



THE POWER OF COMMUNICATIONS: MOVING TOWARDS IEC 61850

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The IEC 61850 protocol is being used increasingly within distribution, transmission, and generation projects. Applications range from new facilities to upgrades. With the IEC 61850 standard, implementing control and protection operations is shifting from the decades-old hard-wiring methods to networked communications.

The year 2007 saw a major change with IEC 61850 in North America: the alignment with the IEC 61850 trend seen in Europe and Asia. Utilities are now requesting IEC 61850 capabilities. If not for immediate use, its deployment is planned for the near future. This usually starts with well-defined pilot projects to explore the protocol's potential as well as the challenges of this new approach within the electric utilities.

A New Paradigm

The IEC 61850 protocol is gaining more and more ground in North America's substations. This increasing popularity is highlighting challenges with its implementation.

The protocol is based on three major concepts that change the way substation integration is handled:

1. Hard wires are replaced with high-priority network messages; the famous GOOSE (Generic Object Oriented Substation Event) messages. This requires highly reliable communication links between the devices. Using redundant network solutions, ideally with fiber optics, brings the needed reliability.
2. All data uses a pre-defined naming convention included in the IEC 61850 standard. This ensures clear and unequivocal identification of the data. Based on the naming convention, it is now possible to easily establish vendor-independent inter-relay communication.
3. The Substation Configuration Language (SCL) promotes vendor-independent configuration. Configuration files are used to facilitate information sharing between vendor tools and thus reduce the required engineering time.

After proving the concept through pilot projects of limited scale, utilities face new challenges when extending these projects to larger and more complex applications. While users are trying to properly integrate devices from different vendors, it is often discovered that each vendor may have a slightly different approach to implementing IEC 61850 in their devices. Moreover, one must ensure that the overall design allows for proper response times and scalability for future expansion without ruling out the ability to handle even more advanced control possibilities, such as future smart grid applications.

Example of a Large IEC 61850 Application

One typical large project, as presented in Figures 1 and 2, was the integration of IEC 61850 devices in a 220 kV switchyard combined with a 33 kV distribution substation for a major petroleum refinery. This application involved approximately three hundred devices using IEC 61850. The site included fiber-optic communication rings, full redundancy, hot-standby data concentrators, protection-relays interaction, and other metering devices.

The equipment for the 220 kV area was subdivided into three redundant fiber-optic rings. The relays have integrated, redundant fiber-optic interfaces for easy integration into the network. Using fiber optics was necessary as the equipment is spread out over ten local control bays located one kilometer from the control center.

Within the 33 kV switchyard there was no need for each relay to be on a fiber-optic bus, since the distances were relatively short, lowering the potential noise level. Here the communication architecture is a mix of a redundant fiber-optic ring between the network switches and a copper ring connection between the switches and the relays.



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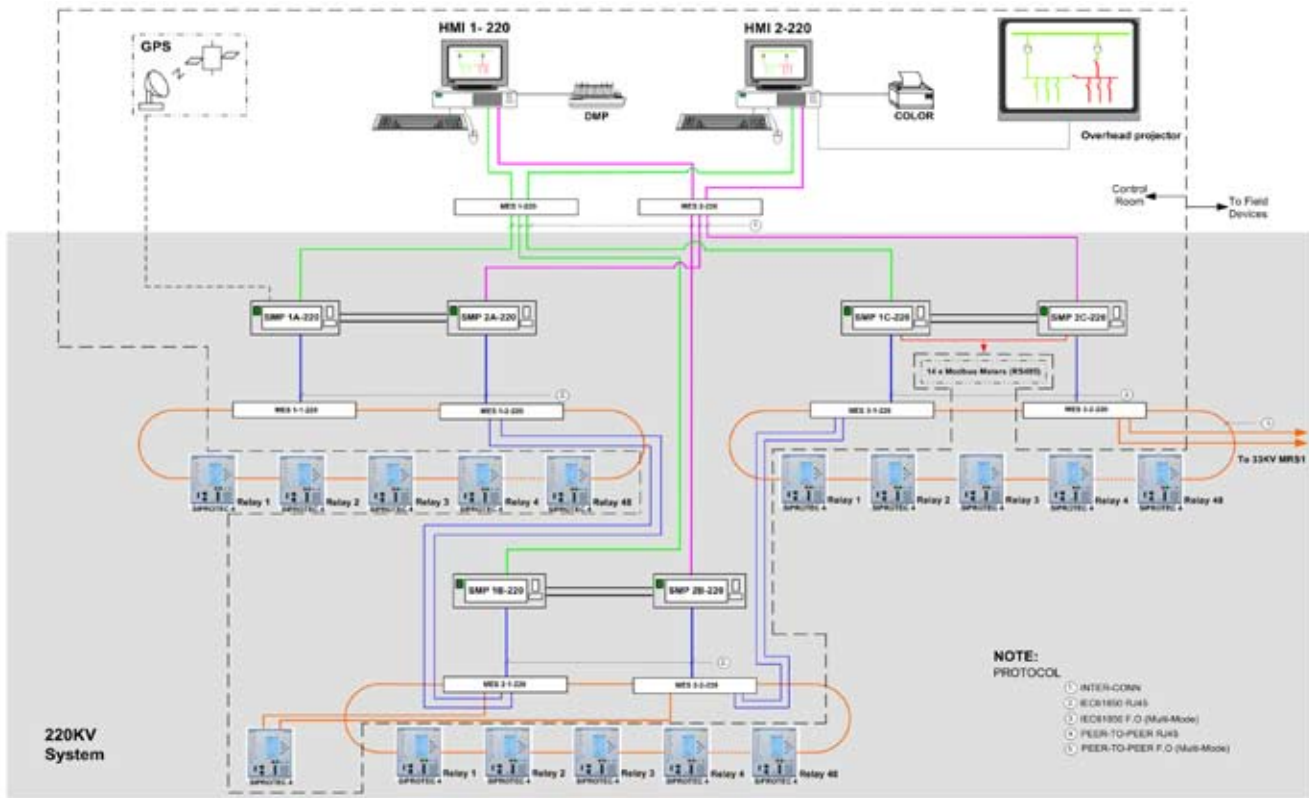


Figure 1. Example of a 220 kV switchyard.

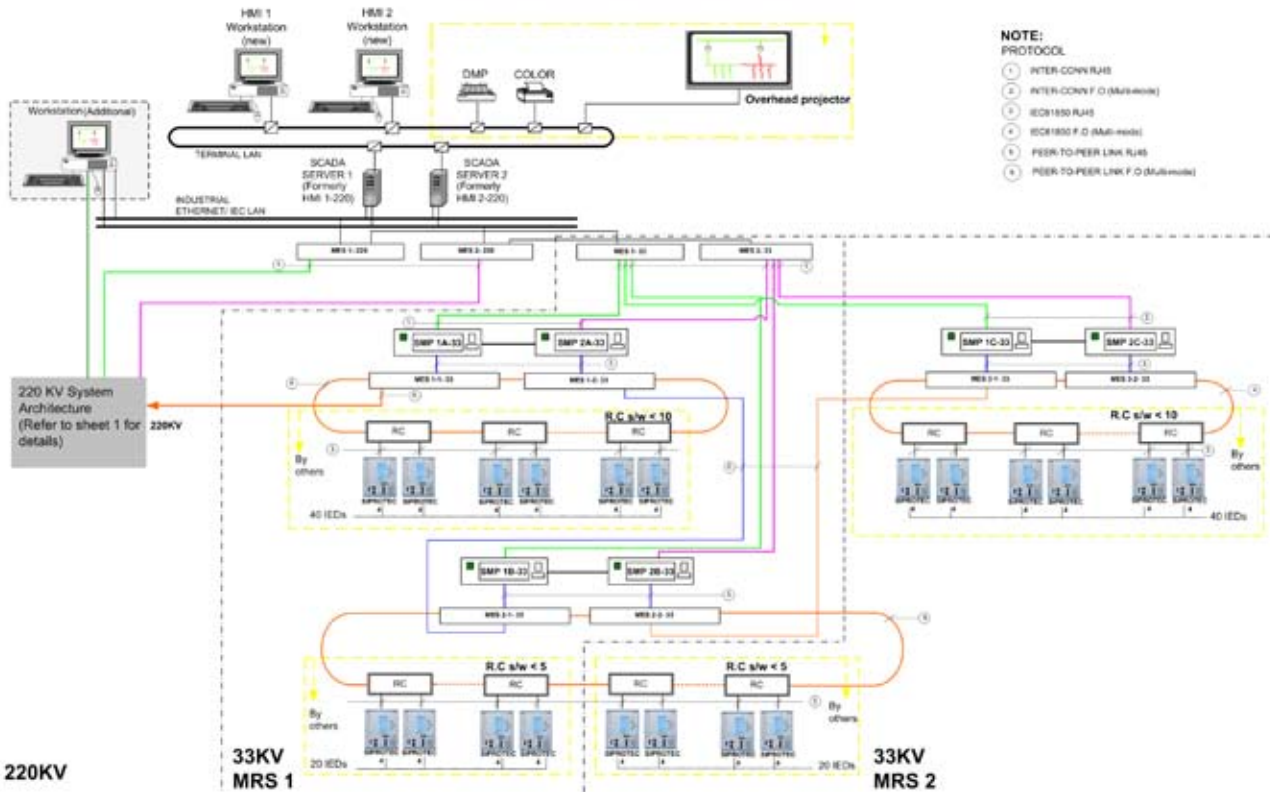


Figure 2. Example of a 33 kV distribution substation.

Redundancy Issues with IEC 61850

To be able to replace the hard-wiring with network messages and permit inter-relay communication, the communication architecture must be highly reliable. The IEC 61850 standard strongly recommends the use of a redundant network architecture. This is especially true when dealing with protection issues.

In this project, redundant bidirectional fiber-optic rings are used for each main ring. This ensures the needed reliability even in case of a cable breach.

Cooper Power Systems' Cybectec SMP Gateways with hot-standby capability are used to provide a continuous information flow to the redundant HMI/SCADA systems. The intelligent gateway's hot-standby capability ensures no communication loss during failure of the active gateway. To correctly handle the total amount of information, there are three pairs of gateways for the 220 kV switchyard and three pairs of gateways in the 33 kV substation.

Besides the normal data gathering, the IEC 61850 DFR (Digital Fault Record) file-retrieval feature is also used. The gateways read the DFR files and push them to the redundant SCADA system as soon as they are detected on the relays. This gives the operator instant access to the fault data without the need to go to the relay

or to create a separate remote connection. The gateway pushes the file to one of the two servers. The server software synchronizes the files to the second server.

The Future of IEC 61850

Even though IEC 61850 has been here for some time, there is still work to do to make IEC 61850 more accessible in future projects. The standard committee is working on the official second version (expected in 2008), which will resolve some of the integration issues encountered by the early adopters of the standard. At the same time, additional efforts are being made to promote conformity testing.

Currently, the main focus is to increase the acceptance of the standard. The next step is to improve the integration tools. These tools should facilitate accessing all the benefits of easy relay integration. These improvements are required not only for the data exchanges but also for DFR files and non-real-time information now available in the relays.

Even though the naming convention is one of the key advantages of the standard, new users find it hard to grasp. The new generation of integration tools should better hide this complexity. This will significantly lower the hurdle utilities are encountering when using the

IEC 61850 standard. However, the new tools should not deviate from the standard.

The next step for the IEC committee is extending the standard to include control center to remote substation communication definition.

Conclusions

IEC 61850 is now here and will be used increasingly in the future. The benefits outweigh some of the drawbacks of this type of technology, especially now that users are becoming more dependent on communication integration in and between the substations.

There is still work ahead to increase the effective interoperability characteristics of this standard. Without such a concerted effort, the overall use of different vendors within a project may become a burden for the users who require such interoperability from the IEDs on their project and may ultimately undermine the IEC committee's efforts for easy relay integration. Ideally, integration software should be completely device independent and able to be used with any IEC 61850 compatible device. It should be as user friendly as possible. In the meantime, vendor configuration software must be able to easily use the SCL configuration files to improve ease of use. ■



Cooper Power Systems' line of Cybectec SMP Gateways offers a reliable way to meet IEC 61850 protocol standards for implementing control and protection operations.

