A MODEL FOR USING MULTIPLE COMMUNICATION
CHANNELS IN SIGNAL-SECURITY SYSTEMS*

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Abstract

The paper describes the operation principles of signal-security systems using wireless channel for transmission of messages. The hardware and software shortcomings are described. The message transmission frame and the restrictions on objects' numbering imposed by it are discussed. A model for using multiple communication channels based on the available hardware is proposed. A method for logical extending of the message transmission frame is described, as well as the functionality of applied module, supporting multiple communication channels. New trends for development of signal-security systems are presented.

Key words: signal-security system; communication channel; message frame.

1. Introduction

Companies dealing with security, design and build security systems to restrict access to certain objects, watch the movement of people through the pertaining area of a certain object, signalling the violation of established restrictions and documenting violations. Each of these purposes is accomplished by an individual subsystem. All such subsystems, interacting

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between themselves and exchanging information, constitute an object's complete security system, named signal-security system [1].

Centralized security is implemented by monitoring centres, comprised of hardware and software. The hardware acquires the incoming signals and the software processes, analyzes, and stores the received messages, indicating the changes in the objects' status.

The communication between the different objects and the monitoring centre can be realized by means of different independent message transmission systems: wireless security system, telephone line security system and GSM transmitter security system [2].

2. Operation principles of signal-security systems

Each signal-security system has its message transmission technology. This technology includes installed hardware, both in the security objects and the monitoring centre.

The system software provides information about all registered objects, whereas the received signals are analyzed, printed and saved in physical files in the form of messages [3].

Wireless security system. The wireless security is realized through cellular digital wireless network using two wireless frequencies. The transmitters, located in the security objects, broadcast signals in one wireless frequency, in contrast to repeaters and receivers which communicate between themselves in another wireless frequency. Usually, each monitoring centre has an individual receiver station [2].

Each security object delivers a test signal over a certain span of time. This signal indicated the status of the security system.

Fig. 1 presents the connection circuitry between the hardware and the security object.

The designation of the inputs and outputs of the security station are:
AC – alternating current, AUX – direct current output for detectors' power-supply, GRND – grounding, SIRN – siren output, PGM_0, PGM_1, ..., PGM_n – programmable outputs, Z_1, $Z2$, ..., Z_n – inputs for zone detectors connected in series, COM – grounding, R, G, Y, B – keypad interface.

The outputs of the security station – PGM_0, PGM_1, ..., PGM_n are programmable. Each of them (PGM_i) can be programmed to transmit two events, one when there is voltage (i.e. "high potential") and second, when there is no voltage (i.e. "low potential").
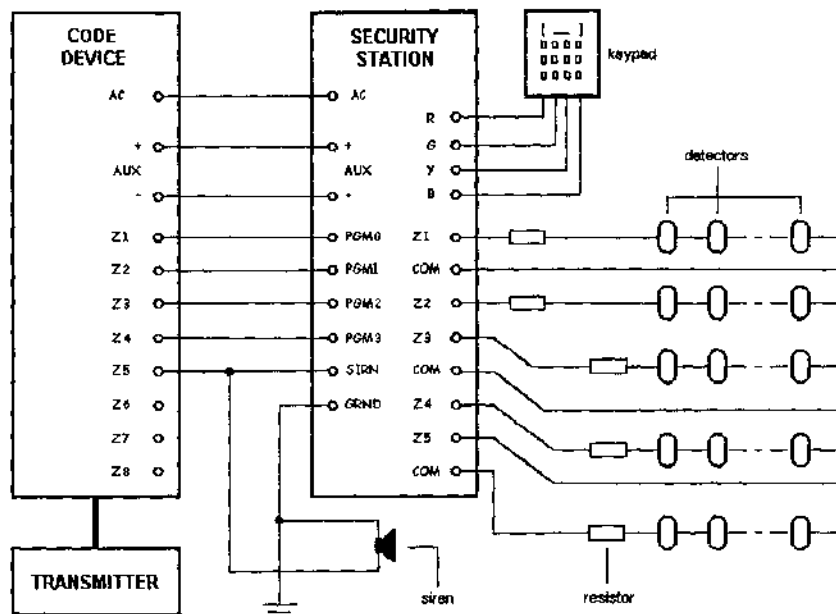
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Fig. 1. Hardware connection circuitry

A coder and a transmitter are connected to the security station. They can be assembled in one module, or can be autonomous. When starting, the coder generates a message about the current status of all zones. The coder has its own control, comprising a central processor, an operating memory, registers, and message coding software. In the transmitter, the coded message is modulated by a higher frequency and is sent in the air.

The sent messages from the security objects are received in the monitoring centres. The receiver station demodulates (separates the low frequency from the high one), after which sends a message to the decoder. In the decoder, the received message is transformed into standard RS232 asynchronous signal and then is transferred bit by bit to a communication port of an application server. After analyzing the message by the application server, it is transferred to the database server where it is stored. Fig. 2 presents the schematic diagram of the described process.
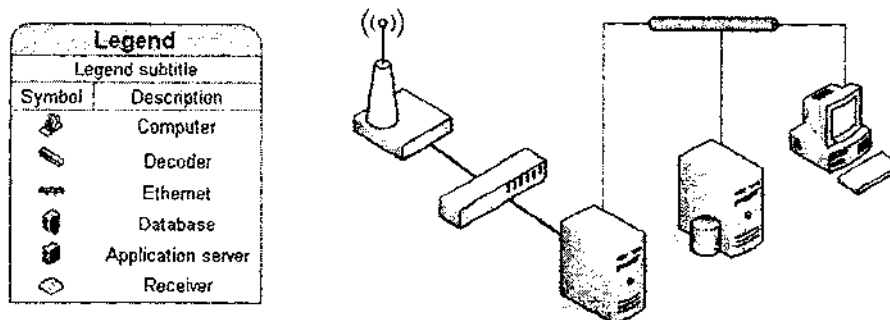
Fig. 2. Receiving, transforming, and storing a message

The frame of the message is fixed (i.e. with constant size) and its length is 24 bytes (24*8 = 192 bits). Fig. 3 presents an example frame of a message.

1	1	0	7	0	1	7	R	E	S	T	O	R	A	L	Z	O	N	E	I	#13
object number			message code				message text													end

Fig. 3. Example frame of a message

For each object, only 4 (four) symbols (0..9) are used, which sets the restriction for a total number of objects not exceeding 10,000. The paper suggests a solution for this problem.

3. A model for using multiple communication channels in signal-security systems

In the security station, the number of objects can be programmed and it may vary between 0 and 9999. The transmitter may be set up to broadcast signals of a second wireless frequency, thus creating a system of objects transmitting messages over a new transmission network. We shall name this transmission network "communication channel".

During this implementation it is possible that, in the monitoring centre, two identical messages are transmitted from two receivers to the decoder, the

difference between them being the frequency by which they are sent and the receivers that receive them.

The described problem can be solved in two ways:

Hardware solution to the problem. This solution requires reconstruction or replacement of a part of the hardware which codes and decodes the messages, received from the security objects. The purpose of the reconstruction is to extend the physical frame of the sent messages so that the object numbers be coded in more than 4 (four) symbols. This solution has the following disadvantages: the reconstruction will affect a great part of the hardware (coders, decoders or/and transmitters and receivers); it will take time and money. Taking into consideration these disadvantages, the conclusion may be drawn that it is necessary to find another, more effective solution in terms of time, money and use of the available devices.

Software solution to the problem. This article suggests another possible solution to the above-described problem. The idea is to use the possibility of building different communication channels, which is possible with the available hardware. The setting of the receivers and transmitters to another frequency does not resolve the problem with the length of the messages' frame, but only creates a new communication channel, which nevertheless provides to extend the frame of the message at its receiving. This solution to the problem has the following advantages: the available hardware can be used without reconstruction; a new communication channel requires only a program setting of a definite number of receivers and transmitters, using the available hardware, as well as new ones. A prerequisite for this solution to the problem is the design of an applied module providing the required functionality.

4. Requirements to the applied module, complying with the functionality of the proposed model

The applied module must provide for the extending the messages' frame, when they are received, but before being analyzed and saved. In this way, the maximal possible object number is increased and the problem of receiving two identical messages from two different objects is resolved. This can be achieved by adding to the number of the object in the message the number of the communication channel that has received the message. The applied module should provide for registration of the communication channels, security objects, messages from objects and hardware (including coders, decoders, transmitters,

receivers, and communication ports). Fig. 4 presents the frame of a message, that has been extended by the applied module.

0	1	1	1	0	7	0	1	7	R	E	S	T	O	R	A	L		Z	O	N	E	1	#13
channel number		object number			message code				message text														end

Fig. 4. Frame of the message after the number of the channel has been added to it

5. Conclusion

The size of the paper does not allow to describe all aspects of signal-security systems, but the proposed ideas might be used as a basis for further development of these systems, by building an integrated information system, oriented to them. This system should provide the for registration of hardware and messages, computer processing of documents, automated dispatching (GIS and GPS), Web- and WAP-based information system for customers, and data and applied modules security system.

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МОДЕЛ ЗА ИЗПОЛЗВАНЕ
НА МНОЖЕСТВО КОМУНИКАЦИОННИ КАНАЛИ
В СИГНАЛНО-ОХРАНИТЕЛНИТЕ СИСТЕМИ

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Резюме

В статията са разгледани принципите на действие на сигнално-охранителните системи, използващи радиоканал за пренос на съобщения. Описани са хардуерните и софтуерните недостатъци на апаратното и програмно осигуряване. Разгледан е кадъра за пренос на съобщения и наложените от него ограничения за номериране на обекти. Предложен е модел за използване на множество комуникационни канали, с помощта на съществуващото апаратно осигуряване. Описан е начин за логическо разширяване на кадъра за пренос на съобщения. Описана е функционалността на приложен модул, поддържащ множество комуникационни канали. Представени са тенденциите за развитие на сигнално-охранителните системи.