



**THE APPLICATION OF NETWORK SIMULATORS AND THEIR  
SIGNIFICANCE IN EDUCATING AND ENABLING STUDENTS  
TO APPLY THEM IN SOLVING TRAFFIC  
AND TRANSPORT PROBLEMS**

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**Abstract:** *This project demonstrates the work of network simulator, CISCO Packet Tracer 5.3., where the network infrastructure of Stock company “Železnice Srbije” is presented in real time. As simulative software, CISCO Packet Tracer provides students of the study program Electrical Engineering in traffic and transport, department of Telecommunications in Railway College, with the possibility to apply the theoretical knowledge learned before, to project, and it enables them to apply new technologies, or computer communications that have been in practice not only in railway systems, but in other forms of transport as well.*

**Key words:** *network simulator CISCO Packet Tracer 5.3, Stock company “Železnice Srbije”*

## **1. INTRODUCTION**

Students of Railway College, student program of Electrical engineering in traffic and transport, Telecommunications Department, attend the course Protocols and standards in computer networks, where they acquire theoretical knowledge of the work of computer networks during their undergraduate applied studies, while they have their first experience in projecting, adjusting of network equipment by attending the course Administration and maintenance of computer networks by using simulative software CISCO Packet Tracer 5.3 during their postgraduate applied studies.

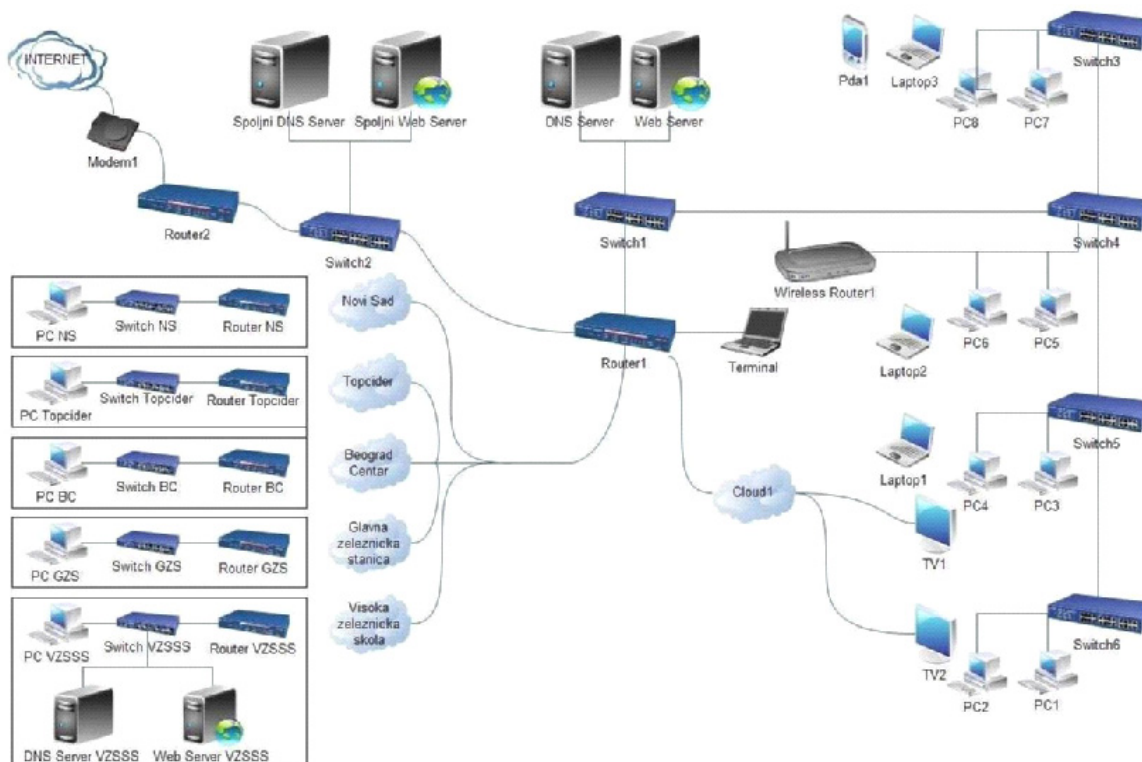
Network simulators make studying and students specializing more serious due to their real-time work, as well as simulative work, that is to say, through simulation mode in which a student manipulates time distances by having a better insight into project, disadvantages and drawbacks of complex computer-communication network.

In this way through the use of simulative software a student can easily adjust network equipment, monitor the processes in place, eliminate problems, while he specializes in adjusting network equipment in real time, not through applications but through consoles of active network equipment, all that with teacher's monitoring.

## **2. NETWORK SIMULATOR CISCO PACKET TRACER 5.3.**

Emulators and network simulators are the main issue of a number of companies, or producers of network simulators, in other words simulative networks, among which the most famous ones are: Boston NetSim, USA, Dynagen, USA, IMUNES, Europa, OPNET Modeler<sup>®</sup>, USA, as well as CISCO Packet Tracer, USA.

This paper symbolically presents the computer network of Stock company “Železnice Srbije”, that is projected and in which active network equipment is appropriately adjusted so that it demonstrates a real, complex computer-communication network. The project of the network infrastructure of Stock company “Železnice Srbije” is shown in picture 1.



Picture 1. Computer network Stock company “Železnice Srbije”

### 3. SETTING UP, CONNECTING AND CONFIGURING OF NETWORK EQUIPMENT

This section describes the set-up and connection of network equipment, as well as the configuration of active network equipment. After the project has been chosen (Picture 1), the first thing to do is to set up active network equipment on the work surface of network simulator CISCO Packet Tracer 5.3. We choose certain group of network equipment or connections, for example the group that contains routers (we click on that), then we are offered the routers that the program has. When we decide on the router that meets our needs, we click on it, then we click on the work surface and so we actually set it up (Picture 2). In the same way we organize the remaining active network equipment that is offered in the network simulator CISCO Packet Tracer.



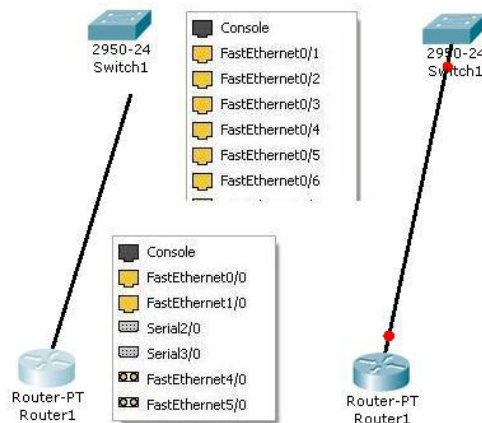
Picture 2. Active network equipment set-up

Connecting of active network equipment is similar to network equipment setting up. First thing to do is to choose the group with connections, Picture 3, then we choose the connection we need.



Picture 3. Selection of necessary connection

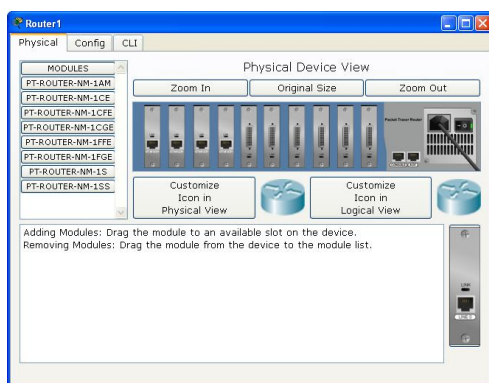
After choosing the necessary connection we should click on the selected one, then on the router where it offers a list of available interfaces of the router to which we want to join the selected connection, and finally we click on the switch where we are asked a question about the available interface we want to join the connection to (Picture 4). The other network devices are joined in a similar way. As to automatic selection of connection, the most favorable connection is automatically chosen and there is no free choice of the interface we want to join the connection to, but there is an automatic connection to the first available interface that matches the type of selected connection instead.



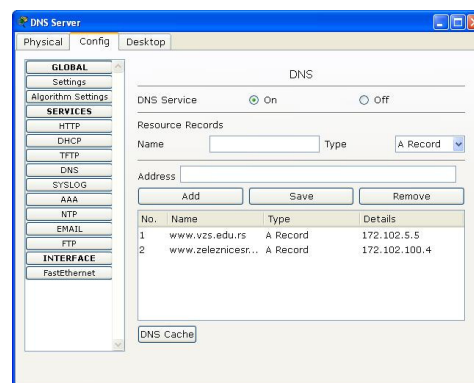
**Picture 4.** Connection of active network

After setting up and connecting network equipment it is necessary to configure network infrastructure, allocate IP addresses to routers, servers, work stations and other network devices. The configuration of router (Picture 5) has an application window that consists of three TAB cards (Physical, Config and CLI). The first Physical card is used to define physical features of a router, the second Config card is for configuration, addition of IP addresses, routing, and the third CLI card shares the same function as the second except that it is used as a terminal, which means that it shows the work of a router more realistically.

Configuring of server (Picture 6) is performed in a similar way to configuring of router. The application program of server consists of three TAB cards Physical, Confi and Desktop. The first Physical card has the same functions as that of router; the second Config is used for configuration of HTTP, DHCP, DNS, EMAIL servers, while the third Desktop card serves to define IP addresses.



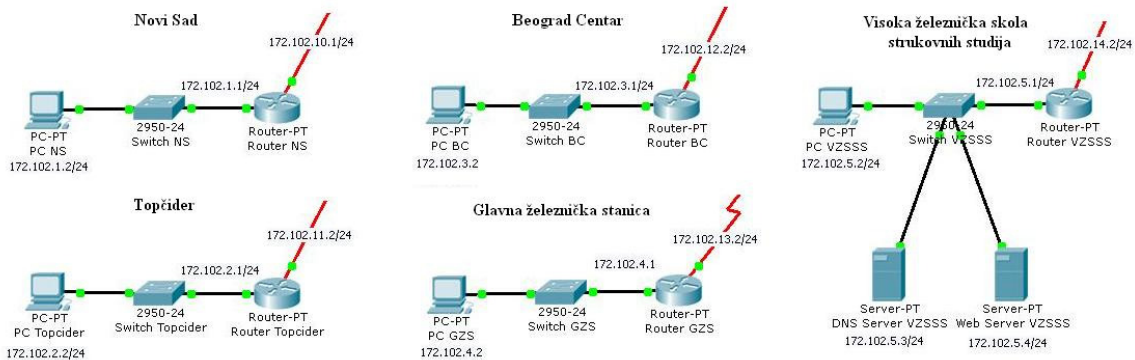
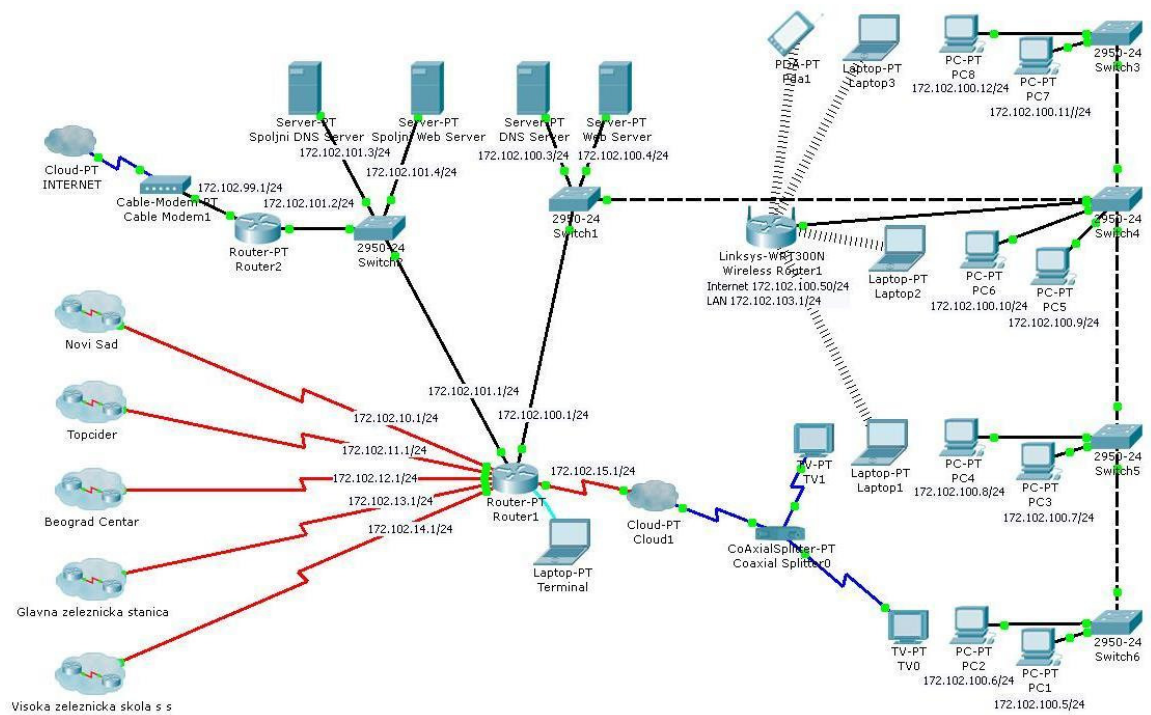
**Picture 5.** Configuration of router



**Picture 6.** Configuration of server

After adding work stations to the work surface of simulative program CISCO Packet Tracer 5.3, it is necessary to configure it, and the process is similar to router configuration and server configuration, we allocate IP addresses, network gateways (Default Gateway), addresses of DNS server.

When network devices have been set up, connected and configured, the network infrastructure of Stock company “Železnice Srbije” with IP addresses looks like in Picture 7, where at the bottom of the page there are remote groups which are symbolically “packed” into clusters, and are important to Stock company “Železnice Srbije”.



Picture 7. Network infrastructure of Stock company “Železnice Srbije”

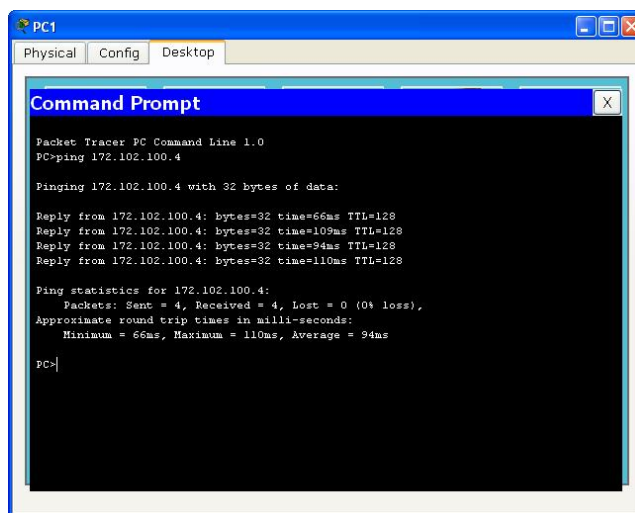
**4. TESTING OF PROJECTED NETWORK INFRASTRUCTURE**

After the network equipment has been set up, connected and configured according to the given network infrastructure, we test the work of the network, in other words, we test if the communication among all devices has been maintained. The testing of network work can be performed in two possible ways, one is through a graph and the other one is through typing the instructions in Command Prompt.

Through Ping (Packet InterNet Groper) method four packages are sent to the assigned point and after each successful response the time that packages need to get to the assigned point and back is written in milliseconds. As it has been already said here, testing of the communication among devices through Ping method can be performed in two ways.

In this project where we have projected CISCO Packet Tracer simulative program (Picture 7), we will show the workable connection of the network. To start with, we open the configuration window of work unit (PC1), select the third TAB card – Desktop, then we click on Command Prompt and type ping 172.102.100.4, which stands for the IP address of Web Server and which we ping from work unit PC1. In response we will see that four packages have been sent and that all of them have been put back (Picture 8).





**Picture 8.** *Testing of the projected network infrastructure by Ping method*

The other way to test this by Ping method is through graph. In Cisco Packet Tracer window on the right hand page in the middle we can see two buttons: Add Simple PDU and Add Complex PDU. We click on Add Simple PDU (Picture 9) then on the device we want to ping, which in our case is work unit (PC1), and after that on Web Server which we want to send packages to. Pinging process can be performed in two ways: Realtime or Simulation. Realtime presents simulation in real time, while Simulation shows the simulative process of the package going through the whole network.



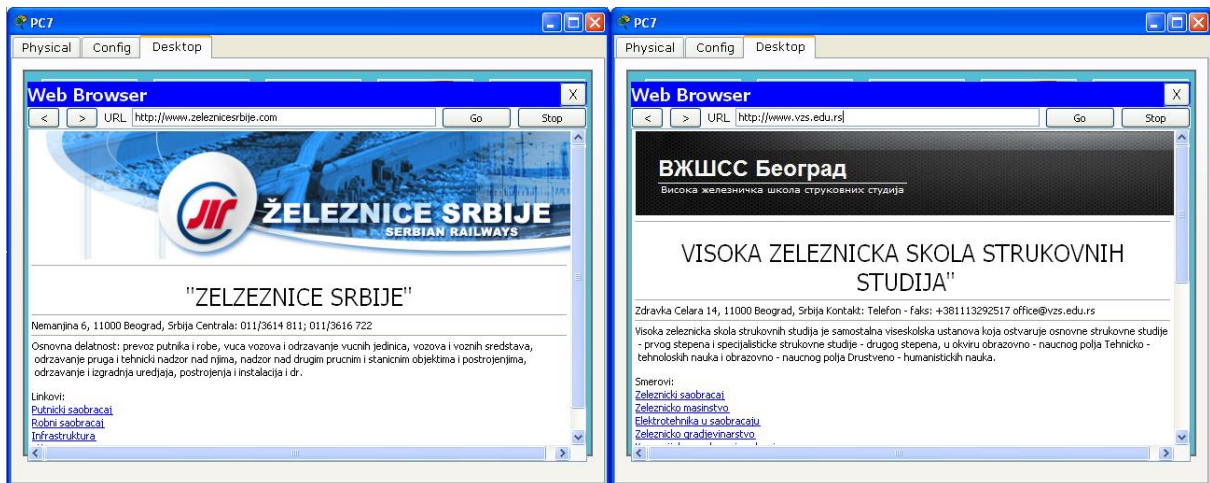
**Picture 9.** *Add Simple PDU button*

In the left bottom corner of Cisco Packet Tracer window we can see the confirmation of a successful communication among pinged devices (work unit (PC1) and Web Server), Picture 10.

Fire	Last Status	Source	Destination	Type	Color	Time (sec)	Periodic	Num	Edit	Delete
	Successful	PC1	Web Server	ICMP		0.000	N	0	(edit)	(delete)

**Picture 10.** *The confirmation of a maintained communication between PC1 and Web Server*

The way of testing the work of DNS and HTTP servers is actually an everyday and most common way of using the Internet and its essential services. The testing of DNS and HTTP servers is based on starting up Web Browser (the third TAB card – Desktop and we select Web Browser) at some work unit (PC1 for instance). In address field – URL (Uniform Resource Locator) we type the site we want to go to, in our case there are two possible sites, the site of Stock company “Železnice Srbije” (www.zeleznicesrbije.com) and the site of Railway College (www.vzs.edu.rs). When we have typed the address, we click on GO in order to load the page (Picture 11).



Picture 11. Testing of the server of Stock company "Železnice Srbije" and Railway College

## 5. CONCLUSION

By studying Cisco Packet Tracer simulator through a graph, and then the work and configuration through terminal, a student masters both projecting and operating computer networks. The simulator itself demonstrates in an easy and simple way the work of a complex computer network, while students can take an advantage of the knowledge acquired during their vocational work.

Network simulators are the means of testing the work of a projected computer-communication network through the use of modern methods of data transferring. They affect students' participation in a direct way and provide them with the possibility to realistically realize almost all theoretical foundations that they had by attending the above mentioned special courses during undergraduate and postgraduate studies.

Through the application of the simulative program such as Cisco Packet Tracer, a student trains in working in real systems, eliminating problems and monitoring the work of network infrastructure. By doing projects in this simulative program a student applies the acquired theoretical knowledge and demonstrates capability of solving problems in real systems and discerning drawbacks, while he initiates a curriculum fulfillment at the same time.

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# ПРИЛАГАНЕ НА МРЕЖА ОТ СИМУЛАТОРИ И ТЯХНОТО ЗНАЧЕНИЕ В ОБРАЗОВАНИЕТО И ДАВАНЕ ВЪЗМОЖНОСТ НА СТУДЕНТИТЕ ЗА ПРИЛАГАНЕ ПРИ РЕШАВАНЕ НА ПРОБЛЕМИ ЗА ПРЕВОЗИ И ТРАНСПОРТ

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**Ключови думи:** *мрежов симулатор CISCO Packet Tracer 5.3, акционерно дружество "Železnice Srbije".*

**Резюме:** *Този проект демонстрира работата на мрежов симулатор, Cisco Packet Tracer 5.3, когато мрежовата инфраструктура на акционерно дружество "Železnice Srbije" е представена в реално време. Като имитационен софтуер, пакетът Cisco Packet Tracer предоставя възможност на студентите от курса по електротехника в транспорта при катедрата по телекомуникации в железопътния колеж да прилагат теоретичните си знания, получени преди това, в проекти, както и нови технологии или компютърни комуникации, които са внедрени в практиката не само на железопътните системи, но също и в други видове транспорт.*