

# НАСТРОЙКА VPN



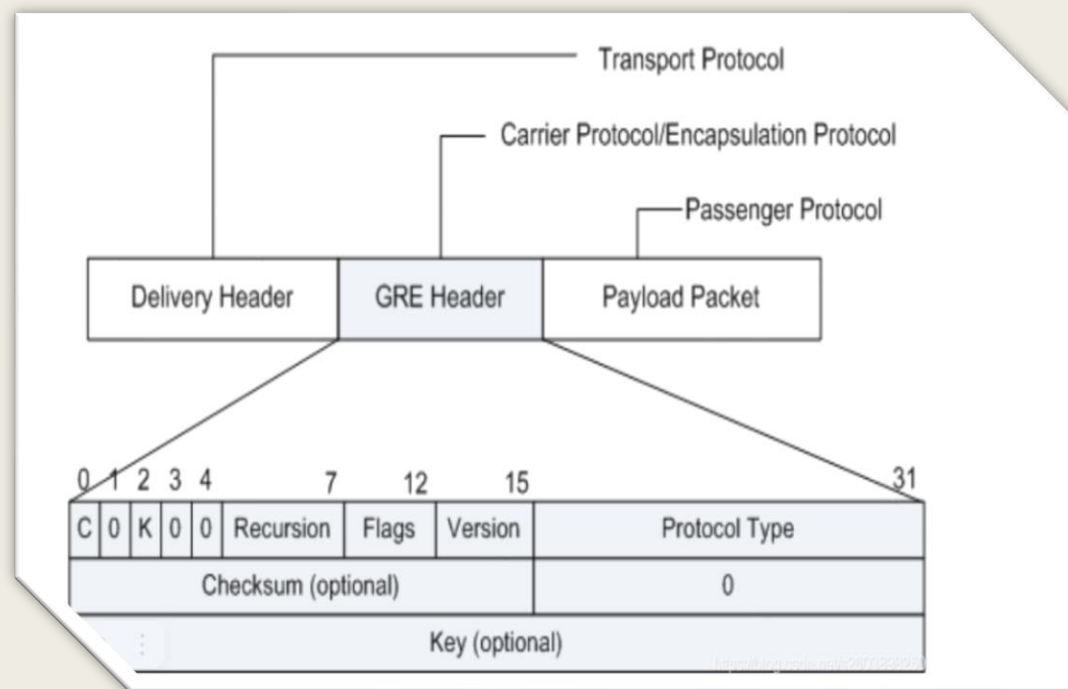
Подготовил: Махорин Иван Сергеевич

Студ. билет: 1032211221

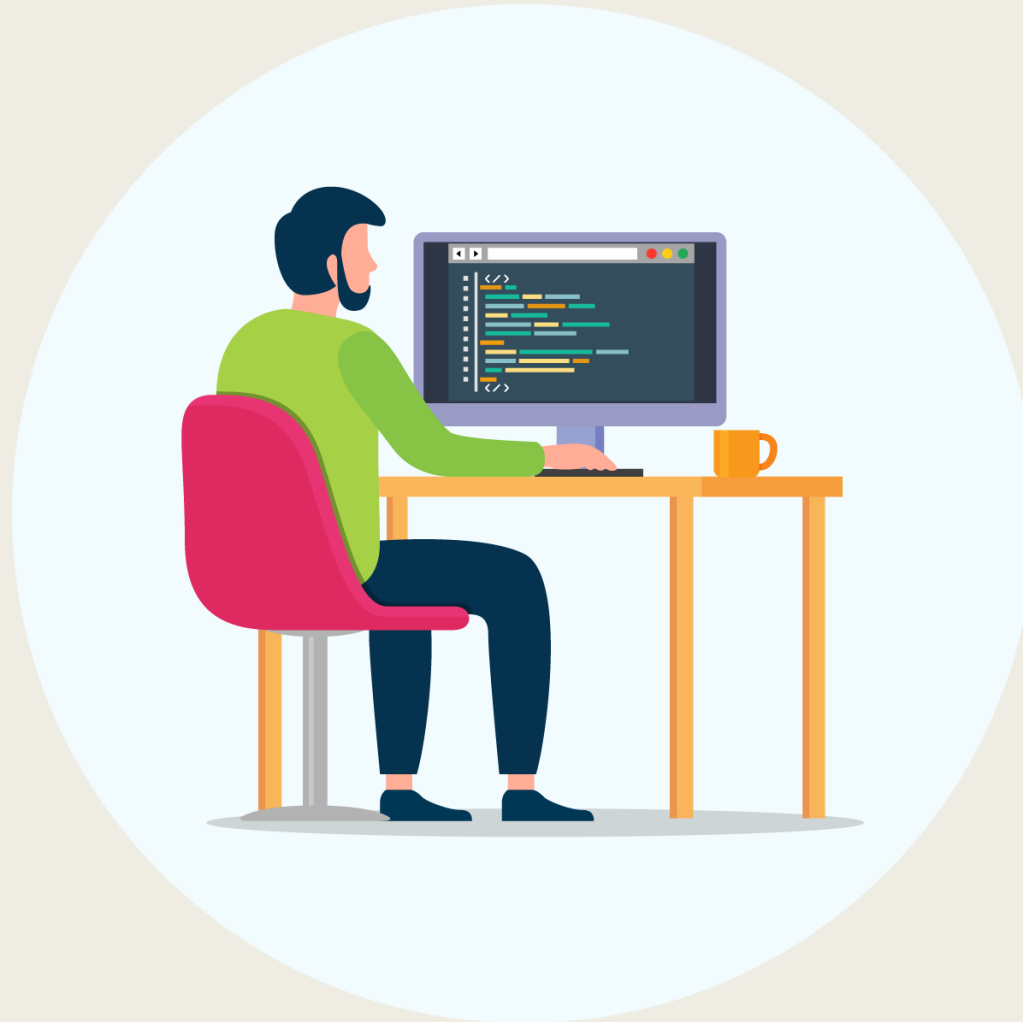
Группа: НПИбд-02-21

# Что такое протокол GRE?

Encapsulation (GRE) - это протокол туннелирования, разработанный компанией Cisco, который позволяет инкапсулировать широкий спектр протоколов сетевого уровня в point-to-point каналах.



# Пример настройки и использования



# Открытие проекта

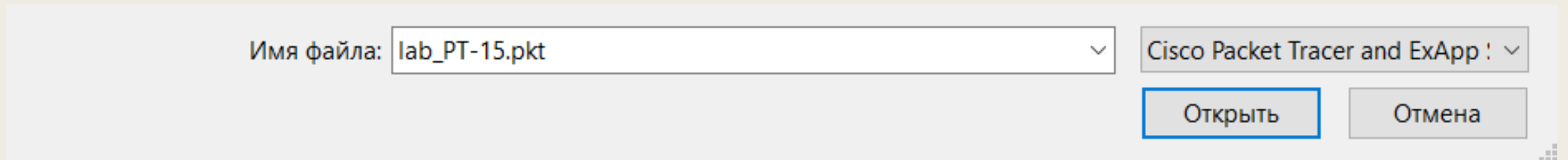


Рисунок 1: Открытие проекта.

# Размещение оборудования

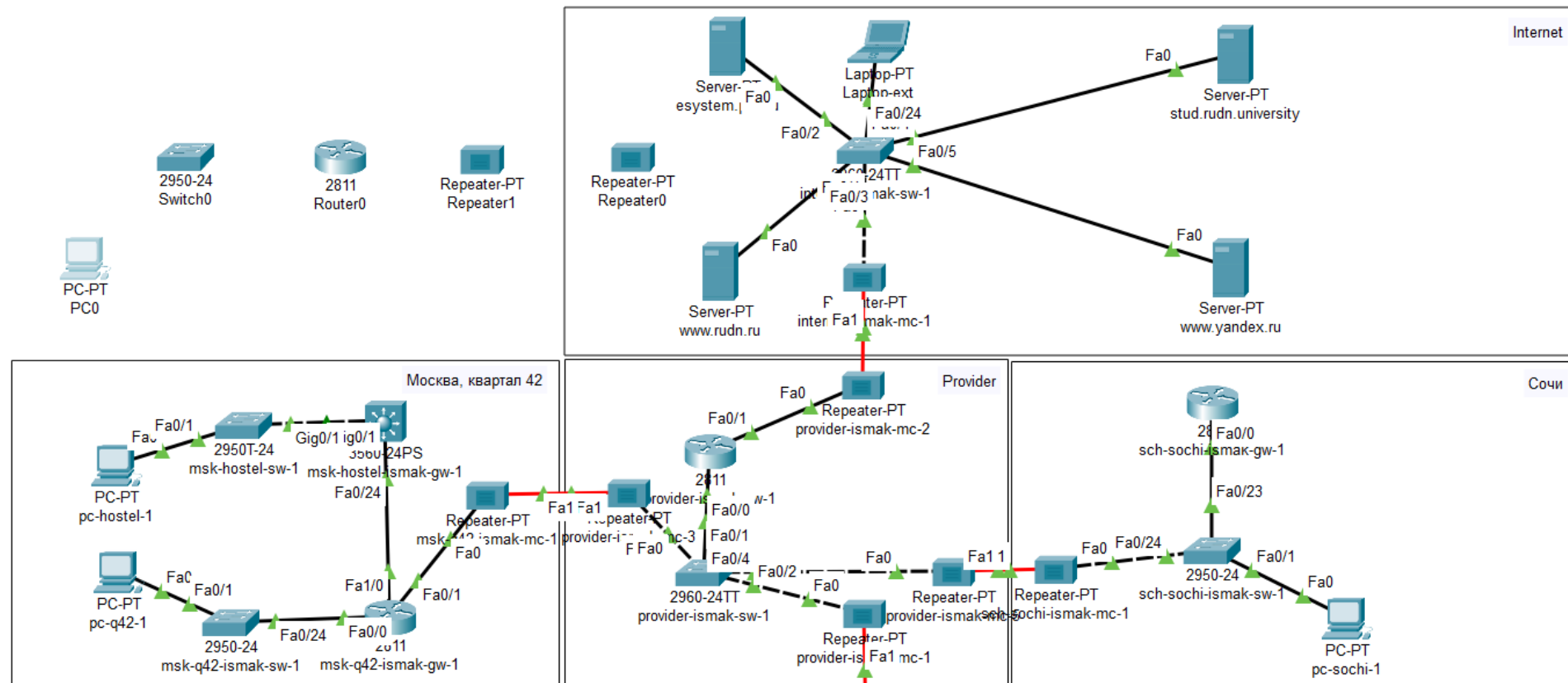


Рисунок 2: Размещение оборудования в рабочей области проекта.

# Замена модулей

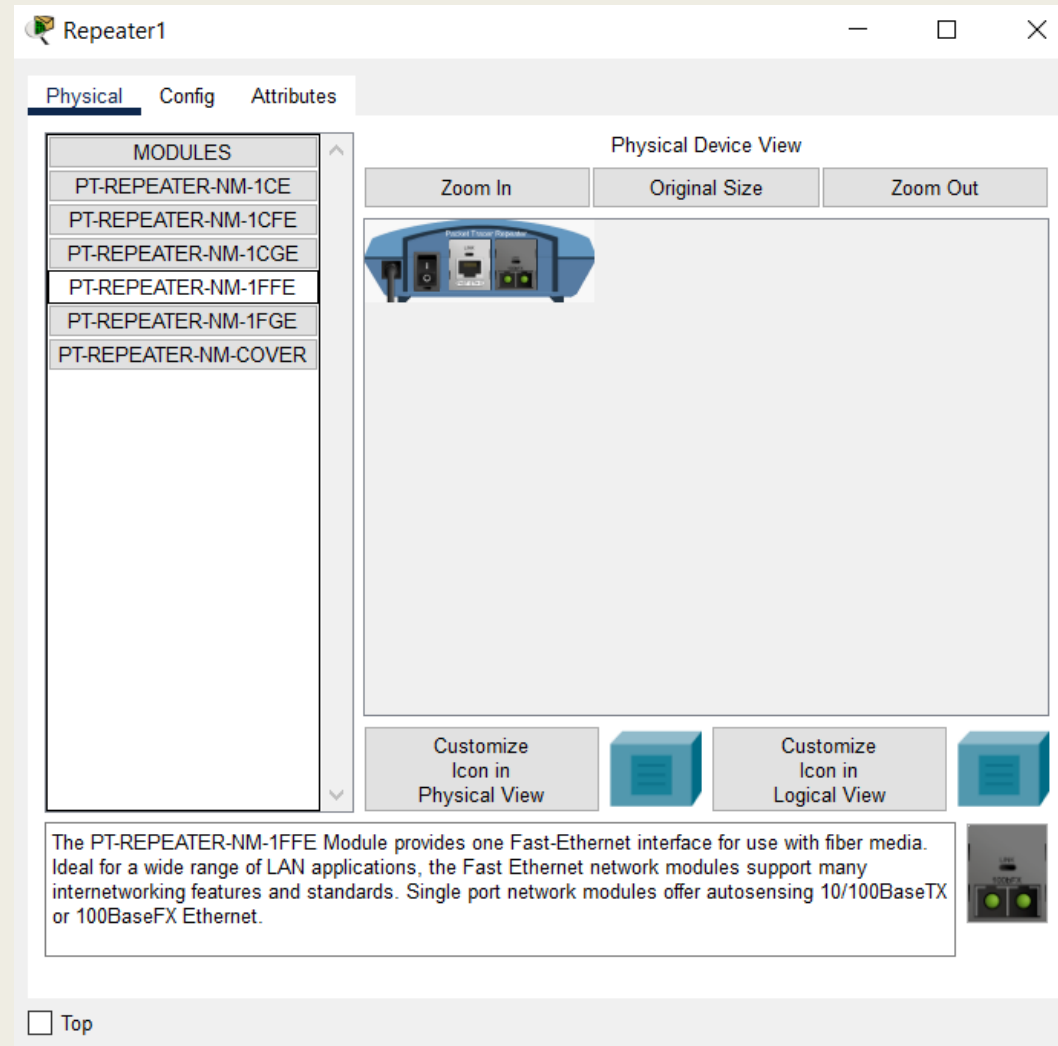


Рисунок 3: Замена модулей на Repeater-PT.

# Подключение

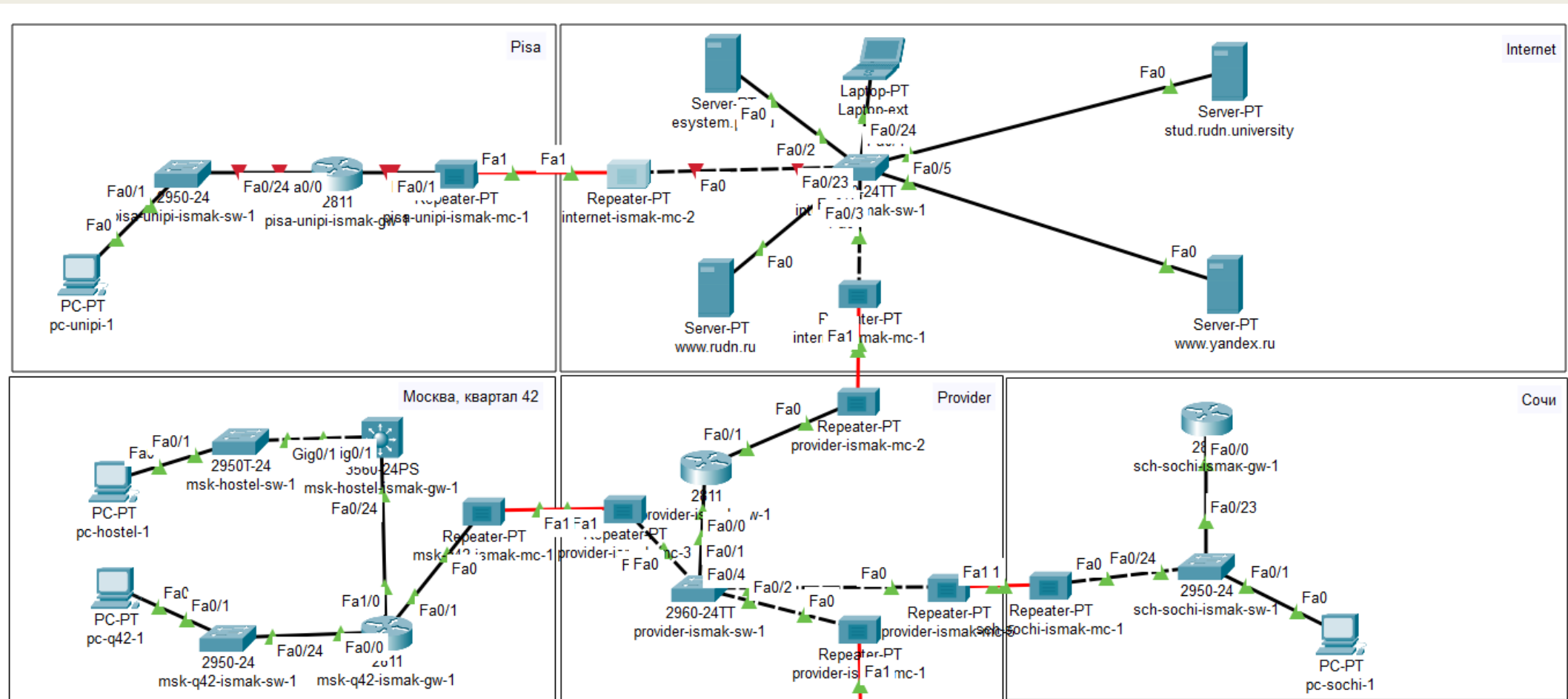


Рисунок 4: Подключение оборудования.

# Создание города

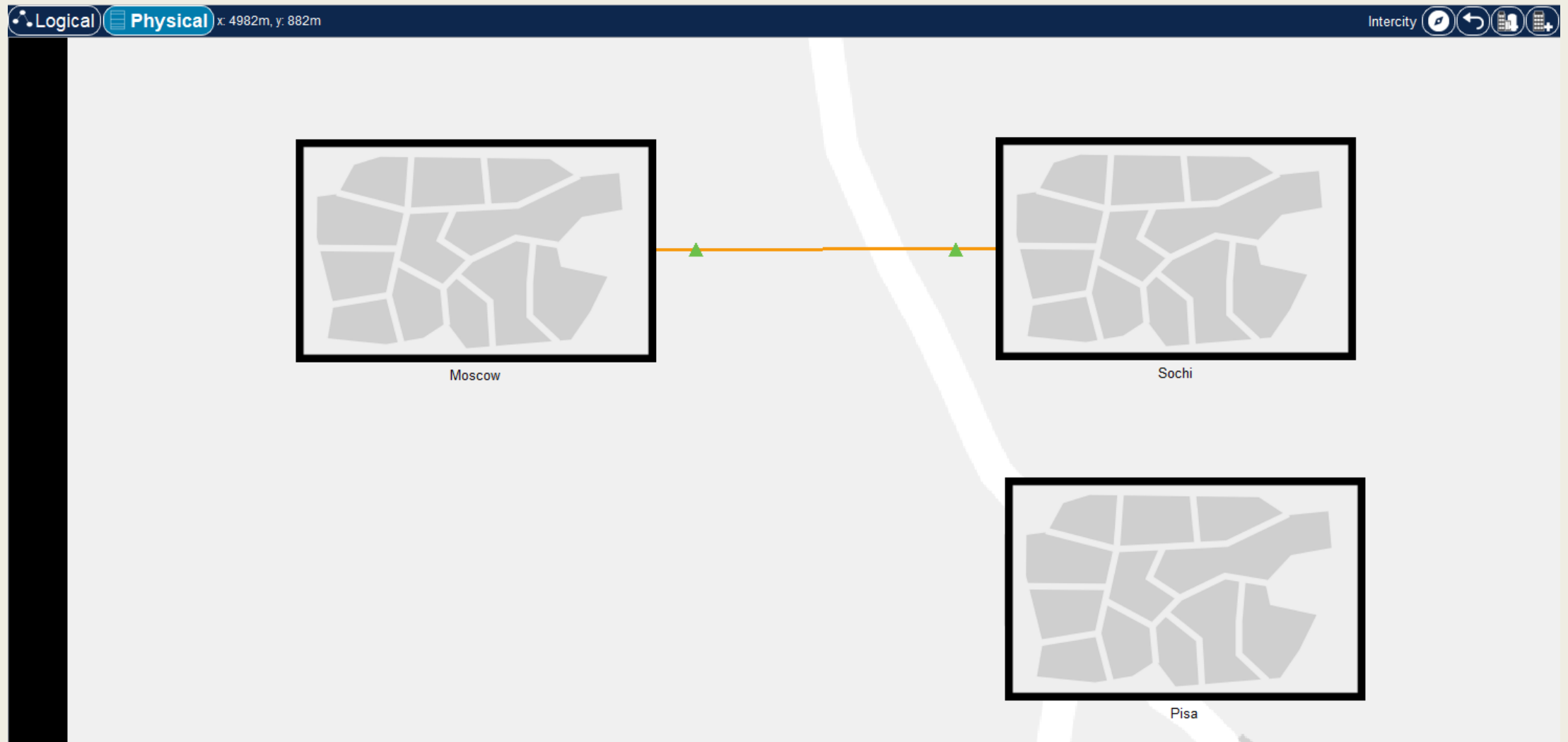


Рисунок 5: Создание города Пиза в физической рабочей области.



# Перемещение оборудования

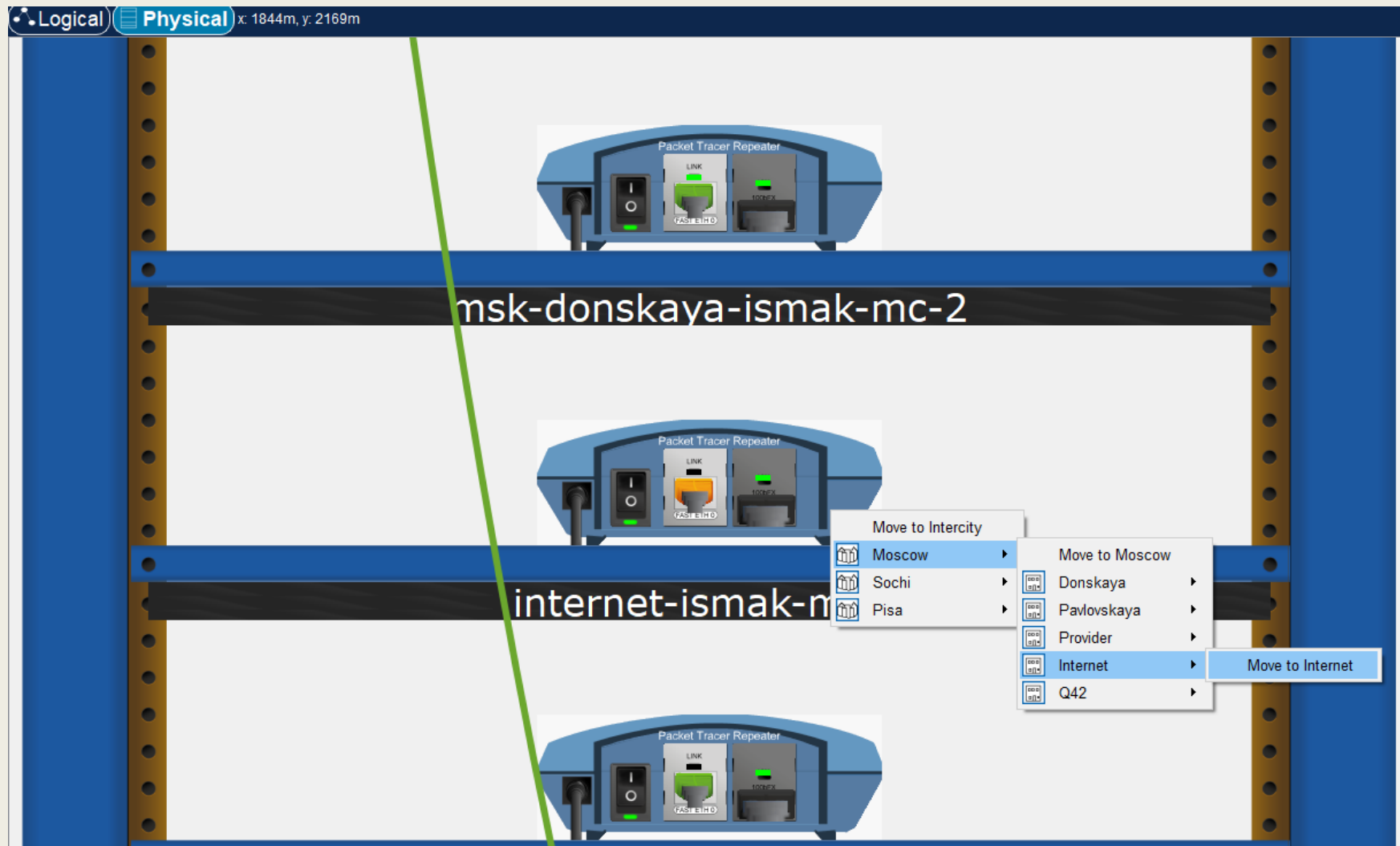
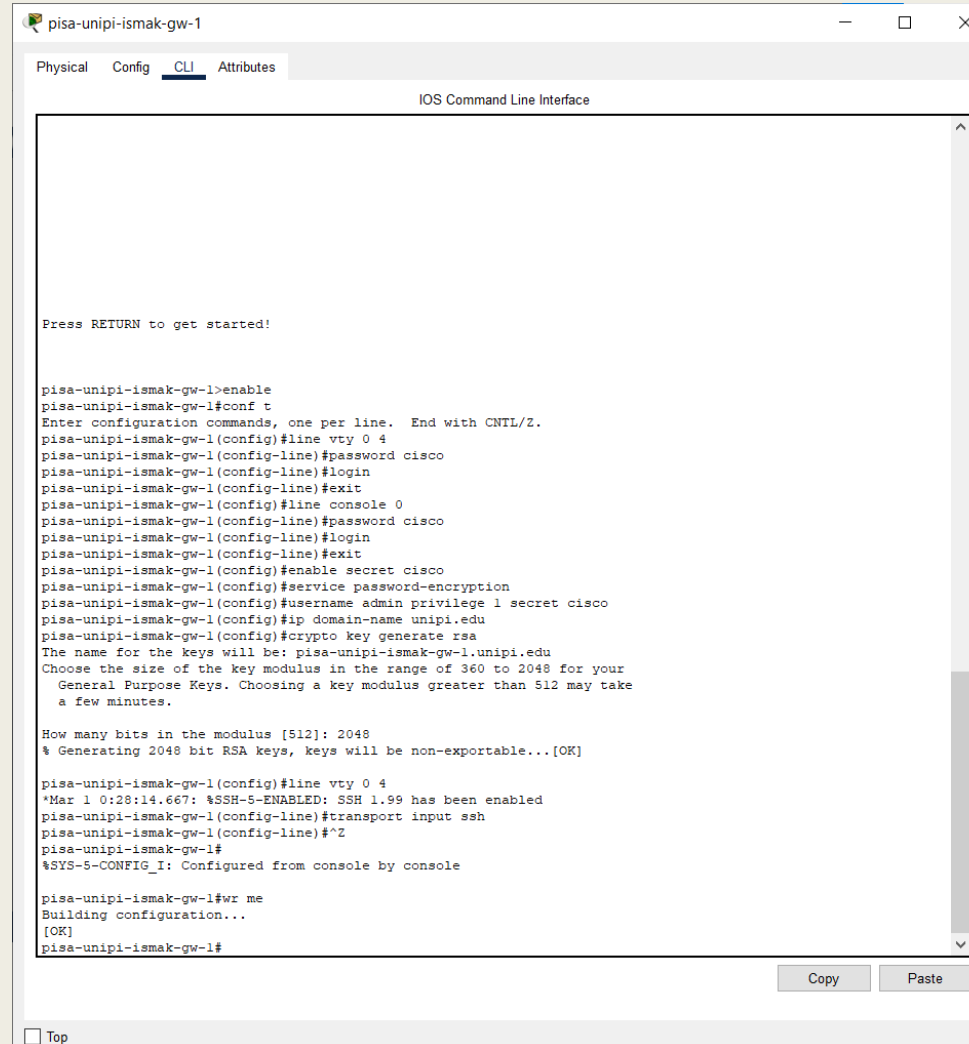


Рисунок 6: Перемещение оборудования.

# 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 output shows the following sequence of commands and responses:

```
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]

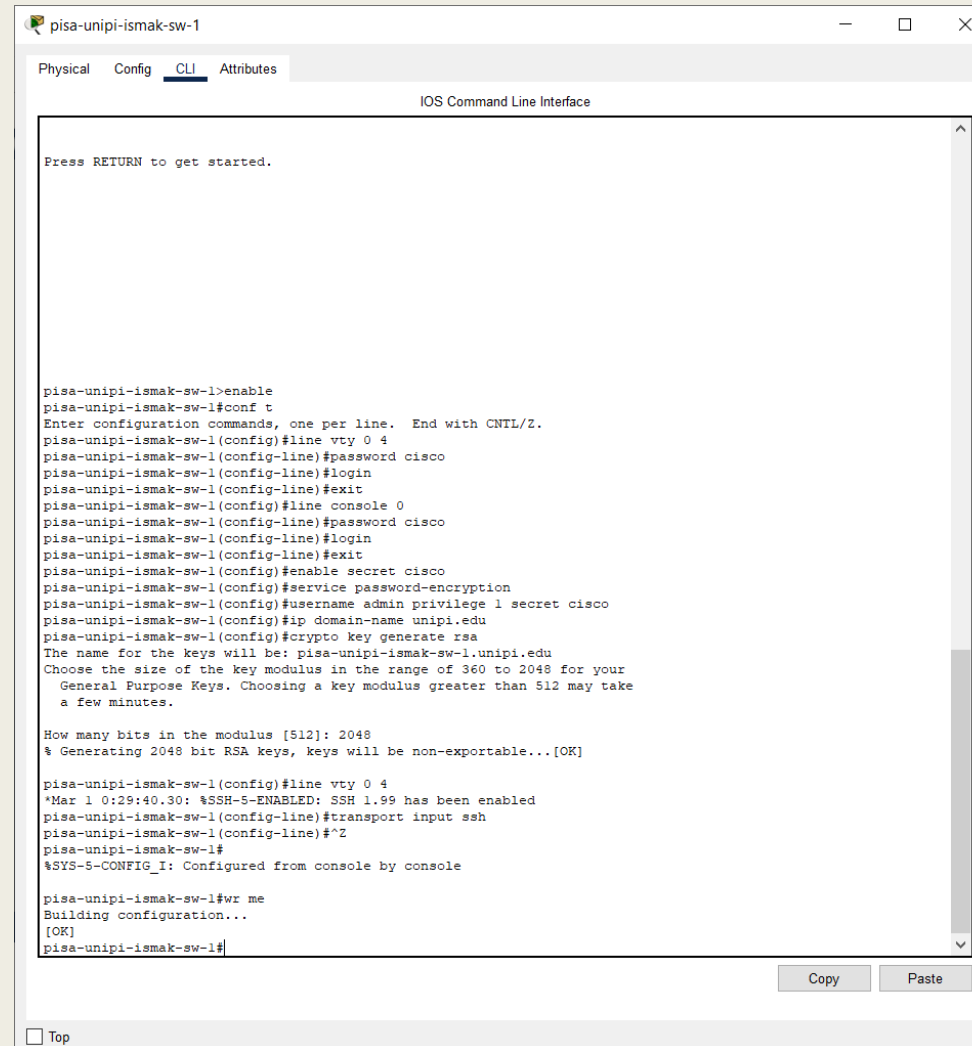
pisa-unipi-ismak-gw-1(config)#line vty 0 4
*Mar 1 0:28:14.667: %SSH-5-ENABLED: SSH 1.99 has been enabled
pisa-unipi-ismak-gw-1(config-line)#transport input ssh
pisa-unipi-ismak-gw-1(config-line)#^Z
pisa-unipi-ismak-gw-1#
%SYS-5-CONFIG_I: Configured from console by console

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. A "Top" button is located at the bottom left of the window frame.

Рисунок 7: Первоначальная настройка маршрутизатора pisa-unipi-ismak-gw-1.

# Первоначальная настройка



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

Press RETURN to get started.

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.

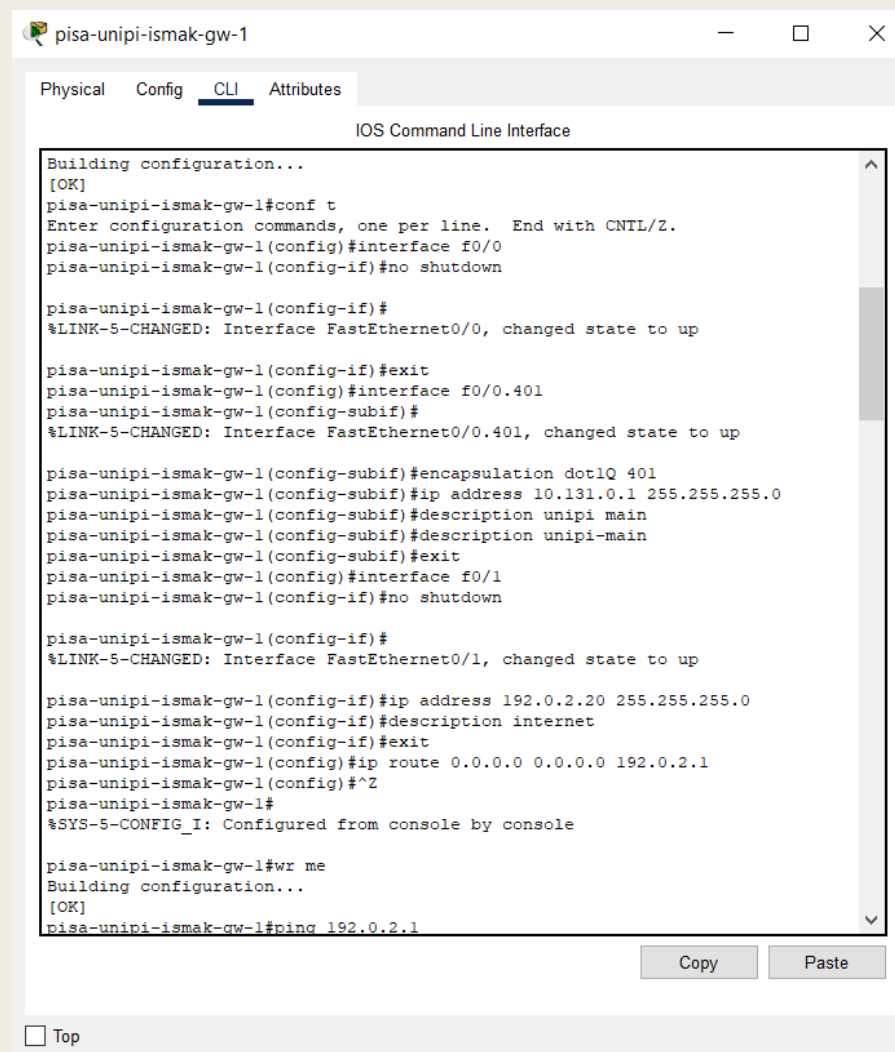
How many bits in the modulus [512]: 2048
% Generating 2048 bit RSA keys, keys will be non-exportable...[OK]

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#
```

Рисунок 8: Первоначальная настройка коммутатора pisa-unipi-ismak-sw-1.

# Настройка интерфейсов



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 output shows the following commands and responses:

```
Building configuration...
[OK]
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

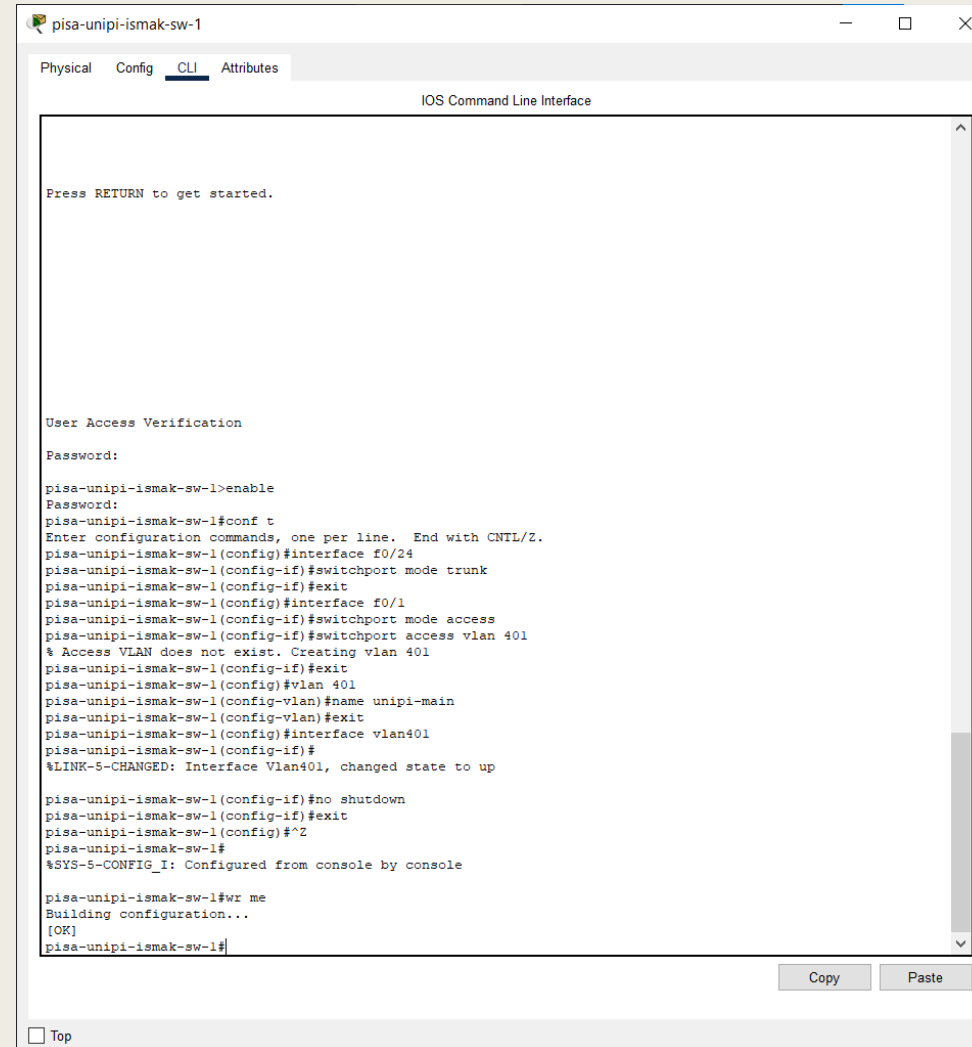
pisa-unipi-ismak-gw-1(config-if)#ip address 192.0.2.20 255.255.255.0
pisa-unipi-ismak-gw-1(config-if)#description internet
pisa-unipi-ismak-gw-1(config-if)#exit
pisa-unipi-ismak-gw-1(config)#ip route 0.0.0.0 0.0.0.0 192.0.2.1
pisa-unipi-ismak-gw-1(config)#^Z
pisa-unipi-ismak-gw-1#
%SYS-5-CONFIG_I: Configured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

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

At the bottom of the terminal window, there are "Copy" and "Paste" buttons. Below the terminal window, there is a "Top" button.

Рисунок 9: Настройка интерфейсов маршрутизатора pisa-unipi-ismak-gw-1.

# Настройка интерфейсов



```
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 unipi-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#
```

Рисунок 10: Настройка интерфейсов коммутатора pisa-unipi-ismak-sw-1.

# Присвоение адресов

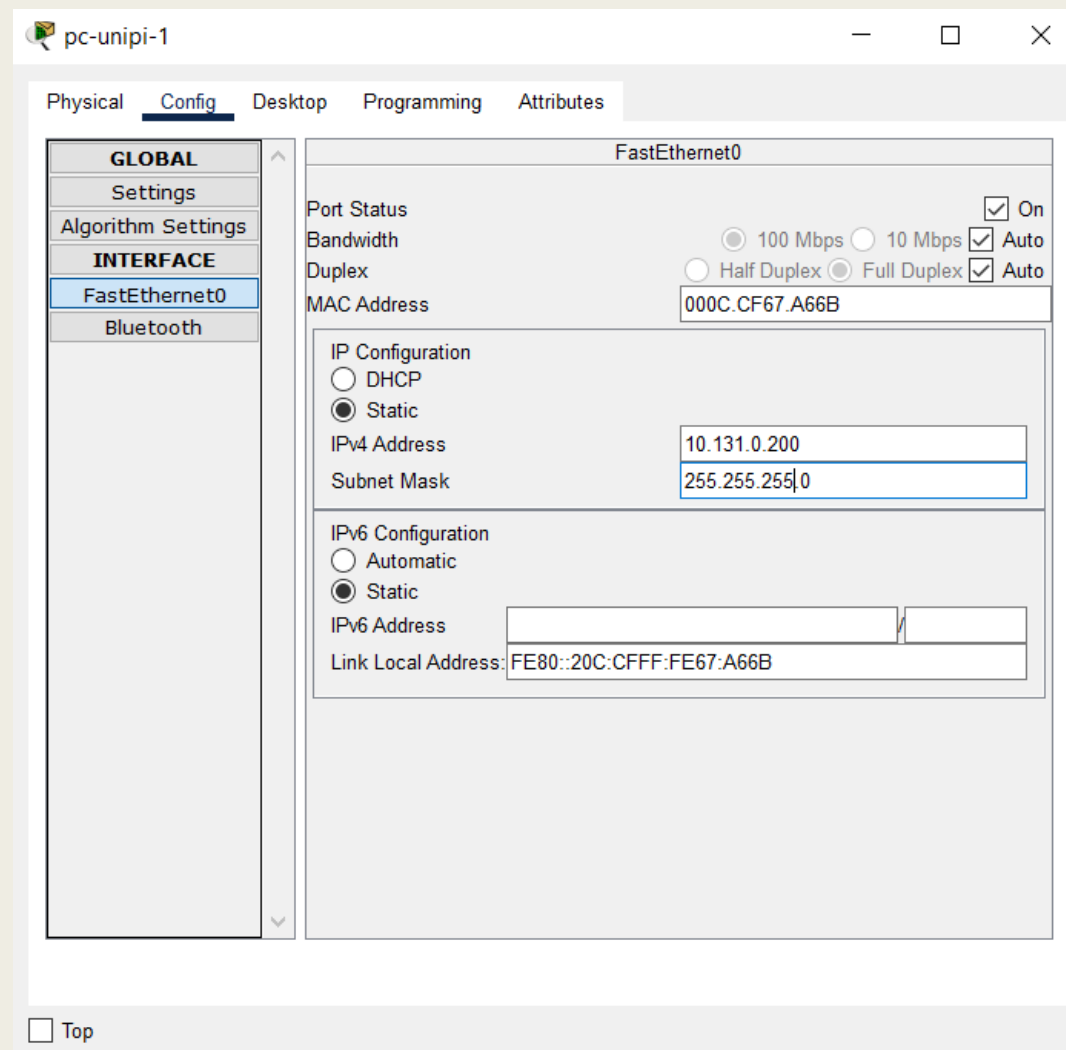
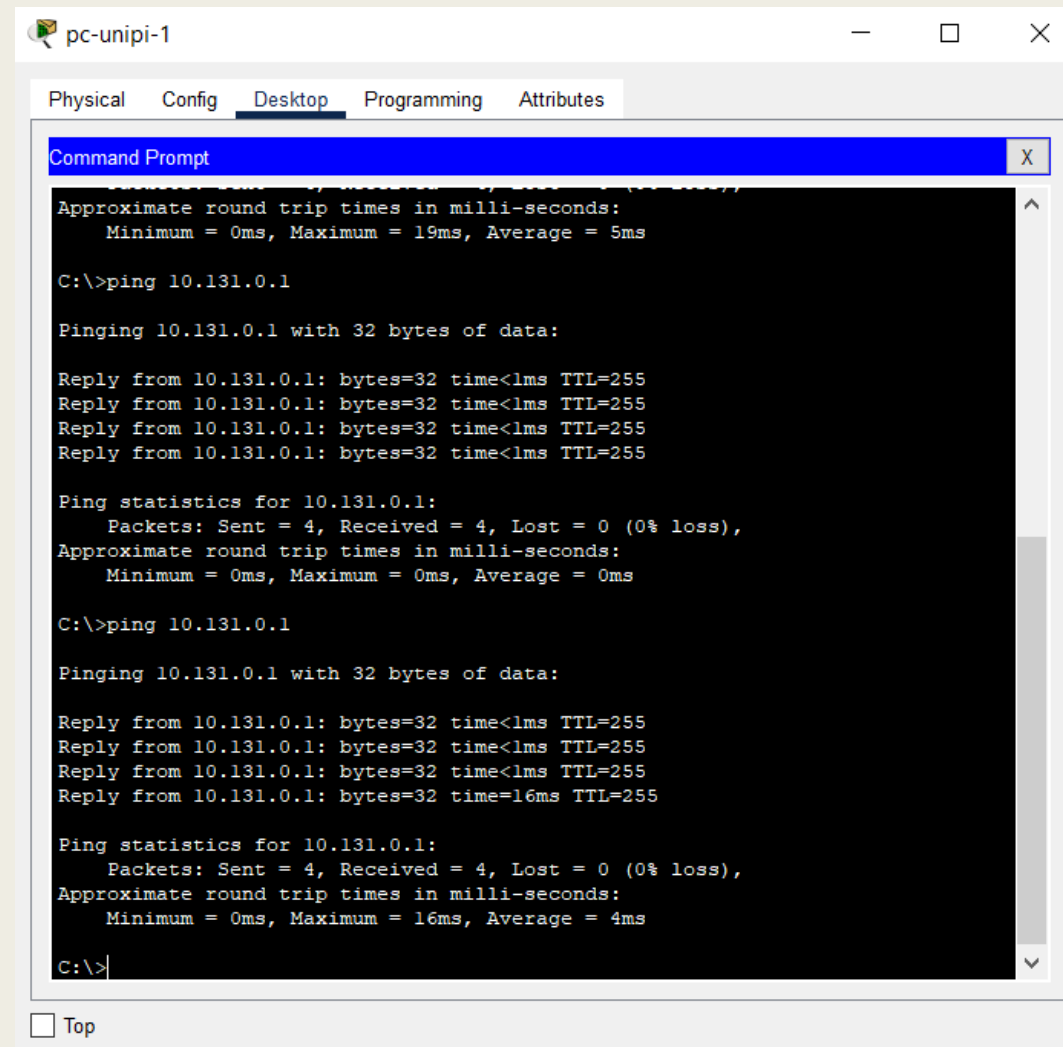


Рисунок 11: Присвоение адресов оконечному устройству.

# Ping



The screenshot shows a window titled "pc-unipi-1" with tabs for "Physical", "Config", "Desktop", "Programming", and "Attributes". The "Desktop" tab is active, displaying a "Command Prompt" window. The Command Prompt shows the results of two ping commands to the IP address 10.131.0.1. The first ping shows a round trip time of less than 1ms, and the second ping shows a round trip time of 16ms. Both pings show 0% loss and 4 packets received.

```
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:

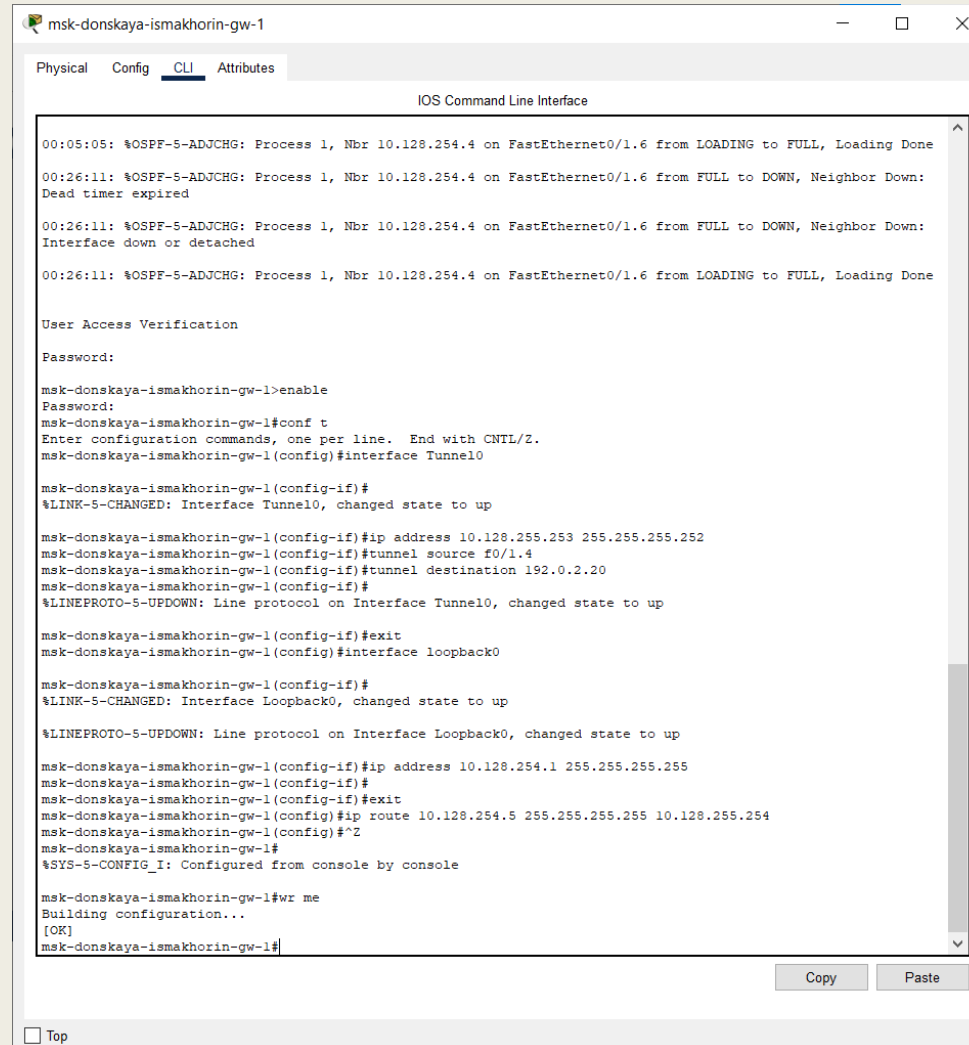
Reply from 10.131.0.1: bytes=32 time<1ms TTL=255
Reply from 10.131.0.1: bytes=32 time<1ms TTL=255
Reply from 10.131.0.1: bytes=32 time<1ms TTL=255
Reply from 10.131.0.1: bytes=32 time=16ms TTL=255

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:\>
```

Рисунок 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

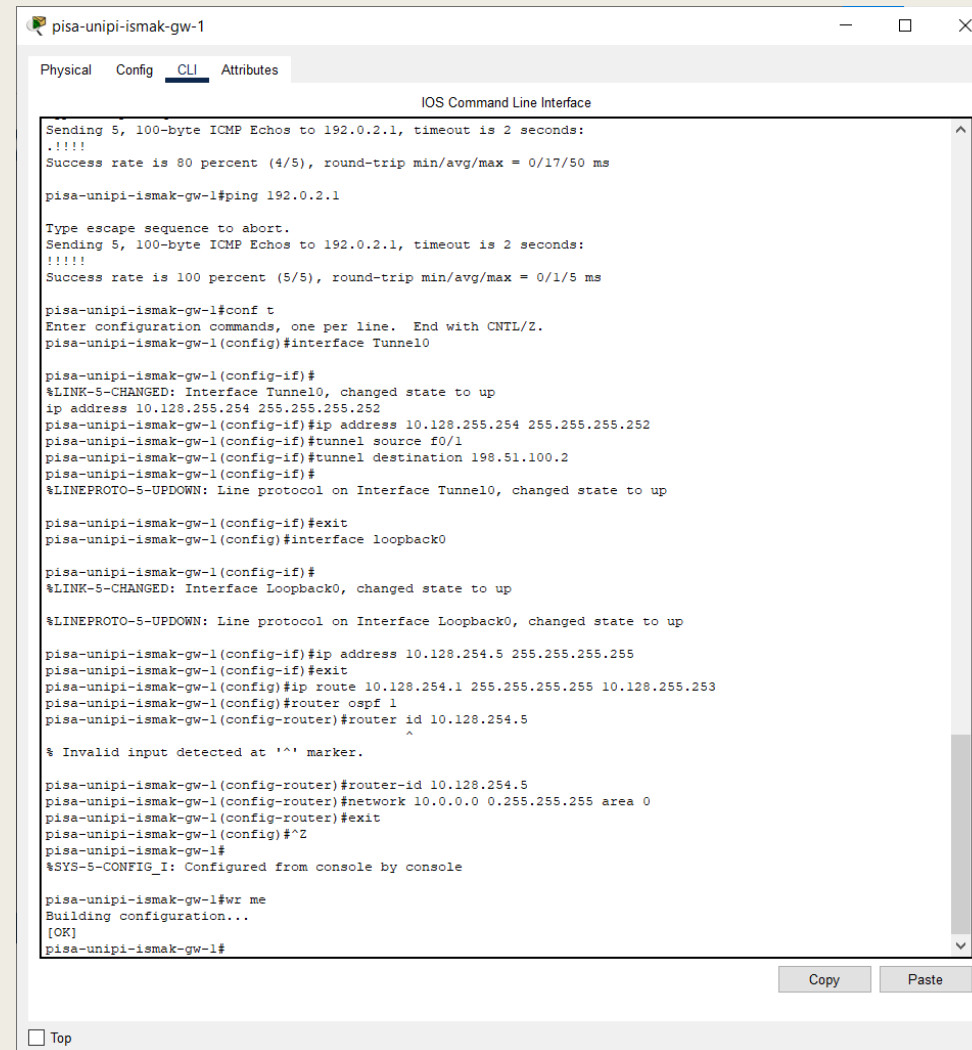
msk-donskaya-ismakhorin-gw-1(config-if)#ip address 10.128.254.1 255.255.255.255
msk-donskaya-ismakhorin-gw-1(config-if)#
msk-donskaya-ismakhorin-gw-1(config-if)#exit
msk-donskaya-ismakhorin-gw-1(config)#ip route 10.128.254.5 255.255.255.255 10.128.255.254
msk-donskaya-ismakhorin-gw-1(config)#^Z
msk-donskaya-ismakhorin-gw-1#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

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

Рисунок 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#
```

Рисунок 14: Настройка маршрутизатора pisa-unipi-ismak-gw-1.

# Проверка

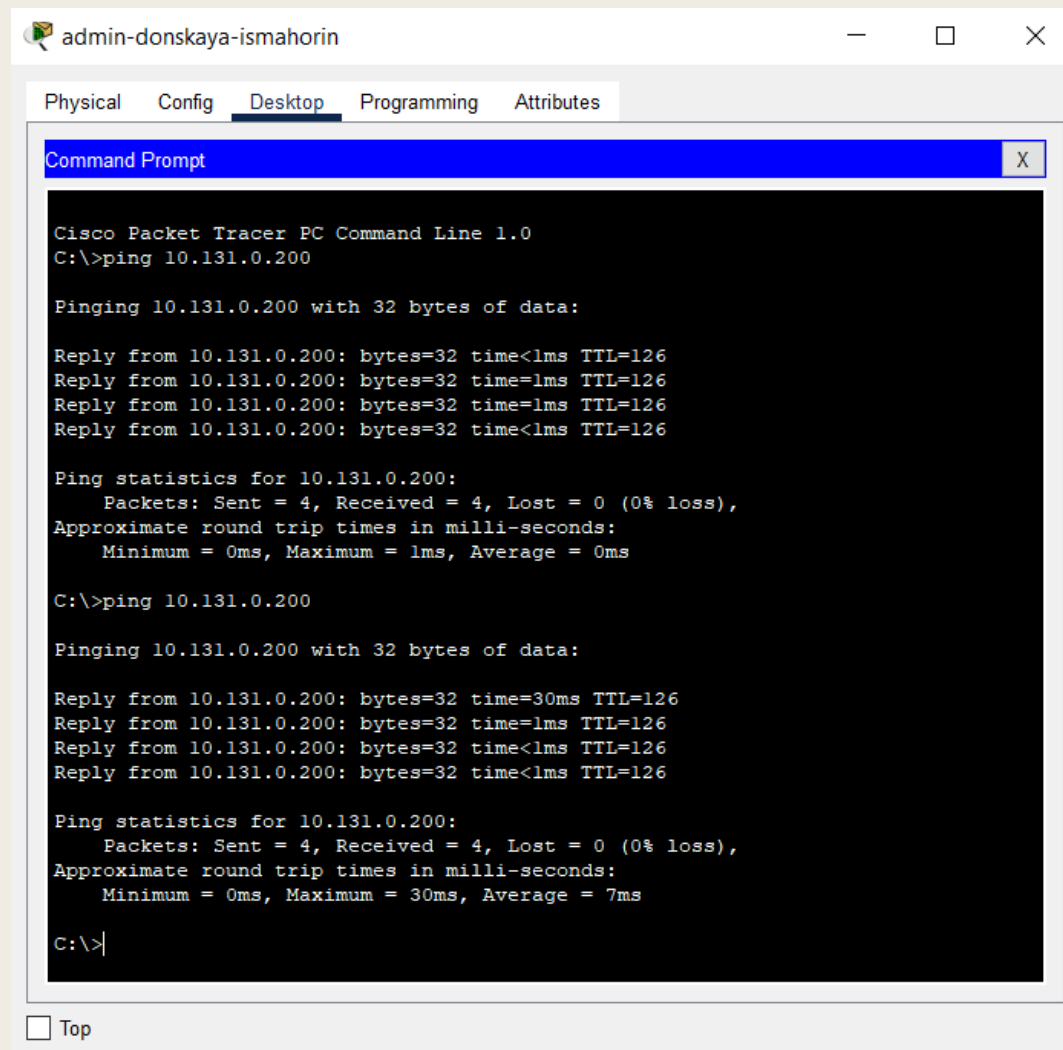


Рисунок 15: Проверка доступности узлов сети Университета г. Пиза с ноутбука администратора сети «Донская».

# Заключение

В заключение, можно сказать, что технология туннелирования GRE (Generic Routing Encapsulation) открывает перед нами широкие возможности для эффективного и безопасного обмена данными между сетями. Разработанный компанией Cisco, этот протокол позволяет инкапсулировать различные протоколы сетевого уровня в point-to-point каналах, обеспечивая тем самым гибкость и надежность в передаче данных.



# Источники

1. Настройка GRE туннеля на Cisco // MERION URL:  
<https://wiki.merionet.ru/articles/nastroyka-gre-tunnelya-na-cisco> (дата обращения: 05.06.2024).
2. Лабораторная работа № 16. Настройка VPN // ТУИС РУДН URL:  
[https://esystem.rudn.ru/pluginfile.php/2293167/mod\\_resource/content/12/016-vpn.pdf](https://esystem.rudn.ru/pluginfile.php/2293167/mod_resource/content/12/016-vpn.pdf)  
(дата обращения: 05.06.2024).

Спасибо за внимание!