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STATIC ALLOCATION METHOD IN A CLOUD ENVIRONMENT WITH A SERVICE MODEL IAAS

Annotation. The article discusses a method that allows the allocation of the required computing resources for the initial launch of a virtual host. The method is focused on the functioning of a virtual host in a cloud environment focused on the service model "Infrastructure as a Service". The subject of research is the methods of static resource allocation in cloud environments. The object of study is the process of functioning of a virtual host in a cloud environment that provides all information technology resources for it. The purpose of the study is to develop a method for the static allocation of resources in the cloud environment, focused on the features of the service model "Infrastructure as a Service". Results: An approach has been developed for carrying out the decomposition of a cloud computing environment with the IAAS service model. The analysis of existing methods of static allocation of resources has been carried out. The application of the method of analysis of hierarchies for this problem is substantiated. A step-by-step algorithm for finding the most acceptable alternative from the set proposed has been developed. An example of the application of the developed method for initializing a virtual host in a cloud environment with the IAAS service model is given. Conclusion. The proposed method makes it possible to rationally use the computing resources of the cloud environment, which uses the "Infrastructure as a Service" service model. Direction for further research. The development of this direction is the development of a method for dynamic redistribution of resources in a cloud environment with the IAAS service model.

Keywords: cold technologies; cold resources; hierarchical analysis method; static distribution of resources.

Introduction

Cloud computing is getting more popular this year. Khmarni calculation - the value of the data of the calculation of the resource through the Internet. With any obov'yazkovi such characteristics [1]:

self-service for demand, self-sustaining and changing the calculation of consumption, such as the server hour, accessibility and data collection, data collection, which are taken care of, without interfering with the representative of the postal worker;

universal access to the network, services available to helpers as soon as data is transferred independently from the terminal building, which is victorious;

pooling resources, post-employee pooling service resources for a large number of supporters in a single pool for dynamic redistribution of capacities between supporters for the minds of a fast change to drink fatigue; with this support, control over the main parameters of the service (for example, obligatory data, security of access); the actual distribution of resources, which are expected to be slow, the post-employee (in some situations, the slow can still be changed with certain physical parameters, for example, to show the data processing center due to the geographic proximity);

elasticity, services can be expanded without additional costs;

consumption accounting, the service provider automatically calculates consumed resources at a certain level of abstraction (for example, the amount of data stored, bandwidth, number of users, number of transactions); on the basis of these data, he evaluates the volume of services provided to consumers.

Meeting these requirements significantly affects the allocation of resources in the cloud infrastructure. In the scientific literature, there are a lot of methods for distributing resources in informational and numerical structures.

In the article [2] the author proposes the random swap clustering algorithm. However, wines are essentially efficient in case of congestion for gloomy infrastructures. When carrying out the optimal distribution of throughput rates for self-healing (eng. self-healing) segment of computer storage in [3], the specifics of cold storage systems are not considered.

The methods proposed by [4] are focused only on mobile components. In [5], the larger world is insured by the features of roaming objects, and not by the characteristics of cloud computing.

In the article [6] one can see the methods and distribution of resources, which put clocks on another plan, showing an emphasis on non-penetrating meals.

The articles [7, 8] are directed only to the specifics of Big Data.

Article [9] is focused only on systems that process video images. And in [10], the emphasis is only on specific applications.

However, look at the approaches and methods of allocation of resources are not taken into account the particularities of gloomy calculation. It can lead to an inefficient botched infrastructure, especially the IAAS service model.

To this end, this article provides a description of the method of static allocation of resources in the cloud environment, focused on the features of the service model "Infrastructure as a Service".

1. Decomposition of the cloud computing environment

Developing a method for allocating resources in a cloud computing environment focused on the service "Infrastructure as a Service" (IaaS) is a multi-stage task. It consists of two main tasks: initial allocation of resources; dynamic reallocation of resources.

In this article, we will consider the approach to solving the first task.

Given the heterogeneity of the cloud environment, it is proposed to solve this task in 2 stages:

stage 1: decomposition of the cloud computing environment into zones, based on the defining features of the resources provided in each zone;

stage 2: initial static provisioning for all hosts running in the cloud environment.

At the first stage, the cloud computing environment is decomposed into zones, based on the defining features of the resources provided in each zone. Each of the zones includes servers and storage resources with similar characteristics.

Consider the mathematical model of the process of decomposition of the cloud environment S into n zones using the IaaS service model:

$$S = \bigcup_{i=1}^{n} S_i, \quad \bigcap_{i=1}^{n} S_i = \varnothing, \tag{1}$$

where S_i is the i-th zone, which includes resources with similar characteristics, i.e.

$$S_i = \left(\bigcup_{j=1}^{n_{ih}} h_{ij} \right) \bigcup \left(\bigcup_{\ell=1}^{n_{id}} d_{i\ell} \right), \tag{2}$$

where n_{ih}, n_{id} – are the number of servers and the number of data storages in the i-th zone of the cloud environment with the IaaS service model, respectively; h_{ij}, $j = \overline{1, n_{ih}}$, $d_{i\ell}$, $\ell = \overline{1, h_{id}}$ – are servers and data storages located in the i-th zone of the cloud environment with the IaaS service model, respectively.

Each server and each data warehouse will be characterized by the numerical characteristic-specification that is the most significant $|h_{ij}|, |d_{i\ell}|$ for this task, respectively. Then, to implement the process of decomposition of the cloud environment in accordance with expression (1), we can introduce two numerical decreasing, non-uniform in the general case, ordinal scales (Fig. 1):

$$K_h = (K_{h0}, \ldots, K_{hi}, \ldots, K_{hn}), \quad K_{h0} \ge K_{h1} \ge \ldots \ge K_{hi} \ge \ldots \ge K_{hn}; \tag{3}$$

$$K_d = (K_{d0}, \ldots, K_{di}, \ldots, K_{dn}), \quad K_{d0} \ge K_{d1} \ge \ldots \ge K_{di} \ge \ldots \ge K_{dn}. \tag{4}$$

The constructed scales (3) and (4) allow us to write down the necessary and sufficient conditions for the formation of n non-overlapping zones during the decomposition of a cloud environment with an IaaS service model. To do this, consider a randomly selected server h with a numerical characteristic-specification $|h|$ and a data warehouse d with a numerical characteristic-specification $|d|$. Then:

$$(h \in S_i \Leftrightarrow h_{i-1} \le |h| < h_i) \,\&\, (|h| = h_n \Rightarrow h \in S_n); \tag{5}$$

$$(d \in S_i \Leftrightarrow d_{i-1} \le |d| < d_i) \,\&\, (|d| = d_n \Rightarrow d \in S_n). \tag{6}$$

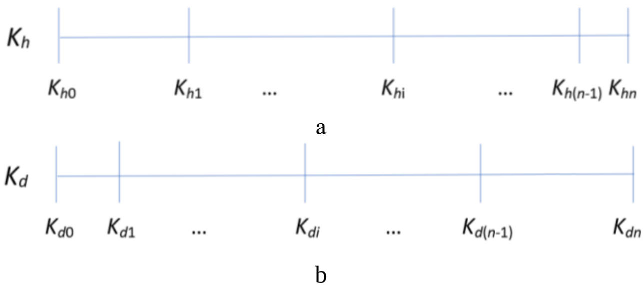

Fig. 1. Type of scales for servers (a) and data storages (b)

Expressions (5) and (6) determine the conditions for performing decomposition (1) and are based on scales (3) and (4). In turn, these scales are formed by the administrator of the cloud computing environment, based on his expert knowledge about the features of the equipment and its compatibility. Also, the history of operation of this cloud environment with the IaaS service model can be taken into account.

For example, consider the process of decomposing a cloud computing environment into 3 zones. The characteristic-specification for servers determines the number of CPUs, and for disk storages **-** the type of disk array class (DA, determines potential uses). Let the cloud environment under study be based on the following computing facilities:

– 2 dual processor servers;
– 2 four-processor servers;
– 3 eight-processor servers;
– 1 sixteen-processor server;
– 2 twenty-four processor servers;
– 2 DA HP XP12000 (Hi-End class);
– 1 DA Hitachi USP-V (Hi-End class);
– 2 DA IBM DS-4700 (Mid-Range class);
– 3 DA SDS DS-207 (Entry-level class).

Based on a preliminary analysis of user requests, it is planned to build zones of high (High load zone, HZ), medium (Medium load zone, MZ) and low (Low load zone, LZ) load. Based on this, at startup, the virtual host will be placed in the zone whose resources it will most likely need, based on the initial characteristics (number of CPUs, amount of RAM, amount of storage). For decomposition, two scales are formed: numerical scale K_h = (24, 8, 4, 2); quality scale K_d = (Hi-End; Mid-Range, Entry-level, 0).

The result of the decomposition is clearly shown in Fig. 2.

2. Choosing a method for initial allocation of computing resources

When choosing a static resource allocation method, you should be guided by the characteristic features of the IaaS service model. The analysis of existing resource allocation methods for multicriteria decision-making problems, carried out in [11], showed the possibility of using the mathematical apparatus of the hierarchy analysis method [12].

The main application of the method is decision support through the hierarchical composition of the problem and the rating of alternative solutions. Let us describe the capabilities of this method [12].

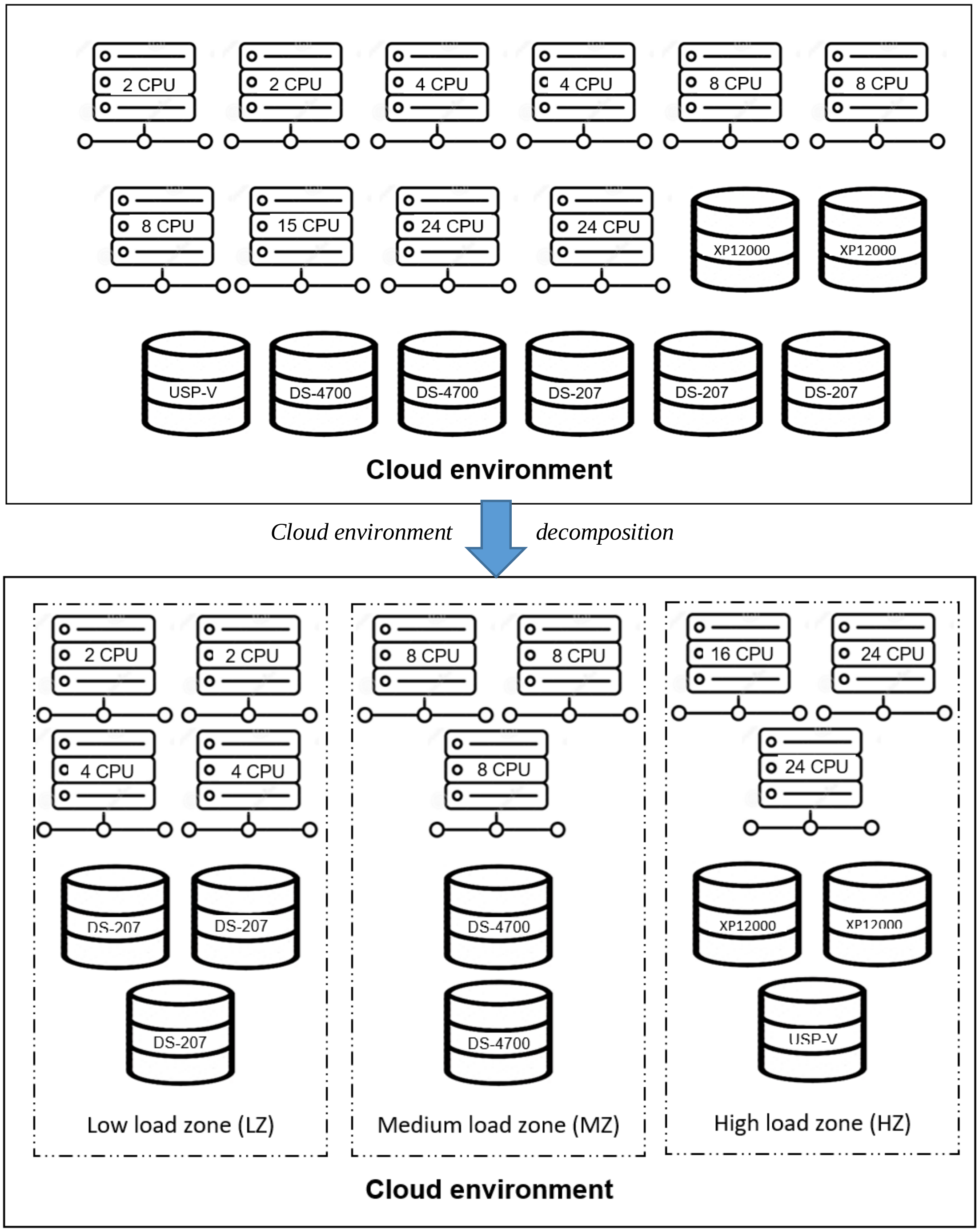

Fig. 2. An example of decomposing a cloud environment into 3 zones

• The method allows to analyze the problem; at the same time, the decision-making problem is presented in the following form of hierarchically ordered components:

– the main goal (main criterion) of rating possible solutions,

– several groups (levels) of the same type of factors, one way or another affecting the rating,

– groups of possible solutions,

- systems of links indicating the mutual influence of factors and decisions.

• The method allows you to collect data on the problem. In accordance with the results of hierarchical decomposition, the decision-making situation model has a cluster structure. The set of possible solutions and all factors influencing decision priorities are divided into relatively small groups - clusters. The procedure of paired comparisons developed in the hierarchy analysis method makes it possible to determine the priorities of the objects included in each cluster. For this, the eigenvector method is used. So, the complex problem of data collection is broken down into a number of simpler ones that can be solved for clusters.

• The method allows us to evaluate data inconsistency and minimize it. For this purpose, matching procedures have been developed in the hierarchy analysis method. In particular, it is possible to identify the most conflicting data, which allows you to identify the least clear areas of the problem and organize more careful selective thinking about the problem.

• The method allows to carry out the synthesis of the problem of decision making. After the analysis of the problem has been carried out and data has been collected for all clusters, the final rating is calculated using a special algorithm - a set of priorities for alternative solutions.

The properties of this rating allow for decision support. For example, the decision with the highest priority is made. In addition, the method allows you to build ratings for groups of factors, which allows you to evaluate the importance of each factor.

• The method allows you to organize a discussion of the problem, contributes to the achievement of consensus. The opinions that arise when discussing a decision problem can themselves be considered as possible solutions in a given situation. Therefore, the method of analyzing hierarchies can be applied to determine the importance of taking into account the opinion of each participant in the discussion.

• The method allows assessing the importance of taking into account each decision and the importance of taking into account each factor that affects the priorities of decisions. In accordance with the formulation of the decision-making problem, the priority value is directly related to the optimality of the solution. Therefore, decisions with low priorities are rejected as irrelevant. As noted above, the method allows to evaluate the priorities of the factors.

Therefore, if at the exclusion of a certain factor the priorities of solutions change insignificantly, such a factor can be considered insignificant for the problem under consideration.

• The method allows assessing the stability of the decision being made. The decision being made can be considered justified only if the inaccuracy of the data or the inaccuracy of the structure of the model of the decision-making situation do not significantly affect the rating of alternative decisions.

The advantages of this method in solving the problem of initial allocation of resources in cloud computing environments in comparison with other methods of multicriteria analysis should include [12]:

Lack of general rules for the formation of the structure of the decision-making model, which allows to take into account the "human factor" in the preparation of decision-making. Thus, it is possible to bring the work of the resource allocation subsystem closer to the actions of a system administrator, who is able to take into account the implicit relationships between various parameters of the functioning of a cloud computing environment.

• Simplicity of the rating calculation procedure, which makes it possible to make the decision selection process as transparent as possible when setting up the resource allocation subsystem.

• The method provides an opportunity to take into account the opinion of not one, but several experts, which makes it possible to obtain a more objective assessment of the significance of indicators.

• The method provides rich opportunities for identifying and minimizing contradictions in the source data, which allows you to effectively operate with a large number of indicators in the decision-making process.

• The method not only provides a way to identify the most preferred solution, but also quantifies the degree of preference through ratings, reflecting the natural course of human thinking and giving a more general approach than the method of logical chains. This allows us to use the results more fully when we use them later (for example, if starting a virtual host on a server that is the best alternative fails).

However, the hierarchy analysis method also has a number of disadvantages, which are listed below.

• Within the Hierarchy Analysis Method, there is no means to validate the data. This is an important drawback, which partly limits the possibilities of applying the method.

However, when choosing the optimal Hardware for hosting a virtual host in a cloud environment, in principle, there can be no objective data due to their poor formalizability and implicit dependencies. At the same time, the procedure of paired comparisons for data collection has practically no worthy alternatives. If the data collection was carried out with the help of experienced experts, and there are no significant inconsistencies in the data, then the quality of such data is considered satisfactory.

• The method only provides a way to rate the alternatives, but has no internal means for interpreting the ratings, ie. It is believed that the person making the decision, knowing the rating of possible solutions, must, depending on the situation, draw a conclusion himself. However, the data obtained is sufficient to make a decision within the resource allocation subsystem in a cloud environment with an IaaS service model.

Thus, the above shortcomings of the hierarchy method in the initial allocation of resources for the problem under consideration are not essential.

Thus, the expediency of using the hierarchy analysis method for solving the problem of initial resource allocation in a cloud environment with the IaaS service model is substantiated.

3. Methods of resource allocation in cloud infrastructures

The initial or base allocation of resources for each running virtual host in a cloud environment with an IaaS service model is performed using a hierarchy analysis method.

As is known, the Saaty hierarchy analysis method is successfully used in various fields of science and technology to solve similar problems [11], however, due to the peculiarities of the problem being solved, it requires a number of steps that take into account the specifics of cloud computing environments with the IaaS service model [53] (Fig. 3).

At the first step, the computing cloud environment is decomposed into zones in accordance with the approach described above. Hardware characteristics in each of the zones are close to each other.

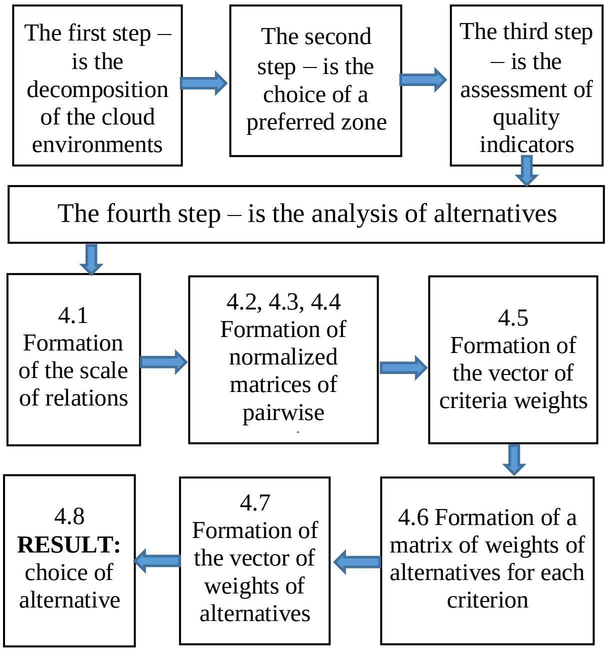

Fig. 3. Scheme of application of the method of Saaty hierarchies' analysis

At the second step, taking into account the restrictions set for the virtual host (on the number of processors, memory size, storage resources, etc.), the most preferable zone is selected for it. The use of zones allows you to take into account the limitations of the launched instance in terms of characteristics in order to choose its location already where there will be enough resources for the operation of applications running on the virtual host. In the selected zone, the set of all possible alternatives for the Hardware that ensures the functioning of the required virtual host is defined:

$$A = \{A_1, \dots, A_m\}, \quad card\ A = m. \tag{7}$$

The third step evaluates the quality indicators that describe the functioning of each Hardware component included in the selected zone. At this step, for each host from the zone defined in the previous step, the values of quality indicators [11] are evaluated, which describe the functioning of the Hardware.

The complex quality indicator is determined by the set of considered quality indicators. This set consists of three subsets, which are groups of key quality indicators for a cloud environment with an IaaS service model:

$$MP = \{P, R, S, C\},$$

where P – is a subset of particular performance indicators; R – is a subset of particular reliability indicators; S – is a subset of particular load indicators; C – is a subset of cost indicators.

Accordingly, the subset data consists of the following partial quality indicators:

$$P = \{p_1, \dots p_{n1}\}; \tag{8}$$

$$R = \{p_{n1+1}, \dots p_{n2}\}; \tag{9}$$

$$S = \{p_{n2+1}, \dots p_{n3}\}; \tag{10}$$

$$C = \{p_{n3+1}, \dots p_n\}. \tag{11}$$

where n – is the total number of partial indicators, among which $n1$ – is the number of performance indicators, ($n2$ - $n1$) – is the number of reliability indicators, ($n3$ - $n2$) – is the number of load indicators, (n - $n3$) – is the number of cost indicators

At the same time, the set of particular quality indicators that affect the complex quality indicator can be summarized in 2 groups: deterministic (associated with equipment configuration) and stochastic (associated with load and operating time). Some of these indicators, such as the physical condition of the equipment and the level of competence of the maintenance personnel, cannot be quantified, and therefore are fuzzy and can be represented as linguistic variables [12].

At the fourth step, to select the most preferred Hardware for hosting a virtual host, an analysis of alternatives is performed based on the obtained values of quality indicators [11]. Each indicator has its own predetermined weight, determined by an expert for each zone based on the generalized needs of customers and available equipment. As a result, the Hardware composition is selected to host the virtual host, providing the maximum probability of optimal resource allocation p_{max}.

Table 1 – **Scale of relations (degrees of significance of the parameters of the functioning of the cloud computing environment)**

Z*	Definition	Explanation
1	Equal importance	Two parameters contribute equally to the achievement of the goal
3	Some predominance of the significance of one action over another (weak significance)	There are considerations in favor of preferring one of the parameters, but these considerations are not convincing enough
5	Substantial or strong significance	There are reliable data or logical judgments to show preference for one of the options
7	Obvious or very strong significance	Strong evidence in favor of one parameter over another
9	Absolute significance	The evidence for favoring one parameter over the other is overwhelmingly compelling.
2,4,6,8	Intermediate values between two neighboring judgments	A situation where a compromise solution is needed

* *Z* - degree of significance

Consider step by step the algorithm for performing the analysis of alternatives based on the obtained values of quality indicators.

Step 4.1. A qualitative scale is preliminarily determined for pairwise comparison with subsequent conversion to scores in accordance with Table 1. Pairwise comparisons are carried out in terms of the dominance of one element over another.

If the parameter i is assigned one of the non-zero numbers defined above when compared with the parameter *j*, then the opposite value is assigned to the parameter *j* when compared with the parameter *i*.

Step 4.2. We form a square matrix of pairwise comparisons of all indicators with the size $n \times n$:

$$M_{crit} = \left(\xi_{j\ell}\right), \quad j,\ell = \overline{1,n}. \tag{12}$$

Step 4.3. For each indicator, we form a square matrix of pairwise comparisons of all possible alternatives, i.e. get an array of matrices

$$M_{pi} = \left(\eta_{ij\ell}\right), \quad i = \overline{1,n}; \;\; j,\ell = \overline{1,m}. \tag{13}$$

Step 4.4. We normalize matrices (12), (13) according to the following scheme:

$$M_{crit}^{(norm)} = \left(\xi_{j\ell} \Big/ \sum_{\zeta=1}^{n} \xi_{\zeta\ell}\right), \quad j,\ell = \overline{1,n}; \tag{14}$$

$$M_{pi}^{(norm)} = \left(\eta_{ij\ell} \Big/ \sum_{\zeta=1}^{m} \eta_{i\zeta\ell}\right), \quad i = \overline{1,n}; \;\; j,\ell = \overline{1,m}. \tag{15}$$

Step 4.5. From the normalized matrix (14) we form a weight column-vector of criteria of size $(1 \times n)$, finding the average value for each row of this matrix:

$$V_{crit}^{(weight)} = \left(v_j\right) = \left(\sum_{\ell=1}^{n}\left(\xi_{j\ell} \Big/ \sum_{\zeta=1}^{n} \xi_{\zeta\ell}\right) \Big/ n\right), \quad j = \overline{1,n}. \tag{16}$$

Step 4.6. From normalized matrices (15), we form a matrix of weights of alternatives for each criterion (consisting of weight columns obtained in a similar way) with the size $(m \times n)$:

$$M_{p}^{(weight)} = \left(m_{ij}\right) = \left(\sum_{\ell=1}^{m}\left(\eta_{ij\ell} \Big/ \sum_{\zeta=1}^{m} \eta_{i\zeta\ell} \Big/ m\right)\right), \quad i = \overline{1,n}; \;\; j = \overline{1,m}. \tag{17}$$

Step 4.7. Multiplying the resulting matrix (17) by column (16) according to the rule of matrix multiplication, we obtain a normalized (by construction) vector of weights of alternatives of size $(1 \times m)$ in terms of achieving the goal:

$$W_A = M_{p}^{(weight)} \cdot V_{crit}^{(weight)} = \left(w_j\right), \quad j = \overline{1,m}; \quad \sum_{j=1}^{m} w_j = 1. \tag{18}$$

Step 4.8. Then the most acceptable solution from the point of view of the hierarchy analysis method is the alternative corresponding to the maximum element of the vector (18), i.e.

$$A_{pr} = \left(A_i \,\middle|\, w_i = \max_j \left(w_j\right), \quad j = \overline{1,m}\right). \tag{19}$$

4. Initial boot of the virtual host

Let's consider the launch of a virtual host in a cloud environment with an IaaS service model using a specific example.

As an example, consider the cloud computing environment discussed above, the decomposition result of which (step 1) is shown in Fig. 2. The main parameters of the functioning of the computing environment (expressions (8) - (11)) are described by such values:

$$P = \left\{N_{CPU}, N_{Nucl}, V_{CPU}, V_{net}\right\}; \tag{20}$$

$$R = \left\{\Delta T_{fail}, Cond_{hw}, Serv_{pers}, VM\right\}; \tag{21}$$

$$S = \left\{V_{RAM}, Z_{CPU}, Z_{net}, EM, N_{vh}\right\}; \tag{22}$$

$$C = \left\{c_{rent}\right\}. \tag{23}$$

where N_{CPU} is the number of CPU;

N_{Nucl} – number of cores in each CPU;

V_{CPU} – clock frequency of the CPU;

V_{net} – network speed;

ΔT_{fail} – mean time between failures;

$Cond_{hw}$ – the degree of the physical state of the Hardware;

$Serv_{pers}$ - the level of competence of personnel for equipment maintenance;

VM – average speed of access to external memory;

EM – the amount of available external memory;

V_{RAM} – free area of RAM;

Z_{CPU} – CPU load,

Z_{net} – network load,

N_{vh} – number of running instances of virtual hosts;

c_{rent} – relative cost of monthly rent

To perform step 2, we determine the minimum hardware requirements to ensure the functioning of the virtual host:

$$N_{CPU} \ge 12; \; N_{Nucl} \ge 12;$$
$$V_{CPU} \ge 2 \text{ GHz}; \; V_{net} \ge 1000 \text{ Mbps};$$
$$\Delta T_{fail} \ge 1000 \text{ hour}; \tag{24}$$
$$Cond_{hw} \ge 0.95;$$
$$Serv_{pers} = 1.$$

As can be seen from the conditions (24), for this virtual host, it is necessary to select a high performance zone (High load zone, HZ, Fig. 2).

To perform the third step, let's determine the current values of indicators for Hardware from the HZ zone (Table 2, 3).

Table 2 – **Server specifications**

Hardware	**Performance**				**Reliability**			**Loading**			
	N_{CPU}	N_{Nucl}	V_{CPU}	V_{net}	ΔT_{fail}	$Cond_{hw}$	$Serv_{pers}$	V_{RAM}	Z_{CPU}	Z_{net}	N_{vh}
Server 1	16	12	2 GHz	10^3 Mbps	10^4 h	0,96	1	50 %	60 %	30 %	5
Server 2	24	16	4 GHz	$5{\cdot}10^3$ Mbps	10^4 h	0,96	1	70 %	20 %	30 %	2
Server 3	24	20	8 GHz	$8{\cdot}10^3$ Mbps	10^5 h	0,99	1	60 %	40 %	50 %	3

Table 3 – **Disk array specifications**

Дисковый массив	*VM*	*EM*
XP12000 - 1	7 Gb/s	40 %
XP12000 - 2	11 Gb/s	60 %
USP-V	25 Gb/s	90 %

Conditions (24) are satisfied by any Hardware options, so at the output of step 3, 9 alternative options will be formed (Table 4).

The unit of relative rental cost is the cost of the cheapest alternative.

Now it is possible to proceed to the analysis of alternatives (step 4). The qualitative scale for pairwise comparison with subsequent conversion into points is determined in accordance with Table. 1.

Matrices of pairwise comparisons are formed for all indicators and all possible alternatives.

After all the transformations in accordance with (14) - (18), we obtain the vector of weights of alternatives (Table 5).

Table 4 – **List of alternatives**

№	**Hardware**	c_{rent}
1.	Server 1, XP12000 - 1	1
2.	Server 1, XP12000 - 2	1.1
3.	Server 1, USP-V	1.5
4.	Server 2, XP12000 - 1	1.2
5.	Server 2, XP12000 - 2	1.3
6.	Server 2, USP-V	1.6
7.	Server 3, XP12000 - 1	1.7
8.	Server 3, XP12000 - 2	1.8
9.	Server 3, USP-V	2.4

Analysis of the results (Table 5) shows that the most acceptable at the moment for the initial loading of a virtual host with requirements (23) is alternative 5: Server 2, XP12000 - 2, the rent is 30% more than the minimum possible for these requirements.

Таблица 5 – **Vector of weights of alternatives**

№	**1**	**2**	**3**	**4**	**5**
The weight	0.09	0.11	0.07	0.18	0.21

№	**6**	**7**	**8**	**9**
The weight	0.17	0.08	0.14	0.05

Analysis of the results (Table 5) shows that the most acceptable at the moment for the initial loading of a virtual host with requirements (23) is alternative 5: Server 2, XP12000 - 2, the rent is 30% more than the minimum possible for these requirements.

Conclusions

The article proposes a method that allows allocating the required computing resources for the initial launch of a virtual host. The method is focused on the functioning of a virtual host in a cloud environment focused on the service model "Infrastructure as a Service".

An approach has been developed for carrying out the decomposition of a cloud computing environment with the IAAS service model.

The analysis of existing methods of static allocation of resources has been carried out. The application of the method of analysis of hierarchies for this problem is substantiated. A step-by-step algorithm for finding the most acceptable alternative from the set proposed has been developed.

An example of the application of the developed method for initializing a virtual host in a cloud environment with the IAAS service model is given.

The proposed method makes it possible to rationally use the computing resources of the cloud environment, which uses the "Infrastructure as a Service" service model. Direction for further research. The development of this direction is the development of a method for dynamic redistribution of resources in a cloud environment with the IAAS service model.

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Метод статичного виділення ресурсів у хмарному середовищі з моделлю обслуговування IAAS

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Анотація. У статті розглянуто метод, що дозволяє виділити необхідні обчислювальні ресурси початкового запуску віртуального хоста. Метод орієнтований на функціонування віртуального хоста у середовищі хмар, орієнтованої на модель обслуговування «Інфраструктура як сервіс». Предмет дослідження – методи статичного розподілу ресурсів у хмарних середовищах. Об'єкт дослідження – процес функціонування віртуального хоста у середовищі, що забезпечує йому всі інформаційно-технологічні ресурси. Мета дослідження – розробити метод статичного виділення ресурсів хмарного середовища, орієнтований на особливості моделі обслуговування «Інфраструктура як сервіс». Отримані результати. Розроблено підхід щодо декомпозиції хмарного обчислювального середовища з моделлю обслуговування IAAS. Проведено аналіз існуючих методів статичного виділення ресурсів. Обґрунтовано застосування для цього завдання методу аналізу ієрархій. Розроблено покроковий алгоритм пошуку найбільш прийнятної альтернативи з безлічі запропонованих. Наведено приклад застосування розробленого методу ініціалізації віртуального хоста в хмарному середовищі з моделлю обслуговування IAAS. Висновок. Запропонований метод дозволяє раціонально використовувати обчислювальні ресурси хмарного середовища, яке використовує модель обслуговування «Інфраструктура як сервіс». Напрямок подальших досліджень. Розвиток цього напряму – розробка методу динамічного перерозподілу ресурсів у хмарному середовищі з моделлю обслуговування IAAS.

Ключові слова: хмарні технології, хмарні ресурси, метод аналізу ієрархій, статичний розподіл ресурсів.