Tools and Technique of Monitoring Resource Distribution for Design Simulation of Organization of Information Processing

Oleg Demidenko

Abstract:

Usage of the distributed information databases (DIDB) is the most spread way of allocation of service of clients and support of cooperation between large corporations or banks. At usage DIDB in real-time mode (the actual data are accessible to all valid users at the moment of inquiry to reading or upgrade) most essential is the factor of capacity of networks. Change of the physical characteristics of modern networks is very expensive procedure. Moreover, if a gorge by transmission becomes data links, their replacement also requires essential time, that can reduce in the additional losses. In such conditions the mechanism of backup is applied to support of continuity of the computing process (CP). Except for data links a gorge in operation with DIDB can be intermediate sites, gateway servers, routers and other equipment. Frequently these functions can fulfil the same computational capabilities, which are used for processing DIDB. In this case (if the backup is not stipulated by network architecture) it is necessary to reallocate a working load (WL) between other network nodes on time of exception of a site for realization of adaptive operations or its replacement.

Keywords: *monitoring, local area network, information.*

1. Introduction

To reallocate WL and to not deform the characteristic of operation with DIDB the inspection of the computing process (CP) in a site of the local area network (LAN) is necessary, which is eliminated from the network, and also those sites and workstations that will fulfil its functions. The research CP in computing environment (CE) is possible as from the point of view of the developers of personal computers (PC) and software, and designers of the local area network.

If the first are interested by influence those either others structural or functional changes in CE on its general efficiency and productivity, the second consider CE in a context of its interaction with other components of the network. Thus for the designers of networks the execution times of the tasks on workstations and servers (are important depending on implementation of structures of databases (DB)), and also sizes of streams of the connecting information between them. It is offered to create models CE for the first and second user groups on identical principles. In this case network in relation to the PC is represented as one of its devices, that is stipulated by features of collection of statistics in modern CE, having as operating system Windows XXXX (the functions of call to the network register only, that entitles to gather statistics about behaviour of the network as well as about other units CE).

2. A technique of usage of resources of monitoring at designing and maintenance of the local area network

For all resource types we shall define the following basic performances: kij - probability of transition of the process k from a resource i on a resource j (ij, i,j = CPUNet); hi (i = CPUNet) - load of a resource, tki - average operating time of the process k on a resource i. Any of these components has the following algorithm of behaviour. The processor (CPU). Any process captures a resource CPU, the part of a resource of the RAM and accesses to the peripheral memory. The resource CPU always allocated completely to any process, that is CPU is always identified in a couple with any process.

Purely resource allocation CPU is organized by operating system (program - manager). Obviously, the resource CPU disperses on all processes and for its selection on the defined time the system of pilot signals formed on the requests of the users is used. The peripheral memory (HDD) is simulated as a place of allocation of the database. Therefore the call to the peripheral memory is imitated as operation with the information block of the defined size Qhdd, with which the readings and records are made. The RAM (Mem) is considered as a resource with maximum parameters, which is completely selected (allocated) for the accessing unit phase task (PT). For it we allocate only moments, when the system initiated a beginning or termination with memory (selection and release of memory).

These processes in CE, as a rule, are short-term. Therefore for memory it is not meaningful to define option values tki. Therefore it is difficult to make output about character and features of its usage. This circumstance allocates memory from the remaining resource types. The video resource (Video) belongs to group of standard resources. Its difference consists only in a way of monitoring, when some various functions of call to Video but no one are fixed. Resource of the network (Net) is simulated, as well as remaining standard resources (for example HDD).

The functions of call to a resource (in this case to network protocols) register only, that entitles to consider a network resource as internal in relation to CE and possessing all by the same basic performances, as remaining resources. The interaction of components CE can be presented as implementation of processes on resources or competition of processes for resources. All main resources for implementation CP are allocated PT at interaction

of components CE. Let's select two main parameters of inter-process communication. The first parameter represents average execution time of the process k on a resource i tki. The concrete values of these times are set by a matrix of allocations M(tki). The second parameter is the matrix of probabilities of capture by the process of various resources Mk(Pij).

With the help of these two parameters there is a possibility for the half-markovsky of representation of processes accordingly definition CP as the weighed graph, in which the tops are resources, and weights of arcs will be probabilities of transitions of the process from one resource to another. The specificity of watching by the system of monitoring of the moments of control transfer at implementation CP is those, that there is only possibility to register, for example, beginning and extremity of the disk operation, pre-emptive some times by processes of sort System. These processes fulfil the call to resources of other user's processes (purely implementation of multitasking), but we cannot authentically tell which of them. The following two characteristics therefore are entered. "Complete time" tki, meaning time between the beginning and extremity of the obvious operation above a resource and "exact times" tki, defining complete time minus an operating time System from complete (tki = tki-tsys).

Correlating these times for model and real system it is possible to speak about adequacy to model (i.e. thus criterion of adequacy of measurements) is determined. The monitoring of interaction of program components in operating system WINDOWS 95 is carried out by fixing the moments of control transfers and result of the subordinate processes. It is known that any process generated by the user, has the rights of use by all system resources, but has no any information on other user's processes fulfilled by the system simultaneously with it. This mechanism is intended for protection of processes against failures of operation of the parallel tasks. CP in multitask operating system consists of periodic transmissions of the rights of use by system resources from one process to the other. Depending on executable functions each of processes uses system resources on its own algorithm. Depending on the requirement to serving resources the processes can be divided into the following types: The auxiliary tasks (are used only RAM and processor). An interactive process of exchange with the user (usage of a subsystem of video output) is added. The background tasks, which do not require(demand) output to the screen (demand processing by the file - server, operation from the remote DB).

Processes operating a complete spectrum of equipment. Each process captures a resource of the CPU, the part of a resource of the RAM and accesses to the peripheral memory. The resource of the CPU is always allocated completely to any program module that is the CPU is always identified in a couple with any process. Purely resource allocation of the CPU is organized by the program - manager. It is obvious that the resource of the CPU as though disperses on all processes and for its selection on the defined time the system of pilot signals formed on the users requests. The system of monitoring watches the moments of switching between processes realized by the manager, of the tasks.

For this purpose used VMM tools under a title Call When Thread Switched. The pointer to the function of callback Thread Switeh CallBack (OldThread, NewThread) is transmitted to this tool. The manager of the tasks calls this function at switching threads, which fulfils the following operations: fixes a switching time; brings in a log record about completion of processor quantum for old thread; calculates the identifier of the current process; brings in a log record about the beginning of quantum of the processor for new thread. During initialization the monitor "inserts" "hooks" on main information data highways of an operating system. The data gathered by these sensors, characterize specialized operations of control transfer between processes.

The obtained information is only statistical and is authentic only at the reliable system of identification of processes - sources of service requests. According to one of main principles of construction of modern operating systems, the vertical levels of operating system should be isolated from each other. It means that they should know nothing about a structure of inner patterns each other. The interaction between them should be carried out through the documentary interfaces. Besides, for support of compatibility and expandability, the lower layers should not know about existence of top levels at all. Therefore at development of algorithms of monitoring there was a problem coupled to identification of the process, fulfilled any of watched operations, which was necessary for deciding at writing the driver of the system of monitoring. The driver can determine identifiers of "thread" and process, but cannot determine a name of the process. It was possible to write the program operating library ToolHelp, which enumerates all "threads" and processes in the system. But thus the identifiers, obtained by it would not coincide with values obtained by the driver. It is stipulated by that the identifiers of a level of a kernel differ from identifiers of the user's mode Win32.

Therefore it was necessary to find correspondence between these identifiers. For solution of this problem the following way was offered. The driver submitives user's processes "service" returning current system identifiers of "thread" and the process. But to find correspondence of identifiers for all processes, it was necessary to fulfil the given procedure in a context of each process. To hit in a context of each process it is possible with the help of usage of global system "traps". "Traps" are stored in dynamic loaded libraries and after registration in the system are connected to each executable process. In this case "trap" function can not fulfil any operations that are it simply returns handle.

Let's remark that all necessary operations should be fulfilled at the moment of initialization and termination of the library. So, during initialization of "trap" the following operations are fulfilled: loading of the driver of the system of monitoring; function call of obtaining of system identifiers of a thread and process; definition of a name of the process; finding and obtaining of a descriptor of the window of the program of collection of statistics; a dispatch to this message box about creation of the process containing item of information on the process. Besides during termination of the library the addi-

tional operations are fulfilled: finding and obtaining of a descriptor of the window of the program of collection of statistics; a dispatch to this message box about termination of the process.

The driver of the system of monitoring writes the items of information on all watched events in the local buffer. The given buffer is in unloaded memory. Therefore its size is limited to 4 thousand records. The necessity of layout of the buffer in unloaded memory is coupled to the requirements about minimum effect of the system of monitoring on CP. As the speed of filling of the buffer varies over a wide range, given from buffers should be periodically read out and be saved in the appropriate file. The write operation of the buffer on the disk could be carried out and from limits of the driver, but the given way is ineffective, that is stipulated by that fact, that in the file of an event log the unique identifiers of the process should be brought. But the same identifiers obtained by the driver, can be repeated.

Therefore, each time is necessary to fulfil the special procedure of identification of processes, which algorithm is circumscribed above. But it is impossible to fulfil this procedure at a level of the driver. Therefore the task of collection of statistics was necessary for realizing as the separate program. Thus this program fulfils the following operations: the start of the driver of the system of monitoring; the periodic reading given from buffers of the driver; identification of processes in the system; the record of a sequence of events in a log. The program of collection of statistics cooperates with the driver of the system of monitoring and program of identification of processes.

The operation of the main unit is made permanently in a background. The program of collection of statistics is the main "launched" unit of the system of monitoring. The given program is installed in the menu of autoload Windows. By default it does not output on the screen of any additional items of information, except for the list of triggered processes and quantity of events per one second. It is also possible to install an output mode of the list of events on the screen. But such mode renders essential influence on a response time of the system, because the majority of events, registered by the monitor, will be coupled to mapping of a log on the screen. Besides there is a possibility of suspension of system operation of monitoring.

On a program termination of collection of statistics happens: out swapping of the driver from memory, file closing of a loge and termination of watching of system events. The program of collection of statistics at start registers appearance in the "trap" system, responding for identification of processes in the system. Then at start of the new process it receives all items of information on it, including its system identifiers. On the basis of these items of information the table of correspondence of identifiers is created. After each reading given from the driver there is a conversion of identifiers to the help of the table of correspondence. As to write the data in a log to the disk after each reading requires many resources, these data in the be-ginning are stored in the buffer of the program of collection of statistics, which approximately in 10 times more buffer of the driver.

Furthermore, the data record in a log happens only after filling this buffer. The system of monitoring brings the items of information on operation of user's processes in a special magazine, the information from which in further is used at problem solving of simulation. All items of information are stored in a log in the binary format and can be independently interpreted by the user. For obtaining common view about character of operation of the computing process there is a possibility of a display image of a path of system operation.

The program of graphics representation of results of monitoring therefore was developed. The express train - analysis of results of monitoring can be carried out under the state transition diagram and on a summary matrix of probabilities of transitions between service devices. This statistics allows building the Kiviata diagrams, describing load of each system resource by separate components WL.

3. Results of approbation of a technique and resources of monitoring of the local area network

The system of monitoring has passed experimental approbation in computer centre of faculty "the Automated systems of information processing" of the Gomel State University named after F. Scorina. At trials 18 computers of the various configurations were involved. By results of experiments the system of monitoring has produced good metrics by criterion of a similarity of the characteristics of the real system and characteristics of systems simulated by results of the analysis of statistics (of deviation about 10 Operating characteristics: - a size of consumed memory - 213 Kilobytes. Is used for storage calculated statistics; - a required disk space - 10 MB per hour (at maximum loading of thesystem); - of CPU on monitoring - 2 of statistics - 0.3 session).

The analysis of statistics is made by the contributor with the help of the separate program. The technique allows constructing a picture CP, established by the concrete user CE, depending from sort WL and characteristics CE. At design simulation there is a possibility of manipulation both characteristics CE, and structure WL, that is reached by means of the detailed analysis of a log of statistics. In result the contributor receives toolkit for planning adaptive operations of the local area network.

AUTHOR

Oleg Demidenko - Gomel State University, Gomel, 246019, Belarus. E-mail: demidenko@gsu.by.

References

[1] Maximey I.V., Levchuk V.D., Eskova O.I., *et al.*, *Technology of setting of imitative experiments on PC at research of computer networks*. The theses of the reports of international conference devoted memory of the academician Chunihina S.A., Gomel, 1995.