

# IEEE INTERNATIONAL CONFERENCE ON INDUSTRIAL INFORMATICS INDIN'16

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## INDIN'2016 Tutorial

### Title:

Industrial Informatics for Future Smart Homes and Buildings

### Presenter(s):

- 1, Zhibo Pang (ZP), Principal Scientist, ABB Corporate Research, Sweden
- 2, Gordon Padkin (GP): Thread Group and NXP Semiconductors, Germany
- 3, Kim Fung TSANG (KF), Associate Professor, City University of Hong Kong, Hong Kong
- 4, Gerhard Hancke (Jr) (GH), Assistant Professor, City University of Hong Kong, Hong Kong
- 5, Wing-Kuen Ling (WK), National Young Thousand People Distinguished Professor, Guangdong University of Technology, China

### Brief Description of Tutorial:

The emerging breakthrough of the Internet-of-Things (IoT) offers promising prospects for all sectors. Subsequently enabled by the Industrial IoT, the 4th industrial revolution (Industry4.0) has been ignited by industrial giants. Under this context we believe the future (residential, commercial, and industrial) building infrastructure will be redefined and largely expanded from the conventional functionalities due to unprecedented integrations at three level: 1) cross-technology integration of smart devices from different service suppliers, 2) cross-organization integration of information and services from different enterprises, and 3) cross-domain integration of business ecosystems from different industries.

In this tutorial, the implications of IoT and Industrial4.0 will be reviewed from industrial point-of-view. New visions and concepts of future buildings will be inspired such as automated building, sustainable building, healthy building, robotized building, and manufacturing building. Market forecast of building automation, energy efficiency, micro grids, wired and wireless connectivity technologies will be overviewed. Then we will introduce technical trends of enabling technologies like wireless sensor network (WSN), high accuracy real time localization system (RTLS), in home healthcare, etc. New challenges and future research directions will be identified. A number of example projects from academia and industry, not only on horizon technologies but also on vertically integrated solutions, to give more insights about the upcoming revolution. Additionally, cross domain standardization efforts will be introduced by globally leading standardization body.

### Outline

Part 1, ZP and KF: trends in wireless communications

Part 2, ZP/KF/GH: potential applications e.g. energy efficiency, ambient assisted living, etc.

Part 3, ZP/WK: Home healthcare informatics

Part 4, CB: Standardization efforts

**Intended Audience:**

This tutorial is prepared for researchers (both academic and industrial practitioners) in any of the following technical areas: wireless communications, wearables, industrial IoT, industrial informatics, service computing if they are working for any of the following application domains: building automation, smart home, and healthcare. Since the tutorial will be cross-disciplinary, the audience don't need to have deep knowledge of all the above areas, instead they need to have some understanding of at least one of them. So the audience could follow the tutorial and get into insights from different angles based on their own expertise.

## Presenter(s) Biography:

### 1, Zhibo Pang

Dr. Zhibo Pang (*Senior Member IEEE*) received B.Eng. in Electronic Engineering from Zhejiang University, Hangzhou, China in 2002, MBA in Innovation and Growth from University of Turku, Turku, Finland in 2012, and PhD in Electronic and Computer Systems from the Royal Institute of Technology (KTH), Stockholm, Sweden in 2013. He is currently a Principal Scientist and Project Manager at ABB Corporate Research, Västerås, Sweden and serving as Adjunct Professor or similar roles at universities such as Royal Institute of Technology (KTH), Sweden, Tsinghua University, China, and Beijing University of Post and Telecommunication (BUPT), China. He is a Senior Member of IEEE and serves as Vice Chair of STC in the Technical Committee on Cloud and Wireless Systems for Industrial Applications, Industrial Electronics Society of IEEE.

He has been leading various projects related to wireless communication and embedded systems at ABB including real-time industrial wireless sensor networks, high accuracy localization, IP-based convergence of communications, and vertical solutions of internet-of-things for smart homes and buildings, smart factory and manufacture, and smart grids. Before ABB, he started his career in semiconductor industry, designing baseband and application processors and turn-key solutions for mobile smart devices. He led the development of the world first single chip DVB-S receiver SoC and turn-key solution which gained 30% world market share quickly and was awarded as National Great Invention Award by the Ministry of Information Industry of China in 2005. Then at KTH, he led the development of wireless sensor network platform for logistic, industrial, and healthcare applications. He won the First Place Prize of the RFID Nordic EXPO in 2008 by an Interactive and Intelligent Packaging Solution (TouchMe), and conceptualized and demonstrated for the first time the Intelligent Medicine Box (iMedBox) for ubiquitous healthcare in 2009.

He has 25 patents and 10+ refereed journal papers and 30+ conference papers including the Outstanding Paper Awards in ICACT2013. His current research interests include the Internet-of-Things, wireless sensor network, industrial communication, real time embedded system, enterprise information systems, automation networks, multicore system-on-chip and network-on-chip. He also works on the business-technology joint research such as strategy, business model, value chain, and entrepreneurship.

“From Automated Home to Integrated Sustainable, Healthy and Manufacturing Homes: A New Story Enabled by the Internet-of-Things and Industry 4.0”, *Journal of Management Analytics* (Taylor & Francis), DOI: 10.1080/23270012.2015.1115379

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“An emerging technology – wearable wireless sensor networks with applications in human health condition monitoring”, *Journal of Management Analytics* (Taylor & Francis), vol2, Iss 2, 2015, DOI: 10.1080/23270012.2015.1029550

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“A Health-IoT Platform Based on the Integration of Intelligent Packaging, Unobtrusive Bio-Sensor and Intelligent Medicine Box”, *IEEE Transactions on Industrial Informatics*, 2014, DOI: 10.1109/TII.2014.2307795

“REALFLOW: Reliable Real-Time Flooding-Based Routing Protocol for Industrial Wireless Sensor Networks”, *International Journal of Distributed Sensor Networks*, Volume 2014 (2014), Article ID 936379, 17 pages

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“Ecosystem-Driven Design of In-Home Terminals Based on Open Platform for the Internet-of-Things”. *ICACT Transactions on Advanced Communications Technology (TACT)*, 2013,

“Intelligent Packaging and Intelligent Medicine Box for Medication Management towards the Internet-of-Things”. *ICACT Transactions on Advanced Communications Technology (TACT)*, 2013,

“Prototyping and Experimental Comparison of IR-UWB based High Precision Localization Technologies”, *IEEE Smart World Congress 2015*, Beijing, China

"RESTful Information Exchange among Engineering Tools for Wireless Home Automation Devices", The 2015 International Conference on Computer, Information, and Telecommunication Systems, CITS 2015, Gijon, Spain

"Industry-Friendly Engineering Tools for Wireless Home Automation Devices", INDIN 2015 IEEE International Conference on Industrial Informatics, Cambridge, UK

"Preliminary Study on Industry-Friendly and Native-IP Wireless Communications for Building Automation", International Conference on Industrial Networks and Intelligent Systems (INISCom2015), Mar 2015

"Preliminary Study on Wireless Home Automation Systems with Both Cloud-Based Mode and Stand-Alone Mode", 13th IEEE International Conference on Ubiquitous Computing and Communications (IUCC2014), Dec 2014

, "Positioning Infrastructure for Industrial Automation Systems based on UWB Wireless Communication", The 40th Annual Conference of IEEE Industrial Electronics Society (IECON 2014), Dallas, USA, Oct 2014

"Methodology of Implementing Distributed Function Block Applications using TinyOS WSN nodes", 19th IEEE International Conference on Emerging Technologies and Factory Automation (ETFA'2014), Barcelona, Spain, September 2014

"Experimental Study of UWB-based High Precision Localization for Industrial Applications", The 2014 IEEE International Conference on Ultra-Wideband (ICUWB 2014), Paris, France, Sep 2014

## **2, Gordon Padkin**

Gordon Padkin is a key player and evangelist in the Thread Group EMEA market education efforts, and has been active in the group for 1 year. Gordon is also responsible for regional marketing, microcontrollers at NXP Semiconductor. He has an extensive career in the semiconductor industry, beginning in 1996 when he worked for Motorola SPS as it evolved to become Freescale Semiconductor (one of the seven founding members of the Thread Group), which recently merged with NXP Semiconductors.

## **3, Kim Fung TSANG**

Dr. K F Tsang obtained the Ph.D. degree from the University of Wales at Cardiff in 1996. KF is now an Associate Professor as well as the Director of Wireless Sustainability Center in the Department of Electronic Engineering, City University of Hong Kong (CityU). He is also the Founder and Chairman of the Internet of Things Users Group – Hong Kong responsible for organizing and promoting activities for Internet of Things and sustainability.

KF joined City University of Hong Kong (CityU) in 1988 and has been enjoying his teaching, research and professional development at CityU since then. Apart from the normal teaching and research activities, he highly honors and enjoys the applied research in CityU. In 1997, KF set up Citycom Technology Ltd. (Citycom) with CityU so that he could excel his applied research by consolidating some of his work into product development, for instance, ZigBee Home Area Network (HAN) and Advanced Metering Infra-structure (AMI) solutions for energy applications under the Smart Grid initiative. KF has been listed in the one of the few successful stories in ZigBee AMI rollout for high rises in the world. His work in ZigBee was listed on ZigBee Alliance "Members Success Story" (<30 success members out of ~400 members in the world).

KF has published about 170 technical papers. He has been actively engaged in professional activities including the Interviewer for CEng IET (2002 till date), the Chairman of IET Electronics Section 2003-5, The Chairman (2008) and Vice Chairman (2015) of IEEE Consumer Electronics Hong Kong Chapter, the Chairman of Chinese Institute of Electronics Hong Kong 2006-2010, and Chairman (2015-16) and Deputy Chairman of HKIE Electronics Division (2013-15). KF also organizes and chairs a lot of conferences, including the HKES 2013, HKES 2014 and HKES 2015 organized by HKIE EN Division, Special session IEEE Industrial Electronics Society: for IECON 2013, INDIN 2014, IECON 2014, INDIN 2015, IECON 2015, ICIT 2016, ISIE 2016, INDIN 2016, IECON 2016, Track Co-Chair for IECON 2015, ICIT 2016, ISIE 2016, INDIN 2016, IECON 2016. . KF also holds the following key posts in IEEE societies/community: ZigBee Chair of IEEE Consumer Electronics Society (2014-15), Associate Editor of IEEE Transactions on Industrial Electronics, Guest Editor of IEEE Transactions on Industrial Electronics, Advisor for Office of the Communications Authority (OFCA), Expert Review Panelist for Hong Kong R&D Centers for Logistics and Supply Chain Management Enabling Technologies (LSCM), Advisor for Energy Development, Hong Kong Police.

KF was also the recipient of numerous awards including the Prize winner of the Applied Research Excellence Award by the City University of Hong Kong in 1997, the Certificate of Merit in both the first Hong Kong Science & Product Innovation Competition in 1998 and the World Chinese Invention Exposition'98, the *EDN Asia Innovator Award in 1999*, the *Super-Wireless Application Award* by Ericsson in 2000, the *Best Award* by Freescale Semiconductor Ltd. in 2008, the Best Innovative Technology Enterprise Award in 2009, and Excellent Product Awards at the 12th China Hi-Tech Fair in 2010.

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- P. Zhou, G. Huang, L. Zhang, and K. F. Tsang "Wireless sensor network based monitoring system for a large-scale indoor space: data process and supply air allocation optimization," *Energy and Buildings*, vol. 103, pp. 365-374, Sep. 2015.

#### 4, Gerhard Hancke

Dr. Gerhard Hancke is currently an Assistant Professor at the Department of Computer Science, City University of Hong Kong. His area of expertise is in security and reliability of low-resource wireless devices in the context of IoT applications, like item tracking/logistics, smart cities, building automation, etc.

He is Senior Member of IEEE, a Chartered Engineer with the UK Engineering Council and a Smart Card Alliance 'Certified Smart Card Industry Professional' (CSCIP). He is the secretary of the IEEE IES Technical Committee on Cloud and Wireless Systems for Industrial Applications and a member of the IFIP Working Group 11.2 on Pervasive Systems Security.

He obtained PhD Computer Science (2003-2008) from University of Cambridge, M.Eng Computer Engineering (2003), University of Pretoria, and B.Eng Computer Engineering (1999-2002), University of Pretoria.

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## 5, Wing-Kuen Ling

Wing-Kuen Ling received the B.Eng. (Hons) and M.Phil. degrees from the department of Electronic and Computer Engineering, the Hong Kong University of Science and Technology, in 1997 and 2000, respectively, and the Ph.D. degree in the department of Electronic and Information Engineering from the Hong Kong Polytechnic University in 2003. In 2004, he joined the King's College London as a Lecturer. In 2010, he joined the University of Lincoln as a Principal Lecturer and promoted to a Reader in 2011. In 2012, he joined the Guangdong University of Technology as a Full Professor. He is a Fellow of IET, a senior member of IEEE, a China National Young Thousand-People-Plan Distinguished Professor, a Pearl Scholar, and a University Hundred-People-Plan Distinguished Professor. He was awarded the best reviewer prizes from the IEEE Instrumentation and Measurement Society in 2008 and 2012. He currently serves as the associate editors of the *Circuits, Systems and Signal Processing*, the *Journal of Franklin Institute*, the *Journal of Industrial and Management Optimization* and the *International Journal of Bifurcation and Chaos*. He has published an undergraduate textbook, a research monograph, four book chapters, more than 100 internationally leading journal papers and about 100 highly rated international conference papers. His research interests include time frequency analysis, optimization theory, nonlinear digital signal processing systems and control theory.

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