

## SUMMARY OF QUALIFICATIONS

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- **Specialization:** Network Optimization, Network Anomaly Detection, Distributed Systems, Optimization Models, Network Virtualization, Cloud Resource Management, SDN, Network Function Virtualization (NFV), Edge Computing
- **Programming:** Python, Java, C/C++, Matlab, SQL
- **Big Data:** Hadoop, SPARK, Pig, SPARQL
- **Optimization:** CPLEX, LP, ILP, MIP, PuLP python, docplex, MATLAB optimizer
- **Others:** Control Theory, AWS, OpenStack, OpenWhisk, GENI, ChameleonCloud

## EDUCATION

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- **Ph.D. Computer Science** September 2019  
*Boston University* Boston, MA
- **M.S. Computer Science** August 2013  
*Koç University* Istanbul, Turkey
- **B.Sc. Computer Science** July 2011  
*Lahore University of Management Sciences (LUMS)* Lahore, Pakistan

## EXPERIENCE

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- **Akamai Technologies** Cambridge, MA, USA  
*Senior Performance Engineer II* Oct. 2019 - Present
  - **Akamai Backbone Network Modeling:** I am part of the *Network Control* group. My work involves creating mathematical models to predict the traffic routing and congestion on Akamai's backbone network. These models are used for capacity planning and answer questions related to reliability and performance issues on the Akamai backbone network. Part of the work involves gathering a large amount of data, generating network topologies, and running the models on them.
- **Akamai Technologies** Cambridge, MA, USA  
*Two Research Internships | Mentor: Karim Mattar* June-Sep 2015 & June-Sep 2016
  - **Anomaly Detection System:** Worked with the *Akamai Media Performance* team to design and develop a distributed system to detect problems (anomalies) in Akamai's media delivery. The system is designed to run on a SPARK cluster. System ingests Akamai/customer logs in CSV format. User inputs "badness" definition for sessions, *e.g.* video session with re-buffering is defined as "bad". The system initially runs **Feature Selection** for dimensionality reduction. The **Anomaly Detection** finds the irregularities for the selected features. The **Change Detection** module detects feature values that trigger change in performance. The system has a web interface, standalone API, SPARK cluster API, and Interactive Mode
- **CREATE-NET** Trento, Italy  
*Visiting Research Scientist* Jan. 2016 - May 2016
  - **Virtual Network Function management and deployment for 5G network:** The management of a multi-technology intelligent transport network, with compute and network resources, for future 5G technology. I developed algorithms, which use optimization theory to place network, storage and compute resources on the edge of the network. Problem is formulated using mixed-integer programming (MIP) and solved using CPLEX solver. Proposed heuristic provides close to optimal results at order of magnitude faster time.
- **Boston University** Boston, MA, USA  
*Research Assistant | Advisor: Ibrahim Matta* Aug. 2013 - Aug. 2019
  - **Placement and Traffic steering of Application Functions over a Virtualized Cloud Infrastructure:** We show that dividing an application into multiple smaller modules (virtual functions) and running them over the edge network can decrease latency and increase throughput. The joint optimal placement of application virtual function modules and the steering of traffic through them, over a multi-technology edge network, consisting of both wired and wireless, is an NP-hard problem. We provide a mathematical formulation using mixed-integer programming (MIP) and propose a faster heuristic solution to solve this problem.
  - **Adaptive configuration finder for Serverless Functions using statistical learning:** To run a job as a serverless function, the user requests the function's configuration from the cloud provider. These configurations include memory, location, edge vs core, etc. Requesting the "best" configuration from the cloud providers, which minimizes the price paid and fulfills the QoS requirements for a function, is a hard problem to solve. The user has little information about the underlying hardware, co-location of functions, edge vs core execution, etc. Moreover, predicting the exact amount of resources needed by user function is hard. In this work, we use Bayesian Optimization (a statistical learning technique) to intelligently sample different configuration parameters for a serverless function. Within as few as 15 samples, we predict the optimal/near-optimal configuration in 75%-90% of the time.

- **EL-SEC: ELastic Management of SECurity Applications on a Virtualized Infrastructure:** Designed and implemented the EL-SEC architecture that enables the elastic management of a virtual network/application function (VF) over SDNs. It involves a distributed monitoring application to measure the state of VF (e.g., Snort intrusion detection system) instances, an attack analyzer and a load balancer on the controller node to analyze traffic/access patterns/intrusion alerts, and to dynamically increase/decrease the number of VF instances in response to load conditions and QoS requirements. The controller node also involves a process that communicates using the OpenFlow protocol with underlying switches to install traffic forward rules to steer traffic toward one of the VF instances and to block attack traffic.
- **EcoForecast: Serverless Cyberinfrastructure for Ecological Research:** My team and I designed and implemented EcoForecast, a serverless system for supporting ecological research. We deployed the [Apache OpenWhisk](#) serverless framework on [GENI](#) Edge nodes and [Chameleon Cloud](#) Core nodes. To run Ecological models, users submit code, along with dependencies, via the web interface. The Orchestrator installs user dependencies and finds the “best” place to run the user code either on an Edge node or Core node. The code runs as a “Serverless” function in a containerized environment in the cloud. The output of the function is sent to the user, where the user can plot and compare it using the web interface, or download it for further analysis.

## • Koç University

Istanbul, Turkey

Research Assistant | Advisors: [Sinem Ergen](#) & [Oznur Ozkasap](#)

Sep. 2011 - Aug. 2013

- **Analysis of realistic Channel Models for VANETs:** This project deals with analyzing different channel models and proposing a realistic model for the vehicular ad-hoc network (VANET).
- **Realistic Mobility Modeling for VANETs:** In this project, we integrate real-world road topology and real-time data extracted from the Freeway Performance Measurement System (PeMS) database into a microscopic mobility model in order to generate realistic traffic flows along the highway.
- **Distributed Algorithms for density estimation in VANETs:** The project deals with proposing fully distributed and infrastructure-free mechanisms for the density estimation in vehicular ad-hoc networks. This study is inspired by the mechanisms proposed for system size estimation in peer-to-peer networks.

## SELECTED PUBLICATIONS [[GOOGLE SCHOLAR](#)]

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- A. Raza, I. Matta, **N. Akhtar**, V. Kalavari, V. Isahagian, “Function-as-a-Service: From An Application Developer’s Perspective”. *Journal of Systems Research (JSys)*, 2021 (pdf)
  - A. Raza, Z. Zhang, **N. Akhtar**, V. Isahagian, I. Matta, “LIBRA: An Economical Hybrid Approach for Cloud Application with Strict SLAs”. *IEEE International Conference on Cloud Engineering (IEEE IC2E)*, 2021 [BEST PAPER AWARD] (pdf)
  - **N. Akhtar**, I. Matta, A. Raza, L. Goratti, T. Braun and F. Esposito, “Managing Chains of Application Functions over Multi-Technology Edge Networks”. *IEEE Transactions on Network and Service Management (IEEE TNSM)*, 2021 (pdf)
  - **N. Akhtar**, A. Raza, V. Ishakian and I. Matta, “COSE: Configuring Serverless Functions using Statistical Learning”. *IEEE International Conference on Computer Communications (INFOCOM)*, 2020 (pdf)
  - **N. Akhtar**, I. Matta, A. Raza, L. Goratti, T. Braun and F. Esposito, “Virtual Function Placement and Traffic Steering over 5G Multi-Technology Networks”. *IEEE Conference on Network Softwarization (NetSoft)*, 2018, Montreal, Canada., June 2018 (pdf)
  - **N. Akhtar**, I. Matta, A. Raza and Y. Wang, “EL-SEC: ELastic Management of SECurity Applications on Virtualized Infrastructure”. *IEEE INFOCOM International Workshop on Computer and Networking Experimental Research Using Testbeds (CNERT)*, 2018, Honolulu, Hawaii, USA, April 2018. (pdf)
  - Z. Zhao, E. Schiller, E. Kalogeiton, T. Braun, S. Burkhard, M. Garip, J. Joy, M. Gerla, **N. Akhtar**, I. Matta. “Autonomic Communications in Software-Driven Networks”. *IEEE Journal on Selected Areas in Communications (JSAC)*, 2017. (pdf)
  - **N. Akhtar**, I. Matta, Y. Wang, “Managing NFV using SDN and Control Theory”. *IEEE/IFIP International Workshop on Management of the Future Internet (ManFI 2016)*, co-located with NOMS 2016, Istanbul, Turkey, April 2016. (pdf)
  - Y. Wang, I. Matta, **N. Akhtar**, “Application-Driven Network Management with ProtoRINA”. *IEEE/IFIP Network Operations and Management Symposium (NOMS 2016)*, Istanbul, Turkey, April 2016. (pdf)
  - **N. Akhtar**, S. Coleri Ergen, and O. Ozkasap, “Vehicle Mobility and Communication Channel Models for Realistic and Efficient Highway VANET Simulation,” *IEEE Transactions on Vehicular Technology (TVT)*, vol.64, no.1, pp.248-262, January 2015 (pdf)
  - Y. Wang, **N. Akhtar**, I. Matta, “Programming Routing Policies for Video Traffic,” *International Workshop on Computer and Networking Experimental Research using Testbeds (CNERT)*, co-located with ICNP, Raleigh, NC. Oct. 2014. (pdf)
  - Y. Wang, I. Matta, **N. Akhtar**, “Experimenting with Routing Policies using ProtoRINA over GENI,” *GENI Research and Educational Experiment Workshop (GREE2014)*, Atlanta, Georgia. March, 2014 (pdf)
  - **N. Akhtar**, O. Ozkasap, & S. Coleri Ergen, “VANET Topology Characteristics under Realistic Mobility and Channel Models,” *IEEE Wireless Communication and Networking Conference (WCNC 2013)*, Shanghai, China, April 2013 (pdf)
  - **N. Akhtar**, S. Coleri Ergen, & O. Ozkasap, “Analysis of Distributed Algorithms for Density Estimation in VANETs,” *IEEE Vehicular Networking Conference (VNC 2012)*, Seoul, Korea, Nov. 2012 (pdf)

## TECHNICAL REPORTS

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- **N. Akhtar**, I. Matta, Y. Wang, “Managing NFV using SDN and Control Theory,” *Technical Report BUCS-TR-2015-013, Boston University, 2015* [\(pdf\)](#)
- Y. Wang, I. Matta, **N. Akhtar**, “Application-Driven Network Management with ProtoRINA,” *Technical Report BUCS-TR-2015-003, Boston University, 2015* [\(pdf\)](#)
- Y. Wang, **N. Akhtar**, I. Matta, “Programming Routing Policies for Video Traffic,” *Technical Report BUCS-TR-2015-005, Boston University, 2014* [\(pdf\)](#)

## TEACHING EXPERIENCE

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### Teaching Fellow

#### Department of Computer Science, Boston University

<i>CS101 Introduction to Computing</i>	Fall 2013
<i>CS105 Introduction to Databases and Data Mining</i>	Fall 2015
<i>CS655 Computer Networks</i>	Fall 2016
<i>CS210 Computer Systems</i>	Spring 2018

#### Department of Computer Engineering, Koç University

<i>ENG 200 Probability</i>	Spring 2013
<i>COMP 416 Computer Networks</i>	Fall 2012
<i>COMP 202 Data Structures and Algorithm</i>	Spring 2012
<i>COMP 132 Advanced Programming</i>	Fall 2011

#### Department of Computer Science, LUMS

<i>CS 212 Computational Problem Solving</i>	Spring 2011
<i>CS 371/ CMPE 371 Computer Networks</i>	Fall 2010

## SERVICES

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### Reviewer for Scientific Publications:

IEEE ICVES, 2012	IEEE ITST, 2012	IEEE ICNP, 2014
IEEE Communications Letters, 2016	Elsevier FGCS, 2016	IEEE TMC, 2017
IEEE NFV-SDN 2017	IFIP WWIC, 2018	IEEE TMC 2018
IEEE ITS, 2018	IEEE INFOCOM, 2018	IEEE CNERT, 2018
IEEE CNERT, 2019	IEEE NetSoft, 2019	MERIT, 2019
IEEE Networking Letters, 2019	IEEE TNSM, 2019	IEEE NOMS, 2020
ITC/VT, 2020	IEEE NetSoft, 2020	IEEE ICC-AffectiCom, 2021
IEEE T-ITS, 2021	IEEE NetSoft, 2021	IEEE TNSM, 2021

### Others:

- Guest editor for **Computer Communications** journal special issue on “**Edge Intelligence for 6G Networks**“, 2021
- Co-chair for CNSM workshop on Edge Intelligence (EI), 2021
- Technical Program Committee (TPC) member for IEEE NetSoft, 2021
- Technical Program Committee (TPC) member for IEEE NetSoft, 2020
- Technical Program Committee (TPC) member for IEEE NOMS, 2020
- Technical Program Committee (TPC) member for IEEE NetSoft, 2019
- Technical Program Committee (TPC) member for IEEE MERIT, 2019
- Publicity Chair for IEEE CNERT, 2019
- Chaired *Design, Management and Orchestration of Edge Computing and Tactile Internet* session at *Smart network Technologies and Edge computing for the Tactile Internet (STET 2018)*, Montreal, Canada.
- Organizer for Network Reading Group (NRG) in CS@BU
- Organizer for GENI Regional Workshop and Camp, Texas A&M University, TX

## AWARDS

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- **Best Paper Award - Research Track** by IEEE International Conference on Cloud Engineering (IC2E) for our paper *LIBRA: An Economical Hybrid Approach for Cloud Applications with Strict SLAs* Oct 2021
- **Neal Shepherd Memorial Best Propagation Paper Award** by IEEE Vehicular Technology Society for our paper *Vehicle Mobility and Communication Channel Models for Realistic and Efficient Highway VANET Simulation* June 2020
- **NSF Grant (worth \$500,000)**: Project **HEECMA**, which is based on my PhD thesis, got accepted. Sep 2019
- **First Place Award** for **EL-SEC** project at IEEE INFOCOM 2018, Hawaii March 2018
- **Best Project Award** at International Conference on Machine Vision (ICMV 2010) 2010
- Vehbi Koç Fellowship for M.S. at Koc University 2011-2013
- Top 50 in National Science Talent Contest (NSTC) for International Physics Olympiad (IPhO) 2007