Tenure Review Dossier
(VOLUME 1)

Dr. Eyuphan Bulut

Assistant Professor

Department of Computer Science

College of Engineering

Virginia Commonwealth University

Submitted: May 21st, 2019

Period covered: Sept 2015 – May 2019

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1 SUMMARY OF RESEARCH, TEACHING, AND SERVICE ACTIVITY

Research

- Refereed journal articles (**17**): 15 in print, 2 under review.
- Refereed conference paper (**54**): 46 in print, 3 accepted, 5 under review
- Refereed book chapters (**3**): 3 in print
- **1514** citations, h-index: **20**, i-index:**29** (Google scholar)
- Talks given (18): Invited 8, Conference/workshop 10
- Proposals/grants: Submitted 21 proposals (17 NSF CISE), 1 pre-proposal and 1 REU supplement. PI in 19 of them (out of 23).
- 2 funded research proposals + 1 REU supplement
  - NSF CNS Award# #1647217 (VCU share: **$380,000 (lead PI),** total budget $600,000)
    - Additional REU supplement of **$16,000**
  - NSF CNS Award# #1815603 (VCU share: **$162,500 (institutional PI),** total budget $500,000)

Teaching

- 3 courses prepared and taught: 2 at the undergraduate level, 1 at the graduate level
- 7 course sections taught (total enrollment: 344 students)
- Average course rating: 3.7
- Average instructor rating: 4.0

Advising

- Dissertation advisor for 2 Ph.D. students (1 is defending in summer 2019)
- Hiring a new Ph.D. student in Fall 2019.
- Thesis advisor for 1 M.S. student
- Ph.D. committees for 3 Ph.D. Students (1 graduated, 2 defended their proposal)
- M.S. thesis committee for 1 M.S. student (graduating in summer 2019)
- Undergraduate students advising: 13 (including 3 senior design project)

Service

- School & Department Service
  - Faculty Search Committee (2017-2018)
  - High School Programming Contest committee (Fall 2016-present)

- CS Department Marketing - Mug Distribution (Fall 2015-Fall 2016)
  - RamHacks committee (Fall 2015-present)

- Academic Service
  - Associate Editor, IEEE Access (2018-present)
  - Organization Committee Member (as Publicity and EDAS Chairs) for LCN 2019 and 2018 Conferences (CORE rank A)
  - Technical program committees for 12 conferences
  - Participated in 4 NSF panels and reviewed ~40 grant proposals
  - Reviewed a proposal for Singapore Land Transport Authority (LTA)
  - Papers reviewed: **130+ papers** (journal +conference) reviewed

2 CURRICULUM VITAE

Eyuphan Bulut, Assistant Professor,

Department of Computer Science, Virginia Commonwealth University

401 West Main Street, Rm E4254, Richmond, VA 23284

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Education

Ph.D., Computer Science   Aug. 2007 - May 2011

Rensselaer Polytechnic Institute   Troy, NY

Dissertation: *Opportunistic Routing Algorithms for Delay Tolerant Networks*

Advisor: Dr. Boleslaw K. Szymanski

M.S. in Computer Engineering   Aug. 2005 - June 2007

Bilkent University   Ankara, Turkey

B.S. in Computer Engineering   Aug. 2001 - June 2005

Bilkent University   Ankara, Turkey

Academic Appointments and other Work Experience

Assistant Professor, Department of Computer Science,   Sept. 2015 - present

School of Engineering, Virginia Commonwealth University   Richmond, VA

Summer Visiting Faculty (scheduled),   June 2019- Aug. 2019

Air Force Research Lab (AFRL)   Rome, NY

Senior Engineer, Mobile Internet Technology Group (MITG)   June 2011- Sept. 2015

Cisco Systems   Dallas, TX

Research Intern   Aug. 2010- Nov. 2010

IBM T.J. Watson Research Center   Hawthorne, NY

(worked at Army Research Lab in Adelphi, MD, for collaboration)

Publications

Graduate student Ⓖ and undergraduate student Ⓤ authors mentored by Dr. Bulut.

(*) denotes corresponding author if not last author.

Refereed Journal Articles

<u>Completed works (in print)</u>

1. A. DhunganaⓌ, T. Arodz, and <u>E. Bulut</u>, "Exploiting Peer-to-Peer Wireless Energy Sharing for Mobile Charging Relief", **Ad hoc** Networks, 2019, doi:10.1016/j.adhoc.2019.101882. **(IF$_{2018}$ 3.151)**

2. F. YucelⓌ, K. Akkaya, and <u>E. Bulut</u>, "Efficient and Privacy Preserving Supplier Matching for Electric Vehicle Charging", **Ad hoc** Networks Journal, pp. 1-10, 2018, doi:10.1016/ j.adhoc.2018.07.029. **(IF$_{2018}$ 3.151)**

3. F. YucelⓌ, and <u>E.Bulut</u>, "Clustered Crowd GPS for Privacy Valuing Active Localization", **IEEE Access**, 6(1), pp. 23213-23221, 2018. **(IF$_{2018}$ 3.557)**

4. H. Binol, I. Guvenc*, <u>E. Bulut</u>, and K. Akkaya, "A hybrid evolutionary search method for complex function optimization problems", **Electronics Letters**, 54(24), 1377-1379. 2018. **(IF$_{2018}$ 1.232)**

5. X. Lu, <u>E. Bulut*,</u> and B. Szymanski, "Towards Limited Scale-free Topology with Dynamic Peer Participation", **Computer Networks**, 106: 109-121, 2016. **(IF$_{2018}$ 2.522)**

6. <u>E. Bulut*,</u> S. Geyik, and B. Szymanski, "Utilizing Correlated Node Mobility for Efficient Routing in DTNs", Pervasive and Mobile Computing (**PMC**), 13: 150-163, 2014. **(IF$_{2018}$ 2.974)**

7. <u>E. Bulut*</u> and B. Szymanski, "Constructing Limited Scale-Free Topologies Over Peer-to-Peer Networks", IEEE Transactions on Parallel and Distributed Systems (**TPDS**), 25(4): 919-928, 2014. **(IF$_{2018}$ 3.971)**

8. <u>E. Bulut*</u> and B. Szymanski, "WiFi Access Point Deployment for Efficient Mobile Data Offloading", ACM Mobile Computing and Communications Review (**MC2R**) 17(1):71-78, January, (**invited paper**), 2013. (IF: not published)

9. S. Geyik, <u>E. Bulut</u>, and B. Szymanski, "Grammatical Inference for Modeling Mobility Patterns in Networks", IEEE Transactions on Mobile Computing (**TMC**), 12(11), 2119-2131, 2013. **(IF$_{2018}$ 4.098)**

10. <u>E.Bulut*</u>, and B.Szymanski, "Exploiting Friendship Relations for Efficient Routing in Mobile Social Networks", in IEEE Transactions on Parallel and Distributed Systems (**TDPS**) , 23(12), 2254-2265, 2012. **(IF$_{2018}$ 3.971) – best (spotlight) paper of the issue.** [cited by 190]

11. <u>E.Bulut*</u> and B.Szymanski, "Secure Multi-copy Routing in Compromised Delay Tolerant Networks", Wireless Personal Communications, 73(1), 149-168, 2013. **(IF$_{2018}$ 1.2)**

12. Z.Wang, <u>E.Bulut</u>, and B.Szymanski, "Energy Efficient Location Service for Mobile Ad Hoc Networks", **Ad hoc** Networks Journal, 11(1), 273-287, 2013. **(IF$_{2018}$ 3.151)**

13. <u>E.Bulut*</u>, and I.Korpeoglu, "Sleep Scheduling with Expected Common Coverage in Wireless Sensor Networks", ACM Wireless Networks Journal (**WiNet**), 17(1), 19-40, 2011. **(IF$_{2018}$ 1.981)**

14. Z.Wang, <u>E.Bulut</u>, and B.Szymanski, "Distributed Energy Efficient Target Tracking with Binary Sensor Networks", ACM Transactions on Sensor Networks (**ToSN**), 6(4), p.32, 2010. **(IF$_{2018}$ 2.313)**

15. <u>E.Bulut*</u>, Z.Wang, and B.Szymanski, "Cost Effective Multi-Period Spraying for Routing in Delay Tolerant Networks", IEEE/ACM Transactions on Networking (**ToN**), 18(5), 1530-1543, 2010. **(IF$_{2018}$ 3.11)**

<u>Submitted works (in review)</u>

16. <u>E. Bulut*,</u> M. Kisacikoglu, and K. Akkaya, "Spatio-Temporal Non-intrusive Direct V2V Charge Sharing Coordination", submitted to IEEE Transactions on Vehicular Technology (TVT), March 2019 (major revision). **(IF$_{2018}$ 4.432)**

17. A. Dhungana Ⓖ, and <u>E. Bulut</u>, "Peer-to-Peer Energy Sharing in Mobile Networks: Applications, Challenges, and Open Problems", submitted to Elsevier Journal of Network and Computer Applications, Feb, 2019. **(IF$_{2018}$ 3.991)**

Refereed Conference Proceedings

<u>Completed works (in print)</u>

18. A. Dhungana Ⓖ, and <u>E.Bulut*</u>, "Energy sharing based Content Delivery in Mobile Social Networks", in Proc. of 20th IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks (WoWMoM), Washington D.C., June, 2019 (**acceptance ratio 16%). (CORE rank A)**

19. <u>E. Bulut*</u> and M. Yuksel, "Integrating In-Network Computing for Secure and Efficient Cascaded Delivery in DTNs", in Proc. of the 39th IEEE International Conference on Distributed Computing Systems (ICDCS 2019) Workshop on Network Meets Intelligent Computations – NMIC), July, 2019.

20. <u>E.Bulut*</u>, I. Guvenc and K. Akkaya "Privacy Preserving Distributed Matching for Device-to-Device IoT Communications", in Proc. of The 12th ACM Conference on Security and Privacy (ACM WiSec), Miami, May, 2019 (Poster).

21. M.U. Chowdhury, S.J.Maeng, I. Guvenc* and E. Bulut, "Effects of 3D antenna radiation and two-hop relaying on optimal UAV trajectory in cellular networks", in Proc. IEEE Aerospace Conference, Big Sky, MT, March, 2019.

22. M.U. Chowdhury, E. Bulut and I. Guvenc, "Trajectory Optimization in UAV-Assisted Cellular Networks under Mission Duration Constraint", in Proc. IEEE Radio & Wireless Week (RWS), Orlando, Jan, 2019.

23. F. Yucel⑧, E.Bulut* and K. Akkaya, "Privacy Preserving Distributed Stable Matching of Electric Vehicles and Charge Suppliers", in Proc. IEEE Vehicular Technology Conference (VTC-Fall), Chicago, August, 2018. **(CORE rank B)**

24. E.Bulut*, and I. Guvenc, "Dynamically Shared Wide-Area Cellular Communication for Hyper-dense IoT Devices", in Proc. Local Computer Networks (LCN) Workshops, Chicago, October, 2018.

25. H. Binol, E.Bulut, K. Akkaya, and I. Guvenc, "Time Optimal Multi-UAV Path Planning for Gathering ITS Data from Roadside Units", in Proc. IEEE Vehicular Technology Conference (VTC-Fall), Chicago, August, 2018. **(CORE rank B)**

26. E. Erdin, M. Cebe, K. Akkaya, S. Solak, E.Bulut, and S. Uluagac, "Building a Private Bitcoin-based Payment Network among Electric Vehicles and Charging Stations", in Proc. of The International Conference on Blockchain (Blockchain-2018), Halifax, Canada, July 30-Aug 3, 2018.

27. E. Bulut*, S. Hernandez⑪, A. Dhungana⑧ and B. Szymanski, "Is Crowdcharging Possible?", to appear in Proc. of The 27th International Conference on Computer Communications and Networks (ICCCN 2018), 2018. **(CORE rank A)**

28. E. Bulut* and I. Guvenc, "Trajectory Optimization for Cellular-Connected UAVs with Disconnectivity Constraint", in Proc. of IEEE International Conference on Communications (ICC) Workshop on Integrating 5G into UAVs , Kansas City, May, 2018.

29. A. Dhungana ⑧ , T. Arodz, and E.Bulut, "Charging Skip Optimization with Peer-to-Peer Wireless Energy Sharing in Mobile Networks,", in Proc. of IEEE International Conference on Communications (ICC) , Kansas City, May, 2018. **(CORE rank B)**

30. B. Roberts, K. Akkaya*, E.Bulut, and M. Kisacikoglu, "An Authentication Framework for Electric Vehicle-to-Electric Vehicle Charging Applications", in Proc. **MASS REU** Research in Networking and Systems Workshop 2017, Orlando, October, 2017.

31. E.Bulut*, and A. Gossain, "Mobile Core Network Redimensioning for Efficient Resource Utilization", in Proc. IEEE International Conference on Computer Communications (**INFOCOM**) **Perfecto** Workshop 2017, Atlanta, May, 2017.

32. A. Dhungana(g), and E. Bulut, "Timely Information Dissemination with Distributed Storage in Delay Tolerant Mobile Sensor Networks", in Proc. IEEE International Conference on Computer Communications (**INFOCOM**) **MiseNet** Workshop 2017, Atlanta, May, 2017.

33. E. Bulut*, and B. K. Szymanski, "Identifying the Space Buddies to Track Lost Items", in Proc. **SocialSens** 2017 (in conjunction with **CPSWeek**), Pittsburg, April, 2017.

34. E. Bulut*, and M. Kisacikoglu, "Mitigating Range Anxiety via Vehicle-to-Vehicle Social Charging System", in Proc. IEEE Vehicular Technology Conference (**VTC**) 2017, Sydney, June, 2017.

35. E. Bulut*, and B.Szymanski, "Mobile Energy Sharing through Power Buddies,", in Proc. IEEE Wireless Communication and Networking Conference (**WCNC)** 2017, San Francisco, March, 2017. **(CORE rank B)**

36. E. Bulut*, and B.Szymanski, "Rethinking Offloading WiFi Access Point Deployment from User Perspective", Workshop on Smart Environments & Urban Networking, (**SEUNet**) in Proc. IEEE **WiMob** 2016, New York, NY, October 17, 2016.

37. E.Bulut*, and B.Szymanski, "Understanding User Behavior via Mobile Data Analysis", in Proceedings of Proc. IEEE **ICC Workshops**, pp. 1548-1553., June 8, London, UK, 2015.

38. E. Bulut*, M.E.Ahsen, and B.Szymanski, "Opportunistic Wireless Charging for Mobile Social and Sensor Networks", in Proceedings of the 6th IEEE International Workshop on Management of Emerging Networks and Services (IEEE **MENS** 2014) in conjunction with IEEE **GLOBECOM** 2014, 8-12 December, Austin, 2014.

39. B. O. Holzbauer, B.Szymanski* and E.Bulut, "Impact of Socially Based Demand on the Efficiency of Caching Strategy", in Proceedings of the Proc. 6th IEEE Int. Conf. Pervasive Computing and Communications Workshops (**PERCOM Workshops**), IEEE Press, pp. 401-406. , Budapest, Hungary, March 24-28, 2014.

40. E. Bulut*, and B.Szymanski, "WiFi Access Point Deployment for Efficient Mobile Data Offloading", in Proceedings of ACM International Workshop on Practical Issues and Applications in Next Generation Wireless Networks (**PINGEN** 2012) at **Mobicom** 2012., Istanbul, Turkey, August 26, 2012, pp. 45-50.

41. B. O. Holzbauer, B.Szymanski* and E.Bulut, "Socially-Aware Market Mechanism for Participatory Sensing", in Proceedings of ACM International Workshop on Mission-Oriented Wireless Sensor Networking (**MiSeNet**) at **Mobicom** 2012, Istanbul, Turkey, August 26, 2012, pp. 9-14.

42. S. Geyik, E.Bulut, and B.Szymanski, "Utilizing PCFGs for Modeling and Learning Service Compositions in Sensor Networks", to appear in Proceedings of IEEE International Conference on Service Computing, Hawaii, June, 2012.

43. E.Bulut, and B.Szymanski, "On Growth of Limited Scale-free Overlay Network Topologies", in Proceedings of Fourth International Workshop on Network Science for Communication Networks (**NetSciCom** 2012), in conjunction with **INFOCOM** 2012, Orlando, March, 2012.

44. E.Bulut*, and B.Szymanski, "On Secure Multi-copy based Routing in Delay Tolerant Networks", in Proceedings of the First International Workshop on Privacy, Security and Trust in Mobile and Wireless Systems (**MobiPST** 2011), in conjunction with **ICCN**, 2011, July, 2011.

45. E.Bulut*, S.Geyik and B.Szymanski, "Efficient Routing in Delay Tolerant Networks with Correlated Node Mobility", in Proceedings of 7th IEEE International Conference on Mobile Ad-hoc and Sensor Systems (**MASS**), Nov, 2010. **(CORE rank B)**

46. E.Bulut*, and B.Szymanski, "Friendship based Routing in Delay Tolerant Mobile Social Networks", in Proceedings of IEEE Global Telecommunications Conference (**GLOBECOM**), Dec, 2010. **(CORE rank B)**

47. S.Geyik, E.Bulut, and B.Szymanski, "PCFG Based Synthetic Mobility Trace Generation", in Proceedings of IEEE Global Telecommunications Conference (**GLOBECOM**), Dec, 2010. **(CORE rank B)**

48. Z.Wang, E.Bulut, and B.Szymanski, "Service Discovery in Delay Tolerant Networks", in workshop on Heterogeneous, Multi-Hop, Wireless and Mobile Networks (HeterWMN), in conjunction with IEEE Global Telecommunications Conference (**GLOBECOM**), Dec, 2010. **(CORE rank B)**

49. E.Bulut, S.Geyik and B.Szymanski, "Conditional Shortest Path Routing in Delay Tolerant Networks", in Proceedings of 11th IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks (**WoWMoM**) , June, 2010. **(CORE rank A)**

50. Z.Wang, E.Bulut, and B.Szymanski, "An Energy Efficient Location Service for Mobile Ad Hoc Networks", in Proceedings 25th International Symposium on Computer and Information Sciences (**ISCIS**), Sept, 2010.

51. E.Bulut, Z.Wang, and B.Szymanski, "Cost Efficient Erasure Coding based Routing in Delay Tolerant Networks", in Proceedings of IEEE International Conference on Communications (**ICC**) , Capetown, May 2010. **(CORE rank B)**

52. E.Bulut, Z.Wang, and B.Szymanski, "The Effect of Neighbor Graph Connectivity on Coverage Redundancy in Wireless Sensor Networks", in Proceedings of IEEE International Conference on Communications (**ICC**) , Capetown, May 2010. **(CORE rank B)**

53. E.Bulut, Z.Wang, and B.Szymanski, "Impact of Social Networks in Delay Tolerant Routing", to appear in Proceedings of IEEE Global Telecommunications Conference (**GLOBECOM**), Dec, 2009. **(CORE rank B)**

54. Z.Wang, E.Bulut, and B.Szymanski, "Distributed Target Tracking with Directional Binary Sensor Networks", to appear in Proceedings of IEEE Global Telecommunications Conference (**GLOBECOM**), Dec, 2009. **(CORE rank B)**

55. Z.Wang, E.Bulut, and B.Szymanski, "Energy Efficient Collision Aware Multipath Routing for Wireless Sensor Networks", in Proceedings of IEEE International Conference on Communications (**ICC**) , Dresden, Germany, June 2009. **(CORE rank B)**

56. E.Bulut, J.Zheng, Z.Wang, and B.Szymanski, "Balancing the Cost-Quality Tradeoff in Cooperative Ad hoc and Sensor Networks", in Proceedings of Military Communications Conference (**MILCOM**) , San Diego Convention Center, November 17-19, 2009.

57. E.Bulut, Z.Wang, and B.Szymanski, "Minimizing Average Spraying Cost for Routing in Delay Tolerant Networks", in Proceedings of Second Annual Conference of International Technology Alliance (ITA), **ACITA**, Imperial College London, September 2008.

58. E.Bulut, Z.Wang, and B.Szymanski, "Time Dependent Message Spraying for Routing in Intermittently Connected Networks", in Proceedings of IEEE Global Telecommunications Conference (**GLOBECOM**), vol., no., pp.1-6, New Orleans, November 2008. **(CORE rank B)**

59. Z.Wang, E.Bulut, and B.Szymanski, "Distributed Target Tracking with Imperfect Binary Sensor Networks", in Proceedings of IEEE Global Telecommunications Conference (**GLOBECOM**), vol., no., pp.1-6, New Orleans, November 2008. **(CORE rank B)**

60. E.Bulut, Z.Wang, and B.Szymanski, "Cost-Quality Tradeoff in Cooperative Sensor Networking", in Proceedings of IEEE International Conference on Communications (**ICC**) Workshops, Beijing, China, pp. 112-117, May 2008.

61. Z.Wang, E.Bulut, and B.Szymanski, "A Distributed Cooperative Target Tracking with Binary Sensor Networks", in Proceedings of IEEE International Conference on Communications (**ICC**) Workshops, Beijing, China, pp. 306-310, May 2008.

62. E.Bulut, and I.Korpeoglu, "DSSP: A Dynamic Sleep Scheduling Protocol for Prolonging the Lifetime of Wireess Sensor Networks", in Proceedings of Third IEEE International Workshop on Heterogeneous Wireless Networks, in conjunction with **AINA**, Niagara Falls, Canada, Volume 2, pp. 725 - 730, May 21-23, 2007.

63. E.Bulut, and T.Capin, "Key Frame Extraction from Motion Capture Data by Curve Saliency", in Proceedings of 20th Annual Conference on Computer Animation and Social Agents, Belgium, June 2007.

Works accepted for publication

64. S. Chaudhry, E.Bulut, and M. Yuksel*, "A Distributed SDN Application for Cross-Institution Data Access", in Proc. of the 28th International Conference on Computer Communications and Networks (ICCCN 2019), July, Valencia, Spain, 2019. **(CORE rank A)**

65. E. Ucer, R. Buckreus, M. C. Kisacikoglu*, <u>E. Bulut</u> , M. Guven, Y. Sozer, L. Giubbolini, "A Flexible V2V Charger as a New Layer of Vehicle-Grid Integration Framework", in IEEE Transportation Electrification Conference (ITEC), June, Novi, MI, 2019.

66. E. Erdin, M. Cebe, K. Akkaya, <u>E. Bulut</u> and S. Uluagac, "A Heuristic-based Private Bitcoin Payment Network Formation Using Off-Chain Links", in Proc. of IEEE International Conference on Blockchain (Blockchain), 2019.

<u>Submitted works (in review)</u>

67. A. Dhungana⑧, and <u>E.Bulut</u>, " Loss-Aware Efficient Energy Balancing in Mobile Opportunistic Networks", submitted to IEEE Global Communications (Globecom) Conference, 2019. (CORE rank B)

68. F. Yucel⑧, and <u>E.Bulut</u>, "Joint Optimization of System and User oriented Task Assignment in Mobile Crowdsensing", submitted to IEEE Global Communications (Globecom) Conference, 2019. (CORE rank B)

69. F. Yucel⑧, and <u>E.Bulut</u>, " Location-dependent Task Assignment for Opportunistic Mobile Crowdsensing", submitted to IEEE Global Communications (Globecom) Conference, 2019. (CORE rank B)

70. S. Hernandez⑧, and <u>E.Bulut</u>, "TrinaryMC: Monte Carlo Based Anchorless Relative Positioning for Indoor Positioning", submitted to IEEE Global Communications (Globecom) Conference, 2019. (CORE rank B)

71. F. Yucel⑧, and <u>E.Bulut</u>, "Maximum Satisfactory Task Assignment in Mobile Crowdsensing", submitted to IEEE International Conference on Mobile Ad-Hoc and Smart Systems (MASS), 2019. (CORE rank B)

Book Chapters

<u>Completed works (in print)</u>

72. <u>E. Bulut</u>, "Delay Tolerant Mobile Sensor Networks: Opportunities and Challenges", The Philosophy of Mission-Oriented Wireless Sensor Networks (H. Ammari Ed.) Springer Publisher, 2018.

73. B. O. Holzbauer, <u>E.Bulut</u>, B.Szymanski, Incentivizing Participatory Sensing via Auction Mechanisms, Chapter in Opportunistic Mobile Social Networks, (Jie Wu and Yunsheng Wang Eds), Taylor and Francis, CRC Press, 2014, to pp. 339-376.

74. <u>E.Bulut</u>, B.Szymanski, Bio-inspired Multi-Period Routing Algorithms in Delay Tolerant Networks, in Springer Lecture Notes in Computer Science (LNCS), vol. 6745, 2011.

Technical Talks

<u>Invited Talks</u>

1. Rapid and Resilient Critical Data Sourcing for Public Safety and Emergency Response, US-Ignite Research Summit, Austin, TX, June 2017.
2. Limited Scale-Free Topologies Over Peer-to-Peer Networks, Department of <u>Computer Science</u> Seminar Series, **Virginia Commonwealth University**, October 2016.
3. Introduction to iOS Programming and Swift, **RamDev Talk Series (VCU),** November, 2016.
4. Mobile Social Networks: Challenges and Opportunities, Department of <u>Computer and Electrical Engineering</u>, **Virginia Commonwealth University**, Dec 2015.
5. Mobile Social Networks: Challenges and Opportunities, Department of Computer Science & Engineering, University of Nevada, Reno, March 2014.
6. Routing in DTNs, Department of Computer Science and Information Systems, Texas A&M University-Commerce, May 2011.
7. Opportunistic Routing Algorithms in Delay Tolerant Networks, CReWMaN Lab, Computer Science and Engineering Department, University of Texas - Arlington, Dec 2010.
8. Opportunistic Routing Algorithms in Delay Tolerant Networks, Altschuler Lab, UT Southwestern Medical Center, May 2010.

<u>Conference/workshop Presentations</u>

9. Dynamically Shared Wide-Area Cellular Communication for Hyper-dense IoT Devices, Local Computer Networks (LCN) Workshops, Chicago, 2018.
10. Mobile Core Network Redimensioning for Efficient Resource Utilization, INFOCOM Perfecto Workshop, Atlanta, 2017.
11. Timely Information Dissemination with Distributed Storage in Delay Tolerant Mobile Sensor Networks, INFOCOM Misenet Workshop, Atlanta, 2017.
12. Identifying the Space Buddies to Track Lost Items, SocialSens Workshop (CPSWeek), 2017
13. Mobile Energy Sharing through Power Buddies, Wireless Communications and Networking Conference (WCNC), 2017.
14. Rethinking Offloading WiFi Access Point Deployment from User Perspective, Wireless and Mobile Computing, Networking and Communications (WiMob) SeuNet Workshop, 2016.
15. Opportunistic Wireless Charging for Mobile Social and Sensor Network, GLOBECOM MENS Workshop, 2014.
16. Efficient Routing in Delay Tolerant Networks with Correlated Node Mobility, International Conference on Mobile Ad-hoc and Sensor Systems (MASS), 2010. **(Travel grant)**

17. Time Dependent Message Spraying for Routing in Intermittently Connected Networks, GLOBECOM, 2008.
18. Distributed Target Tracking with Imperfect Binary Sensor Networks, GLOBECOM, 2008.

Sponsorship of Scholarly Activities

See Section 4.3 for details on pending proposals.

Submitted: 21 proposals (17 NSF CISE), 1 preproposal and 1 REU supplement.

Funded: 2 NSF CISE (PI), 1 REU supplement (total VCU share $558,500 out of total budget of 1.1M)

Present Funding:

1. *Individual's responsibility:* **Lead P.I.**
   Funding Agency: National Science Foundation (NSF) – US Ignite program
   Title: Rapid and Resilient Critical Data Sourcing for Public Safety and Emergency Response
   Amount of total funding: **$600,000 +$16,000** (REU supplement) with UCF
   Amount of funding attributable to candidate: Total **VCU Share: $396,000** (my share is $283k including $16k REU supplement, co-PI Dr. Manic's share is $113k)
   Period of funding: 2/1/2017 - 1/31/2020 (will get one year no-cost extension on this)

2. *Individual's responsibility:* **Institutional P.I.**
   Funding Agency: National Science Foundation (NSF) – CNS core (NeTS) program
   Title: Improving Spectrum Efficiency for Hyper-Dense IoT Networks
   Amount of total funding: **$500,000** with NCSU and Georgia Tech
   Amount of funding attributable to candidate: Total **VCU Share: $162,500** (no co-PI)
   Period of funding: 10/1/2018 - 9/31/2021

Student Advising

Advisor of Ph.D. students (2+1) – See Section 4.5 for accomplishments of students

1. Aashish Dhungana, VCU, Fall 2016-present (defending proposal in summer 2019)
2. Fatih Yucel, VCU, Fall 2017-present
3. New student, VCU, starting in Fall 2019

Advisor of M.S. students (1) – with thesis

1. Steven M. Hernandez, VCU, Fall 2018-present – ***NSF GRFP Fellow***
   (was undergraduate researcher in Dr. Bulut's lab)

Member of advisory committee of Ph.D. students (3)

1. Bahman Rashidi, Advisor: Carol Fung (CS)
2. Manziva Akanda Nishi, Advisor: Kostadin Damevski (CS)
3. Javad Abed, Advisor: Manoj Thomas (Information Systems)

Member of advisory committee of M.S. students (1)

1. Pulkit Rustgi, Advisor: Carol Fung (CS)

Departmental, School & University Service

Department of Computer Science, VCU

- Faculty Search Committee (Fall 2017-2018)
- High School Programming Contest committee (Fall 2016-present)
- CS Department Marketing - Mug Distribution (Fall 2015-Fall 2016)
- RamHacks committee (Fall 2015-present)

Honors and Awards

- VCU CS Departmental Teaching Award, 2018.
- VCU CS Departmental Publication and Teaching Awards, 2017.
- Ranked with exceptional performance (top 5% of employees), Cisco Systems, 2014.
- Promotion to Upper Level, Cisco Systems, 2013.
- Spotlight (Best) Paper of IEEE TPDS Dec 2012 Issue.
- IEEE Student Travel Grant, MASS 2010.
- Full scholarship (tuition and stipend) during B.S., M.S. and Ph.D., 2001-2011.
- Gold and Bronze medals in Nationwide Math Olympics, 1998-2000.

Memberships

- Institute of Electrical and Electronics Engineers (IEEE)
- Association for Computing Machinery (ACM)

3 PERSONAL STATEMENT

My research area in general is wireless networks and mobile computing. I have been working on several problems including designing new (Device-to-Device (D2D) based multi-hop) routing and content dissemination algorithms, developing accurate mobility/behavior models for networking components, building novel networking systems and applications for the good of public, government or army, enhancing privacy and security of mobile networking systems with new cost-efficient designs and network data mining and feature extraction to develop smart designs for these networks.

Mobile networks include several different domains, such as mobile ad hoc and sensor networks (MANET), delay tolerant networks (DTN), mobile social networks (MSN), unmanned aerial (UAS) systems, vehicular ad hoc networks (VANET), cellular networks (CellNet), and Internet-of-Things networks. We are in a world with billions of mobile devices having wireless communication capability based on different technologies (WiFi, Bluetooth, cellular etc.). Each of these networks has different problems depending on the domain and application they are used for. While heterogeneity in communication technology used in these networks offers opportunity for building systems that will satisfy the needs of different application requirements, it also brings challenges towards unifying these networks. On the other hand, the dynamicity and mobility of the agents involved in mobile networks differentiate these networks from fixed networks and emerges additional challenges for the network functions involved (such as routing of packets).

Building new networking systems for the good of society and optimizing the functions of current network operations requires knowledge not only from computer science concepts but also from computer engineering and mathematics. Thus, in my research group I aim to hire students with backgrounds from several disciplines together to have them sufficient motivation and capability towards achieving our goals. Currently, I am advising two Ph.D. students with backgrounds in computer science, computer engineering and mathematics. They are B.S. to Ph.D. students. While this caused them to be busy with course load in their early years in Ph.D., it also gave me the opportunity to have them take the courses (e.g., stochastic processes) that will benefit them more during their research in our group. I am also advising an M.S. student who is doing M.S. with thesis. He is an NSF GRFP Fellow and has the support from NSF to continue Ph.D. The student was an undergraduate researcher in my lab and I encouraged him to apply to the NSF GRFP Fellowship. I am also hiring a new Ph.D. student to start in Fall 2019. He will be supported from my second NSF grant.

In addition to my graduate students, I also enjoy integrating undergraduate students in my research. I have hired a total of four undergraduates, who worked on two different projects in

mobile networks. One project was about developing both iOS and Android app to realize (wireless) energy sharing between the smartphones of people through a social network. The other one is related to the research in the context of the first NSF grant we received. Specifically, the goal is to develop an iOS app that lets eye-witnesses send their data (image/video) to law enforcement agency servers, extracts faces of people from the data and compares with the database of criminals automatically. The app has also been designed to work through D2D communication without using cellular connection. I also received REU supplement for this project, thus hiring more students and new students as the existing ones graduate.

I do think that as faculty in a Computer Science department, our role is significant for building this nation's future workforce for better technological improvements. Therefore, I see this position not as a job for salary but also an opportunity to transfer my life view, knowledge and enthusiasm for discovery to the next generations. This is also one of the reasons I moved back from industry to academia. During my years at VCU, I have leveraged every opportunity to interact with students. I have integrated research aspects or critical thinking in my classes besides the regular content. I have conveyed my industrial experience at Cisco Systems to the students. I have involved undergraduate students in my lab. I am also actively seeking to include high school students to my research. We have published a paper about wireless charging based energy exchange between smartphones with one of the undergraduate students, who is now an NSF GRFP Fellow and doing M.S. with thesis with me. With the recent REU supplement I received, I am eagerly looking for new undergraduate students and aiming to expose them to research with a goal of publishing.

Research Statement

The Mobile and Wireless Networking Group (MoWiNG) I lead is pursuing research in building efficient mobile networking systems as well as enhancing and optimizing their current functionalities. The challenges with mobile networks arise due to their being highly dynamic, distributed, localized and having needs of privacy preservation and limited resources (e.g., bandwidth, hardware capacity). We have leveraged several techniques from Computer Science including dynamic programming, ILP, clustering algorithms, matching theory for various problems in different applications. However, research in mobile networks by nature links to several other disciplines. For example, wireless radio layer components require electrical and computer engineering background. For privacy preservation, integration of cryptographic solutions is sometimes needed. Moreover, these networks sometimes consist of people who carry the mobile devices, and understanding and modelling of people's behavior is significant to develop efficient functioning models for these networks. Thus, sociological aspects of mobile

networks have to be integrated to the designs. Due to such interdisciplinary nature, I have started collaborations with colleagues from several disciplines including computer engineering, sociology and social and behavioral economics. For example, for a project on charge sharing among Electric Vehicles, I have reached out an ECE faculty at University of Alabama who is expert in Vehicle-to-Grid (V2G) systems and power electronics in general. I have also reached out faculty in VCU Economics and Sociology departments (e.g., Laura Razzolini who recently moved to University of Alabama as a chair of the Department of Economics, Finance and Legal Studies) to have their expertise in behavioral economics in the system that we aim to build in. For my research in UAV and IoT networks or core wireless electronics, I also reached out a colleague from North Carolina State University and a faculty from VCU ECE department (Dr. Robert Klenke). We have prepared and submitted several proposals (one of them recently funded), papers with these colleagues and currently working on several others. These collaborations also enhanced my vision and let me see other parts of the real networking systems. I also have been collaborating with Dr. Manic in our department on a funded NSF project which leverages GENI slicing capability for emergency communication networks. For this project, I also collaborate with a colleague from UCF, with whom we are working on D2D communication-based resilience improvement for these emergency networks. Finally, I collaborate with a colleague from Florida Institute of Technology on the privacy preservation models in mobile networks.

My work at VCU has resulted in *35 written articles* including 7 refereed journal articles (5 in print and 2 under review), 27 refereed conference proceedings (19 printed, 3 accepted, and 5 under reviews) and 1 book chapter. As an indication for the research quality, my research has been cited 1514 times with the h-index 20 (according to Google Scholar: https://tinyurl.com/eb-vcu).

My work has also led to *21 grant proposal submissions (17 of which to* Computer & Information Science & Engineering (CISE) directorates at NSF)*, one preproposal and 1 REU supplement request* to NSF CISE. Out of these 21 proposals, 4 of them was submitted to other agencies and industry including NIST, DoE (Arpa-E program), ARL and Sony. I am eagerly working on expanding my agency portfolio for grant applications. In upcoming years, I plan to submit proposals to other agencies including DARPA, DoD and ONR.

Below are more details about the research topics we have been following in our group.

Research Topic: Disaster Recovery and Emergency Communication through Crowdsourcing and Device-to-Device communications

In public safety and emergency response, the key for a successful recovery is on time and reliable communication capability between the people reporting the incident and the emergency management authorities. Moreover, it should be coupled with a rapid collection of eyewitness

data for successful investigation of any criminal or root causes of the incident. Widespread proliferation of mobile devices combined with ubiquitous network accessibility has opened a new horizon for rapid information sharing. Recently many crowd sourcing applications are proven to be a promising tool to gather information through tremendous participation from the crowd and solve complicated problems. In emergency scenarios, however, such crowd sourcing solutions should be robust and resilient as network could be congested or the underlying cellular infrastructure is damaged or lost. Moreover, an agile analysis of the massive amount of data collected should be supported with necessary equipment so that time sensitive feedbacks could be retrieved and shared between different agencies. Otherwise, a major public safety incident could trigger huge tidal-wave like submissions of eyewitness data from crowd yielding crashes in agency systems. In this research, we plan to address these challenges by introducing a novel framework that integrates various technologies (D2D, GENI slicing) and tools for modeling and operating of resilient and rapid response capable large-scale crowd sourcing-based emergency response systems.

We have received an NSF grant on this project in the amount of **$380,000 for three years (an additional $16,000 as an REU supplement)**. We are working on this project with Dr. Milos Manic (who is co-PI on this project) and a colleague from UCF. The project has been supporting 2 graduate students in our department. We have published 8 papers related to the project and working on several others.

Research Topic: Leveraging Peer-to-Peer Interactions for Energy Management in Mobile Networks

This project aims to leverage recent technologies for energy management in mobile networks through collaborative solutions among peers. For example, with recent advances in wireless charging, several smartphones have been released with built-in wireless charging capability. Users can place their devices on a charging pad (which could be embedded in other things such as a desk, or cup holder in a car) and start charging their devices without the hassle of cables. While this form of wireless charging still requires the charging pad or the equipment used to be plugged to a power source, recently, this somewhat limited usage of wireless charging has further been extended with energy transfer between mobile devices. Through bidirectional chargers, mobile devices could exchange energy without the need of being connected to an outlet. Such a peer-to-peer (P2P) energy sharing opportunity brings flexibility to users for finding energy ubiquitously and mitigates the risks of facing an emergency situation with depleted battery.

Led by an undergraduate research student, who is now an NSF GRFP Fellow doing M.S. with thesis in my lab (and probably continue Ph.D.), we have developed an Android and iPhone app that lets

smartphones exchange energy wirelessly, which could be controlled, scheduled etc. We published a paper with the student about this "Is Crowdcharging Possible?" in ICCCN'18 (CORE rank A) Hot Topics in Networking track. The paper not only includes the theoretical work but also implementation details on Android phones. After our publication, Samsung has also released a new phone (e.g., Samsung Galaxy S10), which essentially does the same peer-to-peer charging as in our paper.

We have been also working on integration of peer-to-peer energy sharing on several problems in mobile networks. For example, for content delivery in delay tolerant and mobile social networks, we have used energy shared between peers as an incentive for carrying and delivering the others' content. We recently published a paper on this in Wowmom'19 (CORE rank A) which had an acceptance rate of 16% for regular papers. In another related problem, we studied the charging relief of users by skipping regular charging sessions through energy received from their peers. A paper in ICC'18 is published and its journal extension has recently been accepted to Ad Hoc Networks.

In the vehicular networks domain (so for Vehicle-to-Vehicle energy sharing), we have approached the problem using cable-based energy sharing through a converter between the Electric vehicles. Vehicle-to-vehicle (V2V) energy sharing system can potentially provide more flexibility to electric vehicles (EVs) with increased range operation without depending on the charging station infrastructure. However, the assignment between the EVs with surplus energy and EVs that demand energy has to be coordinated in real-time within their spatio-temporal limits. In this research area, we have studied charge sharing coordination among supplier and demander EVs in a V2V charge sharing network. To this end, we have developed different V2V charging mechanisms that optimize the process at system level and individual users' levels. We also worked towards realization of this V2V charge sharing network. There is already a product by a startup company called Andromeda Power which lets energy sharing (controlled by a mobile app) between EVs. While such a product is an evidence for us to show the possibility of such energy sharing between vehicles (without violating the vehicle battery warranty etc.), the current solution is bulky and expensive. We have been working with colleagues from University of Alabama on building a compact solution which could be easily applicable for V2V energy sharing in a social network domain. In our group, we work on the challenges for building a Vehicle-to-Vehicle Charge Sharing Network by several means. For example, the matching algorithms for suppliers and demanders, the security and privacy preservation of the system and authentication of vehicles before sharing starts. So far, we have made important progress on this research topic and have published/submitted several papers in this topic (Adhoc Networks, VTC'17, MASS REU'17, Transactions on Vehicular Technology (in revision)). Moreover, in order to see our path

towards realizing such a system in real life and to see the interest from EV owners, we have conducted a survey (which is VCU IRB approved) among 153 EV owners and got very positive feedback on the idea. I am also planning to submit my CAREER proposal around the idea of utilizing peer-to-peer energy sharing for resource management in mobile networks.

Research Topic: Cellular core network optimization for mobile (smartphone, IoT) networks performance and capacity enhancements.

This research area aims to build research on my background at Cisco Systems where I have worked on several important problems in cellular networks and mobile packet core. With the wide-spread proliferation of smartphone like devices, cellular networks have switched from the voice world to data world and a tremendous increase has been seen in mobile data usage recently. However, this increased demand from users has caused severe traffic overloading in cellular networks. As a remedy for such a problem, we have studied the offloading of cellular network traffic through several other devices like femtocells and WiFi access points (AP). We have also worked on several mobile core optimization techniques to release the burden on cellular networks. In continuation of such efforts, in my group at VCU, we have focused on grouping of connections from IoT devices to the mobile core network. That is, an aggregation-based connectivity model is developed to manage multiple device traffic utilizing the same resources (i.e., bearers). Corresponding architectural enhancements has also been investigated to realize the proposed model without any performance degradation. Furthermore, efficient clustering algorithms of IoT devices have been investigated based on the heterogeneous traffic characteristics to improve the robustness, stability, latency, and spectral/energy efficiency in the proposed model.

I have collaborated with a colleague from North Eastern University (in PAWR office) on connection sharing idea and published an INFOCOM workshop paper recently. I also collaborated with a colleague from North Carolina State University (NCSU) and a colleague from Georgia Institute of Technology (GT) on applying the same idea within the context of IoT devices. Recently, we have been also awarded an NSF project on this idea with VCU share in the amount of **$162,500 for three years (total $500,00)**. The project will support 1 graduate student at VCU which will arrive in Fall 2019. So far, we also published 2 papers related to the project and working on several others.

Research Topic: UAV networks: routing, trajectory optimization and energy management.

With the recent advances in aerial systems, unmanned aerial vehicles (UAVs) have become popular due to their potential to provide solutions for various communication problems in mobile network applications. Even though there are barriers to ubiquitous use of unmanned aerial

vehicles (UAVs) such as compliance to flight regulations, and cost versus efficiency concerns, the popularity of unmanned aerial vehicles (UAVs) has been increasing recently thanks to their enhanced functionalities and decreasing manufacturing costs. Many military and civilian applications involve UAVs for use cases and missions ranging from surveillance to search and rescue. However, despite their advantages, UAVs typically require near ubiquitous network connectivity for a successful fulfillment of their missions, which is a challenging task to achieve. Thus, for example, the trajectories of UAVs are important for achieving continuous connectivity. Moreover, in multi-UAV systems, the problem gets more challenging.

In this research direction, we aim to address several challenges of UAV based mobile networks, including routing of messages between UAVs, trajectory optimizations based on application requirements, energy management of UAVs to prolong their interrupted functioning. I have been collaborating with a colleague from NCSU on this. We have published 4 conference papers so far. We also submitted two research proposals to NSF which also includes a faculty from VCU ECE department.

Research topic: Self-awareness of Internet-of-Things (IoT) Networks for Performance Optimizations

The Internet of things (IoT) technology is expected to connect billions of intelligent objects in the near future. It will enable applications ranging from smart cities to self-driving cars, from industry automation to wearable devices. The emerging proliferation of massive IoT networks requires dealing with several key challenges as they could be in highly dynamic, mobile, and resource-constrained environment. The significance of each IoT device towards accomplishment of a task may vary dramatically depending on time, location and power. For example, in military setting, while an IoT device near an enemy region can be very important, it will be highly risky to use its data as it could be tampered. Similarly, the data that will be provided during the time the adversaries are tracked by a specific IoT device will be invaluable compared to regular time surveillance data. Finally, the data from IoT device conducting heavy computations should not have been highly reliant on as there could be long delays. The energy of IoT devices is also a vital component towards achieving the goal on time. These differences require IoTs be self-aware of their characteristics to provide efficient and intelligent utilization in dynamic environments. Such capability can be obtained through continuous monitoring, analysis and learning of its properties over time, and space. While self-awareness will enhance the IoT functionality, it comes with new challenges in terms of security and mission requirements. In this research, we aim to develop accurate models for predicting different characteristics of IoTs and investigate self-awareness strategies and its outcomes through comprehensive analysis of different type of IoT devices at different service modes.

We initially started with a specific IoT application that aims to localize lost objects or individuals through usage of Beacons. By attaching affordable Beacon tags to them, objects of care could be tracked and localized by the user devices in the proximity through crowdsourcing based solutions. While such a crowd GPS service has gained popularity recently, it does not consider the privacy value as well as the active collaboration between the nodes. We have extended the current functionality of such Beacon networks with a clustered privacy valuing approach without sacrificing the benefit of users from the system. 1 journal and 1 conference paper are published on this topic recently. There are also others under review and in preparation.

Teaching Statement

My philosophy in teaching is to increase enthusiasm of students for the content of the lectures through examples and hands-on and interactive involvement of students. I believe whatever is taught, there will be ways to accomplish this. The student portfolio in the class, the difficulty of content or the abstraction of the concepts might make it challenging, however, with dedication of sufficient time and effort, we could find a way to engage students in every specific class organization.

I have applied several ways to be able to realize such philosophy in my courses. For example, I have provided interesting applications of the concept studied from real life. I have provided example problems and solutions, then I asked a student to come to the board and solve another question. I have provided hands-on assignments with examples from real life. Moreover, I have opened my doors beyond the office hours. That is why one of the high scores I have got in my teaching evaluations is regarding my enthusiasm and availability.

I have taught two different undergraduate courses since I joined VCU, namely, CMSC 491/428 Mobile Programming – iOS and CMSC 401 Algorithm Analysis with Advance Data Structures. I taught each of them three times. I also developed my graduate course (CMSC 628: Mobile Networks) and taught once in Spring 2019. CMSC 491/428 is a course that I developed from scratch including lectures, assignments etc. It has not been offered at VCU before and it is also rare to find such course offerings in CS departments of universities. Since it is mainly an app development course, I aimed to make it a fun class rather than overwhelming students with a yet another language and interface builder. Students design and develop several different apps and enjoy installing them in their own devices. I became the lead of Apple's University Program at VCU and organized the membership among students through which app development could be done without paying the regular developer fee ($99). We have also renewed the Mac lab (with departmental support) and gave students opportunity to build their apps in this lab.

In CMSC 401, I have extended the works of previous instructors with additional content and lectures, as well as enhancement on programming assignments, and homeworks. I have also integrated applications from real-life examples to give them the understanding that these algorithmic concepts are very useful in solving real-life problems and have many applications.

In my graduate class (CMSC 628) I developed the lectures, assignments from scratch. I covered different types of mobile network applications (e.g., MANETS, DTNs, VANETs, Sensor networks) and their specific problems. Students are exposed to assignments that require them learn how to use network simulators (ns3) as well as have read several publications and present one of them in class. The students are also grouped to do project and they are guided towards writing a paper as an outcome of their projects.

Through my courses, in general, I also aim to create a course environment and lecture organization that will facilitate in-class learning. I have encouraged attendance and associated my lectures with quizzes. While those quizzes are mostly for checking attendance, they are designed to challenge students to motivate to the content. I have also made my lectures more interactive for everybody so that students feel comfortable to ask questions even though they think they could be the only one who is not sure about what is covered. I have also collected feedback during my lectures regarding content, my teaching and even structure of the course and revised the necessary components immediately. I have received so many good feedbacks in my course evaluations regarding this approach. I also do plan to integrate several applications such as Top Hat (had a meeting with the company representative recently) to increase the involvement of students and to be able to see what percent of the students grab the content of the lecture.

Service Statement

As faculty at universities, we are not only responsible for active research and teaching but also for service. I do think that this is significant in terms of engaging and building a strong relationship with the institution. This also helps creating the ideal environment for faculty, staff and students at the universities. I think being a relatively new school and department, in VCU Computer Science department, we have the opportunity to build a desired academic environment that will benefit everybody. Thus, I am motivated to provide my support and service towards building such environment.

To this end, at the department level, I have served at different committees. I was a member of the faculty search and hiring committee (during 2017-2018 academic year) in which we have reviewed all applicants, and provided a list of selected candidates to the chair. Then, with on-site visits of candidates, we have attended breakfast meetings, lunch and seminar. I also served as

the members of High School Programming contest and RamHacks committee in which I helped for successful organization of these events actively. I also led a marketing effort for the visibility of our department in my first year at VCU. We have prepared and distributed mugs with VCU logo and Claude E. Shannon's centennial logo. I managed the entire process including the design, purchase, and shipping of all materials to 175 computer science department in US.

For academic service, I am volunteering as an Associate Editor for IEEE Access journal since summer 2018. Due to the one week review policy of the journal, so far I have handled more than 30 journal papers. I have been also part of the organizing committee in Local Computer Networks (LCN) conference (CORE rank A) since 2018 in several roles. I did serve in 4 different NSF panels and reviewed 40 proposals. I also reviewed proposals for an international funding agency (Singapore Land Transport Authority). Beyond these, I enjoyed reviewing papers for several IEEE/ACM journals and conferences (the details could be found in Section 6).

4   RESEARCH PORTFOLIO

4.1   RESEARCH INTERESTS

My research interests include developing efficient and optimized solutions for the functionality of mobile networks with applications in Internet-of-Things, Cyber-Physical Systems, Mobile Social Networks, UAV networks, Vehicular Networks and Cellular Networks.

Research Topic: **Disaster Recovery and Emergency Communication through Crowdsourcing and Device-to-Device communications**

Approach: There are two goals in this research direction. First, we aim to leverage crowdsourcing for disaster recovery and public safety scenarios. Within that context specifically we aim to find efficient task assignment protocols within the limits of the application. Moreover, we target both user preferences and system goals and propose solutions that will jointly satisfy both goals as much as possible. Second, we aim to design and develop efficient Device-to-Device (D2D) routing algorithms within the context of emergency networks. This will require fast connectivity, and efficient two-way communication with less overhead. Moreover, the application may sometimes require informing all the nodes in the network about the presence of a message while delivering it to a specific destination node. But, due to constraints on buffer space, it may not be efficient to keep these message copies in the buffer of all nodes. On the other hand, due to scarcity of energy in mobile devices, the energy efficiency of the proposed protocols should be taken into consideration. Recently, two graduate students have looked at these problems and proposed solutions from different aspects.

Outcome: **1 NSF grant** (**VCU share $396,000** including REU supplement of $16,000), Publications: 3 accepted: 1 Wowmom'19 (CORE rank A), 1 INFOCOM'17 workshop, 1 poster. 2 software products (mobile app and web platform). 3 submitted: Globecom'19 (2), MASS'19, 2 journals in preparation.

Research Topic: Leveraging Peer-to-Peer Interactions for Energy Management in Mobile Networks

Approach: We analyzed the charging patterns of various smartphones and the meeting patterns between the users. Finding the potential energy exchange opportunities, we have aimed to minimize the regular way of charging of smartphones from wall outlets with the help of energy exchanges between the smartphones. We have utilized dynamic programming for optimization purposes and found that with cooperative energy sharing the devices can achieve charging relief more than they can do individually. We also studied content delivery through energy sharing

problem in mobile social networks and using Optimal Stopping Theory we found the optimal strategy of sharing content and energy with peers met opportunistically.

For Vehicle-to-vehicle (V2V) energy sharing, we have studied charge sharing coordination among supplier and demander EVs in a V2V charge sharing network and developed new matching algorithms which consider optimization at network level and individual user level. We have also developed privacy preserving matching algorithms. For realistic simulations, we have extracted real original destination (O-D) patterns for commuting of people and charging stations in three different cities (Dallas, Miami, Chicago), and modeled users charging behavior and EV mobility. With the initial simulation results we have shown that V2V charge sharing network can help mitigate the range anxiety of drivers and more EVs can operate in the area without having to install new dedicated charging stations.

Outcome: 6 accepted papers: Ad hoc Networks'18 and '19, Wowmom'19, ITEC'19, VTC'17, MASS REU'17. 1 journal (IEEE Transactions on Vehicular Technology (TVT)) and 1 conference (Globecom) paper under review. 3 proposal submitted (and declined), working on others.

Research Topic: Cellular core network optimization for mobile (smartphone, IoT) networks performance and capacity enhancements.

Approach: We have proposed grouping of connections from mobile devices to the operator's core network. That is, an aggregation-based connectivity model is developed to manage multiple device traffic utilizing the same resources (i.e., bearers). Corresponding architectural enhancements has also been investigated to realize the proposed model without any performance degradation. Furthermore, efficient clustering algorithms of IoT devices have been investigated based on the heterogeneous traffic characteristics to improve the robustness, stability, latency, and spectral/energy efficiency in the proposed model.

Outcome: 1 NSF grant (VCU share $162,500). 3 accepted papers: WiSec'19, LCN'18 workshop, INFOCOM'17 workshop. 1 journal in preparation.

Research Topic: UAV networks: routing, trajectory optimization and energy management.

Approach: Using different optimization techniques, we model the problem based on the application requirements and investigate efficient models for the specific problems. For example, recently, we have studied the trajectory optimization for cellular-connected UAVs with a disconnection duration constraint. That is, the UAV with the mission of flying from a start location to a final location needs to find a path during which it does not lose its cellular connection via one of the ground base stations (GBS) in the area more than a given time constraint. As the

problem is difficult to be optimally solved, we studied a dynamic programming based approximate solution within polynomial time and with simulations showed that the proposed solution gives close-to-optimal results with remarkably low computation costs. Moreover, with a colleague from North Carolina State University, we have also studied impact of antenna radiation and other constraints on the UAV trajectory design.

Outcome: Publications: 4 accepted paper (AeroSpace'19, RWS'19, ICC'18, VTC'18), 1 journal in preparation. 2 research proposals submitted (and declined, will resubmit). Yielded new collaborations with several new colleagues (from VCU-ECE department and from NCSU).

Research topic: Self-awareness of Internet-of-Things (IoT) Networks for Performance Optimizations

Approach: We have studied the localization of lost objects through the crowd GPS service (that uses Beacons) in an active manner. We propose clustering of users in a Beacon tag network based on the benefits they can receive from each other in terms of the localization of their lost items. A new metric is developed to quantify this benefit and the users that can provide most of the total possible benefits to each other are then grouped together so that they can provide active localization service for only the users that can provide high benefit to them. The clustering of users is achieved based on both a greedy heuristic based algorithm and a genetic algorithm. With extensive simulation results based on real and synthetic data, we have observed effective partitioning of the users under different user counts and groups while valuing the privacy of users at its maximum by limiting the number of interactions between users. We have been also looking at other problems such as Bluetooth based indoor localization and device-free localization recently.

Outcome: 1 research proposal submitted (declined), Publications: 1 journal (IEEE Access'18) and 2 conference (SocialSens'17, WiSec'19) papers. 1 conference paper (Globecom'19) under review.

4.2 PUBLICATIONS

Summary: **74** journal articles/conference proceedings, **1514** citations, h-index: **20**, i-index:**29**
(Google scholar: https://tinyurl.com/eb-vcu)

Remark: Conference publication is preferred in the field of Computer Science. This is due to "shorter time to print (7 months vs 1-2 years), the opportunity to describe the work before one's peers at a public presentation, and the more complete level of review (4-5 evaluations per paper compared to 2-3 for an archival journal" according to the "Evaluating Computer Scientists and Engineers For Promotion and Tenure" by Computing Research Association (CRA).

Summary of Publications.

Refereed Publications	Overall (74)			At VCU (35)		
	Journal	Conference	Book chapter	Journal	Conference	Book chapter
In Print	15	46	3	5	19	1
Accepted	-	3	-	-	3	-
Pending revision	1	-	-	1	-	-
Submitted	1	5	-	1	5	-
Total	17	54	3	7	27	1

Journal Impact Factor (Web of Science)

Dr. Bulut have published 15 journal articles. The impact factors of the journals are summarized in the below table.

Journal	Quantity	Impact Factor
IEEE/ACM Transactions on Networking (ToN)	1	3.11
IEEE Transactions on Mobile Computing (TMC)	1	4.098
IEEE Transactions on Parallel and Distributed Systems (TPDS)	2	3.971
ACM Transactions on Sensor Networks (ToSN)	1	2.313
ACM Wireless Networks	1	1.981
Elsevier Adhoc Networks	3	3.151
Springer Wireless Personal Communications	1	1.2
ACM SigMobile Mobile Computing and Communications Review (MC2R)	1	Not published
Elsevier Pervasive and Mobile Computing	1	2.974
Elsevier Computer Networks	1	2.522

IEEE Access	1	3.557
IET Electronics Letters	1	1.232

4.3 RESEARCH PROPOSALS

Dr. Bulut has submitted 21 proposals, 1 preproposal and 1 REU supplement since he joined VCU. Two of these main proposal submissions have been funded by NSF. In the first one (US-Ignite program) Dr. Bulut is the lead PI and collaborated with a colleague from University of Central Florida (UCF) and a colleague from VCU. The total amount of the project is $600,000. VCU portion is **$380,000** and Dr. Bulut shares it with coPI Dr. Manic ($267k for Dr. Bulut and $113k for Dr. Manic). Dr. Bulut has also received an REU supplement for this in the amount of **$16,000**. In the second funded project, Dr. Bulut collaborated with colleagues from North Carolina State University (NCSU) and Georgia Tech. The total amount of the project is $500,000. VCU portion is **$162,500** and Dr. Bulut is the only PI at VCU.

Dr. Bulut submitted the other proposals mostly to NSF CISE directorate. Other agencies include Arpa-E program under Department of Energy (DoE), Sony, NIST, NSA and Army Research Lab (ARL). All of these proposals typically request support for up to two graduate students and mainly for 3-4 years. 4 of the proposals are still in pending, 1 of them (CAREER proposal) will be submitted in July. Dr. Bulut's future plan is to keep this pace of submission with an increased quality and apply to other agencies including ONR and DARPA.

The list of submitted proposals is presented below. Summaries of selected proposals are presented in Section 8.

List of submitted proposals:

Title	Role	Agency	Amount requested	Submission date	Status
CRII: NeTS: Mobile Core Network Re-dimensioning via Social Offloading Groups (SoG) and Core Network Collaboration	PI	NSF	$175,000	09/28/ 2015	Declined
NeTS: Small: Collaborative Research: Crowd Charging: Design, Model, and Implementation of Opportunistic Wireless Power Transfer to Charge Crowds	PI	NSF	$247,231	11/18/ 2015	Declined

CRII: NeTS: Towards Power Sharing Mobile Networks	PI	NSF	$175,000	8/10/ 2016	Declined
US Ignite: Collaborative Research: Focus Area 1: Rapid and Resilient Critical Data Sourcing for Public Safety and Emergency Response	PI	NSF	$600,000 (**VCU $380,000**)	6/14/ 2016	**Awarded**
mmWave Based Moving Networks for 5G Communications	PI	Sony	$60,000	10/15/ 2016	Declined
S&CC-IRG Preliminary Proposal Track 1: Vehicle-to-Vehicle Direct Energy Transfer for Social Charge Sharing	PI	NSF	$1,000,000	11/30/ 2016	Encouraged
S&AS: FND: COLLAB: Towards Autonomous Multi-UAV based Victim Search and Aid	PI	NSF	$200,000	12/19/ 2016	Declined
SBIR Phase I: Localization-As-A-Service: An Infrastructure Free Indoor Location-Based Services Platform (PI: Wei Cheng, CS)	Senior Person nel	NSF	$ 225,000	12/5/ 2016	Declined
S&CC-IRG Track 2: Vehicle-to-Vehicle Direct Energy Transfer for Social Charge Sharing	PI	NSF	$1,000,000	2/16/ 2017	Declined
Infrastructure Free Device-to-Device Ad-Hoc Positioning and Dissemination (PI: Wei Cheng, CS)	Co-PI	NIST	$573,939	2/27/ 2017	Declined
Power Electronics Charge Coupler for Vehicle-to-Vehicle (V2V) Fast Energy Sharing (PI:Mithat Kisacikoglu, University of Alabama)	PI	Arpa-E (DoE)	$2,000,000 (VCU: 250,000)	5/1/ 2017	Declined
Reconfigurable Army Networks for Global Expeditionary Response (RANGER) Project in Internet of Battlefield Things (IoBT) (PI: George Cybenko, Dartmouth College)	Sub-award	ARL	(VCU: 850,000)	5/1/ 2017	Declined
CAREER: End-to-end Communication Resilience under Public Safety Situations	PI	NSF	$434,460	7/19/ 2017	Declined
REU Site: Undergraduate Research in Cyber-Physical Systems (PI: Wei Zhang-ECE)	Senior Person nel	NSF		8/23/ 2017	Declined

SaTC: CORE: Small: Collaborative: Privacy-preserving Blockchain-based Electric Vehicle Charging Network	PI	NSF	$225,000	11/15/2017	Declined
NeTS: Small: Collaborative Research: Improving Spectrum Efficiency for Hyper-Dense IoT Networks	PI	NSF	$500,000 (**VCU $162,500**)	11/15/2017	**Awarded**
US Ignite: Collaborative Research: Focus Area 1: Rapid and Resilient Critical Data Sourcing for Public Safety and Emergency Response **(REU Supplement)**	PI	NSF	$16,000	11/20/2017	**Awarded**
SCC: Community-Engaged Vehicle-to-Vehicle Charge Sharing Network for Smart and Green Cities	PI	NSF	$1,743,861 (**VCU $413,861**)	02/2018	Declined
Course Development in Internet of Things	PI	NSA	$1760,000 (**VCU $80,000**)	08/2018	Pending
CNS Core: Small: Collaborative Research: SSD-ESU: Secure, Scalable and Dynamic Network Models for Energy Storage Units	PI	NSF	$500,000 (**VCU $155,000**)	11/2018	Pending
Autonomous Search and Rescue using UAVs	PI	VCU Internal	$50,000	4/2018	Pending
FW-HTF-P: Collaborative Research: Managing Interruptions to Improve Productivity of Knowledge Workers in Smart Office Environments	PI	NSF	$150,000 (**VCU $130,000**)	2/2018	Pending
CAREER: Mobile Network Optimization through Energy Sharing	PI	NSF	~$500,000	7/2019 (will be)	Pending

4.4 RESEARCH COLLABORATIONS

Dr. Bulut has been collaborating with the faculty from the same and other departments at VCU, as well as with faculty from other universities. Below are some main research collaborators.

Collaborators: Milos Manic, Professor, Virginia Commonwealth University, and Murat Yuksel, Associate Professor, University of Central Florida.
Topics: Device-to-Device (D2D) communications, GENI, Emergency management, Software Define Networks (SDN)
Outcomes: 1 funded grant, 2 publications, others in preparation.

Collaborator: Kemal Akkaya, Professor, Florida International University.
Topics: Privacy Preserving Models and Security, Blockchain Lightning Network
Outcomes: 2 proposals submitted, 8 publications, others in preparation.

Collaborators: Ismail Guvenc, Associate Professor, North Carolina State University (NCSU), Geoffrey Li, Georgia Institute of Technology.
Topics: Internet-of-Things (IoT) and Unmanned Aerial Vehicles (UAV)
Outcomes: 1 funded grant, 2 other proposals submitted, 7 publications, others in preparation.

Collaborator: Mithat Kisacikoglu, Assistant Professor, University of Alabama
Topics: Electric Vehicles, V2V Charging
Outcomes: 3 proposals submitted, 4 publications, others in preparation.

Collaborators: Robert Klenke, Professor, Electrical and Computer Engineering, Virginia Commonwealth University
Topics: Unmanned Aerial Vehicles (UAV)
Outcomes: 2 research proposals, ongoing research.

4.5 RESEARCH ADVISING

Dr. Bulut currently advises 2 Ph.D. students and 1 M.S. student with thesis in his lab. He is also hiring a new Ph.D. student in Fall 2019.

Aashish Dhungana:
Program: Ph.D. in Engineering, Computer Science Track, started in Fall 2016 (full-time)
Research topic: "Energy management in mobile networks through peer-to-peer sharing."
Mr. Dhungana completed all (11) courses required for BS to PhD students. He also passed the

comprehensive (qualification) exam. He has published 1 journal paper (Adhoc Networks with impact factor 3.151) and 4 papers in conference proceedings (one in WoWMoM, a CORE rank A conference, with acceptance ratio of 16% for regular papers). He has 1 other journal (JNCA) paper and 1 conference (Globecom'19) paper under review. He attended ICC 2018 to present his paper. He also attended several GENI workshops and summer camps for training purposes for the US-Ignite grant. He will do his proposal defense in Summer 2019 (the report can be updated in September to reflect this.)

Fatih Yucel:
Program: Ph.D. in Engineering, Computer Science Track, started in Fall 2017 (full-time)
Research topic: "Efficient Resource Allocation and Task Assignment in Mobile Crowdsourcing Systems". Mr. Yucel had his B.S. Degree from Turkey. He had taken 10 courses in the first two years and passed the comprehensive (qualification) exam. He has published 2 journal and 1 conference papers. He has also 3 other conference (MASS, Globecom(2)) papers under review.

Steven M. Hernandez:
Program: M.S. in Engineering, Computer Science Track, started in Fall 2018 (full-time)
Research topic: "Bluetooth based indoor localization". Mr. Hernandez had his B.S. Degree from VCU. He was working as an undergraduate researcher in Dr. Bulut's lab. He also co-authored a paper on wireless energy sharing between phones during undergraduate (he developed the app) years. He applied and received the NSF Graduate Resarch Program Fellowship (GRFP) and stayed in Dr. Bulut's lab for M.S. initially (he will most likely continue Ph.D.). In the first year, he took 6 courses and need one more course to finish the requirements. He has also one conference (Globecom'19) paper under review.

A new student joining in Fall (offer sent – pending visa)
Program: Ph.D. in Engineering, Computer Science Track, starting in Fall 2019 (full-time)
Research topic: Resource Management in IoT and UAV communication (will be funded by second NSF grant).

Dr. Bulut is a member of advisory committee of 3 Ph.D. and 1 M.S. students:

1. Bahman Rashidi, Advisor: Carol Fung (CS)
2. Manziva Akanda Nishi, Ph.D., Advisor: Kostadin Damevski (CS)
3. Javad Abed, Ph.D., Advisor: Manoj Thomas (Information Systems)
4. Pulkit Rustgi, M.S., Advisor: Carol Fung (CS)

5 TEACHING PORTFOLIO

5.1 COURSES TAUGHT

| Semester	Course #	Name	Enrollment	Course Evaluation	Instructor Evaluation
Spring 2016	CMSC 491	Mobile Programming - iOS	19	3.4	3.7
Fall 2016	CMSC 401	Algorithm Analysis with Advanced Data Structures	74	3.4	3.7
Spring 2017	CMSC 491	Mobile Programming - iOS	31	3.6	3.9
Fall 2017	CMSC 401	Algorithm Analysis with Advanced Data Structures	86	3.6	3.8
Spring 2018	CMSC 428	Mobile Programming - iOS	32	3.8	4.0
Fall 2018	CMSC 401	Algorithm Analysis with Advanced Data Structures	89	3.8	4.0
Spring 2019	CMSC 628	Mobile Networks	13	4.3	4.7
Average			Total 344	3.7	4.0

5.2 COURSE EVALUATIONS

Figures 1 and 2 show the evaluation scores for all courses taught at VCU. Figure 1 presents the overall rating of the course, while Figure 2 shows overall rating of the instructor given by students as the last metric in each part. They also very closely match with the average rating of the course and the average rating of the instructor through all criteria. The course and the instructor scores average 3.7 and 4.0, respectively. Out of 7 courses taught, 6 of them were undergraduate courses (per departmental request). With the re-teaching of the courses, it can be observed that all the individual scores and the averages are increasing. Dr. Bulut expects that these scores will be

better in the next semesters. The course and instructor scores in the only graduate course (CMSC 628 Mobile Networks taught in Spring 2019) he taught are 4.3 and 4.7, respectively.

Dr. Bulut is also the recipient of the two teaching awards from the department due to his teaching evaluation scores for the courses taught in 2017 and 2018.
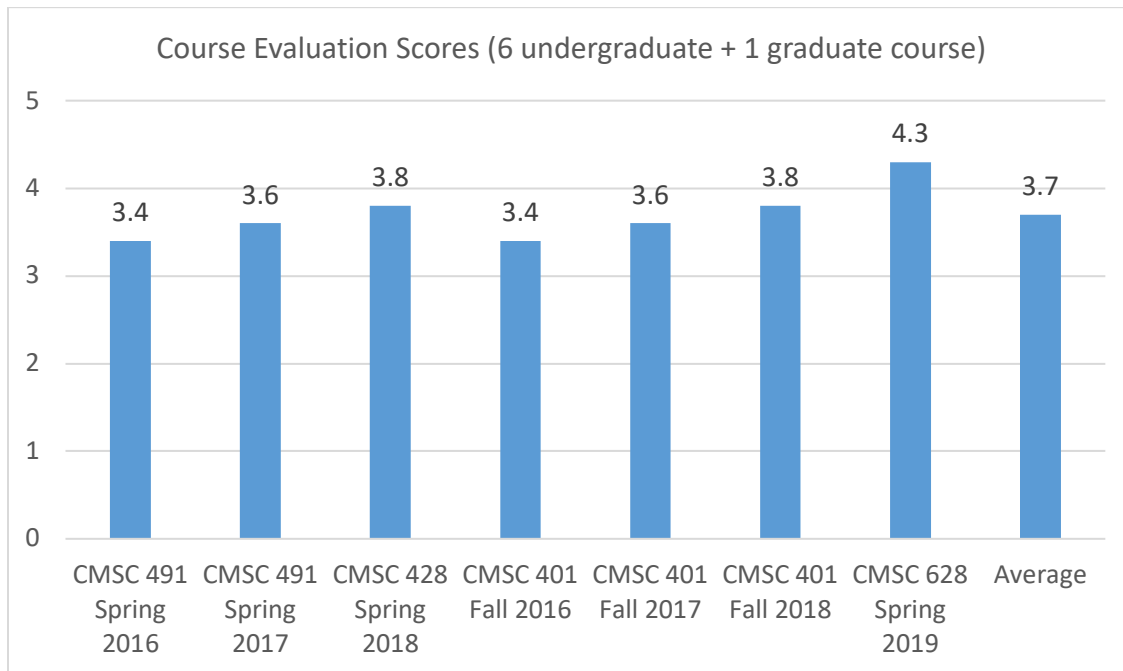
Figure 1 Course evaluation scores on the scale from 1 to 5.
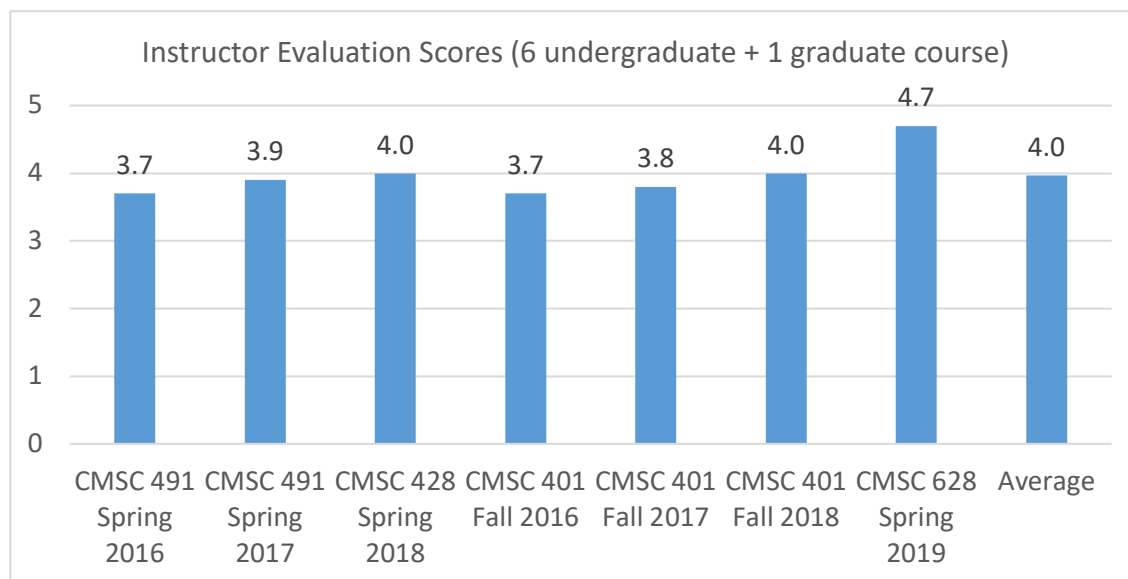
Figure 2 Instructor evaluation scores on the scale from 1 to 5.

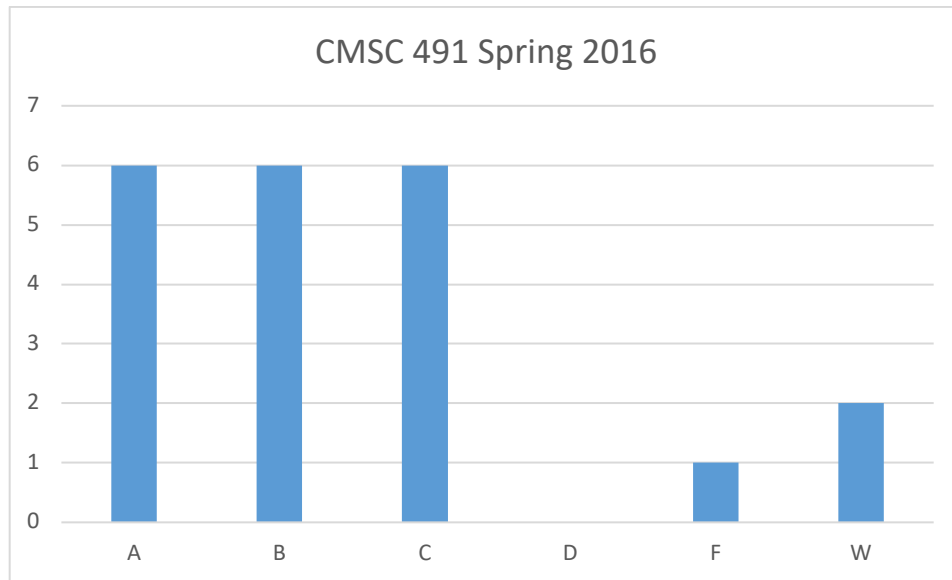| Course	CMSC 491 Spring 2016	CMSC 491 Spring 2017	CMSC 428 Spring 2018	CMSC 401 Fall 2016	CMSC 401 Fall 2017	CMSC 401 Fall 2018	CMSC 628 Spring 2019	Average
Title	Mobile iOS Prog.	Mobile iOS Prog.	Mobile iOS Prog.	Algorithms Analysis with Adv. Data Struc.	Algorithms Analysis with Adv. Data Struc.	Algorithms Analysis with Adv. Data Struc.	Mobile Networks	
Enrollment	19	31	32	74	86	89	13	
Responded	17	21	27	60	74	72	12	
Response Ratio	89.5%	67.7%	84.4%	81.1%	86.0%	80.9%	92.3%	83.1%
Course Rating								
The course organization and format	3.6	3.6	3.8	3.3	3.6	3.8	4.1	3.7
The course effectiveness in significantly increasing student knowledge and skills in the subject area	3.8	4.0	3.9	3.4	3.7	3.9	4.3	3.9
The lecture notes, homework solutions, syllabus, or other instructor supplied material used in this course	3.5	3.5	3.5	3.5	3.7	3.7	4.3	3.7
The relevance of the homework assignments to the course material	3.9	3.9	3.7	3.6	3.8	4.0	4.2	3.9
The usefulness of the homework assignments as a learning / feedback aid	3.5	4.1	3.9	3.3	3.9	3.8	3.9	3.8
The relevance of the tests, quizzes, and examinations (Were questions clearly related to the course material?)	2.8	3.7	3.6	3.4	3.3	4.0	4.3	3.6
The usefulness of the tests, quizzes, and exams as a learning / feedback tool	2.5	3.5	3.6	3.2	3.7	3.8	4.3	3.5
The fairness of the tests given in this course (Did the tests reasonably cover the course material as expected? Was sufficient time allotted to complete tests?)	2.4	3.3	3.7	3.4	3.6	3.9	4.4	3.5
The textbook used for this course	3.3	4.0	4.1	3.5	3.3	3.3	3.7	3.6
Give an overall rating of the course.	3.4	3.6	3.8	3.4	3.6	3.8	4.3	3.7

Table 1 Detailed information about Course Evaluation of Courses

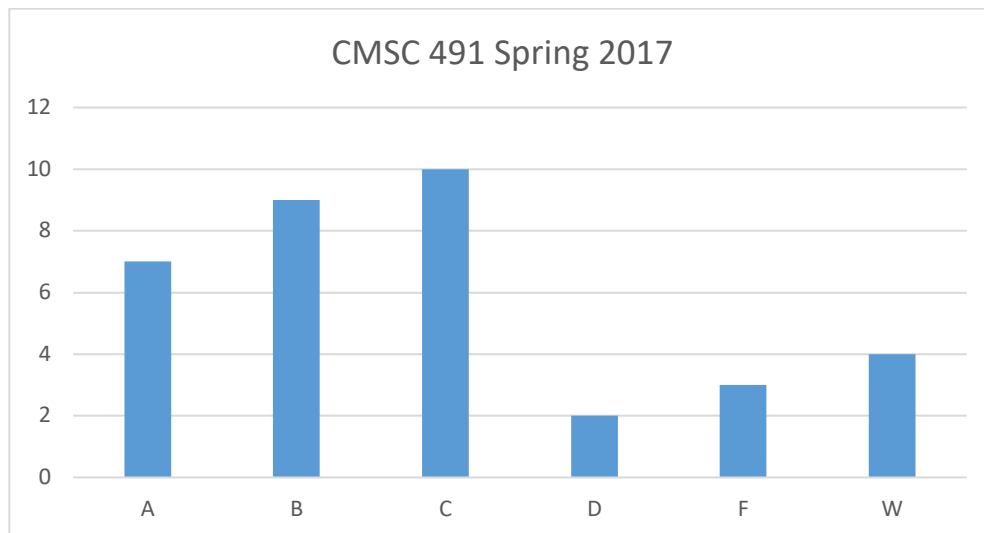| Course	CMSC 491 Spring 2016	CMSC 491 Spring 2017	CMSC 428 Spring 2018	CMSC 401 Fall 2016	CMSC 401 Fall 2017	CMSC 401 Fall 2018	CMSC 628 Spring 2019	Average
Title	Mobile iOS Prog.	Mobile iOS Prog.	Mobile iOS Prog.	Algorithms Analysis with Adv. Data Struc.	Algorithms Analysis with Adv. Data Struc.	Algorithms Analysis with Adv. Data Struc.	Mobile Networks	
Enrollment	19	31	32	74	86	89	13	
Responded	17	21	27	60	74	72	12	
Response Ratio	89.5%	67.7%	84.4%	81.1%	86.0%	80.9%	92.3%	83.1%
Instructor Rating								
The instructor's organization for the course (Was the material presented in a logical, systematic sequence?)	3.8	3.8	3.8	3.7	3.9	4.0	4.6	3.9
The instructor's level of preparation for lectures and use of class time	3.7	4.0	3.9	3.7	3.8	4.1	4.6	4.0
The instructor's use of example problems to illustrate key points or techniques	3.8	4.0	3.9	3.5	3.7	3.9	4.7	3.9
The instructor's ability to offer practical applications for the topics covered	3.8	4.2	4.0	3.5	3.7	3.7	4.7	3.9
The instructor's ability and willingness to answer questions clearly and to alleviate confusion about key concepts	3.8	3.8	3.9	3.5	3.9	3.9	4.6	3.9
The instructor's ability to "connect" the course material to the things you have learned in previous courses	3.5	3.9	3.8	3.3	3.7	3.9	4.3	3.8
The instructor's use of learning objectives for the course (Did the instructor convey clear expectations of the material you should learn in this course for exams, quizzes, etc.)	3.1	3.8	3.7	3.3	3.6	3.8	4.4	3.7
The availability of the instructor	4.0	4.2	3.8	3.6	3.8	4.0	4.7	4.0
The enthusiasm of the instructor	3.8	4.2	4.2	3.7	4.0	4.0	4.8	4.1
The instructor's attitude toward the students	3.7	4.0	4.1	3.7	3.9	3.9	4.8	4.0
The overall effectiveness of the instructor in the classroom	3.6	4.1	4.0	3.5	3.7	3.9	4.7	3.9
The overall fairness of the instructor	3.8	4.0	3.9	3.8	3.9	3.9	4.7	4.0
Give an overall rating of the instructor	3.7	3.9	4.0	3.7	3.8	4.0	4.7	4.0

Table 2 Detailed information about Instructor Evaluation of Courses

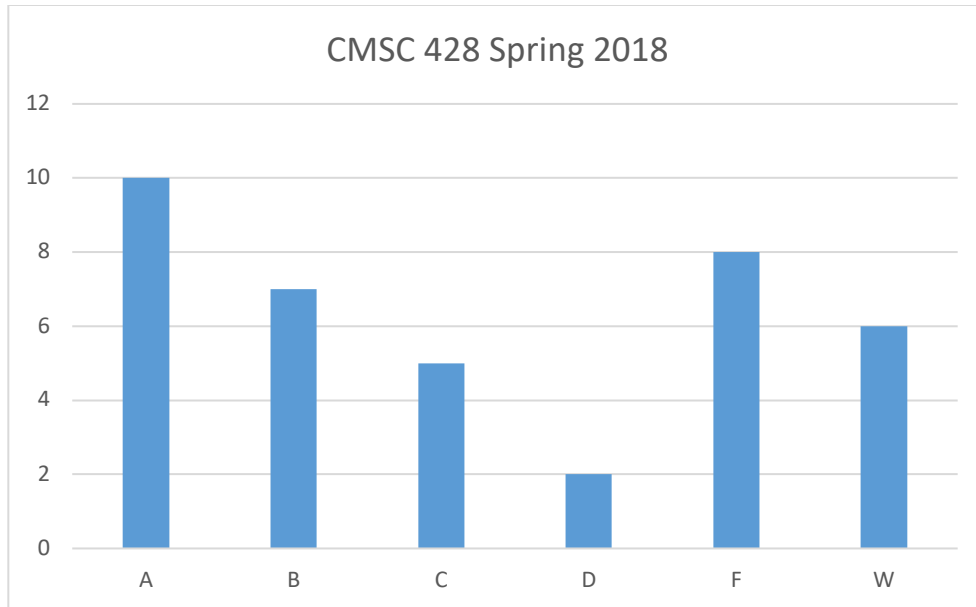## 5.3   COURSE GRADE DISTRIBUTIONS

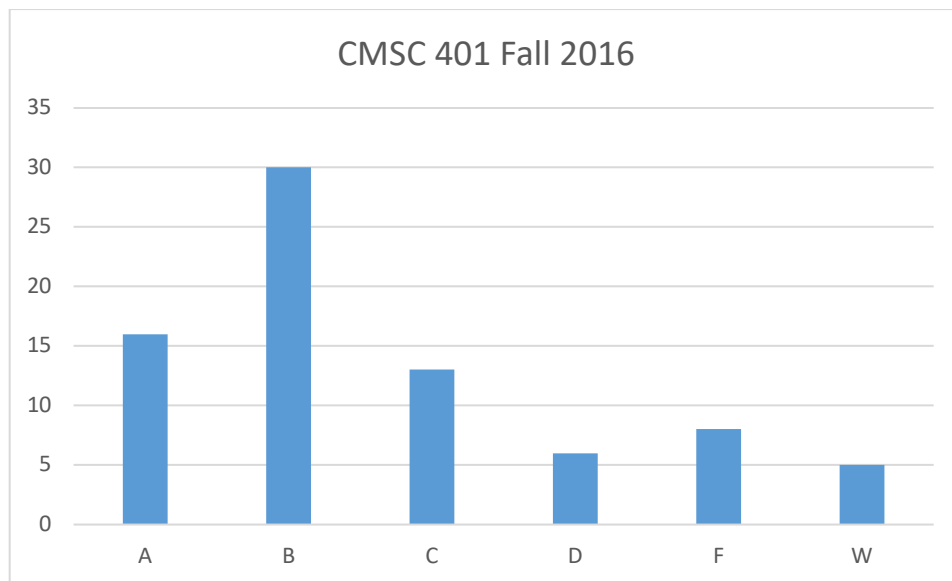The grade distributions for each of the sections taught is presented in Figures 3-9.

Figure 3 Grade distribution for CMSC 491 Spring 2016

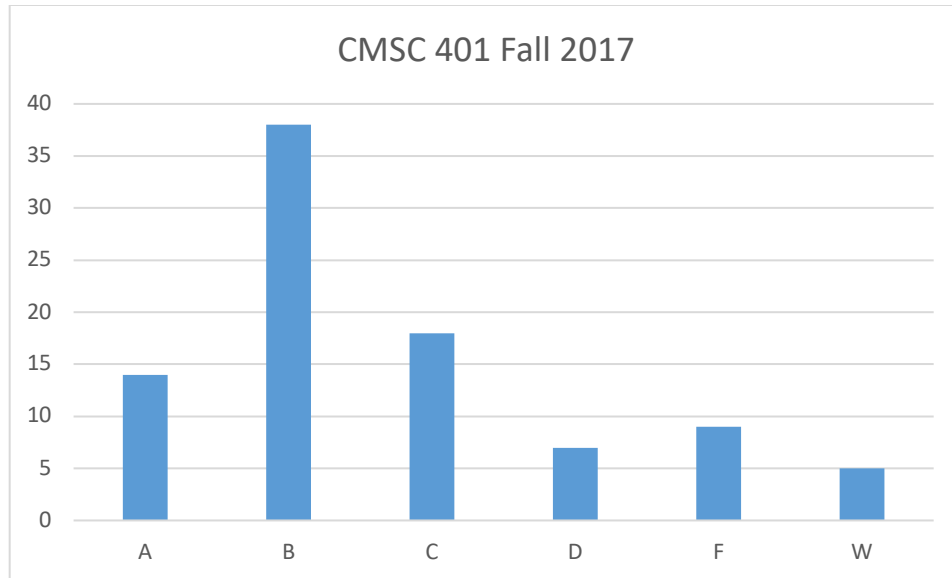**Figure 4 Grade distribution for CMSC 491 Spring 2017**

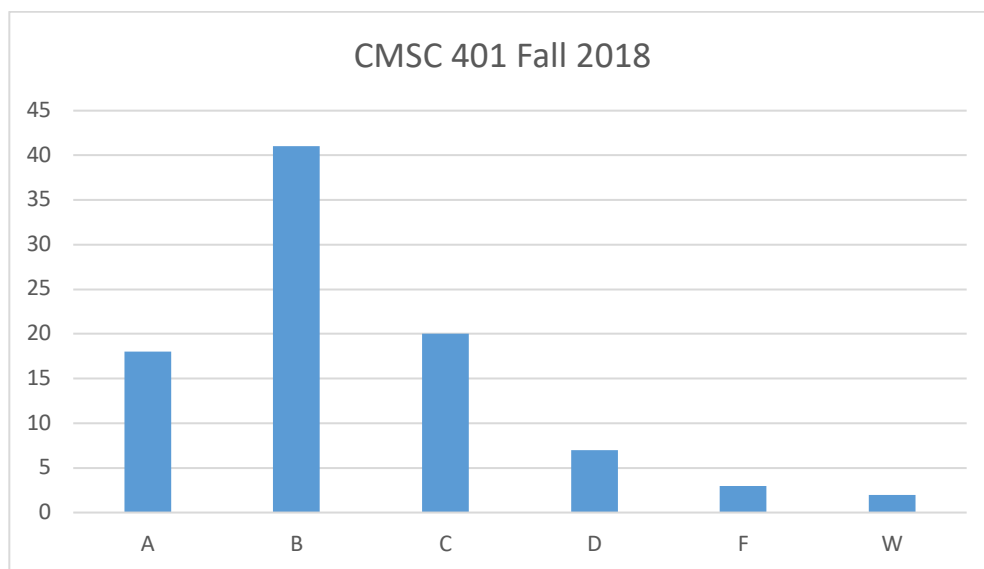**Figure 5 Grade distribution for CMSC 428 Spring 2018**

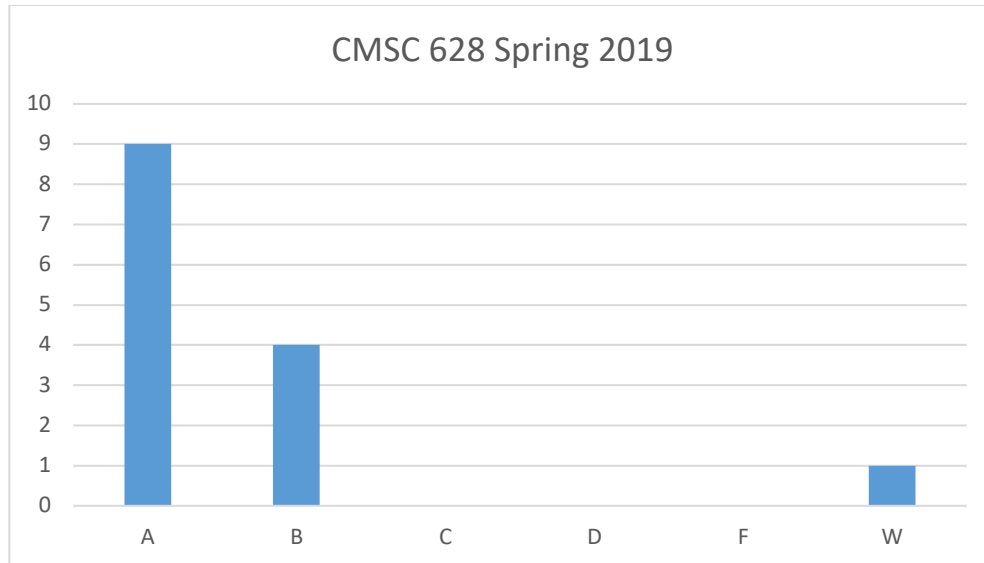**Figure 6 Grade distribution for CMSC 401 Fall 2016**

Figure 7 Grade distribution for CMSC 401 Fall 2017

Figure 8 Grade distribution for CMSC 401 Fall 2018

Figure 9 Grade distribution for CMSC 628 Spring 2019

5.4 UNDERGRADUATE ACADEMIC ADVISING

Dr. Bulut has advised a senior project team in the last three years. The list of the students and the project information is listed below:

- 2018-2019: Remote Patient Monitoring
  (Students: James Peake, Kevin Hall, Mit Amin)

- 2017-2018: Campus Bluetooth Tag Network
  (Students: Nicholas Bennett, Jordan Mays-Rowland, Justin Yirka)

- 2016-2017: Automated Parking Reminder Application
  (Students: Will Steiner, Corey Gates, Huy Nguyen)

Dr. Bulut has also hired several undergraduate students as researchers in his lab (through start up and NSF project funds).

- Steven Hernandez: He developed both iOS and Android app to realize energy sharing between the smartphones of people through a social network. We also published a paper on that. Steven received NSF GRFP Fellowship and doing M.S. with thesis with me.

- Dongchen (Jay) Guan: He developed an iOS app and an associated web portal that lets eye-witnesses send their data (image/video) to law enforcement agency servers, extracts faces from the data (through Microsoft FACE API) and compares with the database of criminals automatically. The app has also been designed to work through D2D communication without using cellular connection. Jay was part of the lab in Summer 2017, now he is with Microsoft.

- Fidel Rodriguez: He has taken over what Jay was doing and trying to complete the missing parts. He is also extending the functionalities with map view etc. He is funded from REU supplement received.

- Ray Rohan: He will work through the summer 2019. As Fidel will be doing internship Rohan take over it during summer.

5.5 COURSE ENHANCEMENT AND DEVELOPMENT

Dr. Bulut has developed contents of three courses while at VCU: 1) CMSC 491/428 Mobile Programming – iOS, 2) CMSC 401 Algorithm Analysis with Advanced Data Structures and 3) CMSC 628 Mobile Networks. CMSC 491/428 is completely new course and have not been offered at VCU before. It is also very rarely taught at other universities. In CMSC 491/428, students learn the basics of Swift, Xcode and build five different apps through assignments which they can install to their devices. He became the lead of Apple's University Program at VCU and organized the membership through which app development could be done without paying the regular $99 fee. We have also renewed the Mac lab (with departmental support) and gave students opportunity to build their apps in this lab. In CMSC 401, he has also extended the works of previous instructors with additional content and lectures, as well as enhancement on programming assignments, and homeworks. Dr. Bulut has also developed his graduate course CMSC 628 Mobile Networks from scratch (lectures, assignments and projects) which is taught in Spring 2019 with 13 students. He also created a curriculum that includes paper reviews and presentations on the state-of-the-art solutions in mobile networking problems so that students are exposed to recent advances in the area. He will continue teaching CMSC 428 and CMSC 628 in every other Spring in future years.

6 SERVICE PORTFOLIO

6.1 COMPUTER SCIENCE DEPARTMENT SERVICE

Faculty Search Committee (Fall 2017-Spring 2018) Dr. Bulut has served as a member of the faculty search committee. Responsibilities include review of all applications and preparing a list of selected candidates through discussions with other members of the committee and providing it to the department chair, attending breakfast meetings with the candidate, lunch and seminar.

High School Programming Contest committee (Fall 2016-present) Dr. Bulut serves as a member of the organizing committee for the high school programming contest which happens every Spring in the department. He has been involved in collecting and selection of problems as well as other organizational needs.

CS Department Marketing - Mug Distribution (Fall 2015-Spring 2016) Dr. Bulut has led an individual effort of preparing and distributing mugs with VCU logo and Claude E. Shannon's centennial logo. He managed the entire process including the design, purchase, and shipping of all materials to 175 computer science department in US.

RamHacks committee (Fall 2015-present) Dr. Bulut serves as a member of the RamHacks committee and helps in organization of the yearly event.

6.2 OUTREACH

Dr. Bulut has reached out 153 Electric Vehicle owners through an online survey (which is IRB approved) and collected their opinion about an NSF project proposal he has been writing as a lead PI. This gave opportunity to advertise VCU Computer Science brand to others involved. Dr. Bulut has also been working with a non-profit organization called Virginia Clean Cities, with which he has collaborated on two research proposals. He is also planning to reach local high schools to attract early researchers and leverage DERI program for the same purpose.

6.3 PROFESSIONAL SERVICE

Associate Editor: IEEE Access (2018-present)

Conference Organizing Committee:

- (Edas Chair) Conference on Local Computer Networks (LCN), October 14-17, 2019, Osnabrück, Germany [Ranked A according to CORE 2014 conference ranking],

- (Publicity Chair) Conference on Local Computer Networks (LCN), October 1-4, 2018, Chicago, USA [Ranked A according to CORE 2014 conference ranking],

NSF Panelist:

- National Research Traineeship (NRT) Program, March 2017, 2018
- Cyber-Physical Systems (CPS) program, June 2017
- Japan-US Network Opportunity 2 (JUNO2) Program, February 2018 (R&D for Trustworthy Networking for Smart and Connected Communities

International Proposal Review:

- Singapore Land Transport Authority (LTA)

TPC member: IEEE Wowmom'19, IEEE LCN'19,'18,'17,'16, IEEE PIMRC'19'18, IEEE VTC-Fall'19, VTC-Spring'18, IEEE VTC-Fall'17, MobiSPC'17, IEEE SOCIALCOM'16, IEEE MobiPST'15,13,12, IEEE DCOSS'13, IEEE PerNem'13, IEEE IQ2S'13, MobiWIS'11

Reviewer:

Journals:

1. IEEE Transactions on Mobile Computing 2019, 2018, 2017
2. IEEE Transactions on Vehicular Technology, 2019, 2018
3. IEEE Transactions on Communications 2019
4. IEE/ACM Transactions on Networking 2017
5. IEEE Transactions on Parallel and Distributed Systems 2017, 2016
6. IEEE Transactions on Signal Processing, 2017, 2016
7. IEEE Transactions on Industrial Informatics 2017
8. IEEE Transactions on Intelligent Transportation Systems (ITS) 2018
9. IEEE Transactions on Wireless Communications 2018, 2016
10. IEEE Transactions on Cyber-Physical Systems 2018
11. IEEE Wireless Communications Magazine 2018
12. IEEE Journal on Selected Areas in Communications, 2016
13. IEEE Communications Magazine 2016
14. IEEE Internet of Things Journal 2018
15. IEEE Access, 2019, 2018, 2017
16. ACM Transactions on Sensor Networks, 2018
17. ACM Computing Surveys 2016
18. Elsevier Computer Networks 2018, 2017

19. Elsevier Adhoc Networks, 2019, 2018, 2017, 2016

20. Elsevier Computer Communications 2018

21. Springer Wireless networks 2017, 2016

22. Computer Journal 2018, 2017

Conferences:

23. Wowmom 2019, 2018

24. PIMRC 2019, 2018

25. INFOCOM 2017

26. Vehicular Technology Conference (VTC) 2019, 2018, 2017, 2016

27. Local Computer Networks (LCN) 2019, 2018, 2017,2016, 2012, 2011

28. Globecom 2018, 2017, 2012, 2011

29. ICC 2019, 2018, 2017, 2016, 2011, 2010

30. SocialCom 2016

31. PerNem 2013

32. WCNC 2013

33. ACITA 08/09/10/11

34. FutureNetworks 2010

Number of Manuscripts reviewed (journal + conference submissions): 130+

7   RECOMMENDED REVIEWER NAMES

- Klara Nahrstedt, University of Illinois at Urbana-Champaign

Klara Nahrstedt is the Ralph and Catherine Fisher Full Professor at University of Illinois at Urbana-Champaign, Computer Science Department, and the Director of Coordinated Science Laboratory at University of Illinois, Urbana-Champaign. Her expertise is on network and systems and she is highly cited (h-index: 82). She is selected as a member of the Computing Research Associations (CRA)'s Computing Community Consortium (CCC) (2014-2017). She is the ACM Fellow, IEEE Fellow, and the Member of Leopoldina German National Academy of Sciences. More about her is in https://monet.cs.illinois.edu/people/klara/

I have no relationship with her.

- Ellen Zegura, Georgia Tech

Ellen Zegura is the Fleming Professor in the School of Computer Science at Georgia Tech. She works in two primary areas, computer networking and computing for social good. In mobile wireless networking, she and colleagues invented the concept of message ferries to facilitate communications in environments where network connectivity is unreliable and/or sparse. She is a Fellow of the IEEE, a Fellow of the ACM, and an elected member of the Computing Research Association Board (CRA). Since Fall 2014 she has been on the Executive Board of the CRA. She is highly cited (h-index:54). More about her is in https://www.cc.gatech.edu/~ewz/Welcome.html

I have no relationship with her.

- Kevin Almeroth, UC Santa Barbara

Kevin C. Almeroth is currently a Professor in the Department of Computer Science at the University of California in Santa Barbara where his main research interests include computer networks and protocols, wireless networking, and mobile applications. He is the Associate Editor-in-Chief of IEEE Transactions on Mobile Computing (TMC) and on the Editorial Boards of several other journals and magazines; a member of the steering committees for the IEEE International Conference on Network Protocols (ICNP), ACM Workshop on Challenged Networks (CHANTS). He is a Member of the ACM and a Fellow of the IEEE. He is highly cited (h-index: 48). More about him is in https://sites.cs.ucsb.edu/~almeroth/

I have no relationship with him.

- Guohong Cao, Pennsylvania State University

Guohong Cao is a Distinguished Professor in the Department of Computer Science and Engineering at the Pennsylvania State University. His research interests include wireless networks, mobile systems, wireless security and privacy, and Internet of Things. He has been cited over 20000 times, with an h-index of 75. He has served on the editorial board of IEEE Transactions on Mobile Computing, IEEE Transactions on Wireless Communications, and IEEE Transactions on Vehicular Technology, and has served on the organizing and technical program committees of many conferences, including the TPC Chair/Co-Chair of IEEE MASS, and INFOCOM. He is a Fellow of the IEEE. More about him is in http://www.cse.psu.edu/~gxc27/

I have no relationship with him.

- Mohamed Younis, University of Maryland Baltimore County

Mohamed Younis is currently a Professor in the Department of Computer Science and Electrical Engineering at the University of Maryland Baltimore County (UMBC). Dr. Younis' technical interest includes network architectures and protocols, wireless sensor networks, communication and distributed real-time systems. Dr. Younis is a senior member of the IEEE and the IEEE communications society. He is highly cited (h-index: 52). More about him is in https://www.csee.umbc.edu/~younis/

I have no relationship with him.