УПРАВЛЕНИЕ В СОЦИАЛЬНЫХ И ЭКОНОМИЧЕСКИХ СИСТЕМАХ

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CREATING CORPORATIVE NETWORK FOR MANAGEMENT OF HIGHER EDUCATIONAL INSTITUTION AND ITS TECHNOPARK

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Abstract. The article presents the analysis of the principles of a higher educational institution effective management and its technopark and provides the solution of organizing corporate governance within the local network of educational departments of Sumgait State University (SSU) and a scientific - research center and the manufacture module. On the basic of the hierarchical structure of SSU and its technopark, an IP-addressing scheme was offered to organize a corporate network between SSU faculties and a scientific research center with automated workplaces of a flexible manufacture module. The number of junctions and the percent values of a corporate network for the departments of faculties, scientific and manufacture parts of technology parks are determined and presented as a table. The number of points of educational and technopark sections of SSU have been calculated. For junctions in the corporate local network of management and training faculties of SSU there were used C-class IP addresses on 192.168.1.0–192.168.1.44. There has been worked out the algorithm for defining the number of junctions of SSU and technopark sections providing effective managing of their corporative network.

Key words: higher education institution, technopark, corporative network, IP address, local network, junction points.

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Introduction

For adapting Azerbaijani higher educational institutions (universities) to the international standards and increasing their status it is necessary to use the automated information systems, innovative methods, innovative research areas, and new technologies. Technoparks are one of the priority areas for implementing the innovative development model in the universities, which provides a high scientific, technical and educational level of the entire institute. Analysis of the technopark operation [1, 2] has shown that between the faculties, teaching staff and research and production units of the technopark there is no coordinated interface based on the network technologies under intelligent control.

The main tasks of the scientific and technological park created at the university are the development of scientific researches and projects, application of the research results in production, creation and development of new scientific technologies, and development of interregional and international relations in the field of innovations. The introduction of new principles for building relations between the university and its innovative infrastructure is an important scientific task for solving promising design works and integrating the universities into the verbal systems of the successful economic development. The published research works on this problem [3, 4] suggest that it is necessary to develop the tasks for updating the research of sustainable functioning of the institute and its innovative infrastructure by using the corporate data system for creating an up-to-date technological network simulating the effective on-line connection scheme: «research – innovation – flexible production – economic management».

In this regard, the consideration of the scientific task of developing an effective corporate network system with modeling the local network interface between the research, production, and economic structure of the university and the technopark is an important scientific task, for the solution of which it is necessary to use mathematical and algorithmic modeling methods. The aim of the study is modelling corporate network tools to support the interaction of the university and the technopark infrastructure using intelligent and mathematical modeling methods.

For this purpose, the following scientific and technical tasks should be performed:

1. Developing an IP-addressing scheme for a corporate network between the university's infrastructure and its technopark.

2. Sizing IP-addressing for the corporate interface of the university structure and its technopark.

Creating an IP addressing scheme for a corporate network between the university's infrastructure (under Sumgait State University) and its technopark

Unlike the existing local network technology used in the university and its blocks [5], where a large number of cable networks are used, the advanced technology of a local wireless network, its technical, software application and practical deployment are needed to ensure the viability, productive and efficient interfacing of the corporate network between Sumgayit State University (SSU) and its technopark infrastructure.

Due to the large distance between the SSU blocks and the technopark centers, using UniFi local wireless network technology is a more efficient option, which can be supported by the fast sending of electronic documents, database management, and support a rapid response between clients.

The perimeter dimensions of the technopark area are given in real size (Fig. 1).

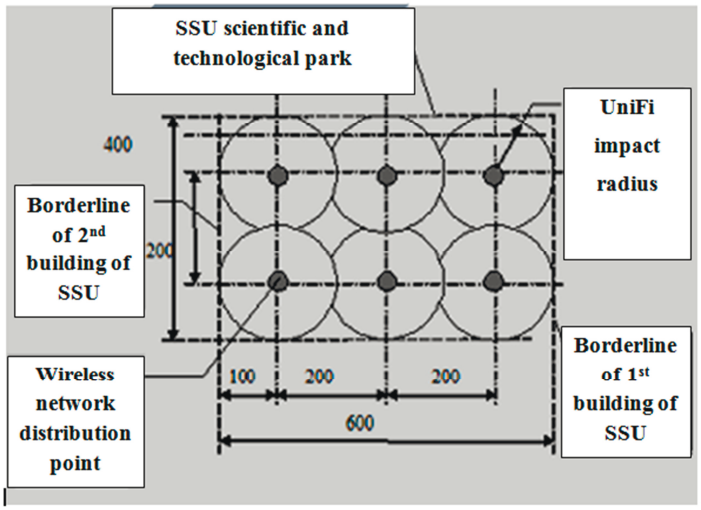

Fig. 1. Scheme of position coordinates of UniFi distribution points on the territory of SSU and its technopark

The position of the scientific division of SSU is selected in a 2-dimensional coordinate system and, depending on these positions, the location coordinates of the UniFi distribution points are determined. The distance between the coordinate positions varies within 100–150 m. UniFi operates on top of UAP: 802.11 n MIMO-capable drive having speed up to -300 Mbit/s. The range of the wireless network is 120 m.

The address space of the corporate network of the SSU technopark consists of the local network addresses and official addresses used by the telecommunications center. A computer connected to the auxiliary network of the technopark has a network number. Using a telecommunication center, the process of splitting IP addresses is carried out, domain names are recorded and network routes are configured [6].

In accordance with the hierarchical structure of SSU and its technopark (Fig. 2), there are automated workstations (AWP), according to expert assessment (AWP), research laboratories (AWP lab.1, AWP lab.2, AWP lab.3, AWP lab.4), a flexible production cell of technopark (ARM FPC) with wireless access to the management structure of the technopark.

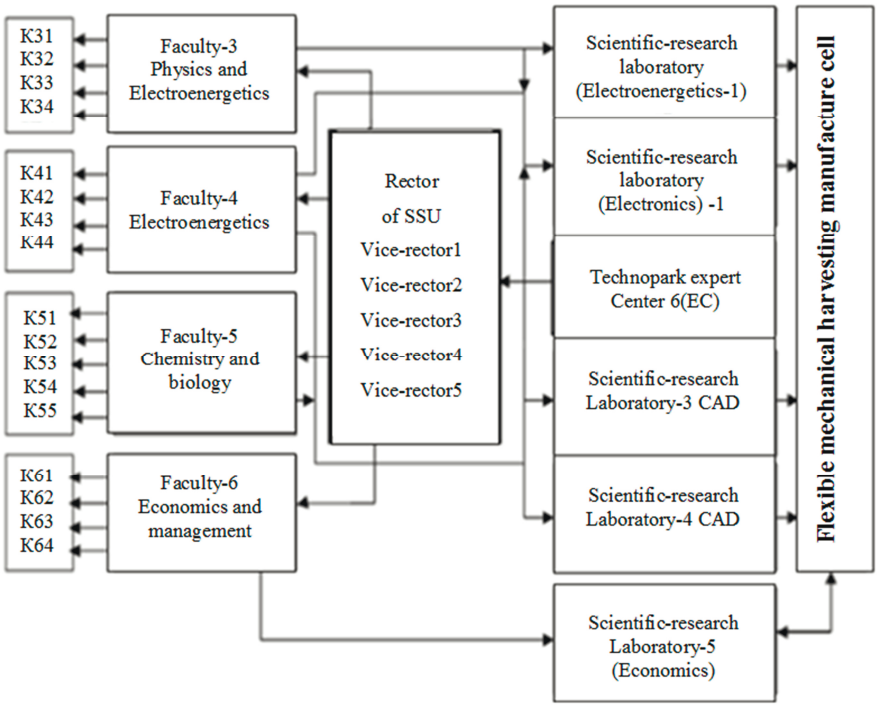

Fig. 2. İP addressing scheme of SSU and its technopark structure

A large number of workstations are associated with workstations of SSU departments.

Sizing IP addressing for the corporate interface of SSU structure and its technopark

To provide functioning of the corporate network of a particular university and its hierarchical technopark levels, the accurate distribution of percent (%) between the departments of the structure is needed. In this regard, it is necessary to set up an IP-addressing scheme for organizing a corporate network between the technopark and the teaching building of SSU. When constructing the addressing scheme, the routing principle [7] is used. The number and interest rates of departments and technoparks to determine the address sizes are given in Table 1.

Table 1

Names, numbers and percentages allocated for units of the SSU and its technology park

SSU and names of main technopark facilities	Number of education, research and manufacture units	% for SSU and its technopark units
SSU_directory , $p=\overline{1,5}$	6	10
Faculty_Physics and electoenergetics engineering, $pee^k=\overline{1,4}$	5	10
Faculty_Engineering, $m^k=\overline{1,4}$	5	10
Faculty_Chemistry and Biology _cb, $cb^k=\overline{1,5}$	6	10
Faculty_Economics, $em^k=\overline{1,4}$	5	10
Faculty_History and geography, $hg^t=\overline{1,4}$	5	10
SSU_Center of technopark_expert _tec, $tec^e=\overline{1,6}$	7	18
Scientific_research laboratory_srl, $srl^l=\overline{1,5}$	6	15
Flexible manufacture island_fmi, $fpa^m=\overline{1,3}$	4	7

Using the address area from Table 1, the reserve interest rates allocated to management of SSU with its faculties, departments and technopark can be determined. When summarizing the number of administrative, educational, scientific and production units of SSU, one should take into account the number of administrative staff, teaching staff and, respectively, vice-rectors, staff of each operation unit of the technopark.

Then, according to the serial number in Table 1, the algebraic sum of the numbers of each educational institution, faculty and technopark is calculated as follows:

$$S_1 = \sum_{Rp=1}^{6} S_{rp}\ , \tag{1}$$

where Rp is a number of senior officials of SSU; Srp = rector (1) + number of vice rectors – expression of the definition of an algebraic sum:

$$S_2 = \sum_{fee=1}^{5} S_{fee}\ , \tag{2}$$

where fee^k – a number of departments of the Engineering faculty of SSU that implement the interface with SSU technopark; S_{phe} is a number of departments of a certain faculty (Department of Automation of Technological Processes (1) + the Department of Metrology and Standardization (1) + the Department of Information Technologies and Programming (1) + the Department of Information Technologies (1)), $fee^k = \overline{1,4}$:

$$S_6 = \sum_{tem=1}^{7} S_{tem}, \tag{3}$$

where *tem* is a number of resident units in the SSU technopark; S_{tem} = head of the technopark (1) + a number of technopark residents $(tem^e = \overline{1,6})$.

Based on the hierarchical structure of SSU and technology park, and using equations (1)–(3), the total nodal points are determined:

$$S_{dn} = \sum_{i=1}^{8} S_i,$$

where *i* is a total number of educational sections of SSU and technopark residents; $S_i = S_1 + S_2 + S_6 + S_{dn}$.

Algorithm for determining the number of nodal points of SSU and technopark

To ensure effective joint management of the SSU and its technopark, modern means of a local computer network are needed. Moreover, in accordance with the quantitative indicators of SSU and the technopark units, the values of the nodal points are determined in a matrix form to ensure the complete distribution of information flows between the governing body, vice-rectors, the engineering faculty of SSU and residents of the technopark. Thus, the number of common nodal points of the automated workplaces of the training and management staff and SSU technopark is determined by the following matrix:

$$S_{dnij} = \begin{vmatrix} S_{11(pr)} & S_{12(pr)} & S_{13(pr)} & S_{14(pr)} & S_{15(pr)} & S_{16(pr)} & 0 \\ S_{21(d)} & S_{22(k)} & S_{23(k)} & S_{24(k)} & S_{25(k)} & 0 & 0 \\ S_{31(d)} & S_{32(k)} & S_{33(k)} & S_{34(k)} & S_{35(k)} & 0 & 0 \\ S_{41(d)} & S_{42(k)} & S_{43(k)} & S_{44(k)} & S_{45(k)} & 0 & 0 \\ S_{51(d)} & S_{52(k)} & S_{53(k)} & S_{54(k)} & S_{55(k)} & S_{56(k)} & 0 \\ S_{61(tr)} & S_{62(e)} & S_{63(k)} & S_{64(k)} & S_{65(e)} & S_{66(e)} & S_{67(e)} \\ S_{71(1)} & S_{72(1)} & S_{73(1)} & S_{74(1)} & S_{75(1)} & S_{76(1)} & 0 \\ S_{81(ir)} & S_{82(im)} & S_{83(im)} & S_{84(im)} & 0 & 0 & 0 \end{vmatrix},$$

where $S_{ij(n)}$ is a matrix element corresponding to the nodal points of the corporate local network of SSU and its technopark; 1 line corresponds to SSU administrative staff; 2^d–7^{th} lines correspond to the faculties (deans) and departments; line 8 corresponds to the residents of the technopark.

Given that in the matrix (4) the squares S_{ij} reflect the nodal points, then their values are summed up and recorded in each block of the matrix. In this case, the matrix (4) is expressed as follows:

$S_{dnij} =$

S_{rp}	S_{fee}	S_m	S_{kb}	S_{ii}	S_{tem}	S_{etl}	S_{cis}
6	0	0	0	0	0	0	0
0	5	0	0	0	0	0	0
0	0	5	0	0	0	0	0
0	0	0	5	0	0	0	0
0	0	0	0	6	0	0	0
0	0	0	0	0	7	0	0
0	0	0	0	0	0	6	0
0	0	0	0	0	0	0	4

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44 logical IP networks are used to provide addressing with SSU rectors, faculties, departments, as well as residents of the technopark (specialists, planner, programmer, technologist, economist and operator of the production module (Table 2).

Table 2

Network addresses and nodal points of SSU units and its technology park

Bodies of SSU and techno park	Percen-tage of address field, %	Address of knot points	Network address
Management board of SSU	20	0.0.0.1–0.0.0.6	192.168.1.0
Faculties	40	0.0.0.7–0.0.0.16	192.168.1.0
Technopark	24	0.0.0.17–0.0.0.44	192.168.1.0
Reserve	16	0.0.0.45	192.168.1.0

IP addresses used in the corporate network are considered as private. For this reason, intranet of C-class and technopark addresses IP addresses of C-class on the wall 192.168.1.0–192.168.1.44.

Thus, SSU IP addresses 192,168.0.0–192.168.0.44 are defined to ensure the data exchange by combining workstations (44 nodes) within the corporate local area network of education and the technology park.

But to provide the reliability and mobility of the local network, it is necessary to use a network node and an appropriate workstation. Thus, maximum 45 workstations (1 reserve) and other network devices can be applied to users in the local network of SSU academic departments and the technopark. In this case, the netmask is accepted as 45.45.45.0.

The 32nd class of IP address used in the local TCP/IP network of the SSU training and technological park identifies each workstation (nodal point). The accepted IP addresses 192.168.0.0–192.168.0.44 are described at 4 levels. Using subnet masks to identify 44 network nodes can be identified by double marks.

Routers are used to exchange data packets for the effective operation of the local TCP/IP network of SSU training and technological park.

192.168.1.0–192.168.1.*Xi* (where $i = 0.45$) IP addresses are divided into two parts. The first part - 192.168.1.0 - is the name of the network of educational and technological parks of SSU, the second part - 0.0.0.*Xi* - is the address node.

Given SSU mask and the technopark unit - 45.45.45.0. The subnet mask will be written as follows, according to the double code of this number: 00101101.00101101.00101101.0000000

So, when replacing the IP addresses and subnet masks of the SSU educational and technological park objects, the address of the network address of SSU board, the addresses of the node points are as follows:

$SU^{ssu}{}_{R}$	**11000000.10101000.00000001.00000000**
$DNU^{ssu}{}_{R}$	00000000.00000000.00000000.00000001
$DNU^{ssu}{}_{p1}$	00000000.00000000.00000000.00000010
$DNU^{ssu}{}_{p2}$	00000000.00000000.00000000.00011110
$DNU^{ssu}{}_{p3}$	00000000.00000000.00000000.00011111
$DNU^{ssu}{}_{p4}$	00000000.00000000.00000000.00100000
$DNU^{ssu}{}_{p5}$	00000000.00000000.00000000.00100001

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Addresses of the faculties (a study of the Engineering Faculty) of SSU and its departments as nodal points are defined as follows:

SU	11000000.10101000.00000011.00000000
DNU_{fd}	00000000.00000000.00000000.00000111
DNU_{d1}	00000000.00000000.00000000.00001101
DNU_{d2}	00000000.00000000.00000000.00001110
DNU_{d3}	00000000.00000000.00000000.00001111
DNU_{d4}	00000000.00000000.00000000.00010000

The network address of the technopark with its residents as nodal points and a reserve nodal point are defined as follows:

SU_{tp}	11000000.10101000.00000110.00000000
DNU_{tp_r1}	00000000.00000000.00000000.00100001
DNU_{tp_r2}	00000000.00000000.00000000.00100010
DNU_{tp_r3}	00000000.00000000.00000000.00100011
DNU_{tp_r4}	00000000.00000000.00000000.00100100
DNU_{tp_r5}	00000000.00000000.00000000.00100101
DNU_{tp_r6}	00000000.00000000.00000000.00100110
DNU_{tp_r7}	00000000.00000000.00000000.00100111
DNU_{tp_r8}	00000000.00000000.00000000.00101000
DNU_{tp_r9}	00000000.00000000.00000000.00101001
DNU_{tp_r10}	00000000.00000000.00000000.00101010
DNU_{tp_r11}	00000000.00000000.00000000.00101100
DNU_{tp_r12}	00000000.00000000.00000000.00101101
DNU_{tp_r13}	00000000.00000000.00000000.00101101

The algorithmically presented model for determining the network address and nodal points for each SSU facility and its technopark allows to obtain more accurate data when managing the main departments of the university and its technopark, as well as to provide the efficient and reliable corporate network management for enterprises with educational and innovative structure.

Conclusions

In the course of the research there have been obtained the following results:

1. Using the hierarchical structure of SSU and its technopark, there has been built the IP-addressing scheme for organizing a corporate network for the effective management of large educational and innovative structures with automated workplaces for academic departments, with expert evaluation of innovative projects, a research center and a flexible production unit as a whole.

2. The number and percentage values of the research offices, production units of departments and technoparks that are a part of the faculty are determined in tabular form to determine the degree of targeting for the reliability and productivity of the integration process of SSU and its technopark.

3. A model developed algorithmically for determining the number of nodal points of SSU and its technopark sections has made it possible to obtain the prompt and accurate calculation of this date, which would effectively manage the corporate information system.

The results obtained in determining the key positions of SSU and its technopark, the organization of a local computer network using the intranet addresses of the technopark and the IP addresses of a class c network, will allow to accurately build a corporate information system with technical support and software for the joint work of SSU and its technopark.

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СОЗДАНИЕ КОРПОРАТИВНОЙ СЕТИ ДЛЯ УПРАВЛЕНИЯ ВУЗОМ И ЕГО ТЕХНОПАРКОМ

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На основе анализа принципов эффективного управления работой ВУЗа и его технопарка определена цель статьи, которая предусматривает решение вопроса организации корпоративного управления в рамках локальной сети учебных подразделений Сумгаитского государственного университета (СГУ) и научно-исследовательского центра и производственного модуля технопарка. На основе иерархической структуры СГУ и его технопарка была предложена схема IP-адресации для организации корпоративной сети факультетов СГУ с научно-исследовательским центром и автоматизированными рабочими местами гибкого производственного модуля. Определены количество узлов и процентные значения корпоративной сети для кафедр факульте-

тов, научного и производственного подразделений технопарков и представлены в виде таблицы. Рассчитано количество узловых точек учебного и технопаркового отделов СГУ. Для узлов в корпоративной локальной сети факультетов управления и обучения СГУ использовались IP-адреса класса С по 192.168.1.0–192.168.1.44. Разработан алгоритм определения количества узловых позиций СГУ и технопарка, обеспечивающий эффективное управление их корпоративной сетью.

Ключевые слова: высшее учебное заведение, технопарк, корпоративная сеть, IP-адрес, локальная сеть, узловые точки.

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