

# Лабораторная работа №16

Настройка VPN.

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НПИБД-02-21

# Открытие проекта

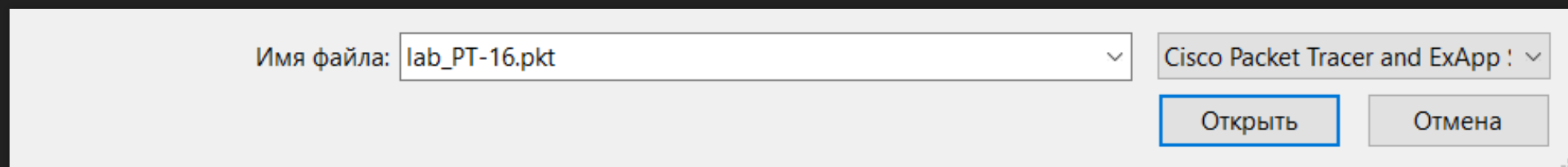


Рис. 1.1. Открытие проекта lab\_PT-16.pkt.

# Размещение оборудования

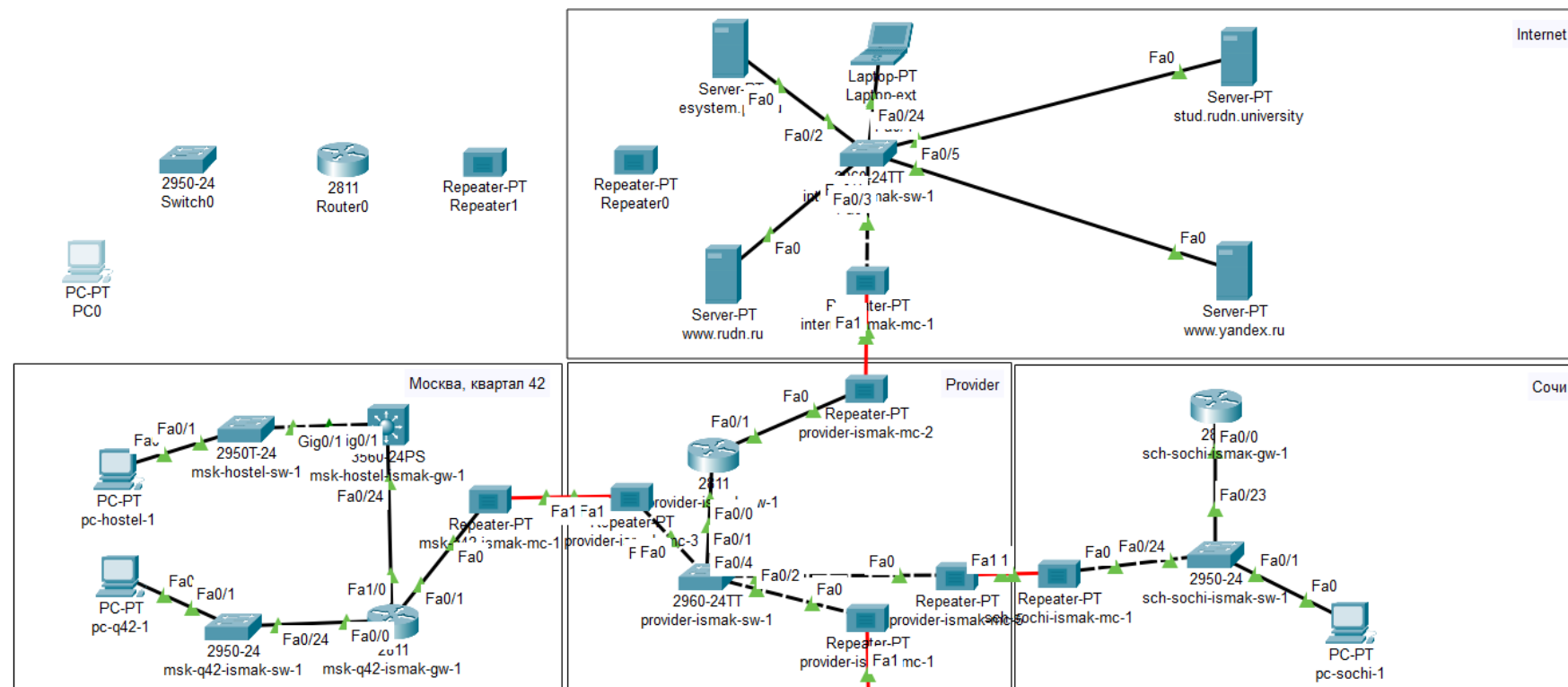


Рис. 1.2. Размещение оборудования в рабочей области проекта.

# Замена модулей

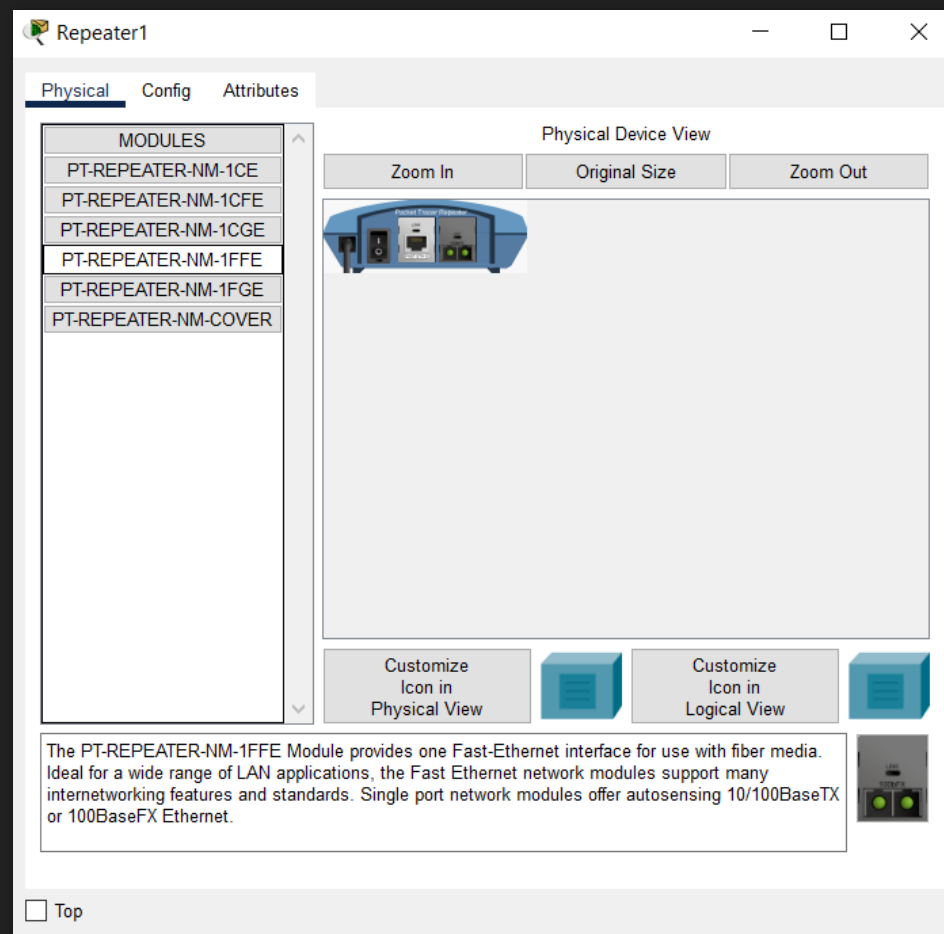


Рис. 1.3. Замена модулей на Repeater-PT.

# Подключение

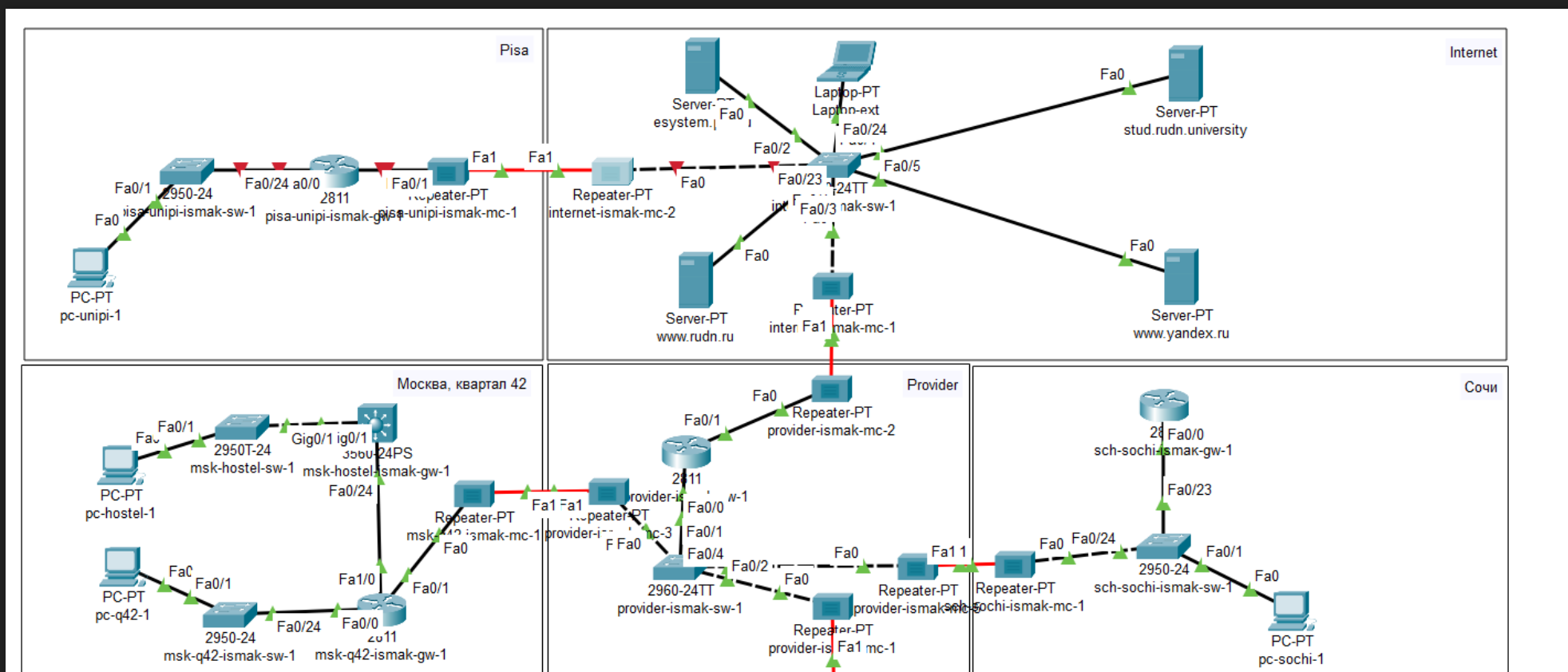


Рис. 1.4. Подключение оборудования.

# Создание города

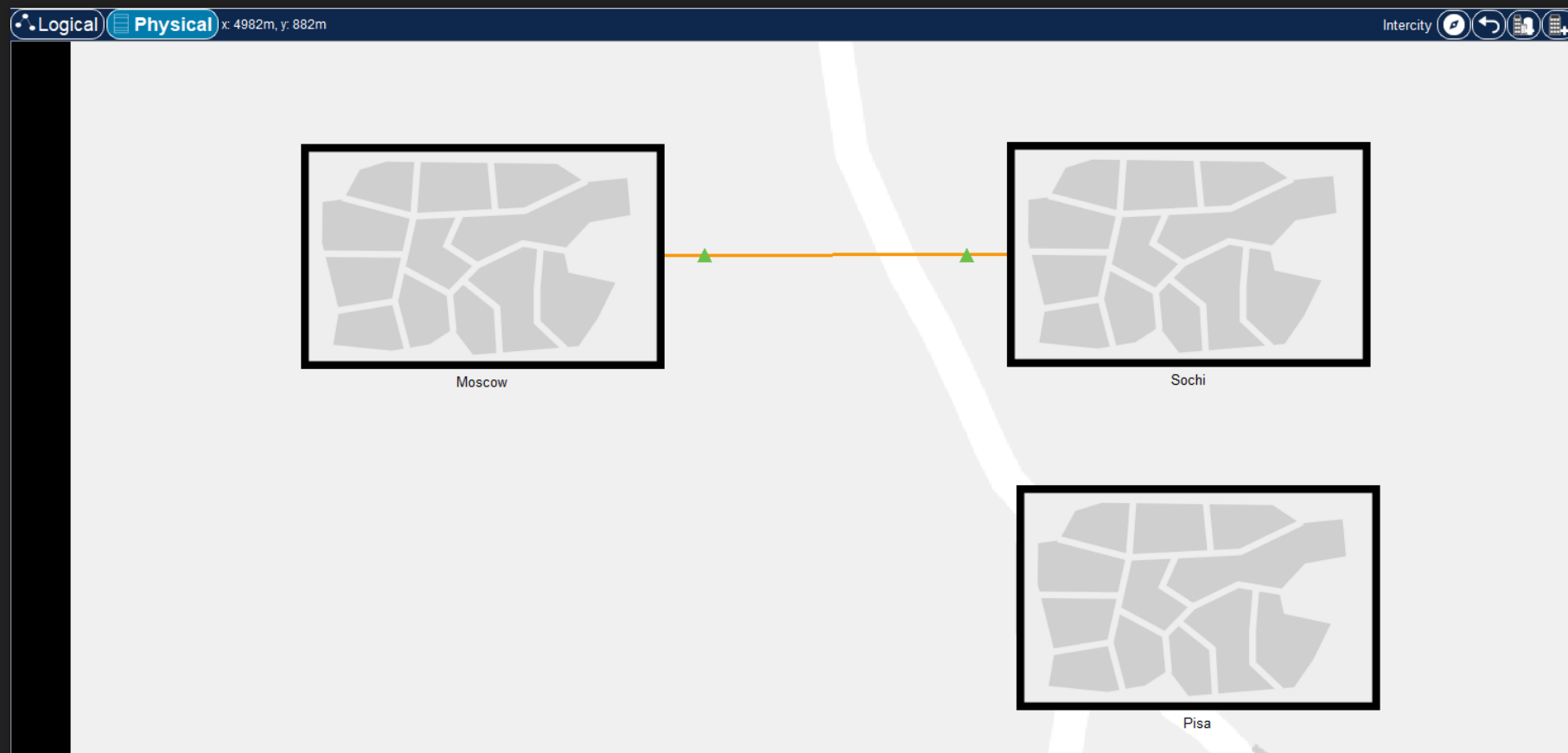


Рис. 1.5. Создание города Пиза в физической рабочей области.

# Перемещение оборудования

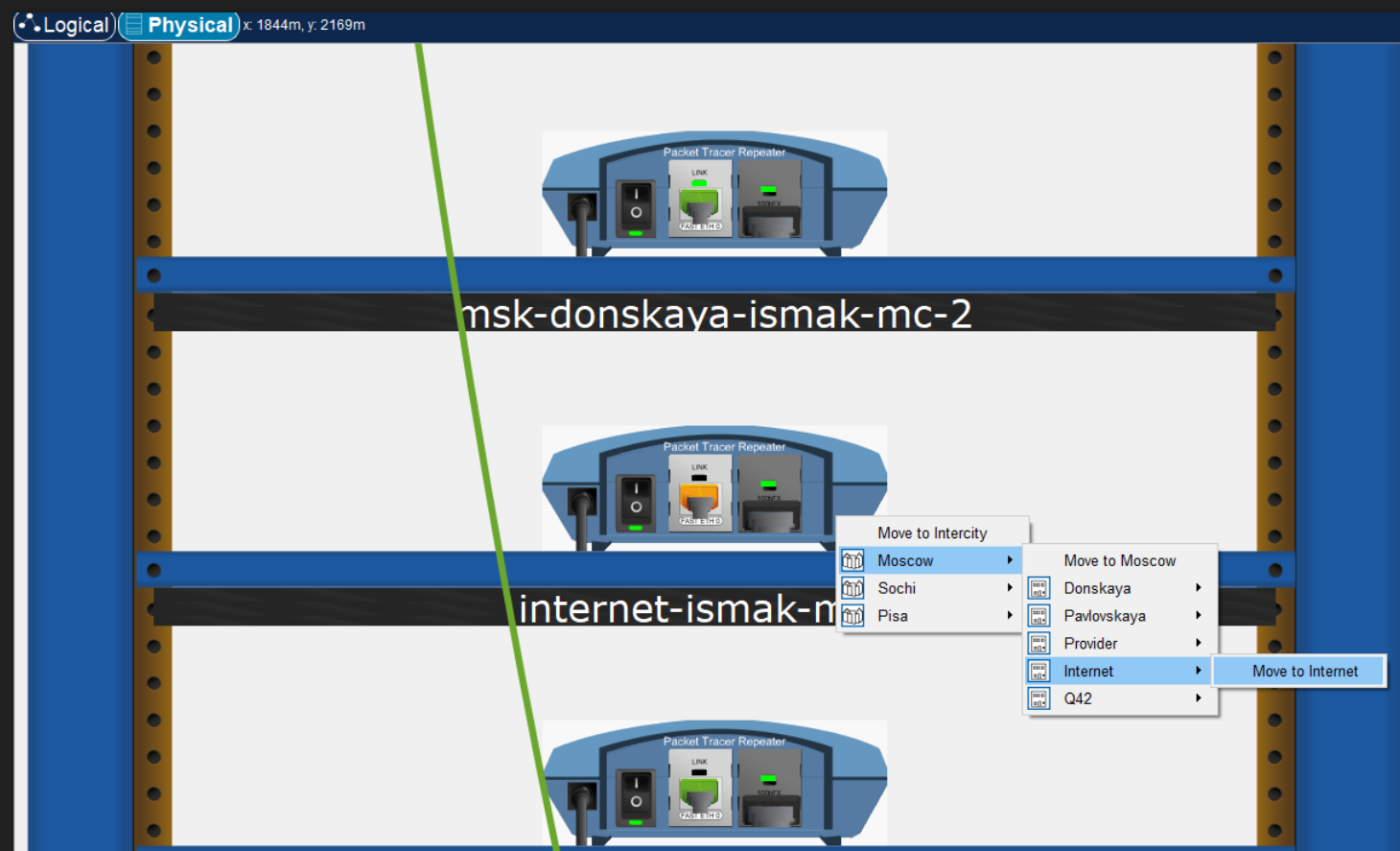
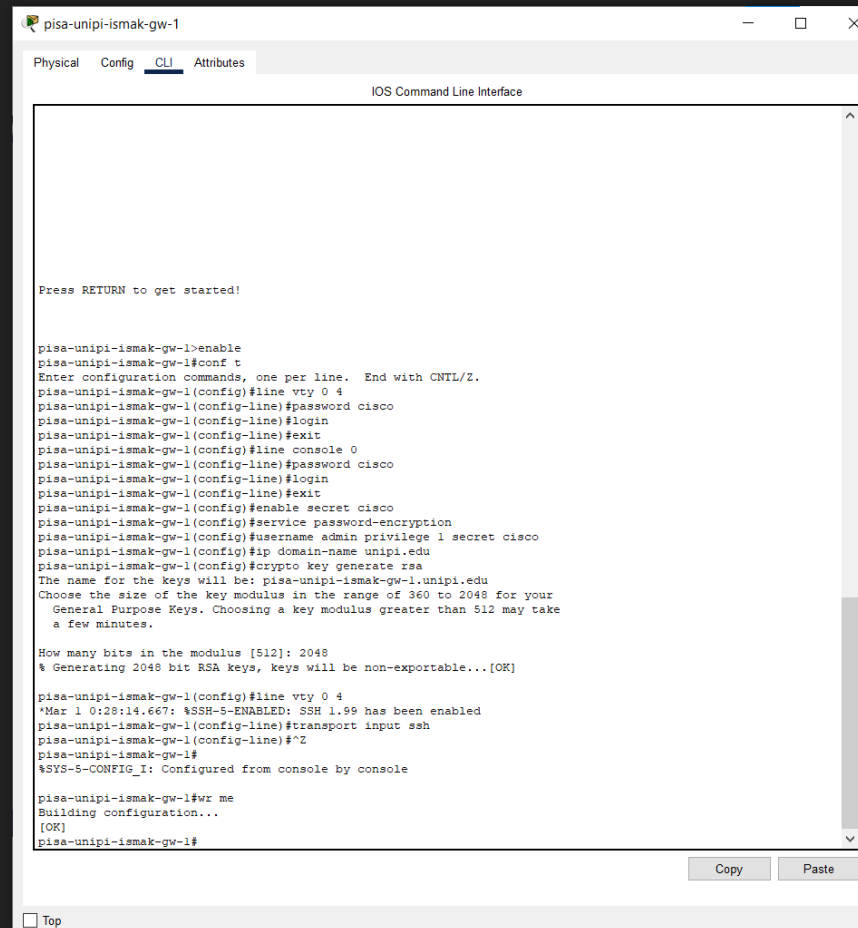


Рис. 1.6. Перемещение оборудования.

# Первоначальная настройка



The screenshot shows a terminal window titled "pisa-unipi-ismak-gw-1" with tabs for "Physical", "Config", "CLI", and "Attributes". The "CLI" tab is active, displaying the "IOS Command Line Interface". The terminal text shows the following sequence of commands and outputs:

```
pisa-unipi-ismak-gw-1>enable
pisa-unipi-ismak-gw-1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
pisa-unipi-ismak-gw-1(config)#line vty 0 4
pisa-unipi-ismak-gw-1(config-line)#password cisco
pisa-unipi-ismak-gw-1(config-line)#login
pisa-unipi-ismak-gw-1(config-line)#exit
pisa-unipi-ismak-gw-1(config)#line console 0
pisa-unipi-ismak-gw-1(config-line)#password cisco
pisa-unipi-ismak-gw-1(config-line)#login
pisa-unipi-ismak-gw-1(config-line)#exit
pisa-unipi-ismak-gw-1(config)#enable secret cisco
pisa-unipi-ismak-gw-1(config)#service password-encryption
pisa-unipi-ismak-gw-1(config)#username admin privilege 1 secret cisco
pisa-unipi-ismak-gw-1(config)#ip domain-name unipi.edu
pisa-unipi-ismak-gw-1(config)#crypto key generate rsa
The name for the keys will be: pisa-unipi-ismak-gw-1.unipi.edu
Choose the size of the key modulus in the range of 360 to 2048 for your
General Purpose Keys. Choosing a key modulus greater than 512 may take
a few minutes.

How many bits in the modulus [512]: 2048
% Generating 2048 bit RSA keys, keys will be non-exportable...[OK]

pisa-unipi-ismak-gw-1(config)#line vty 0 4
*Mar 1 0:28:14.667: %SSH-5-ENABLED: SSH 1.99 has been enabled
pisa-unipi-ismak-gw-1(config-line)#transport input ssh
pisa-unipi-ismak-gw-1(config-line)#^Z
pisa-unipi-ismak-gw-1#
%SYS-5-CONFIG_I: Configured from console by console

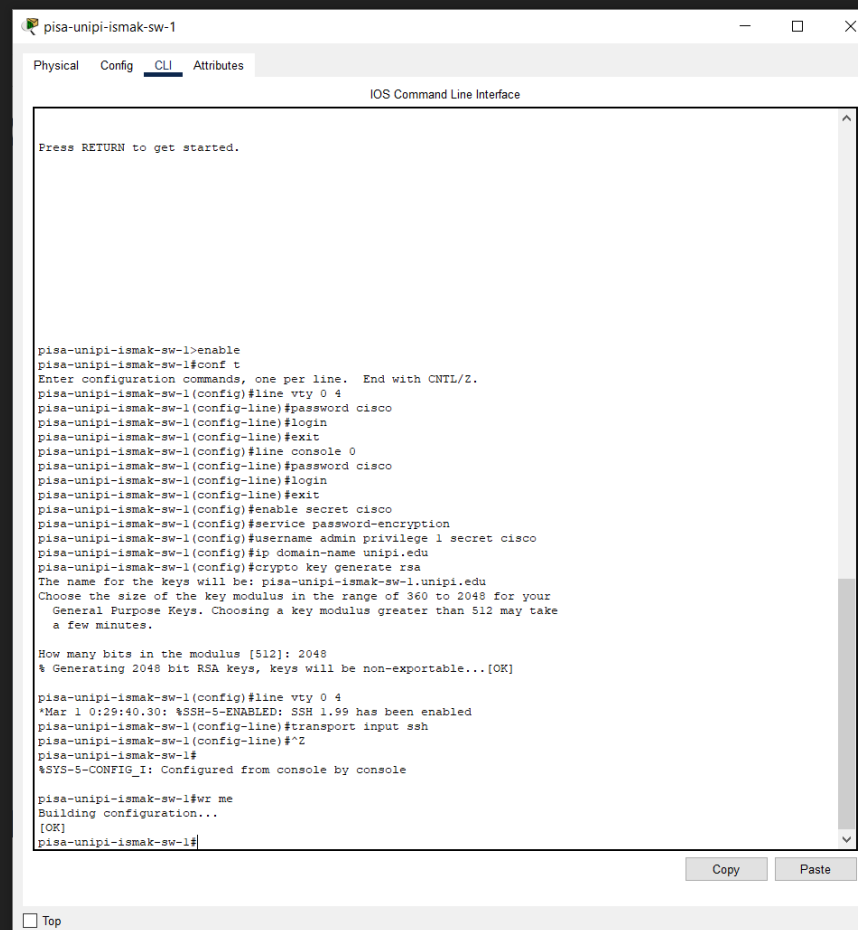
pisa-unipi-ismak-gw-1#wr me
Building configuration...
[OK]
pisa-unipi-ismak-gw-1#
```

At the bottom of the terminal window, there are "Copy" and "Paste" buttons, and a "Top" button in the bottom left corner.

Рис. 1.7. Первоначальная настройка маршрутизатора pisa-unipi-ismak-gw-1.



# Первоначальная настройка



```
pisa-unipi-ismak-sw-1>enable
pisa-unipi-ismak-sw-1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
pisa-unipi-ismak-sw-1(config)#line vty 0 4
pisa-unipi-ismak-sw-1(config-line)#password cisco
pisa-unipi-ismak-sw-1(config-line)#login
pisa-unipi-ismak-sw-1(config-line)#exit
pisa-unipi-ismak-sw-1(config)#line console 0
pisa-unipi-ismak-sw-1(config-line)#password cisco
pisa-unipi-ismak-sw-1(config-line)#login
pisa-unipi-ismak-sw-1(config-line)#exit
pisa-unipi-ismak-sw-1(config)#enable secret cisco
pisa-unipi-ismak-sw-1(config)#service password-encryption
pisa-unipi-ismak-sw-1(config)#username admin privilege 1 secret cisco
pisa-unipi-ismak-sw-1(config)#ip domain-name unipi.edu
pisa-unipi-ismak-sw-1(config)#crypto key generate rsa
The name for the keys will be: pisa-unipi-ismak-sw-1.unipi.edu
Choose the size of the key modulus in the range of 360 to 2048 for your
General Purpose Keys. Choosing a key modulus greater than 512 may take
a few minutes.

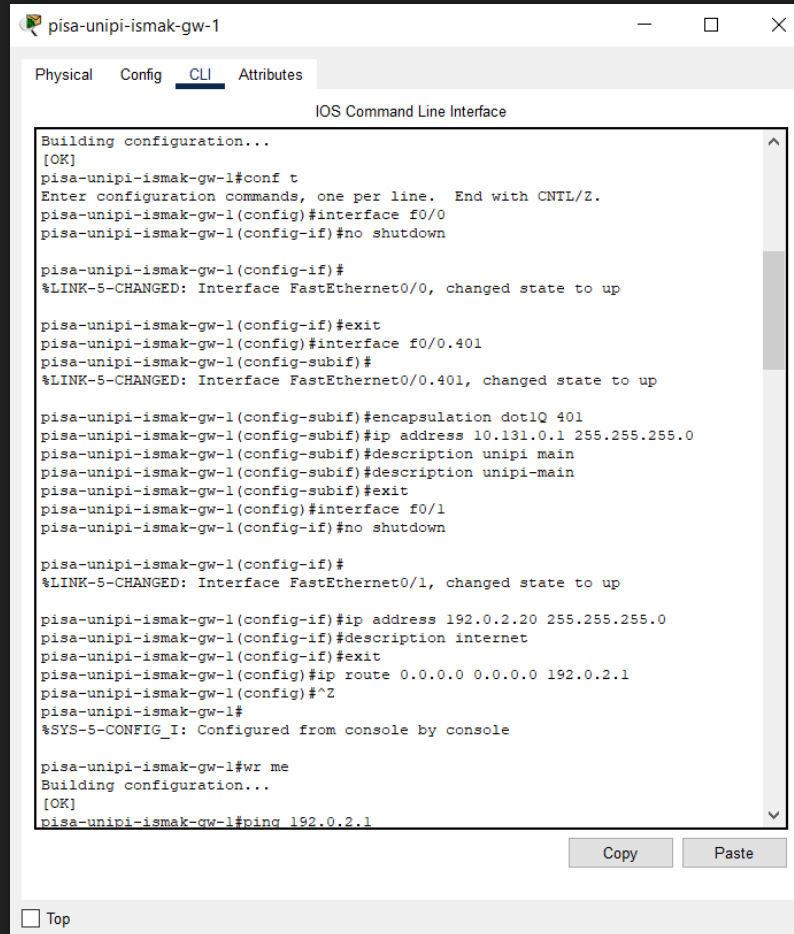
How many bits in the modulus [512]: 2048
% Generating 2048 bit RSA keys, keys will be non-exportable...[OK]

pisa-unipi-ismak-sw-1(config)#line vty 0 4
*Mar 1 0:29:40.30: %SSH-5-ENABLED: SSH 1.99 has been enabled
pisa-unipi-ismak-sw-1(config-line)#transport input ssh
pisa-unipi-ismak-sw-1(config-line)#^Z
pisa-unipi-ismak-sw-1#
%SYS-5-CONFIG_I: Configured from console by console

pisa-unipi-ismak-sw-1#wr me
Building configuration...
[OK]
pisa-unipi-ismak-sw-1#
```

Рис. 1.8. Первоначальная настройка коммутатора pisa-unipi-ismak-sw-1.

# Настройка интерфейсов



The screenshot shows a network configuration window titled "pisa-unipi-ismak-gw-1". It has tabs for "Physical", "Config", "CLI", and "Attributes". The "CLI" tab is active, displaying the "IOS Command Line Interface". The interface shows a series of configuration commands and their outputs, including interface setup for f0/0, f0/0.401, and f0/1, IP address assignments, and route configuration. The window includes a "Copy" button and a "Paste" button at the bottom right, and a "Top" checkbox at the bottom left.

```
pisa-unipi-ismak-gw-1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
pisa-unipi-ismak-gw-1(config)#interface f0/0
pisa-unipi-ismak-gw-1(config-if)#no shutdown

pisa-unipi-ismak-gw-1(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

pisa-unipi-ismak-gw-1(config-if)#exit
pisa-unipi-ismak-gw-1(config)#interface f0/0.401
pisa-unipi-ismak-gw-1(config-subif)#
%LINK-5-CHANGED: Interface FastEthernet0/0.401, changed state to up

pisa-unipi-ismak-gw-1(config-subif)#encapsulation dot1Q 401
pisa-unipi-ismak-gw-1(config-subif)#ip address 10.131.0.1 255.255.255.0
pisa-unipi-ismak-gw-1(config-subif)#description unipi main
pisa-unipi-ismak-gw-1(config-subif)#description unipi-main
pisa-unipi-ismak-gw-1(config-subif)#exit
pisa-unipi-ismak-gw-1(config)#interface f0/1
pisa-unipi-ismak-gw-1(config-if)#no shutdown

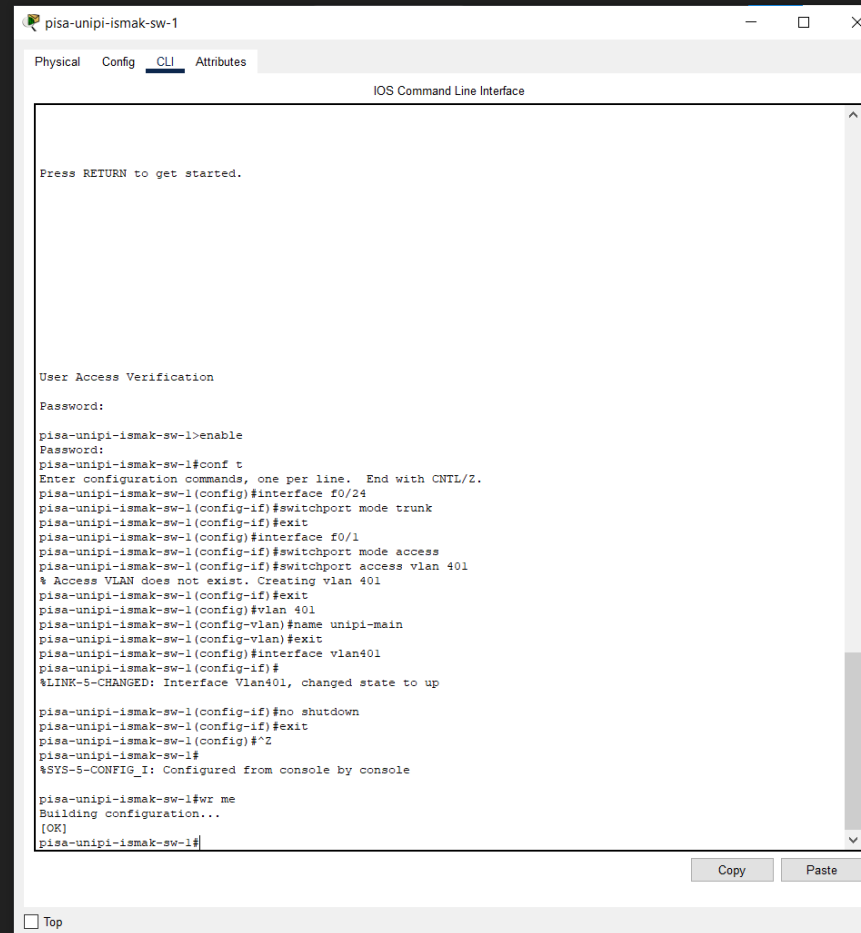
pisa-unipi-ismak-gw-1(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up

pisa-unipi-ismak-gw-1(config-if)#ip address 192.0.2.20 255.255.255.0
pisa-unipi-ismak-gw-1(config-if)#description internet
pisa-unipi-ismak-gw-1(config-if)#exit
pisa-unipi-ismak-gw-1(config)#ip route 0.0.0.0 0.0.0.0 192.0.2.1
pisa-unipi-ismak-gw-1(config)#^Z
pisa-unipi-ismak-gw-1#
%SYS-5-CONFIG_I: Configured from console by console

pisa-unipi-ismak-gw-1#wr me
Building configuration...
[OK]
pisa-unipi-ismak-gw-1#ping 192.0.2.1
```

Рис. 1.9. Настройка интерфейсов маршрутизатора pisa-unipi-ismak-gw-1.

# Настройка интерфейсов



```
pisa-unipi-ismak-sw-1
Physical Config CLI Attributes
IOS Command Line Interface

Press RETURN to get started.

User Access Verification
Password:

pisa-unipi-ismak-sw-1>enable
Password:
pisa-unipi-ismak-sw-1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
pisa-unipi-ismak-sw-1(config)#interface f0/24
pisa-unipi-ismak-sw-1(config-if)#switchport mode trunk
pisa-unipi-ismak-sw-1(config-if)#exit
pisa-unipi-ismak-sw-1(config)#interface f0/1
pisa-unipi-ismak-sw-1(config-if)#switchport mode access
pisa-unipi-ismak-sw-1(config-if)#switchport access vlan 401
% Access VLAN does not exist. Creating vlan 401
pisa-unipi-ismak-sw-1(config-if)#exit
pisa-unipi-ismak-sw-1(config)#vlan 401
pisa-unipi-ismak-sw-1(config-vlan)#name unpipi-main
pisa-unipi-ismak-sw-1(config-vlan)#exit
pisa-unipi-ismak-sw-1(config)#interface vlan401
pisa-unipi-ismak-sw-1(config-if)#
%LINK-5-CHANGED: Interface Vlan401, changed state to up
pisa-unipi-ismak-sw-1(config-if)#no shutdown
pisa-unipi-ismak-sw-1(config-if)#exit
pisa-unipi-ismak-sw-1(config)#^Z
pisa-unipi-ismak-sw-1#
%SYS-5-CONFIG_I: Configured from console by console

pisa-unipi-ismak-sw-1#wr me
Building configuration...
[OK]
pisa-unipi-ismak-sw-1#
```

Рис. 1. 10. Настройка интерфейсов коммутатора pisa-unipi-ismak-sw-1.

# Присвоение адресов

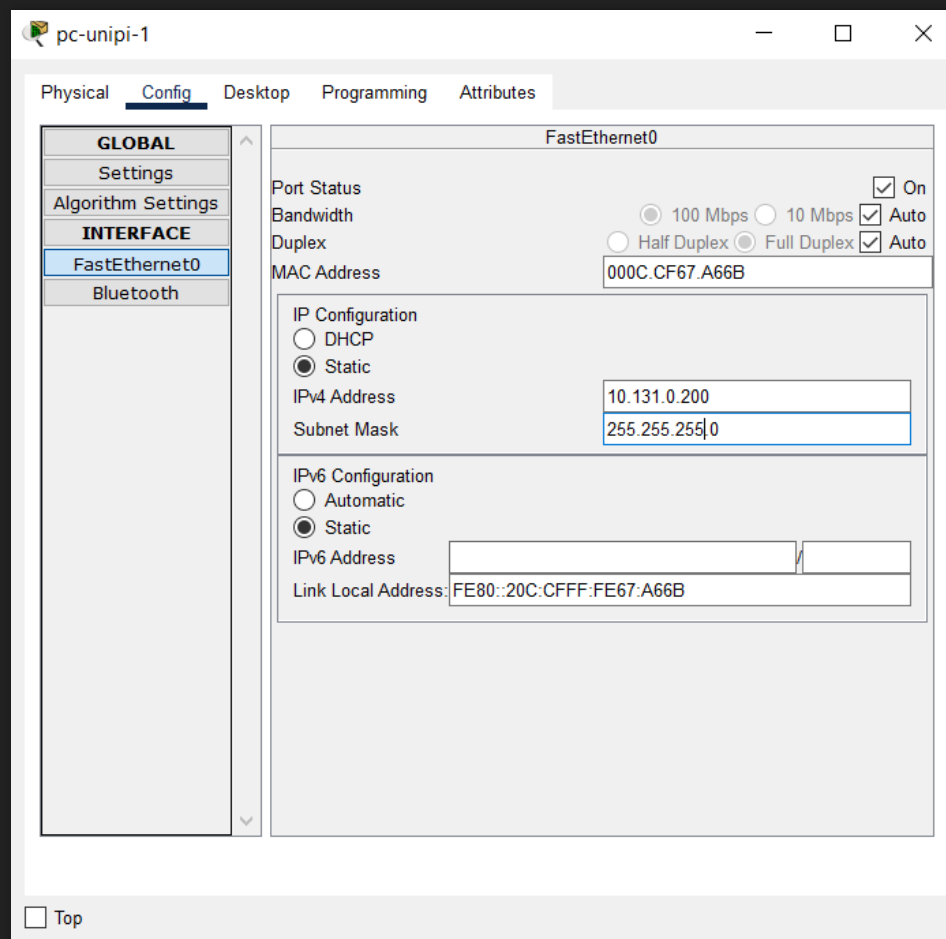
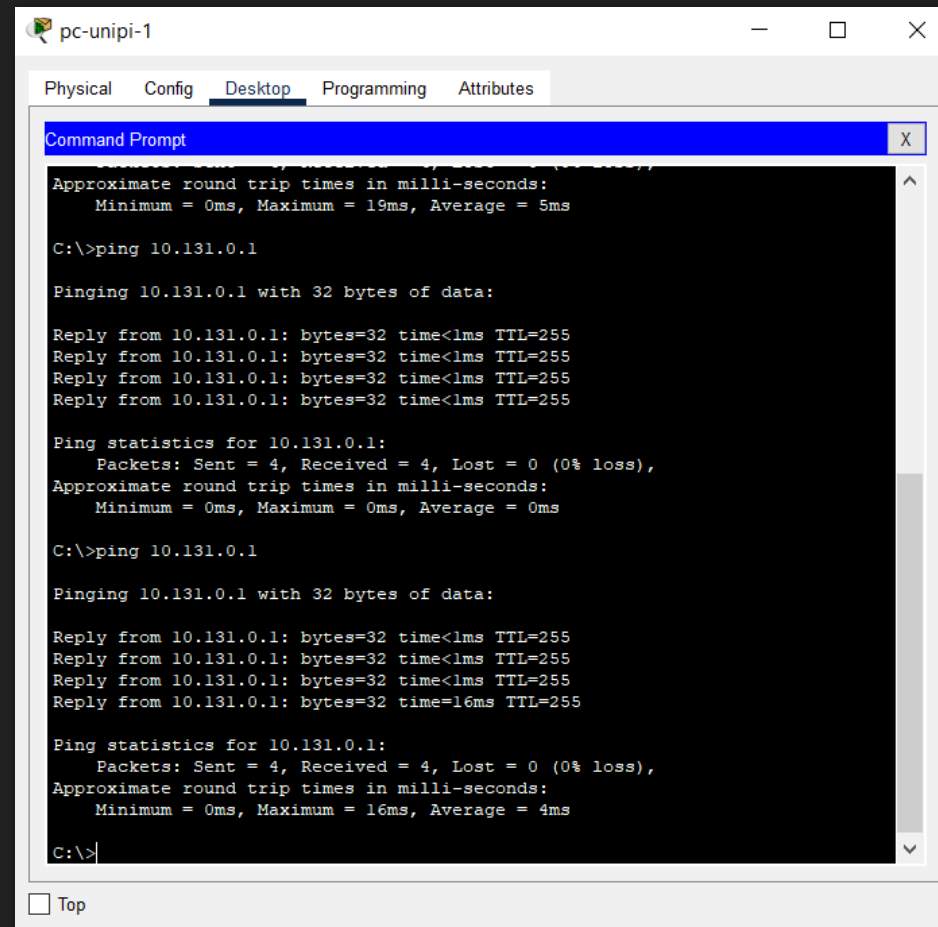


Рис. 1. 11. Присвоение адресов оконечному устройству.

# Ping



The screenshot shows a Windows Command Prompt window titled "pc-unipi-1" with tabs for Physical, Config, Desktop, Programming, and Attributes. The Desktop tab is active, and a Command Prompt window is open. The prompt shows the execution of the command "ping 10.131.0.1". The output displays the approximate round trip times in milliseconds for the first ping, followed by four successful replies from 10.131.0.1 with 32 bytes of data, each taking less than 1ms. The ping statistics for 10.131.0.1 show 4 packets sent, 4 received, and 0% loss, with approximate round trip times of 0ms minimum, 0ms maximum, and 0ms average. The second ping command is also shown, with four successful replies, the last one taking 16ms, and ping statistics showing 4 packets sent, 4 received, and 0% loss, with approximate round trip times of 0ms minimum, 16ms maximum, and 4ms average.

```
pc-unipi-1
Physical Config Desktop Programming Attributes
Command Prompt
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 19ms, Average = 5ms

C:\>ping 10.131.0.1

Pinging 10.131.0.1 with 32 bytes of data:

Reply from 10.131.0.1: bytes=32 time<1ms TTL=255
Reply from 10.131.0.1: bytes=32 time<1ms TTL=255
Reply from 10.131.0.1: bytes=32 time<1ms TTL=255
Reply from 10.131.0.1: bytes=32 time<1ms TTL=255

Ping statistics for 10.131.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 10.131.0.1

Pinging 10.131.0.1 with 32 bytes of data:

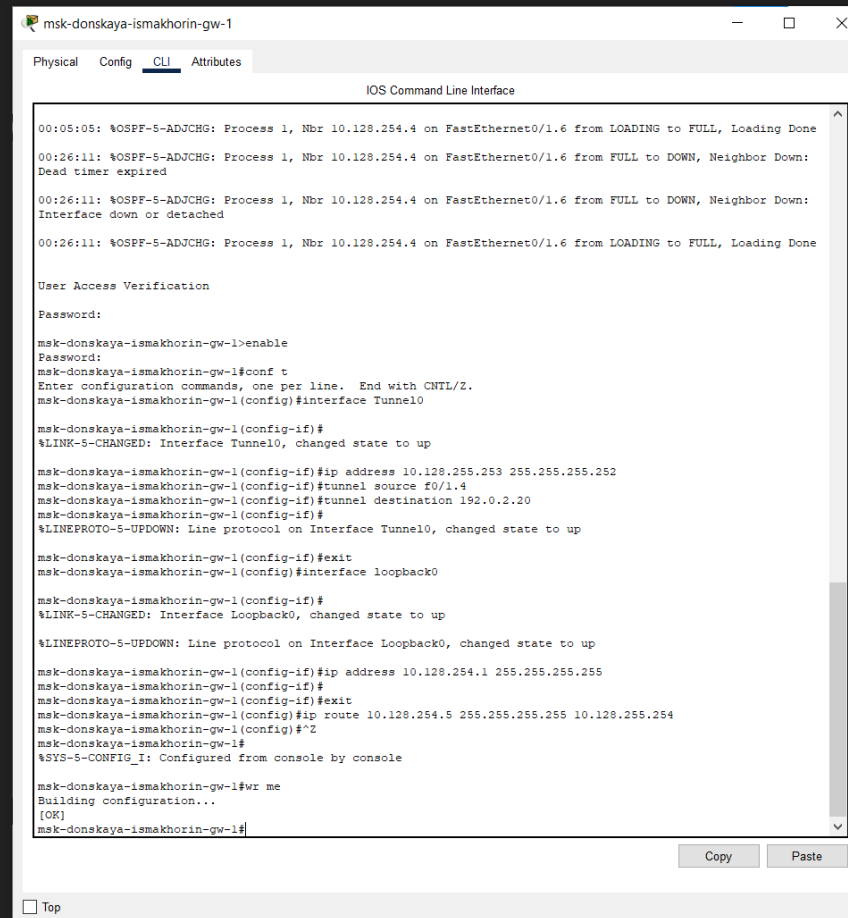
Reply from 10.131.0.1: bytes=32 time<1ms TTL=255
Reply from 10.131.0.1: bytes=32 time<1ms TTL=255
Reply from 10.131.0.1: bytes=32 time<1ms TTL=255
Reply from 10.131.0.1: bytes=32 time=16ms TTL=255

Ping statistics for 10.131.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 16ms, Average = 4ms

C:\>
```

Рис. 1. 12. Пинг адреса 10.131.0.1.

# Настройка VPN на основе GRE



```
msk-donskaya-ismakhorin-gw-1
Physical Config CLI Attributes
IOS Command Line Interface

00:05:05: %OSPF-5-ADJCHG: Process 1, Nbr 10.128.254.4 on FastEthernet0/1.6 from LOADING to FULL, Loading Done
00:26:11: %OSPF-5-ADJCHG: Process 1, Nbr 10.128.254.4 on FastEthernet0/1.6 from FULL to DOWN, Neighbor Down:
Dead timer expired
00:26:11: %OSPF-5-ADJCHG: Process 1, Nbr 10.128.254.4 on FastEthernet0/1.6 from FULL to DOWN, Neighbor Down:
Interface down or detached
00:26:11: %OSPF-5-ADJCHG: Process 1, Nbr 10.128.254.4 on FastEthernet0/1.6 from LOADING to FULL, Loading Done

User Access Verification
Password:
msk-donskaya-ismakhorin-gw-1>enable
Password:
msk-donskaya-ismakhorin-gw-1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-ismakhorin-gw-1(config)#interface Tunnel0

msk-donskaya-ismakhorin-gw-1(config-if)#
%LINK-5-CHANGED: Interface Tunnel0, changed state to up

msk-donskaya-ismakhorin-gw-1(config-if)#ip address 10.128.255.253 255.255.255.252
msk-donskaya-ismakhorin-gw-1(config-if)#tunnel source f0/1.4
msk-donskaya-ismakhorin-gw-1(config-if)#tunnel destination 192.0.2.20
msk-donskaya-ismakhorin-gw-1(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Tunnel0, changed state to up

msk-donskaya-ismakhorin-gw-1(config-if)#exit
msk-donskaya-ismakhorin-gw-1(config)#interface loopback0

msk-donskaya-ismakhorin-gw-1(config-if)#
%LINK-5-CHANGED: Interface Loopback0, changed state to up

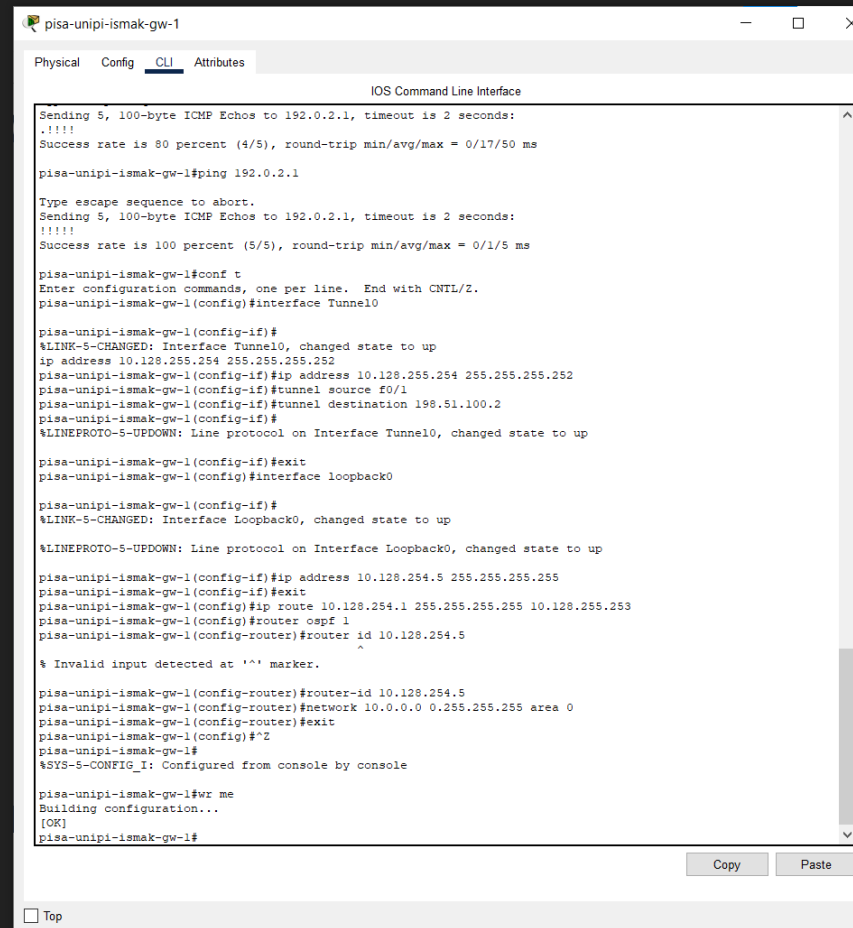
%LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback0, changed state to up

msk-donskaya-ismakhorin-gw-1(config-if)#ip address 10.128.254.1 255.255.255.255
msk-donskaya-ismakhorin-gw-1(config-if)#
msk-donskaya-ismakhorin-gw-1(config-if)#exit
msk-donskaya-ismakhorin-gw-1(config)#ip route 10.128.254.5 255.255.255.255 10.128.255.254
msk-donskaya-ismakhorin-gw-1(config)#^Z
msk-donskaya-ismakhorin-gw-1#
%SYS-5-CONFIG_I: Configured from console by console

msk-donskaya-ismakhorin-gw-1#wr me
Building configuration...
[OK]
msk-donskaya-ismakhorin-gw-1#
```

Рис. 1.13. Настройка маршрутизатора msk-donskaya-ismakhorin-gw-1.

# Настройка VPN на основе GRE



```
pisa-unipi-ismak-gw-1
Physical Config CLI Attributes
IOS Command Line Interface

Sending 5, 100-byte ICMP Echos to 192.0.2.1, timeout is 2 seconds:
!!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 0/17/50 ms

pisa-unipi-ismak-gw-1#ping 192.0.2.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.0.2.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/1/5 ms

pisa-unipi-ismak-gw-1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
pisa-unipi-ismak-gw-1(config)#interface Tunnel0

pisa-unipi-ismak-gw-1(config-if)#
%LINK-5-CHANGED: Interface Tunnel0, changed state to up
ip address 10.128.255.254 255.255.255.252
pisa-unipi-ismak-gw-1(config-if)#ip address 10.128.255.254 255.255.255.252
pisa-unipi-ismak-gw-1(config-if)#tunnel source f0/1
pisa-unipi-ismak-gw-1(config-if)#tunnel destination 198.51.100.2
pisa-unipi-ismak-gw-1(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Tunnel0, changed state to up

pisa-unipi-ismak-gw-1(config-if)#exit
pisa-unipi-ismak-gw-1(config)#interface loopback0

pisa-unipi-ismak-gw-1(config-if)#
%LINK-5-CHANGED: Interface Loopback0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback0, changed state to up

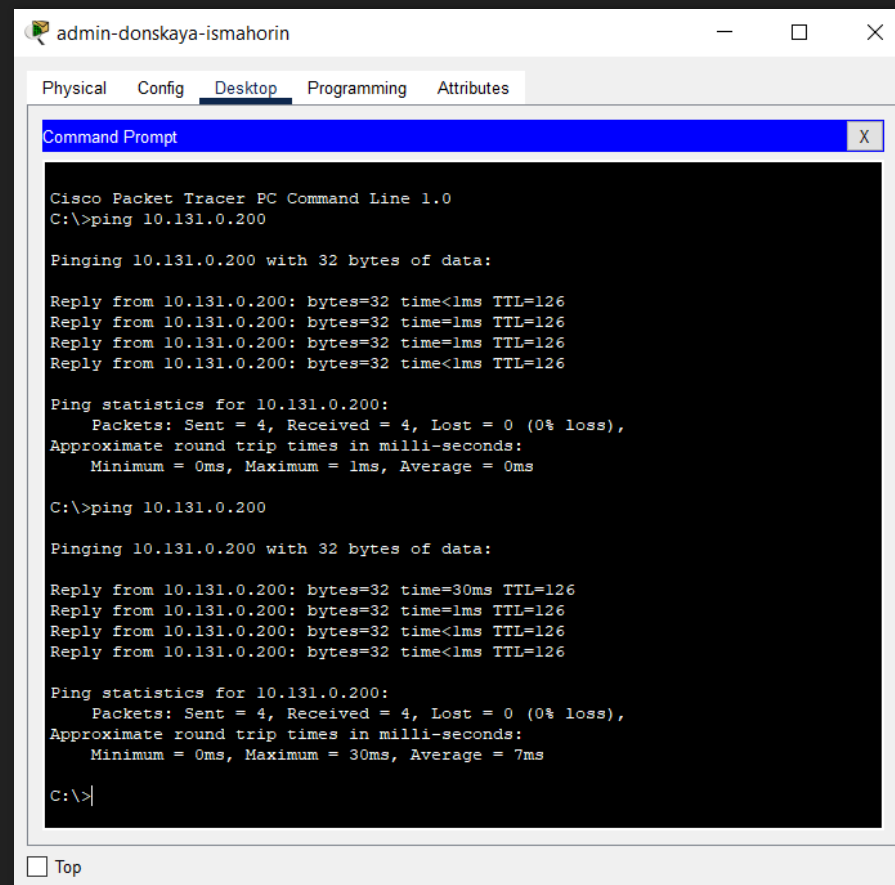
pisa-unipi-ismak-gw-1(config-if)#ip address 10.128.254.5 255.255.255.255
pisa-unipi-ismak-gw-1(config-if)#exit
pisa-unipi-ismak-gw-1(config)#ip route 10.128.254.1 255.255.255.255 10.128.255.253
pisa-unipi-ismak-gw-1(config)#router ospf 1
pisa-unipi-ismak-gw-1(config-router)#router id 10.128.254.5
^
% Invalid input detected at '^' marker.

pisa-unipi-ismak-gw-1(config-router)#router id 10.128.254.5
pisa-unipi-ismak-gw-1(config-router)#network 10.0.0.0 0.255.255.255 area 0
pisa-unipi-ismak-gw-1(config-router)#exit
pisa-unipi-ismak-gw-1(config)#^Z
pisa-unipi-ismak-gw-1#
%SYS-5-CONFIG_I: Configured from console by console

pisa-unipi-ismak-gw-1#wr me
Building configuration...
[OK]
pisa-unipi-ismak-gw-1#
```

Рис. 1.14. Настройка маршрутизатора pisa-unipi-ismak-gw-1.

# Проверка



The screenshot shows a Cisco Packet Tracer PC Command Line window for a device named 'admin-donskaya-ismahorin'. The window has tabs for 'Physical', 'Config', 'Desktop', 'Programming', and 'Attributes', with 'Desktop' selected. The Command Prompt shows the execution of a 'ping 10.131.0.200' command. The output indicates that the ping was successful, with 4 packets sent and received, 0% loss, and an average round trip time of 7ms. The window also includes a 'Top' button at the bottom left.

```
admin-donskaya-ismahorin
Physical Config Desktop Programming Attributes
Command Prompt X
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 10.131.0.200

Pinging 10.131.0.200 with 32 bytes of data:

Reply from 10.131.0.200: bytes=32 time<1ms TTL=126
Reply from 10.131.0.200: bytes=32 time=1ms TTL=126
Reply from 10.131.0.200: bytes=32 time=1ms TTL=126
Reply from 10.131.0.200: bytes=32 time<1ms TTL=126

Ping statistics for 10.131.0.200:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 10.131.0.200

Pinging 10.131.0.200 with 32 bytes of data:

Reply from 10.131.0.200: bytes=32 time=30ms TTL=126
Reply from 10.131.0.200: bytes=32 time=1ms TTL=126
Reply from 10.131.0.200: bytes=32 time<1ms TTL=126
Reply from 10.131.0.200: bytes=32 time<1ms TTL=126

Ping statistics for 10.131.0.200:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 30ms, Average = 7ms

C:\>
```

**Рис. 1.15.** Проверка доступности узлов сети Университета г. Пиза с ноутбука администратора сети «Донская».



# ВЫВОД

- В ходе выполнения лабораторной работы мы получили навыки настройки VPN-туннеля через незащищённое Интернет-соединение.

Спасибо за внимание!