

# IEC 61850 Tutorial

Five Leading Professionals  
Monday 7-Wednesday 9 March 2011  
Sydney

Registration Deadline Friday 11 February 2011

4 Streams  
14 Modules  
Free software

Christoph Brunner  
It4power  
Chairman IEC TC57 WG 10



Karlheinz Schwarz  
Netted Automation  
UCA Users Group



Joerg Reuter  
Helinks  
IEC TC57 WG10



Alex Apostolov  
Omicron  
IEEE PSRC



Rod Hughes  
Rod Hughes Consulting  
CIGRE SC B5

Tailored Program

Gaining a comprehensive understanding of the IEC 61850 Standard as a whole new world of engineering and technology for the power industry is a difficult task to do on your own. This tutorial program is a unique opportunity to listen to five of the leading professionals in the industry to learn how the whole system of IEC 61850 comes together. The program is structured as four parallel streams which will be tailored to suit the attendees preference nominations to provide maximum relevance for the industry.

# The Program

	Monday	Tuesday	Wednesday	Thursday	Friday		
AM		S1	S2	S3	S4	SEAPAC	SEAPAC
PM	S1	S2	S3	S4	SEAPAC		

This course excellent associated program to the CIGRE Australia SEAPAC event in the same week. [www.cigre.org.au/events](http://www.cigre.org.au/events)

Four half day Modules will be presented in four parallel Streams will be provided commencing in the afternoon of Monday 7th March and finishing by lunch time on 9th March. Participants will be able to arrive from interstate on Monday morning and also be able to attend the CIGRE SEAPAC optional Technical Tour on Wednesday afternoon ([www.cigre.org.au/events](http://www.cigre.org.au/events))

IEC 61850 is a vast new subject for some organisations and individuals or some may be particularly interested in certain aspects based on their experiences so far. This is a **tutorial with a difference** where the attendees Module preferences will be the basis of determining the content of each stream. This will allow us to tailor the four parallel streams to suit the needs of the attendees and to give maximum exposure to the expertise of the presenters.

- Each Stream consists of four Modules.
- Each attendee must nominate at least their top six Module preferences.
- Each Stream will have four Modules selected to provide maximum coverage across the attendees nominated areas of interests.
- Each attendee will be assigned to one of the four Streams as best matches their selection preferences.

Whilst some nominated preferences will obviously not be possible to satisfy, the opportunity to meet and discuss issues with the five presenters will still be available.

**Exceptional Opportunity**  
**Five IEC 61850 professionals**

**Nominate six preferences from the following Modules:**

1. **Vendor independent specification and engineering tools (double session).**
2. **Essential Principles and application**
3. **Communication Principles**
4. **Device Stack Implementation and Development**
5. **Choosing communication networks (Star, ring, duplicated, PRP,...)**
6. **Increased capabilities and performance in Edition 2**
7. **Beyond the IEC 61850 substation network**
8. **Process Bus: Sampled Values Publishing and Subscription, Applications and Benefits**
9. **Testing - Equipment Requirements and Tools**
10. **Migration Strategies**
11. **Implications of IEC 61850 on protection system implementation**
12. **Implementation strategy and experiences**
13. **Ethernet Communications in Substations**
14. **GOOSE Messages, Publishing/Subscribing, Applications and Benefits**

# The Presenters

it4power

## Christoph Brunner

Christoph is President of it4power LLC based in Switzerland — a private consultant in application of IEC 61850 in power system engineering and deployment of Smart Grid solutions. He is world known for his knowledge of the application modelling and communication requirements of IEC 61850 in product development and substation deployment in station bus and process sbus applications. He is also Chairman of the IEC Working Group responsible for the IEC 61850 Standard.



HELINKS

## Joerg Reuter

Joerg is the CEO of Helinks LLC based in Switzerland providing vendor independent solutions for IEC 61850 systems. He has worked as a software architect and R&D Manager in the process automation and substation automation industries. Joerg is a member of IEC TC 57 WG 10



NettedAutomation GmbH  
Information & Communication Systems

## Kark-Heinz Schwarz

Karlheinz Schwarz (president of Schwarz Consulting Company based in Karlsruhe, Germany) specializing in distributed automation systems. He has provided consulting services and training to more than 2.200 experts from utilities, system integrators, consultants, and vendors. He is a well-known authority on the application of mainstream information and communication technologies in the utility industry. He is involved in the international standardization since 1985.



## Rodney Hughes

Rod is Managing Director of Rod Hughes Consulting Pty Ltd based based in Australia and has thirty years experience in the Australian and international power industry. He is a protection engineer who is well known for his experience in providing leading industry training courses over many years and thought leadership within Australia on IEC 61850 for more than 6 years.



pacworld  
PROTECTION, AUTOMATION & CONTROL WORLD

## Alex Apostolov

Alexander Apostolov has more than 30 years experience in power systems protection, automation, control and communications, presently Principal Engineer for OMICRON electronics based in USA. He is IEEE Fellow and Member of the Power Systems Relaying Committee and Substations Subcommittee.

He is member of IEC TC57 and highly active member of CIGRE B5 Protection and Automation Committee. He is Chairman of the Technical Publications Subcommittee of the UCA International Users Group.



# Program Modules

## Module 1 Vendor independent specification and engineering tools (double session).

Using a vendor independent tool, the participants will be guided through the entire substation engineering process as it is defined by IEC61850. At the end of the one day course the participants will have created SSD, ICD, IID and SCD files. They will also validate their work by downloading and running their application to a simulated IED server.

Covered topics (theoretically and hands on):

- How to use the IEC61850 data model to specify the substation automation system
- IEC61850 model as data integration platform for engineering data
- XML and SCL basics
- Device independent system specification and engineering
- Vendor independent system integration and communication engineering

These module topics must be taken together



Free limited  
day licence  
copy of new  
Helinks STS V2

## Module 2 Essential Principles and application

It is essential to understand the technology correctly given there are so many new terms, file descriptions and processes defined by the Standard which are so often misunderstood even in the international community. This module covers the purpose of the standard, the correct use of the Part 6 System Configuration Language engineering process and the various file types as well as the core elements of compliance and interpretation of Compliance Certificates. Participants will be able to recognise good engineering processes, the core criteria for tool selection and be able to recognise the requirements for Logical Node model implementation.

## Module 3 Communication Principles

This module gives an independent and detailed presentation of the IEC 61850 standard for substation and device modelling as well as communication principles (GOOSE, Sample Values, Client/Server applications). This module tells what you need to know about the standard as a basis for specification and application. The second part presents the Substation Configuration Language and use a vendor independent tool, to demonstrate specification of IEC 61850 systems. The module focuses on using SCL for design of typical substation functions and the engineering of the substation and IEDs according to the engineering process. The presentations will be accompanied by demonstrations.

- IEC 61850 basics in the context of automation
- The information models (IEC 61850-7-x and IEC 61400-25)
- The information exchange services and mappings (IEC 61850-7-2 and 8-1)
- System design (IEC 61850-6 and tool demonstration)
- Configuration of IEDs (IEC 61850-6 and tool and IED demonstration)

## Module 4 Device Stack Implementation and Development

This module will provide comprehensive experience with implementation of IEC 61850 software for IEDs. The various third-party solutions will be introduced and discussed. The focus is on the Application Program Interface (API) between the IEC 61850 world and the application software. Students will have receive a getting started package to run IEC 61850 client/server and publisher/subscriber roles on a PC. The packages provide an API that can be used immediately with applications programmed in C, C++, or C#. The application examples are provided in executable code and source code.

- The concepts of integrating IEC 61850 in applications for client/server and publisher/subscriber
- Available third party solutions.
- The use of SCL to configure IEDs
- Presentation of concrete API
- Demonstration and explanation of Getting Started package. Students will get a copy of the Getting Started package to use on their PCs.

It is recommended that students **bring their own Laptop or Notebook to the class.**

# The Program

## **Module 5 Choosing communication networks (Star, ring, duplicated, PRP,...)**

This module addresses the most critical aspects of 61850 such as protection related tripping via GOOSE and Sampled Values. It addresses the network in terms of substation automation, for instance consider the multicast data transfer of large volumes of sampled values from merging units. High precision time synchronization and “bump-less” guaranteed transport of data across the network under failure conditions is central to the Process Bus concept. The module describes existing and best practices of the network design and explains some of the issues related to that design.

- Network Design and Ethernet Technology
- Network Topologies
- Substation topologies
- Quality of service
- Clock Synchronization

## **Module 6 Increased capabilities and performance in Edition 2**

This module is intended for participants with a basic knowledge on IEC 61850 that intend to get an update on what has been added to the Edition 2 of the standard. As part of this module, the extension of the scope beyond the substation will as well be discussed.

- Modelling statistical and historical information
- Overview on new logical nodes and common data classes
- Extensions for testing support
- Extensions to the Substation Configuration Language and clarifications concerning the engineering process
- Buffered reporting
- Redundancy protocol support
- Communication between substations
- Application domains beyond substations

## **Module 7 Beyond the IEC 61850 substation network**

While the original scope of IEC 61850 was limited to a substation, this has been changed in the mean time. New object models have been defined for Wind power, Distributed Energy resources and for Hydro Power Plants. The communication between substations is now included in the scope as well as the communication to the control centre and the communication for wide area monitoring. Mappings of IEC 61850 on existing SCADA protocols like DNP3 or IEC 60870-5-101/-104 have been defined. This module will provide more information about these developments.

- IEC 61850 object models for wind power, DER and hydro
- Communication between substations
- Mapping of IEC 61850 on DNP3 and IEC 60870-5-101 / -104
- Synchrophasor communication using IEC 61850
- Communication with the control centre based on IEC 61850 and Harmonization with CIM

## **Module 8 Process Bus: Sampled Values Publishing and Subscription, Applications and Benefits**

IEC 61850 Process bus is the foundation for the development of the substations of the twenty first century. The concept of process bus, implementation agreements, applications and benefits are presented. Process bus applications for the protection of transmission lines, transformers and busbars are discussed. Improvements in the reliability of protection, automation and control systems, reduction in the possibility for CT saturation, increased flexibility are described. Benefits related to safety are also analysed.

# The Program

## **Module 9 Testing - Equipment Requirements and Tools**

IEC 61850 based substation automation and protection systems are different from conventional systems due to the use of communications to replace hard wiring for many functions in the substation. This imposes different requirements for the testing equipment and software tools that are described in the lecture from the perspective of the quality assurance process defined in the standard. Functional testing of IEC 61850 GOOSE based devices, process bus based IEDs and Merging units are presented. Methods for testing of distributed applications are discussed as well.

## **Module 10 Migration Strategies**

IEC 61850 is designed for implementation in existing and new installations and supports the integration of IEDs designed specifically for optimal performance based on it, as well as to allow the integration of legacy IEDs and even electromechanical relays. Tools supporting different migration strategies are described together with possible migration scenarios – from "green field" substations to bays and individual devices. The migration based on GOOSE only, followed by sampled values is described. A look at the future of IEC 61850 based substation protection, automation and control systems based on process interface units and centralised substation computer applications is presented. The concept of a proxy server and its use in the integration of legacy devices is described.

## **Module 11 Implications of IEC 61850 on protection system implementation**

IEC 61850 allows the development of protection system applications that replace the hard wired analogue and binary signals used in conventional systems with communications messages over the substation LAN. This module discusses protection applications of GOOSE messages for distribution protection, transmission bus protection, adaptive protection and communications based transmission line protection. Applications of analogue GOOSE for protection are also described. Protection applications based on sampled values publishing are later presented. Issues related to redundancy, impact of the communications architecture on the performance of the system and the benefits from the use of sampled values are analysed.

## **Module 12 Implementation strategy and experiences**

Implementation of IEC 61850 is based on not just buying new specification IEDs. World experience shows that success is most importantly based on the change management process that supports the first projects and the subsequent embedding of IEC 61850 in the processes and skills of the organisation. This module presents The business case

- Documentation and approval issues
- Opportunities and requirements of corporate asset management databases
- Role based training requirements
- Operating, test and maintenance facilities
- Standardisation of IED ICD files and Bay templates

## **Module 13 Ethernet Communications in Substations**

Ethernet is the underlying communications protocol in IEC 61850 based substation automation systems. The structure of Ethernet messages needs to be well understood in order to implement and troubleshoot such systems. Priority tagging and VLAN applications are also presented.

## **Module 14 GOOSE Messages, Publishing and Subscription, Applications and Benefits**

GOOSE messages are one of the key differentiators of IEC 61850 in comparison with other substation communication protocols. Detailed structure of GOOSE messages, repetition mechanisms and Publishing/Subscription concepts are discussed. Protection applications and their benefits are discussed as well.

**Dates: Monday 7th —Wednesday 9th March 2011**

**Cost: \$2750.00 including GST**

**Times:** Monday 12:30pm—5.00pm  
Tuesday 8.30am—5.00pm (including lunch)  
Wednesday 8.30am—12.30pm

**Venue: Sydney—tba**

Lunch provided on Tuesday

## **Registration Deadline Friday 11th February 2011**

Places are strictly limited so please book early

### **Important Information**

1. Registrations will be confirmed on receipt of full payment prior to the event, unless by prior arrangement, e.g. Purchase Order. Payment by Cheque or EFT only - sorry, no credit cards.
2. Completed registration forms should be completed as a Word document and returned as an attachment with the email subject line containing **“IEC 61850 Tutorial—YourCompanyName”** for efficient processing—please no PDF or handwritten forms).
3. Tax invoices will be issued following receipt of registrations
4. Terms of payment strictly 14 days from date of Invoice
5. The organisers reserve the right to accept or refuse registrations at its sole discretion and without explanation.
6. The course cost does not include travel, accommodation or other expenses as may be incurred by attendees, which will be the responsibility of attendees in all respects.
7. Attendance cancellation up to seven working days prior to the event will be subject to a 10% cancellation fee.
8. Cancellations less than seven working days prior to the event will not be refunded and must be paid in full. Substitute attendees can attend.
9. Course materials are only provided to the attendees on the day in hard copy only. Course content is subject to copyright.
10. The course is subject to a minimum number of attendees. Cancellation of the course for any reason by the organisers will be fully refunded.
11. Please request any special dietary requirements at least three days prior to the event.

#### **Registrations and further details contact:**

rgh@rodhughesconsulting.com

Office +61 8 7127 6357

Mobile +61 419 845 253

PO Box 757, Blackwood, SA 5051, Australia