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**DEVELOPMENT OF AN INTEGRATED INFORMATIONAL  
EDUCATIONAL ENVIRONMENT AT THE TUSUR UNIVERSITY**

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***Abstract***

Existing legislative and normative acts considerably increase application capabilities of various elements of electronic learning in educational process. Taking into account educational standards of the fourth generation which directly state the necessity of development of an electronic informational educational environment, the urgency of the development of such environment on the basis of available solutions has grown even more. Though the application of ready solutions ‘on a turn-key basis’ is an effective way of development of such environment, it remains very expensive. Within the limits of the given paper, the process of designing, development and realisation of an interactive educational environment on the basis of interaction of several free or available components on the example of the Faculty of Security at Tomsk State University of Control Systems and Radioelectronics is considered. In the given paper, the analysis of approaches to the informational educational environment development is carried out. On the basis of this analysis, the requirements to the informational educational environment are given and the development of its base structure is made. The components allowing realising all necessary functions and requirements to the development of the teaching aids used in the informational educational environment are chosen. The offered solutions allow meeting the requirements to the organisation of educational process according to educational standards of the fourth generation.

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**Keywords:** Integrated Informational Educational Environment, educational process, e-learning, webinars.



## 1. Introduction

The market of electronic education in Russia is still being formed. Considerable rates of growth are observed. By available estimations (Docebo, 2010) in the Eastern Europe (including Russia) rates of growth are more than 15 % a year.

In 2014, Tomsk State University of Control Systems and Radioelectronics (TUSUR) earned more than 150 million roubles on distance (electronic) education. One of the basic problems is the small amount of teachers who develop courses for electronic education. At the same time, the urgency of course adaptation to electronic education has increased after a number of legislative acts came into force.

For example, the order of the Ministry of Education and Science of the Russian Federation January, 9th, 2014 № 2 states that ‘the Organizations which are carrying out educational activity, realise educational programs or their parts with application of electronic education ... by carrying out of studies, practical training, current, intermediate, total control of progress and (or) State Final Certification of students’. In fact, by means of electronic education only, it is possible to organise the educational process including all forms of lessons and control. At the same time ‘the in-person presence is not mandatory’.

It is necessary to integrate elements of electronic education into the full time educational process in order to involve larger quantities of teachers to developing the electronic courses. It will allow teachers to get used to the system of electronic education and later to transfer all elements of the courses on an electronic platform.

In the Federal Law ‘About Education in the Russian Federation’ the concept of the electronic informational educational environment including ‘electronic information resources, electronic educational resources, set of information technologies, the telecommunication technologies, corresponding technological means’ is presented. Besides, the informational educational environment should provide ‘acquiring educational programs in full irrespective of the physical location of the students’.

Development of the informational educational environment and its implementation in the full-time education form can become the base for development of electronic education as a whole. In particular, the creation and development of courses intended separately for full-time and electronic education will not be required. It will be a uniform process on the basis of identical teaching aids and education methods.

## 2. Problem Statement

After approval of educational standards of the fourth generation in which the necessity of development of the interactive educational environment is registered in an explicit form, the urgency of the given problem becomes abundantly clear.

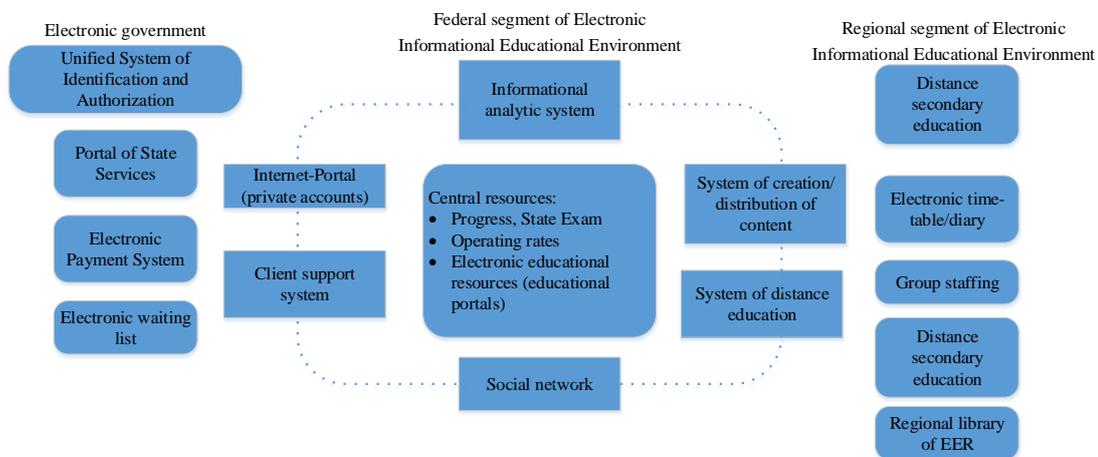
Besides, introduction of the informational educational environment can improve some aspects of the organisation of educational process. For example, to provide availability of teaching aids not only from a local network of university but from any point of the world through the Internet.

### 3. Research Questions

#### 3.1. Approaches to formation of the informational educational environment

The concept of the informational educational environment covers development of communicative and academic directions at several levels: federal, regional and on the level of an educational institution. Besides, not only higher educational establishment but also schools are engaged in the formation of the corporate informational educational environment. In the given section a number of approaches to the structure of the informational educational environment is considered.

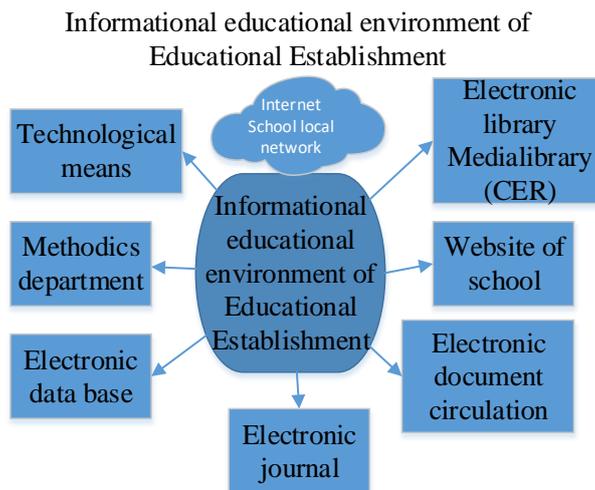
According to The concept of a unified information educational environment in the Russian Federation (2014) the uniform informational educational environment as a kernel of a uniform education system includes electronic resources: library of essays, qualification works with authorship, control sheets, an electronic diary, teaching aids, electronic textbooks, electronic information resources, electronic educational resources. The general architecture of the uniform informational educational environment is given on fig. 1. In this example, the approach to architecture from the point of view of the government is considered. The given approach is focused on establishments of the general secondary education. For solving the problem given in this paper, the following components matter: online account of a user, electronic time-table, electronic diary, system of distance education, electronic resource with works of the students.



**Figure 01.** Architecture of uniform informational educational environment (Kazakov, 2014)

For the formation of informational educational environment architecture of a specific educational institution, expansion of the list of components needed for maintenance of educational process is necessary.

So, for example, in Analysis of information in Krasnokutsky region for 2012-2013 academic year, (2014) the following items are specified as components of the informational educational environment of establishment of the general secondary education: official site of the educational institution, electronic library (with text, audio- and video-materials), system of electronic document circulation (fig. 2).



**Figure 02.** The informational educational environment of educational institution

Most components can be realised and supported only at the level of an establishment. It is advisable to implement a database for the record-keeping and the control for learning kits of subjects and also a test system integrated with corresponding learning kits.

It is offered to use means for conducting online webinars and for exchanging of messages via forum and e-mail.

### 3.2. Requirements to the informational educational environment

Based on the review carried out in the previous section, it is possible to make a typical list of components of the informational educational environment. At the same time it is necessary to consider that a number of components is already realised in the university or at the faculty. The analysis of availability of typical components of the informational educational environment at the university and at the faculty is given in tab. 1. In the analysis the administrative components such as the system of electronic document circulation, working out of teaching load, etc. are not considered. Besides, information resources such as an official website of the establishment, a selection committee website, etc. are also not considered. If a component is not implemented in the whole university and is absent at the Faculty of Security, there is the name of the department where the component functions.

All standard components are present formally. Three of them are used exclusively with the purpose of distance education. There is a gradual implementation of the system of distance learning and the testing system. But the implementation is carried out on the initiative of several teachers on a number of several subjects and only for support of self-study work of students.

**Table 01.** The analysis of availability of components

Component	Availability in TUSUR
Electronic library	TUSUR library Scientific-educational portal of TUSUR
Electronic time-table	Time-table of TUSUR
Electronic journal of attendance	Journal of attendance of TUSUR

Electronic journal of progress	Current progress of students in TUSUR
Online account of the teacher, the student	Account in TUSUR
System of distance education	Faculty of Distance Education
Testing system	Faculty of distance education
Legal-reference systems	Consultant, Garant
System of plagiarism detection	Antiplagiat.vuz
Corporate e-mail	Corporate e-mail of the Faculty of Security
Service of videoconference	Faculty of Distance Education

During the analysis of disadvantages is revealed that the formation of the informational educational environment at the Faculty is topical. At the given stage it is necessary to minimise duplication of introduced components with the components used at the level of the university. On the basis of the enumerated disadvantages it is possible to formulate following requirements to the informational educational environment of Faculty of Security:

- availability of all components via the Internet;
- availability of system of teaching aids allocation;
- availability of testing system;
- engaging of all teachers and students to the work in the informational educational environment;
- availability of all subjects in system of teaching aids allocation;
- correspondence of the subject format in system of teaching aids allocation to format of arning kits;
- realisation of sending assignments and progress monitoring through the system of teaching aid allocation;
- availability for students to send reports on assignments in electronic form via the system;
- availability of corporate e-mail for students;
- availability of videoconference system;
- integration of the following systems: teaching aids allocation, testing, current progress control, videoconferences.

If all requirements are met, the following will be possible:

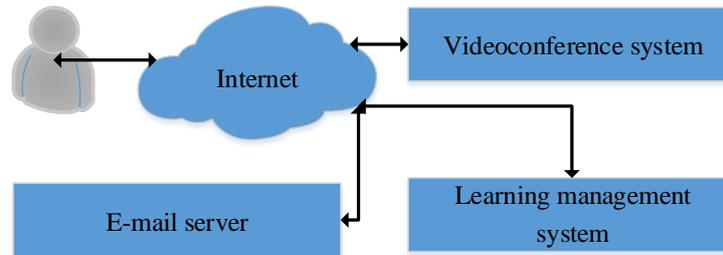
- to raise the dean's office overall performance;
- to increase availability of teaching aids for students;
- to accelerate information interchange process between participants of educational process;
- to expand quantity of the subjects adapted for teaching in the distance form;
- to prepare the technological base to implantation of network education.

#### **4. Purpose of the Study**

The main purpose is creation of the structure of the informational educational environment.

#### 4.1. Structure of the informational educational environment

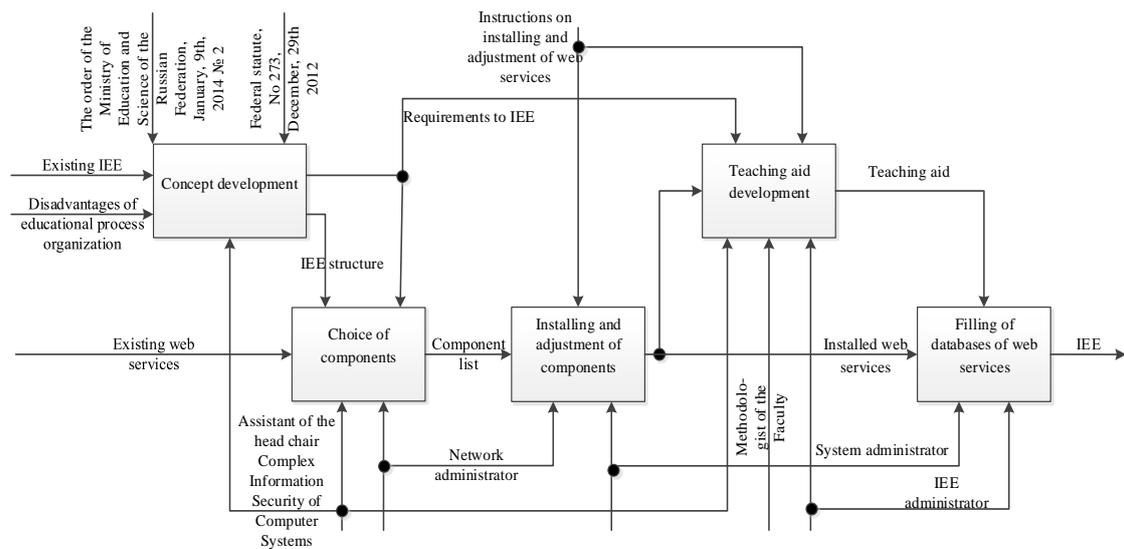
In accordance with the requirements and considering that there is no duplication of the services, the informational educational environment should include: learning management system (including systems of testing, control of progress and teaching aid allocation); a videoconference system and an e-mail server for students. The offered structure is presented on fig. 3.



**Figure 03.** Offered structure of the informational educational environment

Thus, the purpose of the work is to build the informational educational environment at Faculty of Security in the capacity of an infrastructure for development of the electronic form of education. To succeed in object, it is necessary to solve the following tasks:

- to choose the network services for realizing the components of developed structure of the informational educational environment;
- to install and adjust the chosen network services;
- to determine the functions of network services according to the requirements to the informational educational environment;
- to work out the teaching aids on network services usage;
- to develop the database of network services of all teachers' and students' accounts of the full-time education on the Faculty of Security;
- to develop a section for each subject and to differentiate the access of teachers and students to the created sections.to raise the dean's office overall performance.



**Figure 04.** Functional process model of formation of the informational educational environment

To guarantee the fulfilment of tasks on developing of the informational educational environment, it is necessary to solve following tasks in management sphere:

- to determine the sequence and terms of execution of the defined production tasks;
- to determine the roles of participants of the development process;
- to choose and assign the employees for each role;
- to control the execution of the defined production tasks. to work out the teaching aids on network services usage;

Stages of development of informational educational environment (IEE), and also connection between them are schematically presented on fig. 4 in notation IDEF0.

## 5. Research Methods

### 5.1. Choice of Learning Management System.

The use of Learning Management System (LMS) in Russia has received widespread occurrence in the sphere of distance education. Reviews of systems show that leaders by quantity of introduction in universities providing services of distance learning are LMS Moodle, LMS ‘Prometheus’ and eLearning Server of ‘Hypermethod’. LMS ‘Prometheus’ and eLearning Server are commercial products. LMS Moodle is a free, open source system.

Based on these data and considering necessity of usage of free software, LMS Moodle has been chosen as a component for control system.

Capabilities LMS Moodle (Beatty & Ulasewicz, 2006; Al-Balushi, & Al-Abdali, 2015; Jackson, 2017):

- usage of an open-source code allows to make any necessary changes to the system functional;
- the system offers a big set of interactive elements: forums, tests, glossaries, resources, chats etc., including the possibility to send report;
- extensive toolkit for development of tests and realization of intermediate and final testing;

- the complete information on progress of a student is traced for each course;
- the system is integrated with mail systems, that is the information from the teacher to students and vice versa can be exchanged by e-mail;
- by means of the built-in calendar it is possible to determine the date of the beginning and end of each course, to change certain assignment dates and testing due dates.

Due to additional programs supporting integration with LMS Moodle, it is possible to extend the functional. For example, additional estimation of students' knowledge is possible by means of assessment tool SIETTE (Conejo, Guzmán, & Trella, 2015).

Thanks to this possibilities, LMS Moodle is used for the development of an interactive educational environment in many countries of the world by preparation of experts both technical and other specialties, and also at the realization of additional refresher courses (Nagy, 2016; Costa, Alvelos, & Teixeira, 2012; Warden, Stanworth, Ren, & Warden 2013).

Thus, all requirements to the learning management system are met. The hardware and software configuration of the server in the faculty local area network meets the system requirements of LMS Moodle.

## **5.2. Choice of videoconference system.**

Extensive reviews of videoconference systems are presented on websites Webinarmarket: Places (2015) and Places for webinar holding (2015). In these reviews, the websites offering services of webinar are presented: gvoconference.com, myownconference.ru, www.comdi.com, www.webinary.biz, www.v-class.ru, www.webinar.ru, www.webinarpro.ru, etc.

Basically the functional of webinar platforms is approximately identical (Features and functionality of webinar places, 2015, Key features - Webinars - a virtual classroom WebSoft, 2015, Nagy, & Bernschütz 2015):

- unlimited quantity of participants;
- broadcasting of video, sound and presentation materials (ppt, pdf, etc.);
- an interactive board;
- desktop demonstrating;
- delegation of moderator's function to other participants;
- sending of messages to all participants (a common chat) and personally to one of the participants (private chat);
- a function 'to raise the hand' to draw attention of the moderator;
- determination of a list of people admitted on webinar, and demonstration of this list during the webinar;
- switching on/off the video and sound for other webinar participants by the moderator;
- history record keeping of a webinar.

The main disadvantage of these platforms is that they are payware. The second disadvantage is the absence of integration into the learning management system. Since LMS Moodle is chosen as a learning management system, it is necessary to consider those videoconference systems which can be integrated in Moodle.

Two freeware videoconference systems allowing integration with LMS Moodle (OpenMeetings, Moodle plugins directory: OpenMeetings, BigBlueButton, Morales, 2010) are most popular. The advantage of these systems is that only participants registered in LMS Moodle can access a certain videoconference.

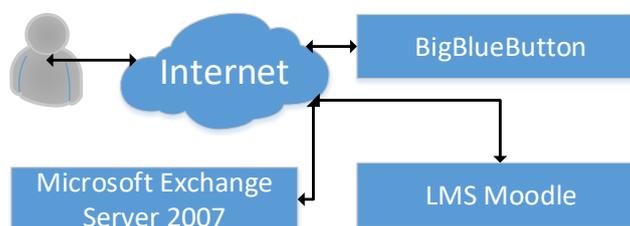
Both videoconference systems have a complete set of base functions of similar systems. Following the results of acquaintance with videoconference systems, BigBlueButton has been chosen. The hardware configuration of the faculty server in the local area network meets the LMS Moodle requirements. The Ubuntu operating system on the server is necessary for program configuration.

## 6. Findings

### 6.1. The list of the chosen components

Microsoft Exchange Server 2007 has been chosen as an e-mail server since it is integrated with ActiveDirectory service which already has all accounts of students. Accounts in ActiveDirectory are necessary for the entrance in the local area network; therefore students can work with the mail server and the local area network with the same account and password.

The total structure of the informational educational environment with the specific components is presented on fig. 5.



**Figure 05.** Structure of the informational educational environment with chosen components

### 6.2. Development of teaching aids

The main functions that are executed in the informational educational environment by participants of educational process should be present in teaching aids. In fact, teaching aids should represent instructions on usage of the chosen components for implementation of the given functions. All limitations of executable functions should be accurately formalized by developing instructions.

On the basis of the requirements presented in subsection 1.3, the main functions are selected, which should be fulfilled by teachers and the manager of the informational educational environment.

Creating of accounts in LMS Moodle (fig. 6 at the left) means registration of each student and teacher in the system. The account name in a control system of learning should coincide with the name of the account of this user in the faculty local area network. These limitations consist in usage of the initials of the user for employees (for example, Zykov Dmitry Dmitrievich - zdd). For students group number (for example, Malakhov Nikolay Vladislavovich group No 741 - 741\_mnv) is added before the initials. The address of corporate mail of a student should be introduced as the e-mail address. Function of

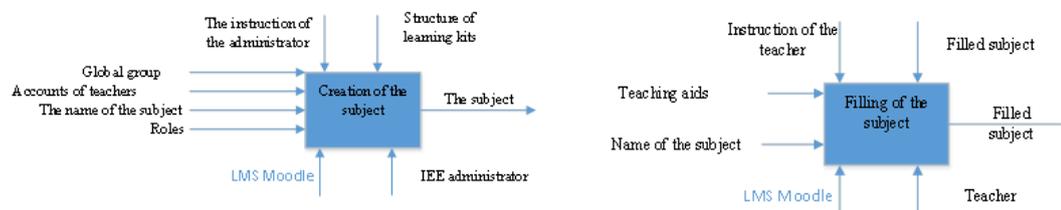
account creating is fulfilled by the manager of the informational educational environment. Except the mentioned data, the manager should enter a temporary password with the function of mandatory password change by the user after the first log-in.



**Figure 06.** Functional model of accounts (left) and functional model of global group (right) creation

Creation of a global group in LMS Moodle (fig. 6 on the right) is necessary for automation of the students' admission to disciplines that allow to rolling in a whole group, not each student separately.

Creation of subjects in LMS Moodle (fig. 7 on the left) occurs in some stages: creation of a subject as a structural unit of LMS Moodle; granting access to the subject to students and teachers of the given subject and assignment of the appropriate roles to these users; creation of the subject structure according to learning kit structure. If required, the name of the subject, the code of the specialty and-or the semester is specified. It occurs if there are subjects with identical names but with differing contents for different specialties. Also it occurs if the subject is studied during a number of semesters.

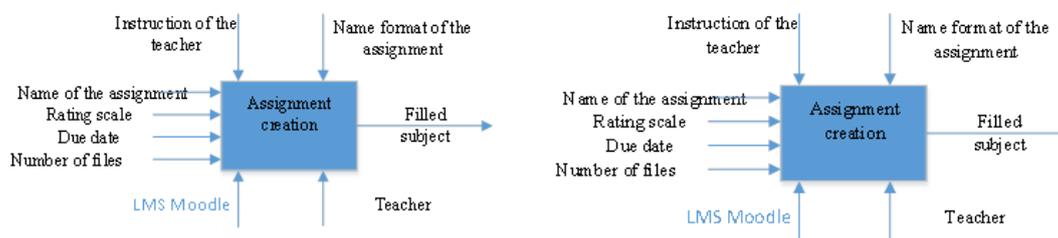


**Figure 07.** Functional model of creation (left) and filling (right) of the subject

Filling the subject with teaching aids (fig. 7 on the right) is carried out by the teacher of the given subject. The teacher can delete all sections of learning kit structure which have been not involved in educational process according to the working program. Each teacher can control the subject, in particular, to upload teaching aids, and also if necessary to change the list of the participants assigned to the course. For example, when a postgraduate student supervises laboratory works. Besides, when filling the subject, it is necessary to consider the aspect of intellectual property protection on uploaded materials.

Creation of assignments in LMS Moodle (fig. 8 on the left) allows organizing feedback of execution of practical and laboratory works. Students can upload reports on the finished work, and the teacher can evaluate them. When adding the element 'Assignment' the teacher can: set a rating scale including the maximum quantity of points; define the maximum quantity of files uploaded by students (report, requirement specification, archive with program source texts etc.); set up the due date of report

upload. If the student has exceeded the time limit of the report, the period of delay will be displayed to teacher.



**Figure 08.** Functional model of the assignment creation. Functional model of videoconference creation

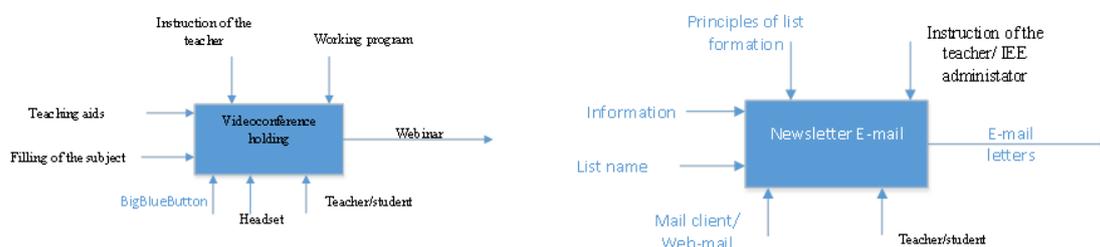
Videoconference BigBlueButton in LMS Moodle (8 on the right) can be created on any subject. Only the participants rolled in to the course will be admitted to the videoconference. A videoconference can be created by the manager of the informational educational environment according to the dean's office time-table or by the teacher, for example, for consultations. The videoconference system BigBlueButton grants access to records of the held webinar and to viewing the created records during the lessons. In order to implement this function, it is necessary to activate recording to indicate the duration of the record.

During the videoconference (fig. 9 on the left) BigBlueButton gives the teacher possibility to use various tools of representation of teaching aids for various types of lessons.

For any kinds of lessons there is a function of audioconference.

For lectures there is an interactive board with the function of drawing and demonstration of documents.

For practical and laboratory works the teacher can assign the role of moderator to one of the course participants with the purpose of answering the questions and also of showing the desktop for demonstration of the additional software or protection of laboratory works. The function of desktop demonstration requires the installation and running Java VM in the Internet browser.



**Figure 09.** Functional model of videoconference realisation (on the left) and functional model of the mailing list application (on the right)

Sending the information by teachers, the manager and dean's office to students is realised on the basis of mailing lists. Mailing lists are formed on the e-mail server and the mailing to participants of groups, courses and to all students can be conducted. Teaching aids should include the description of mailing lists usage and principles of mailing lists formation (fig. 9 on the right).

The presented functional models are implementation of the function determination task of network services. According to these models, the manager of the informational educational environment develops instructions for the teacher, for the manager of IEE and the student. Thus, the stage 'Development of methodical instructions' is successfully completed.

### **6.3. Development of the informational educational environment.**

The network administrator and the system administrator have realised all network services and have assigned it network addresses and-or corporate domain names. The manager of the informational educational environment has customised the learning management system, having created accounts of all users and the subjects. The system administrator has created accounts of students and mailing lists on e-mail server.

Control system of learning (LMS Moodle) - edu.fb.tusur.ru.

Videoconference system (BigBlueButton) - 79.136.240.154. Launch of videoconference is carried out at LMS Moodle.

E-mail server (Microsoft Exchange 2007) - stud.fb.tusur.ru. Accounts for all students and mailing lists are created. A standard e-mail address of the student – 'number of group\_initials@stud.fb.tusur.ru».

Examples of mailing lists:

- rstudents (mailing to all students);
- r714 (mailing to all students of group No 714);
- r1kurs (mailing to all students of 1st course).

In LMS Moodle, accounts of all participants of the informational educational environment with the indication of e-mail addresses are created. Thus, all components are given in a ready condition and integrated with each other. It means, that stages 'Installation and adjustment of components' and 'Filling of databases of web services' are completed and the informational educational environment is generated.

## **7. Conclusion**

During the development of the informational educational environment, the concept IEE on the Faculty of Security is defined. The concept also includes some components which are absent on the level of the university: learning management system, videoconference system, a server of corporate e-mail for students. The choice of components is founded on the requirements to the informational educational environment, formulated on the basis of the revealed disadvantages. The main disadvantage is low involvement of teachers of the Faculty into the sphere of electronic learning, i.e. absence of materials suitable for self-study learning, and insufficient usage of modern communication resources in educational process.

At various stages, the reasonable choice of components of the informational educational environment (CMS Moodle, BigBlueButton, MS Exchange Server 2007) and their installation was carried out. The main advantage of developed structure of IEE is integration of all installed components with each other. During the adjustment of components the following has been created: accounts of all

teachers and students in learning management system; accounts of all students and mailing lists on the e-mail server.

The teaching aids considering the main functions of participants of the informational educational environment have been developed for the subsequent learning of teachers and students to the work in the informational educational environment.

The received informational educational environment is ready-to-use in educational process in full time study and is at the stage of approbation.

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