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RESEARCH AND EDUCATIONAL ACTIVITIES IN NGN FIELD

LABORATORY COMPLEX OF STUDY AND RESEARCH OF NGN/IMS/OSS NETWORK TECHNOLOGIES AND PROTOCOLS – SOTSBI-U

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INTRODUCTION

Novadays we can see that development of NGN/IMS network requests educational institutions to design new model of research and educational activities in NGN field.

In this article authors are going to tell about laboratory complex SOTSBI-U created to study and research NGN/IMS/OSS network technologies and protocols.

The complex is aimed to create a totally new approach to education in telecommunication area and Next Generation Network technologies.

At this point complex is successfully running in The Bonch-Bruevich Saint-Petersburg State University of Telecommunications (SUT). More than thousand students of SUT have passed education on the complex, about fifty graduation works were written about the complex. Also the complex is deployed in Moscow, Yekaterinburg, Astrakhan, Rostov-on-Don.

NGN RPOTOCOLS AND TECHNOLOGIES LEARNING MODEL

The main concept of the complex SOTSBI-U is in providing students with possibility of research and practical work with telecommunication equipment under lecturer's control and with guidelines. We can mention, that student's research work is the main part of new Russian educational conception.

Education on the complex consists of four stages:

- Learning of theoretical material
- Knowledge test
- Laboratory tasks on computers
- Practical and research work with real equipment

First three stages are realized in educational computer program SOTSBI-U and the last stage – in NGN equipment area of the complex.

The complex can be conditionally divided in two parts: NGN equipment area and student's and lecturer's workstations.

A Next generation network (NGN) is a packet-based network which can provide services including Telecommunication Services and able to make use of multiple broadband, Quality of Service-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies.

Particularity of NGN is that the voice and data transmission occurs over packet-based network (TCP/IP). So NGN entities can be considered as software applications.

Network area consists of NGN entities connected by LAN. All entities are realized on open software.

Lecturer's and student's workstations also are connected to NGN area with LAN. On workstations are installed educational computer program SOTSBI-U, NGN terminals, NGN protocol testers-analyzers, text editor, other NGN elements management interfaces. So workstations can be considered as part of NGN area.

On the lecturer's workstation are installed statistic system, management interfaces for all elements of the complex and student's workplaces remote control system.

Also for lecturer and students ware prepared special tutorials with described learning activities and guidelines on how to work with NGN equipment.

EDUCATIONAL COMPUTER PROGRAM SOTSBI-U

To improve theoretical knowledge of NGN protocol educational computer program was created on base of Macromedia Flash Technology. It has theoretical material in form of multimedia presentation about main NGN protocols (RTP, SIP, H.248 Megaco, Sigtran). The example is shown in Fig.1.



Figure 1. General view of theoretical material

To check student's knowledge were designed tests with questions about NGN protocols and technologies. Program can check answers and point out topics which are not well studied.

After passing tests students can do laboratory tasks. These tasks are to study message sequence during call establishment and format of messages of NGN protocols.

Example task from protocol SIP course is shown in Fig. 3. Students here are asked to form 200OK answer message while they have initial INVITE message and some additional information. The program checks automatically if the task was performed correct or not.

●IP-agpeca		INVITE		
Значения	Request-Line: INVITE sip Content-Length: 337 Contact: <sip:116@1 Call-ID: 94D7CF8A-E Content-Type: applio From: "Alex"<sip:116 CSeq: 1 INVITE Max-Forwards: 70 To: "Elena"<sip:114(Via: SIP/2.0/UDP 192 Message body</sip:114(</sip:116 </sip:116@1 	114@192.168.0.196 SIP/2.0 '92.168.0.18:1000> E91FF452@192.168.0.18 vation/sdp @192.168.0.18;tag=125727 @192.168.0.196> 2.168.0.18:1000;rport;branch=z9hG4bKc0a800		
		200 0 K		
	Status-Line:	Status-Line		
	From:	URI отправителя запроса		
	To:	URI логического адресата запроса		
	Via:	Список пройденных элементов сети SIP		
	Call-ID:	Уникальный идентификатор сеанса связи		
Удалить все	Cseq:	Уникальный идетификатор запроса		
Ответить	Content-Length:	Длина тела сообщения		
Блокнот	Content-Type:	Тип тела сообщения		
Глоссарий	Contact:	Текущий адрес пользователя		
Проверить 0/5	Message body			
Лабораторная В при	верхней части экрано едназначенного для ин льзователь с номером 2.168.0.196). Заполнить з м дания теля сообщени	и представлен трейс запроса INVITE ициации сеанса связи в режиме точка-т 116 (IP-адрес 192.168.0.18) вызывает пол иначения соответствующих заголовков для в (ответа) равна 220	(тело сообщения не очка (без участия Про ьзователя с номером ответа 200 ОК на запр	отображе жси-сервер 114 (IP-ад юс INVITE, г

Figure 2. General view of laboratory task in course 'Protocol SIP'

Also the glossary was integrated in the program. It contains terms about all telecommunication technologies. Students have access to this glossary from every point in the program, so they can always find out what means every new term they meet.

COMPLEX REALIZATION

NGN network area consists next open-source based elements:

- IP PBX Asterisk software IP PBX. GNU GPL license.
- GNU-GK gatekeeper H.323. GNU GPL license.
- FreeSWITCH software IP PBX. Mozilla Public License.
- SIP Express Router (SER) software IP PBX. GNU GPL license.
- SipX ECS IP PBX software IP PBX. GNU GPL license.
- OpenIMS IP Multimedia Subsystem server.

Software installed on student's workplaces:

- Twinkle SIP Softphone. GNU GPL license.
- SJPhone SIP, H.323 Softphone.
- Ekiga SIP Video Softphone.

- SIPp SIP tester-emulator.
- WireShark Network protocol analyzer.
- Text editor OpenOffice

Base structure of the complex is shown in Fig. 3.



Figure 3. Base structure of the complex

Hardware realization

The complex consists of server (powerful computer), on which all software elements are installed and user's personal computers on workplaces.

Usage of open source software Xen-server (virtual-machine monitor) allows several guest operating systems to execute on the same computer hardware concurrently. This way all NGN network elements are installed on one physical machine.

Due to usage of open source software LTSP (Linux Terminal Server Project) is a free and open source add-on package for Linux that allows many people to simultaneously use the same computer. Applications run on the server with a terminal known as a thin client (also known as an X terminal) handling input and output. Generally, terminals are low-powered, lack a hard disk and are quieter than desktop computers because they do not have any moving parts.

The usage of LTSP and Xen-server technologies allows essentially reduce expenses for hardware.

Student's workplace control

Student's workplace control is realized with open source software ITALC (Intelligent Teaching And Learning with Computers).

iTALC(intelligently Teaching And Learning with Computer) is a free open source software for managing classroom computers in Linux and Windows, which is aimed at a school environment. iTALC enables teachers to remotely monitor and control students' computers. This allows the teacher to perform demonstrations, to close windows and to shut down the computer.

OPEN SOURCE SOFTWARE EXPLOITATION SPECIFICS

Open source software Web-interface development

Main elements of the NGN network of the complex are software platforms (Softswitch) Asterisk and FreeSwitch. This is open source software and it is installed on Linux operating system. Platform managing proceeds via command line.

Direct operating with command line requests user to know main commands and parameters and rules for their input and of work with configuration files. Also work via command line is not obvious and there is no graphic interface. So it is clear that managing via command line is quiet difficult for unprepared user

Also there is realized option of remote management of all elements of NGN network on the complex, wich is quiet hard to realize with command line.

To solve this problems special web-interface was designed. This interface contains highly understandable commands in Russian language, graphical display, possibility of command choice from the list. Also the benefit of web-interface is that through it NGN equipment can be managed from every workstation of the complex.

Web-interface was designed with next technologies :

- PHP programming language Hypertext Preprocessor is a widely used, general-purpose scripting language that was originally designed for web development to produce dynamic web pages
- MySQL relational database management system that runs as a server providing multi-user access to a number of databases
- JavaScript language standard and is typically used to enable programmatic access to computational objects within a host environment

Guidelines were created for each new interface.

General view of the interface of IP PBX Asterisk is shown in Fig. 4.

📕 😢 Web-интерфейс управ.	× 🛨							
	http://8	4.204.14.207:22444/index.php					QIP Search	
		Vr	прарлоцио	SID эбоцоцта		Astorisk		
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	0 130	phones	181			0.0.0.0	alaw	
актирование фаилов конфигурации	0 191	internal	191				alaw	
дактирование БД SIP								
осмотр LOG-файла								
В начало	disallow	all						
Выход	allow	alaw						
	callorid	150						
		130						
	call-limit	1						
	canreinvite	no						
	context	internal						
	defeulturen	150						
	fullcontact							
	host							
	ipaddr							
	lastme							
	name	150						
	port							
	regseconds	0						
	cocrat	150						
	secret	150						
	type	friend						
	useragent							

Figure 4. Interface for IP PBX Asterisk

Methodological guidelines

For educational and research activity organization methodological guidelines need to be designed for the complex. Were created guidelines with tasks on educational and research work on the complex.

Students are offered to:

- Perform base operations with equipment
- Configure equipment in definite way
- Analyze Wireshark traces
- Develop new features for web-interfaces
- Analyze parameters or RTP-payload
- Analyze dependence of transmitted multimedia quality from different NGN network parameters.

Also were created tasks with usage of tester SIPp, which are aimed on analyzing of network reaction on unexpected action (wrong message, error message) and network testing under load.

One of the tasks consists in finding out a mistake especially and rpeviously made in a message in SIPp scenario. This task is illustrated in Fig. 5.

SIPp	- Astoriek	
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Новый » Отправ. О » Сооб. клиента		<pre>4 From: "[\$sipp]" <sip:[\$sipp]@[\$domen]>;tag=[pid][call_numbe 5 To: "[service]" <sip:[service]@[\$domen]></sip:[service]@[\$domen]></sip:[\$sipp]@[\$domen]></pre>
Новый » Принять О » Сооб. сервера		<pre>6 Call-ID: [call_id] 7 CSeq: 1 INVITE</pre>
Новый » Собств.сооб Новый » Атрибут »		<pre>© Contact: <sip:[\$sipp]@[local_ip]:[local_port]></sip:[\$sipp]@[local_ip]:[local_port]></pre>
Новый» RTP»		10 Content-Length: [len]
Новый » собств.тэг О »		11 12 v=0
УДАЛИТЬ О		
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HOREIX	subscribe	

Figure 5. Task using tester SIPp

CONCLUSION

So we can see new approach for study in NGN using the most progressing software – open software.

The two main ideas of the project:

- Students should have possibility to work with real equipment.
- Open software is the most developing software.

Advantages of open software usage are clear:

- It is constantly developing
- There is possibility to configure it for particular needs
- There is no need to pay for it.

But in the same time the usage of open software has limitations:

- Configure process is quit hard
- Need to develop web-interfaces
- Translation of documentation into language of the country where it is used.

In spite of these limitations it is clear that the usage of open software is upcoming trend in educational institutions such as schools and universities. Described complex is an example of usage open software in field of NGN studies.

The project is aimed to develop and produce research-and-development complex designed for intensive study of NGN/IMS/OSS network technologies and signaling protocols. The complex is to be consisted of a range of interconnected NGN/IMS telecommunication entities based on a local area IP network thus it can be considered as a real NGN/IMS network imitation. Learners will have the possibility to manage every element of the complex.

Particular qualities of the project are:

- The usage of open and free software;
- Web-interface for managing telecommunication equipment;
- Provision with technical documentation under equipment management in Russian language;

• Provision with methodological guidelines for education organization

Due to the facilities described above education based on the research-and-development complex SOTSBI-U surpasses by far traditional means of education in area of next generation telecommunications.

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