Development & Application of Computer Techniques to Environmental Studies VII,
C.A. Brebbia, P. Zannetti & G.Ibarra-Berastegi (Editors) © 2000 WIT Press, www.witpress.com, ISBN 1-85312-819-8

Contemporary software solutions in designing the real-time environmental information systems

M. Lesjak, M. Boznar, & P. Mlakar
AMES d.o.o., Jamova 39, SI-1000 Ljubljana, Slovenia

Abstract

Software design of the real-time environmental information systems is turning from the dedicated solutions to the open networks. Standard software is being extensively used as a platform on all levels: from measuring units to database management, data transmission, and distribution of environmental information. In the paper, we are presenting results of our recent work on LAN- and WAN-based continuous monitoring systems. They feature full network connectivity, distributed databases and use of intra/internet solutions. As an example, a newly designed environmental information system for the thermal power plant is described.

1 Introduction

Most of the existing continuously monitoring environmental information systems (or networks) is still built according to the hierarchical, star-topology concept. In practice this means that measuring stations (representing the basic source of data) transmit their information in sequence to the local sub-centers, centers, and finally to the end users. Usually, the transmission media are dedicated, such as leased lines, switched lines, or radio links. An additional characteristic is use of specialized software, communication procedures, and hierarchically organized databases.

In recent years, the opposite concept is becoming extensively popular. It connects the measuring stations, data-processing computers and information-

users through the local or wide-area computer networks. In this case, data transmission paths are normal network computer interconnections (often not directly transparent in WANs), data transfer is realized by standard network file transfer system, TCPIP or FTP, databases are distributed, and presentation of data can be made by use of standard software (such as Internet browsers).

There are several advantages of this approach. First, the concept is much more flexible. It is opened to freely add the new system components (such as measuring stations, instruments, data processing and data storing computers and data users) to the net. Secondly, in the network environment, especially in the wide area networks, (e.g. Internet), there are redundant connections, making the network less sensitive to the loss of communication. Thirdly, since the computers share their resources, databases need not be multiplied throughout the system. Instead, system can maintain virtually unique, but in reality distributed database, available to all the system computers. At last, information can be spread by use of modern tools, such as Internet browsers and multimedia.

2 Concept of the network based environmental information system of the Brestanica Thermal Power Plant, Slovenia

In 1999, the project for Brestanica TPP Environmental Monitoring System has been launched. System consists of a transportable ambient air pollution station (located in the container), emission station for both blocks of TPP, hydrological station, meteorological station in the TPP, central computer (capable of supplying data to several local users), and remote (100 km) data user (Environmental group of the Electric Power Authorities in Ljubljana).

From the beginning, we have planed the system on all levels to be the real computer network, as schematically shown on Fig. 1. Main system elements are:

- ambient air quality (and meteo) station
- emission station
- hydrological station
- meteorological station on the location of Brestanica TPP
- data-processing computer inside the TPP
- computers of local users
- remote computer in Ljubljana

Development & Application of Computer Techniques to Environmental Studies VII,
C.A. Brebbia, P. Zannetti & G.Ibarra-Berastegi (Editors) © 2000 WIT Press, www.witpress.com, ISBN 1-85312-819-8

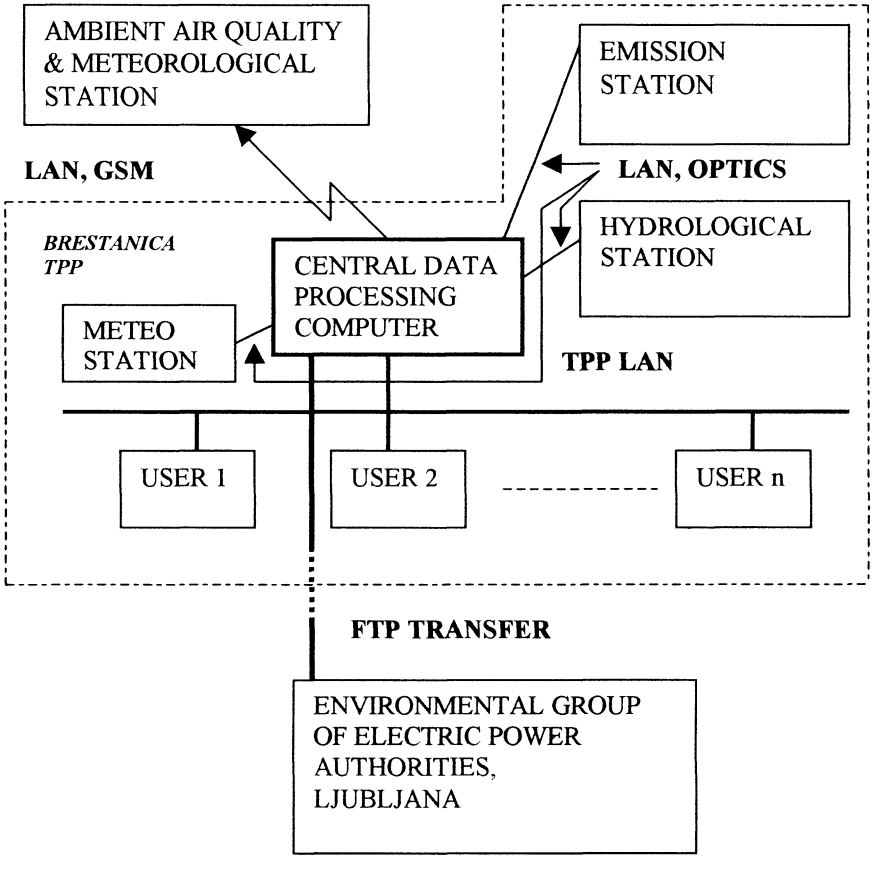

Figure 1. Environmental Information System of the Brestanica TPP

Network is realized in four different ways: toward the transportable field station, there is a connection through the GSM cellular phone. To the emission, meteorological, and hydrological stations, there are optical links. Central data processing computer and local users are connected to the existing infrastructure of the plant LAN. To the distant user in Ljubljana, Internet connection and FTP transfer are used.

Regardless of different physical ways of interconnection, the whole system acts as unique computer network. There is no specialized data transfer between the computers. Databases, though located locally at each measuring point, are globally accessible from the whole net.

3 Software

3.1 Local Area Network and Wide Area Network

All computers in the system run Windows NT® 4.0 operating system. Inside the power plant, there is an existing LAN. To this network, central data-processing computer and local users of the environmental information system are connected. Since local meteorological station, emission station, and hydrological station are at greater distances (up to 500 m), in the industrial environment of the power plant, there are optical links connecting them to the plant LAN.

Transportable ambient air quality / meteorological station does not have a permanent location. Therefore, a GSM connection was selected for this station, permitting to move it occasionally from place to place. Network connection in this case is by remote access service (RAS). RAS is started when the data should be accessed, network connection is established, data transferred, and remote station disconnected from the network.

To the remote users, file transfer protocol (FTP) is used. Over the Internet, data are accessed from the remote users and transferred to their locations.

3.2 Databases

Each station maintains it's own database of local data. Through the network, users get data by Open Database Connectivity (ODBC) and SQL queries. For redundancy and archiving, central data processing computer maintains also the centralized system database.

3.3 Data Quality Controls

Each station performs data quality controls: control of physical acceptability of data, statistical distributions, and measuring conditions. Data are labeled by the result of data quality controls, thus indicating possible errors. Long term (daily, monthly) reports on system performances are generated at the central computer (analysis and statistics of data availability, sources of errors).

3.4 Presentation of Data

Data are presented to the users in two ways. Local users can run dedicated, central-computer located software package to browse, inspect, analyze and print data in several predefined forms. In parallel, there exists an Internet WEB server

on the central computer. This server enables both local users, and remote (WAN) users to get data through the Internet-based data-presentation system by using only standard Internet browsers [2].

4 Conclusions

Environmental information system of Brestanica Thermal Power Plant is the first continuous monitoring system in Slovenia that was built strictly following the concept of computer network. Before, there were some attempts to integrate partially such sollutions to the existing conventional systems (such as FTP transfer of data and Internet data presentations from Krsko Nuclear Power Plant [2], or network connection of stand-alone station by GSM to the computer of Electric Power Authorities).

It is not possible yet always to realize environmental information system as a pure computer network; restrictions lie in the lack of network connections, Internet availability, or specific hardware requirements of some equipment. However, spreading of new technologies, such as optical and radio links, cellular telephony, and Internet, will make networking approach extensively attractive.

5 References

1. Lesjak M., Boznar, M., Mlakar, P., *Design, Construction and Exploitation of the Environmental Information Systems*, PEPPER, D. W. (ed.), BREBBIA, C. A. (ed.), ZANNETTI, P. (ed.). Development and application of computer techniques to environmental studies, (Environmental studies series, Vol. 2). Boston; Southampton: WIT Press, pp. 309-316, 1998

2. Lesjak, M., Boznar, M., Mlakar, P. *Internet Applications as a Link Between the Environmental Information Systems and Public*, BREBBIA, C. A. (ed.), JACOBSON, M. (ed.), POWER, H. (ed.). Air pollution VII, (Advances in air pollution series, Vol. 6). Southampton; *Boston:* WIT Press, pp. 111-120, 1999

3. Lesjak, M., Mlakar, P, Diallo, B., Rupnik, Z., Boznar, M., *Continuous Automatic Monitoring of Air Pollution in the Areas Influenced by the Major Power Plants in Slovenia,* International Symposium on Environmental Contamination in Central and Eastern Europe, Budapest, Proceedings, pp. 491-495, 1993