Questions from the participants of the IEC 61850 seminar

Moscow, 2009-03-10/12

Note: The questions below are those that have been asked by the attendees of the three day seminar. These answers are revised for publication in a magazine and in the web.

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1.	What are the ways of providing the redundancy when using different protocols like IEC 61850 and IEC 60870-5? [Moscow, 2009-03-10]	**IEC 60870-5-104** The only standard of the series of IEC 60870-5 that has a redundancy solution is the standard IEC 60870-5-104. This standard applies for the communication between substations (RTUs) and control centers. The redundancy is controlled by the master station in the control center. Details see: clause 10 of the standard edition 2 of IEC 60870-5-104 (2006-06). **IEC 61850** The basic redundancy solution for IEC 61850 is provided by the Ethernet standard protocol RSVP (Rapid Spanning Tree Protocol). RSVP provides redundancy in mashed Ethernet networks. The switch-over time is moderate in the range of one or more seconds. Applications that need a bumbles switchover require redundant networks and/or redundant Ethernet ports or even redundant IEDs. A very limited number of standardized solutions are under discussion within IEC TC 57. The Technical Report "IEC 61850-11 – Network Engineering Guidelines" (draft of 2009-02 available) will provide definitions, guidelines, and specifications for the network engineering of IEC 61850 based systems. The Technical Report addresses issues such as network redundancy, traffic latency, multicast traffic management, VLANs, network based security, network based time synchronization, and the test and verification of networks in substations and other utility automation systems. The Technical Report is based on existing standards for semantics, services, protocols, system configuration language, and architecture. It will also reference to and use input from • IEC 62439 (High Availability Automation Networks), • IEC 62351 (Power systems management and associated information exchange - Data and communications security), • IEC 61918 (Profiles covering installation practice for fieldbus communications media), • IEEE Power System Relaying Committee H6 (PSRC), • IEEE 802.1 bridging standards, • IEEE 1588, and the • UCA International Users Group.
2.	What are the ways of providing precise time	**IEC 61850**

	synchronization when using protocols like IEC 61850 and IEC 60870-5? [Moscow, 2009-03-10]	Synchronization at the station bus level is achieved through SNTP providing time synchronization in the range of +/- 1...40 ms. One or two, for redundancy reasons, SNTP server can be present as well as one or two GPS receivers and GPS antenna. At the process bus level, time synchronization is achieved through a 1PPS signal (one pulse per second) which is carried on by a dedicated network, i.e. dedicated cables. The 1PPS signal goes from the GPS receiver to each individual device of the process bus that needs a precise synchronization (e.g. merging units). IRIG-B (i.e. 100PPS) is also mentioned in the document as a future option for 1PPS. The future alternative to the 1PPS signal synchronization mechanism will be IEEE 1588 (IEC 61158). IEEE 1588 can be implemented on top of IEEE 802.3 and therefore does not required dedicated cables while still being able to achieve clock synchronization in the order of hundreds of nanosecond. IEEE 1588 standard profiles are sets of required options, prohibited options, and the range and defaults of configurable attributes. The definition of a specific profile for power system is currently under discussion and should be ready by the end of 2009. The group in charge of this profile is the group H7 of the IEEE Relaying Communication Subcommittee, Power System Relaying Committee from the Power Engineering Society. The implementation of IEEE 1588 depends highly on the network topology and the network redundancy protocol. Standard: IEEE 1588, IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems IEEE 1588 requires dedicated hardware support. **IEC 60870-5** Clause 6.7 of IEC 60870-5-5 defines the time synchronization ptotocol for IEC 60870-5-101. This cannot be used for IEC 60870-5-104 because the 104 is running on TCP. The special clock synchronization for IEC 60870-5-104 is defined in clause 7.6. This allows time synchronization in the range of +/- 1 ... 5 seconds. SNTP may also be used – this not defined in the standard.
3.	Comparative analysis of data transmission reliability and integrity when using different standard interfaces and protocols - can it be done? If yes, then what are the conclusions? [Moscow, 2009-03-10]	Interfaces to the applications are not defined with the protocols like IEC 60870-5-10x or IEC 61850. The behavior on the interface is out of scope. Ethernet and TCP based protocols provide the same magnitude of reliability and integrity as RTU protocols. Exact requirements on integrity can be found in IEC 61850-5 (refers to the three classes defined in IEC 60870-4). Critical information like the GOOSE messages are repeated at a high frequency after a state change. Additionally the GOOSE message has a state change counter and a message counter leading to a high level of reliability and integrity. The requirements depend highly on the application.
4.	There is a set of standard logical node classes, in which different data groups and	The standard has a powerful extension rule (the name space concept), that allows to define new LN classes, new data

	corresponding services are described. If in one IED there is a function that partly do not match with standard logical node class (most part does match, but there are 3 or 4 parameters that differ), what should be done in this case? Is there a need to create a new logical node class? [Moscow, 2009-03-10]	objects (in new LN or in existing LN classes). Whenever there is a need for a new data object, the object can be defined using your name (recommended to be based on the many hundred abbreviations like “Pos” for “position”). The name MUST be market as an extended object. In this case the data name space (dataNs of type VISSIBLE STRING255) must be filled out with a reference to a specification in which the data object is defined and described. The name space rule is defined in IEC 61850-7-1. Today sometimes this name space information is missing in real implementations. This kind of attributes that are intended to provide useful information are often not understood. And by the way, what people put in will be provided: garbage in – garbage out.
5.	How is the question of local back up protection handled when designing protection systems based on IEC 61850? Are there any recommendations on that matter at the present moment of time? Does not the usage of instrument transformers with digital interface contradict the principles of local back up protection implementation? [Moscow, 2009-03-10]	The connection of the primary and secondary (back up) protection IEDs to the communication network depends on the network topology used. Currently there is some work on part IEC 61850-11 for the network engineering (see above). Instrument transformers with digital interface and digital exchange by sampled values may also be redundant (see German RWE R&D Process Bus project). Redundancy concepts for the various requirements are still under preparation.
6.	IEC 61850 emulators – areas of usage, justification of the usage. What should be requirements for IEC 61850 emulators? [Moscow, 2009-03-10]	An IEC 61850 emulator (or simulator) can easily be used by a client IED (e.g., an HMI or RTU) to test the client application with regard to the information models and services. Since the IEC 61850 (or the underlying MMS) server is a virtual device, it does not matter, if a report message on a state change of circuit breaker xyz/XCBR2.Pos.stVal is issued by the real IED (a bay controller or an intelligent circuit breaker controller) or by the emulation. All models and services can easily be simulated and used instead of real IEDs. The values of the data objects provided by the simulator may or may not be realistic. The frequency value communicated may be 500 Hz.
7.	What are the methods for testing IEC 61850 based systems (relay protection systems, automation systems) during the commissioning and after the regular maintenance procedures? What is the role of the testing procedures in conditions of high data flow (data traffic)? Programs and methods for testing IEC 61850 based systems in the conditions of high data flow (data traffic) in substation. What are they? Do any documents exist that define them? [Moscow, 2009-03-10]	Function testing is beyond the standard. The standard IEC 61850-10 provides just the basics for conformance testing. Interoperability and function testing has to be done by the system integrator. Function testing has been discussed the last years. So far, we have just some basic means defined in the models to support function testing (test bits, state machine, ...). Vendors like Doble, Megger (Programma) and Omicron are involved in these discussions. It is too early to expect a mature guideline soon to arrive. One thing is for sure: the SCL documents of a substation (SCD files) are very helpful in developing various tools for testing. The SCD file can be used to simulate missing IEDs, can be used to drive the inputs and outputs of the IEDs terminals ...
8.	What are the ways of providing the needed transmission time of GOOSE-messages?	The transmission of GOOSE messages is influenced by the publishing and receiving IEDs (application software,

	[Moscow, 2009-03-10]	communication software, hardware), the Ethernet switches (including their configuration) and the topology of the network. In order to meet your requirements, one has to look on these three main components and the topology. The performance tests are recommended to figure out how IEDs behave under low, normal and high load. These tests are out of scope of IEC 61850. Part IEC 61850-11 may give some first guidelines. Many IEDs that have been developed five or ten years ago may be too slow for some critical applications like busbar protection, because often they have a low performance local communication interface between the communication and application; which may have been designed for, e.g., Modbus. New developments are under way to improve the performance. In one case the hardware at the Ethernet level is used to repeat the GOOSE messages after a state chance.
9.	What should the process of engineering of IEC 61850 be based on? [Moscow, 2009-03-10]	The most crucial issue to be solved is: To know precisely the requirements you want to solve. The process of engineering will change over time because there are more and more tools under development that help to support the engineering process. It may take another one two or three years before we have a set of powerful tools available and useable for different vendors' IEDs. The vendors like ABB or … have already a set of tools – But usually these system integration supporting tools may not sold by the vendors. Almost all projects today use one or the other form of tables to convert internal signals to IEC 61850 (in this regard IEC 61850 is just another communication system).
10.	IEC 61850 Process bus – the evolution with time. Is it a temporary solution when the traditional instrument transformers are connected to the merging unit? [Moscow, 2009-03-10]	No! The merging units may communicate both values: from conventional and non-conventional sensors. The merging units may be used for any kind of information to be exchanged. One crucial objective today is to replace copper wires between the switch yard and the control house. See the GE Multilin Brig concept with HardFiber.
11.	Is the number of clients connected to the server is regulated? If it is not, is it in plans to do so? The way of providing channel redundancy from the client to the server? [Moscow, 2009-03-10]	The number of TCP connections is limited due to resource limitations. A typical value for IEDs is five to ten, for HMIs or data concentrators it is 50 to 100. Everything is limited!! The standard has no limits defined. TCP redundancy mainly for the communication between SS and CC is still under preparation.
12.	Question of security: is there password policy for control activation in IEC61850 standard? [Moscow, 2009-03-10]	Yes, IEC 61850-8-1 mapping to MMS provides user name and password. IEC 62351 (Data and Communication Security) can be used for encryption etc. RBA (Role Based Access) is under development (as part IEC 62351-8).