XILINX

Xilinx Adaptive Compute Cluster
XACC - UIUC

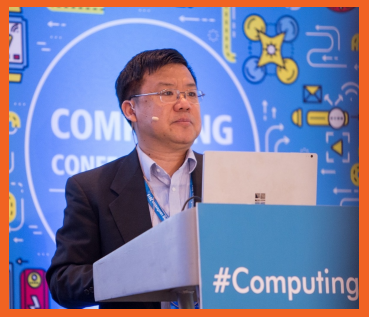
Prof. Deming Chen
Abel Bliss Professor of Engineering
Department of Electrical and Computer Engineering
University of Illinois at Urbana-Champaign

© Copyright 2021 Xilinx

Meet The Team

UIUC Faculty

Deming Chen (Director)



Wen-Mei Hwu

Volodymyr Kindratenko

Ravi Iyer

Nam Sung Kim

Zuofu Cheng

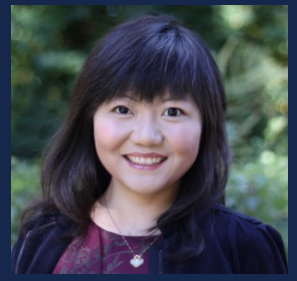
External Collaborators

Miriam Leeser (Northeastern Uni)

Martin Herbordt (Boston Uni)

Zhiru Zhang (Cornell Uni)

Jing (Jane) Li (U Penn)



Andre' DeHon (U Penn)

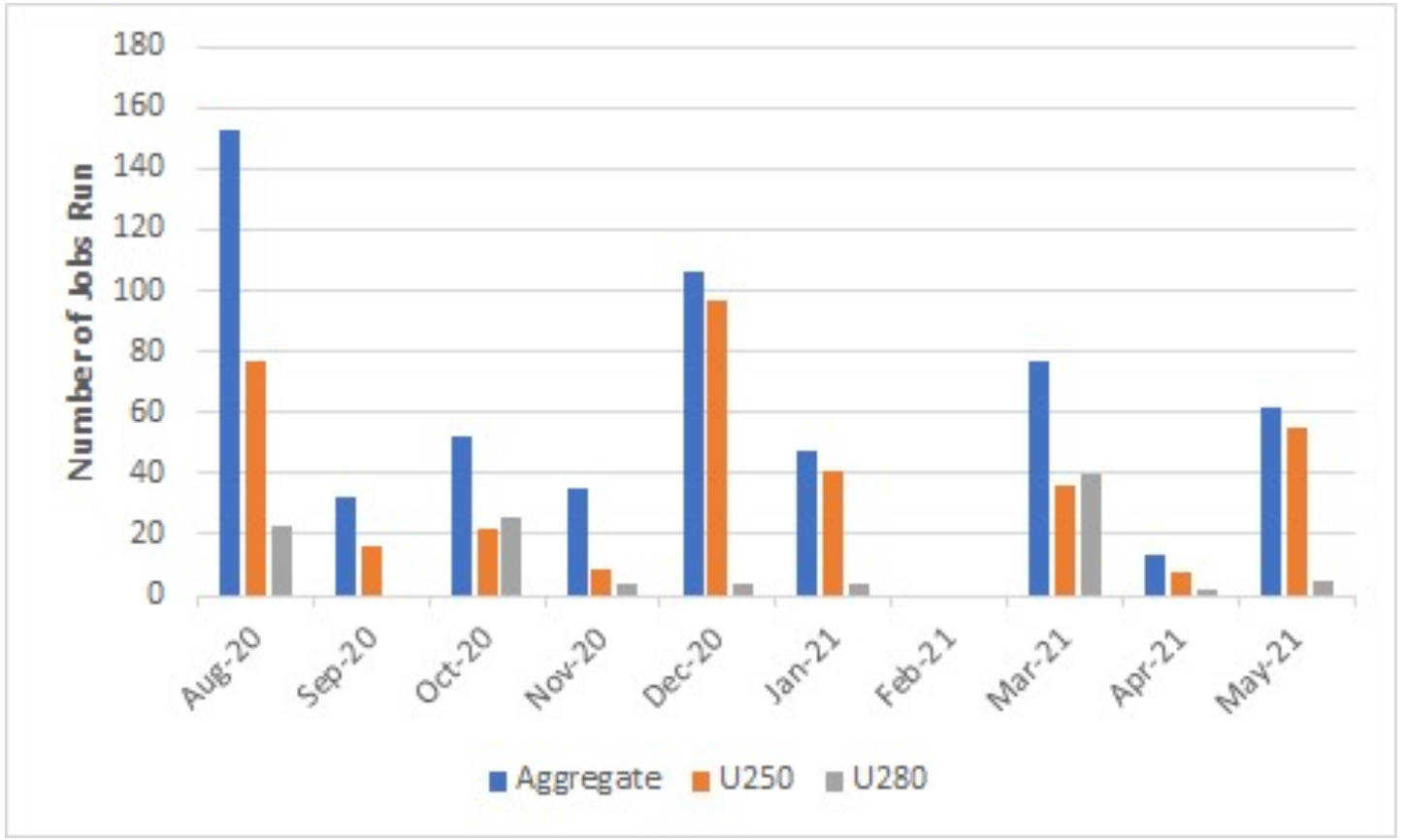
Jinjun Xiong (SUNY Buffalo)

XILINX.

© Copyright 2021 Xilinx

UIUC XACC Usage

- 69 Users
  - 49 UIUC
  - 7 Boston University
  - 4 PES
  - 4 UPenn
  - 2 Northeastern
  - 1 Cornell
  - 1 SMU
  - 1 U Chicago
- 4 Pending Users
  - 1 Harvard
  - 2 Polytechnique Montreal
  - 1 SUNY Buffalo

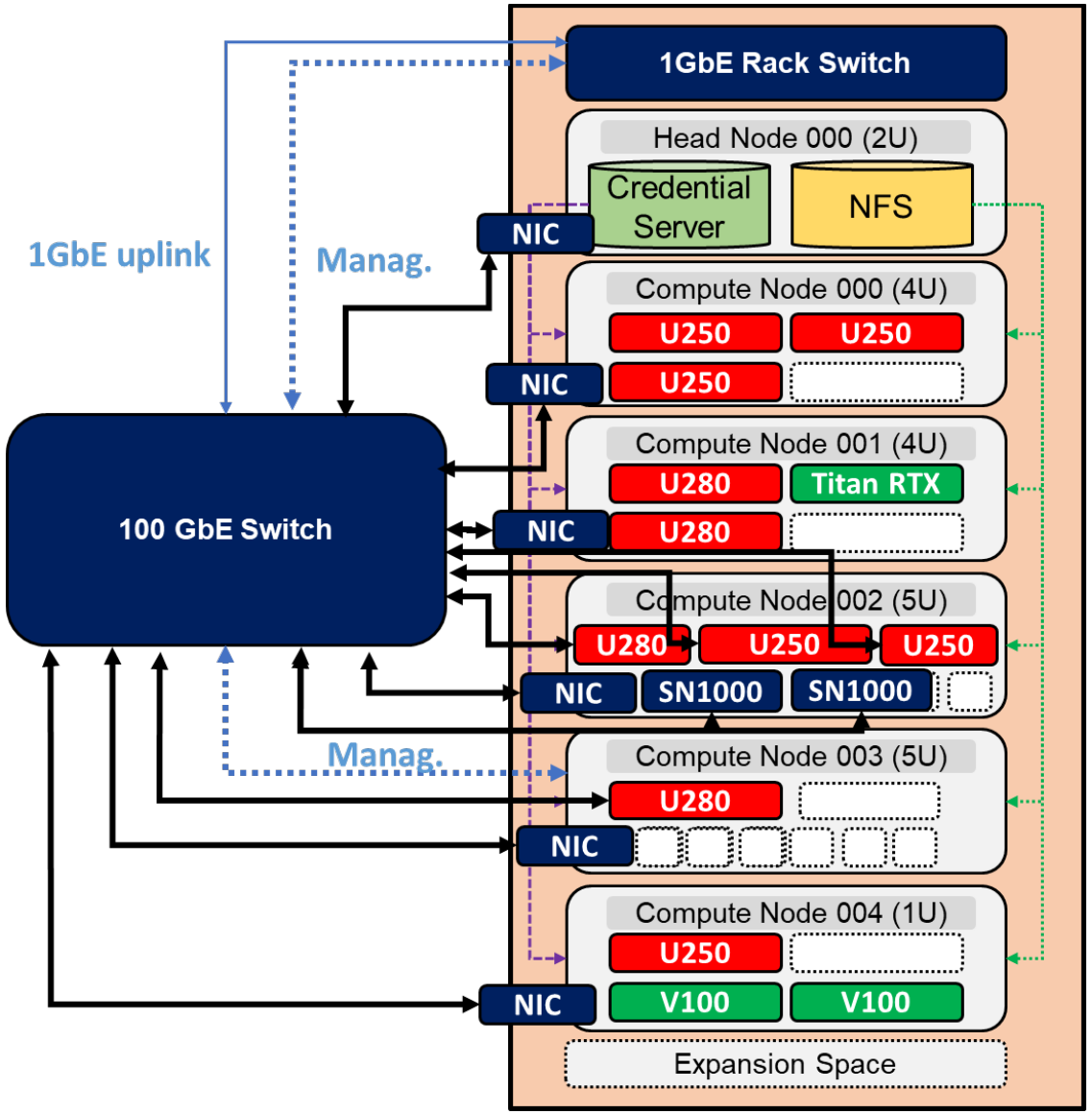


© Copyright 2021 Xilinx

XILINX.

UIUC XACC Infrastructure

- 6 primary machines:
  - 10 Alveo FPGA cards
  - 2 SN1000 SmartNICs
  - 1 Titan RTX
  - 2 Tesla V100
  - 3 Versal VCK190 (Local development)
- 100G networking between all nodes
- SLURM job manager to flexibly share resources
- **Unique features:**
  - Heterogenous: U250+U280; FPGA+GPU
  - High speed: 100 GbE switch and link
  - Flexible: job on single FPGA or networked FPGAs
  - Smart: NIC & SmartNIC across multiple nodes
  - Adaptive!



© Copyright 2021 Xilinx

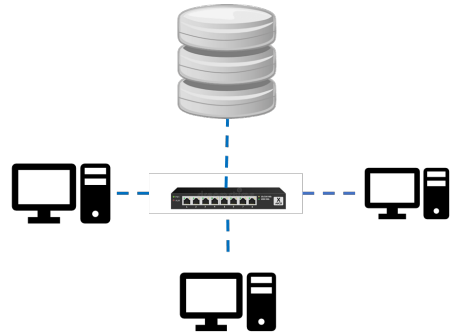
XILINX.

Research Overview

- Research center investigating:
  - System solutions for high-performance computing (HPC), distributed computing, machine learning (ML) and other computation intensive applications.
  - Create new opportunities in data center and HPC domains, with a focus on increasing the flexibility of the memory hierarchy and exploiting parallelism at a large scale with networked FPGAs and other types of accelerators.
- Four research thrusts:
  - Compilers and languages
  - Systems solutions for heterogenous computing
  - Distributed computing, networking, and storage
  - Applications and algorithms acceleration

Computer System Solutions

Distributed Computing, Networking, and Storage



Applications and algorithms

Acceleration

© Copyright 2021 Xilinx

XILINX.

Research Thrusts

- Compilers and languages – **programmability**
  - New high-level synthesis solutions, programming models, and fast compilers.
- Systems solutions – **flexibility, scalability and heterogeneity**
  - Innovative frameworks for unified memory, virtualization, scheduling and resource allocation.
  - Targeting multi-FPGA and multi-accelerator setups.
- Distributed computing, networking, and storage **– parallelization, security and reliability**
  - Smart NICs, cloud RPC, NVMe over fabric, near-data acceleration, security and reliability.
  - P4 and eBPF targeting cloud computing.
- Applications and algorithms acceleration – **performance and efficiency**
  - Tuning, optimizing, and accelerating HPC, ML, bioinformatics, encryption, and other types of applications.
- Inter-XACC collaboration opportunities
  - E.g., unified memory work with Coyote of ETH XACC and graph processing with NUS XACC.

© Copyright 2021 Xilinx

Future and Impact

- Demonstration of a working system with multi-FPGAs/Accelerators
  - Virtualization, Scheduling, RPC in the cloud
  - SmartNICs for high performance and security
  - Incorporate other types of accelerators, e.g., GPU
  - Leverage AMD ROCm framework
- Compilation and language models
  - Overlay-based fast compiler and linker
  - Just-in-time for both software and FPGA logic – connect to the Pynq system
  - End-to-end scalable HLS
  - Target both edge and cloud
- Eco-system and global impact
  - Research and education
  - New teaching modules for global dissemination

© Copyright 2021 Xilinx

Thanks!

© Copyright 2021 Xilinx

XILINX