тернет. Однако особенности алгоритмов кодирования видеоинформации в сочетании с особенностями сети Интернет делают невозможным непосредственное использование стандартных систем кодирования видеоинформации для передачи сигналов от точки производства сигнала до точки приема (обычно ТВ студии). Для эффективного использования современных систем кодирования видео для передачи через сеть Интернет необходимо введение специализированной надстройки, которая позволит учесть особенности как производимого сигнала (с учетом сложности изображения и его динамики), а также особенности предполагаемых маршрутов передачи данных. Данная надстройка позволит скорректировать параметры кодирования видеосигнала с учетом как самого входного сигнала, так и с учетом параметров маршрута передачи данных до точки назначения. Отдельного внимания заслуживает возможность создания сети видеосерверов, позволяющих обойти ограничения, связанные с гетерогенностью сети Интернет.

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UDC 004.054:004.771:378.147.88

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METHODS OF DATA COLLECTION TO EVALUATE THE QUALITY OF DISTANCE LEARNING SYSTEM

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МЕТОДИ ЗБОРУ ДАНИХ ДЛЯ ОЦІНКИ ЯКОСТІ СИСТЕМИ ДИСТАНЦІЙНОГО НАВЧАННЯ

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МЕТОДЫ СБОРА ДАННЫХ ДЛЯ ОЦЕНКИ КАЧЕСТВА СИСТЕМЫ ДИСТАНЦИОННОГО ОБУЧЕНИЯ

The issues, associated with the evaluation of quality of distance learning system, were discovered. The most significant data and statistical units, which are used to asses the quality of distance learning system, were investigated. The data, which can be obtained from the internal database of the distance learning system using standard tools, was considered. The method of obtaining data, based on the network traffic monitoring using active network techniques, was proposed.

***Key words**: distance learning, E-learning, statistical units, quality evaluation, Moodle, database, traffic monitoring, active network techniques, active node.*

Розглянуто проблеми, пов'язані з оцінкою якості системи дистанційного навчання. Досліджено найбільш значущі дані і статистичні одиниці, які використовуються для оцінки якості системи дистанційного навчання. Виявлено дані, які можуть бути отримані з внутрішньої бази даних системи дистанційного навчання за допомогою

стандартних інструментів. Запропоновано метод отримання даних, на основі моніторингу мережевого трафіку з використанням методики активних мереж.

***Ключові слова**: дистанційне навчання, статистичні дані, оцінка якості, Moodle, база даних, моніторинг трафіку, методика активних мереж, активний вузол мережі.*

Рассмотрены проблемы, связанные с оценкой качества системы дистанционного обучения. Исследованы наиболее значимые данные и статистические единицы, используемые для оценки качества системы дистанционного обучения. Выявлено данные, которые могут быть получены из внутренней базы данных системы дистанционного обучения с помощью стандартных инструментов. Предложен метод получения данных, на основе мониторинга сетевого трафика с использованием методики активных сетей.

***Ключевые слова**: дистанционное обучение, статистические данные, оценка качества, Moodle, база данных, мониторинг трафика, методика активных сетей, активный узел сети.*

Introduction. To archive the high level in modern cultural, social, economic, scientific and technological development Ukraine requires comprehensively developed, professionally trained specialists. That is the reason why the problem of development and practical implementation of the most effective information technologies of studying, which are corresponding to the general concept of education, is becoming increasingly relevant. The essence of this concept is to prepare the individual, who has not only basic knowledge, sufficient for the requirements of the current level of production, science, culture and the state, but who also has the ability to actively creative professional and social activities. An important role is given to the new software and technological tools of individualization of learning process.

The traditional form of education is the education with the teacher. However different aids are often used in the learning process for a long time. Considering the modern level of development of telecommunications there are abilities to provide access to educational resources for students, who are outside of university campus.

Informatization of Education is one of the key conditions for successful development of modern society. The objective of distance learning is fast and convenient dissemination of knowledge, providing accessibility of education for all groups of the population. This goal is implemented using software, constructed on modern information and communication technologies, which received the title "e-learning system" (system of distance learning).

Distance learning (E-learning) is the interaction between teachers and students at a distance, which reflects all the typical components of the educational process (objectives, content, methods, organizational forms, learning tools etc.) that is implemented using specific facilities of Internet technologies or other means, which provides interactivity [1].

Providing of quality education services by educational institutions first of all should be governed by state regulations, where the quality of distance education is determinate as the combination of the properties of educational system, that provide trainees obtaining the knowledge, skills and abilities, which satisfy certain requirements, specified in the state standards of professional education. International standards of the ISO 9000 series are methodological foundation for any approach to evaluation and quality control of E-learning [2].

However, these regulations can not cover all the learning parameters and guarantee the receipt of the full range of knowledge and skills that the student must master during the educational process. Consequently each educational institution requires its own quality management system, including documents, methods and procedures used in the learning process to achieve the desired quality of service. Based on the basic principles and requirements of the traditional forms of learning, this system should cover all the aspects, inherent to the particular institution.

Related work. Distance learning is becoming an increasingly widespread form of acquiring knowledge (and a document of graduation, which is not always the same thing) for several reasons. The number of people wishing to study in various educational institutions is increasing, however, the provision of all learning opportunities and ensuring the necessary level of educational services through traditional forms of learning is not possible. On the other hand, the need to ensure material welfare under conditions of real market validity stimulates the growth of the number of students who wish to study without interruption from the main practice [3].

In the most cases distance learning courses are developed and provided based on two technological solutions: case - technology and network technology [4]. Interactive case – technologies that are designed to strengthen the cognitive activity of students are currently used. There are online tutorials, including anthology, handbooks, training programs with multimedia support, computer lab workshops, video conferencing, e-mail etc.

Therefore, feature of case - technologies is that the basic school and student are separated here much greater than in the classical form of distance learning. In case of such learning technology there are no traditional sessions and exams; trainings are usually conducted on an individual schedule (supplementary agreement). The introduction of this technology in the educational process is a less radical transition to a distance form. Current approach can be used by universities as one of the areas to improve distance education [5] [6].

Purpose. The aim of the current investigation is to consider the most valuable parameters and statistical units, which are used to evaluate the quality of distance systems. The methods to obtain the required data and statistical units are presented in the paper. Current investigation discovers the data, which can be received using the standard tools from the internal database of the most widely used distance learning systems. The method to obtain the data using the traffic monitoring system, based on the active network techniques, is also proposed.

Investigations. Distance learning is an independent form of education; information technology is the leading tool in distance learning. According to many experts, E-learning is a solution for the most part of educational problems. Innovations, carried by remote education, should enhance the productivity and efficiency of training. Among the problems of modern education the issue of concerning the necessary and sufficient level of quality of training received much attention. Such tendency in Ukraine coincides with the world trend [7]. It is necessary to consider that there is a tendency to compare E-learning with full-time learning in task of quality assessment due the fact that the benefits of e-learning compared to part-time form of training is obvious because of continuous dialogue between teachers and students, students with each other. Methods to analyze the quality of E-learning systems are different among groups of experts and scientists, user groups with different interests. The parameters that scientists use to determine the quality of e-learning systems are presented bellow:

- curriculum, content and organization;
- presentation, training and evaluation;
- achievements of students;
- student support system;
- teaching resources;
- guarantee and quality improvement etc.

Should be considered, that the quality of distance education consists of a set of consumer properties of educational services, which provide an opportunity to satisfy the complex requirements for the comprehensive development of the student's personality. Set of quality indicators of distance learning can be divided into several components:

1. Teacher qualifications and student body. Teacher manages students' independent work and performs the following functions: target; diagnostic; motivational; design and construction of the educational process; consulting; information and learning; organizational; communication skills; controlling.

2. Methods and techniques of learning, providing traditional or innovative educational technology, computer, traditional or active methods of learning.

Since the quality of e-learning system directly depends on the quality of information technology, these categories can only be considered inseparably connected. The quality of education can be characterized by such groups as:

- indicators of quality of educational content;

- indicators of quality of learning technologies;
- indicators of quality of educational outcomes.

Each of these groups corresponds to a number of quality properties and certain aspects of security, organization and conduction of the educational process. A large number of distance learning courses developed even in one institution leads to natural questions, including the following:

- which courses contain real work and are visited by many users, and which courses waste web-resources;
- what the reasons are for changes in the users activity: rating and quality of the course, technical problems or there are any other reasons;
- how the load on the system of distance learning changes, and what measures should be taken to avoid a collapse of the system.

Answers to such questions can improve the quality of distance learning, timely detect faults in the system, get rid of the obviously unnecessary and unpopular courses.

Collection of statistical data in the Moodle e-learning system. To monitor the user activity the distance learning systems contain the information (logs) about attending courses, individual courses resources, user activities etc. For instance, e-learning system Moodle has the ability to construct the reports, based on the information from logs, which contain such information:

- which user entered the system and what IP-address he used;
- when was the first and last entrance;
- what elements were opened, what actions were performed (can be seen in figure 1), total number of views;
- detailed reports about estimates.

Such reports are convenient for courses developers and lecturers, who need to monitor user activity on their course. On the other hand such reports are less convenient for the system administrator due to large amount of unnecessary detailed information.

СДН ЧНТУ: All participants, Wednesday, 12 February 2014 (Server's local time)

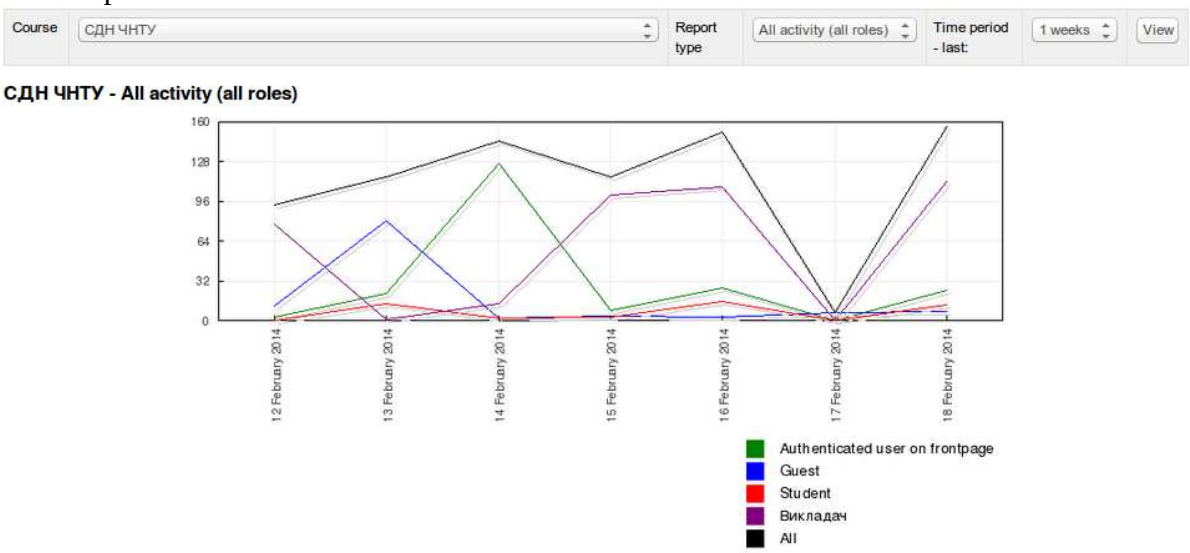
СДН ЧНТУ (Site) | All participants | [more]
Wednesday, 12 February 2014 | All activities | All actions | Display on page | Get these logs
Displaying 159 records
Page: 1 2 (Next)

Course	Time	IP address	User full name	Action	Information
СДН ЧНТУ	Wed 12 February 2014, 10:45 PM	46.200.46.219	Гость	course view	СДН ЧНТУ
СДН ЧНТУ	Wed 12 February 2014, 10:44 PM	46.200.46.219	Гость	course view	СДН ЧНТУ
СДН ЧНТУ	Wed 12 February 2014, 10:42 PM	46.200.46.219	Гость	course view	СДН ЧНТУ
СДН ЧНТУ	Wed 12 February 2014, 10:42 PM	46.200.46.219	Гость	user login	1
СДН ЧНТУ	Wed 12 February 2014, 8:58 PM	193.46.201.171	Александр Дрозд	user logout	2
СДН ЧНТУ	Wed 12 February 2014, 8:47 PM	193.46.201.171	Александр Дрозд	course view	СДН ЧНТУ
Site	Wed 12 February 2014, 8:47 PM	193.46.201.171	Александр Дрозд	role assign	Создатель курса

Fig. 1. The report about actions of system Moodle users

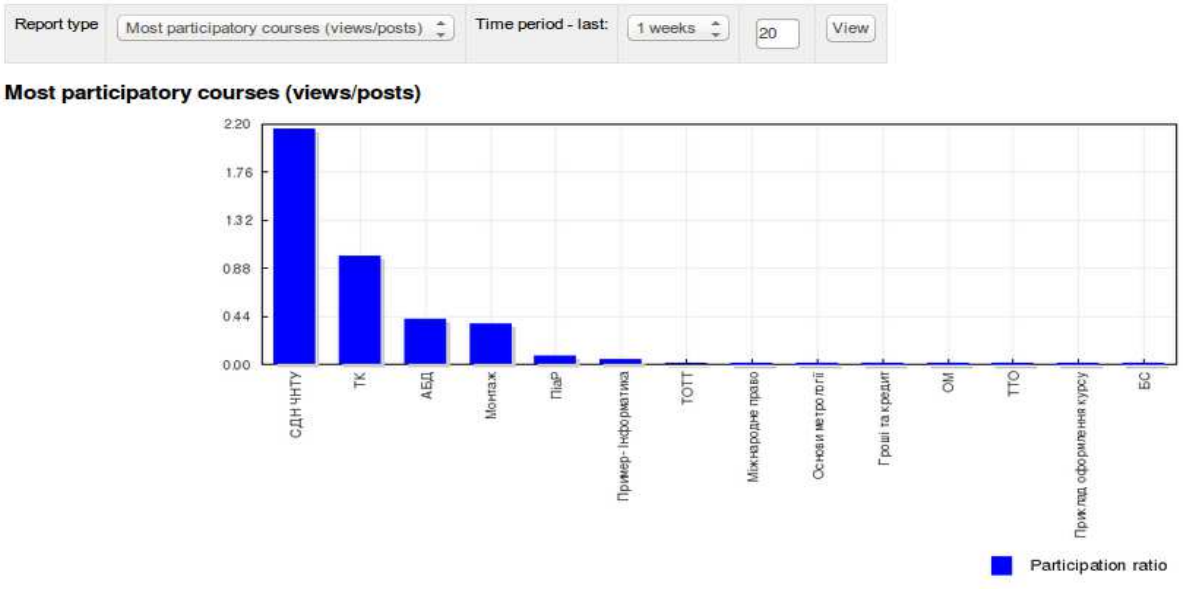
List of reports are significantly extended in a special mode of collecting statistics, using the task scheduler *cron*, which starts at a specified time and collects data for ascertainable period of time. Reports based on these statistics are more focused on the comparative assessment of the options within the entire system of distance learning (shown in figure 2). The in-

dicators of courses visits count by date, by users' role, the indicators of users' activity by courses (shown in figure 3), the indicators of courses activity by absolute number of elements, count of possible visitors etc. can be obtained from such statistical units.



Period ending (day)	Authenticated user on frontpage	Guest	Student	Викладач	All	Logs
18 February 2014	24	7	13	112	156	Course Logs
17 February 2014	0	6	0	0	6	Course Logs
16 February 2014	26	3	15	108	152	Course Logs
15 February 2014	8	4	3	101	116	Course Logs
14 February 2014	127	2	2	14	145	Course Logs

Fig. 2. The report with the results of statistics collection



Course	Views	Posts	Participation ratio
СДН ЧНТУ	96	151	2.16
ТК	93	113	0.99
АБД	68	28	0.41
Монтаж	48	18	0.38
ПіаР	14	1	0.07

Fig. 3. The report about activity of users in different courses

The main disadvantage of such mode of statistics collection is the increased load on the server and impact on the performance of the total system. This is the reason why this mode is often left disabled.

Despite the fact that statistical data collection in the Moodle e-learning system is performed automatically, the reports building should be started manually. Therefore there is no continuous monitoring tool, which automatically reported the administrator or teacher about the problems in user activity or rating of the course. To perform the monitoring of activity of e-learning systems users additional external systems can be used. Such systems often use a ready-made statistics, collected in the database. An example of such a system is the analytical platform Deductor [8]. The disadvantage of such systems is the connection with a particular e-learning system and database structure. The most universal approach to the monitoring of user activity is to analyze the network traffic.

Method of collection data based on the network traffic monitoring. The task of obtaining real and objective data that will be used and analyzed for decision making, is one of the most important to perform any evaluation, because the results are directly dependent from the quality of the source material.

Considering the fact that the majority of modern systems of distance learning use the computer network technology, are available through computer networks and built using basic network protocols, the task of collecting data about the usage of distance learning system can be solved by monitoring network traffic, i.e. requests from users and responses of e-learning system.

The scheme of the method of data collection, based on network traffic monitoring is shown in figure 4.

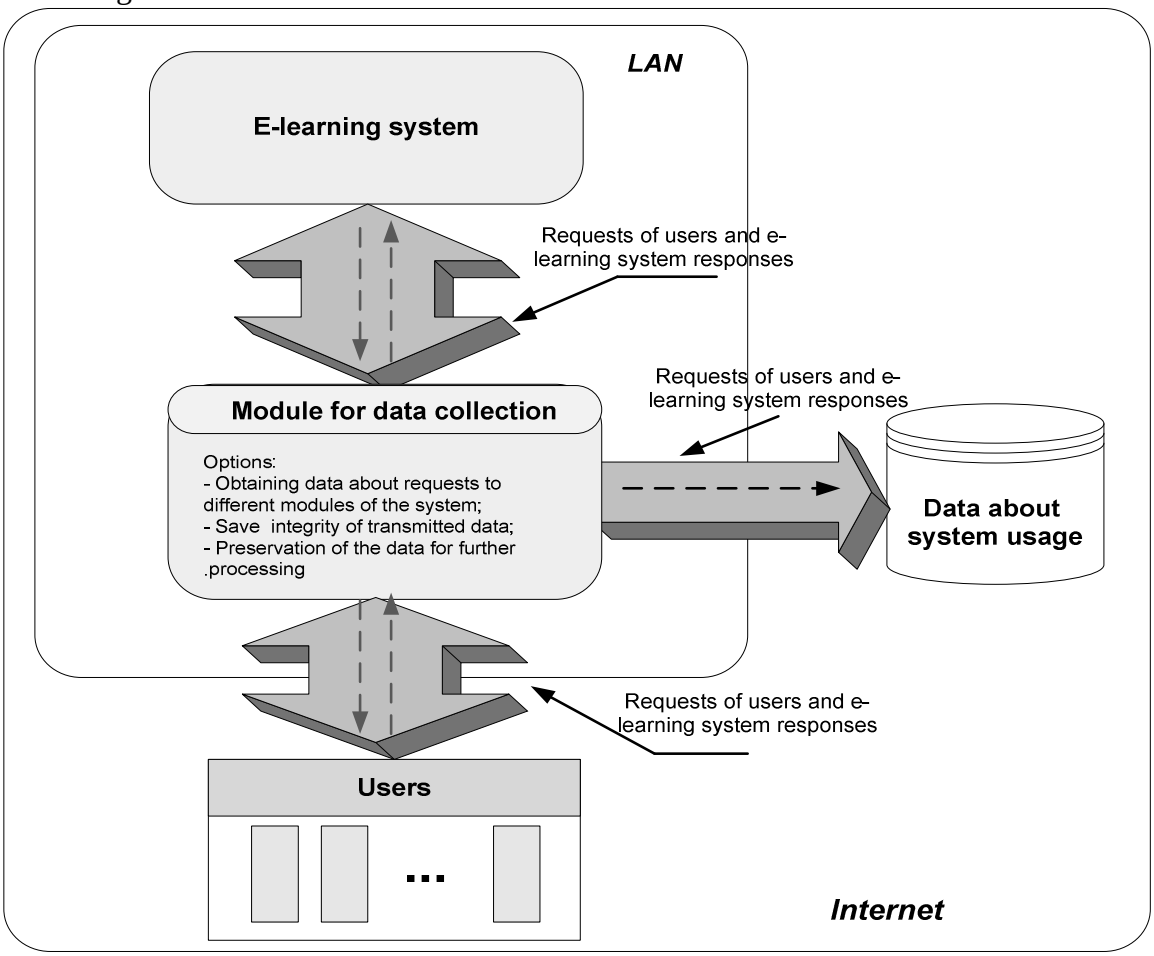


Fig. 4. Method of data collection, based on the network traffic monitoring

The basic functional unit of the proposed method of monitoring network traffic is data acquisition module, which has to fulfill the following functions:

- obtaining user requests to the system and its modules;
- processing and analysis requests (packets) to obtain the required information;
- transfer of the original request (packet) to the system, because the violations of the structure of the package can create problems in the interaction between the system and the user;
- obtaining system responses;
- processing and analysis responses (packets) to obtain the required information;
- transfer of the original response (packet) to the user,
- preservation of information received.

The main requirements for data acquisition module is receiving data about the interaction of the system - user and storing relevant information for further processing, preserving the integrity of the transferred data and minimizing the impact of the module on the performance of the system (data transmission delay, packet loss, etc.).

Usage of active network techniques to solve the task of network traffic monitoring. In traditional packet-switched networks e.g. the internet the processing of the network traffic is reduced to the transfer of data in original form. Network nodes perform a series of computational processes, such as the filtering of packet addresses, protocol conversion and packet encapsulation, distribution of routing information and updating of the routing tables. This functionality is limited to information contained within the packet header. Due to network performance issues only the end systems consider application specific data processing especially in the conditions of significant increasing in network traffic. Considering the fact, that the existing network infrastructure also has difficulties with the integration of new services, technologies and standards, the several strategies, united by the common name of "active networks", were proposed to solve the problems [9].

Active networking is the emerging field, which provides intelligence mechanisms in the network nodes (switches and routers) to perform data processing during the transmission over the network. According to the active networks concept processing of traffic is performed considering the application requests and changing of network state. Two main approaches of construction of active networks can be identified: Strong Active Networks and Moderate Active Networks. In Strong Active Networks the program code, which should be executed by switches or routers, is placed into the capsules (packets) and sent thought the network. In Moderate Active Networks the program code is placed into the network nodes (switches and routers) to be executed, as and when required [10]. This code can implement network services to monitor and manage networks, deploy new protocols and provide network security and intrusion detection.

The key component of the active network is the active node (switch or router) that has the ability to perform the active processing at the particular stage of data transmission. The active node reference architecture, developed by DARPA, is used as the basis for the active nodes architecture and is shown in figure 5 [11].

Depending on the packet type the active node decides whether to fast forwarding the packet or execute a processes on the packet packets. Active networks rely on the traditional routing functionality provided by the node’s standard hardware and software. Additional functionality is implemented by specific structural units of Active Node:

- packet filters are used to identify the smart packets that require additional active processing;
- Node OS performs standard operating system services;
- Execution environments (EEs) provide the managing, control, language and execution environment for active services;
- Active Applications (AAs) provides the execution of active services;

- Managing execution environment (MEE) and Managing active applications (MAAs) provide the services for active node management.

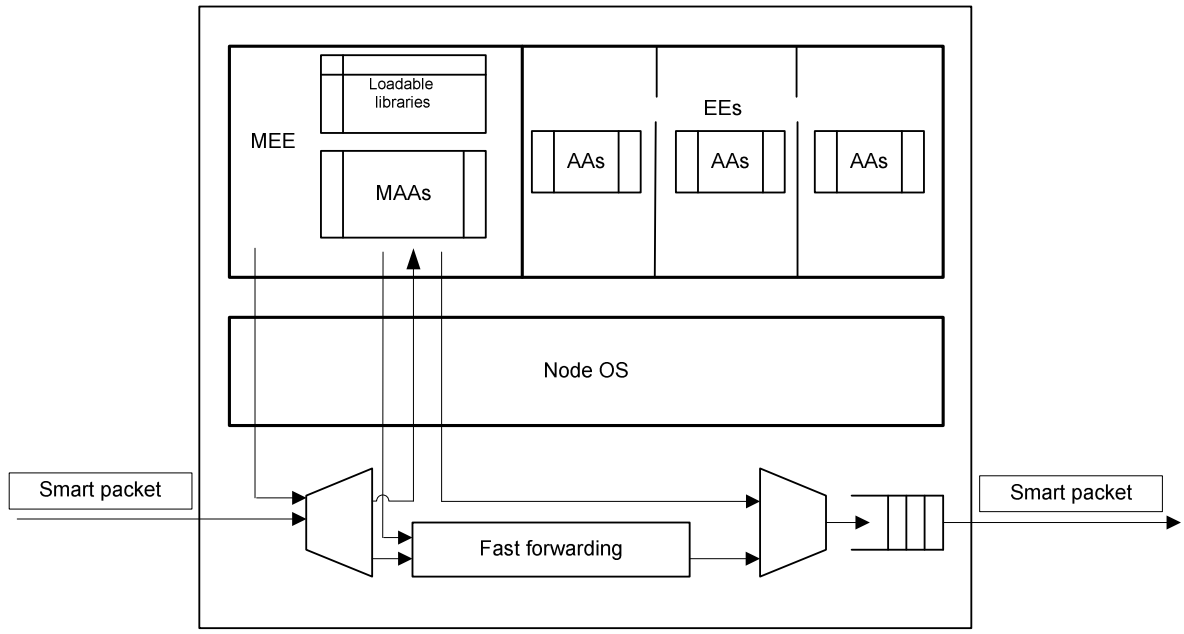


Fig. 5. Architecture of the Active Node proposed by DARPA

Proposed architecture of the Active Node is used as the basis for the development of the Active Node, which performs the function of the network traffic monitoring for the traffic that contains data about usage of the e-learning system and its modules and courses. Based on the architecture of active networks this system for network traffic monitoring was developed and implemented and was cable to capture live data. Current system was developed to monitor the activity of network users in case of using external recourses in working time at working place [12]. However due to special attention, which was paid to the task of traffic monitoring, this system can be used to solve additional tasks with minor changes in program code without any modifications in architecture.

The proposed system intercepts http packets transmitted through the network active node, which are used and should be placed as the network gateway, using a filtering technique, performs analysis and provides statistical information about network activity of each user by IP address of the network and summary information for all network traffic. The open source operating system GNU / Linux was used as the Node OS due to its advantages, such as flexibility and ability to modify the existing software. Linux has a wealth of useful tools for data capturing and filtering, such as firewall Netfilter and a utility for firewall management of Iptables that enables the use of the additional modules for data processing and analysis. Netfilter performs analysis of data packets and filtering according to chains of rules, but normally it is unable to conduct sophisticated analysis of transmitted data, so the extension of the Netfilter by utilising additional modules is required. Netfilter functionality is extended by the addition of a specially developed module and applying an extension to Iptables rules to enable specific packets that are matched to execute this code before being forwarded. This code is the Active applications in the Active Node and can be customised to meet the requirements, which in this case is network monitoring. An architectural diagram of the proposed system is shown in figure 6.

Each packet, transmitted with an HTTP header, is intercepted by Netfilter firewall and transmitted to the Match module, which copy the packet into the device file and then return it to the network for forwarding as usual. To reduce the impact on the network performance and prevent data loss during the interaction between the systems parts the copies of the packets are created and are organized in a queue to perform the ordered data processing and minimize the

data lost. The processing of the data from packet is performed by the Logger daemon, which reads the packets copied from the device file, processes it and writes the obtained data to the MySQL database. This database provides the information for the Web application, which is used to analyse the data obtained from the network. Once the information has been stored in the database then it is possible to analyse it in many ways.

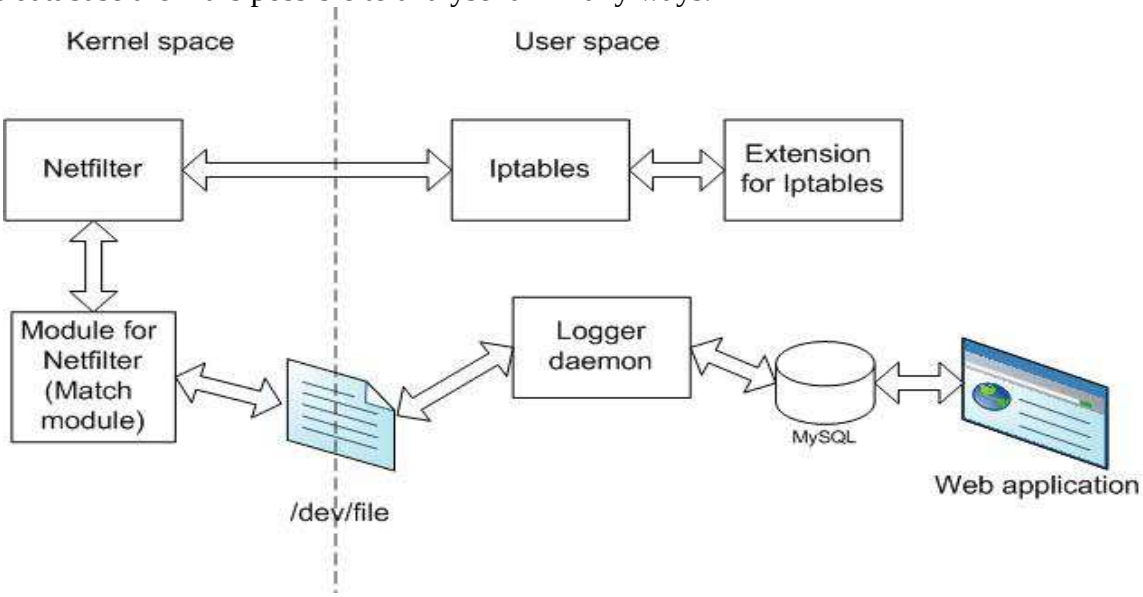


Fig. 6. Architecture of the proposed system of network traffic monitoring

Conclusions. The evaluation of the quality of the distance learning system is an important task of the modern education. Due to lack of standardization in development of e-learning system and its content each system requires unique approach in evaluation. Another important issue in the area of distance learning is the lack of standards of indicators that should be used to perform assessment of quality of e-learning system. Considering there facts the conclusion can be made that evaluation of quality of e-learning system and its courses is a complex and difficult task, which requires innovative approaches to be solved.

One of the most important tasks to perform the assessment is the task of collection data, which are used for further processing and analysis to make conclusions about quality of service. Current task can be divided for subtasks: determine the necessary data, obtain this data, and get rid of redundant data. Other important issues are the accuracy, credence and relevance of the collected data. To implement the task of data collection the methods should be used, which provide the data, that correctness and veracity is not in doubt.

The most popular distance learning systems, such as Moodle, contains standard internal tools, which can be used to obtain statistical data about e-learning system usage. However, the provided data are often incomplete and redundant, that makes the task of quality evaluation impossible due to lack of necessary parameters. The method of collecting data using network traffic monitoring was proposed in the current paper. Presented method is designed using active networks techniques and provides data filtering and monitoring. The proposed system of traffic monitoring was implemented using standard Linux tools, such as Iptables, Netfilter and MySQL and also contains several additional developed programs.

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УДК 004.75: 004.451.44

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THE ALGORITHM OF JOB SCHEDULING IN GRID ENVIRONMENT BASED ON THE DYNAMIC PROGRAMMING METHOD

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АЛГОРИТМ ПЛАНУВАННЯ ЗАВДАНЬ У ГРІД-СЕРЕДОВИЩІ НА БАЗІ МЕТОДУ ДИНАМІЧНОГО ПРОГРАМУВАННЯ

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АЛГОРИТМ ПЛАНИРОВАНИЯ ЗАДАЧ В ГРИД-СРЕДЕ НА БАЗЕ МЕТОДА ДИНАМИЧЕСКОГО ПРОГРАММИРОВАНИЯ

The problem of the effective usage of the grid environment for solving different types of computing tasks of large dimension is researched in the paper. We study the problem of optimal task scheduling at an affordable set of resources on the one hand and the equitable distribution of resources between the tasks that come into the input queue of a centralized workflow management system, on the other hand. Two stage strategy of task scheduling in grid environment that takes into account user-defined QoS requirements, structural features and execution dynamicity of the task is presented. The dynamic programming method application to the workflow scheduling problem is proposed in the paper and the effectiveness evaluation experimental results of the proposed decision are given.

Key words: *grid, workflow, scheduling, quality of service.*

Досліджується проблема ефективного використання грід-середовища для вирішення різних типів обчислювальних задач великої розмірності. Розглядається задача оптимального розміщення обчислювальних блоків завдання на доступній безлічі ресурсів з одного боку і справедливого розподілу ресурсів між завданнями, які надходять у вхідну чергу централізованої системи управління потоками завдань, з іншого боку. Представлена двоетапна стратегія планування завдань у грід-середовищі, що враховує встановлені користувачем вимоги до рівня QoS, структурні особливості та динаміку виконання завдання. Запропоновано застосування методу динамічного програмування до задачі планування в грід-середовищі і представлені результати експериментального дослідження ефективності запропонованого решення.

Ключові слова: *грід, потік завдань, планування, якість обслуговування.*