAMOS). July 2016.

### **Data Partitioning Strategies for Graph Workloads on Heterogeneous Clusters**

Michael LeBeane, Shuang Song, Reena Panda, Jee Ho Ryoo, and Lizy K. John.  
International Conference for High Performance Computing, Networking, Storage and Analysis (SC). November 2015.

### **Performance Characterization of Modern Databases on Out-of-order CPUs**

Reena Panda, Christopher Erb, Michael LeBeane, Jee Ho Ryoo, and Lizy K. John.  
International Symposium on Computer Architecture and High Performance Computing (SBAC-PAD). October 2015.

### **WattWatcher: Fine-Grained Power Estimation for Emerging Workloads**

Michael LeBeane, Jee Ho Ryoo, Reena Panda, and Lizy K. John.  
International Symposium on Computer Architecture and High Performance Computing (SBAC-PAD). October 2015.

### **WattWatcher: Fine-Grained Power Estimation on Live Multicore Systems Using Configurable Models (Best in Session)**

Michael LeBeane, Jee Ho Ryoo, Reena Panda, and Lizy K. John.  
SRC TECHCON. September 2015.

### **GPGPU Benchmark Suites: How Well Do They Sample the Performance Spectrum (Best Paper Runner-Up)**

Jee Ho Ryoo, Saddam Quireem, Michael LeBeane, Reena Panda, Shuang Song, and Lizy K. John.  
International Conference on Parallel Processing (ICPP). September 2015.

## ***PATENTS***

Michael LeBeane, Brad Benton, and Vinay Agarwala. Network cache injection for coherent GPUs. Advanced Micro Devices Incorporated, assignee. Filling Number 15/498076.

Michael LeBeane and Steve Reinhardt. Efficient GPU remote communication with triggered operations. Advanced Micro Devices Incorporated, assignee. Filling Number 15/297079.

Michael LeBeane, Abhisek Pan, and Steve Reinhardt. Network interface controller-based scheduling of processing tasks in a distributed computing system. Advanced Micro Devices Incorporated, assignee. Filing Number 15/267936.

Mauricio Breternitz, Deepak Majeti, and Michael LeBeane. Power-aware Work Stealing. Advanced Micro Devices Incorporated, assignee. Filling Number 14/862038.