PRACTICAL ASPECTS OF THE CONFIGURATION OF HOMOGENOUS SET OF SERVERS

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Abstract: Results on the configuration of homogeneous set of servers for computer networks, aiming the minimization of its total cost are presented. The optimal solution significant dependence with the number of server types (from which is done the selection) and, also, with the structure of total flow of users' requests is reveal.

Keywords: *computer networks, server set, configuration, flows of requests, optimal solution.*

1. INTRODUCTION

The Internet development and information society edification need to store, process and retrieve huge amount of data. Computer centers/data centers interconnected in networks are created in this purpose. Information of common use is processed by networks' servers. The growth of amount of data requires increasing server set's performance and, respectively, the expenses with their creation. Therefore, it is important the optimization of server set configuration, aiming to minimize expenses with servers but satisfying the requirements for processing of users' requests flows.

Diverse theoretical aspects of computer networks set of servers configuration are discussed in [1]. There is formulated the problem of homogeneous set of servers configuration and an algorithm for its solution is proposed. In this paper some practical results in the domain are presented – results obtained by using the ConfigServer application elaborated in this purpose.

2. CONCRETIZATION OF THE PROBLEM

Used notices:

m – the number of server types, from which the selection of server set is done;

C_j, U_j – the cost and, respectively, the performance of a server of j type, $j = \overline{1, m}$;

n – the total number of users requests categories in the network;

u_i – the mean processing laboriousness of a user request to the $i = \overline{1, n}$ service (category i request);

$u_i^{(2)}$ – the 2th moment of processing laboriousness of a i category request;

T_{di} – the established top limit of the mean response time to a request of i category;

Λ_i – the total flow rate of category *i* requests to the respective server set.

Roughly, the problem can be formulated as follows. Let are known values of parameters: *m*; *n*; C_j, U_j, $j=\overline{1,m}$; u_i, $u_i^{(2)}$, T_{di}, Λ_i, $i=\overline{1,n}$. It is required to determine the type j^* and the optimal number $M_{j^*}^*$ of servers of this type that would assure the minimal total cost $C^*=M_{j^*}^*\cdot C_{j^*}$ with network servers in processing all requests of flows $\Lambda_i, i=\overline{1,n}$ and not exceeding durations $T_{di}, i=\overline{1,n}$.

Evidently, the growth of number *m* of server types assures more large possibilities for the selection of server set and, eventually, for obtaining a better solution. But it is difficult to estimate how much significant could be the improvement of the solution with growing of *m* value without special calculations. Therefore, it is opportune to estimate the dependence of optimal solution with the value of *m* by using such calculus.

For real problems, the values of parameters C_j, U_j, $j=\overline{1,m}$ are specified depending of concrete case on the base of offer of servers on market etc. In research purposes, to determine concrete common dependences, it is opportune to generate some threads of values for pairs $\{C_j, U_j\}$, $j=\overline{1,m}$, using the following relations:

$$U_{j+1}=hU_j,\ j=\overline{1,m-1};\qquad \frac{C_{j+1}}{C_j}=\left(\frac{U_{j+1}}{U_j}\right)^{\frac{p-1}{p}}. \qquad (1), (2)$$

One could mention, that relation (2) at p=2 is reducing to the Grosh law [2]. From relations (1) and (2) one could obtain:

$$h=\sqrt[m-1]{\frac{U_m}{U_1}};\qquad p=\frac{\lg\frac{U_m}{U_1}}{\lg\frac{U_mC_1}{U_1C_m}}. \qquad (3), (4)$$

In the case of multidimensional flows of users' requests ($n>1$), the structure of total flow, determined by the weight of flows of requests of different categories, could sometimes influence the solution. To investigate such dependence, it is opportune to fix the value of laboriousness $U_{\min}$ of total flow Λ of user requests and to modify the weight of laboriousnesses $U_{\min i}$, $i=\overline{1,n}$ of requests' flows $\Lambda_i, i=\overline{1,n}$:

$$U_{\min}=\sum_{i=1}^{n}\Lambda_i u_i;\qquad U_{\min i}=\Lambda_i u_i, i=\overline{1,n}. \qquad (5), (6)$$

3. RESULTS AND DISCUSSIONS

For calculus by algorithms for server set configuring proposed in [1], the application ConfigServ in C++ Builder is elaborated. The executable application's module is of circa 700 Kbytes.

Calculus are done to determine the dependence of minimal cost C^* with the number *m* of server types from which the selection is done and with the structure of total flow Λ of user requests. It is considered that the flow Λ consists of requests of two categories (*n* = 2): dialog (*i* = 1) and request-answer (*i* = 2). The used in calculus characteristics of requests, at general repartition of their processing duration, are presented in table 1.

Regarding the total laboriousness of users requests' flows, value U_{min} = 2 Gflops is used. The weight of laboriousness of flows of category 1 and 2 in the total laboriousness U_{min} is represented by three variants:

1) $U_{\min 1} = 9U_{\min 2}$; 2) $U_{\min 1} = U_{\min 2}$ şi 3) $U_{\min 2} = 9U_{\min 1}$.

Tabelul 1. Caracteristicile cererilor

Caracteristica cererilor \ *i*	1	2
T_{di}, s	0,3	60
u_i, Gflops	0,2	20
$u_i^{(2)}$, Gflops^2	0,4	30 0

Value *p* = 6,481, used in calculus, is determined on the base of information on concrete computer/servers, namely:

1) U_1 = 2 Gflops, C_1 = 2000 USD – values obtained as arithmetic average of the respective characteristics for IBM xSeries 306 and HP ProLiant DL 320 G2 types of servers;
2) U_m = 360 Tflops, C_m = 100 mln USD – values inherent to IBM Blue Gene/L Beta supercomputer.

Some obtained results are presented în figure 1, and at *m* = 999 optimal values for C^* are:

1) C^*= 6118 USD at $U_{\min 1} = 9U_{\min 2}$;

2) C^*= 4592 USD at $U_{\min 1} = U_{\min 2}$;

3) C^*= 3830 USD at $U_{\min 2} = 9U_{\min 1}$.

From figure 1, one could see a strong dependence, at $U_{\min}$ = 2 Gflops, of cost C^* of optimal set of servers with the number *m* of server types. Thus, at $U_{\min 1} = 9U_{\min 2}$ one has:

1) $\Delta C(7;11) = C^*\big|_{m=7} - C^*\big|_{m=11} = 4156$ USD, and $\delta C = \dfrac{\Delta C(7;11)}{C^*\big|_{m=7}} \cdot 100\% \approx 39\%$;

2) $\Delta C(7;999) = C^*\big|_{m=7} - C^*\big|_{m=999} = 4316$ USD, and $\delta C = \dfrac{\Delta C(7;999)}{C^*\big|_{m=7}} \cdot 100\% \approx 41\%$.

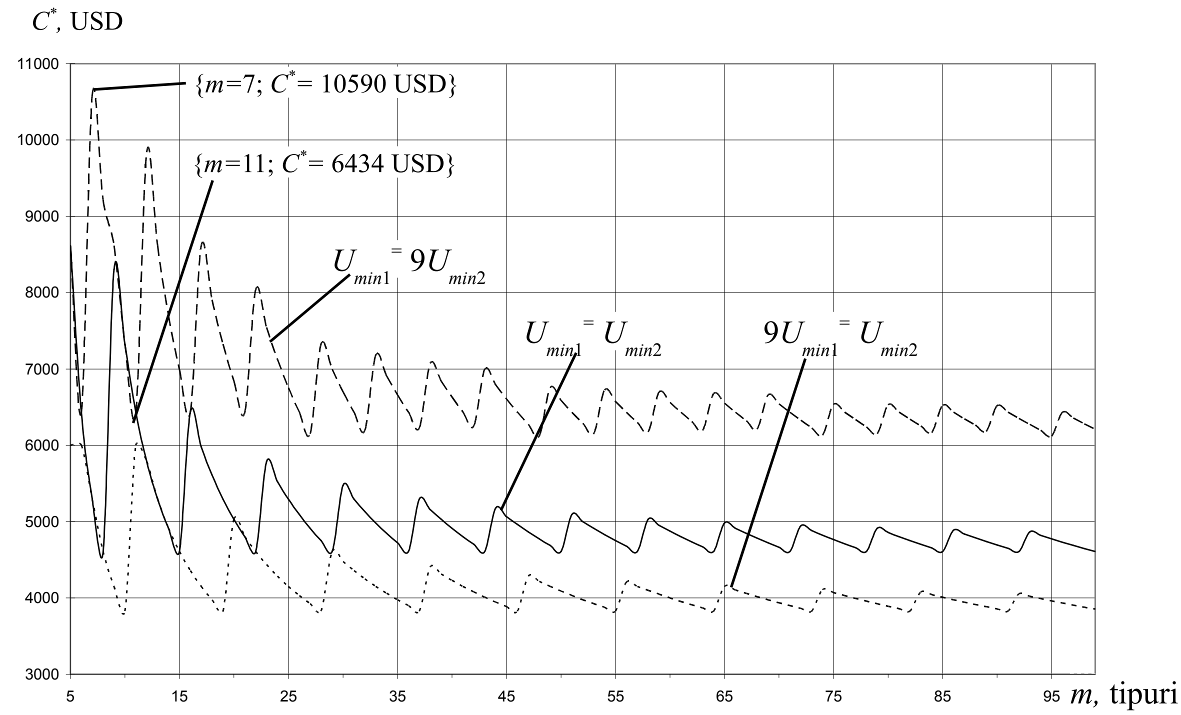

Fig. 1. Dependence of the cost C^* of optimal server set with the number *m* of server types and the structure of total flowof users' requests.

In many cases, the selection from $m = 7$ types of servers is considered acceptable. But, as show the made calculus, the solution could differ, depending on value of $m > 7$, by more than 39 %.

CONCLUSIONS

On the base of calculus done using the application ConfigServ, at non too high laboriousness of total flow of users' requests, it is reveal a significant dependence of optimal set of servers' cost with the number *m* of server types from which it is done the selection and with the structure of this flow. The variation of the optimal solution could exceed 39 %. This confirms the necessity of special investigations depending of concrete case in configuring the computer networks set of servers.

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