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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

PhD Student, Electrical Engineering (Sept 2010-onwards)

- Advisor: KyoungSoo Park

University of Pittsburgh, Pittsburgh, Pennsylvania, USA

MS, Computer Science (Apr 2010)

- Advisors: KyoungSoo Park & Daniel Mossé

Lahore University of Management Sciences, Lahore, Pakistan

BSc (Hons), Computer Science, (May 2005)

- Minor in Mathematics

Research Experience

Networked & Distributed Computing Systems Lab **Fall '10-onwards**
Graduate Researcher, EE Dept., KAIST
(i) Smart resource management in heterogeneous systems: See [4] in Projects section for details.
(ii) High performance networked systems: See [1, 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.

International Computer Science Institute, Berkeley, CA, US Summer '14 & **Fall '15**
Research Intern, Bro team
(i) Developed a packet acquisition & filter framework for 10 Gbps network applications.

Distributed Systems Lab **Summer '09-Spring '10**
Graduate Researcher, CS Dept., Univ of Pittsburgh
(i) Email spam detection: Analyzed spamming behaviors using honeypots in open-proxy settings.
(ii) Human detection in the Internet: See [5] in Projects section for details.

Network Systems Lab **Summers '07** & **'08**
Graduate Researcher, CS Dept., Univ of Pittsburgh
Defense against application-level DDoS attacks: See [6] in Projects section for details.

Refereed Publications

[1] **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)

[2] 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)

[3] 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)

[4] 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)

[5] **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

[6] 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)

[7] 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) - **NSDI Community Award**

[8] **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)

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

[10] **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

[11] Djalaliev, P., **Jamshed, M.**, Farnan, N., Brustoloni, J.C. "Sentinel: Hardware-Accelerated Mitigation of Bot-Based DDoS Attacks." 17^{th} IEEE International Conference on Computer Communications and Networks (ICCCN 2008) Network Security Track.

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

Non-refereed Publications

[1] **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)

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

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.

Projects/ Software

1. mOS Stack (https://github.com/ndsl-kaist/mOS-networking-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 in-

stead 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. <*Pub:* **CCR 2015**, *URL:* http://mos.kaist.edu/>

2. Packet Bricks (https://github.com/bro/packet-bricks) Sept 2014-

A netmap-based packet layer for distributing and filtering traffic.

3. mTCP (https://github.com/eunyoung14/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 **NSDI Community Award 2014** and was declared runner-up in the **Samsung HumanTech Paper Award 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**>

5. 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**>

Employment Experience

International Computer Science Institute (ICSI), Berkeley, CA May 2014-Aug 2014
- Research Intern, Bro security monitoring team: Developed Packet Bricks. See [2] in Projects section.

Palmchip Corporation, Lahore, Pakistan May 2005-July 2006
- Software Engineer, Embedded Systems Group: Optimized bootloader & filesystem performances for an in-house System-on-Chip Network-Attached Storage device series.

Syed Murad Ali, Toronto, Canada Summer 2004
- Intern, Web Development (PHP & HTML)

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

Relevant Coursework

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, Think Like an Adversary, Performance Analysis of Communication Networks, Parallel and Distributed Computation in Communication Network, Software-defined Networked Computing

† *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, RTCSA 2014, CCS 2013, APSYS 2013, ASIACCS 2013, OAKLAND 2013, WWW 2013, CODASPY 2013, CCSW 2012, NSDI 2011, NDSS 2011, CoNEXT 2011
Journal Reviewer: Elsevier Computer Networks Journal, Computer Communication Review

PhD Thesis Reviewer

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

Honors

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

Skills

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

References

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