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Formation of Communication Innovations in the Development of the Territorial Telecommunications Complex

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Abstract*: The purpose of the thesis is to study existing solutions in the field of content delivery networks. On the basis of the study to propose a model of a distributed content delivery network. Using the model to develop traffic management algorithms within the CDN network to minimize the load on the channel. A model of content delivery network has been developed. Algorithm an algorithm has been developed to evenly distribute the load within the content delivery network and reduce the percentage of rejected requests at the time of peak loads. The algorithm is implemented within a model content delivery network crime reports and evidence. The algorithm is tested on model data, the results confirm a decrease in the percentage of rejected packets and the uniformity of the distribution of requests across the servers. The simulation results show that the heuristic algorithm is almost as good as the optimal solution on simple topologies. On complex topologies, direct comparison is not possible, but it can be seen that the results are close to the optimal solution.

***Keywords*: IT, balance crime report, evidence, TCP, IP, load network.**

I. INTRODUCTION

There are several algorithms that can be used to select a server when routing a request. The easiest to implement are random selection and alternate choice. In addition to these two algorithms, there are algorithms that select the most suitable server based on some parameters, such as the available bandwidth (BW), the availability of media (HD) and the number of current connections to the server or connection availability (CON) [6].

When the system sends a user request to one of the servers using one of the five algorithms listed, the bandwidth from the client to the server, the media load and the number of connections to the server are three important factors that determine whether the server can serve the client request. If at least one of these parameters overloads the server, the request will be rejected, which means that the CDN will not be able to process the client request. In content delivery network architecture, minimizing the percentage of rejected requests is the most important factor when comparing the performance of different algorithms [3].

Decision making algorithm using fuzzy logic

For this algorithm, BW, HD, and CON are input parameters. Relying on these three parameters, the algorithm uses a fuzzy logic mechanism to make a decision about choosing a server.

For this algorithm, BW, HD, and CON are input parameters. Relying on these three parameters, the algorithm uses a fuzzy logic mechanism to make a decision about choosing a server [2].

In the first step, the input parameters are converted to the corresponding fuzzy logic values according to the membership functions. Membership functions are defined for each input parameter. For the channel availability (BW) parameter, this function will look like this. HBW is a high bandwidth accessory value, MBW is a medium value and LBW is a low value respectively.

II. LITERATURE REVIEW

Load Balancing (Load Balancing) is used to optimize the execution of parallel calculations using a parallel computer system, it assumes a uniform load of processors of a multiprocessor computer. When new tasks appear, the balancing software must decide on which processor (compute node) to perform the calculations associated with this new task. Load balancing also involves moving part of the computation from the most loaded processors to the less loaded ones [1].

One of the steps in the process of creating a parallel program is decomposition. It is designed to split the application into tasks that will be executed on separate processors [4]. As a result of this decomposition, a set of tasks is created, which are simultaneously engaged in the task. These tasks can be either independent or linked through data exchange. Distribution of tasks occurs in a separate stage, allowing to distribute the modules received at the decomposition stage between processors [7].

A distributed application is a collection of logical processes that interact with each other by exchanging messages with each other. Logical processes are distributed to different computing nodes and operate in parallel. Logical processes are distributed to
compute nodes in such a way that the load of compute nodes is uniform [8].

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However, when running a parallel application, there may be a conflict between the balanced distribution of objects across processors and the slow rate of data exchange between these processors [1].

When informing citizens' appeals to public authorities, it should be borne in mind that certain such appeals have their own specificity in terms of their form and content, in particular, a statement and notification to law enforcement agencies about a crime, a bona fide citizen's request to a law enforcement agency to identify certain objects or documents, which, in his opinion, can be used as evidence in a criminal case, which he learned, for example, from the media, etc.

In many countries, in particular in Ukraine and others, national law does not specify the form and procedure for reporting crime to citizens by law enforcement agencies. In some countries, for example, in Russia, etc., such a procedure and form of appeals are defined by law. Many countries have criminal charges for false reporting of a crime. Regarding a citizen's message to a law enforcement agency about the identification of certain objects or documents that he / she believes can be used as evidence in a criminal case, in almost every country criminal procedural law provides that such a citizen will be questioned by the police or prosecutor, and by a police or prosecutor further and in court as to the circumstances of his discovery of these objects and documents.

Some processors may be idle, while others will be overloaded if communication between processors is conducted at a low speed [3]. On the other hand, communication costs can be high for a balanced system. That is why the balancing method should be chosen in such a way that the computing nodes are loaded evenly, and the speed of data exchange between processors is optimal.

The implementation of such a parallel computing system requires the development of algorithms for synchronizing objects that operate on different nodes of the computing system. Conversely, the effectiveness of synchronization algorithms depends on the load balance across the nodes of the computer system.

Load imbalance can occur for several reasons:

the heterogeneity of the structure of the parallel application, i.e. the various logical processes require different computational power;

heterogeneity of the structure of the computing complex, i.e. different computing nodes have different performance;

heterogeneity of interaction structure between nodes of computer network, i.e. communication lines between nodes can have different characteristics of throughput [4].

III. MATERIALS AND METHODS

The membership values HHD, MHD, LHD for the media and HCON, MCON, LCON for the number of connections are determined similarly.

In the second stage, the rules are calculated. There are 9 accessory values (HBW, MBW, LBW, HHD, MHD, LHD, HCON, MCON, LCON). There are 27 possible combinations of these values. For each of these combinations we define a fuzzy solution of four possible

Highly recommended service-Yes (Yes, Y)

Recommended service-Probably Yes (Probably yes, PY)

Not recommended service-Probably not (Probably no, PN)

Strongly recommended service - No (No, N)

Each value of the fuzzy solution FD is the minimum of the three membership values. [1].

Thus 27 values belonging to four groups are obtained. A minimum is taken from each group. The result is four values FD (Y), FD(PY), FD(PN) and FD(N).

In the third stage of the algorithm, a set of weighted values is assigned to the four solution values. Each value represents a different set of weights. The final "clear" value (eng. Crisp Value-CV) is calculated based on weighted values and fuzzy decision values.

Each server calculates its own CV. The request distribution system can use the CV to determine the most appropriate server to process the request. The server with the highest CV is preferred for optimal CDN performance.

The model content delivery network was created on the basis of virtual machines located on two physical host machines. This allowed you to simulate different network topologies, as well as vary the performance of virtual machines and bandwidth. The number of virtual machines ranged from 5 to 15 in various tests. Content delivery was carried out with the help of nginx web server. The distribution of content copies and request routing were managed by changing nginx configuration files by the system control module.

Thus, the software component of the model network consists of two main components-the administrative management interface implemented using the Django framework and the node management module based on the Twisted framework. This architecture allows you to simulate all the necessary operations for checking algorithms (changing routes within the network, creating additional copies of content on the nodes) through nginx cache management.

IV. RESULT AND DISCUSSION

The speed of loading a web page and its contents is strongly affected by the distance of the user from the server. This is due to the fact that when using TCP/IP technology, which is used to distribute information on the Internet, the delay in the transmission of information depends on the number of routers on the path between the source and the consumer of the content. Placing content between multiple servers via CDN shortens the network data route and makes the site load faster from the user's point of view.

The use of CDN reduces the number of transitions between network nodes, which significantly increases the speed of downloading content from the Internet. End users experience less latency when downloading content, no sudden changes in download speed, and high quality data flow. Bandwidth

allows CDN operators to deliver high-resolution video content (1080p, 4K), provide fast download of large files or organize video broadcasting with high quality of service (QoS) and low network costs.

CDN technology is able to prevent data transmission delays, possible communication interruptions and losses on congested channels and interfaces between them. Load management for network traffic allows you to offload large interconnects and network nodes, distributing the resulting load between remote servers.

Placing servers in close proximity to end users can increase the outbound throughput of the entire system. For example, the presence of a single port of 100 Mbit / s does not mean this speed at all in the network, since the free bandwidth of the link at the time of transmission can be as little as 10 Mbit / s. in the case where 10 distributed servers are used, the total bandwidth can be 10×100 Mbit/s.

Table 1. Proposed solutions

Proposed solution	Expected result
Using CDN	Reduces the number of transitions between network nodes, which significantly increases the speed of downloading content from the Internet
Placing servers in close proximity to end users	Can increase the outgoing bandwidth of the entire system
Dynamic load balancing	The distribution of traffic flow between all users, without losing the connection, helps to prevent overloading of equipment during the downtime of another
Algorithm " Weighted Least Connections "	Allows load balancing between servers
Distribution of connections via UDP port	Allows you to quickly restore connections through other servers in the network in case of a server failure

Modern content delivery and distribution networks are capable of performing automatic data integrity monitoring on each of the network servers. This ensures 100% availability of content for the end user in case of loss of connectivity between network nodes, failure of the Central or remote server.

The most advanced CDNs provide statistical control of content delivery and distribution processes. The content provider can get all the necessary information about the download, availability and popularity of its content in each region of presence in real time.

In the rapidly developing banking world, the time / quality ratio determines a lot. It is reflected in the requirements for it technologies. After all, in addition to the adequate price, ease of implementation and maintenance, the arguments in favor of a particular ABS are those features that allow the Bank not so much to support the existing business as to gain a foothold in new positions. This applies to the specifics of the work of a variety of applications — both back office and front office. Take at least such promising areas today as retail and lending. Competition in this sector is great, and any trifle missed in the organization of service can turn into unpleasant consequences for a financial institution. Again, the terminal does not work, once again the transaction is not carried out, the payment does not pass for a long time — these and other annoying misunderstandings undermine the client's trust and force him to turn his eyes towards other banks. Can such situations be avoided?

In favoring a particular financial institution, consumers are guided by a certain list of priorities. It takes into account the availability of the necessary banking products and services, as well as the peculiarities of their provision, including the "24 hours 7 days a week" mode. Banks build their own business concept based on these criteria and, in turn, are looking for SOFTWARE developers who can implement it at a high level [5].

It is no secret that the work of any modern Bank is based on the use of a local network. But not all ways of its organization provide uninterrupted operation of application servers [5]. Let's dwell on one of the main — dynamic load balancing. In the field of banking automation, this is not a new concept is of fundamental importance: it depends on such parameters as scalability, performance and fault tolerance of software systems.

Let's imagine a typical situation: a large number of users are trying to access one of the application servers being operated. What happens next? While the other servers associated with it are idle, this one begins to "choke" from the influx of requests, and as a result, its performance decreases.

Yes, the speed of user service depends, of course, on many factors (computer failure, preventive measures, etc.), but the danger is even a slight suspension of the process. After all, for the Bank it always means loss of money, and in some cases, customer loyalty.

A special technology — the so-called dynamic load balancing-helps to prevent overload of one equipment when another is idle. It is designed to automatically distribute the flow of requests from clients between the combined application servers. Although the algorithms that implement the mechanism may be different, the ultimate goal of dynamic balancing is to improve the efficiency of applied it solutions.

The load on the interconnected servers is distributed taking into account the roles assigned to them. There are four such roles:

– standalone server. This is the default configuration of any application server. Does not participate in the dynamic balancing process, meaning users use it the same way as before;

– production server. Perform two functions:

1) serves users;

2) communicates with the master server, passing it the necessary information;

– master server. This is a working server that not only serves users, but also provides them with the addresses of other working servers, that is, coordinates the balancing process;

– a dedicated master server is a production server that "specializes" only in coordinating the balancing process.

The proposed dynamic balancing mechanism is implemented using the algorithm "minimum connections with weighting coefficients" (Weighted Least Connections). In other words, the master server provides the client with a working server that has fewer active connections and more capacity than others. Power is indicated by the weight factor set by the administrator in the weight settings of the application server. In principle, the load distribution between the servers can be made even if desired.

The interaction of terminals with the master server and production servers is based only on the TCP\IP Protocol. Therefore, it must be configured and activated on each of these servers. When connecting a terminal to any production server, the same term parameters are used.ini, not related to the communication method (terminal number, authentication method, etc.).

The application servers that you want to distribute the load between must be on the same local network. Computers are grouped based on the same UDP port number that is specified in the configuration (UDPPORT configuration parameter). In principle, in a local network, nothing prevents you from organizing several groups at once. This is useful, for example, when each of them has its own set of tasks (one-interactive work, the other-the release of reports, etc.) or when they use different resources (say, different versions of RS-Bank).

Before you run dynamic balancing, you must define a role for each server to participate in the process. There can be only one master server in one group, whether it is dedicated or not.

To clients, the group is represented as a single server that processes requests from them. If necessary, network administrators can add servers to it or, conversely, exclude them. And it will be made without termination of service of users.

Even if any working server fails unexpectedly, the clients will not be fatally affected. All they have to do is restart the terminal and automatically connect to another server within seconds.

As for the settings, only one of them is mandatory — specifying the role of servers, the rest have default values.

V. CONCLUSION

You can use the ADM console utility and HTTP access tools from a web browser to administer dynamic balancing SOFTWARE. The Distribution command has been added to the ADM utility. If the server with which the utility "works" performs the functions of the wizard, then selecting this command displays information about all the working servers involved in the load distribution, and the number of clients attached to them. For example:

Use the web browser allows a special configuration of the server to work on HTTP. To configure it, you need to set the HTTPPORT parameter, and to display information about working servers in the web browser, go to the URL: http://<serverName>:<port>/distribution, where server Name is the host name on which the master server is running, port is the port number specified in the HTTPPORT configuration parameter.

The dynamic balancing mechanism is indispensable for a Bank whose it infrastructure is supported by two or more application servers. It provides a number of advantages that significantly enhance the competitiveness of the financial institution. From a technical point of view, this is the most efficient use of it resources. By optimally distributing users between servers, the balancing mechanism ensures their smooth operation and, therefore, fault tolerance. Helping to process a huge amount of data per unit of time increases the performance of systems. Providing ample opportunities to connect additional servers to the network, improves the scalability of the entire it infrastructure. And the algorithms underlying the mechanism facilitate the task of managing the flow of information.

From the point of view of the user, rational distribution of server resources makes his work more comfortable. This is expressed in the operational and qualitative performance of any operation. In particular, without prejudice to customer service significantly reduced the time of preparation of different types of reporting. If we talk about the benefits of the Bank as a whole, there are savings. Hardware, for example, is insured against unwanted downtime and, therefore, pays off faster.

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