Smart Grid: Secure and Sustainable Energy for all forever

Electricity costs are predicted to skyrocket in the coming years and it's expected to double over the next 5 years due to challenges in resources development and climate change, and this is a worldwide issue.

Smart Grid achieves bidirectional energy and information flow between the energy user and the utility grid, allowing energy users to generate energy and share with the utility grid or with other energy consumers.

"*Prosumer*" is the energy user who consumes as well as generates energy and they form a "*Prosumer Community Smart Grid*". The *key objective* of a prosumer community smart grid is to be self-sufficient and sustainable and to share the excess energy amongst the community first and then auction the rest to the utility grid.

There are a number of *research issues* and *challenges* that need to be addressed to implement and realize the community smart grid vision. These are

1. identifying and attracting more dynamic prosumers to the community
2. motivating new prosumers to join the community
3. keeping sustainable growth in prosumer base
4. understanding and optimizing energy generation, consumption and sharing patterns
5. understanding and managing negative or selfish behaviours in a community
6. securing the community grid from cyber-attacks
7. providing a trusted environment for the community to operate
8. innovative sensor technology design and development
9. risk assessment, management and mitigation
10. ensure network availability and integrity
11. load modelling and prediction under different weather conditions

This tutorial will discuss these issues and outline how these issues can be addressed. Specifically this tutorial will cover the following:

1. Introduction to the Prosumer Community Framework of Smart Grids for Community Formation, Community Growth and Community Management using crowd-sourcing and crowd-sensing approach to ensure long term and sustainable community participation in the energy generation process.
2. Introduction and interplay between Smart Grids, Wireless Sensor Networks and Cyber-P Systems infrastructure for efficiently capturing high quality sensor data for communication, network monitoring (i.e. load prediction, load balancing) and network visualization.
3. Introduction to smart grid communication protocols for load modelling and prediction, heterogeneous communication across different sensors, optimal service and resource discovery, price forecasting, incentive schemes for prosumer motivation and participation, trust and risk management
4. Introduction to cyber-security infrastructure within the smart grid community to protect the critical energy infrastructure against malicious network attacks and anomalies.

About Dr. Vidyasagar Potdar

Dr. Vidyasagar Potdar is a Senior Research Fellow at Curtin University, Australia. His key areas of research include Smart Grids, Cyber Physical Systems and Information Security.

He has published more than 125 scientific research publications in journals and conferences. His research has been widely cited, so far he has 1345 citations and his h-index is 19 and i10 index is 41. He has attracted more than one million dollars in research funding in the areas of smart grids and sustainable development.

He has supervised to completion 6 PhD students and is currently supervising 4 full time PhD students. He has been awarded best researcher award in 2011 and 2012 across all faculties in Curtin University.

He regularly reviews articles for top international journals including IEEE Transactions on Industrial Electronics, IEEE Transactions on Information Security and Forensics, IEEE Transactions on Industrial Informatics, Journal of Systems and Software. He is also a guest editor for IEEE Transactions on Industrial Electronics and IEEE Transactions on Industrial Informatics.

He has organized more than 25 international workshops at IEEE and ACM conferences worldwide and was the General Chair for CEAS 2011, CUBE 2012 & CUBE 2013. He has more than 10 years of full time research experience and in this period he was involved in the management of a Multi-Disciplinary Research Institute at Curtin University, where he took the responsibility of research commercialization, research mentoring, business development and research student recruitment.

Recent Publications on Smart Grids & Wireless Sensor Networks

Refereed Journal Articles

1. Rathnayaka, A. J. D., **Potdar, V. M.**, Dillon, T., Hussain, O., & Chang, E. (2014). Methodology to Find Influential Members in Prosumer-Community-Groups. IEEE Transactions on Industrial Informatics, 10(1), 706-713. ERA A, Impact Factor : 8.785
2. Rathnayaka, A. J. D., **Potdar, V. M.**, Dillon, T. & Chang, E. (2014). Framework to Manage Multiple Goals in Community based Energy Sharing Network in Smart Grid. International Journal of Electrical Power & Energy Systems, accepted, in press, Impact Factor: 3.43.
3. Rathnayaka, A. J. D., & **Potdar, V. M.** (2013). Wireless Sensor Network transport protocol: A critical review. Journal of Network and Computer Applications, 36(1), 134-146. ERA A, Impact Factor: 1.5.
4. Rathnayaka, A. J. D., **Potdar, V. M.**, Dillon, T., & Hussain, O. (2014). Goal Oriented Prosumer Community Groups for Smart Grid. IEEE Technology and Society Magazine, 33(1): 41-48 ERA B, Impact Factor: 0.541.
5. Rathnayaka, A.J. D., **Potdar, V. M.**, & Dillon, T. (2014). Formation of Virtual Community Groups to Manage Prosumers in Smart Grids. International Journal of Grid and Utility Computing, in press.
6. Rathnayaka, A. J. D., **Potdar, V. M.**, & Dillon, T. (2014). Prosumer Recruitment Framework for Prosumer Community Groups in Smart-grid. International Journal of Computer Systems Science & Engineering, in press.
7. Rathnayaka, A. J. D., & **Potdar, V. M.** (2012). Design of Smart Grid Prosumer Communities via Online Social Networking Communities. International Journal of Infornomics, 5, 544 - 556.
8. Sharif, A., **Potdar, V. M.**, & Rathnayaka, A. J. D. (2010). LCART: Lightweight Congestion Aware Reliable Transport Protocol for WSN Targeting Heterogeneous Traffic. Australian Journal of Intelligent Information Processing Systems, 12(1), 1-9.
9. Sharif, A., **Potdar, V. M.**, & Rathnayaka, A. J. D. (2010). Dependency of Transport Functions on IEEE802. 11 and IEEE802. 15.4 MAC/PHY Layer Protocols for WSN: A Step towards Cross-layer Design. International Journal of Business Data Communications and Networking (IJBDCN), 6(3), 1-30.
10. Sharif, A., **Potdar, V. M.**, & Rathnayaka, A. J. D. (2010). ERCTP: End-to-End Reliable and Congestion Aware Transport Layer Protocol for Heterogeneous WSN. Scalable Computing: Practice and Experience, 11(4).

Peer Reviewed Conference Publications

1. Rathnayaka, A. J. D., & **Potdar, V. M.** (2012). Evaluation of wireless home automation technologies for smart mining camps in remote Western Australia. In Sustainability in Energy and Buildings (pp. 109-118): Springer Berlin Heidelberg. ERA A
2. Rathnayaka, A. J. D., & **Potdar, V. M.** (2012). Energy resource management in smart home: State of the art and challenges ahead. In Sustainability in Energy and Buildings (pp. 403-411): Springer Berlin Heidelberg. ERA A
3. Rathnayaka, A. J. D., **Potdar, V. M.**, Dillon, T., & Hussain, O. (2012). Analysis of energy behaviour profiles of prosumers. In Industrial Informatics (INDIN), 2012 10th IEEE International Conference on (pp. 236-241): IEEE.
4. Rathnayaka, A. J. D., **Potdar, V. M.**, Hussain, O., & Dillon, T. (2011). Identifying prosumer's energy sharing behaviours for forming optimal prosumer-communities. In Cloud and Service Computing (CSC), 2011 International Conference on (pp. 199-206): IEEE.
5. Rathnayaka, A. J. D., **Potdar, V.M.**, & Ou, M. H. (2012). Prosumer management in socio-technical smart grid. In Proceedings of the CUBE International Information Technology Conference (pp. 483-489): ACM.
6. Rathnayaka, A. J. D., **Potdar, V. M.**, & Kuruppu, S. J. (2011). Evaluation of wireless home automation technologies. In Digital Ecosystems and Technologies Conference (DEST), 2011 Proceedings of the 5th IEEE International Conference on (pp. 76-81): IEEE.
7. Rathnayaka, A. J. D., **Potdar, V. M.**, & Kuruppu, S. J. (2011). An innovative approach to manage prosumers in smart grid. In Sustainable Technologies (WCST), 2011 World Congress on (pp. 141-146): IEEE.

8. Rathnayaka, A. J. D., **Potdar, V. M.**, Sharif, A., Sarencheh, S., & Kuruppu, S. (2010). Wireless Sensor Network Transport Protocol-A State of the Art. In Broadband, Wireless Computing, Communication and Applications (BWCCA), 2010 International Conference on (pp. 812-817): IEEE.
9. Rathnayaka, A. J. D., **Potdar, V. M.**, Sharif, A., Sarencheh, S., & Kuruppu, S. (2010). Wireless sensor networks: Challenges ahead. In Broadband, Wireless Computing, Communication and Applications (BWCCA), 2010 International Conference on (pp. 824-829): IEEE.
10. Deshpande, V., Helonde, J., Wadhai, V., **Potdar, V.M.**, & Rathnayaka, A. J. D. (2012). Handling the Quality of Service for the data dissemination in Wireless Sensor Networks. In Proceedings of the CUBE International Information Technology Conference (pp. 853-856): ACM.
11. Sharif, A., **Potdar, V.M.**, & Rathnayaka, A. J. D. (2010). Performance Evaluation of different Transport layer protocols on the IEEE 802.11 and IEEE 802.15. 4 MAC/PHY layers for WSN. In Proceedings of the 7th International Conference on Advances in Mobile Computing and Multimedia (pp. 300-310): ACM.
12. Sharif, A., **Potdar, V.M.**, & Rathnayaka, A. J. D. (2010). LCART: Lightweight Congestion Aware Reliable Transport protocol for WSN targeting heterogeneous traffic. 17th International Conference on Neural Information Processing, 22-25.
13. Sharif, A., **Potdar, V.M.**, & Rathnayaka, A. J. D. (2010). Prioritizing information for achieving QoS control in WSN. In Advanced Information Networking and Applications (AINA), 2010 24th IEEE International Conference on (pp. 835-842): IEEE.
14. Sharif, A., **Potdar, V. M.**, & Rathnayaka, A. J. D. (2010). LCART: A cross-layered transport protocol for heterogeneous WSN. In Sensors, 2010 IEEE (pp. 793-796): IEEE.
15. Sharif, A., **Potdar, V. M.**, & Rathnayaka, A. J. D. (2010). Priority enabled transport layer protocol for wireless sensor network. In Advanced Information Networking and Applications Workshops (WAINA), 2010 IEEE 24th International Conference on (pp. 583-588): IEEE.