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# CIGRE MALAYSIA TECHNICAL WORKSHOP

*Software Defined Substation*

Virtualizing Substation Monitoring,  
Control, Automation and Protection

7-10 SEPT 2021

# PROGRAM BOOK

Organised by





# INTRODUCTION

## WELCOME TO CIGRE MALAYSIA'S ONLINE TECHNICAL WORKSHOP ON

“SOFTWARE DEFINED SUBSTATIONS – Virtualizing Substation Monitoring, Control, Automation and Protection”

CIGRE Malaysia, along with Tenaga Nasional Berhad and Intel Corp as co-organizers, is proud to host its first on-line technical workshop on “Software Defined Substation – Virtualizing Substation Monitoring, Control, Automation and Protection” which will be held from the 7th to the 10th of September 2021.

The concept of “software defined” was introduced in the IT industry and is growing to be the biggest buzzword in the IT world. . It started out as a way to manage issues related to the IT infrastructure in trying to break down IT silos – compute, storage, networking. Software Defined Network SDN, Software Defined Storage SDS, Software Defined Data Center SDDC are part of a broader trend which has come to be known as software defined everything, SDx. The software-defined concept proposes to separate/detach the functionalities of a device from its hardware base by using software to define the functions. The aim is decouple the functionalities and capabilities of the device from the hardware allowing the use of generic hardware devices that can configured or defined by the software functions implemented. The term software defined is also synonymous with virtualization which means to emulate hardware using software. The concept of SDx has been defined as any physical item or function that can be performed by software.

How does this relate to Software-Defined Substation? A possible manifestation of this concept in a substation would be to run all the protection, automation, control and monitoring functions for the whole substation by virtualizing them into a single generic substation computer,. A possible model of the digital substation of the future applying this software-defined concept is one that will consist of smart sensors feeding data to the substation computer that has all the protection, automation, control and monitoring functions embedded inside providing it with the capability to control an army of smart actuators. There will no longer be discrete IEDs or protection devices, controllers etc. In this workshop, we plan to explore the viability and benefits of implementing the software-defined concept to the electricity supply industry and in particular, to gauge how it can shape the digital substations for the grid of the future. For this purpose, we have assembled speakers from utilities, organizations and electricity supply industry who have graciously agreed to share their experiences, aspirations and thoughts on this technology.

In this 4 days program, we will start with a pre-workshop tutorial to give a background of the key technologies that are enabling this software-defined concept before delving deeper into the subject of Software Defined Substation through sharing sessions by both utilities and industry players and

finally ending the workshop with a panel session consisting of members discussing Software Defined Substation from different aspects and perspectives.

We hope that this workshop will provide a greater understanding and appreciation on the concept of virtualization of the substation's monitoring, control, automation and protection functions and provide valuable insights into the application of this technology.

Lastly, please enjoy yourself in this workshop, albeit virtually, and we hope that you will participate actively.

# Objective of the Technical Workshop

- To allow participants to get a general understanding and appreciation on the concept of Software Defined Substation
- To share learnings from various work by utilities and industry players
- To strengthen existing collaborations as well as spur new technical collaborations amongst the participants.
- To provide strategic as well as technical insights to owners and operators of electrical networks,
- To help industries gain insights on customer needs.

14 participating organizations from utilities and industries



# FOREWORD BY TENAGA NASIONAL BERHAD



It is our pleasure to support this technical workshop by CIGRE Malaysia, which focuses on the future electrical substation. In collaboration with Intel Corporation, this workshop is a gathering of presenters from utilities and industries from around the world to share their aspirations and experience in this technology. As energy utilities worldwide work to facilitate the energy transition, it is timely that this workshop, which will explore and deliberate the concept of virtualising protection, automation and control, is held.

TNB aspires to be the leading provider of sustainable energy solutions in Malaysia and internationally. We believe that a flexible and reliable grid that can integrate a larger volume of renewable energy to support the energy transition – Grid of the Future - will play a critical role. The future digital substation will be a vital component of this Grid of the Future initiative. The ability to quickly adapt to the changing power flows and operational constraints by reconfiguring protection settings and even modifying protection and automation schemes remotely is a prerequisite for the digital substation to manage the power system reliably, efficiently, and securely.

This event is a perfect opportunity to focus on the future, deliberate on possibilities and explore the path less taken in determining the journey we must take. We hope that as this workshop delves into the subject of Software Defined Substations, it will provide power utilities and industries with pertinent information and feedback. We thank CIGRE Malaysia for the opportunity to co-organise this workshop and extend our appreciation to all presenters and organisations that will contribute to this technical workshop.



## FOREWORD BY INTEL Corp.



Intel is pleased to co-organize this Technical Workshop on SDES, along with Cigre Malaysia and Tenaga Nasional Berhad. Intel has been developing key technologies and enablement frameworks to drive transformation of electrical grid networks.

Electrical grids in most parts of the world were setup for the traditional purpose of delivering electricity from generation to end-use. However, these electrical grids are nowadays being operated beyond their intended design and subjected to new use-cases like distributed generation at the edge of grid and renewable energy.

These grids were also mostly setup using dated infrastructure and fixed-function appliances, which were never designed for agility and flexible reconfiguration of the network. Modernizing the grid to enable it to be more agile yet resilient, using cutting-edge technologies, can help greatly reduce the frequency and duration of power outages, reduce storm impacts, and restore service faster when outages occur.

Technologies like Virtualization, Artificial Intelligence (AI), Real-Time data analytics and the Industrial Internet of Things (IIoT), open a vast number of application opportunities to help lower maintenance costs, reduce disruptions, improve quality control and more.

As the promises of 5G become a reality, utilities are also presented with even more ways to propel their operations into the future. Utilities may also benefit from a modernized grid, including improved security, reduced peak loads, increased integration of renewables, and lower operational costs. It is with these motivations that Intel is committed to working with power utilities and the solution providing ecosystem, to help transform the grid network through enablement technologies, and constant sharing of such developments through workshops such as the SDES Technical Workshop 2021.



# PROGRAM AGENDA

Day 1 : 7th Sept 2021

Pre-Workshop Tutorial :

Introducing the concept of Software Defined Substation and its underlying technology enablers

<b>Time (MYT)</b>	<b>Program</b>
0845 - 0900	Participants register daily attendance
0900 – 0915	Welcome and Introduction by Secretary of CIGRE Malaysia Hasrul Wira Loubna Mohamed
0915 - 1000	Utility 2.0 : Future of Power Utilities & Substation Automation and Controls Prithpal Khajuria, Intel Corporation, USA
1000 - 1045	Digital Transformation Acceleration With Software-defined Anything (Sdx) Prasanna Lohar, DCB Bank Mumbai, India
1045 - 1100	<b>BREAK</b>
11.00 – 12.00	<b>Tutorial Session 1:</b> Software Defined Networks and Network Function Virtualization Wan Azlan Wan Kamarulzaman, Tenaga Nasional Berhad, Malaysia
1200 - 1400	<b>BREAK</b>
1400 - 1500	<b>Tutorial Session 2:</b> Software Containers Lawrence Law, Intel Corporation
1500 - 1630	<b>Tutorial Session 3:</b> Virtual Substation Technology Substation Software Architecture Wan Azlan Wan Kamarulzaman, Tenaga Nasional Berhad, Malaysia
1630	Closing Remarks by Secretary of CIGRE Malaysia Hasrul Wira Loubna Mohamed

# PROGRAM AGENDA

Day 2 : 8th Sept 2021

Official Opening and Utility Sharing Session

Time (MYT)	Program
0830 -0845	Participants register daily attendance
0845 – 0900	Session Morning briefing Hasrul Wira Loubna Mohamed
0900 - 0920	Welcoming Speech by the Organizing Committee Mohamad Firdaus Yon   Opening Video
0920 - 0925	Introduction of Utility Sharing Session Chairman Hasrul Wira Loubna Mohamed
0925 – 0930	Session Chairman's introduces the session objectives, topics and speakers Nik Sofizan Nik Yusuf, Tenaga Nasional Berhad, Malaysia
0930 – 1015	<b>Paper 1:</b> Substation Virtualization at Southern California Edison Zeus Xioco& John Vogel, Southern California Edison
1015 – 1100	<b>Paper 2:</b> A Utility Perspective in Defining the Power System Virtualization Roadmap Anthony Sivesind, Salt River Project, Arizona, USA
1100 - 1115	<b>BREAK</b>
1115 – 1200	<b>Paper 3:</b> Software Defined Substation : A TNB Grid Perspective Wan Azlan Wan Kamarulzaman, Tenaga Nasional Berhad, Malaysia
1200 - 1300	<b>Paper 4: Petronas Malaysia</b> 1. Realizing Electrical Digital Twin for Intelligent Substation in Oil and Gas environment - Adri Thauriq Mohamed and Noor Mohd Fadzli 2. Value driven aspiration of CPC in Oil and Gas Industry - Mohd Khairil Mohd Hatta and Faizah Othman
1300 - 1345	<b>Break for lunch</b>
1345 - 1400	Session Chairman introduce the afternoon program
1400 - 1445	<b>Paper 5:</b> 61850 configuration in the Software Defined Electrical Substation Sander Jansen, Alliander, Netherlands
1445 - 1530	<b>Paper 6:</b> SEAPATH, Virtualization for Real-time Power Grid Substation Automation WATARE Aurelien, RTE France
1530 -1600	Closing Remarks by Session Chairman
1600 - 1630	Housekeeping Announcements by Session Facilitator



# PROGRAM AGENDA

Day 3 : 9th Sept 2021  
 Industry Sharing Session

<b>Time (MYT)</b>	<b>Program</b>
0800 -0830	Participants register daily attendance
0830 – 0840	Session Morning briefing Farah Diba binti Norddin, Tenaga Nasional Berhad, Malaysia
0840 - 0850	Introduction of Utility Sharing Session Chairman Farah Diba binti Norddin, Tenaga Nasional Berhad, Malaysia
0850 - 0900	Session Chairman's introduces the session topics and speakers Avinash Rajah, Intel Corporation, USA
0900 – 0945	<b>Paper 1:</b> Container-based virtualization platform for integrating and deploying power system automation, device management and security applications. Darrin Kite, Schweitzer Engineering Laboratories, Pullman WA USA
0945 – 1030	<b>Paper 2:</b> Software-defined architectures of substation Digitization enabling Decarbonization & Decentralization for the Grid of the Future Dr. Mital Kanabar, GE Renewable Energy (Markham, Ontario, Canada)
1030 - 1045	<b>BREAK</b>
1045 – 1130	<b>Paper 3:</b> Virtualized Edge Computing Platform for Substation Protection and Control Mr. Kannan Devarajan, TTEch Industrial North America, Santa Clara
1130 – 1215	<b>Paper 4:</b> Key Computing Platform Requirements for SW-defined Substation Automation and Controls Systems Shashikiran Tadas, Intel Corporation, USA
1215 - 1345	<b>Break for lunch</b>
1345 - 1400	Session Chairman introduce the afternoon program Avinash Rajah, Intel Corporation, USA
1400 - 1445	<b>Paper 5:</b> Applying container technology for lightweight virtualization of secondary substations Dr. Mariano Ortega de Mues, Minsait an Indra company, Spain
1445 - 1530	<b>Paper 6:</b> Centralized protection, measurement and control for digital substations Harlem Tsai, ABB (Taiwan)
1530 – 1615	<b>Paper 7:</b> A service-oriented architecture for the automation of future distribution grids: the experience of the SOGNO project. Dr.-Ing. Marco Pau, E.ON Energy Research Center, Aachen Germany
1615 - 1700	Closing Remarks by Chairman Messages from Facilitator for next day program

# PROGRAM AGENDA

Day 4 : 10th Sept 2021

General Question & Answer, Panel Session & Closing Ceremony

Time (MYT)	Program
0830 - 0845	Participants register daily attendance
0845 – 0900	Session Morning briefing & Introduction of Panel Session Moderator Ida Kesuma binti Adi Negara, Tenaga Nasional Berhad, Malaysia
0900 - 0915	Moderator explains how the panel session will be conducted Mohamad Firdaus Yon, CIGRE Malaysia
0915 – 0945	<b>Summary by Workshop Session Chairman:-</b> - Utility Sharing Session - Industry Sharing Session - Summary of Participants Response
0945 - 1000	<b>BREAK</b>
1000 – 1200	<b>Panel Session:</b> • <b>Panel Session Members</b> 1. Mohamad Firdaus Yon, CIGRE Malaysia 2. Ir. Salmey Abdul Halim, Petronas 3. Mike Bates, Intel Corp, USA 4. Dr. Ricardo M. Pagiliarella, Deloitte, Australia 5. Nik Sofizan Nik Yusuf, Tenaga Nasional Berhad, Malaysia 6. Avinash Rajah, Intel Corp, USA  The panel will discuss on the potential impact of Software Defined Substation and how it can be leveraged into all areas in the utility business such as asset investment/replacement strategy, network planning/expansion, asset maintenance, network operations, etc. Panelists will also share their vision on how utilities should pivot to benefit from this technology as well as managing the associated risks.
1200	Closing Remarks by Intel Corp, Michael Bates
1210	Closing Remarks by Tenaga Nasional Berhad, Datuk Ir. Hj. Husaini Husin
1215	Closing Remarks by CIGRE Malaysia Deputy Chairman, Dato' Azmi Abdullah
1230	Final Messages from Workshop Organizer/Facilitator

# Pre-Workshop Tutorial

## Utility 2.0 : Future of Power Utilities & Substation Automation and Controls

### Synopsis:

Traditional substation automation and control systems in utilities are very costly to maintain because of their inflexibility to adopt new applications. These systems required complex redundancy for reliability and resilience, limited capabilities to fight back cyber and physical threats, high operational inefficiency due to requirements of truck roles, longer response time to deal with emergency situations and longer recovery cycle. With technical advancements in IT/OT integration practices, virtualization can simplify substation automation & control systems and solve current industry challenges while addressing cybersecurity and manageability concerns. This presentation aspires to highlight the current day challenges in the Power Sector and specifically to Grid operators. The substation virtualization will accelerate the innovation and brings operational benefits such as O&M cost reduction. The presentation will also cover recommended practices in deploying resilient and scalable platforms for substation virtualization.

### Presenter Biodata:

Prithpal Khajuria joined the Internet of Things Group (IOTG) of Intel Corporation as Global Segment Leader to drive grid modernization in the Power Sector. The vision of Intel is to help utilities innovate and modernize using software defined systems for next generation infrastructure which is based on standardized hardware, scalable software platform, standardized tools, easy to manage and be ready to deal with all kind of cyber and physical threats. The focus for Intel is to apply the virtualization technologies to modernize the power sector infrastructure in generation, transmission and distribution of electricity.

Prithpal is working with the ecosystem of equipment manufacturers, automation and software vendors, as well as utilities and service providers to develop and deploy connected devices, edge platforms and cloud architectures for operational excellence and transformative businesses. Prithpal has 15 years of experience in providing advanced solutions to the global energy industry. Before joining Intel in May 2015, he was consulting with electric utilities worldwide on Grid Modernization strategies and emerging technologies. Prior to his consulting activities, Prithpal led the Smart Grid Product Management teams at SK Telecom, Onramp Wireless and Silver Spring Networks. Prithpal holds a MBA in in Global Business Management and BS degree in Computer Sciences and Engineering.



**Prithpal Khajuria**  
Head of ISD Segment,  
Intel Corporation, USA

## Digital Transformation Acceleration with Software-Defined anything (SDx)

### Synopsis:

This presentation explains the concept of “software defined” as it began in the IT industry and what it may mean to other industries. The presentation goes beyond just the technical concepts but discusses the impact of SDx as well as what an organization will need to leverage SDx. The software-defined movement is truly a disruptive technology shift that is dramatically changing the IT industry on how it manages its infrastructure.

As business requirements continue to increase in speed and number, forward-thinking IT departments are moving away from hardware commitments and rigid architectures that constrict their ability to react and adjust to changing needs. Software-defined technologies are becoming the innovative powerhouses behind building more efficient and agile IT services for today and well into the future.

It will be interesting to determine if we can find parallels between the IT industry and the power supply industry and contemplate the changes SDx may bring in deploying resilient and scalable platforms for substation virtualization.

### Presenter Biodata:

Prasanna Lohar is currently the Head of Digital, Innovation and Architecture responsible for delivering Digital Platform Solutions and Products and entrusted with keeping Architecture Baseline , Adoption of Emerging Technology , Integrations , API Banking , Open Banking, while driving innovation to build culture , Industry collaboration for Disruptive & Unique Innovations in DCB Bank, India. He has actively contributed in the field of IT, digital and innovation through his involvement in many technical associations such as by being the Co-Chair of the Blockchain Committee of the Internet and Mobile Association of India as well as a member of the National Committee on Artificial Intelligence and Digital Transformation in FICCI. He has been an active speaker at many conferences and events, and is an accomplished writer having contributed to eight publications to date. He has been acknowledged for his many contributions through the awards he has received such as the Global Innovation Leadership Award from the World Innovation Congress, the BFSI Leadership Award 2020 by Elets Technomedia and the NextGen Digital Leader award (2019) by Data Quest India.



**Prasanna Lohar**  
Head Digital, Innovation,  
Architecture, DCB Bank,  
Mumbai India

**This pre-workshop tutorial is conducted by the TNB/Intel team that is currently collaborating on understanding the HW and SW needs to realize Software Defined Substation.**

Mr. Wan Azlan has worked in TNB in the area of control and automation for more than 30 years. He is currently a Principal Engineer (Real Time Systems) in the Grid of the Future unit of GSE. His work covers development of ETL and integration for the Grid Data Lake, setting up a data analytics platform, domain driven application design, cyber security and substation virtualization. He has an MSc in Real-Time Software Engineering from UTM. He is a registered Professional Technologist with the Malaysia Board of Technologist. Mr. Wan Azlan is a member of CIGRE Malaysia, the Association of Computing Machinery and the Australian Computer Society.



**Mr. Wan Azlan**  
Tenaga Nasional Berhad,  
Malaysia

Lawrence Law is an Industry Technical Specialist from Intel with over 10 years IT solutioning experience including oversight of ICT infrastructure designing, planning, implementing, and managing projects across industries.

In his most recent experience, he is responsible for understanding customer's business requirements and providing professional services solution to accelerate technology adoption for customers in South Asia (Malaysia and Indonesia).

Lawrence Law graduates from Multimedia University with a Bachelor Degree in IT majoring in Data Communications and Networking.



**Lawrence Law**  
Intel Corporation

The Pre-Workshop tutorial aims to provide participants a basic understanding on the concept of virtualization and the associated technologies. This tutorial is presented by the TNB/Intel team that is currently collaborating on understanding the HW and SW needs to realize Software Defined Substation.

## SESSION 1

### Software Defined Network and Network Function Virtualization

This session starts the pre-workshop tutorial on Software Defined Substations by providing the background on the rise of importance of virtualization and software defined movement that began in the IT data centre and telecommunication industry, the influence of open source standardization to the IT and telecommunication and the beginnings of containers and orchestration

## SESSION 2

### Software Containers (Intel)

This part introduces Intel virtualization and container technology, the selection of open source components that are used in the technology and modifications made to the open source components to realize performant implementations that exploits Intel hardware capabilities for use in time-sensitive manufacturing, transportation and energy industries

## SESSION 3

### Session 3: Virtual Substation Technology & Substation Software Architecture (TNB)

This part dissects the technology used in substation monitoring, protection, automation and control and how it is used to realized virtualized substation functions and the transformations that are required to realize containerized substation functions. Using use cases this part attempts to highlight software architecture issues that exists in current substation functional implementation and role of standards like OpenFMB, software architecture styles and containerization of software defined substation functions can play to support Grid of the Future operations.



## Utility Session

### Substation Virtualization at Southern California Edison

#### Synopsis:

Increased consumer demand for distributed energy resources is driving the need for more computing capability, application support, and connectivity in the substation environment. Southern California Edison (SCE) is addressing this gap by applying virtualization technology in the substation environment. The product of this effort is what SCE calls the Common Substation Platform (CSP). The CSP is a general-purpose computing platform designed to run in a substation environment, using virtualization software capable of running a variety of operating systems and applications simultaneously. The CSP enables data center like capabilities in a substation environment providing a high level of redundancy, scalability, and cybersecurity based on each substation's needs. SCE is also looking to apply similar technologies to have a more flexible power systems protection platform, that can meet the needs of a diverse power grid that includes large scale deployment of renewables and smart grid technologies.

#### Presenter 1 Biodata:

Zeus Xioco is currently an Engineering Manager at Southern California Edison with 17 years of utility experience in the two largest investor owned utilities in California. His current role is to lead the Substation Demonstrations group within SCE's Grid Technology Innovation department. His team is tasked with identifying, evaluating, testing, and piloting the next generation substation technologies that could have significant impact to SCE and the industry. Zeus lead the development SCE's latest substation protection and control system, providing an IEC 61850 based system to SCE and is currently working towards realizing a centralized protection system utilizing machine virtualization. Zeus is a California Licensed Professional Engineer, and he holds a B.S. degree from California State University, Los Angeles.



**Zeus Xioco**  
Engineering Manager,  
Asset & Engineering Strategy,  
[Southern California Edison](#)

## Presenter 2 Biodata:

John Vogel is the Senior Manager of SC&M's Commissioning group, Start up Engineers, Substation Instructions and Contract Test groups. These groups perform several key roles in supporting the Test organization with Lap Acceptance Testing and Commissioning of both Green and Brown field substations and server as the owners of the Commissioning program that provides the guidelines for the installation and testing of new substation equipment for SC&M. The group also collaborates with outside stakeholders in performance improvement / corrective action initiatives associated with SC&M Capital project implementation.

John joined SCE in 2010 as a Test Supervisor at SONGS. John joined the SC&M Team in 2013 as the Work Methods Manager that lead a cross function group focused on developing new work practices & procedures across SC&M's crafts that supported improved safety , technology integration and standard changes. John also supported the implementation of many large-scale capital projects as a Start up Engineer within SC&M. Most recently John lead the Automation and Commissioning group within SC&M. This role supported the 2021-2023 GRC testimony, Common Substation Platform deployment and creation of the Substation Cybersecurity Standard. Prior to SCE, John worked for a Midwest utility as a System Protection Technician, Instrumentation & Control Technician, Senior Planner and Forman. John also taught Electrical Apprenticeship courses for IBEW NJACT Local #22 and Metropolitan Community College.

Academically, John holds a bachelor's degree in Management from Bellevue University and an Associate degree from Southeast Community College in Electrical Technology. John also obtained a Project Management Certification from the University of La Verne.

In his spare time, John enjoys fishing, hunting and off-road activities with family and friends.



**John Vogel**

Sr Manager of Commissioning,  
Contract Test, SUE & SSI's,  
SC&M Test & Technology,  
[Southern California Edison](#)

## A Utility Perspective in Defining the Power System Virtualization Roadmap

### Synopsis:

What growing challenges are utilities facing today to continue to effectively protect and control the power grid? This presentation takes a closer look at the key reasons various utilities have for the virtualization of intelligent electronic devices. One utility's continuing journey will be outlined, including challenges faced and those that are yet to come, the incredible benefits that are within reach, and the industry-wide collaboration that is currently necessary.

### Presenter's Biodata:

Anthony received his B.S. degree, as well as his M.S. degree, in electrical engineering from Arizona State University, with emphasis in mechatronics and alternative energy. He has 18 years of overall experience in the utility industry, and has worked in a variety of roles during his tenure at Salt River Project, including designer, engineer, and project manager of major substation construction and transmission jobs, new protection and control initiatives, as well as standards development and implementation. He is presently an Executive Engineer in the Protection, Automation, and Control Strategy department, where he can focus on research and development initiatives to efficiently protect and control the grid, in support of SRP grid modernization. Mr. Sivesind is a member of IEEE, and a licensed electrical engineer in the state of Arizona



**Anthony Sivesind, P.E.**  
PAC Strategy  
Salt River Project  
Phoenix, Arizona, USA

## Software Defined Substation: A TNB Grid Perspective

### Synopsis:

This presentation highlights TNB Grid journey and experience in developing wide area monitoring, protection, automation and control for grid stabilization that planted the idea behind Software Defined Substation which is currently a research project with TNB Research and Intel under the TNB Grid-Intel MOU.

### Presenter's Biodata:

Mr. Wan Azlan has worked in TNB in the area of control and automation for more than 30 years. He is currently a Principal Engineer (Real Time Systems) in the Grid of the Future unit of GSE. His work covers development of ETL and integration for the Grid Data Lake, setting up a data analytics platform, domain driven application design, cyber security and substation virtualization. He has an MSc in Real-Time Software Engineering from UTM. He is a registered Professional Technologist with the Malaysia Board of Technologist. Mr. Wan Azlan is a member of CIGRE Malaysia, the Association of Computing Machinery and the Australian Computer Society.



**Wan Azlan Wan  
Kamarulzaman**  
Principal Engineer  
(Real Time Systems)  
Grid Solution Expertise,  
Grid Division,  
Tenaga Nasional Berhad

## Realizing Electrical Digital Twin for Intelligent Substation in Oil and Gas Environment

### Synopsis:

Electrical equipment failures and network disturbances have caused severe production losses in millions of ringgits to PETRONAS. Electrical digital twin for Intelligent Substation (IS) is a concept that is developed as the key digital transformation to address the issues by providing data transparency from electrical system and equipment for prediction and prescriptive action before failure happen. The concept contains feature and capability for remote electrical system simulation and monitoring. It utilizes tools, applications and cyber-physical solutions to enable physical operation of electrical system and equipment that are capable of autonomous exchange of information in providing real-time visualization of operational condition, health status and fault prediction of electrical system and equipment. The aim is towards attaining a Remote Autonomous Operation of electrical system and equipment.

#### Presenter 1 Biodata:

Adri Thauriq Mohamed, is a Staff Electrical Engineer, based in Kuala Lumpur for PETRONAS Group Technical Solution (GTS). He possessed 15 years of technical experience in the electrical field covering from plant maintenance and project execution across all over Petrochemical, Oil and Gas Industry. Adri's key achievement in successfully delivered RAPID Project in Pengerang which his involvement started from design feasibility study up to plant commissioning covering all major electrical equipment involve varies voltage up to 275Kv. Practicing most of working experience specializing in Electrical system simulation and Protection & Control. He is currently a focal point for Electrical Intelligent Substation taking the leading role for electrical future technology initiative development within PETRONAS. He is also a certificated IECEx Inspector taking the responsibility of Ex Inspection and Ex related issue. He is a Committee Member of HV Cable and Cable Accessories under Jabatan Standard Malaysia.



**Adri Thauriq Mohamed**  
Staff Electrical Engineer  
(Protection & Control)  
Engineering Dept,  
**PETRONAS**

#### Presenter 2 Biodata:

Ir. Noor Mohd Fadzli Bin Othman, is a Staff Electrical Engineer, based in Kuala Lumpur for PRETONAS Group Technical Solutions (GTS). He possessed 16 years of technical experience in electrical maintenance, project execution and delivery spanning over Petrochemical, Oil and Gas Industry. He is currently an Electrical digital Focal Person as well as Electrical team lead for guiding & facilitating the implementation of Remote Autonomous Operation (RAO) for PETRONAS facilities worldwide. He is also currently leading the Improvement Working Group (IWG) of Technical Trade Specialist (TTS) Power Electronics. Co-leader for Electrical Skill Group of Generation, member of Electrical Capability Development Agenda (CaDA) taskforce and a member of Electrical Skill Group advisory council. He is a Senior Member of IEEE, a registered Professional Engineer with Practicing Certificate (PEPC), a member of The Institution of Engineers Malaysia and member of The International Council on Large Electric Systems (CIGRE). He has received several awards at PETRONAS level.



**Ir Noor Mohd Fadzli**  
Staff Electrical Engineer  
(Distribution),  
**PETRONAS**



## Value-driven aspiration of CPC in Oil and Gas Industry

### Synopsis:

Leveraging on CPC potential to unlock values in Remote Autonomous Operation environment of Oil and Gas Industry, capitalizing on data to realize tangible benefits in operation and maintenance. We need to redefine the objective of CPC in term of data analysis to stretch for higher oil and gas production by ensuring continuous operation beyond the name plate. To paint the view of CPC from production perspective and identify the gaps that we need to solve for together with solution provider to realize value of CPC in Oil and Gas industry.

### Presenter 1 Biodata:

#### Presenter's Biodata:

Mohd Khairil Bin Mohd Hatta is a Principal Electrical Engineer specialized in Protection and Control for PETRONAS Group Technical Solution (GTS). He possessed 18 years of experience in maintenance and planning, project execution and delivery, technical consultancy and governance spanning over petrochemical, oil and gas industry. With a background in electrical engineering design, construction, commissioning and operation of Oil and Gas asset, his career expands over several projects' portfolio including upstream, downstream, refines, gas processing and LNG plant. His career highlight is when he has appointed as the Lead Electrical Engineer for the world first floating LNG project. PETRONAS Floating LNG1 responsible for construction, commissioning and early operation of the asset. He is leading PETRONAS Centralized Protection and Control System (CPC) to drive value obsession in for continuous operation of oil and gas production. He is currently focusing on delivering solutions such as STARUPS (Strategic Data Acquisition of Remote Data for UPS), Green Energy Island (off-grid green energy), Electrical Augmented Engineering Review (AER), Smart Energy Efficiency (SEE). He was the Chair for IOGP JIP33 UPS Working group which has published specification for AC/DC UPS and Batteries for Oil and Gas and continue to advocate the industry in standardization effort.



**Mohd Khairil B Mohd Hatta**  
Principal Electrical Engineer  
(Protection & Control)  
Engineering Dept,  
**PETRONAS**



Presenter 2 Biodata:

Faizah bt. Othman is as Senior Electrical Engineer based in Kuala Lumpur for PETRONAS Group Technical Solutions (GTS). She possessed 15 years of technical experience in electrical maintenance, project execution and technical solution delivery spanning over PETRONAS upstream and downstream facilities. Faizah experience in electrical system spanning over offshore and onshore activities covering Petrochemical, Oil & Gas industry. She has 6 years' experience in electrical operation and maintenance activities in Sabah and Sarawak offshore platforms and 8 years' experience in project executing & management. She is currently appointed as Lead Electrical Engineer for PETRONAS BIOMEG pilot plant project which focusing the conversation from biomass products to Bio-Monoethylene Glycol (MEG). She is also team members of PETRONAS Centralized Protection and Control System (CPC) in driving the value obsession for continuous operation of oil and gas operation. She is registered as Graduate Technologist under Malaysia Board of Technologist (MBOT)



**Faizah Bt Othman**  
Senior Electrical Engineer  
(Generation),  
**PETRONAS**

## 61850 configuration in the Software Defined Electrical Substation

### Synopsis:

What growing challenges are utilities facing today to continue to effectively protect and control the power grid? This presentation takes a closer look at the key reasons various utilities have for the virtualization of intelligent electronic devices. One utility's continuing journey will be outlined, including challenges faced and those that are yet to come, the incredible benefits that are within reach, and the industry-wide collaboration that is currently necessary.

### Presenter's Biodata:

Sander has more than 10 years' experience in the DSO sector on the edge of business/IT/OT and has knowledge about applying IEC 61850 and IEC CIM. Ing Sander Jansen is now product owner of the virtual substations team for medium and high voltage within the System operations department. Sander is working at the Dutch DSO Alliander. He is partly responsible to for new substations developments to facilitate the energy transition.



**Sander Jansen**  
Product Owner  
(Virtual Substations)  
System Operation Dept,  
[Alliander N.V. Netherlands](#)

## **SEAPATH, Virtualization for Real-time Power Grid Substation Automation**

Synopsis:

Energy Transition drives change in power transmission and distribution grids. Grid control architectures should adapt swiftly to manage more distributed renewable infeed and greater dynamics in power flows. In this context, grid operators require a new generation of digital automation system for power substations, enabling higher flexibility, scalability, cross-industry innovation while ensuring time and cost-efficiency. Following the path of other sectors such as telecommunication networks, open source and virtualization will be the mainstays of this new systems. To be secure, adaptable, and cost effective, the DSAS relies on virtualisation.

The aim of the SEAPATH project is to develop a “reference design” and “industrial grade” open-source real-time platform that can run virtualized automation and protection applications.

Presenter's Biodata:

Aurelien is Project manager at RTE, the French power transmission system operator. He is in charge of the virtualisation of the digital substation. Aurelien has been with RTE since 2008 and worked as an R&D engineer in particular on the impact of HVDC on the protection



**Aurélien WATARE**  
RTE Campus Transfo

# Industry Session

## Container-based virtualization platform for integrating and deploying power system automation, device management and security applications.

### Synopsis:

In this presentation we will cover SEL's experience building a dependable container solution for substation operations. The solution architecture is built on a common product platform with well-defined APIs and a common databus that allows container-based applications to share information. The architecture allows applications to focus on value-added and data integration workflows that eliminates the need for multiple hardware solutions and reduces the cost of application integration. The presenter will provide overviews and use cases for Device Management; Fault Isolation, Location and Restoration; and integrating cybersecurity solutions.

### Presenter's Biodata:

Darrin Kite is a product manager for SEL's Automation R&D division. Graduating with a BS in Renewable Energy Engineering from Oregon Institute of Technology he has over 10 years' experience working within the electric power industry. Besides working for SEL, Darrin has worked at Bonneville Power Administration and EPB, the municipal electric provider in Chattanooga, Tennessee.



**Darrin Kite**  
darrin\_kite@selinc.com  
Schweitzer Engineering  
Laboratories

## Software-defined architectures of substation Digitization enabling Decarbonization & Decentralization for the Grid of the Future

### Synopsis:

The trends of decarbonization, digitalization and decentralization are leading the future of the grid to address the challenges of grid modernization and more renewable integrations. The presentation will provide software-defined architectures while digitizing a substation while considering value drivers of the system. The concept & definition of virtualization will be detailed with various possible scenarios and comparison of thereof. The Virtualized substation gateway architecture will be shared for substation automation & monitoring, as well as advanced system control & protection applications.

### Presenter's Biodata:

Dr. Mital Kanabar is an Office of Innovation leader and global Chief Applications Architect in GE Grid Automation (GA) of Grid Solutions business, GE Renewable Energy at GE Grid IQ Center in Ontario, Canada. He drives reference architectures for differentiated solutions; innovative customer applications (incl. AI/ML); and digital system & solutions for the power industry.

Mital has 14+ years of power industry experience and holds 12+ international patent applications; and published more than 50+ journal/conference papers; 5 industrial magazine articles, and a book chapter. He holds an honorary Adjunct Professor position at OntarioTech University, Canada.

Mital is also serving as a Chair and Vice-Chair of three Working Groups (WGs) at IEEE PES Power System Relaying Committee (PSRC). And, he is an active member of several technical working groups at IEEE, IEC, NERC and NASPI.

Mital earned his PhD degree from the University of Western Ontario, London, Canada; and joined GE's protection R&D application team. Since then, he has led R&D and applications designs of several Grid Automation's products and solutions, including IEC 61850 based Digital Substations & software systems; Proactive protections with equipment condition monitoring and industrial Asset Performance Management; Renewable integration algorithms for System Integrity Protection Schemes (SIPS) incl. Routable-GOOSE; Synchrophasors solutions and applications (i.e. PMU and PDC); Electric Machines Protection & Controls. He also worked at Larsen & Toubro (L&T) Ltd, as a power station design and commissioning engineer.



**Dr. Mital Kanabar, P.Eng**  
Chief Applications Architect,  
Office of Innovation Leader,  
[GE Renewable Energy](#)  
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# Virtualized Edge Computing Platform for Substation Protection and Control

## Synopsis:

Traditionally power system protection in substations are implemented using discrete IED devices. Consolidating these discrete devices into a virtualized software platform leads to better operational efficiency. The virtualization of computing resources is widely used in the realm of enterprise IT. This presentation will cover the technologies needed to extend virtualization to the industrial realm (especially in electric utilities) with its OT platforms. Consolidation of devices into server class hardware decreases deployment costs and leads to better operational management. Application management enables movement of applications from one server to another leading to better resiliency and delinking of software and hardware deployment cycles. The presentation will also cover the efforts of TTTech Industrial to develop a virtual platform for the utilities.

## Presenter's Biodata:

Kannan Devarajan is a seasoned technology leader and executive. He is based in the San Francisco Bay Area in California. He has 25 plus years of experience in computer software and hardware development, working in a mix of leading companies such as Sun Microsystems, Cisco Systems and in successful startups. Till recently he was a co-founder and VP of Engineering at Nebbiolo Technologies, a pioneer in fog computing. Founded with a vision to develop edge computing for the industrial sector, Nebbiolo was recently acquired by TTTech Industrial. Currently he is serving as its Managing Director for the North American operations.



**Kannan Devarajan**  
Managing Director,  
TTTech Industrial North  
America Inc.  
Santa Clara CA95035

# Key Computing Platform Requirements for SW-defined Substation Automation and Controls Systems

## Synopsis:

Software-defined Automation & Controls systems, which are more flexible and responsive to the dynamically changing operational patterns are expected to become critical building blocks towards Grid and Substations. As such, the underlying HW platforms that execute the Virtualized Automation & Controls systems, must encompass all the necessary features demanded for today and the foreseeable future. Intel has identified key feature sets that would be required by such platforms e.g. Real-Time Compute & Communication, Functional Safety, Industrial use conditions and support for 5G, and features that should be embedded into the systems over time. This session will elaborate on the criticality of these features and their value propositions



Presenter's Biodata:

Shashi is Intel's Technology Planning and Marketing Director, within the IOT Group. He has been at Intel for the past 20 years, beginning his career as a Component Design Engineer and later on assumed the role Product & Platform Planning and Marketing since 2013. Shashi has a Masters Degree and MBA from the Arizona State University and is a holder of 5 different patents around Image Processing.



**Shashikiran Tadas**  
Industrial Technology Planning  
and Marketing Director,  
[Intel Corp USA](#)

## Lightweight Virtualization with Onesait Things™ An architectural cornerstone in the digitalization of the Grid of the Future

Synopsis:

Innovative application containerization technology delivers lightweight virtualization capabilities that enable the digitalization of Smart Grid control. We will discuss how this technology architecture will support the standardization of control and protection equipment, the improvements to infrastructure cyber-security, availability and resilience, the massive roll-out of services leveraging OT/ IT integration over 5G, the optimization of grid O&M efficiency and the delivery of new services to Prosumers.

Onesait Things capabilities will be demonstrated, with use cases including the management of virtual workloads for metering, control automation and last mile equipment maintenance.

Presenter's Biodata:

Dr. Mariano Ortega is Minsait's IoT and Edge Computing CTO and a Member of the Scientific Board of Pontificia Comillas University. For the past 16 years he has led Minsait's several Smart Grid initiatives with a focus on the application of Edge Computing technology architectures and Real Time platforms to the digital transformation of the Power sector.



**Dr. Mariano Ortega de Mues**  
CTO, Phygital IoT & Edge  
Computing,  
Minsait, Spain

## Centralized protection, measurement and control for digital substations

### Synopsis:

The presentation will consist of two parts:

Operating Philosophy of the Centralized Protection and Control unit. Fleet management service from Cloud In the first part, Harlem will share the technology of IEC 61850-9-2 sampling value applied to substation protection function, and how it is adopted in a new centralized protection device to design multi-backup architecture protection function and improve system reliability. He will also share how feeder automation application can be improved and the design of GOOSE automatic logic and dispatcher operation towards shortening the power recovery time. In the second part, Harlem plans to put forward that with the popularization of the IEC61850 standard and the improvement of network reliability, more system services will meet the needs of customers. To meet these needs, a cloud-based offering that provides users the full view of their protection and control devices in their substations. ABB's has developed a cloud-based system services in accordance with this future development trend that offers cost-efficient management of protection and control equipment, and full visibility of substation status. ADAM is a consequence of the approach/strategy for substation protection software as a service towards the future.

### Presenter's Biodata:

Harlem Tsai is ABB's global product marketing manager who is responsible for Digital Substation Products and Digital Systems in South Asia region. His past working experience as an engineer at Taiwan nuclear power plant makes him familiar with the power generation, transmission and distribution network structure in South Asia.

He likes to use his professional skills and experience to share exciting technological progress and contribute to the upgrade of the power grid. Harlem graduated with a bachelor's degree in electrical engineering from Chung Hua University in Taiwan in 2005.



**Harlem Tsai**

Global product Marketing  
Manager (SAS region),  
ABB Electrification -  
Distribution Solutions Division,  
Digital Substation Products  
& Digital Systems

## **A service-oriented architecture for the automation of future distribution grids: the experience of the SOGNO project.**

### Synopsis:

SOGNO was a H2020 European project aimed at developing new concepts of distribution grid management, based on the use of 5G communication, advanced deep learning techniques and cloud virtualization. Relying upon last generation IoT concepts, SOGNO proposed and demonstrated an innovative service-oriented architecture that unlocks a new way to deploy the intelligence needed to control future smart grids, opening also opportunities to create new business models. The SOGNO solution has been tested in different European field trials and it is now used as a reference architecture in other European projects and initiatives. This presentation will show the ideas and results achieved during the SOGNO project and it will give an overview of the possibilities that the SOGNO solution opens for distribution system operators to progress in the digitalization of their grids.

### Presenter's Biodata:

Marco Pau has a PhD in electrical engineering and computer science from the University of Cagliari (Italy). He is currently a post-doc researcher at the Institute for Automation of Complex Power Systems, in RWTH Aachen University (Germany), where he leads the team for Distribution Grid Monitoring and Automation. He worked on several European projects and he was co-technical manager of the European project SOGNO. His research interests include monitoring and control of distribution grids and the development of innovative solutions for distribution system automation.



**Dr.-Ing. Marco Pau**  
RWTH Aachen University,  
Institute for Automation of  
Complex Power Systems,  
Aachen, Germany

## Sessions Chairmen



**Nik Sofizan Nik Yusuf**  
Head of Grid Solution Expertise  
Grid Division, Tenaga Nasional Berhad

Nik Sofizan has been with Tenaga Nasional Berhad (TNB) for the past 30 years and started his career in Grid Operations. After a successful 7 years in Grid Operations, he was placed in charge of Substation Automation Systems, which included design standardization, engineering, testing, commissioning and maintenance of the systems.

From there on, he worked on Wide Area Power Systems Protection, Automation and Control including studies and modelling of system design, which entailed inclusion and integration of multiple data communication protocols such as IEC 61850, IEEE C37.118, Modbus and development of custom algorithms and programmable logic. It is due to this vast and rich experience that he now heads the Grid Solution Expertise Department in GRID Division, TNB and leads TNB's efforts in drafting the plans, requirements and design for their Grid of the Future encompassing Grid Modernization and Grid Digitalization initiatives



**Mohamad Firdaus Yon**  
CIGRE Malaysia Main Committee member

By the time of this workshop, Firdaus Yon would have been officially retired from his position as Head of Grid Solution Expertise after 37 years of faithful service in Tenaga Nasional Berhad. In ideal times, he would be off scuba diving in some tropical islands but because of the pandemic, he has opted to help organize and chair the panel session for the workshop. He started his career in 1984 doing a deep dive into SCADA and telecontrol systems from initially maintaining them, progressing towards implementing projects, and finally towards designing.

He expanded his scope by venturing into Wide Area Protection where he was part of the team that successfully delivered several in-house developed special protection schemes that managed to enhance the reliability of the grid. He later went on to play a key role in the Grid Digitalization Transformation strategy and helped architect the Grid Digital Intelligence Infrastructure, the open data platform to springboard digital innovations in TNB.



**Avinash Rajah**

Director of Business Development (Energy)  
Global Solutions and Scale Intel Corp

Avinash Rajah leads Global Business Development of Intel's Energy Industry Solutions, primarily in the areas of New Energy Management, Grid Transformation and O&G Industrial Automation. Avinash works with leading Power Utilities, IOCs, Energy Service Providers, and the Solutions ecosystem, to drive transformation and sustainability based on Edge AI & IIOT.

Prior to assuming his current role, Avinash spent his first 9 years at Intel as a Chip Design Engineer with Intel's Processor R&D Group, located in various Intel campuses around the world. He worked on many of the Intel x86 Server, Client and Digital Home chipsets available in the market today and influenced the design and productization of these processors.

Avinash now applies his extensive experience and knowledge of advanced computing platforms, along with his academic background in Neuroprocessing, to drive an AI, Cloud and IOT-based sustainable transformation of the Energy vertical. Avinash also aspires to see an expedited shift of the Energy industry towards Renewables and Carbon-neutrality, by leveraging advanced industrial computing.

## Panel Discussion Members



**Ir. Salmey Abdul Halim**  
Custodian for Electrical (Protection and Control)  
Petronas

Salmey has 29 years working experience of which 22 years were related to power industries with direct involvement in PETRONAS Capital projects under various roles and responsibilities. He directly involved in the development and execution of 1200MW COGEN Plant in RAPID, Pengerang, Johor Darul Takzim and 350MW COGEN plant in PETRONAS Integrated Petrochemical Complex in Kertih, Terengganu Darul Iman and Gebeng, Pahang Darul Makmur.

In addition, he provided technical leadership role for various M&A Due Diligence activities and Design Feasibility Studies for PETRONAS ventures in the United Kingdom, Mauritania, Myanmar, Canada and Singapore. Work as Custodian for Electrical (Protection and Control), he also assumed the role of Group Technical Authority (GTA) while at the same time act as an Advisor for Electrical Skill Group fraternities.

His professional industry affiliations include registered as Competent Engineer with Energy Commission of Malaysia, Chairman of National Technical and Management Committee for Explosion Proof Equipment of Malaysia, mirroring IECEx Technical and Management Committee respectively. Affiliation with University include appointment to sit in Industry Advisory Panel for University Technology PETRONAS.





**Michael Bates**  
Worldwide General Manager,  
Energy Intel Corp

Michael Bates joined Intel in June of 2015 as the Worldwide General Manager for Energy reporting up through the worldwide sales and marketing organization. Michael leads a team calling on the world's largest organizations in the Oil & Gas and Utility segments.

His mission is to create business value through the effective adoption of solutions and reference architectures designed to solve the industry's most pressing business challenges. His role is responsible for delivering leadership messaging and setting strategic direction for accounts across the Energy sector. Mike serves on the board of the Gridwise Alliance and the Prime Alliance; working with its members to help navigate the transformation to the Utility of the Future.

Previous to joining Intel Michael spent 20 + years leading within various companies in the energy sector. Most recently he was the general manager of Utilities at EnergyHub, prior to that he founded a consulting company where he led business development effort's focused on implementation of consumer-facing smart energy applications and services. Earlier in his career he was with IBM as a member of their tiger team to lead business development efforts across key Grid Modernization opportunities. Before his time at IBM he served as VP of Sales at GridPoint which was one of the first to offer a full suite of behind-the-meter renewable energy services and solutions to the utility market.

Before moving into the Utility market, Mike spent 13 years with Baker-Hughes, a leading oilfield services company where he served in a variety of business development and sales roles. His last position was head of international sales where he led a team responsible for the rebuilding of the Kuwait oilfields after the Gulf War.

Michael holds a B.S. In Economics from Texas A&M University



**Dr. Riccardo Pagliarella**  
Specialist Director Deloitte,  
Australia

Dr Riccardo Pagliarella is a leading expert in DER integration in the Australian market. Riccardo has worked in many facets of DER integration: technology development, OT/IT transition, techno-financial simulation, VPP tariff product development and go-to-market, technology trials and in regulatory reform towards greater DER enablement.

This is particularly important in the Australian market where renewable transition is strong, thermal baseload withdrawal is accelerating, no nuclear baseload exists and the Australian National Energy Market is the largest AC interconnected power system in the world - Australia is accordingly significantly advanced in market constructs and demand towards DER uptake. More recently Riccardo has been involved in technology and services efforts to integrate EVs into various national power systems and markets by way of participation in wholesale, DSO and primary frequency response opportunities.

He currently leads EV technology as a Director at Deloitte Australia in addition to co-founding an EV DER business in South Korea. His prior work in electromobility and DER development includes being an alumni of Renault F1 Team, Tesla, Toyota Motor Corporation Australia, Telstra, Hydro Tasmania and Mando Corporation.

## Facilitators



**Farah Diba Norddin**  
Senior Manager (Strategic Engagement),  
Business Strategy & Performance Department,  
Grid Division, TNB



**Ida Kesuma Adi Negara**  
Manager (Change Management),  
Business Strategy & Performance Department,  
Grid Division, TNB



**Hasrul Wira Loubna B Mohamed**  
Secretary (CIGRE Malaysia) &  
Manager (Strategies & Benchmarking),  
Grid Strategy Department, Grid Division, TNB

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