Sustainable Computing

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From the Chair's Desk

by Danilo Ardagna, Politecnico di Milano

It is my pleasure to introduce the June newsletter as the new chair of STC-SC. Anirban guided STC-SC through the second year, helping us grow our membership up to more than 550 members. On behalf of the STC-SC community, I would like to thank Anirban for his guidance during the last year and Martin, who funded STC-SC for their hard and excellent work.

Our STC-SC is under an on going renewal process. Many of the chairs have been involved within STC-SC for over two years. Now, we are incorporating new volunteers and re-aligning to new technology and research trends. I thank all the officers that provided a valuable service to STC-SC and I welcome the new officers that are taking part to our community.

Cristina Rottondi has taken up my role as secretary and treasury chair in the STC-SC and she will ensure a good governance by pushing officers for monthly updates. I want to express special thanks to Christopher Stewart who served as Editor for the Sustainable Computing Register since the very beginning. Christopher will continue to work to STC-SC as Information Officer. I welcome new Editor Diwakar Krishnamurthy. Though Diwakar is not new to the STC-SC, since he already had the role of Conference chair. Diwakar will manage the newsletter transition.

The STC-SC initially focused on the design of energy efficient IT systems, addressing the full stack from the servers and networks hardware to middleware and protocol layers. Of course there is still room for research on the design of more efficient IT systems. For example, in US and UK the energy consumed by the data centres is close to 10% of the total energy consumption of the country; reducing IT energy consumption is still a very important problem. On the other hand, nowadays IT is used to monitor the impact of other systems (e.g., buildings, transportation) on the environmental sustainability and to support green-aware decisions. During the next year we will enlarge the scope of our STC-SC to highlight new research proposals, industry projects, and end users experience (e.g., user studies and behavioral change enabled by IT), which deal with the IT use for environmental sustainability considering smart grids, renewable energy sources, smart transportation and urban development, climate and ecosystem monitoring.

We will change the format of our newsletter and we will move to an e-letter that will be published on line every three months. Moreover, we are working closely with the Computer Society staff to enable new methods of operating the STC. Our objective is to explore different ideas that should improve the value our STC provides to members. Our academic and industry chairs along with the secretary-treasurer are working on opportunities to provide greater value to students.

Finally, as always, we welcome suggestions from members on other ways that we can provide value to our STC please let myself or any of the officers know; we would really appreciate hearing from you!

Thanks, ciao

Privacy Concerns in Smart Grids: Are Smart Meters Spies in Your Cellars?

by Cristina Rottondi, Politecnico di Milano

The energy industry is rapidly changing. Smart Grids are developed by massively integrating Information and Communication Technology (ICT) into electricity grids to ensure security of supply [1]. The new energy grid will be equipped with innovative sensing and control systems, capable of performing real time monitoring of power generation, transmission and usage, of analyzing consumption data and providing information about optimization and forecasting of power usage [2]. In particular, the development of systems for Automatic Meter Reading (AMR) is being stimulated by many governments around the world with the goal of allowing a consistent reduction of carbon emissions by integrating Distributed Energy Resources (DERs), increasing the efficiency of energy utilization [3], and removing barriers and constraints in the utility markets.

The design of efficient AMR poses several technical challenges on different issues like the communication infrastructure, the communication protocols, the metering devices, and the information management platform. Technical solutions include powerline communications (PLC) over low/medium voltage lines of the electricity grid, wireless technologies based on machine-to-machine (M2M) architectures of mobile operators, and short range wireless links based on sensor network technologies. As for the communication protocols, several initiatives are active in standardization bodies and industrial associations.

A pivotal role in Smart Grids is played by Smart Meters and communication Gateways, which are installed at the customer's premises. A Smart Meter performs measurements of the energy consumption, of the availability of energy storage capacity, or of local energy generation and sends these data via the Gateway to External Entities, e.g., to a metering operator or a meter service provider, which in turn provide these data to the energy supplier to enable accounting and billing. Also other entities such as Distribution

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Welcome from the Editor

Diwakar Krishnamurthy, University of Calgary

I thank the STC for giving me the opportunity to serve as the newsletter chair. I would like to thank Chris our outgoing chair for the exemplary work he put into the newsletter. Chris's enthusiasm and hard work ensured that the newsletter remained relevant as a valuable source of information and insight for our community members. Thank you Chris!

I am excited to announce that several new information officers have volunteered to provide and curate content for the upcoming issues. With their addition, the STC is well positioned to deliver on the vision of broadening the scope of the newsletter to themes such as green networks and the application of IT to enhance sustainability in other domains such as transportation and agriculture. I welcome the new officers onboard and I look forward to a fruitful new phase of the STC!

STC Updates

By Cristina Rottondi, Politecnico di Milano

Membership: 558

Report from Secretary/Treasurer (Cristina Rottondi):
- Collected officers' activity reports and prepared monthly STC report.

Report from Web/Conferences Chair (Yan Shvartzshnaider):
- Updated social media websites. Updated the main website with new officers.

Report from Academic Chair (Niklas Carlsson):
- Working with the industry chair on the next community highlight feature(s).

Report from Membership Chair and vice-Chair (Sergey Blagodurov, Matthew Forshaw):
- Counted the number of members every week for the past month.
- Sent invitations to potential STC-SC members and continued to work on the new invitation list.

Report from Communications Chair and vice-chair (Abhishek Chandra, Bhuvan Urgaonkar):
- Compiling the list of upcoming events and deadlines for inclusion in the next newsletter

Report from Industry Chair (Canturk Isci):
- Continuing joint work with the academic chair on identifying and presenting interesting research activities and directions in sustainable computing and computing for sustainability from industry and academia. Our goal is to improve visibility of emerging research areas and to enable cross-collaboration opportunities across academia and industry.

Report from Information Officers (Fan Dongrui, Guillaume Jourjon, Cristina Rottondi, Massimo Tornatore):
- Contributed material for newsletter and blogs

Report from the Newsletter Editor (Christopher Stewart):
- I passing the torch to Diwakar. I will server as an advisor and information officer henceforth. Thank you to everyone that has worked with me through this journey.

STC-SC Officers

Chair:Danilo Ardagna, Politecnico di Milano

Secretary/Treasurer: Cristina Rottondi, Politecnico di Milano

Web Master: Yan Shvartzshnaider, University of Sydney

Academics: Niklas Carlsson, Linköping University

Communication:Abhishek Chandra, University of Minnesota

Communication: Bhuvan Urgaonkar, Penn State

Industry Chair: Canturk Isci, IBM

Editor: Diwakar Krishnamurthy, University of Calgary

Editor Emeritus: Christopher Stewart, Ohio State

Membership: Sergey Blagodurov, Simon Fraser University

Membership: Matthew Forshaw, Newcastle University

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System Operators (DSOs) or Regional Transmission Operators (RTOs) might be interested in such data to optimize the distribution network [4]. The customer, i.e., the Gateway, does not only send data but could also receive data, e.g., pricing information when using variable tariffs to which it responds accordingly. Thus, the data of the smart metering system has a certain economic value, may enable several value added services and can be accessed by multiple entities. However, security and privacy are of paramount importance to ensure correct operation and protection of customers' personal data: it has been shown that customers' electrical usage readings can be used to profile their behavior and even to determine which household appliances are being used [5,6]. Therefore, through the analysis of the customers' electrical load profile, detailed information about personal habits and lifestyles can be inferred, leading to potentially threatening consequences: burglars could detect whether houses are unoccupied before attempting burglaries, vendors could select potential targets for their marketing campaigns, insurances could infer the health status or the propensity of an individual to cause accidents at home.

Therefore, numerous governmental authorities and standardization bodies have emanated rules and restrictions about the treatment and diffusion of meter readings: for example, NIST [7] mandates that, unless strictly necessary, metering data should be anonymized in order to prevent utilities and third parties from linking the collected information to the identity of the customers that generated them. A recent Act of the USA Committee on Homeland Security [8] imposes that procedures for the anonymization of cyber-information must be defined in order to make such information available to external parties, e.g. for academic research or actuarial purposes. Depending on the specific contexts and applications, data anonymization can be achieved through different approaches [9], ranging from generalization (where information is coarsened into representative sets) to perturbation (where data are polluted by means of noise addition), pseudonymization (which replaces the individuals' true identities with pseudonyms), and aggregation (which releases cumulative data computed on the information provided by multiple individuals, so that the contribute of a single entity is no longer identifiable in the aggregated data).

Designing a privacy-friendly measurement collection architecture and an associated set of procedures involves several layers: the secure transport of the data over the communication network, the secure storage of collected measurements, and suitable procedures for accessing the data. Though privacy-preserving techniques have been widely investigated by the research community in the last decades, none of the state-of-the-art solutions can be straightforwardly applied to the Smart Grid scenario, due to its characterizing peculiarities [10],[11]. First of all, since Smart Meters are resource-constrained devices and must have a low cost (typically in the order of $100), they are able to support only lightweight cryptographic and communication operations. Secondly, the Smart Grid infrastructure must scale to a large number of meters (100,000 or more) with a retrieval time in the order of minutes, while ensuring reliability above 99.9%. Finally, multiple entities must be allowed to access the metering data, possibly with different requirements in terms of precision and granularity: for example, an energy provider must know the exact amount of energy consumed by each customer in order to compute his/her monthly bill, but such measurements can be time-aggregated on daily/weekly scale. Conversely, a grid operator needs real-time energy consumption data to ensure the correct operation and management of the electricity grid, but they can be space-aggregated at neighborhood level.

Therefore, in the next issues an overview on recently proposed frameworks for a privacy-friendly data collection infrastructure in Smart Grids will be proposed, with particular focus on security issues at both physical and communication/protocol layers.