



ROUTING INFORMATION SECURITY IN THE LOCAL AREA NETWORK OF ACADEMIC DEPARTMENTS USING AN ENHANCED DISTANCE VECTOR ROUTING PROTOCOL - EIGRP

**Petar Boyanov¹, Stiliyan Stoyanov², Hristo Hristov³, Ognyan Fetfov¹,
Tihomir Trifonov¹**

¹ DEPARTMENT OF COMMUNICATION AND COMPUTER TECHNOLOGY, FACULTY OF TECHNICAL SCIENCES, KONSTANTIN PRES LAVSKY UNIVERSITY OF SHUMEN, SHUMEN 9712, 115, UNIVERSITETSKA STR

E-mail: peshoaikido@abv.bg, o_fetfov@abv.bg, t.trifonov@shu.bg

² SPACE RESEARCH AND TECHNOLOGIES INSTITUTE - BULGARIAN ACADEMY OF SCIENCES

E-mail: stil717@yahoo.com

³ DEPARTMENT OF MANAGEMENT OF SECURITY SYSTEMS, FACULTY OF TECHNICAL SCIENCES, KONSTANTIN PRES LAVSKY UNIVERSITY OF SHUMEN, SHUMEN 9712, 115, UNIVERSITETSKA STR

E-mail: hristov63@abv.bg

ABSTRACT:

In this paper a summarized simulation and providing security communication in the local area network of academic department using an enhanced distance vector routing protocol - EIGRP is made. Most of the professional system administrators and IT specialists have to use and apply static and dynamic methods of information routing. Thereby, each network system administrators, security professionals and network architects can use the free of charge software network program Cisco Packet Tracer in order to design and simulate various types of computer networks.

KEY WORDS: *Cisco, Computer and network administrators, Dynamic routing, EIGRP, Information, IPv4, LAN, Protocols, Routing, Security, Switch, Router.*

1. Introduction

Securing the transmitted routing information in the local area network of academic departments is very important task and aim for each network system

administrators, security professionals and network architects. Building and maintaining a specific local area network (LAN) of academic departments has to be simulated using the specialized software program called “Cisco Packet Tracer”. This program consists of many network tools that can simulate the transmitting network process of secured routing information between the hosts in small or large computer networks [33, 35, 37, 39]. The software program is designed and implemented primarily for students and academic lecturers who use different network devices of Cisco Systems Corporation [4, 14]. Thereby, each academic lecturer or student have to possess in-depth knowledge and skills in the designing and maintaining of various types of computer network using the enhanced distance vector routing protocol - EIGRP [15, 41, 44].

This paper is structured as follows. First, in section 2, a related work for the use the routing protocol EIGRP is made. After that, in section 3, a sophisticated implementation of the software program called “Cisco Packet Tracer” version 6.2.0.0052 into the server operating system Windows Server 2008 R2 Enterprise is performed. The achieved results are presented in section 4. The conclusions and recommendations are made in section 5.

2. Related work

In [1] the EIGRP as fast routing protocol based on distance vectors by is analyzed. In [2] performance Evaluation of secured versus non-secured EIGRP routing protocol by Al-Saud, K. A., Tahir, H. M., El-Zoghbi, A. A., and Saleh, M. is made. In [3] analysis of RIPv2, OSPF, EIGRP configuration on router using cisco packet tracer by Archana, C. is made. In [10] introduction to enhanced IGRP (EIGRP) by Farinachi, D is illustrated. In [47] simulation based performance analyses on RIPv2, EIGRP, and OSPF Using OPNET is comparative analyzed. In [46] performance analysis of dynamic routing protocol EIGRP and OSPF in IPv4 and IPv6 network by Chandra Wijaya is illustrated. In [40] dynamic routing protocol implementation decision between EIGRP, OSPF and RIP based on technical background using OPNET modeler by Thorenoor, S. G. is made. In [48] performance analysis of RIP, EIGRP, and OSPF using OPNET by Xu, Don, and Ljiljana Trajkovic is made. The other citations in this paper are based on specific performance analyses, IP configuration and network solutions.

3. Experiment

The experiment in specialized computer network laboratory in the Faculty of technical sciences is made. The used free of charge software program called “Cisco Packet Tracer” version 6.2.0.0052 which is owned by Cisco Systems, Inc. The host has used server operating system - Windows Server 2008 R2 Enterprise x64. Initially was necessary to be enumerated the network devices and hosts. The simulated local area network using Enhanced Interior Gateway Routing Protocol (EIGRP) has consisted of the following items [30, 31, 32, 33]:

- 8 personal computers (PC-PT).
- 7 Server machines (Server-PT).
- 13 Laptops (Laptop-PT).
- Several Copper Straight-Through UTP cables cat.5e
- Two Copper crossover UTP cables cat.5e.
- 3 Serial Smart DCE DB60 cables;
- One router - Cisco 2911 Modular Router.
- One router - Cisco 2621XM Modular Router.
- One router - Cisco 1841 Modular Router.
- One router - Cisco 2901 Modular Router.
- One router - Cisco 2811 Modular Router.
- 4 Generic Printer machines.
- 1 switch - Cisco Multilayer Switch WS-C3560-24PS.
- 4 switches - Cisco Switch WS-C2960-24TT.
- 1 IP phones - Cisco IP Phone 7960.
- Four academic departments (CCT, IL, Geodesy and MSS).
- One Central Equipment Room (CER).
- 3 racks for the CER.
- Six working table for the staff.
- One complete scheme of the entire network.
- One Packet Tracer Cloud Server for Internet.
- One Access Point-PT-N.
- One generic Smartphone-PT.
- One generic TabletPC-PT.

The computer network in the program environment of Cisco Packet Tracer 6.2.0.0052 is simulated. On fig.1 the common logical scheme of the whole computer network is shown. The Enhanced Interior Gateway Routing Protocol (EIGRP) [41, 42, 43, 45, 46, 47, 48] was activated in the configuration of the routers [1, 2, 16, 30, 31, 32, 33].

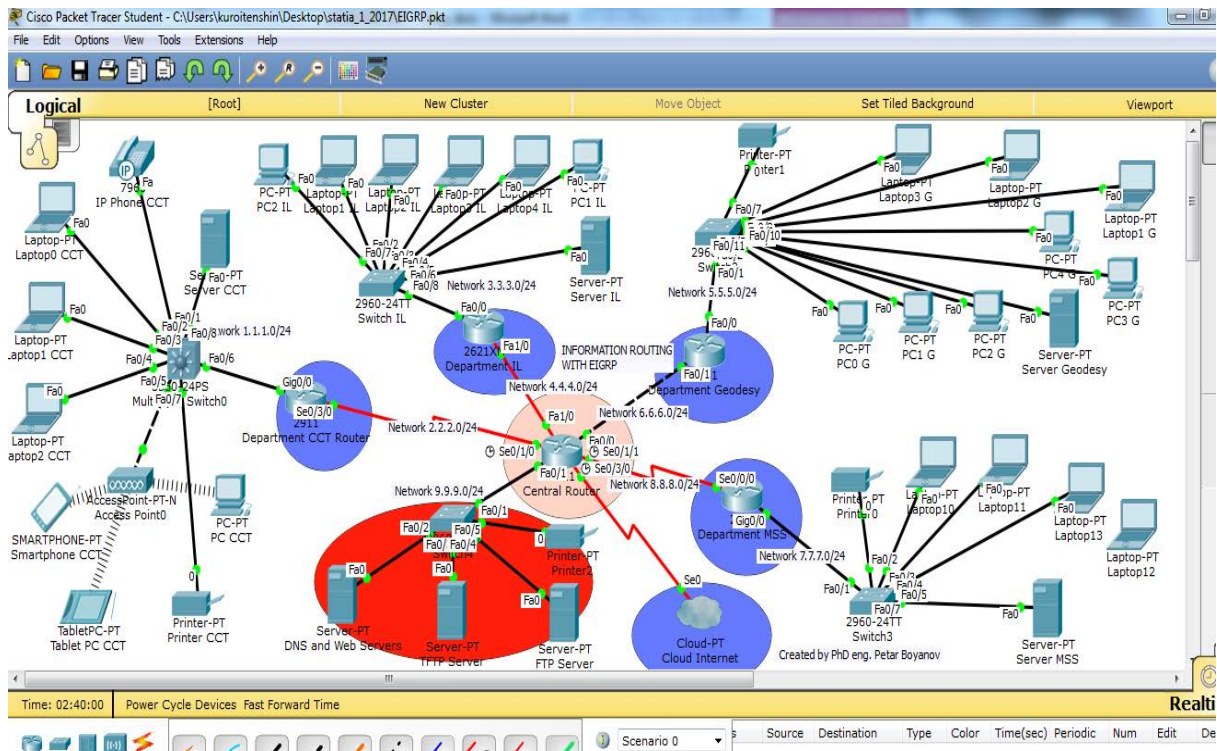


Fig.1. Common logical scheme of the whole computer network of the academic departments

As is known in the network practice each network device as a router consists of determinate numbers of network interfaces [21, 22, 23, 25, 32,]. In this communication scenario the router called “Central Router” has got configured interface Fast Ethernet (Fa0/0) with network number ID (Net ID) - 6.6.6.0/24 and interface Fast Ethernet (Fa0/1) with network number ID (Net ID) - 9.9.8.0/24. The third interface is Serial (Se0/1/0) with network number ID (Net ID) - 2.2.2.0/24. The fourth interface is Serial (Se0/1/1) with network number ID (Net ID) - 8.8.8.0/24. The fifth interface is Serial (Se0/3/0) who is directly connected to the Internet Cloud. The last configured interface is Fast Ethernet (1/0) with network number ID (Net ID) - 4.4.4.0/24.

The router called “Department CCT Router” has got configured interface Serial (Se0/3/0) with network number ID (Net ID) - 2.2.2.0/24 and second configured interface Gigabit (Gig0/0) with network number ID (Net ID) - 1.1.1.0/24. The name CCT is an abbreviation of Communication and Computer Technologies.

The router called “Department IL” has got configured interface Fast Ethernet (Fa0/0) with network number ID (Net ID) - 3.3.3.0/27 and other interface Fast Ethernet (1/0) with network number ID (Net ID) - 4.4.4.0/24. The name IL is an abbreviation of Engineering Logistics.

The router called “Department Geodesy” has got configured interface Fast Ethernet (0/0) with network number ID (Net ID) - 5.5.5.0/24 and other configured interface Fast Ethernet (0/1) with network number ID (Net ID) - 6.6.6.0/24.

The router called “Department MSS” has got configured interface Serial (Se0/0/0) with network number ID (Net ID) - 8.8.8.0/24 and other configured interface Gigabit (Gig0/0) with network number ID (Net ID) - 7.7.7.0/24. The name MSS is an abbreviation of Management of Security Systems [4, 41, 48].

The network with Net ID 1.1.1.0/24 consists of one Cisco Multilayer Switch WS-C3560-24PS and one Cisco 2911 Modular Router. In this switch are connected three Laptops (Laptop-PT), one Generic Printer machine, one Cisco IP Phones 7960, one Access Point-PT-N with connected to it one generic smartphone, one tabletPC and one personal computer with wireless card. The Server CCT is also connected to the multilayer switch. The network 1.1.1.0/24 is private local area network and its IPv4 Default Gateway is 1.1.1.1/24 and in this case this is the configured network address of interface Gigabit (Gig0/0) in router called “Department CCT Router”. The capacity of this network is 254 real hosts. The connection between the Cisco multilayer switch and the hosts with several Copper Straight-Through UTP cables cat.5e and one copper crossover UTP cable cat.5e is made. The connection between the router „Department CCT Router” and the multilayer switch again with Copper Straight-Through UTP cable cat.5e is made [11, 13, 14, 21, 26, 27, 28,].

The network with Net ID 3.3.3.0/24 consists of one Cisco 2621XM Modular Router and one Cisco Switch WS-C2960-24TT. In this case in the switch are connected two personal computers, four laptops and one server machine called “Server IL”. The capacity of this network is 254 real hosts. The connection between the Cisco switch and the hosts with several Copper Straight-Through UTP cables cat.5e is made. The connection between the router called „Department IL” and the switch again with Copper Straight-Through UTP cable cat.5e is made [6, 36, 37, 45, 46, 47].

The network with Net ID 5.5.5.0/24 consists of one Cisco 2811 Modular Router and one Cisco Switch WS-C2960-24TT. In this case in the switch are connected five personal computers, three laptops, one generic printer machine and one server machine called “Server Geodesy”. The capacity of this network is 254 real hosts. The connection between the Cisco switch and the hosts with several Copper Straight-Through UTP cables cat.5e is made. The connection between the router called „Department Geodesy” and the switch with Copper crossover UTP cable cat.5e is made.

The network with Net ID 7.7.7.0/24 consists of one Cisco 2901 Modular Router and one Cisco Switch WS-C2960-24TT. In this case in the switch are connected four laptops, one generic printer machine and one server machine called “Server MSS”. The capacity of this network is 254 real hosts. The connection between the Cisco switch and the hosts with several Copper Straight-Through UTP cables cat.5e is made. The connection between the router called „Department MSS” and the switch with Copper crossover UTP cable cat.5e is

made. The configured network devices and the third racks in Central Equipment Room (CER) are illustrated in fig. 2.

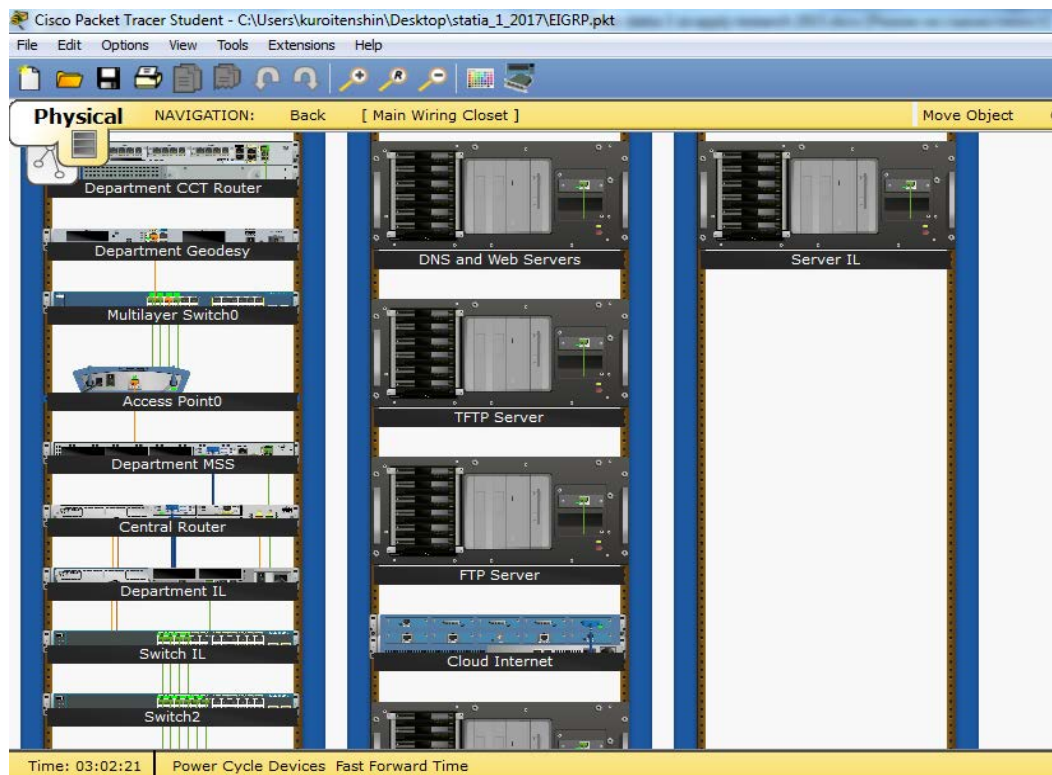


Fig. 2. The physical network devices installed in the racks

4. Results

In the command line interface of each router the network administrators must enter the command “router eigrp 9999”. The number 9999 means that is the number selected autonomous system [9, 10, 18, 19, 20, 35]. After applying other specific network commands in the command line interface of each host, then all routers are able automatically to discover each other although there is additional subnetting in the whole local area network of the academic departments [5, 6, 7, 8, 11, 12, 13, 16, 17].

One of the most important features of this routing protocol is related to the fact that EIGRP can be configured to transmit routing information with authentication process between its neighbor’s routers. Other very important feature is the encryption of the transmitted routing information [28, 30, 31, 36, 38]. Most of the network system administrators, security professionals and network architects must know that process of the authentication does not encrypt the whole routing table of each router [20, 24, 26, 27, 29].

The successful executed command ping from host called “PC2 G” to host called “Smartphone CCT” with IPv4 address 1.1.1.10/24 on fig. 3 is shown.

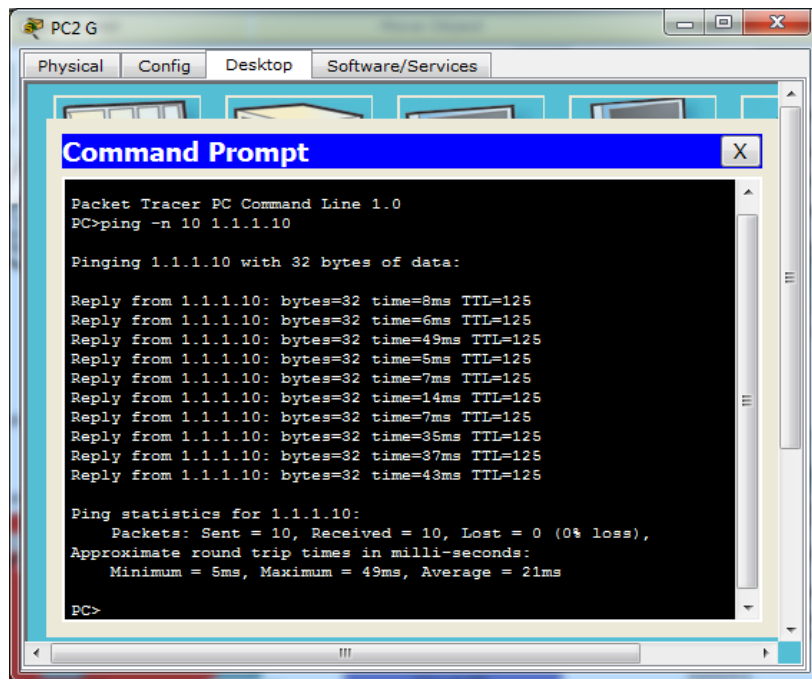


Fig.3 Successful executed command ping from host called “PC2 G” to host called “Smartphone CCT” with IPv4 address 1.1.1.10/24

In order to verify that configuration of the routing protocol EIGRP are correctly applied each network administrator must enter the following commands [47, 48]:

- IP-EIGRP interfaces;
- IP-EIGRP neighbors;
- IP-EIGRP Topology Table;
- IP-EIGRP Traffic Statistics.

The first command IP-EIGRP interfaces shows the following information:

- IP-EIGRP interfaces for autonomous system 9999;
- Interface;
- Peers;
- Xmit Queue Un/Reliable;
- Mean SRTT;
- Pacing Time Un/Reliable;
- Multicast Flow Timer;
- Pending Routes.

The second command IP-EIGRP neighbors shows the following information:

- H (The number of connected adjacency routers);
- IPv4 address;
- Interface;
- Hold time;

- Uptime;
- Smooth Round Trip Timer (SRTT);
- Retransmit Interval (RTO);
- Queue Count;
- Sequence Number.

The successfully execution of these commands on fig. 4 is shown.

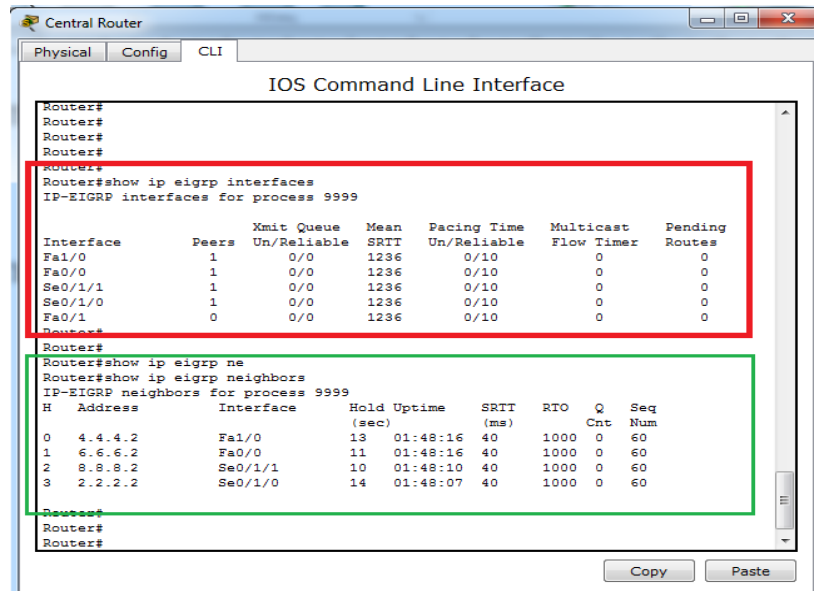


Fig. 4. Successfully execution of IP-EIGRP interfaces and IP-EIGRP neighbors commands

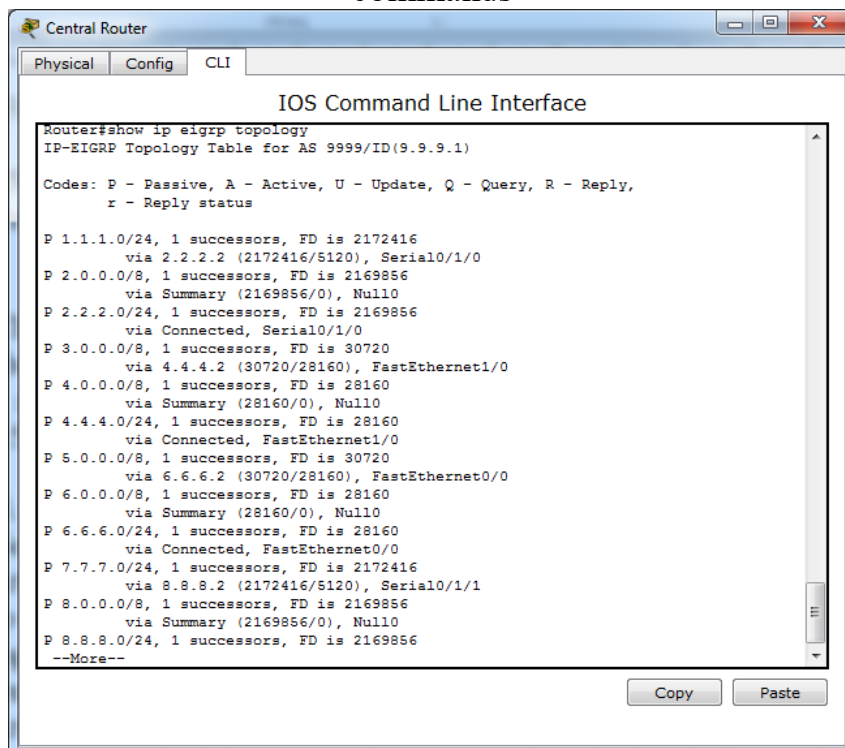


Fig. 5. Successfully execution of IP-EIGRP Topology Table

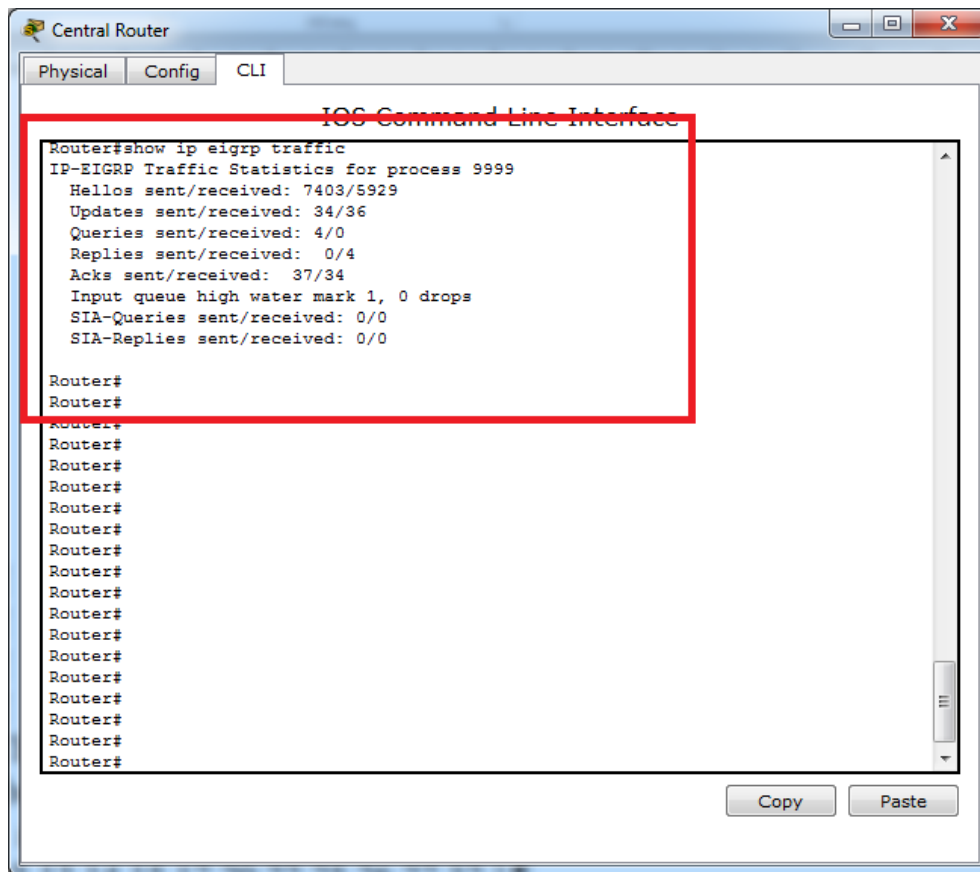


Fig. 6. Successfully execution of IP-EIGRP Traffic Statistics

5. Conclusion

Thanks to the achieved results of the conducted research experiment in this paper each network system administrators, security professionals and network architects can obtain detailed statistical information for the transmitted routing information among all hosts and network devices in the simulated local area network of academic departments using an enhanced distance vector routing protocol - EIGRP. On the other hand program is a powerful tool for designing and simulating small and large computer networks with different routing protocols.

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