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# BAKNET - COMMUNICATION NETWORK FOR RADIATION MONITORING DEVICES

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## Introduction

A system, based on a new concept of controlling and monitoring distributed radiation monitors, has been developed and approved at the NRCN. The system, named "BAKNET<sup>[1]</sup> Network", consists of a series of communication adapters connected to a main PC via an RS-485 communication network (see Fig. 1). The network's maximal length is 1200 meters and it enables connection of up to 128 adapters.

The BAKNET adapters are designed to interface output signals of different types of stationary radiation monitors to a main PC. The BAKNET adapters' interface type includes: digital, analog, RS-232, and mixed output signals. This allows versatile interfacing of different stationary radiation monitors to the main computer. The connection to the main computer is via an RS-485 network, utilizing an identical communication protocol.

The PC software, written in C++ under MS-Windows, consists of two main programs. The first is the data collection program and the second is the Human Machine Interface (HMI).

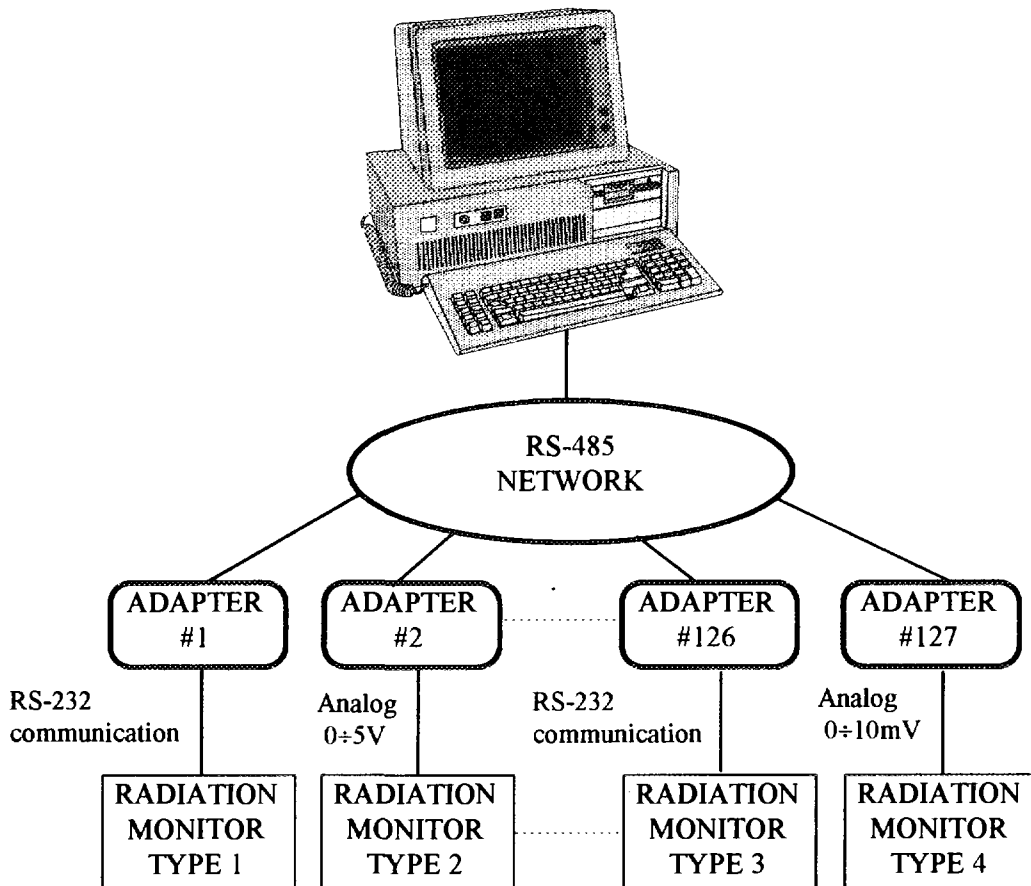


Fig. 1. - Block diagram of the BAKNET network

## **Main Computer**

The main PC serves as the heart of the network system. The PC is equipped with an RS-485 board type PCL-745B. The PC board allows half duplex communications via a 2-wire network with automatic direction switching between reception and transmission.

The software is written in C++ under MS-Windows utilizing object oriented technology. Two major programs manage the main BAKNET network's targets: one is responsible for real time data acquisition via the RS-485 communication network, and the other performs HMI, map displays, data files storing and retrieving, graph displays, failures list printing, etc. The PC, serving as the master in the communication network, sends commands to the BAKNET adapters, which act as the RS-485 network slaves. The adapter sends back its updated data in real time from the various radiation monitors. The updated data from the field is processed by the computer and displayed on screen, on top preloaded maps. In case threshold values were exceeded or alarm conditions met, the PC performs the following: prints out the detailed failure, alters the background color of the value's location on the map, the speaker is activated (until the operator acknowledges it) and the data is stored on file. In addition, the user may request to display on a graph the measurements history of the alarmed point.

## **Communication Network**

The RS-485 communication network's parameters are: half duplex mode, 9600 baud rate, up to 128 stations, and a maximal distance of 1200 meters. The half duplex mode allows receiving and transmitting of data via 2-wire physical layer. The PCL card's unique feature is automatic direction switching in half duplex mode, enabling rapid data acquisition cycle of 250 msec per adapter.

Since the BAKNET network enables connection of up to 128 stations and accurate data collection of 250 msec per station, it improves operation by saving time and personnel, replacing the slow manual data collection previously employed. A special protocol was defined to cover the different types of radiation data formats. The protocol transmits messages from the PC to the adapters, each containing 15 bytes which describe to which adapter the message is addressed to and the kind of data required. The message received from the adapter by the PC, consists of 25 bytes that describe radiation monitor data such as: counts, adapter address, units, coefficient of data, alarms and threshold status, and a checksum. The BAKNET network is a bus shaped communication network, that enables real time control of data received from distant radiation monitors.

## **BAKNET Adapter**

To address output signals of the various radiation monitors, a new adapter has been designed. At the local level, the adapter initiates data collection from the radiation monitors, processes the different data types, and constructs a unique data format that is transferred to the master PC via RS-485 network. The microcontroller on the adapter board is responsible for processing different types of data such as: acquiring data through the RS-232 serial channel, acquiring analog data from radiation monitors, and digital alarms and thresholds outputs. The novelty featured in the new adapter is the ability to interface with different types of radiation monitors. The adapter includes 8-bit switches to determine the adapter address in the network, up to 128 channels can be selected; and 4-bit switches to select the type of attached radiation monitor. This allows the selection of up to 16 different types of radiation monitors. The adapter board includes a 8032 microcontroller, 8-channel A/D converter with differential operational amplifiers to fit various ranges of analog data, 24-line I/O for digital data lines such as alarms, thresholds and range.

The microcontroller software was developed using Kiel Franklin C language, and was programmed into a 27C256 EPROM. Software is constructed of various modules, each handling a different type of monitor. Since the BAKNET adapter's hardware was designed with great flexibility, future addition of new modules for new radiation monitors is reduced to simple software modifications.

## Summary

A system for controlling and monitoring various distributed radiation monitors has been developed and approved at the NRCN. The system was installed and satisfactory results were obtained. The versatility and novelties introduced in the system, offer great flexibility in data acquisition and processing. In addition, the system improves operability by saving both time and personnel, replacing the slow manual handwritten oriented procedure previously implemented. Additional usages are being explored, including data collection from industrial instrumentation and from any device located apart from the control room.

## Reference

- [1] O. Burstein, U. Wengrowicz and D. Tirosh, **BAKNET - Communication Network for Radiation Monitoring Devices**, Research Laboratories Annual Report 1993, IA-1486, pp. 130÷131.