Nirnay Ghosh

Assistant Professor (Grade-II)
Department of Computer Science and Technology (CST)
Indian Institute of Engineering Science and Technology, Shibpur(IIESTS)
Howrah 711 103, West Bengal, India
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RESEARCH AREAS

- *IoT: Security & Smart City Applications*: Design of decentralized, light-weighted access control mechanism for IoT systems, energy-efficient/QoI-aware data collection.
- *Mobile Crowd Sensing/Participatory Sensing*: QoI estimation, reputation scoring, modeling automated decision-support framework, incentive mechanism.
- *Cloud computing*: Estimating risk in business offloading to cloud services, modeling dynamic risk-based access control to secure cloud-centric collaborations, security models to ensure conflict-free interoperations among services hosted in cloud.

EDUCATION

Doctor of Philosophy (PhD) — July 2016
Department of Computer Science and Engineering,
(*erstwhile* School of Information Technology),
Indian Institute of Technology, Kharagpur
Area: Security in Cloud computing,
Thesis defended: December 2015

Master of Science (by research) — July 2010
Department of Computer Science and Engineering,
(*erstwhile* School of Information Technology),
Indian Institute of Technology, Kharagpur
Area: Network Security
CGPA : 9.51/10.0
Thesis defended: June 2010

Bachelor of Technology (B. Tech) — August 2006
Heritage Institute of Technology,
West Bengal University of Technology (WBUT),
Major: Computer Science & Engineering,
DGPA : 8.28/10.0

Higher Secondary Examination (H.S) — June 2002
West Bengal Council of Higher Secondary Education (WBCHSE),
Major: Science,
Percentage: 75.6%

Madhyamik Examination — June 2000
West Bengal Board of Secondary Education (WBBSE),
Percentage: 86.3%

PROFESSIONAL EXPERIENCE

Research Fellow May 2018 - February 2019
Research & Security Innovation Lab for IoT (ReSILIoT),
iTrust Centre for Research in Cyber Security,
Singapore University of Technology and Degisn (SUTD), Singapore 487372
Advisor: Prof. Yuval Elovici

- Part of the team for setting up the testbed comprising of IoT devices.
- Conduct research and development in IoT security using the testbed.
- Collaborating with Research scientists and assistants in the group.

Visiting Faculty January 2018 - April 2018
Department of Computer Science and Engineering,
Indian Institute of Information Technology,
Kalyani 741235, WB, India

- Instructor for BTech 2^{nd} semester course *Discrete Mathematics*.
- Conduct tutorial classes, exams, evaluation of student performances.

Post-Doctoral Research Fellow April 2016 - September 2017
Department of Computer Science,
Missouri University of Science and Technology,
Rolla, MO 65409, USA
Advisor: Prof. Sajal K Das

- Collaborating and mentoring PhD students in Prof. Das's research group.
- Conduct research in cloud computing, participatory sensing, cyber security, and cyber-physical systems with applications to smart cities.
- Writing research grant proposals to the NSF and other agencies and industry for funding.

Project Personnel (Contractual) June 2015 - March 2016
Sponsored Research and Industrial Consultancy (SRIC),
Indian Institute of Technology,
Kharagpur 721302, WB, India

- Teaching assistant duties.
- Propose a framework to filter false reports in vehicular participatory sensing applications; for validation real data sets from *Waze* has been used.
- Propose a statistical distribution-based model for detection of anomalous user requests in SaaS clouds; validation done through simulation by using real data sets.

TCS Research Scholar February 2012-May 2015
Department of Computer Science and Engineering (*erstwhile* School of Information Technology),
Indian Institute of Technology,
Kharagpur 721302, W.B., India
Fellowship Granter: TCS Innovation Labs, India

- Modeling interaction risk with cloud service provides to support customers in trustworthy selection.
- Developing a fuzzy inference-based risk access control (RAC) for request authorization.

- Proposing a heuristic to solve the *Inter Domain Role Mapping (IDRM)* problem, such that minimal additional permissions are granted while mapping into local roles.
- Securing loosely-coupled collaboration in cloud environment through dynamic detection and removal of (i)cyclic inheritance conflict, and (ii) violation of *Separation of Duty (SoD)* constraints.

Research Consultant May 2010 - January 2012
Sponsored Research and Industrial Consultancy (SRIC),
Indian Institute of Technology,
Kharagpur - 721302, WB, India
Sponsoring Agency : DIT, New Delhi, India

- Part of the system design, testing, and documentation team for an integrated security risk management system for enterprise networks.
- System overview: It gathers data using some commercial tools to generate attack graphs. The generated attack graph is refined and formulation of a risk metric is done. Security assessment of networks using the attack graph based security metric.
- Pursued research work in the field of attack graphs, and network security.

Junior Project Officer July 2008 - April 2010
Sponsored Research and Industrial Consultancy (SRIC),
Indian Institute of Technology,
Kharagpur 721302, WB, India
Sponsoring Agency : HQ-IDS, New Delhi, India

- Part of the system design, testing, and documentation team for a penetration testing tool.
- System Overview: It facilitates the scanning a network of hosts, performing vulnerability assessment, and launching exploits (automatically or manually) based on vulnerability assessment reports.
- Pursued research work in the field of penetration testing, attack graphs, and network security.

PGDIT Programme Facilitator July 2006 - June 2008
IIT Kharagpur Bhubaneshwar Campus,
Bhubaneshwar - 751013, Odisha, India

- Supporting the conduction of theory and laboratory classes, assignment evaluation, guidance in project works, and other teaching assistant duties in the PGDIT programme.
- Managing and maintaining Windows & Linux servers, database servers, LAN and all other system related issues in the PGDIT laboratory.

PhD DISSERTATION

Title: Securing Loosely-coupled Collaborations in a SaaS Cloud through Risk Estimation and Access Conflict Mediation
Supervisor: Prof. Soumya K Ghosh

Abstract: In recent times, collaborations among multiple autonomous organizations (public-public, public-private, and private-private) have become essential as it allows these domains to easily connect with partners, customers, and employees from remote locations. As a particular stakeholder may not have all the data and services, sharing information through collaboration has become a natural choice. The nature of such collaboration is loosely-coupled, where collaborating agents share their resources dynamically, and do not have any predefined global policies to govern interoperations.

This thesis attempts to address both security and availability requirements of such collaborations.

Some of the present day Software-as-a-Service (SaaS) clouds, providing online collaboration services, have not been found to deliver consistent service level agreement (SLA) guarantees. As cloud SLAs contains non-standard clauses and unclear technical specifications, it becomes a challenge for customers to select an appropriate service provider to ensure guaranteed service quality. In a service outsourcing environment, like cloud, quality of service levels are of prime importance to any customer, as the latter uses the third-party cloud services to store and process their clients' data. This work focuses on selection of an appropriate collaboration service provider, which is both trustworthy as well as competent enough to fulfil the negotiated guarantees.

A major concern in collaboration is to ensure that the sensitive information are not disclosed or misappropriated by any unauthorized subject or malicious agents. The requested permissions, before being granted, need to be examined for ensuring the principle of least privilege. Traditional MLS (Multi-Level Security) models have certain limitations with respect to multi-party collaboration, since any local domain does not have security clearance level related information for remote requesters. In recent years, researchers have proposed risk-based access control (RAC) to address such limitations. To select the requested permissions for authorization, this dissertation proposes a fuzzy inference-based RAC which solves a multi objective optimization problem with two parameters: (i) access risk, and (ii) security uncertainty due to information sharing. The objective function is to minimize both the parameters.

The authorized permissions are now required to be mapped to a set of roles which are to be activated by the requester to access the local resources. Mapping the requested permissions into appropriate roles is non-trivial and is termed in the literature as the inter-domain role mapping (IDRM) problem. Two variants of the IDRM problem, viz., the IDRM-safety and the IDRM-availability address the security and fairness issues in collaboration, respectively. In this thesis, a distributed role mapping framework has been proposed, which implements a novel heuristic for solving the IDRM-availability problem.

Activation of several local roles during a particular user's session may introduce cyclic conflicts which violate the principle of security. In this thesis, two types of conflicts have been considered: (i) cyclic inheritance, and (ii) violation of SoD constraint. The objective of this work is to propose a distributed security framework which dynamically detects and removes these conflicts, to make the collaboration secure, and the requested objects available.

MS DISSERTATION

Title : Securing Enterprise Networks using Automatically Generated Minimal Attack Graph
Supervisor: Prof. Soumya K Ghosh

Abstract: As the computer networks continue to grow in size and complexity, they are becoming vulnerable against sophisticated cyber attacks. Such attacks combine multiple vulnerabilities existing on different machines and are potentially more harmful than single-point attacks. Attack graph provides a succinct representation of such correlated attacks and consists of a number of attack paths. Each attack path represents an attack scenario and is essentially a logical succession of exploits. This makes attack graph an effective representation for multi-stage, multi-host attacks. In this work, attack graph based security assessment of a local area network has been performed. Major work included in the thesis are : (i) Development of a framework

based on an artificial intelligence technique, called planner, for time-efficient, scalable generation of minimal attack graph. (ii) A minimal attack graph consists of only those attack paths (scenarios) that terminate to a particular goal node. As the number of attack scenarios increases, the overall security of the underlying network reduces. Thus there is a need for quantification of security level of a given network configuration. Security metric based on mathematical models have been formulated and is applied on the attack graph for measuring security strengths of various network configurations. (iii) In a minimal attack graph with large number of attack paths, it is not feasible for the administrator to plug all the vulnerabilities. This may restrict the operability of the network. Moreover, in a dynamic environment, where the degree of threat posed by an exploit varies over time, a framework is required which detects an optimal or most favored attack path from a given attack graph. The present work proposes a framework for finding out optimal attack path(s) under dynamic environment using Ant Colony Optimization (ACO). Given a network configuration and its corresponding attack graph, customized ACO algorithm detects optimal attack path(s) using the severity scores of the exploits. A case study is also presented to demonstrate the efficacy of the proposed methodology.

TECHNICAL SKILLS

Languages & Software: C, Java/NetBeans, Matlab, R, Protege, Octave, MySQL, XML, LaTeX
Platform: Windows 7/10, Ubuntu.

PUBLICATIONS

- *Communicated & Under Revision*
  1. **Nirnay Ghosh**, Rajshekhar Khan, Rishabh Singhal, and Sajal K Das, "R2Q: A Behaviour-based Risk Quantification Framework to Authorize Optimal Requests in Web-based Collaborations", *IEEE Transactions on Dependable and Secure Computing (TDSC)* (Submitted in October 2020).
  2. Satyaki Roy, **Nirnay Ghosh**, Preetam Ghosh, and Sajal K Das, "bioMCS 2.0: A Distributed, Energy-aware Fog-based Framework for Data Forwarding in Mobile Crowdsensing", *Elsevier Pervasive and Mobile Computing (PMC)* Journal (Submitted in July 2020).
  3. Satyaki Roy, Preetam Ghosh, **Nirnay Ghosh**, and Sajal K Das, "Transcriptional Regulatory Network Topology with Applications to Bio-inspired Networking: A Survey", ACM Computing Surveys (CSUR) (Submitted in January 2020).
- *Journals*
  1. Satyaki Roy*, **Nirnay Ghosh***, and Sajal K Das, "bioSmartSense+: A Bio-inspired Probabilistic Data Collection Framework for Priority-based Event Reporting in IoT Environments", *Elsevier Pervasive and Mobile Computing (PMC) Journal* vol. 67, pp. 101179, DOI:https://doi.org/10.1016/j.pmcj.2020.101179, 2020.
  2. Shameek Bhattacharjee, **Nirnay Ghosh**, Vijay K Shah, and Sajal K Das, QnQ: Quality and Quantity based Unified Approach for Secure and Trustworthy Mobile Crowdsensing, *IEEE Transactions on Mobile Computing*, vol. 19, no. 1, pp. 200-216, DOI: 10.1109/TMC.2018.2889458, 2020.
  3. **Nirnay Ghosh**, Saket Chandra, Vinay Sachinandan, and Yuval Elovici, "SoftAuthZ: A Context-aware, Behaviour-based Authorization Framework for Home IoT", *IEEE Internet of Things Journal*, DOI: 10.1109/JIOT.2019.2941767, pp. 1-1, 2019 (Early access).

4. Rajesh P Barnwal*, **Nirnay Ghosh***, Soumya K Ghosh, and Sajal K Das, "PS-Sim: A Framework for Scalable Data Simulation and Incentivization in Participatory Sensing-based Smart City Applications", *Elsevier Pervasive and Mobile Computing (PMC) Journal*, DOI: https://doi.org/10.1016/j.pmcj.2019.04.008, 2019.
5. Rajesh P Barnwal*, **Nirnay Ghosh***, Soumya K Ghosh, and Sajal K Das, "Publish or Drop Traffic Event Alerts? Quality-aware Decision Making in Participatory Sensing-based Vehicular CPS", *ACM TCPS; Special Issue on Transportation Cyber-Physical Systems* vol.4, no.1, pp. 9:1-9:28, 2019.
6. Francesco Restuccia, **Nirnay Ghosh**, Shameek Bhattacharjee, Sajal K Das, and Tommaso Melodia, "Quality of Information in Mobile Crowdsensing: Survey and Research Challenges", *ACM TOSN* vol. 13, no. 4, pp. 34:1-34:43, 2017.
7. **Nirnay Ghosh**, Debangshu Chatterjee, Soumya K Ghosh, and Sajal K Das, "Securing Loosely-coupled Collaboration in Cloud Environment through Dynamic Detection and Removal of Access Conflicts", *IEEE TCC*, vol. 3, no. 4, pp. 349-362, 2016.
8. **Nirnay Ghosh**, Soumya K Ghosh, and Sajal K Das, "SelCSP: A Framework to Facilitate Selection of Cloud Service Providers". *IEEE TCC*, vol. 3, no. 1, pp. 66-79, 2015.
9. **Nirnay Ghosh** and Soumya K Ghosh, "A Planner-based Approach to Generate and Analyze Minimal Attack Graph". *Springer Applied Intelligence* vol. 36, no. 2, pp. 369-390, 2012.

- *Conference & Workshop Proceedings*

1. Satyaki Roy, Ronojoy Dutta, **Nirnay Ghosh**, and Preetam Ghosh, "Adaptive Motif-based Topology Control in Mobile Software Defined Wireless Sensor Networks", *IEEE CCNC* (Accepted - October 2020).
2. Satyaki Roy, **Nirnay Ghosh**, Preetam Ghosh, and Sajal K Das, "bioMCS: A Bio-inspired Collaborative Data Transfer Framework over Fog Computing Platforms in Mobile Crowdsensing", *ACM International Conference on Distributed Computing and Networking (ICDCN)*, 2020 (To appear in the ACM Digital Library).
3. Vinay Sachinandan, Suhas Bhairav, **Nirnay Ghosh**, and Yuval Elovici, "PIT: A Probe into Internet of Things by Comprehensive Security Analysis", *IEEE TrustCom*, pp. 522-529, 2019.
4. **Nirnay Ghosh**, Rishabh Singhal, and Sajal K Das, "R2Q: A Risk Quantification Framework to Authorize Requests in Web-based Collaborations", *ACM ASIACCS*, pp. 247-254, 2019.
5. Satyaki Roy*, **Nirnay Ghosh***, and Sajal K Das, "bioSmartSense: A Bio-inspired Data Collection Framework for Energy-efficient, QoI-aware Smart City Applications", *IEEE PerCom*, DOI: 10.1109/PERCOM.2019.8767392, 2019.
6. Rajesh P Barnwal, **Nirnay Ghosh**, Soumya K Ghosh, and Sajal K Das, "PS-Sim: A Framework for Scalable Simulation of Participatory Sensing Data", *IEEE SmartComp*, pp. 195-202, 2018.
7. Shameek Bhattacharjee, **Nirnay Ghosh**, Vijay K Shah, and Sajal K Das, "QnQ: A Reputation Model to Secure Mobile Crowdsourcing Applications from Incentive Losses", *IEEE CNS* pp. 1-9, doi: 10.1109/CNS.2017.8228635, 2017

8. Shameek Bhattacharjee, **Nirnay Ghosh**, Vijay K Shah, and Sajal K Das, "W2Q: A Dual-Weighted QoI Scoring Mechanism in Social Sensing using Community Confidence", *IEEE IQ2S (IEEE PerCom Workshop)*, pp. 375-380, 2017.
9. Rajesh P Barnwal, **Nirnay Ghosh**, Soumya K Ghosh, and Sajal K Das, "Enhancing Reliability of Vehicular Participatory Sensing Network: A Bayesian Approach". *IEEE SMARTCOMP*, pp. 1-8, 2016.
10. **Nirnay Ghosh**, Rajesh P Barnwal, Soumya K Ghosh, and Sajal K Das, "A Probabilistic Approach to Filter out Spam Reports in a Participatory Sensing-based Vehicular Traffic Management System". *IEEE COMSNETS*, pp. 1-2, 2016.
11. Anant Pushkar, **Nirnay Ghosh**, Soumya K Ghosh, "A Statistical Approach to Detect Anomalous User Requests in SaaS Cloud-centric Collaborations". *ICISS (LNCS-9478)*, pp. 243-262, 2015.
12. **Nirnay Ghosh**, Ishan Chokshi, Mithun Sarkar, Soumya K Ghosh, Anil K Kaushik, and Sajal K Das, "NetSecuritas: An Integrated Attack Graph-based Security Assessment Tool for Enterprise Networks", *ACM ICDCN*, pp. 30:1-30:10, 2015.
13. **Nirnay Ghosh**, Debangshu Chatterjee, and Soumya K Ghosh, "An Efficient Heuristic-based Role Framework for Secure and Fair Collaboration in SaaS Cloud". *IEEE ICCAC*, pp. 227-236, 2014.
14. **Nirnay Ghosh**, Triparna Mondal, Debangshu Chatterjee, and Soumya K Ghosh, "Verifying Conformance of Security Implementation with Organizational Access Policies in Community Cloud - A Formal Approach", *SECRYPT*, pp. 329-336, 2014.
15. Ishan Chokshi, **Nirnay Ghosh**, Soumya K Ghosh, "Efficient Generation of Exploit Dependency Graph by Customized Attack Modelling Technique", *IEEE ADCOM*, pp. 39-45, 2012.
16. Arkadeep Kundu, **Nirnay Ghosh**, Ishan Chokshi, Soumya K Ghosh. "Analysis of Attack Graph-based Metrics for Quantification of Network Security", *IEEE INDICON*, pp. 530-535, 2012.
17. **Nirnay Ghosh** and Soumya K Ghosh. "An Approach to Identify and Monitor SLA Parameters for Storage-as-a-Service Cloud Delivery Model", *IEEE Globecom Workshops*, pp. 724-729, 2012.
18. **Nirnay Ghosh**, Saurav Nanda, and Soumya K Ghosh, "An ACO based Approach for Detection of an Optimal Attack Path in a Dynamic Environment". *ICDCN (LNCS 5935)*, pp. 509-520, 2010.
19. **Nirnay Ghosh** and Soumya K Ghosh, "An Approach for Security Assessment of Network Configurations using Attack Graph". *IEEE NetCom*, pp. 283-288, 2009.
20. **Nirnay Ghosh** and Soumya K Ghosh, "An Intelligent Technique for Generating Minimal Attack Graph", *SecArt (ICAPS Workshop)*, pp. 42-51, 2009.
21. **Nirnay Ghosh**, Sourav Nanda, and Soumya K Ghosh, "A Quantitative Approach towards Detection of an Optimal Attack Path in a Wireless Network using Modified PSO Technique", *IEEE COMSNETS*, pp. 1-10, 2009.

- *Book Chapters*

1. Rajesh P Barnwal, **Nirnay Ghosh**, and Soumya K Ghosh, "Data and Application Security in Cloud", *Bio-inspiring Cyber Security and Cloud Services: Trends and Innovations*, vol. 70, pp. 479-495, Springer Berlin Heidelberg, 2014.
2. **Nirnay Ghosh** and Soumya K Ghosh, "An Intelligent Approach for Security Management of an Enterprise Network Using Planner", *Intelligent Autonomous Systems: Foundations and Applications*, vol. 275, pp. 187-214, Springer-Verlag, 2010.

*Primary co-author

ACADEMIC ACTIVITIES

- *Teaching Assistant Duties*
  - Computing Systems Lab (Autumn 2014-15), Cloud Computing (Spring 2013, Spring 2014 & Spring 2015), Communication Systems & Networking (Autumn 2011-12, 2012-13), Internet & Web-based Technology (Spring 2011, Spring 2012), Data Warehousing and Data Mining (Autumn 2009-10 & 2010-11), Information and Systems Security (Spring 2010), Information and System Design (Autumn 2008-09).
- *Talks and Presentations*
  1. "bioMCS: A Bio-inspired Collaborative Data Transfer Framework over Fog Computing Platforms in Mobile Crowdsensing" in *ACM International Conference on Distributed Computing and Networking (ICDCN)*, Kolkata (January 2020).
  2. "W2Q: A Dual-Weighted QoI Scoring Mechanism in Social Sensing using Community Confidence", *IEEE PerCom-2017 (Workshop)*, Kona, Hawii Island (March 2017).
  3. "Enhancing Reliability of Vehicular Participatory Sensing Network: A Bayesian Approach", *IEEE SMARTCOMP*, St. Louis, MO (May 2016).
  4. "A Statistical Approach to Detect Anomalous User Requests in SaaS Cloud-centric Collaborations", *ICISS 2015*, Kolkata, India (December 2015).
  5. "Securing Loosely-coupled Collaboration in a SaaS Cloud through Risk Estimation and Access Conflict Mediation", *Tata Research Development and Design Centre (TRDDC)*, Pune, India (March 2015).
  6. "NetSecuritas: An Integrated Attack Graph-based Security Assessment Tool for Enterprise Networks", *ACM ICDCN*, Goa, India (January 2015).
  7. "An Efficient Heuristic-based Role Mapping Framework for Secure and Fair Collaboration in SaaS Cloud", *IEEE ICCAC 2014*, London, UK (September 2014).
  8. "Securing Cloud-Based Collaborations through Dynamic Detection And Removal Of Access Conflicts (Poster)", *TACTiCS Symposium*, TCS Chennai (January 2014).
  9. "An Approach to Identify and Monitor SLA Parameters for Storage-as-a-Service Cloud Delivery Model", *IEEE Globecom Workshop*, Anaheim, CA (December 2012).
  10. "Securing Interoperation Requests though Semantic Resolution and Risk-based Permission Authorization in a Trustworthy Cloud Environment", *Second IDRBT Doctoral Colloquium*, Hyderabad, India (December 2012).
  11. "An ACO based Approach for Detection of an Optimal Attack Path in a Dynamic Environment", *ICDCN*, Kolkata, India (January 2010).

12. "An Approach for Security Assessment of Network Configurations using Attack Graph", *IEEE NetCom*, Chennai, India (December 2009).
13. "A Quantitative Approach towards Detection of an Optimal Attack Path in a Wireless Network using Modified PSO Technique", *IEEE COMSNETS*, Bangalore, India (January 2009).

- *Teaching Instructor/Resource Personnel*
  1. Theory class on *Network Security Assessment & Auditing* for short term course *Information Security*, IIT Kharagpur (October 2010).
  2. Theory and practical classes for short term course *Network Security - Theoretical & Practical Perspective*, IIT Kharagpur (August 2010).
  3. Theory and practical classes for short term course *Advanced Networking & Security*, IIT Kharagpur (April 2010).
  4. Theory and practical classes for short term course *Advanced Networking & Security*, IIT Kharagpur (May 2009).
- *Other Activities*
  1. Attended the short term course and workshop on "Machine Learning and Complex Network" organized by the *National Mathematics Initiative (NMI)*, IIT Kharagpur (February-March 2015).
  2. Visited the *Center for Research in Wireless Mobility and Networking (CReWMaN)* Lab in UTA (USA), and the *Center for Secure Information Systems (CSIS)* Lab in GMU (USA) for collaboration and research discussions (December 2012).
  3. Visited Defense Headquarters (HQ-IDS, New Delhi) for project demonstration and technical discussions (September 2010)
  4. Visited Defense Headquarters (HQ-IDS, New Delhi) for code-level training and project demonstration (February 2010)
  5. Attended the tutorials and technical sessions of *ICISS*, Kolkata, India (December 2009).

INTERNSHIP

Worked on a project entitled "Formally Defining Service Level Agreement Parameters for Storage-as-a-Service cloud" during a two month internship (May 2011 - July 2011) in *IBM India Storage Lab*, Pune, India.

- *Project details (in brief)*: Investigation of SLA parameters applicable to storage cloud other than commonly used ones viz. availability, etc. Formally defining the service level objectives constituting those parameters to form a model for formal verification and compliance checking between negotiated guarantees and offered service levels.

AWARDS

- Received *NSF Travel Grant* to attend and present paper at IQ2S Workshop, IEEE PerCom 2017.
- Qualified *TOEFL* exam (score: 94/120) in November 2015.
- Awarded with *TCS PhD Fellowship* for the duration February 2012 to July 2015
- Received best paper award for "Efficient Generation of Exploit Dependency Graph by Customized Attack Modeling Technique" at *IEEE ADCOM 2012*
- Received Institute (IIT Kharagpur) Overseas Travel Grant to attend and present paper at *IEEE ICCAC 2014*, held in Imperial College, London, 8-12 September, 2014.

COMMUNITY SERVICE

- Reviewer - *IEEE TMC, IEEE TSC, IEEE TCC, IEEE TDSC, IEEE ANTS, IEEE SMARTCOMP, ACM CSUR, Springer JONS, Elsevier JPDC*
- Part of the organizing team for one-day workshop on *Windows Azure Cloud*, jointly sponsored by IIT Kharagpur and MSR India (March 2013).
- Part of the organizing team for *IBM Research Day* on *Smarter Planet & Cloud Computing*, jointly sponsored by IIT Kharagpur and IBM-ISL (November 2010).
- Coordinator - *Departmental Research Scholars' Day Programme*, IIT Kharagpur (December 2010, January 2012)
- Volunteer - *ICIIS 2008*, *IHCI 2012*.
- Secretary - *Information Technology Departmental Society (ITDS)*, IIT Kharagpur (January 2013 - December 2013)

REFERENCES

Name	**Position**	**Affiliation**	**Email**	**Telephone**
Soumya K Ghosh	Professor	IIT Kharagpur	skg@cse.iitkgp.ernet.in	+91-3222-282332
Sajal K Das	Professor	Missouri S&T	sdas@mst.edu	+1-573-341-7708
Rajesh P Barnwal	Senior Scientist	CSIR-CMERI	r_barnwal@cmeri.res.in	+91-983-2726694

PERSONAL DETAILS

Father's Name:	Shri Sekhar Kanti Ghosh
Permanent Address:	171/P/6, Picnic Garden Road, Kolkata-700039, WB, India.
Marital Status:	Married
Date of Birth:	December 27, 1983
Sex:	Male
Nationality:	Indian