Muhammad Asim Jamshed, Ph.D.

Contact Information

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Research Interests

Highly scalable networked server and security systems design & implementation
Distributed systems, network security and operating systems

Education

Korea Advanced Institute of Science & Technology (KAIST)
Daejeon, Republic of Korea

Postdoctoral Researcher, Electrical Engineering (02/2017-04/2017)

- Supervisor: Dr. KyoungSoo Park

PhD Student, Electrical Engineering (09/2010-02/2017)

- Advisor: Dr. KyoungSoo Park
- Thesis Title: Networking Stack Abstraction for High-performance Flow-processing Middleboxes

University of Pittsburgh, Pittsburgh, Pennsylvania, 15260, USA

MS, Computer Science (08/2006-05/2010)

- Advisor: Dr. KyoungSoo Park
- Thesis Title: Suppressing Bot Traffic with Accurate Human Attestations

Lahore University of Management Sciences, Lahore 54792, Pakistan

BSc (Hons), Computer Science, (09/2001-05/2005)

- Minor in Mathematics
- Thesis Title: Implementing Fault Tolerant TCP for Generic Single-Threaded Applications

Travel History

United States of America (11 times): Aug 2006-May 2010 (F1), Feb 2012 (B1), Oct 2012 (B1), Feb 2014 (B1), Apr 2014 (B1), June-Aug 2014 (J1), Oct-Dec 2015 (J1), Mar 2016 (B1), Mar 2017 (B1), May 2017 (O1), Dec 2018 (**US Permenant Resident**)
United Kingdom (1 time): August 2015 (C-Visit/Business)
Canada (1 time): Aug-Sept 2019 (eTA)
South Korea (3 times): June 2010 (C3), Sept 2010-Feb 2017 (D2), Feb 2017-Apr 2017 (E3)

Research Experience

Networked & Distributed Systems Lab, EE Dept., KAIST **09/2010-04/2017**
Graduate & Postdoctoral Researcher
(i) Smart resource management in heterogeneous systems: See [4] in Projects section for details.
(ii) High performance networked systems: See [2, 3] in Projects section for details.
(iii) Highly scalable intrusion detection systems: See [4] in Projects section for details.
(iv) Human (& spam) detection in the Internet: See [5] in Projects section for details.
Supervisor: Dr. KyoungSoo Park

International Computer Science Institute, Berkeley, CA, USA 06/2014-08/2014 &
Research Intern, Bro team **10/2015-12/2015**
(i) Developed a packet acquisition & filter framework for 10 Gbps network applications.
Supervisor: Dr. Robin Sommer

Distributed Systems Lab, CS Dept., Univ of Pittsburgh **05/2009-05/2010**
Graduate Researcher

(i) Email Spam Behavior - Detection & Prevention: Analyzed email spamming behaviors as seen by honeypots in open-proxy settings.
(ii) Human Detection in the Internet: See [4] in the Projects section for more details.
Supervisor: Dr. KyoungSoo Park

Network Systems Lab, CS Dept., Univ of Pittsburgh **06/2007** & **06/2008**
Graduate Researcher - Worked on a framework to mitigate the effects of application-level DDoS attacks. See [6] in the Projects section for more details.
Supervisor: Dr. Jose Brustoloni

Publications

[1] Moon, Y., Lee, S., **Jamshed, M.**, Park, K. "AccelTCP: Accelerating Network Applications with Stateful TCP Offloading." 17^{th} USENIX Symposium on Networked Systems Design and Implementation (NSDI 2020)

[2] Bashir, H., Faisal, A., **Jamshed, M.**, Vondras, P., Iftikhar, A., Qazi, I., Dogar, F. "Reducing Tail Latency via Safe and Simple Duplication." 15^{th} International Conference on emerging Networking EXperiments and Technologies (CoNEXT 2019)

[3] **Jamshed, M.**, Moon, Y., Kim, D., Han, D., Park, K. "mOS: A Reusable Networking Stack for Flow Monitoring Middleboxes." 14^{th} USENIX Symposium on Networked Systems Design and Implementation (NSDI 2017) - **Best Paper Award**

[4] Go, Y., **Jamshed, M.**, Moon, Y., Hwang, C., Park, K. "APUNet: Revitalizing GPU as Packet Processing Accelerator." 14^{th} USENIX Symposium on Networked Systems Design and Implementation (NSDI 2017)

[5] Choi, B., Chae, J., **Jamshed, M.**, Park, K., Han, D. "DFC: Accelerating String Pattern Matching for Network Applications." 13^{th} USENIX Symposium on Networked Systems Design and Implementation (NSDI 2016)

[6] Nam, J., **Jamshed, M.**, Choi, B., Han, D., Park, K. "Haetae: Scaling the Performance of Network Intrusion Detection with Many-core Processors." 18^{th} International Symposium on Research in Attacks, Intrusions and Defenses (RAID 2015)

[7] **Jamshed, M.**, Kim, D., Moon, Y., Han, D., Park, K. "A Case for a Stateful Middlebox Networking Stack." SIGCOMM Computer Communication Review, Rev. 45, Pg 355-356, August, 2015

[8] Nam, J., **Jamshed, M.**, Choi, B., Han, D., Park, K. "Scaling the Performance of Network Intrusion Detection with Many-core Processors." 11^{th} ACM/IEEE Symposium on Architectures for Networking and Communication Systems (ANCS 2015) (Poster)

[9] **Jamshed, M.**, Nam, J., Choi, B., Han, D., Park, K. "Balancing between Power Efficiency and High Performance on Software-based Intrusion Detection Systems." 21^{st} Network and Distributed System Security Symposium (NDSS 2014) (Poster)

[10] Jeong, E., Woo, S., **Jamshed, M.**, Jeong, H., Ihm, S., Han, D., Park, K. "mTCP: a Highly Scalable User-level TCP Stack for Multicore Systems." 11^{th} USENIX Symposium on Networked Systems Design and Implementation (NSDI 2014) - **Community Award**

[11] **Jamshed, M.**, Lee, J., Moon, S., Yun, I., Kim, D., Lee, S., Yi, Y., Park, K. "Kargus: a Highly-scalable Software-based Intrusion Detection System." 19^{th} ACM Conference on Computer and Communications Security (CCS 2012)

[12] **Jamshed, M.**, Go, Y., Park, K. "HumanSign: Accurate Bot Message Detection with Reliable Human Attestation." Technical Report, EE-TR-XXXX, EE Department, KAIST, 2012

[13] **Jamshed, M.**, Go, Y., Park, K. "Supressing Malicious Bot Traffic using an Accurate Human Attester." 8^{th} USENIX Symposium on Networked Systems Design and Implementation (NSDI 2011) (Poster)

[14] **Jamshed, M.**, Kim, W., Park, K. "Suppressing Bot Traffic with Accurate Human Attestations." 1^{st} ACM Asia-Pacific Workshop on Systems (ApSys 2010) held in conjunction with SIGCOMM 2010

[15] Djalaliev, P., **Jamshed, M.**, Farnan, N., Brustoloni, J.C. "Sentinel: Hardware-Accelerated Mitigation of Bot-Based DDoS Attacks." IEEE IC3N 2008 Network Security Track

[16] **Jamshed, M.**, Brustoloni, J. "In-Network Server-Directed Client Authentication and Packet Classification." 35^{th} Annual IEEE Conference on Local Computer Networks (LCN) 2010

Invited Talks

[1] "Kargus: a Batched, Parallelizable GPU-Enabled Intrusion Detection System." 2012 International Exposition Yeosu Korea organized by Korea Information Processing Society, April 28, 2012.

Honors

Intel Division Recognition Award for OMEC
NSDI Best Paper Award 2017 for mOS
2^{nd} Runner-up Samsung HumanTech Paper Award 2016 for DFC
NSDI Community Award 2014 for mTCP
Runner-up Samsung Humantech Paper Award 2014 for mTCP
"10 Achievements of 2012 that put KAIST on the Spotlight" for Kargus
ACM SIGCOMM Travel Grant 2010
Graduate Fellowship Spring 2006
Undergraduate Dean's Honor List 2001-03

Teaching Experience

Korea Advanced Institute of Science & Technology (KAIST)
Teaching Assistant, EE Dept.

Led weekly precepts and graded assignments for the following courses:
- EE 209: Programming Structures for Electrical Engineering — Falls {2010, 2011 & 2012}

University of Pittsburgh
Teaching Assistant, CS Dept.

My main responsibilities have ranged from leading weekly recitations and grading assignments to making labs for the following courses:
- CS 0449: Introduction to Systems Software — Springs {2009 & 2008}
- CS 0007: Introduction to Computer Programming — Falls {2008, 2007 & 2006}

Course Grader, CS Dept.
- CS 1550: Introduction to Operating Systems — Spring 2008

Lahore University of Management Sciences
Teaching Assistant, CS Dept.

Led weekly labs/tutorials and graded programming assignments
- CS 292: Advanced Programming Techniques — Winter 2004-05

Lab Instructor, CS Dept.

Designed labs in OPNET simulator
- CS 471: Computer Networks — Spring 2004-05

Professional Experience

Intel Labs, Intel Corporation, Hillsboro, OR, USA — 05/2017-onwards
- Research Scientist

Manager: Christian Maciocco

Palmchip Corporation, — 05/2005-07/2006
1st Floor, 56-Shadman Commercial Market, Tel: +92 42-37503661-63
Lahore, Pakistan

- Software Engineer, Embedded Systems Group: Optimized bootloader & filesystem performances for an in-house System-on-Chip Network-Attached Storage device series.

Supervisor: Ahrar Naqvi

Syed Murad Ali, Toronto, Canada — 08/2004-09/2004
- Intern, Web Development

Supervisor: Syed Murad Ali

Relevant Coursework, Univ of Pittsburgh (Graduate)

Computer Operating Systems†, Computer Architecture†, Design & Analysis of Algorithms†, Wide Area Networks, Computer & Network Security, Principles of Database Systems, Foundations of Artificial Intelligence†, Advanced Topics in Operating Systems, Secure Software Systems, Advanced Topics in Computer Networks, Network Security

† *passed preliminary PhD qualifier for the course*

Professional Service

External Reviewer: OSDI 2016, SIGCOMM 2016, SIGCOMM 2015, SIGMETRICS 2015, NSDI 2015, SIGCOMM 2014, ATC 2014, NSDI 2014, CCS 2013, APSYS 2013, ASIACCS 2013, OAKLAND 2013, WWW 2013, CODASPY 2013, CCSW 2012, NSDI 2011, NDSS 2011, CoNEXT 2011
Program Committee Member: CAN 2017
Journal Reviewer: Elsevier Computer Networks Journal, Computer Communication Review

Phd Thesis Reviewer

Syed Mohammad Irteza, "Resilient Network Load Balancing for Datacenters", November 2018

Projects

1. Omec Project — Feb 2019-

The Open Mobile Evolved Core (OMEC) project is an initiative from the Open Networking Foundation (ONF) to create an open source virtualized evolved packet core for 4G/LTE networks. OMEC comprises of a number of VNFs including (i) OpenMME: a Mobility Management Entity function, (ii) C3PO: a suite packaging Home Subscription Service (HSS), Database, Charge Data Function (CDF), Charge Trigger Function (CTF), and Policy Control Rules Function (PCRF), and (iii) ngic-rtc: a control user plane separated (CUPS) 3GPP TS23501 based Service and Packet gateway functions. **OMEC won the Intel Division Recognition Award 2019.**<*URL:* http://www.omecproject.org/>

2. mOS Stack — May 2016-

mOS networking stack provides elegant abstractions for stateful flow processing tailored for middlebox applications. Our API allows developers to focus on the core application logic instead of dealing with low-level packet/flow processing themselves. Under the hood, the stack implements an efficient event system derived from mTCP, a high-performance user-level TCP/IP stack. Our evaluation demonstrates that the mOS API enables modular development of stateful middleboxes, often significantly reducing development efforts represented by the source lines of code, while introducing little performance overhead. **mOS won the best paper award at NSDI 2017.** <*Pub:* **NSDI 2017**, *URL:* http://mos.kaist.edu/>

3. mTCP Sept 2013-

Scaling the performance of short TCP connections on multi-core systems is fundamentally challenging. Although many proposals have attempted to address various shortcomings, inefficiency in the kernel implementation still persists. For example, even the state-of-the-art design spends 70% to 80% of CPU cycles in handling TCP connections in the kernel, leaving only small room for innovation in the user-level program. mTCP is a high-performance user-level TCP stack for multi-core systems that addresses the inefficiency from the ground up - from packet I/O and TCP connection management to the application interface. In addition to adopting well-known techniques, mTCP (1) allows efficient flow-level event aggregation, and (2) performs batch processing of RX/TX packets for high I/O efficiency. mTCP improves the performance of small message transactions by a factor 25 and 3 than that of latest Linux TCP stack and the best-performing prototype we know. It also improves the performance of various popular applications by 33% to 320% compared with those on the Linux stack. **mTCP won the community award at NSDI 2014.** <*Pub:* **NSDI 2014**, *URL:* **http://shader.kaist.edu/mtcp/**>

4. Kargus Oct 2012

Intrusion attempts on the Internet have consistently risen in the last few years. As the link bandwidths of large campus and meteropolitan area networks reach 10 Gbps, network administrators have employed high-performance intrusion detection systems (IDSes) that use dedicated network processors and specialized memory to cope with the increasing ingress traffic rates. Unfortunately, the deployment and maintainence costs of such solutions are inevitably high, and the hardware design is often too inflexible to adopt new analysis algorithms. Kargus is a highly-scalable software-based IDS that runs on commodity PCs and its performance is comparable to hardware-based IDSes. It effectively exploits the potentials of modern hardware innovations such as multi-core CPUs, heterogeneous GPUs and multi-queue interface of NICs that drives its monitoring rate by up to 33 Gbps in real time. Kargus was mentioned in the **"10 Achievements of 2012 that put KAIST on the Spotlight."** <*Pub:* **CCS 2012**, *URL:* **http://shader.kaist.edu/kargus/**>

5. HumanSign Sept 2010

A device framework under development in which input keystroke events are securely coupled with actual textual content typed by humans for reliable network payload delivery. This scheme is based on trusted computing principles that places the root of trust on a customized input device running a trusted platform module (TPM) chip and a small attester daemon within it. Each input event generates a cryptographic hash that attests to human activity and the combined message attestation (derived from such events) gets a third-party verifiable digital signature. These human attestations are then attached to the actual messages which ultimately assist in reducing false positive rates in the recipients' filter modules.
<*Pub:* **APSYS 2010**>

6. Botbuster Dec 2008

DDoS attacks increasingly use normal-looking application-layer requests to waste HTTP server CPU or disk resources. CAPTCHAs attempt to distinguish bots from human clients and are often used to avoid such attacks. However, CAPTCHAs themselves consume resources and frequently are defeated. I developed Bobuster, an extensible ebtables module that pushes client authentication in the kernel while overcoming several limitations in KillBots (NSDI '05). It can easily be deployed as a bridge in front of server farms, modularly accepts a variety of present and future authentication schemes, and can do server-directed client authentication and packet classification. <*Pubs:* **ICCCN 2008, LCN 2010**>

Programming Skills C/C++, Java, C#, Python, CUDA, Lua, Awk, Javascript, Linux shell scripting, HTML, XML, Unix/GNU Linux, x86 Assembly, TILE-Gx programming, Intel DPDK, LaTeX