THE CONCEPT OF A UNIFIED METEOROLOGICAL AND RADIOLOGICAL MONITORING SYSTEM BASED ON HYPERION TECHNOLOGY

by

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Received on June 20, 2004; accepted on November 15, 2004

For the purpose of tracing the migration of radioactive materials in the environment it is essential to monitor meteorological and radiological parameters by a unified measurement system, because of the strong correlation of meteorological and radiological parameters. The ultimate goal is the prevention of radioactivity-induced diseases and disorders caused by radioactivity in both human population and the environment. A unified meteorological and radiological monitoring system can be readily implemented by using the organization and communication infrastructure of HYPERION technology. This would ensure an automatic and centralized acquisition of all relevant parameters.

Key words: environment, protection, monitoring

INTRODUCTION

Radioactive materials could be propagated throughout human environment by wind, rainfall, water flows and also by human activities. Since radioactivity is a severe health hazard, the important goal is to achieve effective prevention of radioactivity-induced diseases and disorders caused by radioactivity in both human population and the environment. State legislation [1] requires the establishment of a centralized system for strategic automatic measurement and monitoring of the levels of environmental radioactivity. The measurement and monitoring of the environmental radiological parameters alone are not sufficient since there is a strong correlation between the radiological and meteorological parameters which calls for the establishment of a unified distributed automatic measurement/monitoring system. Due to the strong correlation between radiological and meteorological parameters it is necessary to measure and monitor the following meteorological parameters: temperature, relative atmospheric pressure, humidity, wind speed and direction, and rainfall. In order to obtain a complete picture of the behaviour of radiological parameters it is necessary to measure and monitor not only the gamma radiation levels but also the levels of alfa and beta radiation of gasses, particles and aerosols in the air. A unified meteorological and radiological monitoring system can be readily implemented by using the organization and communication infrastructure of HYPERION technology [2] which would provide on-line automatic and centralized acquisition, processing, and communication of data concerning all required radiological and meteorological parameters.

Technical paper
UDC: 551.502/.506:614.876:681.323
BIBLID: 1451-3994, *19* (2004), 2, pp. 74-76

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HYPERION Technology

HYPERION technology introduces the concepts and solutions of industrial automation, based on multi-layer network structures, into radiological and meteorological measurement and monitoring systems. The highly distributed and appropriately organized industrial automation networks represent a convenient pattern for radiological monitoring networks including meteorological parameters, owing to their tree-like topology, modularity, reconfigurability, extensibility and standardized communication protocols. HYPERION technol-

ogy uses Ethernet technologies, private networking through Intranet and public networking through Internet as data transportation highways. The concept of intelligent transmitters taken from industrial networks gives a possibility of measuring various environmental parameters by using advanced digital processing power. The most important feature of HYPERION technology is its capability of performing distributed measurement, processing and storing of measured/processed data.

HYPERION network structure consists of three layers: device network (network of intelligent transmitters mastered by a local control node), field network (network of local control nodes mastered by the central control node), and management network (private and/or public higher information service) [3, 4].

THE OUTLINE OF A UNIFIED MONITORING NETWORK USING HYPERION TECHNOLOGY

The implementation of HYPERION technology in unified meteorological and radiological monitoring contains a device network consisting of diversified intelligent transmitters measuring the environmental (meteorological and radiological) parameters: temperature, atmospheric pressure, humidity, wind speed and direction, rainfall and gamma radiation level. The physical infrastructure of the device network is realized as a powered standard digital interface EIA RS-485 interconnecting the intelligent transmitters and a local control node [5]. Each intelligent transmitter performs digital processing of measured data, and makes preparations for further data processing in the local control node indicating the self-diagnostics status of the transmitter [6]. Figure 1 shows the interconnection

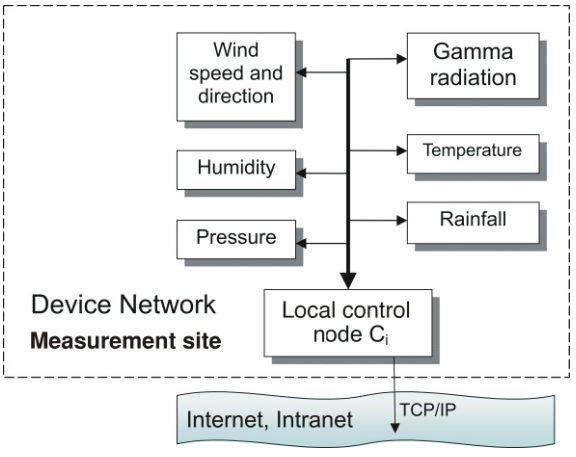

Figure 1. Interconnection of intelligent transmitters and local control node within the device network of unified HYPERION network

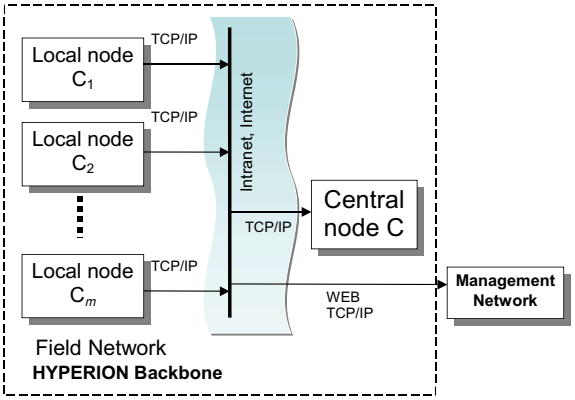

Figure 2. Organization of higher hierarchical layers of unified HYPERION network

of the intelligent transmitters and local control node within the device network.

The organization of higher hierarchical network layers is shown in fig. 2. The field network interconnects the distributed local control nodes with the central control node by using standard digital Internet protocol TCP/IP. This layer could be realized as a private network including authorized access by using VPN technologies or Intranet [7].

The functions of local control node C_i ($i = 1, m$) are: acquisition of measured data from associated intelligent transmitters, advanced processing, visualization and storing of the measured data in local database, and communication with the higher network level (central control node).

The functions of the central control node are: the collection of measured data from local control nodes, processing, visualization and storing of the measured data in central database. The collected data are visualized and presented by using standard WEB technologies [8] that allow an easy incorporation of data into the management network layer. The collected data in the central database constitute the basis for meteorological and radiological modelling and studies.

An extension of the HYPERION infrastructure within the scope of a unified meteorological and radiological monitoring system is the possibility of using wireless links to transport data from the intelligent transmitters to the local control nodes and between local control nodes and the central control node. In some cases laying wired links is either not feasible or economical, so wireless transmission media are the only alternative. In general, there are several ways of implementing wireless data links. Commercially three possibilities are available. The cheapest and easiest possibility is simple cable replacement by radio modems [9]. This approach has its drawbacks such as short range and strong dependence on channel geometry (obstacles, intervening objects, meteorological conditions). The second possibility is to use

GSM/GPRS public mobile networks [10]. This enables the use of the broad coverage zone of a public mobile network, and a variety of data transmission services with guaranteed data integrity and protection. The disadvantages of the GSM/GPRS option are billing and dependence on mobile network providers. The third possibility is using of the global system of satellite links [11] as a distant but very reliable network. The obvious advantages of satellite links are 100% coverage zone world wide and very high data integrity. This approach is very costly and the coverage zone for the present purposes does not have to be so wide; therefore, it is recommended to use one of the first two options.

CONCLUSIONS

For the purpose of tracing migration of radioactive materials in a specified environment it is of ultimate importance to monitor the meteorological and radiological parameters within this environment by the presented unified distributed measurement/monitoring system. By using HYPERION network as a unified meteorological and radiological monitoring system, measured data collected from large areas can be made available to the governmental institutions or public information services for the purpose of making meteorological and radiological studies and/or modelling, taking decisions as regards human/environmental protection, designing protection policies, *etc*.

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КОНЦЕПТ ЈЕДИНСТВЕНОГ МЕТЕОРОЛОШКОГ И РАДИОЛОШКОГ СИСТЕМА ЗАСНОВАНОГ НА HYPERION ТЕХНОЛОГИЈИ

У циљу праћења миграције радиоактивних материјала у околини од суштинског је значаја праћење метеоролошких и радиолошких параметара јединственим мерним системом због јаке корелације метеоролошких и радиолошких параметара. Крајњи циљ је спречавање обољења индукованих радиоактивношћу и поремећаја проузрокованих радиоактивношћу како у људској популацији тако и у околини. Јединствени метеоролошки и радиолошки систем може се једноставно реализовати применом организационе и комуникационе инфраструктуре HYPERION технологије. Ово би обезбедило аутоматско и централизовано прикупљање података о свим релевантним параметрима.