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# ANALYSIS OF THE APLLICATION OF GRAPHIC AND RADIOFREQUENCY IDENTIFICATION METHODS IN IEEE802.11 NETWORKS

*The analysis of various methods of encoding and transmitting of information for identification is carried out. The survey of the basic standards was conducted, their relevance for the use in authentication in IEEE802.11 networks was determined, comparative analysis of the systems was performed.*

***Key words:*** *line codes, two-dimensional codes, RFID, label, IEEE, connection.*

## Introduction

Identification in wireless access networks is an important factor of data protection against interception and access of unauthorized persons [1]. Application of complex encryption methods in IEEE802.11 networks, including WEP, WPA, WPA2 networks [2], and as result of implementation of the measures , aimed at systematization of identification methods in such networks enables to decrease considerably the risk of data interception.

As a result, there appears the problem of the access of the final user to such networks due to the complexity of SSID identification elements and access key that could be composed of 32 symbols and 64 symbols correspondingly [3]. Naturally, this can not provide the complete protection of the network due to the possibility of SSID combinations and access key interception, for instance, in the process of WEPcoding [4] but it will reduce considerably the risks of unauthorized access [5].

For the analysis of the possibility of identification methods (SSID/password) application it is necessary to compare the existing methods of graphic and radiofrequency data coding.

Main problems to be solved are the following: study the characteristics of bar code; study the characteristics of 2D-bar-code; study the methods of QR-code decoding; perform the analysis of the structure of RFID-label transmitter; study the application of OR-code in the process of Wi Fi-authorization.

## Main part

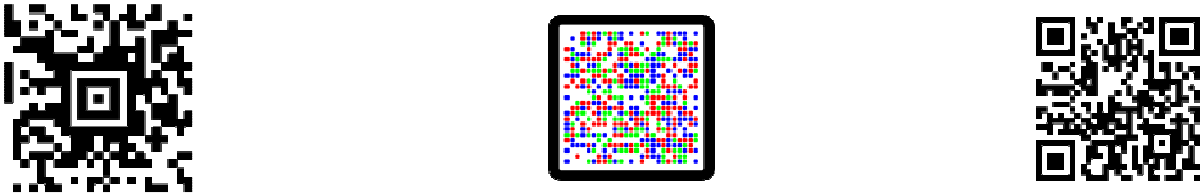
2D-code – it is graphic information, in the form of the succession of black and white strips or other geometrical figures, plotted on the surface, marking or packing of the products that gives the possibility of its reading-out by technical facilities – the succession of black and white strips or other geometrical figures. It contains, depending on the type and coding up to 1314 bytes of information.

Linear bar-codes («one-dimensional » bar codes) – the first generation of bar-codes, composed of rows and blanks of different width. They were divided into a number of sybtypes. The examples of generated bar-codes [6 – 8] are shown in Fig. 1.

a) b) c)

Fig. 1. Examples of the linear bar codes: a) Australia Post bar-code; б) Codabar; c) Code 25 – Interleaved 2 of 5

2D-bar-codes (matrix code) is 2D method of data presentation or the second generation of data coding. It resembles the linear bar code but it can present more data per unit of the area[9]. The examples of 2D bar codes [10] are presented in Fig. 2.



a) b) c)

Fig. 2. Examples of 2D bar-codes: a) Aztec Code; b) CrontoSign; c) QR-code

Table 1 contains the obtained relations of the linear bar-code dimensions and code capacity.

Table 1

**Examples of linear bar code and code capacity relation**

| A, Number of layer with data | L, singly symbol dimension | N, number of bytes |
|---|---|---|
| 1 | 15x15 | 7 |
| 4 | 27x27 | 53 |
| 7 | 45x45 | 145 |
| 11 | 61x61 | 298 |
| 15 | 79x79 | 502 |
| 20 | 101x101 | 824 |
| 26 | 125x125 | 1314 |
| 32 | 151x151 | 1914 |

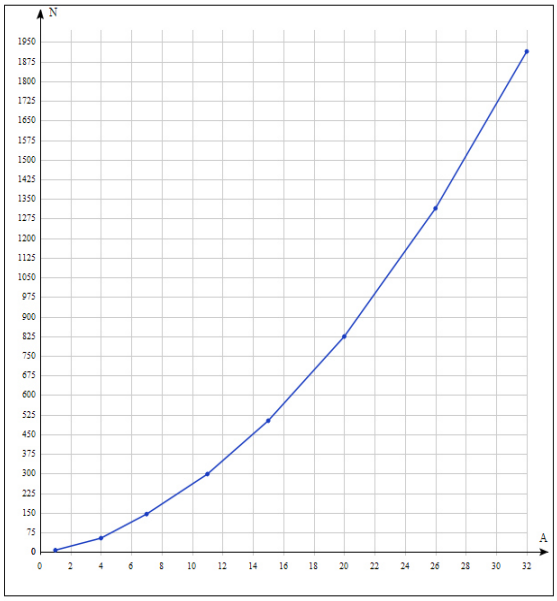



Fig. 3. Dependence of the information capacity on the number of data layers

Proceeding from the obtained dependence on the graph 1, the most informative is QR-code with numerous information layers, it is described by ISO/IEC 18004 specification [11]. This is quick response code, that uses three standardized coding modes: numerical, alphanumerical, binary. Numerical mode of coding contains 10 bits per three digits (up to 7089 digits). Alphanumerical coding mode contains 10 digits, letters from A to Z and several special symbols. Byte (binary) coding mode contains up to 2953 bytes.

Table 2

**Examples of 2D QR-code dimensions and code capacity retio, depending on the version of coding**

| Designation | Version 1-9 | Version 10-26 | Version 27-40 |
|---|---|---|---|
| Numerical | 10 bits | 12 bits | 14 bits |
| Alpha-numerical | 9 bits | 11 bits | 13 bits |
| Byte-wise | 8 bits | 16 bits | 16 bits |

## Radiofrequency identification (RFID)

RFID-technology – it is a technology of contactless identification of the objects by means of radiofrequency communication channel. The technology is used for identification, monitoring, sorting and revealing of the unlimited number of objects.

The technology is based on the wireless data transmission and does not require neither the contact with the reader, nor the direct vision (as in case of bar-codes application). Total bitrate of quality data reading on the product or package – from 30 to 100 milliseconds for label reading-out. RFID can practically simultaneously read-out hundreds of labels without direct vision.

The structure of RFID system. The system of contactless identification consists of four basic elements (Fig. 4):

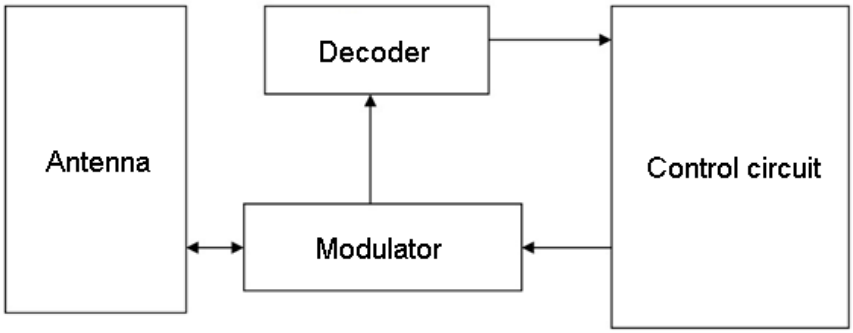



Fig. 4. Structural diagram of the transponder

RFID-label consists of two parts. The first part – is integrated microcircuit, where information is stored and processed, radiosignal modulation and demodulation is performed. The second part is the antenna for signal receiving and transmitting.

The reader contains the generator, that radiates by means of the antenna certain frequency code that corresponds to label frequency. The signal from the label through the antenna passes to the decoder for decoding and after amplification it is sent to microcontroller and computer for reading - out.

The labels operate in so-called SRD-range. Nowadays SRD range is not sufficiently developed, also its licensing is in question due to the coincidence of the frequencies with mobile standard IS-95 (CDMA-800). There exist other frequency ranges where the application of SRD-devices is possible SRD-devices is possible, however their designation differs from classic voice communication and belongs to the sphere of digital systems of telemetering and signalling. They operate in the vicinity of amateur bands, from 13.56 MHz (contactless keys) to 2.4 GHz and 5.8 GHz (Bluetooth, WLAN, ZigBee) [13].

Transponder RFID can be classified by frequency applications [14]:

– high frequency (ultrahigh 850 – 950 MHz and microwaves 2.4 – 5 GHz), which are used where large distance and high speed of reading are required, for instance, control of rail carriages or motor vehicles in motion. Greater operating range makes impossible safe installation of the readers beyond

the reach of the people;

– intermediate frequencies (10 – 15 MHz) are used where greater amount of data must be sent. Fields of application: logistics (monitoring of the turnover), retail business, stocktaking of goods accounting of warehouse facilities.

– low frequency (100 – 500 kHz) are used where small distance between the object and the reader is acceptable. Normal reading distance is 0.5 m, and for the labels, built in a small "keychain", the reading distance, as a rule, is still smaller – approximately 0.1 m. Fields of application – access control systems, contactless cards, warehouses and production control.

Reading-out distance for low frequency labels of 125 kHz and 13.56 MHz is measured in centimeters and meters. Minimal distance of reading-out, necessary for applied program, cost, operation speed and complexity of the communication will help to determine what frequency to use (Table 3).

Table 3

**Frequency characteristics of active labels**

| Frequency | Read-out distance | Main applied programs | Read-out speed |
|---|---|---|---|
| High frequency 13.56 MHz | ~ 1 m | Supply chain, electronic payments | Slow |
| Ultrahigh frequency 860-915 MHz | ~ 6 m | Supply chain, electronic payments, baggage tracing | Slow |
| Microwave 2.45 kHz (active) | to 200 m | Supply chain, electronic customs fees, sensors | Fast |

Information readers contain the transmitter and the antenna, by means of which electromagnetic field of certain frequency is emitted. Radiofrequency labels, which are within the zone of action of reading field, "respond" by the signal, that contains useful information (for instance, product code). Signal is detected by the antenna of the reader, the information is decoded and transmitted to the computer for processing.

Antennas are used as the components of RFID-systems readers, they are intended for the emission of radiosignals, which must activate RFID-label and write or read the data from it. Antennas for each reader may consist of several antennas. Gates enable to read large volumes of information quickly and reliably, even when the object with the product is in motion.

Unlike bar codes, RFID enables to identify objects automatically, without placing the object near the reader. Automatic data collection arranges data in the system, rapidly making the data available. RFID technology solves this problem by means of wireless transmission of identifying information from the objects to the reader, due to the mechanism of anticollisions.

RFID standards. The first standard in the sphere of RFID-labels was the standard ISO 15693, developed specially for the applications in the field of identification of various goods and products. Frequency range of this standard was located at the frequency of 13.56 MHz. Operating distance between the reader and the label is approximately a meter, maximum volume of label memory is 8 Kbyte. Labels support protection function against the theft.

The next stage of RFID technology development was the application of ultrahigh frequency range for labels. In Europe labels of 869.4 – 869.65 MHz and 2.400 – 2.4835 GHz range are used, in the USA 902 – 928 MHz and 2.400 – 2.4835 GHz range.

In these ranges, ISO 18000 standard of part 4 and 6, ISO 18185 and others (depending on the sphere of application) function. Usage of these ranges enabled to increase the operating distance between the reader and labels up to 10 and more meters, also the speed of information reading out considerably increased.

## Application of QR-code

As QR-code is the most efficient for data coding, it can be used for the connection to Wi-Fi network. For this purpose methods of identification SSID and password should be used. SSID

(Service set identification) – is network identifier that only represents its name in the Latin alphabet , the length is not more than 32 symbols. Password (key of the networks) must be of the length from 8 to 63 symbols for coding of the information in WPA/WPA2 standards. Passwords for channel protection should be composed maximally random, mixed of the numbers, letters of Latin alphabet of both registers and signs (all printed signs of ASCII, except space, are used), of the length – the longer, the better (maximal length is 63 symbols). Thus, prepared QR-code contains all the necessary information for the connection to the needed access point [12].

## Conclusion

Usage of RFID-labels and QR-codes as the means for protected information transfer, such as network identifier and the network password, in IEEE802.11 networks, in particular WPA, WPA2 is possible. As a result, we can implement measures aimed at systematization of identification methods change in these networks that will enable to decrease considerably the risk of data interception .

Volume of data, contained in standard identification elements, such as QR-code and RFID-labels is sufficient for transmission of code (key) combinations and SSID identifiers in IEEE802.11 networks.

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