NORMALIZATION OF HETEROGENEOUS COMPUTING CLUSTERS DUE TO USE OF VIRTUAL NODES

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Creation of systems of the distributed computing is the new perspective tendency of development of computing systems. To one of actual problems began maintenance of portable of the software of clustered sites. In this article it is offered to use existing means of a virtualization of the computing environment (system VMWare or similar) for simplification of creation of the software of systems of the distributed calculations. Results of measurement of parameters of a bandwidth and a latency of system of synchronization of a cluster for virtual and real nodes are submitted. Results of the made researches allow recommending use of virtual clusters for simplification of creation of systems of the distributed calculations.

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1. INTRODUCTION

Creation of systems of the distributed calculations is the new perspective tendency of development of computing systems. As uniform definition of a computing cluster does not exist, for simplification of the further statement we shall accept some terminology which will reflect the described properties of a hardware and software platforms essential from the point of view of development of applied programs [1]. The computing cluster is the computing system, consisting of set of the separate computers (nodes) connected among themselves by uniform communication system. One of enough widespread realizations of architecture of the distributed application used for the decision of the big computing tasks is shown on Fig.1. Each node has the local operative memory. Thus the common physical operative memory for sites does not exist. The communication system is used for management and synchronization of work of nodes of a cluster. Usually it allows nodes to cooperate among themselves only by means of messaging.

If all nodes included a computing cluster have the same architecture and productivity we deal with a homogeneous computing cluster, otherwise - with heterogeneous. Now, when speak about clusters usually mean a homogeneous computing cluster. However to keep a high level of a ratio productivity/cost, it is necessary to use at escalating a cluster the computers most suitable at present which can differ not only on productivity, but also on architecture. Therefore gradually the majority of clusters become heterogeneous clusters. Nevertheless, Any cluster can be considered as the uniform hardware-software system having uniform communication system, center control and planning of loading [2]. The system will consist of the unique client and one or several computing servers working on computers, included nodes of a computing cluster. The basic function of the client is management of work of computing servers. The purpose of the server is the decision of the concrete computing task put by the client.
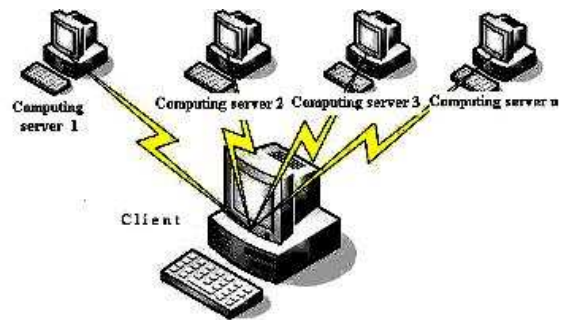

Fig.1. *An example of the distributed system for the decision of the big computing tasks*

The quantity of servers and their site are determined by requirements of the client. During the decision the server can use the information received both from independently prepared files of the data and in dialogue with the client. The applied program in this case represents set of processes, each of which has own local address space. Interaction of processes (data exchange and synchronization) in many cases is carried out by means of messaging on the basis of standard MPI (Message Passing Interface) which generalizes and standardizes a format and procedures of messaging. Now, when there is an opportunity to use the computing server on different, sometimes ge-

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ographically removed computer systems, importance of portable of the software of the computing server its ability to be carried out on various computing systems with comprehensible efficiency) is very great [3]. Therefore portable of the software of clusters and their ability to a reuse can be considered as one of paramount parameters of quality of such systems and programs. The purpose of the given work is research of opportunities of existing software of a virtualization of the computing environment for simplification of portable of the software of clusters.

2. THE PROBLEMS CONNECTED TO HETEROGENEITY OF A CLUSTER

One of serious problems of portable, who arises at use of heterogeneous computing clusters, is necessity of preparation of different executable files for different nodes. It is connected to distinctions, both architecture, and configurations of the operational systems used on computers of the computer network. For example, enough frequently program realization of the server node of a cluster can use complex enough structures of the data and specific means of an operational environment. In case of distinctions in data presentation transformation of the information can be demanded at messaging between nodes (let alone difficulties of use of binary files). Problems can arise not only because of probable differences of architecture of an operational environment. Distinctions in a configuration of parameters of operational system can lead to unstable or (that is even worse) disoperation of program nodes of a cluster.
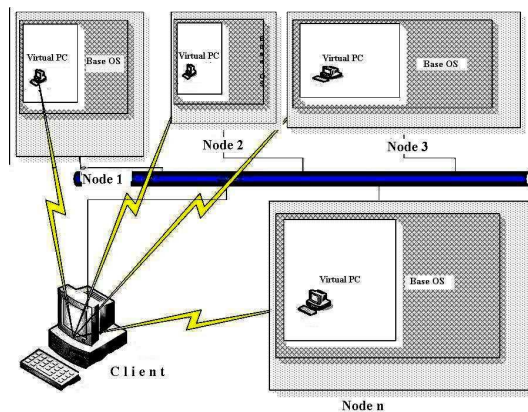

Fig.2. *The Example of virtual pseudo-homogeneous system of the distributed computing*

These circumstances can strongly complicate creation of heterogeneous clusters. Individual debugging adjustment and check of the software practically for each node can be demanded, operational and which hardware environment is not identical to what was used by development of the server node. Application of virtual computing environments can facilitate distribution and start of server program elements of a cluster for heterogeneous clusters.

Use of the virtual computing environment allows encapsulate all connections of the program node of a cluster with operational system (and with elements of the equipment of a computer) inside the virtual system connected to the real computing environment only by network protocols. Due to use of software replication the virtual computing environment it enables creations of the typical software of the virtual server node of the cluster including, except for the applied program of the server node, also all necessary elements and means of operational system, and as the unified subset of opportunities of elements of the equipment of a computer. It allows creating a pseudo-homogeneous virtual cluster (Fig.2) inside the heterogeneous computer network. Server nodes of such cluster will have an identical operational environment and a hardware configuration, and to differ only on productivity, that sharply simplifies both expansion, and escalating of such computing clusters.

3. RESEARCH OF EFFICIENCY OF VIRTUAL CLUSTERED NODES

Among software of a virtualization of the computing environment existing now the group of software products VMware is one of the most popular. VMware provides support of a virtualization of the computing system as a virtual computer (the virtual machine). On a computer working under the control of basic (base) OS, it is possible to create one or several virtual computers, on each of which it is possible to start own "guest" OS and to create the virtual node of a cluster poorly enough dependent on architecture and parameters of base OS. One of the major parameters of an overall performance of a cluster is the bandwidth and a latency of communication system. The probable increased overhead charge of the virtual machine for the organization of an exchange on a local area network could is invalid to lower efficiency of virtual clusters. For a rating of characteristics of communication systems researches of parameters of a bandwidth and a latency of virtual and real clustered nodes have been carried out.
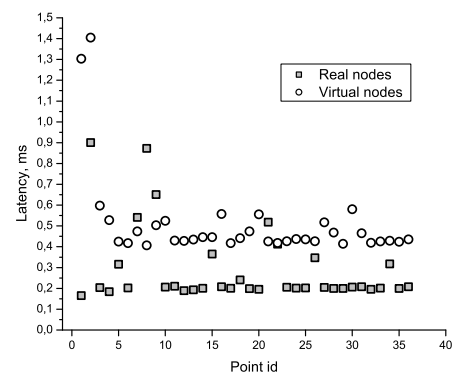

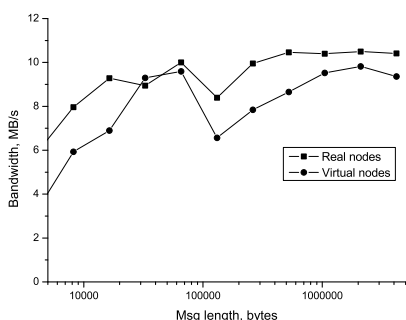***Fig.3.*** *Parameters of latency for virtual and real nodes of a cluster*

Fig.4. *Parameters of a bandwidth of system of synchronization for virtual and real nodes of a cluster*

On Fig.3 and Fig.4 the measured values of latency and a bandwidth for real and virtual computing nodes of a cluster are submitted. Results are submitted for typical test tasks. At comparison of corresponding parameters for real and virtual computing nodes deterioration of key parameters influencing productivity of a cluster is visible, that, is insignificant enough. It allows using virtual nodes of clusters alongside with real at creation of the distributed computing systems without essential decline of productivity of system as a whole.

4. THE CONCLUSION

As a result of the executed work the technique of reduction in expenses for creation and expansion of the distributed computing systems is offered by creation inside local area networks of virtual pseudo-homogeneous clusters. For creation of nodes of virtual clusters use of software of a virtualization of the computing environment of system VMWare or similar is offered. The carried out measurements of parameters of a latency and bandwidth do not show essential deterioration of parameters of virtual nodes in comparison with real, that allows recommending use of virtual clusters for creation of systems of the distributed computing.

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НОРМАЛИЗАЦИЯ НЕОДНОРОДНЫХ ВЫЧИСЛИТЕЛЬНЫХ КЛАСТЕРОВ ЗА СЧЕТ ИСПОЛЬЗОВАНИЯ ВИРТУАЛЬНЫХ УЗЛОВ

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Создание систем распределённых вычислений является новой перспективной тенденцией развития вычислительных систем. В связи с этим одной из актуальных задач стало обеспечение переноса программного обеспечения кластерных узлов. Предложено использовать существующие средства виртуализации вычислительной среды (системы VMWare или аналогичные) для упрощения создания с их помощью программного обеспечения систем распределенных вычислений. Представлены результаты измерения параметров полосы пропускания и латентности системы синхронизации кластера для виртуальных и реальных узлов. Результаты произведенных исследований позволяют рекомендовать использование виртуальных кластеров для упрощения создания систем распределённых вычислений.

НОРМАЛІЗАЦІЯ НЕОДНОРІДНИХ ОБЧИСЛЮВАЛЬНИХ КЛАСТЕРІВ ЗА РАХУНОК ВИКОРИСТАННЯ ВІРТУАЛЬНИХ ВУЗЛІВ

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Створення систем розподілених обчислень є новою перспективною тенденцією розвитку обчислювальних систем. У зв'язку з цим одним з актуальних завдань стало забезпечення переносу програмного забезпечення кластерних вузлів. Запропоновано використати існуючі засоби віртуализації обчислювального середовища (системи VMWare або аналогічні) для спрощення створення з їхньою допомогою програмного забезпечення систем розподілених обчислень. Представлено результати виміру параметрів смуги пропускання і латентності системи синхронізації кластера для віртуальних і реальних вузлів. Результати виконаних досліджень дозволяють рекомендувати використання віртуальних кластерів для спрощення створення систем розподілених обчислень.