MÄLARDALEN UNIVERSITY
SWEDEN

The ITS-EASY Post Graduate School for
Embedded Software and Systems

Knowledge Foundation

Initial Trust Establishment for Heterogeneous Industrial Communication Networks

Apala Ray

Licentiate Thesis, June 16 2014

ABB

Apala Ray is a scientist currently working at ABB Corporate Research, India. She has been working with ABB in the area of wireless and security since 2008. In 2008, she has received her M.Tech. in Information Technology specialized in Networking and Communication from International Institute of Information Technology, Bangalore, India. She also did a short STINT at Technical University Kaiserslautern, Germany for her Master Thesis which is on BLAST Architecture for MIMO System. She has been working with ABB in the area of wireless and security since 2008. At the end of 2011, she is also enrolled as a PhD student in the ITS-EASY Industrial Research School at Mälardalen University (MDH). Her main research area is focused on secured communication for industrial automation network.

Contact information
+91 90 08 58 86 61
apala.ray@in.abb.com
apala.ray@mdh.se
www.es.mdh.se/staff/337-Apala_Ray

Initial Trust Establishment for Heterogeneous Industrial Communication Networks

Apala Ray

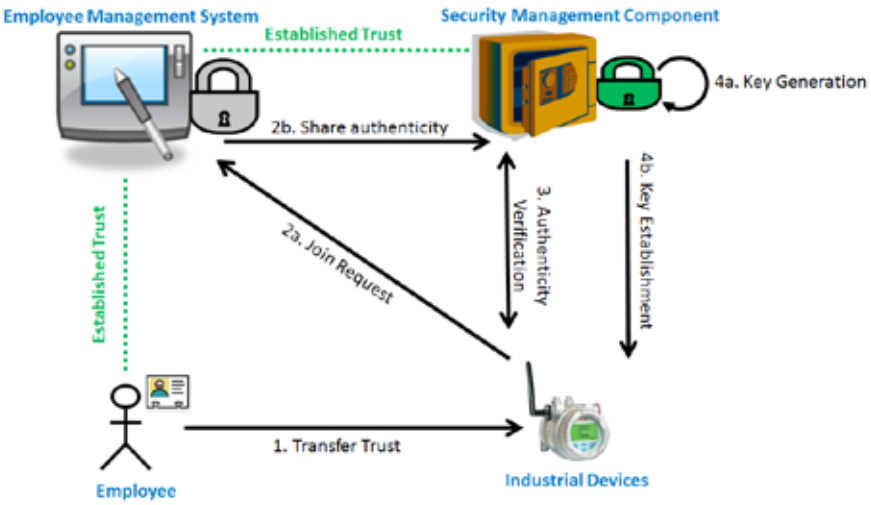
Licentiate Thesis, June 16 2014

Abstract

The severity of cyber threats towards existing and future industrial systems has resulted in an increase of security awareness in the industrial automation domain. Compared to traditional information security, industrial communication systems have different performance and reliability requirements. The safety and availability requirements can also sometimes conflict with the system security design of plants. For instance, it is not acceptable to create a secure system which may take up additional time to establish security and as a consequence disrupt the production in plants. Similarly, a system which requires authentication and authorization procedures before any emergency action may not be suitable in industrial plants. Therefore, there is a need for improvement of the security workflow in industrial plants, so that the security can be realized in practice. This also leads to the requirement of secure device deployment and secure data communication inside the industrial plants.

In this thesis, the focus is on the initial trust establishment in industrial devices. The initial trust establishment is the starting point for enabling a secure communication infrastructure. Reusability analysis with financial sectors has been considered as the reuse of security solutions from this adjacent application domain can be a simple and an effective way to achieve the desired system security. Through this analysis, the reusability features have been identified and workflows have been proposed which can be used to bootstrap initial trust in the industrial process control devices and manage security workflow. A proof-of- concept implementation to prove the feasibility of the device deployment workflow has also been provided.

Initial Trust Establishment Framework



List of Publications

Papers Included in the Licentiate Thesis

Initial Key Distribution for Industrial Wireless Sensor Networks. Apala Ray, Johan Akerberg, Mikael Gidlund and Mats Bjorkman. In proceedings of the 2013 IEEE International Conference on Industrial Technology (ICIT), pages 1309 - 1314, Cape Town, South Africa, February, 2013.

Reusability assessment of financial card readers' security mechanisms in process control devices. Apala Ray, Johan A kerberg, Mikael Gidlund, Mats Bjorkman and Christophe Tremlet. In proceedings of 11th IEEE International Conference on Industrial Informatics (INDIN), pages 494 - 499, Bochum, Germany, July, 2013.

A Solution for Industrial Device Commissioning along with the Initial Trust Establishment. Apala Ray, Johan Akerberg, Mikael Gidlund and Mats Bjorkman. In proceedings of the 39th Annual Conference of the IEEE Industrial Electronics Society (IECON), pages 5570-5575, Vienna, Austria, November, 2013.

An Industrial Device Deployment Framework using the Initial Trust Establishment Workflow. Apala Ray, Johan Akerberg, Mikael Gidlund and Mats Bjorkman. Submitted to the IEEE Transactions on Industrial Informatics.

Additional Papers, Not Included in the Licentiate Thesis

WirelessHART device integration challenges and solutions in industrial automation. Ravish Kumar, Apala Ray, Mallikarjun Kande. In proceedings of the IEEE 18th Conference on Emerging Technologies and Factory Automation (ETFA), pages 1-4, Cagliari, Italy, September, 2013.

Wireless infrastructure for oil and gas inventory management. Shanthi Vellingiri, Apala Ray, Mallikarjun Kande. In proceedings of the 39th Annual Conference of the IEEE Industrial Electronics Society (IECON), pages 5461-5466, Vienna, Austria, November, 2013.

Energy efficient environment control system using wireless condition monitoring. Mallikarjun Kande, Jithendrian Sundaravaradan, Apala Ray, Venkateswaran Narayanan. In 8th International Conference and Expo on Emerging Technologies for a Smarter World (CEWIT), pages 1-4, New York, November 2011.

Planning and analysis tool for large scale deployment of wireless sensor network. Apala Ray. International Journal of Next-Generation Networks (IJNGN), Vol 1, No 1, December 2009.

Patents, Not Included in the Licentiate Thesis

A method and a system for localization in industrial wireless sensor network. Apala Ray, Mallikarjun Kande, Venkateswaran Narayanan, Ravish Kumar. WO2012014008 A1, 02-Feb-2012.

A method of secure multiple joining for a device to join wireless system network and a wireless device thereof. Ravish Kumar, Apala Ray, Mallikarjun Kande, Venkateswaran Narayanan, Hemanta K Kalita. WO/2011/121388, 06-Oct-2011.

Advisors

Main advisor
Prof. Mats Björkman
Mälardalen University

Co-advisor
Johan Åkerbg
ABB Corporate Research

Co-advisor
Mikael Gidlund
Mid Sweden University

Examiner and Committee

Examiner
Docent Christian Rohner
Uppsala University

Committee
Prof. Sasikumar Punnekkat
Mälardalen University

Committee
Docent Mikael Ekström
Mälardalen University

Wireless Communication Research Group

The research group Wireless Communication, led by professor Mats Björkman, is focusing on research in wireless sensor networks; communication energy optimization, safe and secure wireless industrial automation, reliable wireless communication in harsh environments and content distribution network optimization.

The ITS-EASY post graduate school for Embedded Software and Systems

ITS-EASY is an industrial research school in Embedded Software and Systems, affiliated with the School of Innovation, Design and Engineering (IDT) at Mälardalen University (MDH) as an integrated part of the MDH strategic research area Embedded Systems (ES).

ITS-EASY is funded by the Knowledge Foundation (KKS), and the nine participating companies. ITS-EASY started October 1st 2011, and will continue until September 30th 2020. During that period the PhD stu¬dents will complete their studies and obtain the doctoral degree in Computer Science.

ITS-EASY is a large organization: it counts 22 PhD students, 14 main advisors from IDT, 18 co-advisors from IDT and the partner companies, and more than 25 associated members; senior researchers and industrial specialists. The board, led by Helena Malmqvist, ABB, has five members, and the industrial committee where all participating companies are represented, has 11 members. The management team of the research school consists of five members. All in all, about 85 persons are directly engaged in ITS-EASY.

www.mrtc.mdh.se/projects/itseasy

Board

Helena Malmqvist, Chair of the board and Head of the External Research Collaboration, ABB AB Corporate Research
Antonia Bertolino, Leader of the Software Engineering Research Laboratory at ISTI, Istituto di Scienza e Tecnologie dell'Informazione
Kristina Forsberg, Technical specialist at Electronic Defence Systems at SAAB AB
Rikard Mäki, Director Technology Planning and Public Funding, Volvo Construction Equipment
Claes Wohlin, Professor of software engineering, Blekinge Institute of Technology

Industrial Committee

ABB: Peter Löfgren
Addiva: Dag Lindahl
Alten: Detlef Scholle
Bombardier: Christer Persson
Effective Change: Stig Larsson
Ericsson: Sigrid Eldh
Etteplan: Johan Sundell
Hök Instrument: Bertil Hök
MotionControl: Christer Gerdtman
SICS: Marcus Bohlin
VOLVO CE: Peter Wallin

Management Team

School director: Prof. Ivica Crnkovic
Director of studies: Prof. Kristina Lundqvist
School coordinator: Radu Dobrin, Senior Lecturer
Communications manager: Malin Rosqvist
Finance manager: Gunnar Widforss