BRYAN PEARSON

PERSONAL INFORMATION

University: University of Central Florida
College Unit: College of Engineering and Computer Science (CECS)
Address: HPA1-111, University of Central Florida
Email: bpearson@knights.ucf.edu
Expected graduation: Summer 2023

BIOGRAPHY

Bryan Pearson is a Ph.D candidate at the University of Central Florida. His advisors are Dr. Xinwen Fu and Dr. Cliff Zou. He is pursuing his degree in Computer Science, with a focus on Internet of Things (IoT) system and security. He received his B.S. in Computer Science from Stetson University (2014), with minors in Physics and Mathematics. Bryan's research interests include system security, especially software security of IoT systems. He has been publishing in several conferences and journals including ICC, ICPADS, IFIP, INFOCOM, ICNC, and MDPI Sensors.

EDUCATION

University of Central Florida *August 2018 - Present*
Ph.D in Computer Science
Focus: Internet of Things (IoT) security and privacy
Advisors: Dr. Cliff Zou & Dr. Xinwen Fu

Stetson University *May 2018*
B.S. in Computer Science *GPA: 3.507 / 4.000*
Minors in Math and Physics
Advisor: Dr. Daniel Plante

RESEARCH INTERESTS

- IoT system security and privacy
- Fuzz testing
- Memory safety and memory corruption
- Network security and quality assurance

WORK EXPERIENCE

Scholar / Researcher
NSF Scholarship-for-Service *August 2021 - Present*

Graduate Assistant *August 2018 - August 2021*
Florida IT Pathways to Success (Flit-Path)

Graduate Research Assistant *August 2018 - August 2019*
University of Central Florida, Department of Computer Science

Instructor *June 2017 - July 2018*
ID Tech Camps

Clerical Assistant *May 2017 - June 2018*
Stetson University, Departments of English/Computer Science

SCHOLARSHIPS AND GRANTS

University of Central Florida

NSF Scholarship-for-Service	*Fall 2021 - Spring 2023*
Graduate Presentation Fellowship	*Spring 2020*
IEEE ICC NSF Student Travel Grant	*April 2019*
Graduate Presentation Fellowship	*February 2019*
Graduate ORC Doctoral Fellowship	*August 2018*
Flit-Path NSF Grant	*August 2018*

Stetson University

Presidential Scholarship	*August 2014 - May 2018*
Federal Pell Grant	*August 2014 - May 2018*
Bright Futures FASA	*August 2014 - May 2018*

PROFESSIONAL & ACADEMIC DEVELOPMENT

Committee Membership

1. Program Committee, *Consortium for Computing Sciences in Colleges (CCSC SE)* *2020*
2. Web Chair (Organizing Committee), *SecureComm* *2019*

Refereed Journal Papers

1. *IEEE Internet of Things Journal (IoT-J)* *2021*
2. *IEEE Internet of Things Journal (IoT-J)* *2020*
3. *IEEE Internet of Things Journal (IoT-J)* *2019*

Refereed Conference Papers

1. *IEEE International Conference on Computer Communications (INFOCOM)* *2021*
2. *IEEE International Conference on Distributed Computing Systems (ICDCS)* *2021*
3. *IEEE International Conference on Parallel and Distributed Systems (ICPADS)* *2020*
4. *Consortium for Computing Sciences in Colleges (CCSC SE)* *2020*

Capture the Flag / Hackathons

1. NSA Codebreaker Challenge (High Performer) *2021*
2. CSAW CTF *2021*

NOTABLE PROJECTS

Fuzzing MQTT Brokers

- We designed and evaluated a novel fuzz testing model for the MQTT protocol, which directly impacts thousands of devices.
- We modeled our fuzzing engine using two Markov chains for generation-guided fuzzing and mutation-guided fuzzing.
- We discovered 7 major vulnerabilities across 9 different MQTT implementations, including 6 zero-day vulnerabilities. When fuzzing MQTT servers, our project compares favorably against state-of-the-art frameworks such as AFLNet and Boofuzz.
- Paper submitted for publication (INFOCOM 2022).

SIC^2: Securing MCU Based IoT Devices with Low-cost Crypto Coprocessors

- We show that popular MCU based IoT devices may be vulnerable to software attacks such as format string and buffer overflow. We demonstrate how these attacks can be used to compromise private data remotely.
- As a general defense, we propose a framework which pairs MCU based IoT devices with cryptographic coprocessors, which offer secure key storage and secure execution environment

- Our case study is the ESP32 development board paired with an ATECC608A crypto coprocessor. We connect to AWS IoT and EC2. Our performance benchmarks show that crypto coprocessors can reduce the TLS handshake time by 82% and energy consumption by 70%.
- Publication: `https://bpearson.net/papers/ICPADS_2020_Camera_Ready.pdf`

STAIR: Smart Air Network

- This project plots ambient particulate matter, CO2, air pressure, temperature, and humidity data from sensors onto a map. Our current deployment of devices are built using the SAML11 microcontroller.
- My contributions to this project include integration with Amazon Web Services such as IoT Core (communication from/to sensors), Lambda (payload decoding), DynamoDB (data storage), EC2 (web server), and CodePipeline (CI/CD).
- Paper submitted for publication (IoT Journal).
- The website is available here: `http://3.85.149.13/`.

IoT Security Hands-on Laboratory

- We develop a low-cost platform with an industrial grade MCU ESP32 equipped with a crypto co-processor ATECC608A and create teaching materials including labs and case studies for IoT security education.
- Labs include: JTAG hacking, JTAG defense, UART hacking, UART defense, flash ethical hacking, secure key storage, secure booting, network attack, network defense, and secure over-the-air update.
- Publication: `https://link.springer.com/chapter/10.1007/978-3-030-43605-6_17`
- Sample lab: `http://cyberforensic.net/labs/iot_secure_key_storage/secure_key_storage.html`

PUBLICATIONS

1. Z. Ling, H. Yan, X. Shao, J. Luo, Y. Xu, B. Pearson, X. Fu. Secure boot, trusted boot and remote attestation for ARM TrustZone-based IoT Nodes. *Journal of Systems Architecture*, Volume 119, October 2021.
2. M. Cash, S. Wang, B. Pearson, Q. Zhou, X. Fu. On Automating BACnet Device Discovery and Property Identification. *In proceedings of IEEE International Conference on Communications (ICC),* Montreal. June 2021.
3. Z. Ling, R. Liu, Y. Zhang, K. Jia, B. Pearson, X. Fu, L. Junzhou. Prison Break of Android Reflection Restriction and Defense. *In proceedings of IEEE International Conference on Computer Communications (INFOCOM) 2021.* Virtual conference. May 2021.
4. B. Pearson, C. Zou, Y. Zhang, Z. Ling, X. Fu. SIC^2: Securing Microcontroller Based IoT Devices with Low-cost Crypto Coprocessors. *In proceedings of IEEE International Conference on Parallel and Distributed Systems (ICPADS) 2020.* Hong Kong. Dec. 2020.
5. B. Pearson, D. Plante. Secure Deployment of Containerized IoT Systems. *In proceedings of IEEE SoutheastCon 2020.* Raleigh, North Carolina. Mar. 2020.
6. Y. Zhang, J. Weng, Z. Ling, B. Pearson, X. Fu. BLESS: A BLE Application Security Scanning Framework. *In proceedings of IEEE INFOCOM 2020 - IEEE Conference on Computer Communications (INFOCOM).* Beijing, China. Apr. 2020.
7. B. Pearson, L. Luo, C. Zou, J. Brian, Y. Jin, X. Fu. Building a Low-cost and State-of-the-art IoT Security Hands-on Laboratory. *2nd IFIP Internation Internet of Things (IoT) Conference.* Oct. 31-Nov. 1, 2019. (Invited Paper.)
8. C. Gao, L. Luo, Y. Zhang, B. Pearson, X. Fu. Microcontroller Based IoT System Firmware Security: Case Studies. *In proceedings of IEEE International Conference on Industrial Internet (ICII)*, Orlando, FL, Nov. 2019. (**Best Paper Award.)**
9. B. Pearson, L. Luo, Y. Zhang, R. Dey, Z. Ling, M. Bassiouni, and X. Fu. On Misconception of Hardware and Cost in IoT Security and Privacy. *In proceedings of IEEE International Conference on Communications (ICC),* Shanghai, China, May 2019.
10. L. Luo, Y. Zhang, B. Pearson, Z. Ling, H. Yu, and X. Fu. On the Security and Data Integrity of Low-Cost Sensor Networks for Air Quality Monitoring. *Sensors (Basel).* Dec. 2018.

11. N. Domingo, B. Pearson, and Y. Jin. Exploitations of Wireless Interfaces Via Network Scanning. *In proceedings of IEEE International Conference on Computing, Networking and Communications (ICNC),* Santa Clara, CA, 2017.

TECHNICAL SKILLS

Programming Languages: C, Assembly (x86, ARM, Xtensa), Python, Java, JavaScript
Software Experience:

- *Reverse engineering:* Ghidra, OllyDbg, IDA, ScratchABit, ImmunityDebugger
- *Static Analysis*: Mostly GNU/Unix utilities such as readelf, objdump, ldd, binwalk, strings, etc.
- *Dynamic Analysis*: GDB, Valgrind, Qemu, PANDA, AFL++, Boofuzz
- *Network Analysis*: Wireshark, Splunk, tcpdump
- *Cloud Services*: AWS (IoT, DynamoDB, Lambda, EC2, Cloudwatch), GCP (Maps Javascript API)
- *Programming IDEs*: Vim, Eclipse, VSCode, Arduino IDE, Atom, IDLE, Sublime
- *Miscellaneous*: Docker, Virtualbox, VMWare

REFERENCES

Dr. Xinwen Fu (Primary Advisor)
Associate Professor of Computer Science *University of Central Florida*
Email: xinwenfu@ucf.edu

Dr. Cliff Zou (Co-Advisor)
Associate Professor of Computer Science *University of Central Florida*
Email: changchun.zou@ucf.edu