THE IMPLEMENTATION FEATURES OF THE AGGREGATION MODE OF NETWORK INTERFACE CHANNELS IN THE MULTIPROCESSORING COMPUTER SYSTEMS

Shvachych G. G.[1], Moroz B. I.[2], Pobochii I. A.[1], Sushko L. F.[3], Ivaschenko E. V.[1]

[1]National Metallurgical Academy of Ukraine, the city of Dnipro
[2]National TU Dnipro Polytechnic, Ukraine
[3]Dnipro State Agrarian and Economic University, Ukraine

In our opinion, the new qualitative stage of development of multiprocessor cluster systems lies in the use of new modern network technologies. In this case, the efficiency of parallelizing computations depends on many factors, but one of the defining is the choice and organization of the network interface. This is explained in this way. The network of the cluster computer system is fundamentally different from the network of workstations, although for the construction of the cluster, ordinary network cards and hubs/switches that are used to organize the workstations network are required. However, in the case of a clustered computing system, there is one fundamental feature. *The cluster network, first of all, is not intended for computers communication, but for connection of computational processes.* In this regard, the higher the bandwidth of the cluster network, the faster the user-defined parallel problems performed on the cluster are solved. Thus, the technical characteristics of the computing network are of primary importance for multiprocessor cluster systems.

Currently, the problem of selecting and analyzing network technologies for modular, multiprocessor cluster systems has not been properly developed. In addition, there are practically no papers devoted to the study of the impact of network technologies on the efficiency of parallelization in modular multiprocessor cluster systems. In this regard, the studies that are considered in this paper are relevant and of a kind that will be of interest to the relevant specialists.

The operation modes analysis of the multiprocessor computing system network interface allowed to reveal such a problem: *how, due to the computer networks architecture design features in multiprocessor computing systems, can it increase its efficiency and performance?*

This problem can be solved by the fact that data interchange among computing nodes of a multiprocessor computing system can be passed to a separate network that works on the channel (second) level using *channel bonding* technology. This allows to increase the speed of data interchange amkng the nodes of the system and reduce the channel download that connects them [3]. This network interface architecture implements high-speed node access memory. Generally, we note that the use of the reconfigurable network can improve the efficiency of the multiprocessor computing system, *adapting the structure of its resources to resolving each specific type of problem*. Hence, the multiprocessor computing system network architecture should ensure, firstly, an increase in the computing speed when solving tight problems, and secondly, high-speed access to the memory

of nodes, reducing the channel download that connects them. In order to increase the bandwidth of the network system, it is recommended to apply the aggregation procedure or *channel bonding* technology. Such technology allows to combine several network adapters into one high-speed channel.

The purpose of the research is to provide the channels aggregation mode of the network interface in such a way that several computing networks that operate symmetrically on the basis of the corresponding switching matrices are configured in the data interchange network of the multiprocessor computing system.

At the same time it is necessary to solve the following problems:

1. Identify the basic laws regarding the problem computation time, depending on the change in the computing area of a multiprocessor computing system, constructed on the basis of the channels aggregation mode of the network interface.

2. Run the simulation stage of the basic time characteristics of the solvable problem by applying a multiprocessor computing system designed on the basis of the channels aggregation of the network interface. Identify the main regularities of the time of solving the problem depending on the expansion of the computing area.

3. Perform research aimed at determining the deceleration factor associated with the implementation of the network aggregation mode network interface.

4. Run the simulation phase of the deceleration computing and set the patterns of its change, depending on the network interface channels number.

Computational experiments were conducted for a computing platform equipped with an *Intel E*8400 3 *GHz* processor. Here, as the initial one, the corresponding characteristics of the class of solvable problems and the cluster system itself were adopted.

At the first stage, the procedure for simulating the dependence of one iteration computation time on size of the computing area of multiprocessor computing system was performed. The simulation results are presented as graphic dependencies (Figure 1).

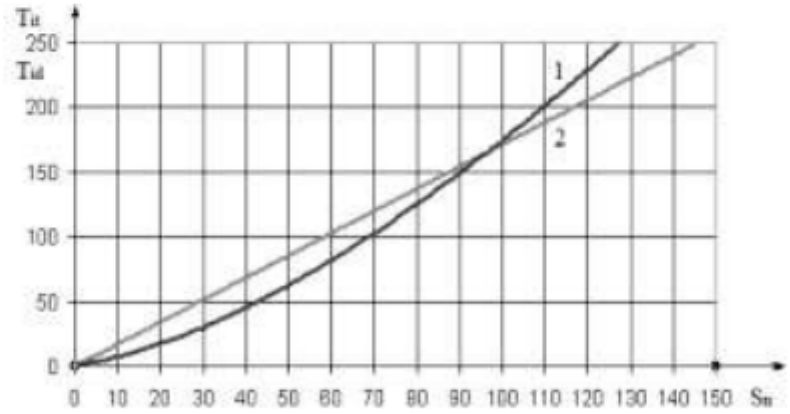

Figure 1 - The curves of the time dependence of one iteration computation time on the size of the computing area of the multiprocessor computing system for the channels aggregation mode of the network interface

It is quite obvious that the network aggregation mode allows the network equilibrium point to be substantially maintained in the direction of an increase in the computation domain S_n. This becomes possible by increasing the speed of data interchange among the nodes of the system and reducing the channels download that connect them [3]. It is obvious that this mode of network interface is implemented, when $S_n < S_{id}$, and under such conditions, the computing time of the multiprocessor system becomes less than time to compute of the ideal computer. This is due to the increase in the number of processors of the multiprocessor computing system.

At the second stage of the research, a procedure was performed to simulate the deceleration rate of the computations, depending on the number of nodes of the multiprocessor system in the case when the aggregation process of the network interface channels was implemented. The simulation results are presented as graphical dependencies (Figure 2).

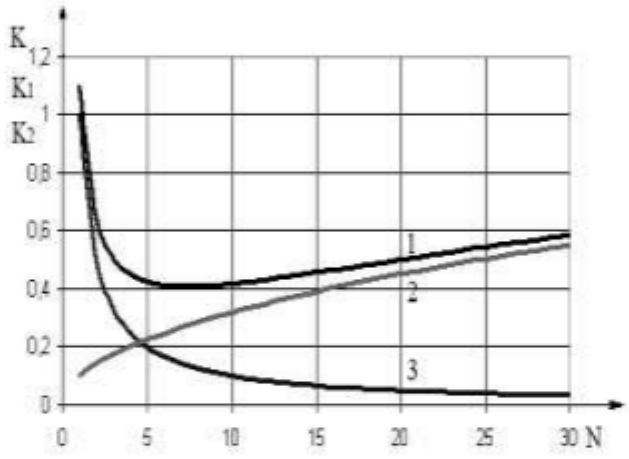

Figure 2 - Dependence curves of the deceleration rate from the number of nodes of the multiprocessor computing system for the aggregation mode of the network interface channels

Figure 2 demonstrates the general trend of decreasing the deceleration rate. Against the background of the noted features, a significant reduction in the time limit data interchange and the deceleration rate values can be noted. By the observed, we get that in this case N_{id} = 5, while the smallest deceleration computations value corresponds to K = 0.4.

The given data testify to the perspective of the chosen research direction. The proposed approach provides a uniform distribution of load between the corresponding nodes of the multiprocessor computing system, and also helps to increase the speed of data interchange between its nodes. Obviously, the higher the bandwidth of the network, the faster the parallel problems will be solved and the lower the deceleration rate will be.

Consequently, on the basis of the conducted researches it is possible to note the following:

1. This paper outlines ways to improve the efficiency of the multiprocessor computing system by changing its network interface architecture. It is established that the undoubted advantage of the channels' aggregation mode is a significant increase in the speed of data interchange among computing nodes of a multiprocessor computing system and a significant decrease in the deceleration factor.

2. The main feature of the proposed operation mode of the network interface is that the operation reliability of the multiprocessor computing system increases. So, in the event of adapter failure, the traffic is sent to the next valid adapter without interrupting the computing process. If the adapter starts working again, the data transfer through it is restored again.

3. The basic regularities regarding the problem computational time are revealed, depending on the change of the computation domain of the multiprocessor computing system in the aggregation mode of the network interface channels. It is shown that this approach allows increasing the network interface bandwidth of the system and significantly reducing the deceleration rate.

4. The current operating mode of the network interface of a multiprocessor computing system provides a wider range of possibilities for the implementation of the procedure for data interchange among the computing nodes, significantly improving the characteristics of its efficiency, performance and reliability of its operation.

Reference

1. Пат. 57663 Україна, МПК G06F 15/16 (2011.01). Модуль високоефективної багатопроцесорної системи підвищеної готовності / Іващенко В.П., Башков Є.О., Швачич Г.Г., Ткач М.О.; власники: Національна металургійна академія України, Донецький національний технічний університет. – № u 2010 09341; заявл. 26.07.2010; опубл. 10.03.2011, Бюл. № 5.

2. Башков Є.О. Високопродуктивна багатопроцесорна система на базі персонального обчислювального кластера / Є.О. Башков, В.П. Іващенко, Г.Г. Швачич // Наукові праці Донецького національного технічного університету. Серія "Проблеми моделювання та автоматизації проектування". – Вип. 9 (179). – Донецьк: ДонНТУ, 2011. – С.312 – 324.

3. Швачич Г.Г. Многоканальный режим сетевого интерфейса кластерных выичслительных систем / Г.Г. Швачич // Восьма Всеукраїнська наукова конференція «Значення сучасної науки для динамічного розвитку України». – Тернопіль, 2011. – С. 16 – 19.