

# COMPUTER SYSTEMS AND NETWORKS

## Client-Server Interaction on the WWW

Iryna Pasternak<sup>1</sup>, Yuriy Morozov<sup>2</sup>

<sup>1</sup>ECM Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: pas\_irusj@ukr.net

<sup>2</sup>ECM Department, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: m\_urij@ukr.net

**Abstract** – Shows the client interaction with the server in WAN. As well the realization of this interaction using the WWW. The model object client interaction with the server for more efficient operation of global network. We consider the software implementation of the web server and client.

Key words – client, server, object, service, network interface, WWW.

### I. Introduction

Client-server architecture is one of the architectural patterns and software is the dominant concept in the creation of distributed network applications and provides interaction and communication between them [ 4-6]. It includes the following main components:

- a set of servers that provide information or other services programs that appeal to them;
- a set of customers using services provided by servers;
- network that provides communication between clients and servers.

Servers are independent of each other. Customers also operate in parallel and independently of each other. There is no strict binding clients to servers . More than typical situation is when one server simultaneously handles requests from different clients, on the other hand , the client can access it to a single server, then another . Clients need to know about available servers , but may not have any idea about the existence of other customers.

In our case, the technology for building client software based on the use of different types of protocols. One of them is the TCP / IP that uses sockets [1-3]. But programming using sockets regarded as too low-level programmers . It is the need of programming at a low level prevents persistent productive writing distributed applications. Another type of protocol is a protocol RPC (Remote Procedure Call). But the protocol is a remote procedure call RPC is quite complex, and in addition there are a large number of its varieties. And also very popular high-level protocols such as CORBA (Common Object Request Broker Architecture - Architecture intermediary object queries ), RMI (Remote Method Invocation - a technology remote method invocation ) and Distributed Component Object Model DCOM

(Distributed Component Object Model). These protocols still difficult for the organization of their work requires special protection as server-side and client-side . All they have also other disadvantages. For example, in

the use of these protocols may have problems in passing data packets through the firewall

(System Network Security). However, one report has received widespread. This is a hypertext transfer protocol file HTTP (Hypertext Transfer Protocol)[7-8]. Because of the ubiquity of the protocol HTTP, companies Microsoft and other manufacturers of network software had to develop a new protocol , called SOAP ( Simple Object Access Protocol - simple object access protocol ). The encryption method request objects related data in SOAP protocol used text language XML ( Extensible Markup Language). The big advantage of SOAP protocol is its simplicity. Due to its simplicity, this protocol can easily be implemented on many devices. Protocol SOAP (Simple Object Access Protocol) can run on top of any standard protocol. But the possibility of working at the top level of standard Internet protocols like hypertext transfer protocol file HTTP (Hypertext Transfer Protocol) and the protocol SMTP ( Simple mail Transfer Protocol - simple mail transfer protocol), allows data packets to pass through the system without network protection any problems associated with the possibility of a connection.

Trends in client- server systems lead to the transfer function to a specialized client software, which is also located on the server and downloaded to the workstation user when it is connected to the information system. This user workstation provides a framework for implementation of client software.

Thus, the development of mechanisms for loading and executing client software and its interaction with the server is actual scientific and applied problems .

### II. Client-server interaction

To find out if an effective principle of modular in client-server interaction, we consider some aspects of client-server interaction in a global network. With a modular client-server interaction is an exchange of data packets over a communications channel in a global network. Of the network can be observed in Figure. 1.

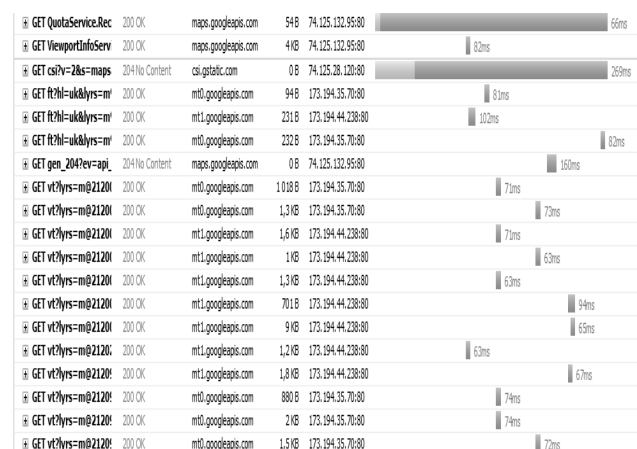


Fig. 1. Working with global network of modular client-server interaction

TABLE 3

CONTENT CACHE

Data Size	54
Device	disk
Expires	Thu Jan 01 1970 02:00:00 GMT+0200
Fetch Count	2
Last Fetched	Mon Apr 08 2013 19:06:28 GMT+0300
Last Modified	Mon Apr 08 2013 19:06:28 GMT+0300

As we can see in Figure 1, mt0.googleapis.com requests from clients and other server response and connecting different modules, one of which is GET vt? Lyrs = m @ 21209.

Sometimes the server uses at same module only changing its parameters according to the customer request, this is an advantage of modular. Also in Figure 1 shows the transmission rate of data packets from the client to the server and their size.

Seeing how the global network, now see what it looks like client request that the server sends it, and the contents of data packets that the client sends to the server (Table 1, 2).

TABLE 1

REQUEST FROM CLIENT TO SERVER

1shttp://194.44.247.7:808...	
3sAlzaSyCMZsCHIVKue55SRgr.	
.	
4e1	
5e0	
6u1	
7s9u1p15	
callback	_xdc_.bkr06s
token	86408

In Table 1, we see the IP-address of the server, and encrypted data as a function callback, which the customer requests the server to create a connection.

TABLE 2

CONTENT OF PACKAGE

Access-Control-Allow-Orig..	*
Cache-Control	private
Content-Encoding	gzip
Content-Length	54
Content-Type	text/javascript; charset=UTF-8
Date	Mon, 08 Apr 2013 16:06:28 GMT
Server	mafe
X-Frame-Options	SAMEORIGIN
X-XSS-Protection	1; mode=block

In Table 2, we see that the same information maybe contained in the packet with data. The content of this package depends on that same client request to the server. In the data packets sent by the client for server contains the following standard fields:

- Access-Control-Allow-Orig ...- feature is the control of access to the server;
- Cache-Control- control access to the data in the cache;
- Content-Encoding - function for unzipping the package with the data;
- Content-Length - length of the data packet;
- Content-Type - the type of data in the packet;
- Date - the date of your request;
- Server - server name;
- X-Frame-Options - Advanced options;
- X-XSS-Protection - protection function.

After receiving a packet with data from relevant field, the server treated with this package and answer form (Pasternak, 2012, 102-106). A server would look like a this: \_xdc\_.bkr06s && \_xdc\_.bkr06s ([0, null, 1]), and stores all sent data in the cache, and that is where we can see the remains in Table 3.

In Table 3 we see that the data remains in the cache server, as follows:

- Data Size - the size of the data;
- Device - specific device (drive name);
- Expires - start exchanging data between client and server;
- Fetch Count - the number of pairing between the client and the corresponding server;
- Last Fetched - client date of last connection to the server;
- Last Modified - last modified request.

If necessary the system administrator so having information about all connections to the server, to determine the client's global network.

### III. Object model

With the prevalence of Internet working with remote data become commonplace. Technology client - server commonly used when working with remote data in the network. Today, with the development of the Internet , this technology is increasingly attracting the views of software developers , because the world has accumulated a wealth of information on various issues.

The system is divided into two parts that can be executed in different nodes of the network - client and server . An application or end user interact with the client part of the system, which in the simplest case provides a network interface. The client part of the system if necessary calls over the network to server side.

Technology client - server can be described by the following algorithm:

- the user changes the state of a client program object , which in turn generates and sends a request to the server , rather - for a program that handles requests;
- this program carries out the appropriate manipulation of the data stored on the server, according to the request state changes associated object and passes it to the client program;
- client receives the object, taking into account the new state of the object and waits for further user action. The cycle repeats until the user terminates the service.\

Standard software technology implemented client - server features: scalability (effective use of extension hardware), resistance to work, protected from unauthorized access and power when working with large projects in the area of databases.

Model of client-server interaction is determined primarily by the distribution of responsibilities between

the client and server applications. In our case the server program will provide information and other services programs that appeal to her, the client will use these services. Model object interaction - is the fastest way of communication for the transmission states of objects (Fig. 1). This protocol uses the direct transmission of the remote object by value [1-3]. Model object interaction using the HTTP protocol for transmission of remote object formatted in binary format over a communication channel. The client is able to send both simple and complex objects on the server. These values are client objects can be attached to the server object by adding metadata, tags to the class object [7].

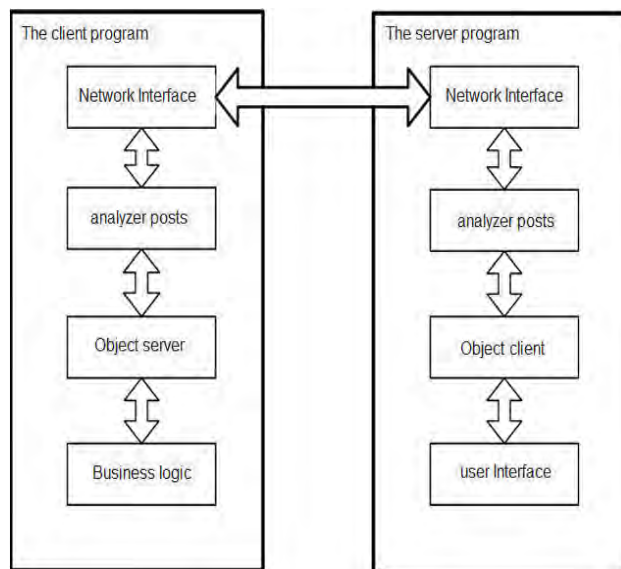


Fig. 1. The model object interactions

Setting model object interactions communications a little more complicated than setting up a client web service. Object interaction model to use proved to be more effective than others, so that the load channel data in binary format, at least as a result of a smaller package. The main problem of systems based on the architecture of "client- server" is that according to the concept of open systems they are required mobility as a wide class of hardware and software solutions in open systems. Attempts to create systems that support all possible protocols leads to overload network parts to the detriment of functionality. Even more difficult aspect of this problem relates to the use of different representations of data in various heterogeneous nodes network. Different computers may be different addressing, representation of numbers, character encoding, etc.

This is especially important for servers and high-level telecommunications, computing, databases. A common solution to the problem of mobility systems based on the architecture of "client -server" is the reliance on software package that implements the remote procedure call (RPC - Remote Procedure Call). When using such an appeal to the service in a remote node looks like a normal procedure call. Means RPC, which naturally contains all the information about the specific hardware LAN and networking protocols, converts the call into a sequence of

network interactions. Thus, the specific network environment and protocol is hidden from the application programmer [3].

Consider the problem of the formation of probability to describe the reaction network interface on request.

There are two approaches to its solution:

1) determine the probability of a particular reaction network interface to a user's query with regard to the value of a specific parameter;

2) determine the overall probability of a particular reaction network interface to a user's query excluding the value of a specific parameter.

The first approach provides the greatest possible certainty reaction network interface to a user's query. However, the drawback of this approach is the complexity of determining the probability of transition. In addition, the use of surgery to eliminate the option to transfer probabilities of transitions. For the physical optimization should be used as the common value of the reaction probability network interface. So better to use the second approach. In this case, the probability of network interface defined for each pair (St, Q) without the query parameters to the network interface and its database. Certainty behavior network interface is less than in the first case, but to eliminate the parameters of the review and optimization of physical network interface will not need additional changes. If the network interface are queries with parameters that significantly affect the response of the system and is important for its optimization, then the pair (parameter query) can be transformed into a single query.

#### IV. Network interface

Network Interface - two or more computers together cables so that they can communicate.

Computer network - these are the two or more personal computers connected to one another to quickly exchange data and share resources. To implement the necessary network components of two types: apapatni and software. The hardware part provides the physical connection of computers.

To configure the PC to connect to the network to consistently perform the following operations:

Stage 1. Physically connect the modem to the PC i phone line. Then you should install the drivers and configure the job.

Stage 2. Adjust settings to connect to the remote access server.

Stage 3. To configure the protocol TCP / IP.

Connecting PCs may occur by using cable and network adapter or cable connected to the port (direct cable connection), telephone or fiber optic lines and modem or radio communication via radio modem.

Network software consists of two major components:

network software is installed on the client computer; software installed on servers.

Operating system combines all the computers and peripheral devices in a network, coordinates their functions, providing secure access to data and peripheral devices in the network.

The software part of a network - a network operating system that provides the personal computer protocols i applications that support the network.

For hardware network include: personal computers , cables , modems , providing network functionality and form its structure.

The main problem to be solved when creating these heterogeneous networks is to ensure compatibility of equipment for electrical and mechanical characteristics and compatibility of programs and data in the system coding and formatting. The solution to this problem on the Internet is a model of open systems interconnection (OSI). According to this model, standardization of hardware and software on the Internet is based on protocols. As in all the other networks, the Internet can be used up to seven levels of interaction between computers.

Consider the scheme of TCP-connection :

- Assume that host A to create a TCP- connection to host B. Then A sends to B the following message : SYN, ISSa.

- This means that the transferred set and the message bits SYN (Synchronize Sequence Number), and the sequence number field set to the original 32- bit value ISSa (Initial Sequence Number). Host complies with : SYN, ACK , ISSb, ACK (ISSa + 1).

- In response to a request received from A, B sends a message that SYN bit set and the ACK bit , in the sequence number field in the host given its initial counter value ISSb; Acknowledgment number field contains the value ISSa, received the first packet from host A and larger by one.

- Host A , completing the handshake (handshake), sent : ACK , ISSa +1, ACK (ISSb + 1). This package ACK bit set , sequence number field contains the value ISSa +1; Acknowledgment number field contains the value ISSb +1. To forward this packet to host B over a three-step handshake and TCP-connection between hosts A and B is established. .

- Now host A can send packets of data to the host in the newly created virtual TCP channel, the following information : ASK , ISSa +1, ACK (ISSb + 1); DATA.

In the considered scheme of TCP-connection , we see that the only identifiers other than IP- address of the initiator of a connection , TCP- subscribers and TCP-connection , there are two 32-bit parameters sequence number and acknowledgment number. So, to create a false TCP- packet must know the IDs for the current connection ISSa and ISSb. This means that an attacker enough picking the appropriate current values of identifiers TCP- packet for the TCP-connection (for example , this compound may be an FTP- or TELNET-connection), send a packet from any host on the Internet on behalf of a participant of the connection ( for example, on behalf of the client) , indicating the title of its IP- packet IP- address and the packet will be accepted as true.

Protocols TCP / IP solve the problem of transportation of packages and their contents may be different ( user data, service information ). Packets are moved from node to node , forming the lower level of the network. Filling the data packets is the top-level program, which runs user. These programs determine its capabilities for the user in the network. They were developed based on some rules ( application protocols ) are called services on the Internet. Almost all network services are built on the principle of "client -server". Server ( the web Internet) - is a computer

or a program that can provide customers with some network services. Client - an application that is loaded in the user's computer , which ensures the transmission of requests to the server and receive responses from it. Different services have different application protocols. With the expansion of the network, new protocols ( services) , changing its appearance and rapidly expanding range of users. So to take advantage of some of the services on the Internet, you must install the client software on your computer that could run the protocol of the service .

After seeing the main problems facing network interface modeling client-server, proceed to the formal description of interfaces. Based on the basic principles of the network interface, select the main components of a network interface - its inputs and outputs. Entrance network interface is a set of customer inquiries, outputs - set of responses to requests. In general, the reaction is determined not only by the current demand, but all the previous ones. To eliminate the need to handle each time all previous customer requests, we introduce the concept of a network interface. State of the network interface is aggregated history requests to this interface. In the Network Interface allocated separate levels (Fig. 2), it is a multilevel and each level contains at least one autonomous subsystem (which is actually a separate system) [4-5].

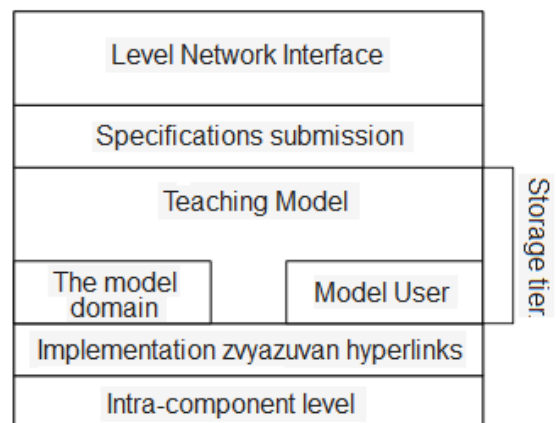


Fig. 2. View level network interface

At each level (except the top and bottom ) is traditionally considered three input streams - stream external disturbances , the flow of orders from the highest level - specifications submission flow reactions lower - internal component. Network Interface must be capable of hierarchical client connections to the server on the network. This connection is based on directing the effluent lower level to a higher level network interface, together with the input excitation signal is input to higher-level network interface . In the formation of the answers to the user query service using network interface (Fig. 1) distinguish the following stages:

1. receiving a request from a user or service higher - level models of teaching;
2. forming queries to lower service - level specification representation ;
3. get answers from lower services - intra- component level;
4. formation response to the request - the level of binding to hyperlinks.

Analyzing these steps, we note two points:

- if we consider only the top slice network interface, then you need to allocate its description as a stream of user's query and flow reactions subcomponent ;
- a network interface as a whole (with all levels included) should specify only one input stream - user requests (because the response of the lower level network interface defined by higher service requests and therefore requests user input ).

Detailing network interface made up to a certain low level. For functions at this level are considered only incoming user requests. This approach is consistent with the statement of nothingness describe input streams from lower-level network interface for network interface at all. All network interface with all levels of the network interface is considered as the lowest level (since it is always possible to identify components of the lowest level ).

Exploring the specific features of the functioning of the network interface , you can even remove or request the user , or the input stream from the lower-level network interface . Exploring the network interface as a whole , not just a slice of it regarded only incoming user requests [8].

In reviewing the rules of composition network interface and its use by applying them to the components of some of the activities take into account that requests to the components forming the network interface and component response sent to it to form the final reaction.

Network Interface describes the traditional orderly set, Eq. 1 :

$$IS = ( Q , R , A , St , \phi , \psi ) \quad (1)$$

where Q - incoming requests IC, R - reply lower level network interface, A - IS output alphabet, St-set of states of the system,  $\phi, \psi$  - function transitions and outputs.

Let us consider each object. The set of characters that are input alphabet network interface, describe as follows, Eq. 2,3,4:

$$Q = \{ Qi \} \quad (2)$$

$$Qi = \left\{ Id_Q^{(i)}, Pq_1^{(1)}, \dots, Pq_{N_Q^{(1)}}^{(1)} \right\} \quad (3)$$

$$P_j^{(i)} \subset D_{Q_j^{(1)}}^{(1)} \times \dots \times D_{Q_j^{(l)}}^{(l)}, l = N_{P_{Qi}}^{(j)} \quad (4)$$

where the set IdQ - set a unique identifier query.

Learning about how the client to the server, we investigate the interaction of the side WWW.

Web server - a server that accepts HTTP-requests from clients are usually web browsers, issuer HTTP-response, usually with HTML-pages, images, files, stream media or other data. Web server - the foundation of the WWW. Web server name as software that acts as a server, and the computer on which the software runs. Software implementation of which will look like:

```
package org.opengts.servers.template;
import java.lang.*;
import java.util.*;
import java.io.*;
import java.net.*;
import java.sql.*;
import org.opengts.util.*;
import org.opengts.db.*;
```

```
import org.opengts.db.tables.*;
/**
*** <code>TrackServer</code> - this module initializes
the various communication
*** methods used to received data packets from the
remote tracking device.
**/
public class TrackServer
    Clients can access the web server URL-address to their
web page, or other resource. Program is implemented as
follows:
package org.opengts.servers.template;
import java.lang.*;
import java.util.*;
import java.io.*;
import java.net.*;
import java.sql.*;
import org.opengts.util.*;
import org.opengts.dbtools.*;
import org.opengts.db.*;
import org.opengts.db.tables.*;
import org.opengts.servers.*;
```

```
/**
*** <code>TrackClientPacketHandler</code> - This
module contains the general
*** "business logic" for parsing incoming data packets
from the remote tracking
*** device.
**/
public class TrackClientPacketHandler
```

Seeing what constitutes a web server in program implementation, discuss its features, which are: logging server for users to request resources, authenticating users, support pages dynamically generated, supports HTTPS for secure connections with clients.

There are many web servers. Today, the most common are:

- NCSA HTTPd - one of the first web server , developed by Robert McCool (born Robert McCool) and other companies in the NCSA.
- Apache - Web server with open source software , often used in Unix-like OS.
- IIS - Web server with Microsoft, delivered with the operating system Windows NT family.
- lighttpd - open-source web server.
- Google Web Server - Web server is based on Apache by Google.
- Resin - open-source application server for java.
- Cherokee - free , multi web server written in C.
- Rootage - multi web server written in java.
- THTTPD - simple, small, fast , portable and well-protected web server designed for Unix- systems.
- GlassFish - Java EE application server and open source , developed by Sun Microsystems.

As clients to access the web server can be used by completely different mechanisms: web browser - the most common way; special software can self- refer to web servers for updates , or other information; mobile phone can access to the resources of the web server via HTTP protocol or WAP; other intelligent devices or appliances Java Servlet API - a standardized API for dynamic content to a web server using platform Java. Servlets -

analog technologies PHP, CGI and ASP.NET. Servlet can save information between multiple transactions by using HTTP cookies , session or through the edit URL.

Servlet API, contained in the package javax.servlet, describes the interaction between web and servlet container . Web container - a component of a Web server that is created to interact with servlets. He is responsible for managing the lifecycle of servlets , converting a URL in a servlet and ensuring that the client that made the request URL has appropriate permissions. Servlets , interfaces and base classes , protocols, work with them, work environment , are described in the relevant specification by Sun Microsystems. To facilitate the development of HTTP servlets , the specification describes an abstract class HttpServlet, from which developers offer their servlets inherit. Scheme of work and use of servlets :

1. The client (eg web browser ), visited pages and sends an HTTP request to the server.

2. Web server receives the request and passes it to the servlet container . Servlet container can run in the same process as the web server in a separate process on the same system as the web server, or even in a separate process on another system .

3. Servlet container ascertains that a servlet should call based on configuration information held servlets , and calls it , passing as parameters the object representing the request and response.

4. Servlet uses the request object to obtain information about the remote user , the parameters of an HTTP request like. Servlet performs the action programmed in it and send results via item response.

5. Once the servlet stops processing the request, the servlet container checks the correctness of the response time , and returns control to the main web server.

Servlets are used in the technology of JSP. Page templates broadcast source Java- classes inherited from class standard servlets. Java- compiler compiles this source code in Java- byte codes.

These compiled classes can be used in a servlet container. Normally, servlet containers do all these auxiliary automatic.

## Conclusion

Client-server technology designed to divide the work of information systems, computer network between the server that provides the basic functionality of the information system and the client that performs input and pre-processing of information and its transmission to the server and end processing and visualization of data received from the server.

Also, the model of object interaction between client and server, which allowed better working WWW. Analyzed the interaction of the client to the server in the WWW and software implementation of a web server and the client.

## References

- [1] I.I. Pasternak and Iu.V. Morozov, "Klasyfikatsiia zasobiv modulnoi vzaiemodii mizh kliientom i serverom" ["Classification of modular interaction between the client and the server"], *Komp'yuterni systemy ta merezhi - Computer systems and networks*, vol.717, pp. 108-113, Mar. 2011.
- [2] I.I. Pasternak and Iu.V. Morozov, "Model ob'iektnoi kliient-servernoi vzaiemodii" ["Object model client-server interaction"], *Komp'yuterni nauky ta informatsiini tekhnolohii - Computer science and information technology*, vol.719, pp. 164-167, Mar. 2011.
- [3] I.I. Pasternak and Iu.V. Morozov, "Merezni interfeisy rivnia kliient-server" ["Network interface level client-serve"], *Informatsiini systemy ta merezhi - Information systems and networks*, vol.743,pp. 121-131,Jan. 2012.
- [4] I.I. Pasternak "Parametryzovani merezni interfeisy" ["Parameterized network interfaces"], *Komp'yuterni nauky ta informatsiyni tekhnolohiyi - Computer science and information technology*, vol.744, pp. 1-9, Mar. 2012.
- [5] I.I. Pasternak "Modul'nyy interfeys kliient-servernoyi vzayemodiyi" ["Module interface client-server interaction"], *Komp'yuterni systemy ta merezhi - Computer systems and networks*, vol.745, pp. 160-163, Apr. 2012.
- [6] I.I. Pasternak "Ohlyad ta analiz navihatsiynoyi systemy OpenGTS" ["Overview and analysis of the navigation system OpenGTS"], *Novi tekhnolohiyi - New Technologie*, vol.2, pp. 88-91, Feb. 2012.
- [7] I.I. Pasternak "Modular interface", in *Proceedings of the 6th International Conference "Computer Science and Information Technologies": CSIT-2012*, November 20-24, 2012, Lviv, Ukraine. Lviv: Vydavnytstvo Lvivskoi politekhniky Publ., 2012, pp. 117-118.
- [8] I.I. Pasternak "Using the principle of modularity of client-server interaction in the global network", in *Proceedings of the 6th International Conference "Advanced computer systems and network: desigh and aplicatuon": ACSN-2013*, September 16-18, 2012, Lviv, Ukraine. Lviv: Vydavnytstvo Lvivskoi politekhniky Publ., 2013. pp. 61-64.