SHERLOG CRX

Transmission and Processing of Fault and Trend Data in Smart Grids

Dipl.-Ing. Hardy Nickell, Product Manager, KoCoS Messtechnik AG, Korbach

The development of broadband communication

Technological advances in the field of broadband communication over the past 20 years have led to progress being made in great leaps and bounds. Nowadays digital data transfer has to cope with amounts of data and transmission speeds which would have been unthinkable at the beginning of the 80's and on into the 90's when analog telephone lines were still the norm. The use of fibre-optic cables as a transmission medium in particular has led to a veritable explosion in attainable transmission speeds. Because the methods and media used for data transmission are constantly developing, in 10 years time we will no doubt smile at the transmission speeds available today, just as we smile now when we look back at the „powerful" acoustically coupled modems of the 80's.

The constant rises in data transmission speeds also bring benefits in the areas of electricity generation, transmission and distribution. The development of smart grids in particular has led to an increase in the amounts of data transferred for monitoring and controlling energy system components which are connected with one other.

The fast, comprehensive and bundled delivery of complex measurement data and operating status information from electrical plants and equipment at decentralized locations to higher-level control points allows optimum monitoring of interconnected network components.

The growing impact of power generation from renewable sources seen over the past few years has had a special role to play in prompting the development of a trend towards distributed generating plants which involves the widespread implementation of smart grids.

Data management requirements of smart grids

Not only does the expansion of smart grids require the construction and provision of primary network components, it also calls for the planning and realisation of suitable transmission structures to cope with the additional volume of data generated.

In order to make the best use of available communication networks and also to be able to work with lower bandwidths, quantities of data from different areas must be coordinated in terms of timing and content in order to monitor efficient communication and evaluation of measurements and controls of decentralized processes.

Different approaches specifically applicable to the transmission and management of fault-recorder-based measurement data are shown below, using the SHERLOG CRX fault recorder manufactured by KoCoS Messtechnik AG as an example:

- Staggered, separate transfers of fault records and long-term data
- Transfer of data at times of low network load, e.g. during the night
- Decision-making for the transfer of records on the basis of a pre-analysis of a smaller amount of data, e.g. lower sampling rates, shorter record duration

Figure 1: SHERLOG CRX Fault Recorder System

- Filtered transfer and notification of individual fault records by weighting fault events
- Bundling using stationary data acquisition (data concentrator) for selective transfer
- Transfer of definable time periods taken out of the long-term data instead of transfer of complete records
- Manual data transfer on-site with prior notification

The multi-functional SHERLOG CRX fault recorder system (see Fig. 1) can be used simultaneously for a wide variety of different measurement tasks ranging from transient fault data acquisition to power quality measurements and network stability monitoring in real time. The system offers the option of assigning individual information contents to different priority and hierarchy levels allowing selective data transfer with regard to both timing and content.

Controlling the data volume using variable points in time for transmission

By varying freely configurable points in time for the transmission of fault records and long-term data to a central main computer, data traffic can be controlled and scheduled in a targeted manner. Long-term recordings can be transferred during the night hours, for example, when a smaller volume of data is generally to be expected. Longer transmission times for downloading newly recorded data are then acceptable, as the data is available for viewing and evaluation the next day. If not only the times at which data is to be transferred can be varied, but also the assignment of the associated recording functions, such as transient fault recorder data and long-term data, for example, these types of data can be individually requested and transferred at different points in time (see Fig. 2).With 2 transient fault recorder functions, an RMS fault recorder and up to 14 long-term archives which run in parallel, the SHERLOG CRX fault recorder is ideally equipped for variable measurement data acquisition. Important measurement

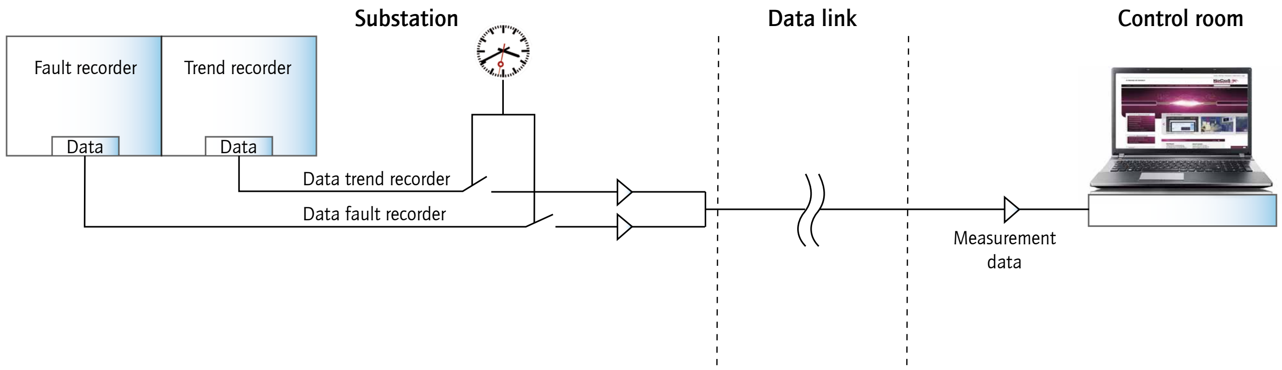

Figure 2: Transfer of measurement data at variable points in time

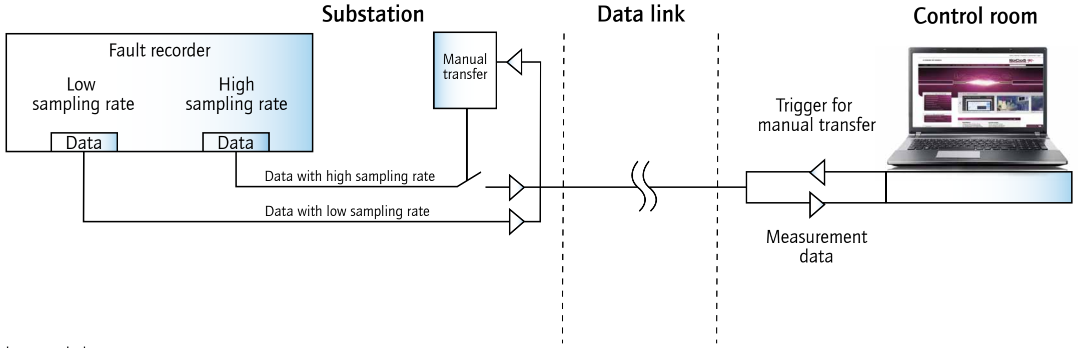

Figure 3: Manual data transfer with pre-analysis

data, which by definition needs to be made available as quickly as possible, can be downloaded several times a day, while new long-term data can be transferred later on at a separate point in time.

Data reduction through pre-analysis of fault records

If the size and the content of fault records lead to lengthy transmission times and a correspondingly large volume of data traffic, it may be helpful to decide beforehand which data is to be transferred and which not. Particularly when using very high sampling rates – with SHERLOG CRX they can be as high as 30 kHz for subsequent harmonics analysis, for example – a correspondingly large volume of data and therefore longer transmission times are unavoidable. If, after the transfer of individual recordings, it turns out that their signal characteristics do not require any further evaluation, valuable data volume and transmission time have been wasted. SHERLOG CRX provides the option of configuring two independent fault recordings and of transferring the data of each one independently of the other. Both fault records are configured for the acquisition of the same fault, but the high sampling rate desired is only selected for one of them. Because the automatic download of both units can be activated separately, only the fault records with the lower sampling rate are transferred in this situation. After an initial evaluation, the high-resolution records can then be downloaded manually as required (see Fig. 3), once pre-analysis has established that they would be useful for further evaluations. If this is not the case, the high-resolution recording remains in the fault recorder and does not contribute unnecessarily to the volume of data traffic.

In addition, the ability to vary and set pre- and post-fault periods for fault recordings as well as to adjust recording duration in line with the fault duration or to set it to a fixed value makes it possible to generate shorter fault records with the second recording unit. A decision as to whether or not to transfer the longer main recording is then easy to make on the basis of the content of the shorter recording.

Data reduction through weighted execution of actions

Another way to keep data traffic to a minimum, without compromising on providing comprehensive notification of recorded faults, is the use of automatic further processing of downloaded records subject to the trigger and content. Individual fault recorder groups are interrogated and managed using a locally stationed PC which is itself connected to the central communications

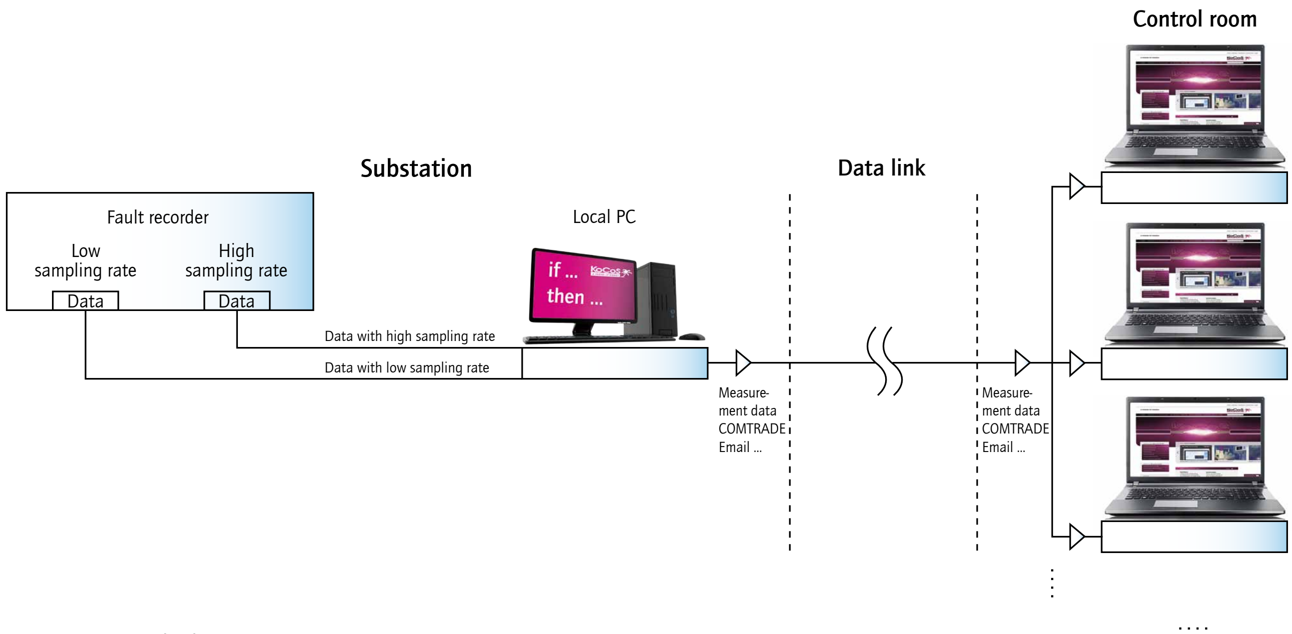

Figure 4: Weighted transfer of measurement data

network. Because the weighting of all the fault types and fault events to be recorded is freely configurable in the fault recorder settings, they can be assessed after automatic download and further actions can be performed (see Fig. 4).

If the weighting is set to a high value, emails can automatically be sent to predefined addresses, for example, in order to inform recipients of the presence of a new fault record which may be significant. The recording concerned could then be added to the email as an attachment in a selection of exported formats such as Comtrade or CSV, as required. This feature could also be used in combination with the method described above by attaching a low resolution version of the recording which could be used to make a preliminary pre-selection for further transfers. A pre-defined PDF report with details of signal characteristics and faults could also be added as a separate attachment. Not only would this reduce the amount of data traffic, it would also meet the frequently imposed requirement to provide information on new faults and fault recordings fast.

Used in combination with other automatic actions too, sending emails can contribute to the optimum dissemination and availability of data and information. Not only can new recordings be automatically downloaded to and saved on a local PC, they can also be archived in freely selectable and fault-dependent target directories within the communication network. By simultaneously sending emails associated with the action, the user responsible can be informed quickly of the presence of a new recording and can then carry out targeted analysis and further processing.

In addition to the management and separation of data, the automatic performance of actions is suitable for central data acquisition too. Here too, transferred recordings can be automatically distributed and exported to individual paths, emails can be generated for notification and data transfer or fault reports can be sent to connected printers.

Reduction in the amount of data through segmentation of long-term recordings

In order to reduce data traffic between the fault recorder and the main computer, fault records can also be downloaded by the user manually and only if required, as described above. Recordings can be pre-sorted for this purpose using the trigger criteria and the duration of recordings. However, this is more difficult to achieve with long-term data, as there is usually only an update of all the data generated since the time of the last transfer. Especially when this data is to be used for the observation of grid behaviour at specific points in time or periods of time, some of the data which is transferred may not be needed for evaluation. However, the transfer of data which is not required causes

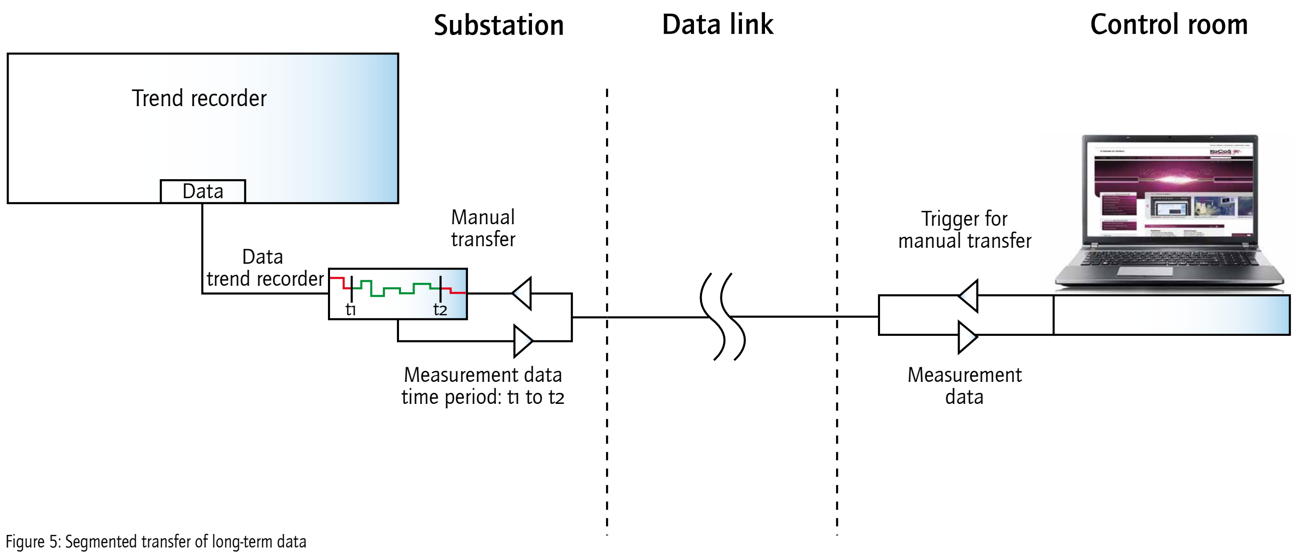

Figure 5: Segmented transfer of long-term data

unnecessary data traffic on the data link and takes up memory capacity on the central main computer. In addition to the transfer of complete long-term archives, SHERLOG fault recorders provide the option of opening or downloading segments of recordings from ongoing long-term archives, the point in time and the length of the segments can be individually selected (see Fig. 5). Memory and transfer requirements can be drastically reduced in this way.

In this way the user receives measurement data which has been customized or segmented to cover the desired analysis periods without having to use up additional memory or do additional work which is not strictly necessary.

Alternative direct transfer of existing recordings

If for technical or safety reasons there is a need to collect recorded data in the short term or event permanently with little or no use of existing data connections, then it becomes necessary to provide options for achieving this while keeping the time and effort involved to a minimum. The option described above of operating a PC locally at the site of the fault recorder for the purpose of automatic data acquisition is one way of meeting this requirement. All relevant fault and long-term recordings are collected on site and can be copied from there for manual transfer if direct network transfer is not possible or is only possible to a limited extent. However, it should still be possible to provide information in advance on the presence of new recordings, ideally for multiple substations, in order to facilitate logistics and personnel planning for picking up the new data. If at least limited access to external data communication were available, the automatic dispatch of emails on the arrival of new fault records would be an optimum solution for the purposes of notification. SHERLOG CRX offers the option of sending this type of email directly from the device itself without an intermediate PC. This provides more selectivity and flexibility for the classification of new data and the devices concerned.

SHERLOG CRX also offers the option of downloading new data on site directly from the device without having to establish a connection to a PC. This is achieved with a USB flash drive and can include an optional security measure which consists of the operator entering a password or identification. All the processes necessary for the notification and transfer of new data would then run only on the fault recorder in use, eliminating the need to rely on intermediate executive components such as a PC with operating software.

Summary and conclusion

An efficient and reliable data link is indispensable for the optimum implementation of the constantly growing need for building, extending and operating smart grids. The monitoring and control of remote components calls for comprehensive availability of measurement data and information to guarantee reliable overall operation. In order to adapt this type of data flow to provide an optimum fit with the processes required, it can often be helpful to intervene in the control and distribution of specific transmission processes or to regulate them suitably. The acquisition and the recording of network disturbances and properties are an essential element within power generation and distribution. However, because appropriate recordings do not necessarily always have to be made available immediately, a wide range of different approaches present themselves for adapting the transfer and distribution of recordings to fit in with overall data traffic.

The approaches described here for improving and regulating data traffic and data volume between fault recorders and a central computer can also be used in various different combinations to provide very good ways of making recorded fault and long-term data available as needed. In addition, by choosing sampling rates, recording times and trigger criteria during the configuration of the fault recorder itself, the number and size of fault records can be suitably adapted in advance.

hnickell@kocos.com

Dipl.-Ing. Hardy Nickell

Product Manager
Digital Fault Recording
KoCoS Messtechnik AG

Hardy Nickell completed an apprenticeship as a communication electronics technician with Deutsche Telekom AG in Kassel. After continuing his education and gaining a vocational baccalaureate diploma, he went on to obtain a degree in automation technology from Paderborn University.

He joined KoCoS Messtechnik AG in 2013 and is now product manager for fault recorder systems.