DETECTING FAULTS IN MV NETWORK USING GPRS

Alen VARŽIĆ
Končar KET – Croatia
alen.varzic@koncar-ket.hr

Krunoslav SLIVARIĆ
HEP DSO - Croatia
krunoslav.slivaric@hep.hr

Marko ŠPOREC
HEP DSO - Croatia
marko.sporec@hep.hr

ABSTRACT

There is a growing need for installation of equipment along the depth of power distribution network in order to quickly detect failures and to obtain information about the state of the network itself. This paper describes the technical implementation of the GPRS communication solution for connecting Faulted Circuit Indicators (FCI), which are installed in MV network, to the supervisory control and data acquisition (SCADA) system at Elektra Zagreb (HEP DSO). FCI devices are used in electric power distribution networks as a means of automatically detecting and identifying faults to reduce outage time

INTRODUCTION

Locations where FCI's are installed usually are not included in the DSO's telecommunications network, so as one of the possible solutions to connect them to the SCADA, is use of GPRS communication. Connecting SCADA/DMS systems in the control centre with remotely installed FCI's and GPRS Switches, in this project, is realized through the Local Data Concentrators (LDC), which are securing a protected communication methods for connecting customer's LAN to the Internet and the GPRS network.

The system configuration is shown in Figure 1

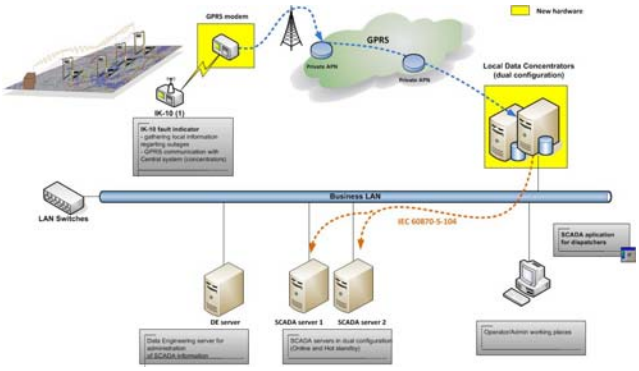

Figure 1: System configuration

SOLUTION OVERVIEW

For connecting Faulted Circuit Indicators (FCI) to the remote control system (SCADA/DMS), GPRS service from local mobile service operator is used. GPRS service provides packet-switched data transmission through the GSM network and allows virtual bidirectional linking computers in intranet HEP-ODS or Internet network with each remote fault indicator in the system.

For communication between the SCADA/DMS system to remote locations, software module Remote Communication Server (RCS) is used, which is distributed to the SCADA servers. RCS is a resident SCADA server application. "Below" RCS is a software module - Process Communication Unit (PCU), which in fact represents a process that is responsible for communicating with devices for communication via protocol IEC 60870-5-104.

For each device that communicates with the SCADA system via IEC 60870-5-104 protocol is necessary to create a special line of communication. that contains one line unit. Line module consists of the lines A and B, each of which belongs to a SCADA server. At any time, one line (A or B) is the leading one and the other trailing.

The main element that needs to be built on a site control centre Elektra Zagreb is Local Data Concentrator (LDC), which needs to communicate with existing dual SCADA/DMS system via IEC 60870-5-104 protocol over ethernet network.

The role of the Local Data Concentrator (LDC) is linking of all Faulted Circuit Indicators (FCI) on one side and the SCADA / DMS system on the other. Incorporating of LDCs also reduces the number of required licensing and communication links in the SCADA system itself.

LDC is implemented in a dual configuration (Online – Standby servers), as a modular system based on client-server architecture and represents a separate system compared to the existing SCADA/DMS system in the control centre. Dual configuration is mounted in order to increase the reliability and safety of the implemented system.

GPRS Switch is a basic element of the system which is

installed on location of Faulted Circuit Indicator (FCI) in order to secure communication via GPRS with SCADA/DMS system. GPRS switch also provides the possibility of connecting with Faulted Circuit Indicator (FCI) via serial interfaces RS232/RS485 using MODBUS protocol.

Connections SCADA/DMS with remote GPRS switches are realized through the LDC, over protected wide/local area network connecting Customers to Internet and GPRS network. The data transfer system is implemented with VPN encryption technology and firewalls, to ensure a high level of data protection. LDC's and GPRS switches are providing a connection to the Customer's APNs with fixed IP addresses.

Data transmission is done using GPRS technology implemented with TCP/IP communication protocol. GPRS switch must provide two-way communication through the GSM network and have the function of automatic verification GPRS connection and automatic restart ("reset") switch in the event of downtime, which ensures high reliability of the GPRS switch.

Frequency of sending messages to the central server is set individually, such as once an hour, once a day, etc. LDS are also enabling remote time synchronize of local devices on site to a central computing devices. Data obtained from the local device to the central SCADA system are transferred with a timestamp.

SCADA SYSTEM

SCADA system is one of state-of-the-art solutions available on the market for this kind of control centre and it consist of:

- HP Alpha servers DS25 in redundant configuration (on-line and hot stand-by) for SCADA and historical database (HDB),
- HP workstations with one, two or three monitors,
- Intel based web server,
- redundant LAN,
- ICCP/TASE2 interface
- printers, plotter,
- interface to business LAN and
- new communication interface, also in redundant configuration.

Software system is based on HP True64 Unix operating system for SCADA/DMS and Historical DB, Windows Server 2003 for web server and Windows XP for workstations. All SCADA software is installed on Alpha servers, while workstations are used for graphical interface and HMI. Historical database uses ORACLE platform for data storage.
New system complies to open systems standards and can be integrated with other systems through number of interfaces:

- ODBC for real-time and historical database
- COM/DCOM for application integration
- Web interface based on JAVA runtime environment

COMMUNICATION

Communication can be initiated by two means: from LDC at the request from RCS and (or) via GPRS Switch (in case there is a change of state). In order to ensure two-way communication that is suitable for GPRS data transfer and cost reducing of data exchange via the GPRS network, communication protocol IEC 60870-5-104 is used.

DATA TRAFFIC

With the condition criteria set for data retrieval and the status check of communication to one hour, in which entire sequence of the General Interrogation (GIT) is performed, the total traffic for the GIT is approximately 0.25 kB, which is 6KB daily and around 186kB monthly.

Fault generated traffic is slightly smaller than the traffic during GIT. Therefore, the total monthly traffic that make periodic checks of connections that are made once per hour, in addition with more frequent tripping indication of failure, can be estimated to be less than 200kB.

CONCLUSION

In order to meet the growing demand for electrical energy, with emphasis on increasing energetic reliability, modern distribution utility must continually work to improve the quality of its distribution network. More rapid fault location and quicker restoring power to the consumers, which is reflected through short interruptions in the delivery of electricity, will have for result both the economic benefit and satisfaction of customers. On other hand, DSO operator will also reduce losses for undelivered electricity and minimize the need for additional resources for locating faults in power distribution network.

REFERENCES

[1] System design documentation, “Delivery of equipment and works for connecting Faulted Circuit Indicators (FCI) with SCADA system in HEP DSO Elektra Zagreb using GPRS communication”, Koncar – KET, Zagreb 2011.

[2] B. Njavro, A. Varžić, 2009, " REVITALIZATION OF REMOTE CONTROL CENTRE AT ELEKTRO PRIMORSKA (SLOVENIA)", 20th International Conference on Electricity Distribution, Prague