Information systems of relay protection for power system analyzing

Conference Paper · June 2006

DOI: 10.1109/MELCON.2006.1653152 · Source: IEEE Xplore

2 authors, including:

Ksenija Zubrinic-Kostovic
HOPS
10 PUBLICATIONS **34** CITATIONS

SEE PROFILE

Information Systems of Relay Protection for Power System Analyzing

J.Simunic, Ph.D & K.Z.Kostovic, dipl.ing.
Transmission Area of Rijeka
HEP–Transmission System Operator d.o.o.
Opatija, Croatia

Abstract— The paper describes information systems of relay protection for analyzing disturbances in transmission systems, their upgrade by Internet technologies, and the systems in the immediate future according IEC 61850. The data for analysis are obtained from the relay protection intelligent devices, disturbances recorders and SCADA system in automated high voltage (HV) substations. The information systems are used for analysis of voltage and current circumstances during disturbances in the network.

I. INTRODUCTION

The data from recording devices, the numeric relay protection devices anf from SCADA are used for in-depth analysis of disturbances occurred in the electric power system (EPS). Details are given on the computer system structure and the links to the disturbance recording devices. Possible application of intranet technology and the new data access enabled by the new IEC 61850 standards has also been described. For data protection purpose on internet one of the possible solution such is virtual networks has been made.

II. INFORMATION SYSTEM FOR ANALYZING EPS DISTURBANCES IN SUBSTATIONS

To analyze disturbances occurring in the EPS, the information systems of relay protection are used with below data sources:

- Disturbance recorders,
- Recorders within the relay protection numerical devices,
- SCADA .

To analyze the data obtained, there should be a possibility of remote retrieval of data by the communication technologies. The communication is achieved by a modem and the use of telephone lines of different telecommunication operators [1]. The devices using fiber optics and HF technology establish the communications. Current architecture of the computer system in substations and Centre of relay protection is described. Architecture of information systems are the same for different producers. For example there are three different producers in our substations. There are three main levels of communication in Information system of relay protection:

- The first level is a substation accommodating intelligent devices of relay protection,
- The second level are the communication paths to be provided for data transmission (telecommunication network of different companies),
- The third level is a centre where the data from all the substations are stored and can be viewed in:
  - Centre of Relay Protection – data from relay protection
  - Control Centre - data of the SCADA system.

A. Data Description

A system of disturbance recording occurring in the network provides the data indispensable for subsequent analysis of disturbances. Any relevant data could be obtained among which are:

- Failure location, voltage and current values at the moment of the failure, before and immediately after the failure,
- Event list,
- A diagram of voltage and current waveforms and logic signals.

Figure 1 illustrates the architecture of the computer system used in the existing substations. There are three levels in the system. The first level is a substation accommodating intelligent devices of relay protection, the second level are the communication paths to be provided for data transmission (telecommunication network of different companies), and the third level is a centre where the data from all the substations are stored and can be viewed. At this level the disturbances are analyzed and the relay protection settings are evaluated. Data on protection operation are compared with the data in the relay protection setting database. The values of the currents obtained are compared

with the data from the program for calculation of short circuit currents. Those data are vital for checking the parameter setting of relay protection devices.

To make a quick analysis of a disturbance the data of the SCADA system, available in the Control Centers is used. Data is in ERM list are signals with data descriptions:

- Date and time,
- name of substation, voltage level , name of bay unit and
- function and state.

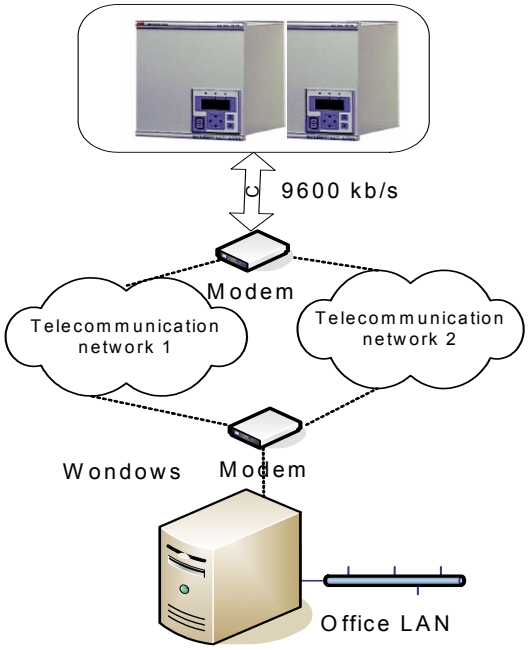

Figure 1. A diagram of the existing information system for analyzing disturbances

The systems described herein are used for in-depth analyses of events such as breakdowns of a part of the EPS caused by the failures due to storms or HV equipment failure in the substation or on the transmission lines. When a transmission line failure is involved, it is important to locate the failure. This data could be obtained from a relay for quick finding and remedy of the failure.

III. Information System for Relay Protection by LAN and WAN Networks

Below text describes the adaptation of the existing relay protection devices for remote retrieval of data by Internet technology. There is a series of applicable solutions with respect to the equipment in the substation. Figure 2 illustrates one of the possible solutions and it is an Ethernet modem installed for each station [3]. Which design will be used depends on the equipment in the substations.

Figure 3 illustrates the second possible solutions for communication with the relay protection device for remote parameter setting and data retrieval by internet technology. To use the new solution, each substation should be provided with a PC connected via a serial port RS232 to a star coupler to which the substation relay protection device is connected by fiber optics [4].
Such a PC is connected via LAN, Router, and WAN to the PC, when there should be a possibility of remote retrieval of data.

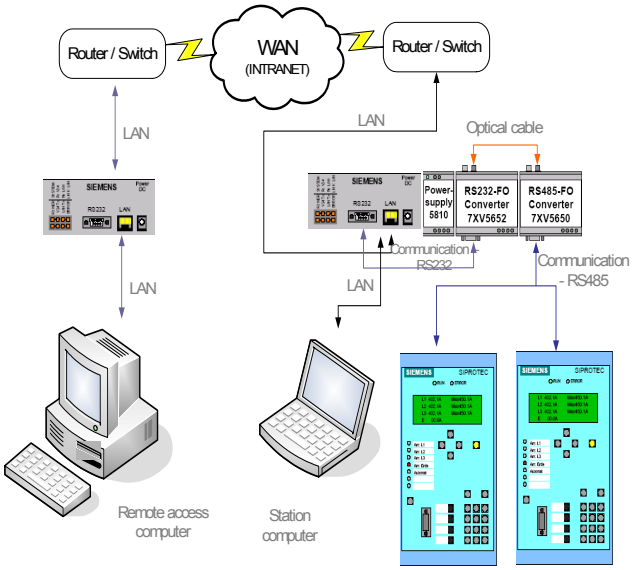

Figure 2. A technical solution for communication with devices via LAN and ethernet modem

The devices described have two communication interfaces, one toward the service place of the protection operator and the other toward the system interface through which there is a data link to the SCADA System.

IV. Information System for Analysys According IEC 61850

Before IEC 61850, the numeric relays had three communication interfaces:

- a service interface for on-line parameter setting,
- a service interface for remote retrieval of data and/or parameter setting, and
- a system interface for communication of devices with the central unit (station PC).

It is sufficient for the devices manufactured following the IEC 61850 standard to be equipped with one communication interface only as illustrated in Figure 3. The entire communication is carried out on Ethernet. Data transmission (failure recording) is automatic, same as data set migration in the central unit that is the station computer. Data evaluation is done by special software allowing browsing of records at the station level and at the level of the transmission or distribution area.

The system architecture supporting remote retrieval of data based on Ethernet should allow the implementation of old and new systems in automated substations supported by different standards, such as:

- IEC 61850 (new standard),
- IEC 60870-5-103 (the standard applied in the existing substations), and
- Profibus FMS.

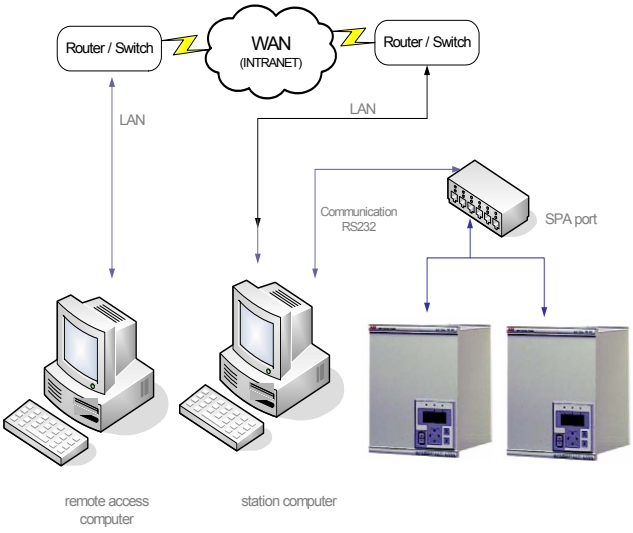

Figure 3. A technical solution for communication with devices via LAN

The characteristics of those systems are:

- Automatic transmission of archives stored in the relay protection unit or in the central units to a uniform database,
- Data scanning/research, comtrade viewer of failure records,
- Use of TCP/IP protocol for communication via Ethernet,
- Data exchange among intelligent devices in XML format, and
- Standardized data according to the information model for automation of electric power facilities according to IEC standards, series 61850.

Before, we had three types of communication and in the immediate future we will have only one type of communication. In substations according IEC 61850 on one side, as is shown in figure 4, there is station unit and on the other side there are process, bay units, station control and network control. Between all this sides are Ethernet as only one type of communication.

V. Data Securyty on Internet

Solutions for data security are virtual LAN and Process LAN as hardware separate network for protection and control . Virtual LAN technology enables logical grouping of users into smaller logic unities regardless of the actual location of the VLAN's user. Grouping of users could be done according to different criteria such as IP addresses, data switch ports, etc. The users' communication within one physical network could be restricted within VLAN to a certain number of users only, whereas the access by other users is prevented by definitions on the router access lists. The standard IEEE 802.1Q specifies the method of data framework design for the information users within VLAN. The standard enables higher level of security between the segments of the internal network [2].

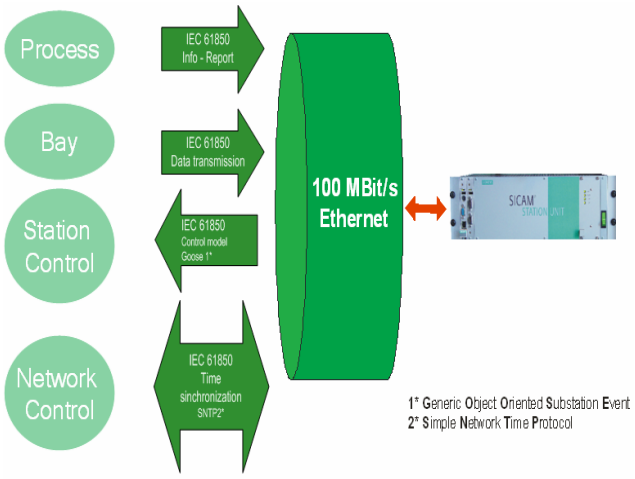

Figure 4. Communication toward IEC 61850 via Ethernet

VI. Conclusion

The possibilities of analyzing disturbances in the system are changed as well with development of technologies. The problem encountered in operation of the existing system is the establishment of communication by modem. Consequently, if Internet is used, faster access to data and fewer problems in communication with the devices in the substation are expected. It is also expected that multiple communication networks and different types of telecommunication networks are replaced with a uniform system that is the Intranet. However, in addition to the system advantages, some new problems and insecurities are anticipated as well. This paper has described VLAN as one of the possible systems of data protection. We are facing new technologies and they should not be rejected, but we have to be careful in using them.

VII. References

[1] Simunic, J; Zubrinic-Kostovic, K; Furac, G; Radosevic, M(2004): *A Review of Existing Technologies and Use of the New Ones for Communication with Relay Protection Devices, Process Information and Measurement Systems,* Transmission d.o.o./Transmission Area of Opatija, Opatija

[2] Kovac, Z; Pongrac, T. (2004): *CWDM and MPLS Technologies in the Networks of Business Users and Service Providers,* 3. CISKO Conference, Cavtat

[3] Siemens (2004), *Catalogue 7XV585*

[4] ABB (2004) – Catalogue EngineerIT TerminalToolBox CAP 540*1.3