CHERI

Reinventing Computer Architecture for Security

ABSTRACT: Over the last seven years, the CTSRD Project at SRI International and the University of Cambridge has been performing intensive hardware-software co-design to redesign core computer architecture around improved security. This talk will introduce Capability Hardware Enhanced RISC Instructions (CHERI), which extend a conventional RISC processor architecture with support for capabilities—a long-discussed but rarely deployed security approach focused on efficiently implementing the Principle of Least Privilege. CHERI is a hybrid capability architecture, in that it blends these historic ideas with contemporary hardware and software design, yielding vastly improved security with strong software compatibility yet acceptable performance overhead for fine-grained memory protection and mitigation—and orders-of-magnitude performance improvement for compartmentalised software designs. These techniques directly support vulnerability mitigation for the C and C++ programming languages, interfering with exploit techniques from buffer overflows to ROP and JOP, as well as protecting against future unknown attack techniques via scalable application-level privilege reduction. Prototyped via hardware-software co-design, and evaluated on FPGA with support from DARPA, the CHERI processor prototype is able to run adapted versions of the FreeBSD operating system (CheriBSD) and open-source application stack, and is targeted by an extended version of the Clang/LLVM compiler. This talk introduces the CHERI architecture and potential applications, and will also describe current research directions.

BIO: Dr. Robert N. M. Watson is a University Senior Lecturer (Associate Professor) at the University of Cambridge Computer Laboratory, where he works across the areas of security, operating systems, and computer architecture. As Principal Investigator of the CTSRD project, he led work on the CHERI architecture from the "ISA up", designing the hardware-software security model, and has led the CHERI software development team working on OS support, compiler support, and applications. He also has research interests in network-stack design, OS tracing and profiling tools, and capability-based operating systems including the Capsicum security model now deployed in FreeBSD. In prior industrial research, he developed the MAC Framework employed for OS kernel access-control extensibility and sandboxing in FreeBSD, Mac OS X, iOS, and Junos. He is an author of the Design and Implementation of the FreeBSD Operating System (Second Edition.)

JOHNS HOPKINS
WHITING SCHOOL
of ENGINEERING

Monday, May 8, 2017
Lecture: 10:30 AM
Hackerman B-17

Robert N. M. Watson
University of Cambridge

NATHAN KRASNOPOLER

Nathan Krasnopoler '13, a computer science major, was severely injured in February 2011 when he was struck by a car while bicycling near the Homewood campus. Although he was wearing a helmet, Nathan suffered irreversible brain damage and passed away from his injuries in August 2011. A student of great promise and a leader in the Johns Hopkins chapter of the Association for Computing Machinery (ACM), Nathan was an active and valued member of the Johns Hopkins community. As a result of the crash and to prevent future injuries and loss of life caused by medically-impaired older drivers, Nathan's family formed Americans For Older Driver Safety, a non-profit organization with a national focus. Since 2012, AFODS has promoted education of older drivers using research-based best practices. AFODS has created a curriculum for educating older drivers, has worked on public policy changes in Maryland, Missouri, and Kansas, and is currently developing a pamphlet for physicians to give to older patients on aging and driving. Additional information is available at www.afods.org.

THE NATHAN KRASNOPOLER MEMORIAL FUND

This lecture series is made possible by the generosity of numerous supporters of the Nathan Krasnopoler Memorial Fund, established at the Whiting School of Engineering to benefit the ACM. Future gifts will be used to sponsor an annual lecture in Nathan's memory and to benefit the activities of the ACM.

If you would like to honor Nathan's memory and his dedication to the ACM, you are invited to make a tax-deductible contribution to the fund.

Please visit engineering.jhu.edu/giving and indicate the Nathan Krasnopoler Memorial Fund in the "other designation" text box. For more information about the fund, please call the Whiting School of Engineering's Office of Development & Alumni Relations at (410) 516-8723.

PROGRAM OF EVENTS

Welcome
Scott Smith
Professor of Computer Science and faculty advisor to the
Johns Hopkins Chapter of the Association for Computing Machinery

Remarks
The Family of Nathan Krasnopoler

Speaker Introduction
Sam Beckley '17
Undergraduate Student and President of the
Johns Hopkins Chapter of the Association for Computing Machinery

Association for Computing Machinery Lecture in
Memory of Nathan Krasnopoler '13

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Robert N. M. Watson
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