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5. Bellifemine F, Caire G, Greenwood D (2007) Developing multi-agent systems with JADE. Wiley, London

6. D. Dimarogonas, E. Frazzoli, K. Johansson, "Distributed event-triggered control for multi-agent systems", IEEE Trans. Autom. Control, vol. 57, no. 5, 2012.

7. Benantar, Messaoud. (2006). Access control systems. Security, identity management and trust models. Access Control Systems: Security, Identity Management and Trust Models. 10.1007/0-387-27716-1.

EMPLOYEES NOTIFICATION SYSTEMS IN THE EVENT OF EMERGENCY SITUATIONS THROUGH PUBLIC WIRELESS ACCESS POINTS

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Abstract. *In the event of an emergency, there are still actions that people must take to save themselves. Currently everyone has a mobile phone. Almost all establishments have an open Wi-Fi network. Therefore, the purpose of the work is to design and develop a system that, when connected to the network, informed about the threats that have arisen and the actions that citizens must take to avoid damage. The alert system works around the clock. It complements the existing fire alarm and security systems.*

In the work a critical analysis of existing and prospective emergency alert systems was carried out, which showed that there is currently a revision of the requirements for the civil protection notification system towards the transition to new structures of such systems organization, taking into account the current state of technical means of communication, protection against unauthorized access and the spread of malware, identified the possibility of improving them.

The mathematical model of choosing the optimal coverage of the territory with the signal WI-FI alert has been improved, which takes into account losses during repeated passage of the signal through obstacles, which allows to predict the frequency reuse on different floors of the building.

The study was made on 19 pages of printed text, contains 3 drawings and a list of references, which consist of 22 sources. The study was done in English.

Key words: *Alerts, Public Wireless APs, Unauthorized Data Access, Alert Nodes, Emergencies.*

Introduction

One of the main ways of protecting the population from emergencies is timely notification of the danger in the situation that has arisen as a result of its development, as well as informing about the procedure and rules of behavior in the context of the emergency.

Today there is a revision of the requirements regarding modern alert systems (AS), which were created for the purpose of civil protection tasks by means of automated systems of centralized notification, communication networks, radio broadcasting. There is a transition to new structures of organization of such systems, taking into account the

current state of technical means of communication, protection against unauthorized access and distribution of malicious software.

However, the current AS structure does not take into account the possibility of using a large number of FREE WI-FI points for notification, and is not intended for hearing impaired people.

Loudspeaker in such places, of course, attracts attention and may provide the necessary information for further action, but at the same time the presence on the screen of a smartphone, tablet, laptop clear scheme, evacuation plan and instructions for actions of the population especially with hearing impairments, which will minimize the time to make decisions about emergency response or mitigation measures.

Thus, it is promising to create ASs that will increase the number of people covered by emergency alert systems. Therefore, the problem posed in the work is certainly urgent

In the event of emergencies, the danger must be notified first. What is there for calls, howls, sirens, whatever. But it is still necessary to report on the actions that love must take to escape. Currently everyone has a mobile phone. Almost all establishments have an open Wi-Fi network. Therefore, the purpose of the work is to design and develop a system that, when connected to the network, informed about the threats that have arisen and the actions that citizens must take to avoid damage.

Review of literature and analysis of the current status of the civil protection notification of employees

Significant contribution to the development of AS in the emergence of emergencies was made by Ukrainian and foreign scientists V.G. Oliver, A.P. Smolyakov, BF Lomov, V.F. Wendy, VP Zinchenko, I.I. Litvak, I.E. Soloveychik, A.M. Smolyarov and others. But at the same time, the use of free WI-FI hotspot for alerting employees in case of emergency situations is not considered enough in the scientific and technical literature today.

This determines the urgency of the problem that needs to be addressed when creating and maintaining it on an ongoing basis, as well as replacing and operating old ones, and implementing and maintaining new alert systems.

The alert system works around the clock. It complements the existing fire alarm and security systems. Each such system operates in real time.

A real-time system is an automated system with time constraints, and it must respond to events within a specified time frame.

Based on the existing systems, we can understand that they are aimed at the target audience, so the goal was to make a more specialized system.

One of the tasks of civil protection (CP) is to inform employees about the threat or emergencies of anthropogenic and natural nature, to constantly inform employees about the current situation.

The main danger of emergencies is their suddenness and spontaneity, which provoke negative consequences. For businesses with potentially dangerous manufacturing processes, there are urgent questions about the need to prevent the panic caused by the suddenness of a disaster, to prepare themselves and others for the inevitable, and possibly very dangerous, reversal of natural disasters or man-made disasters.

Today, the urgency of protecting employees and territories from emergencies, timely alerting and informing employees about emergencies, is driven by the enormous

magnitude of the consequences of accidents, catastrophes and natural disasters. In order to prevent and eliminate these consequences, it is necessary to concentrate the efforts of the whole state, to organize the interaction of different government bodies, forces and means - that is, to form and implement state policy in this field.

Thus, in the current geopolitical, economic, environmental and military-strategic conditions, the problems of protecting employees and territories from emergencies are very urgent.

General principles of state policy in the field of civil protection of Employees and territories from the National Assembly are regulated by the following basic laws and resolutions of the Cabinet of Ministers of Ukraine:

- the Law of Ukraine “On Protection of Employees and Territories from Emergencies of Technogenic and Natural Character” of June 8, 2000;
- the Law of Ukraine “On Civil Defense of Ukraine” of February 3, 1993;
- Resolution of the Cabinet of Ministers of Ukraine No. 192 of February 15, 1999. "On approval of the Regulation on organization of alert and communication in emergency situations";
- Resolution of the Cabinet of Ministers of Ukraine No. 1198 dated January 3, 1998. "On a unified state system of prevention and response to emergencies of anthropogenic and natural character" and others.

According to Article 8 of the Law of Ukraine "On Protection of Population and Territories from Emergencies of Technogenic and Natural Character", timely notification and constant informing of Employees about the threat of emergencies of technogenic and natural character shall be provided.

This determines the urgency of the problem that needs to be addressed when creating and maintaining it on an ongoing basis, as well as replacing and operating old ones, and implementing and maintaining new alert systems.

The notification organization shall be organized in accordance with the requirements of the provision "On the organization of alert and communication in emergencies", approved by the Cabinet of Ministers of Ukraine Resolution No. 192 of 15.02.1999. Accordingly, the AS for civil protection is organized taking into account the structure of government, the nature and level of emergencies, the availability and location of forces that may be involved in the elimination of the consequences of emergencies. For the present period, the CP AS consists of national, regional and specialized centralized notification systems; local and object systems.

Modern AS and information support is created to fulfill the tasks of the CP on the basis of automated systems of centralized notification, communication network, broadcasting. Also, when building alert systems, it is necessary to take into account the security of access points against the penetration of malicious software everywhere, prevention of DDos attacks, etc.

Today in Ukraine there is a need to replace the existing ASs (equipment that has already worked out the installed resource, was discontinued, exhausted spare parts for repair, etc.) with automated ones, which allow to fulfill the requirements of the AS in modern conditions, which also proves the relevance of the issues under study.

Despite the fact that a number of problems in the construction of alert systems are already solved in the world, in Ukraine the introduction of modern AS, early detection of emergency is restrained by a number of economic and other components, lack of

methodological, practical and educational literature on the organization of alerts, as well as in connection with untimely adoption of the relevant legislative acts.

It is known that the existing alert system in Ukraine is created mainly on the basis of equipment P-160, P-164. The equipment has already fulfilled the installed resource, much of it, especially end devices, has been discontinued. The schematic design of the existing P-160, P-164 equipment does not allow upgrading to provide additional functions, including service. Replacing legacy analog telephone exchanges with modern digital automatic telephone exchanges eliminates the possibility of existing equipment. Equipment P-160, P-164 has the ability to transmit commands only on rigid lines, eliminating the possibility of changing their routing.

Therefore, the equipment in use does not allow the following basic functions:

- to carry out remotely reliable diagnosis of the state of the terminal devices, as well as reliable control of the sirens;
- carry out the selective inclusion of individual end devices or the desired group;
- to give the operator information on the presence or absence of power supply 380V, 50Hz for electric sirens;
- Document input and output information;
- visualize the terrain map with installed terminal devices;
- to transmit information to the population when the power supply is switched off 380V, 50Hz from the terminal devices;
- transfer information to officials via mobile phones.

All these shortcomings of the equipment of the existing AS do not allow not only to promptly eliminate the malfunction, but also to maintain it in working order. In addition, employees may not be alerted to employees in any particular case, nor can employees be promptly alerted. The deterioration of the power supply of 380V, 50Hz (protection against switching and lightning surges, especially in rural networks) has led to a significant increase in the number of failures of the final equipment and its inability to repair. All this is mainly due to the fact that the terminal equipment is designed for a standard surge protection 380V, 50Hz, which currently does not meet these requirements.

On the basis of the above, there was an urgent need to replace existing equipment with equipment with a modern element base, which ensures that the requirements of the alert system are fulfilled in the current conditions.

The structure of the AS technical support should be a combination of telecommunication facilities, individual automated workplaces (AWs), end-user devices, end-to-end alerting devices (EEAD), which are integrated into a distributed network by connecting them through different communication channels. On the basis of separate personal electronic computers (PCs), functionally oriented AWs of the operative duty consoles should be created. According to their purpose, AWs must be system, application, software and hardware that implements the functions of subsystems. Software and hardware provide interfaces for interacting with relevant users, thus creating functionally oriented AWs.

End-to-end alert management devices are technical means that should ensure that various types of existing employee alerting systems are used effectively. The ultimate means of alerting employees include: street speakers; sirens; wired radio stations; radio broadcasting stations; television broadcasting stations; dashboards, which include

advertising dashboards, dashboards located in places where employees gather (areas, subways, public transport stops, etc.).

The effectiveness of alerting agents should be understood as the choice of technical solutions with the maximum efficiency. For example, for loudspeakers and sirens, the determination of the efficiency is based on the use of electrical power to obtain the required sound level (dB).

Based on the above analysis of the state of the art and prospective AS employees in the event of emergencies, it can be argued that, the development of such systems should be conducted in the direction of attracting modern communications, security (ensuring access points against penetration through them of malicious software, prevent DDos attacks), processing, data storage. But at the same time, it is promising to create ancillary systems that will increase the number of people covered by emergency alert systems.

Object of the subject matter of research

The object of research is the processes of exchange, transfer, authorization and protection against unauthorized access of data at the sites of alerting employees in case of emergencies.

The subject of the study is a system of high-tech devices in the administrative building

The purpose of the work is to improve the system of alerting employees in case of emergencies by organizing alerts through the points of FREE WI-FI wireless access to the Internet.

To achieve this goal, the following main tasks have been set and solved.

1. The structure of the alert node (AN) is synthesized.

2. Improved mathematical model of the employee notification system through the nodes of wireless Internet access.

3. The software of AP with data protection system and protection against unauthorized access has been developed.

4. The employee alert network has been designed.

5. Testing of AP in real conditions of operation was carried out.

Scientific novelty:

- Improved mathematical model of the choice of optimal coverage of the territory by the signal WI-FI alert, which takes into account losses during repeated passage of the signal through obstacles, which allows to predict the frequency reuse on different floors of the building;

- Improved system of alerting employees in case of emergencies by creating alert nodes through the points of FREE WI-FI wireless access to the Internet, which allows to minimize the time to make decisions on measures to reduce or eliminate the consequences of the emergency.

Let's build a mathematical model of the employee notification system through the nodes of wireless access to the Internet

The peculiarity of the mathematical model of AS employees at the emergency room using WI-FI access points is to optimize the choice of equipment types, placement of used WI-FI access points, the choice of their spatial orientation, taking into account uncertain weather conditions and time of day. Due to the nonlinearity of the problem, the large

dimension and the complex nature of the constraints, we can switch to an approximate model.

Let there be an area in which to place some set of alert devices. As variables we choose: points of dislocation of devices, type of device for each point of dislocation; the orientation of the alert devices (the position of the axis of the radiation pattern) at each point of dislocation. The devices can be placed on existing structures and on special masts. In the latter case, additional costs for the installation of masts are required.

We formulate requirements for the alert network - it should be ensured throughout the territory of the distribution of the alert signal with a power of not less than the specified. This condition must be fulfilled with all possible values of the natural factors characteristic of the locality, which affect the magnitude of the transmitted signal (time of day, humidity, precipitation, air temperature, fog). As a criterion for optimization (minimization) we accept the cost of a synthesized notification system.

Function construction. The values of the signal strength at the distance from the type I source at the angle A between the axis of the access points and the axis of the receiver are shown in table 1. The values of the angles are taken with some steps.

Table 1

Outputs for access points of different types

A	$R(I, A)$
0	$R(I,0)$
l	$R(I,l)$
$2l$	$R(I,2l)$
…	…
3600	$R(I,3600) = R(I,0)$

Let the numbers and the following inequalities hold:

$$nl < E < (n+1)l$$

$$2mL_0 < \sqrt{(\mathrm{x}-\mathrm{v})^2 + (\mathrm{y}-\mathrm{w})^2} < 2m + lL_0$$

The numbers m and n can be clearly defined

$$n = \left[\frac{E}{l}\right] m = \left[\log_2 \frac{\sqrt{(\mathrm{x}-\mathrm{v})^2 + (\mathrm{y}-\mathrm{w})^2}}{L_0}\right]$$

then the function P can be calculated approximately (the template for calculating the function P is shown in Fig. 1, based on the laws of linear approximation as follows

$$P(I, L, \mathrm{x}, \mathrm{y}, \mathrm{v}, \mathrm{w}) \approx (2 - \frac{\sqrt{(\mathrm{x}-\mathrm{v})^2 + (y-w)^2}}{2^{\mathrm{m}} L_0})((n+1-\frac{E}{l})R(I,nl)(\frac{E}{l}-n)R(I,(n+1)l) - mr) +$$

$$+ (\frac{\sqrt{(\mathrm{x}-\mathrm{v})^2 + (y-w)^2}}{2^{\mathrm{m}} L_0} - 1)((n+1-\frac{E}{l})R(I,nl) + (\frac{E}{l}-n)R(I,(n+1)l) - (m+1)r).$$

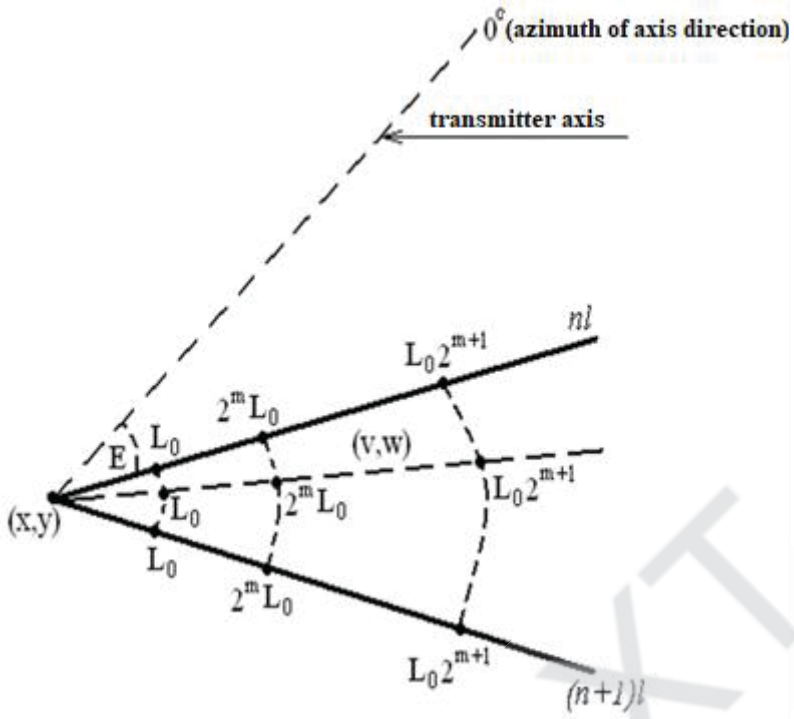

Fig.1 Template for calculating function $P(I, L, \mathrm{x}, \mathrm{y}, \mathrm{v}, \mathrm{w})$

Mathematical model of distributed AS of minimum value, providing signal strength not lower than given in given territory, has the form

$$\begin{gathered}(\sum_{i=1}^{N} C_{I_i} + \sum_{i(x_i, y_i) \in S / S_0} r_i) \to \min_x \\ \max_{1<i<N} P(I_i, L_i, \mathrm{x}_i, \mathrm{y}_i, \mathrm{v}_i, \mathrm{w}_i) \geq P_{\min} \\ (\mathrm{v}, \mathrm{w}) \in S\end{gathered} \quad (1)$$

Where $\mathrm{x} = (N, \mathrm{x}_1, \ldots, \mathrm{x}_N, \mathrm{y}_1, \ldots, \mathrm{y}_N, I_1, \ldots, I_N, L_1, \ldots, L_N)$

The mathematical model (1) does not account for a number of external factors affecting the magnitude of the signal power. From the theory of radio communication it is known that sound pressure depends on such factors as: time of day, humidity of air, precipitation, air temperature, fog.

According to the formulation of the original problem, the AS must provide the minimum permissible signal power in the given territory at all possible values of the external factors listed above. In this case, the mathematical model (1) takes the following form:

$$\begin{gathered}(\sum_{i=1}^{N} C_{I_i} + \sum_{i(x_i, y_i) \in S / S_0} r_i) \to \min_x \\ \min_{(\mathrm{v}, \mathrm{w}) \in S} \max_{1<i<N} \min_{\substack{K_1 \in A_1, \\ \ldots\ldots \\ K_7 \in A_7}} P(I_i, L_i, \mathrm{x}_i, \mathrm{y}_i, \mathrm{v}_i, \mathrm{w}_i, K_1, \ldots, K_7) \geq P_{\min}\end{gathered} \quad (2)$$

Where $\mathrm{x} = (N, \mathrm{x}_1, \ldots, \mathrm{x}_N, \mathrm{y}_1, \ldots, \mathrm{y}_N, I_1, \ldots, I_N, L_1, \ldots, L_N)$.

It is difficult to solve this problem explicitly because of its nonlinearity, considerable dimensions and the complex nature of the constraints. Therefore, an approximation model was constructed. Without fully describing the rules for constructing an approximate model, we formulate the basic ideas of its formation.

The set of points in the coverage area is replaced by the finite number of points in the grid structure. It is assumed that providing a given level of signal power at a given set of points entails fulfilling this condition on the entire set. Only the set points are considered as the locations of the access points. The set of possible angles of access points is approximated by a uniform finite grid with increments.

The dependence of the signal power on external factors is approximated by multiplicative coefficients for the signal power function. At the same time, their least favorable values are considered.

The mathematical model for selecting the optimal coverage of the area with the WI-FI alert signal is fully consistent with the above model (2). However, the specificity of the research task allows the WI-FI alert in comparison with model (2.2) to make two important simplifications.

We are only considering one access point type (R=1). Conditions for checking the achievement of the required signal power at a point (v,w) are simpler than calculating a function P in model (2.2). Namely, only the point in a sector with a given angular size ($d_{\max}$) and a given radius ($R_{\max}$) is checked (Fig. 2.2).

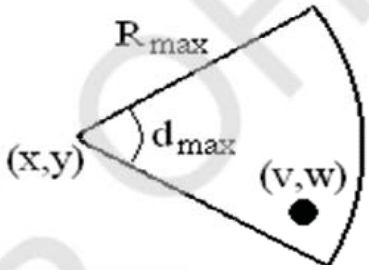

Fig. 2.2 Signal zone

This model takes into account losses during repeated passage of the signal through the floor, which allows to predict such characteristics as frequency reuse on different floors of a building. Remote power loss ratios include implicitly correcting for signal loss through walls or obstructions, as well as other loss mechanisms that may occur within one floor of a building:

$$L = 20\log f + N\log d + P_f(n) - 28(l)$$

where d is the distance (coverage radius), m; f - frequency, MHz; N - signal power loss factor depending on distance; n - number of obstacles; $P_f(n)$ - parameter of signal power loss when passing through obstacles.

Characteristic parameters based on the results of various measurements are given in the reference data, in this case we use values for office space, namely N=30, frequency f = 2,4 GHZ, power loss parameter $P_f(n) = 14$ [2].

The calculations are for non-overlapping channels 1 (2412MHz), 6 (2437MHz), 11 (2462MHz) and 8m coverage radius:

$$L_{ch1} = 20\log(2412) + 30\log(8) + 14 - 28 = 80{,}74 дБ;$$

$$L_{ch6} = 20\log(2437) + 30\log(8) + 14 - 28 = 80{,}83 дБ;$$

$$L_{ch11} = 20\log(2462) + 30\log(8) + 14 - 28 = 80{,}92 \partial B .$$

Development results

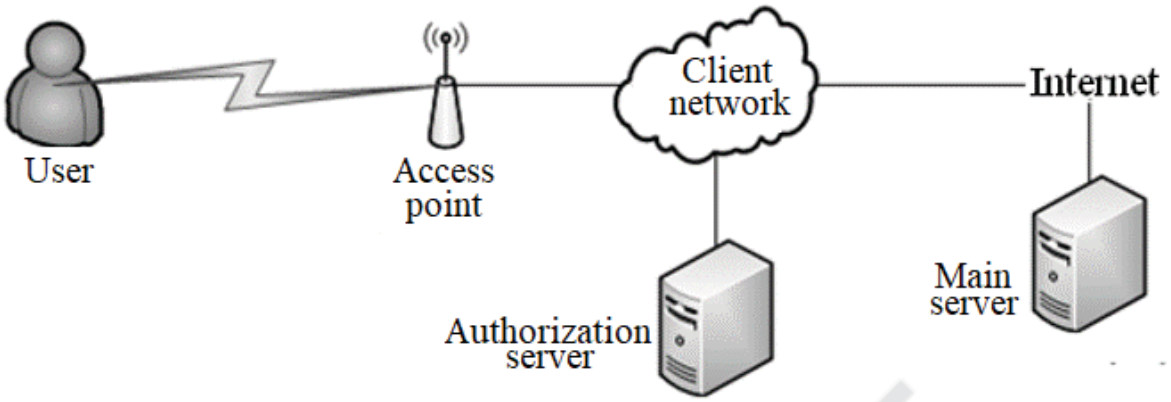

Fig. 1. Alert node scheme

The WI-FI network will be organized in a three-storey building. The network must be expanded on the second floor of the building. There is a grocery store, five convenience stores, three catering facilities, a bathroom and a toilet on this floor.

The need for a WI-FI network is that the marketing policy of the center provides for visitors and employees of the center and shops the opportunity to access the Internet. There are times when you need to access the Internet not only from your computer or laptop, but also from portable devices that allow you to optimize your workflow at the expense of modern network infrastructures - video conferencing, IP-telephony, e-mail, server management and network devices.

The high level of security of WI-FI indicates its advantages when used in public places where information security is one of the main criteria of the network. WI-FI uses sophisticated encryption methods.

Determine the number of access points for the selected room. There are two ways to determine the number of access points when designing a wireless data network for your premises. The first method considers the covering of the premises by zones in the form of a square (Fig. 2.1), and the second method - in the form of a hexagon (Fig.2.2).

Since the selected room has a small space and simple layout, we choose the first way to determine the number of access points for ease of calculation. The calculation is made by the formula

$$, \ S = (\frac{a}{\sqrt{2}(r-t)})(\frac{b}{\sqrt{2}(r-t)}) \qquad (1)$$

Where a is the length of the room; b - width of the room; r - coverage radius of one access point; t - Crossing of zones is required.

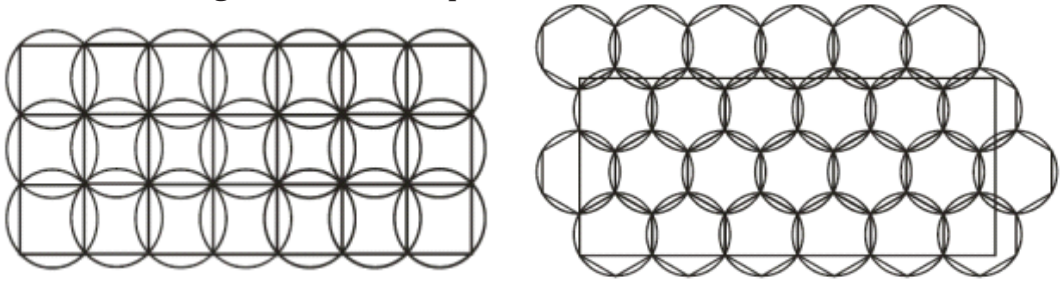

Fig. 2.1. Covering zones in the form of squares 2.2. Hexagonal zone coverings

For this room we calculate the number of points

$$S = (\frac{25}{\sqrt{2}(8-2)})(\frac{10}{\sqrt{2}(8-2)}) = 3.47$$

This value is rounded to the greater side, therefore, 4 access points are needed to cover the room.

Based on the above calculations, the arrangement of the internal access points, as well as the external access point and directional antenna. When connecting the equipment, namely the internal access points, we will use the topology of the type "star", to connect them using a UDP cable, the so-called "twisted pair". The TP-Link TL-ANT24PT3 cable assembly is used to connect the antenna to the external access point. Figure 3 shows a diagram of the connection of the equipment for clarity.

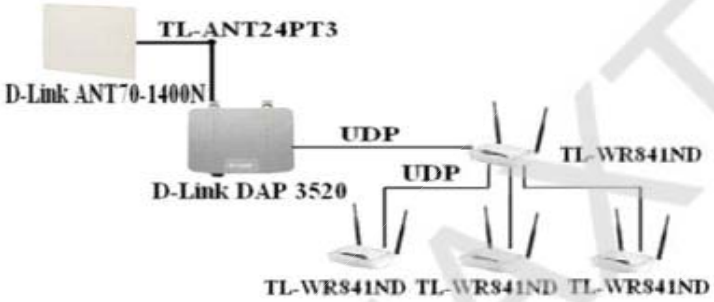

Fig. 3 Wiring Diagram

Developed software based on the FreeRadius server solution and the chillispot installed on the router is used to ensure that the alert node operates properly.

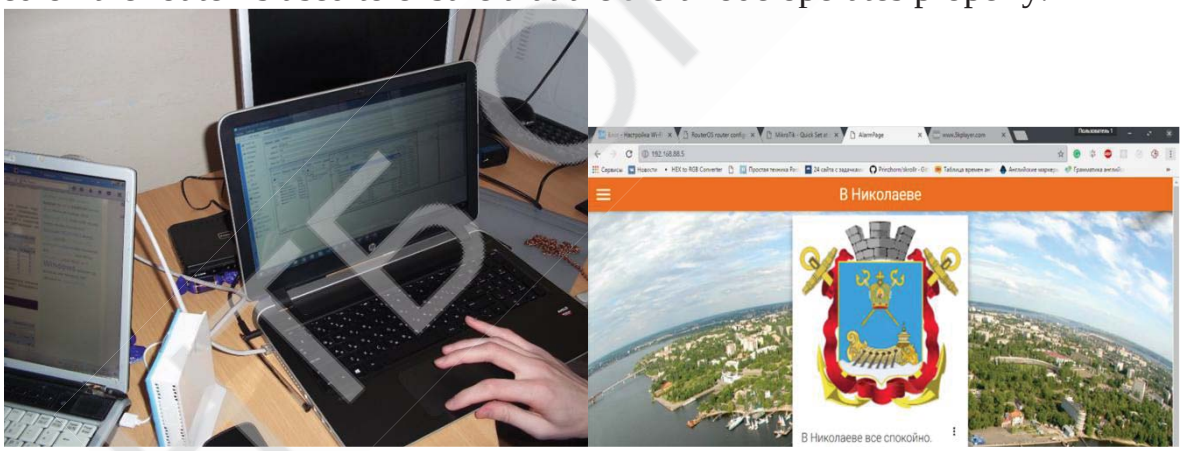

Figure 4 Development results

To protect against unauthorized access to the alert node and save the database of connected subscribers The RADIUS Protocol (aHra. Remote Authentication in Dial-In User Service) is the most common AAA (authentication, authorization and accounting) protocol now developed to transmit information between application programs. (NAS, Network Access Server) and billing system. This protocol owes its popularity to its openness, unlike TACACS + (Cisco) and Kerberos (Merit).

Conclusions

In the work a critical analysis of existing and prospective emergency alert systems was carried out. and the spread of malware, identified the possibility of improving them.

It is suggested to use the FREE WI-FI hotspots as an employee alert center in case of emergencies.

The mathematical model of choosing the optimal coverage of the territory with the signal WI-FI alert, which takes into account losses during repeated passage of the signal through obstacles, allows to predict the frequency reuse on different floors of the building.

References

1. Voliansky, Yu.S. Notification of the population at emergence of emergency situations through WI-FI access to the Internet // Modern information and telecommunication technologies: Materials of scientific-technical conference, November 17-20, 2015. - Kyiv, DUT, 2015. - Volume 3. - P. 75-77.

2. Voliansky, Yu.S. Protection of FREE WI-FI Internet access point in public alert systems in case of emergencies // Yu. Voliansky // Modern Problems of Information Security in Transport: Proceedings of the All-Ukrainian Scientific and Practical Conference with International Participation, December 22-23, 2015. - Nikolaev: NUS, 2015. - P. 102-104.

3. Vorobienko, PP Civil Protection Alert Systems: A Tutorial / P.P. Vorobienko, SI Belousov - Odessa: ONAS them. OS Popova, 2012. - 76 p.

4. Denisov, DV Packet radio networks: [textbook] / DV. Denisov. - Yekaterinburg: UGTISIS of the FGOBU of SibGUTI, 2014. - 44 p.

5. Law of Ukraine "On Protection of Employees and Territories from Emergency Situations of Technogenic and Natural Character", No. 1809-14 // Bulletin of the Verkhovna Rada of Ukraine. - Offic. kind. - K .: Parliamentary view, 2002. - № 6. - 39 p.

6. Kosorukov, OA Operations research: [textbook] / O.A. Kosorukov, A.V. Mishchenko. - M .: Publisher Exam, 2003. - 448 p.

7. Cochin, IV Disaster medicine: [production edition] / IV. Cochin, G.O. Chernyakov, PI Sidorenko - K .: Health, 2008. - 724 p.

8. Cochin, IV Scientific Principles of Organization of General and Medical Evacuation of Employees in Accidents at Chemically Hazardous Objects / IV. Kochin, OO Akulova, I.F. Shiloh // Current issues of medical science and practice: Collection of Sciences. against WASHINGTON. - No. 71. Volume 2. Book 2. - Zaporizhzhia, 2007. - P.104-113.

9. Cochin, IV Optimization of Information Support Flows of Employees in Emergency Situations / IV. Cochin, V.Ya. Kiktenko, PI Sidorenko // Current Issues in Medical Science and Practice: Collection of Scientific Papers of ZMAPO - Issue 69. - Zaporizhzhia, 2006. - P.119-124.

10. Leonenko, AV Optimization problems in MS Excel / AV. Leonenko - St. Petersburg: BHC-Petersburg, 2005. - 704 p.

11. TP-Link Official Site - Electron. dan. - Access mode: http://www.tp-linkru.com/.

12. ZyXEL Official Website - Electron. dan. - Access mode: http://www.zyxel.ru/.

13. TamoGraph's official website is Electron. dan. - Access mode: http://www.tamos.ru/.

14. Regulation on organization of alert and communication in emergency situations / Resolution of the Cabinet of Ministers of Ukraine, No. 192 // Official. kind. - K .: Parliamentary view, 2002. - №6. - 64s.

15. Proletarskiy, A.V. Wi-Fi wireless networks: [textbook] / AV Proletarskiy. - M .: Internet University of Information Technologies; BINOM. Laboratory of Knowledge, 2007. - 215 p.

16. Rudakov, DV On the question of designing wireless LANs WLAN [Electronic resource] / DV. Rudakov, VP Komagorov // TUSUR reports. - T., 2010. - №2 (22). - 5 sec.

17. System of mass notification / [Litovchenko OV, Tkachenko AI, Bozhatin SM, Voliansky YS] // Modern problems of information security in transport: Materials of the All-Ukrainian scientific-practical conference with international participation, December 22-23, 2015 - Nikolaev: NUS, 2015. - P. 48-50.

18. http://en.wikipedia.org/wiki/RADIUS

19. http://en.wikipedia.org/wiki/DIAMETER

20. http://www.128.ibm.com/developerworks/library/wi-diameter/index.html

21. http://www.untruth.org/~josh/security/radius/radius-auth.html

22. http://www.diva-portal.org/diva/getDocument?urn_nbn_se_liu_diva-1195-1_fulltext.pdf

MONITORING AND CONTROLLING AGENT OF MICROGRID CLUSTER

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Annotation

Abstract.*The article is devoted to the research of multiagent systems and methods of their usage in monitoring and controlling Microgrid clusters. Such systems must be able to adapt to changes in energy demand from the user side and respond to changes in environmental parameters, taking into account environmental constraints and the dynamics of energy costs. It allows to easily integrate different energy sources of distributed generation, especially renewable resources. This article is reviewing in detail Multiagent systems and their possible implementation in Microgrid clusters and describes as an example created agent for small energetic system.*

Key words*: distributed systems, multi-agent systems, microgrid systems, remote control*

I. Introduction

With the rapid development of modern technologies, it becomes more and more important to create a reliable network of permanent stable energy supply. Not only important the efficiently divided load distribution on the network, but also the possibility of integration various sources of distributed generation into such systems, especially renewable ones, characterized by the variability of the generation parameters. The system must be able to adapt to changes in energy demand from the user side and respond to