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Proposal of Data Collection from Probes

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Abstract**—**In our paper we describe the security capabilities of data collection. Data are collected with probes located in the near and distant surroundings of the company. Considering the numerous obstacles e.g. forests, hills, urban areas, the data collection is realized in several ways. The collection of data uses connection via wireless communication, LAN network, GSM network and in certain areas data are collected by using vehicles. In order to ensure the connection to the server most of the probes have ability to communicate in several ways. Collected data are archived and subsequently used in supervisory applications.

To ensure the collection of the required data, it is necessary to propose algorithms that will allow the probes to select suitable communication channel.

Keywords**—**Communication, computer network, data collection, probe.

I. Introduction

NOWADAYS, there are a large number of probes, that are able to provide submission of data to the designated data storage, in addition to data collection functions.

The probes are able to communicate through wireless, LAN and GSM networks. The selection of communication channel is mainly conditioned by the type of probe and its location. Stationary probes placed near LAN network are usually connected to it by cable. With mobile probes or probes located in an area where it is not possible to connect to the LAN network using a cable, it is possible to communicate using a wireless connection or using a GSM network. Several probes have the possibility to communicate with several communication channels. In such case it is necessary to ensure the selection of an appropriate communication channel.

II. Communication Methods

A. Cellular Networks – GSM/GPRS/UMTS

Cellular network is cell system for mobile phones. It consists of the BTS (Base Transceiver Station), which serve for mobile devices within range. The core of the cellular network is a central unit which processes, sorts and routes the received calls.

Data calls in cellular networks are realized through a variety of communication protocols. Older and newer transmission technologies are used for ensuring compatibility with different devices. The older technologies include HSCD (High Speed Circuit Switched Data) and GPRS (General Packet Radio System). To the newer technology belong UMTS (Universal Mobile Telecommunications System), HSDPA (High-Speed Downlink Packet Access) and LTE (Long Term Evolution) [1]-[3].

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B. IEEE 802.11x

Concept of building wireless networks based on Wi-Fi is presently due its advantages (low cost + mobility + sufficient bandwidth) one of the most used technologies in creating data networks.

Communication runs on the basis of series 802.11 standards (known as Wi-Fi). During communication are used frequencies 2.4GHz for 802.11b, 802.11g and for latest 802.11n variants, and 5GHz for 802.11a.

Differences are also in modulation. Variants “a“, “g“ and “n“ use OFDM (Orthogonal Frequency Division Multiplexing), or MIMO (Multiple Input - Multiple Output) and variant “b“ uses DSSS (Direct Sequence Spread Spectrum).

Wi-Fi networks can operate in two modes. The so-called Ad-hoc mode allows direct connection of two devices. It is applicable in the case of direct communication of two endpoints. The infrastructure mode works on the principle of having a central AP (Access Point), to which are connected all other devices; thereby, they are creating a certain communication structure. This wireless networks connection method is the most widely used because of possible communication control in the central point [4], [5].

C. IEEE 802.15.4

Network based on IEEE 802.15.4 protocol belong to the inexpensive wireless transmission standards with low maintenance. Their main use is in wireless control of technology equipment, monitoring of technological processes or wireless data collection. With its low energy consumption the network can be operated for long time on backup power. They also provide high reliability and relatively acceptably range. Regarding the physical arrangement of access points on the area, it natively supports star and tree connection, or mixed connection [6], [7].

III. TeleDosimetric System

The whole TeleDosimetric System (TDS) consists of 24 measuring stations. They are located around the production plant in three areas. The first circuit of measuring stations (5 measuring stations) is located on the property of a facility. Consequently, within a radius of 3-6 km, there are another

15 measurement stations. Finally there are 4 more stations in a distance of 15 km. The probes measure 9 parameters of air quality. Data recording is provided by central server.

As the deployment of probes in the field is very appropriate, their position is suitable for using some type of wireless communication. When we take into consideration problems with transmission capacity, it is necessary to realize, that there is a small amount of data transferred at regular intervals. Such transfer is not bandwidth consuming. Therefore the capacity of the network can be relatively small. The entire system must be reliable and the transmission must be guaranteed even in emergency conditions [8], [9].

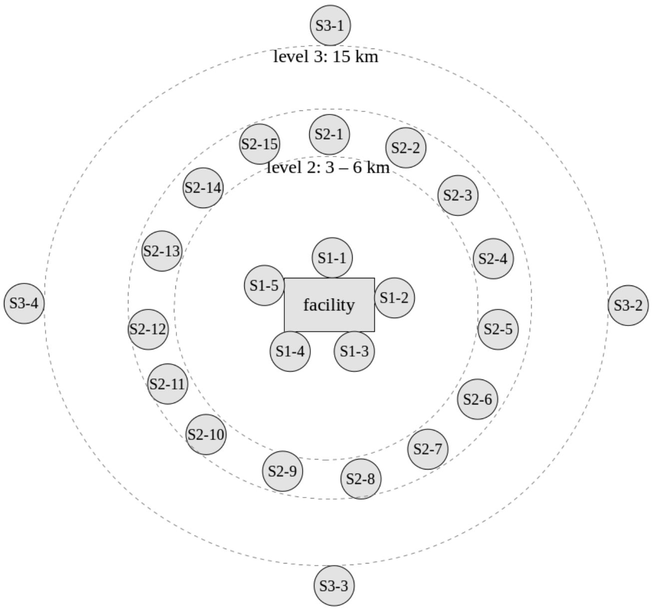

Fig. 1 Positions of probes in monitored area [9]

IV. TeleDosimetric System Architecture

The TDS architecture consists of three basic modules:

i. Data Collection Module.
ii. Data Archiving Module.
iii. Application Interfaces Module.

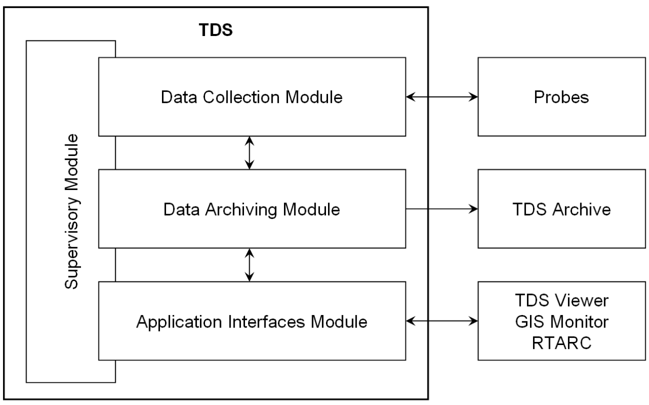

Fig. 2 TDS Architecture

A. Data Collection Module

Collection of the required data can be divided into managed and unmanaged collection.

In the first case the collection process involves extracting data from the probes on the request of the TDS server. In the second case, the data are sent to the server automatically on a regular basis.

TeleDosimetric stations around facility belong to the managed collection category.

The management system of data collection uses database that contains configuration of endpoints. This database contains information about network topology, transmission routes, necessary drivers, scope of data as well as the interval of data collection.

Data collection is organized in groups by location. This means that at the first data from all probes are received, for example in the area 1, then in the area 2, and so on. In the case, that any probe data is unavailable, the record of this issue will be added to queue of unavailable data. The system automatically attempts to get the data from these probes at the end of the collection period (after receiving the last available value from the probe). Analysis verified the possibility of using modules ADAM 4577 to replace current IPC in five stations in the area of facility. The benefit of proposed replacement is particularly higher stability, as well as lower energy consumption and lower maintenance. The possibility of using ADAM 4579 module will be verified after delivery of modules for testing.

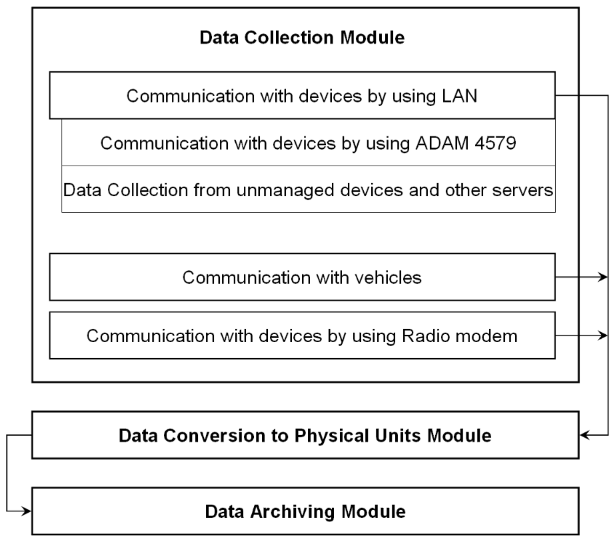

Fig. 3 Data Collection Module

B. Data Archiving Module

The main TDS server makes information about the current status of the queue, as well as the received data available also to secondary TDS server. In this way, the secondary server creates its own copy of the received database data.

The received data are saved in the local database of received data after processing. The data from this database are regularly exported to the TDS database, including functions for recovering data after a link failure.

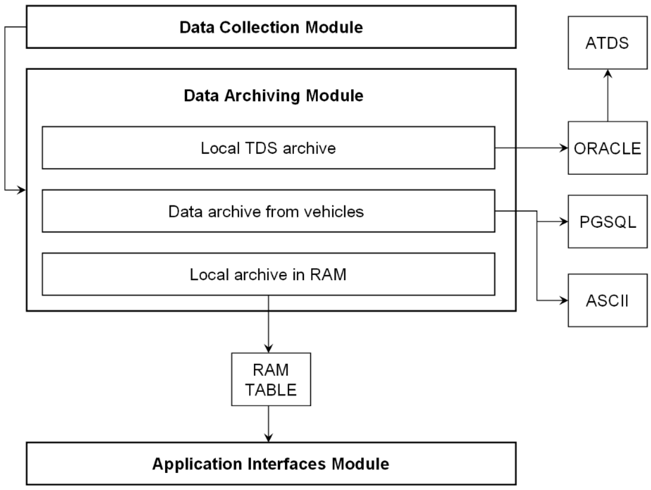

Fig. 4 Data Archiving Module

C. Application Interfaces Module

This module will ensure the cooperation of the control computer with client TDS applications.

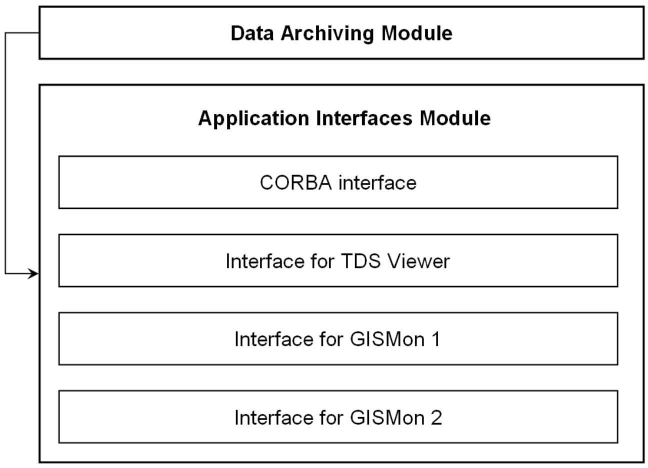

Fig. 5 Application Interfaces Module

CORBA interface – Used to provide access for other applications.

TDS Viewer – The application connects to the server through TDS CORBA technology. It is used to create and update history for clients and user management (username, password).

GISMon 1 – The application enables communicates with the vehicles through TDS files. TDS server writes the received data into the appropriate text files and vice versa - reads the data from files for sending and sends them to the vehicles. Files are shared using SMB protocol (Windows Share).

GISMon 2 – Communication based on the files is replaced by the SQL database that allows improved communication with clients, connecting multiple clients simultaneously, and additional functions such as show vehicle route according to time interval, etc.

V. Algorithms Proposal for Ensuring of Connectivity

A. Solution 1

This proposal allows setting of random routing of devices in the network. This means that it is possible to achieve the following states:

i. All data are transmitted through the network via radio modem.
ii. All data are transmitted through the GSM.
iii. Data of the network 1 are transmitted through the GSM and data of the network 2 are transmitted via radio modem.
iv. Data of the network 1 are transmitted via radio modem and data of the network 2 are transmitted through the GSM.

Automatic switch requires three control inputs:

i. In1 – determines to which node will be connected equipment from the network 1.
ii. In2 – determines to which node will be connected equipment from the network 2.
iii. Clock – timer input.

Control signals for automatic switch can be sent from the output of ADAM4050 module.

B. Solution 1 – Algorithm

Two signals cause change of the equipment output and thus change of the link between different networks communication nodes. The first signal is the leading edge of the impulse on input Clock; the second signal is an internal timer overflow. If the communication is functional, it will never be to overflow the internal timer.

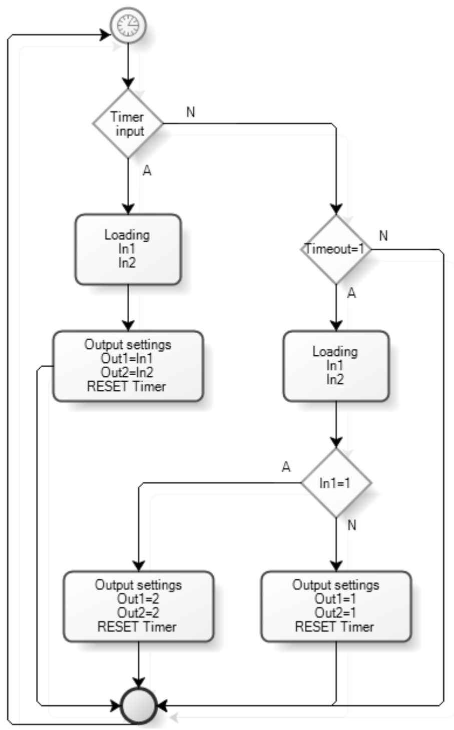

Fig. 6 Algorithm for solution 1

When they are set, the values of inputs In1 and In2 and the impulse Clock are sent consequently. The device switches the end members to the selected states. Thereby the devices are physically connected with proper communication nodes.

It is assumed that the ADAM 4050 module is connected in network 1 (controlled by In1). When clock impulse does not come, it means that the network 1 connection is not functional. In this case, the timer overflow occurs and both networks will be set automatically for connecting via the second communication node.

Recommended timer setting is 6 – 7 minutes. In such setting the end devices enables both RS-485 bus and RS-232 bus.

C. Solution 2

This proposal offers fewer opportunities to manage, but uses only single control input.

The device allows only two states:

i. All data are transmitted through the network via radio modem.
ii. All data are transmitted through the GSM.

Considering the transmission capacity of the individual communication channels, it is recommended to use the radio modem as the primary channel.

Automatic switch requires one control input:

i. Clock – timer input.

Control signals for automatic switch can be sent from the output of ADAM4050 module.

D. Solution 2 – Algorithm

The device output state change causes only timer overflow. If the reset impulse for reset timer does not come, all communication will be switched into the second channel.

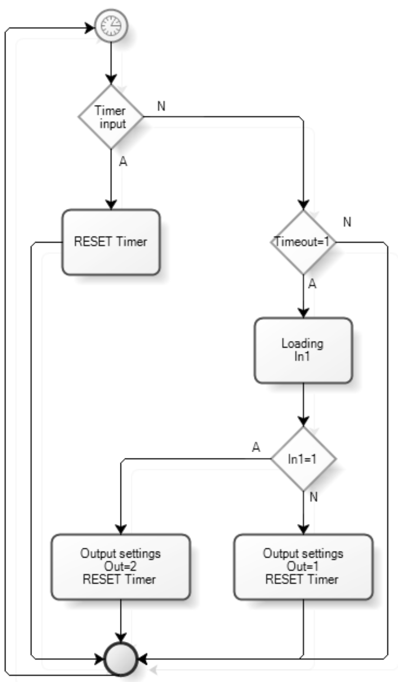

Fig. 7 Algorithm for solution 2

Communication switch back into the original communication channel can be done by not sending reset timer impulse after loading the input values. In the next cycle of the value loading the station will be connected through the second channel.

VI. Conclusion

The proposed solution of probes connections ensure the connection of probes in the near or distant facility neighborhood. The collected data are sent to the server and after their archiving used in supervised applications.

The selection of an appropriate solution is conditioned by probe type and its importance. For probes collecting important data it is recommend using robust solution 1. For probes collecting additional data solution 2 can be used, which offers fewer opportunities to manage, but it is less expensive and easier to maintain.

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