

Концентратор (hub), коммутатор (switch)

Сетевой концентратор - хаб(hub)

Первый уровень модели OSI (L1)

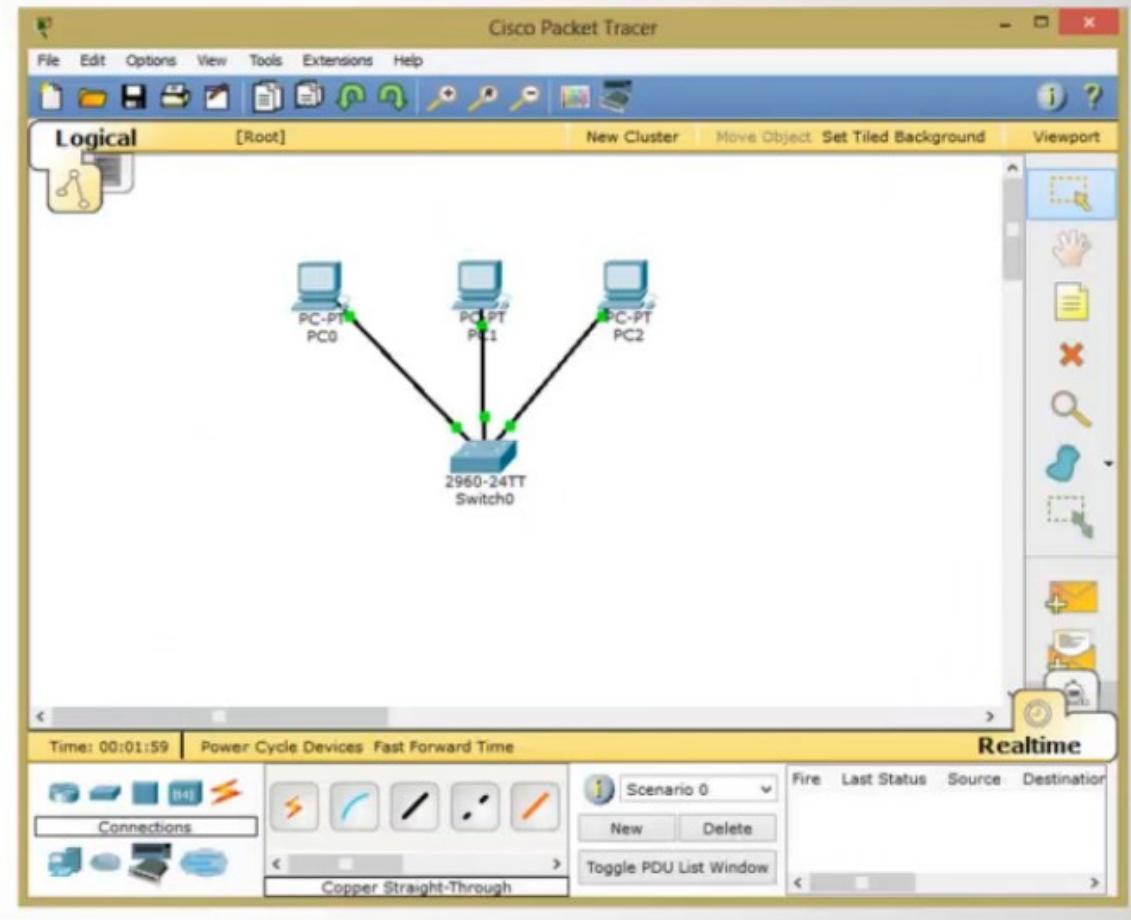
[Подробнее...](#)

Коммутатор - Switch

Второй уровень модели OSI (L2)

[Подробнее...](#)

[Сетевая модель OSI](#)



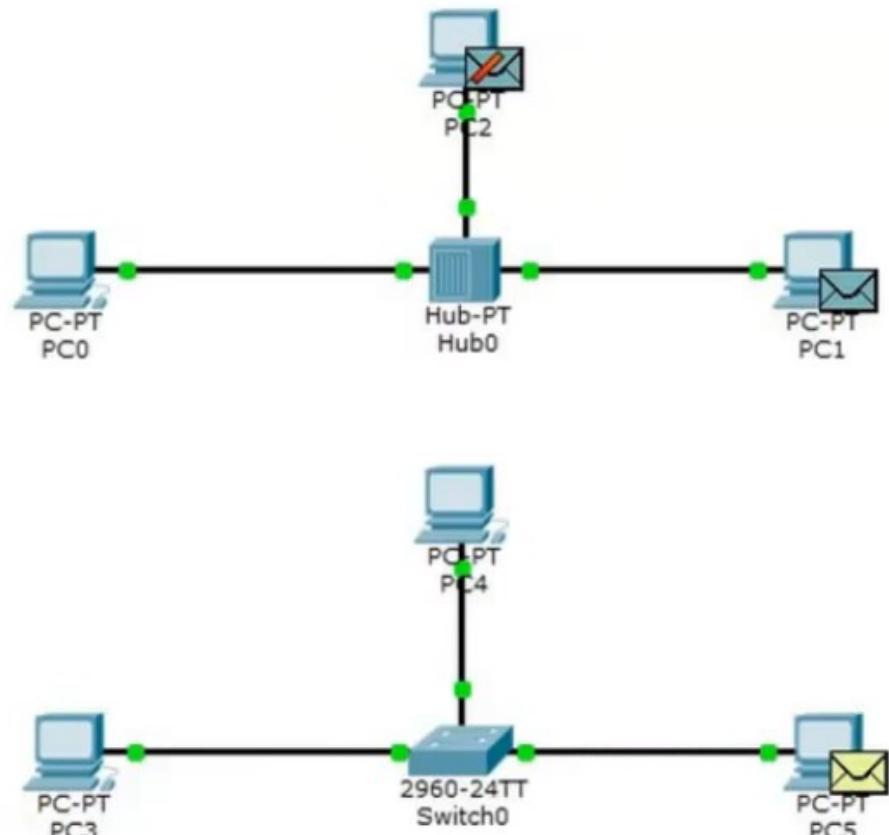
Концентратор (hub), коммутатор (switch)

Хаб - отправляет пакеты во все порты, кроме порта источника

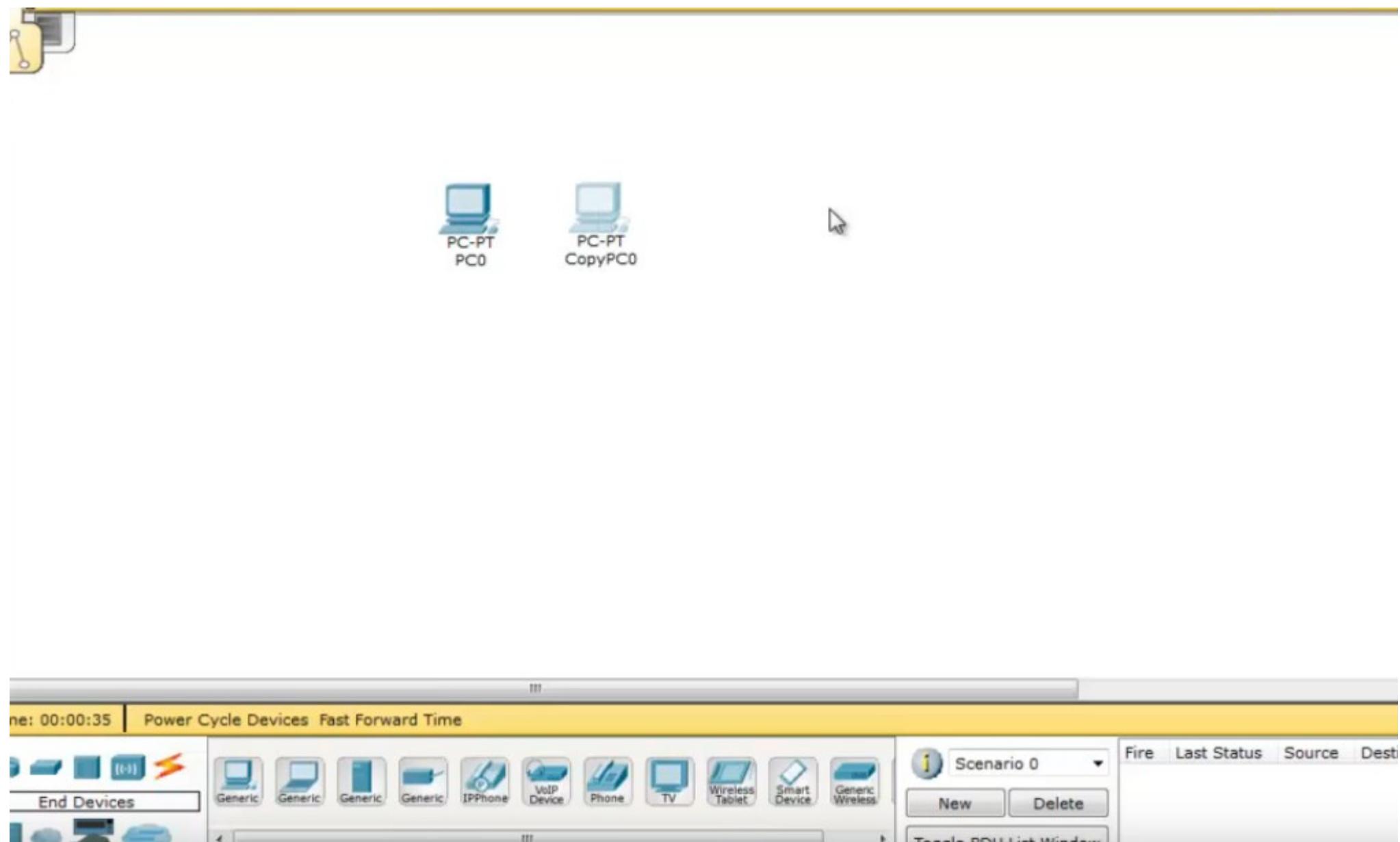
Switch - отправляет пакет только в определенный порт за счет использования таблицы MAC - адресов

Port	Link	VLAN	IP Address	MAC Address
FastEthernet0/1	Up	1	--	0060.7037.A401
FastEthernet0/2	Up	1	--	0060.7037.A402
FastEthernet0/3	Up	1	--	0060.7037.A403
FastEthernet0/4	Down	1	--	0060.7037.A404
FastEthernet0/5	Down	1	--	0060.7037.A405
FastEthernet0/6	Down	1	--	0060.7037.A406
FastEthernet0/7	Down	1	--	0060.7037.A407
FastEthernet0/8	Down	1	--	0060.7037.A408
FastEthernet0/9	Down	1	--	0060.7037.A409
FastEthernet0/10	Down	1	--	0060.7037.A40A
FastEthernet0/11	Down	1	--	0060.7037.A40B
FastEthernet0/12	Down	1	--	0060.7037.A40C
FastEthernet0/13	Down	1	--	0060.7037.A40D
FastEthernet0/14	Down	1	--	0060.7037.A40E
FastEthernet0/15	Down	1	--	0060.7037.A40F
FastEthernet0/16	Down	1	--	0060.7037.A410
FastEthernet0/17	Down	1	--	0060.7037.A411
FastEthernet0/18	Down	1	--	0060.7037.A412
FastEthernet0/19	Down	1	--	0060.7037.A413
FastEthernet0/20	Down	1	--	0060.7037.A414
FastEthernet0/21	Down	1	--	0060.7037.A415
FastEthernet0/22	Down	1	--	0060.7037.A416
FastEthernet0/23	Down	1	--	0060.7037.A417
FastEthernet0/24	Down	1	--	0060.7037.A418
GigabitEthernet1/1	Down	1	--	00D0.BASA.1A01
GigabitEthernet1/2	Down	1	--	00D0.BASA.1A02
Vlan1	Down	1	<not set>	0002.163D.8CE6

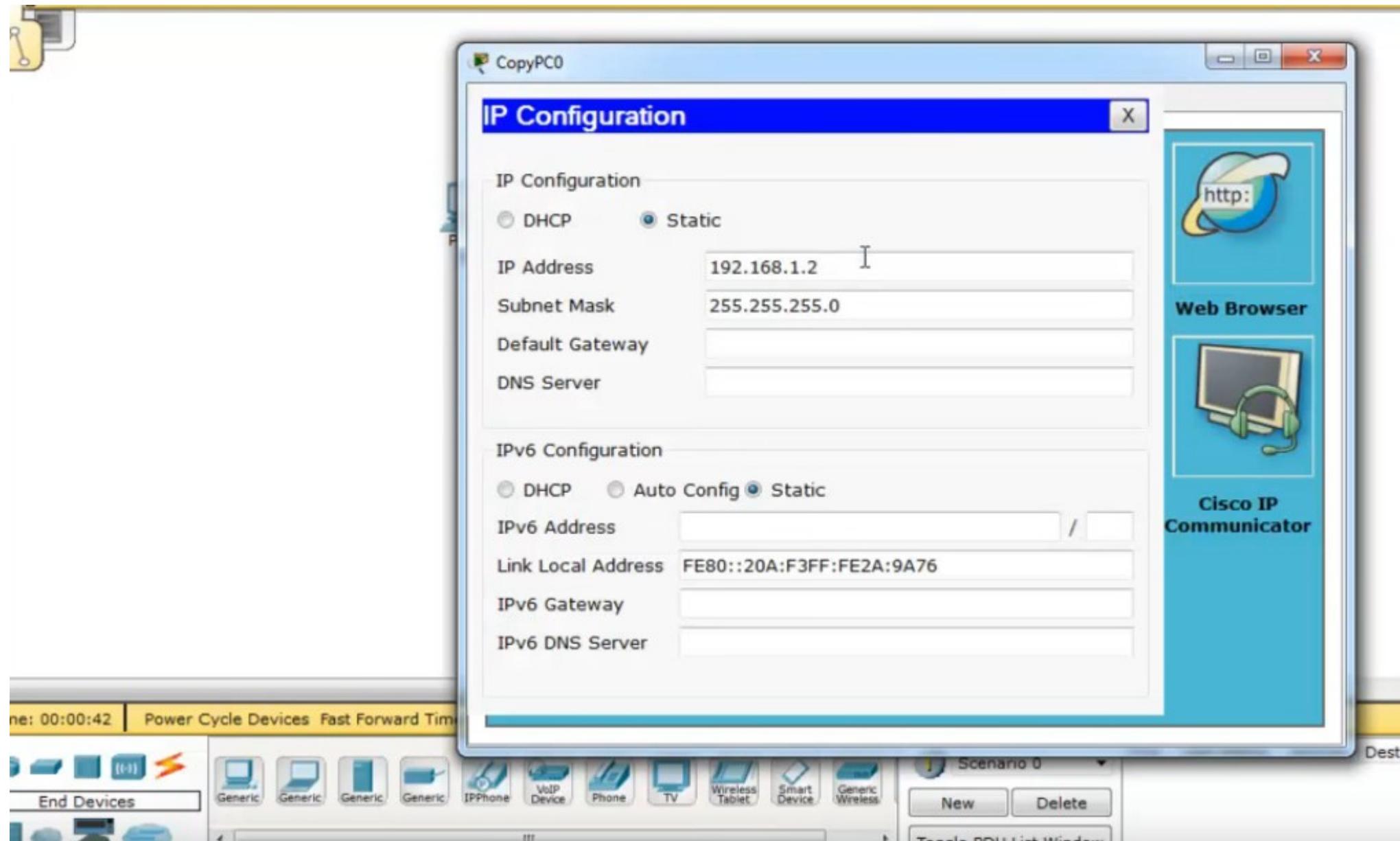
Physical Location: Intercity, Home City, Corporate Office, Main Wiring Closet



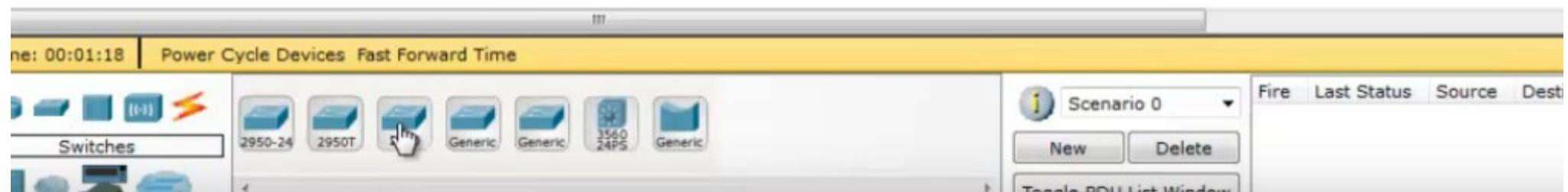
Концентратор (hub), коммутатор (switch)



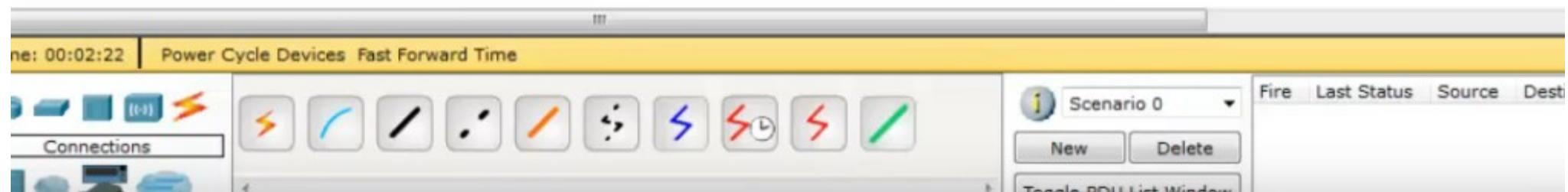
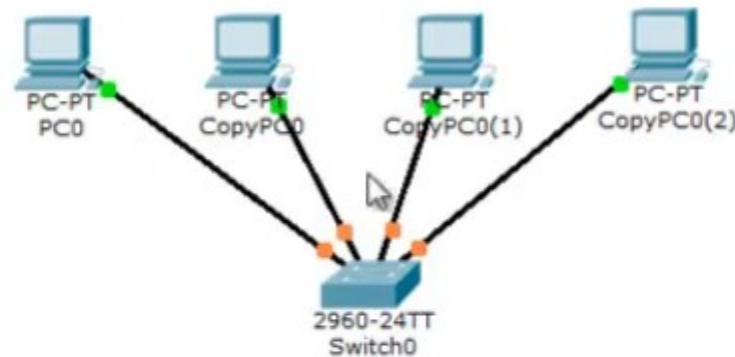
Концентратор (hub), коммутатор (switch)



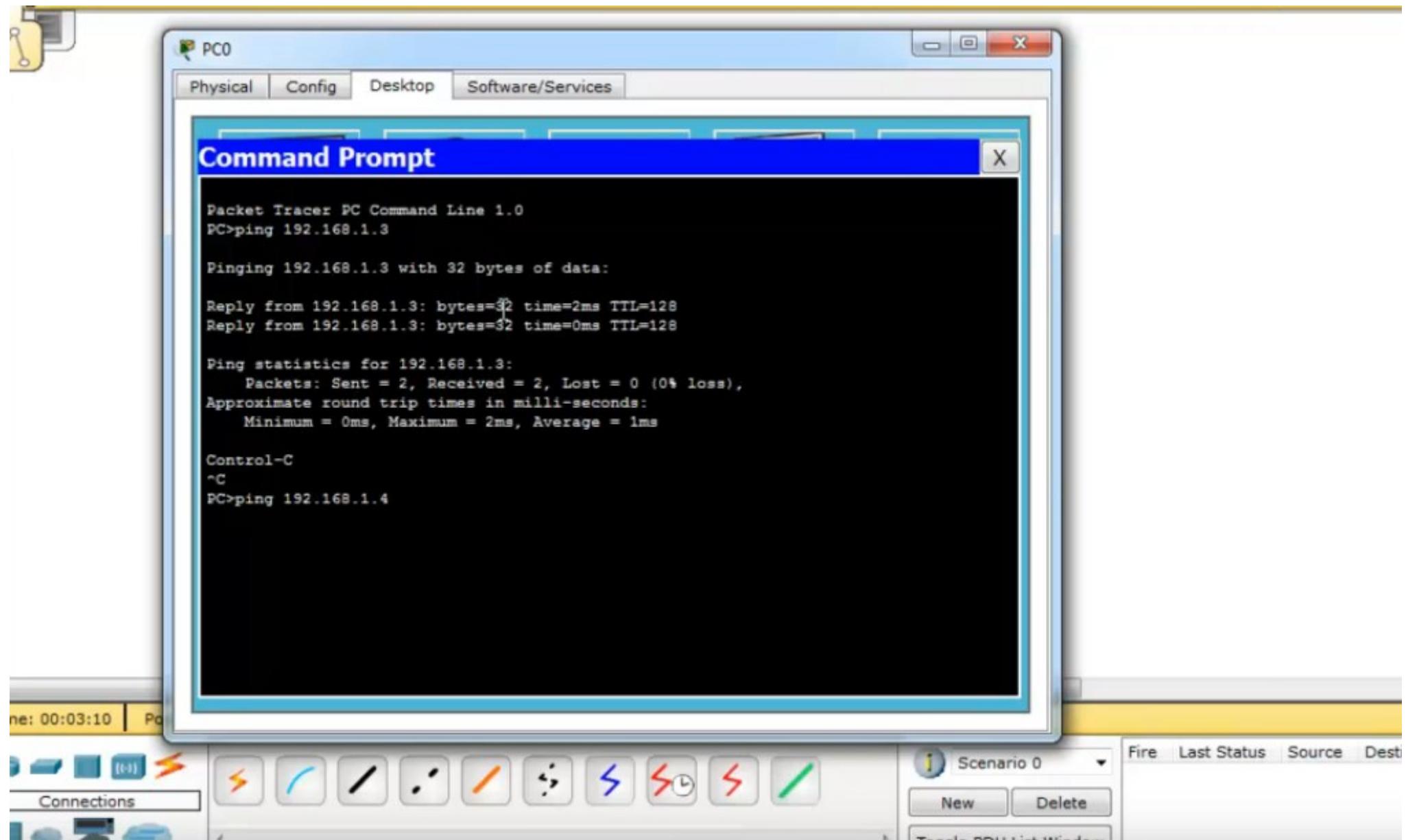
Концентратор (hub), коммутатор (switch)



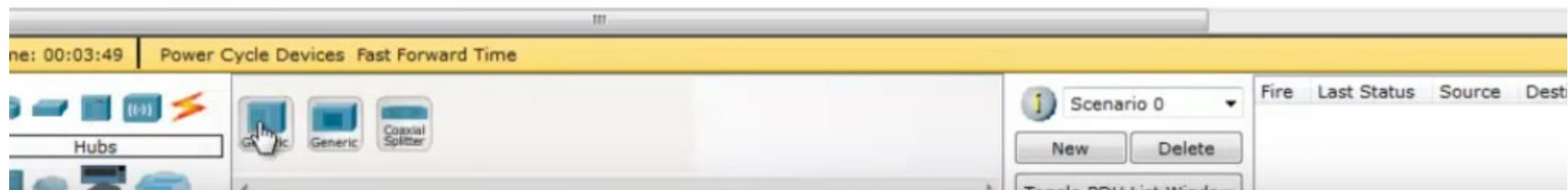
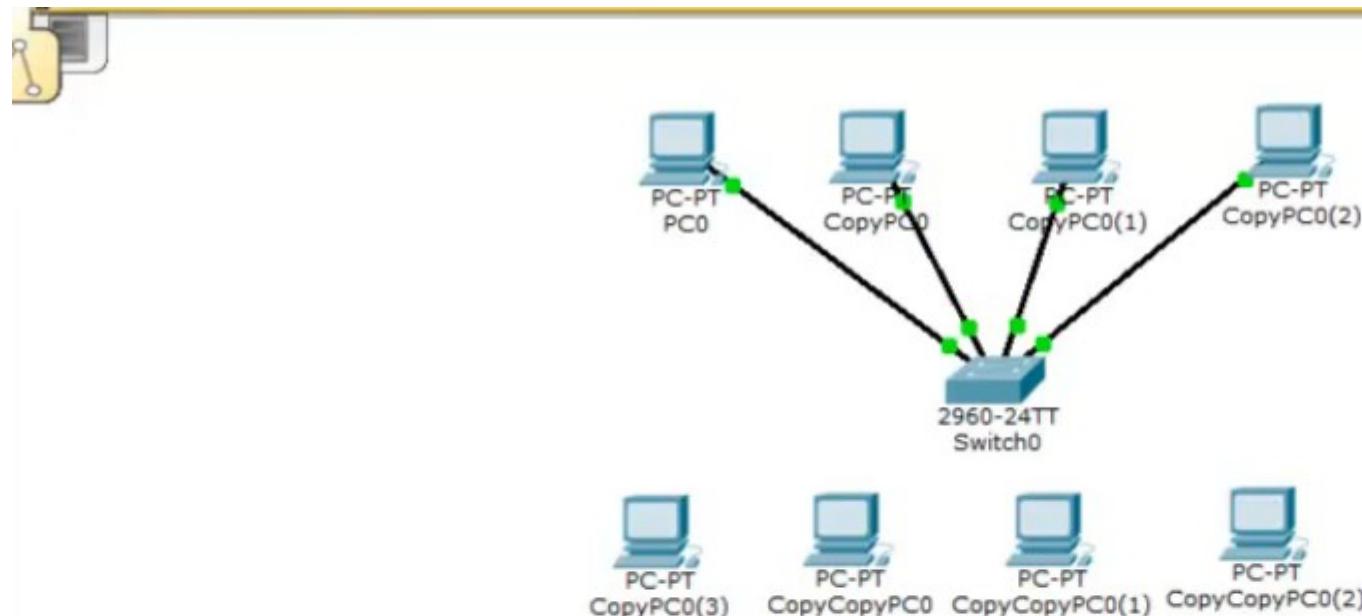
Концентратор (hub), коммутатор (switch)



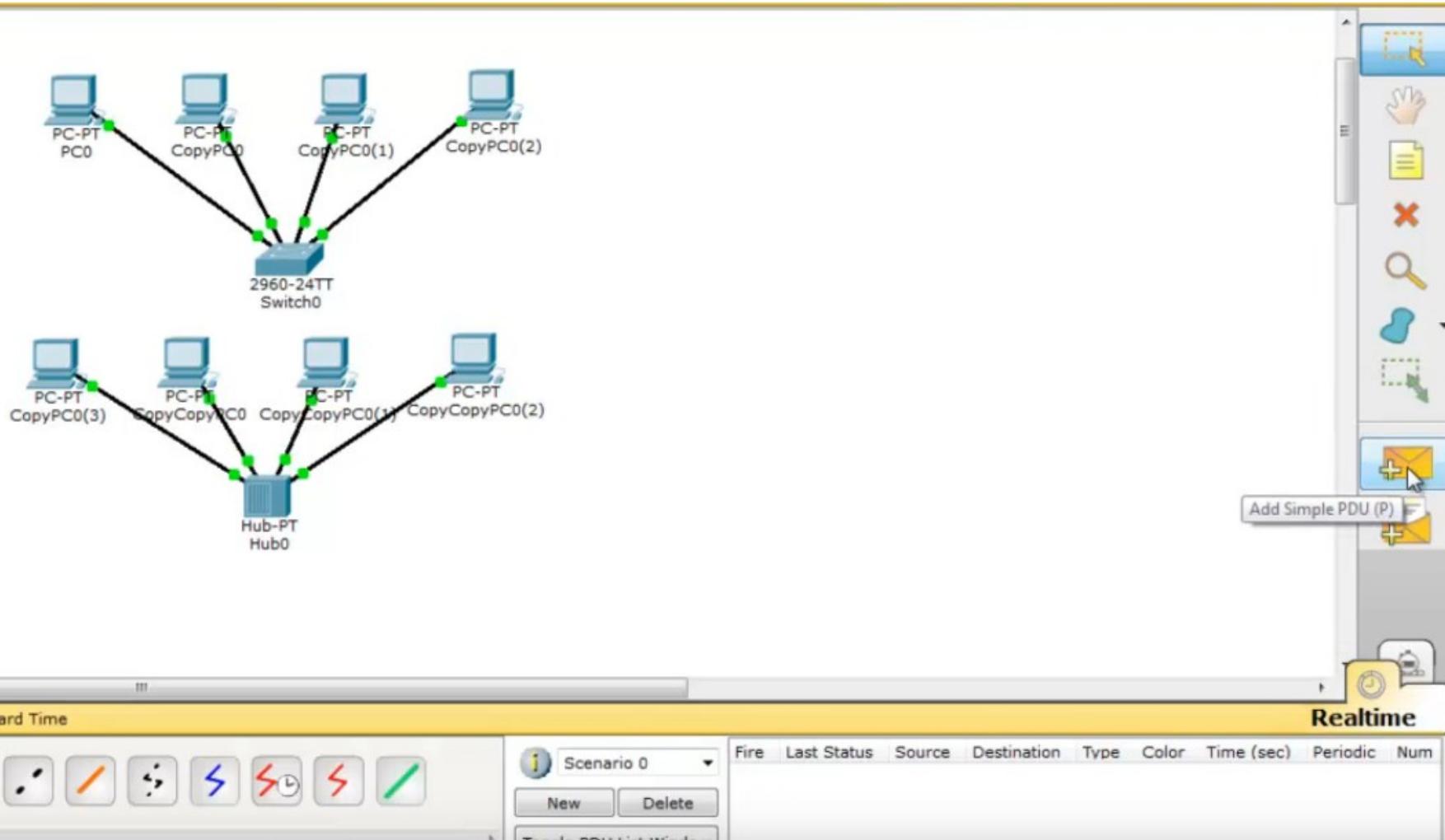
Концентратор (hub), коммутатор (switch)



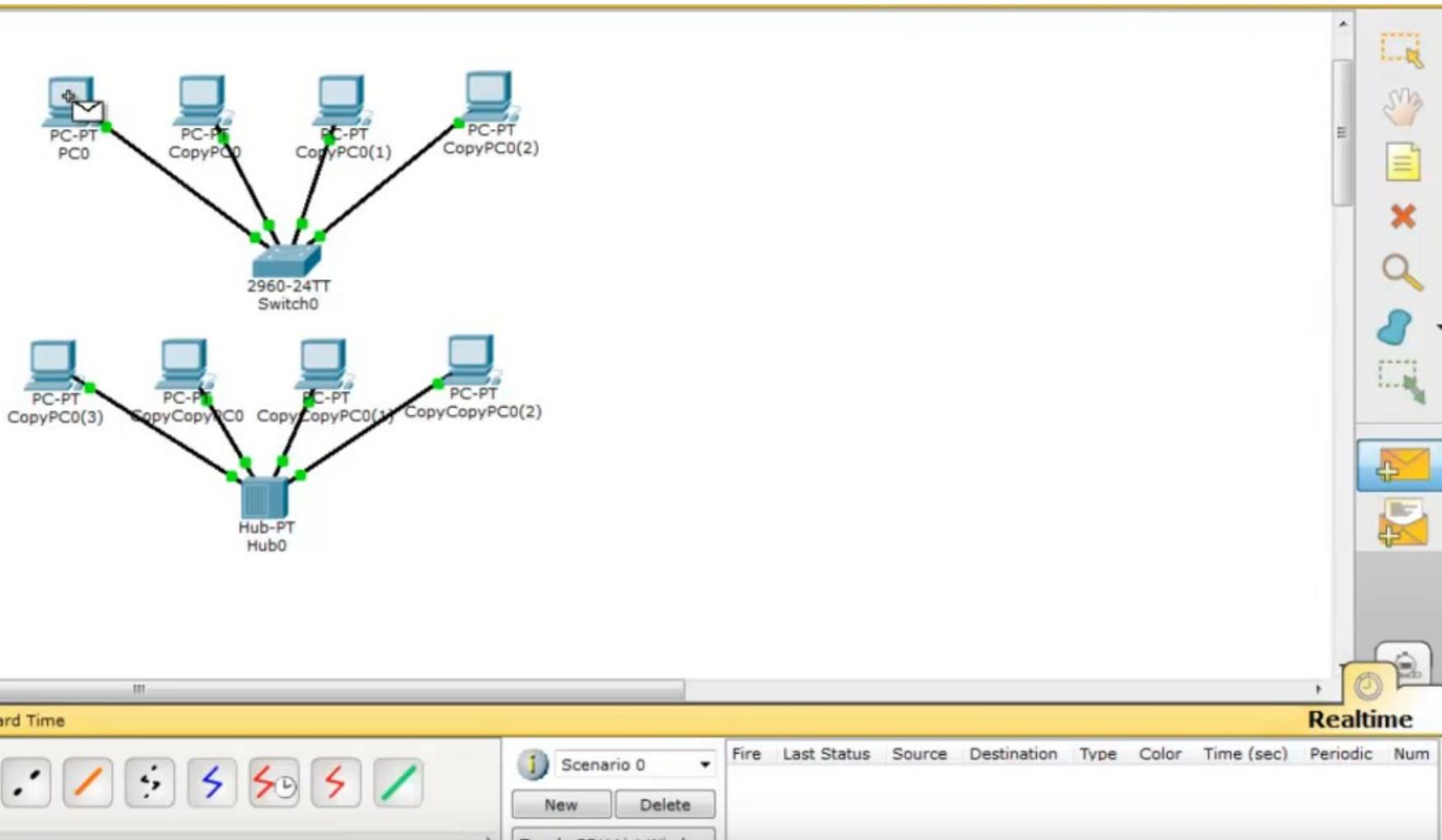
Концентратор (hub), коммутатор (switch)



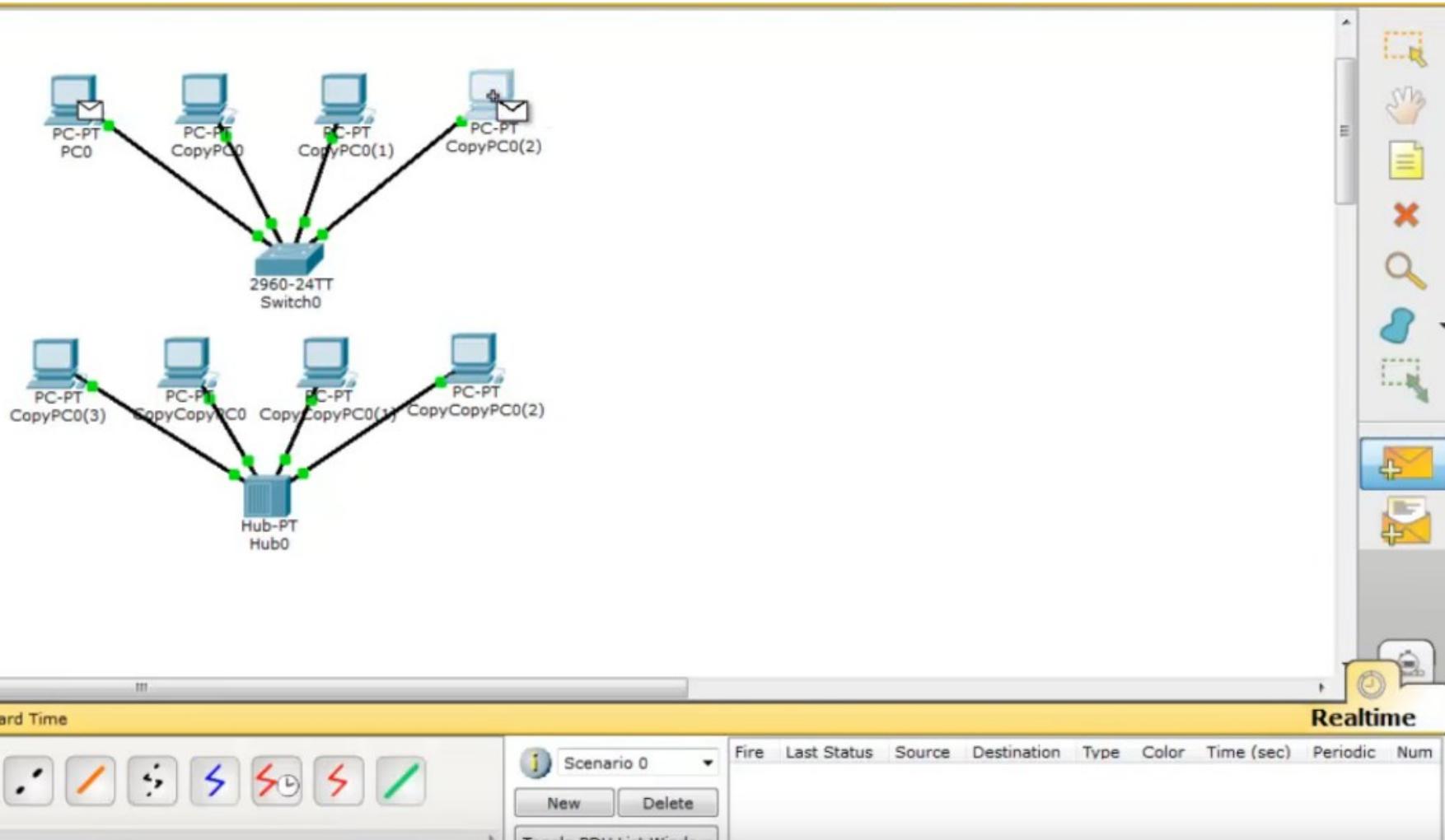
Концентратор (hub), коммутатор (switch)



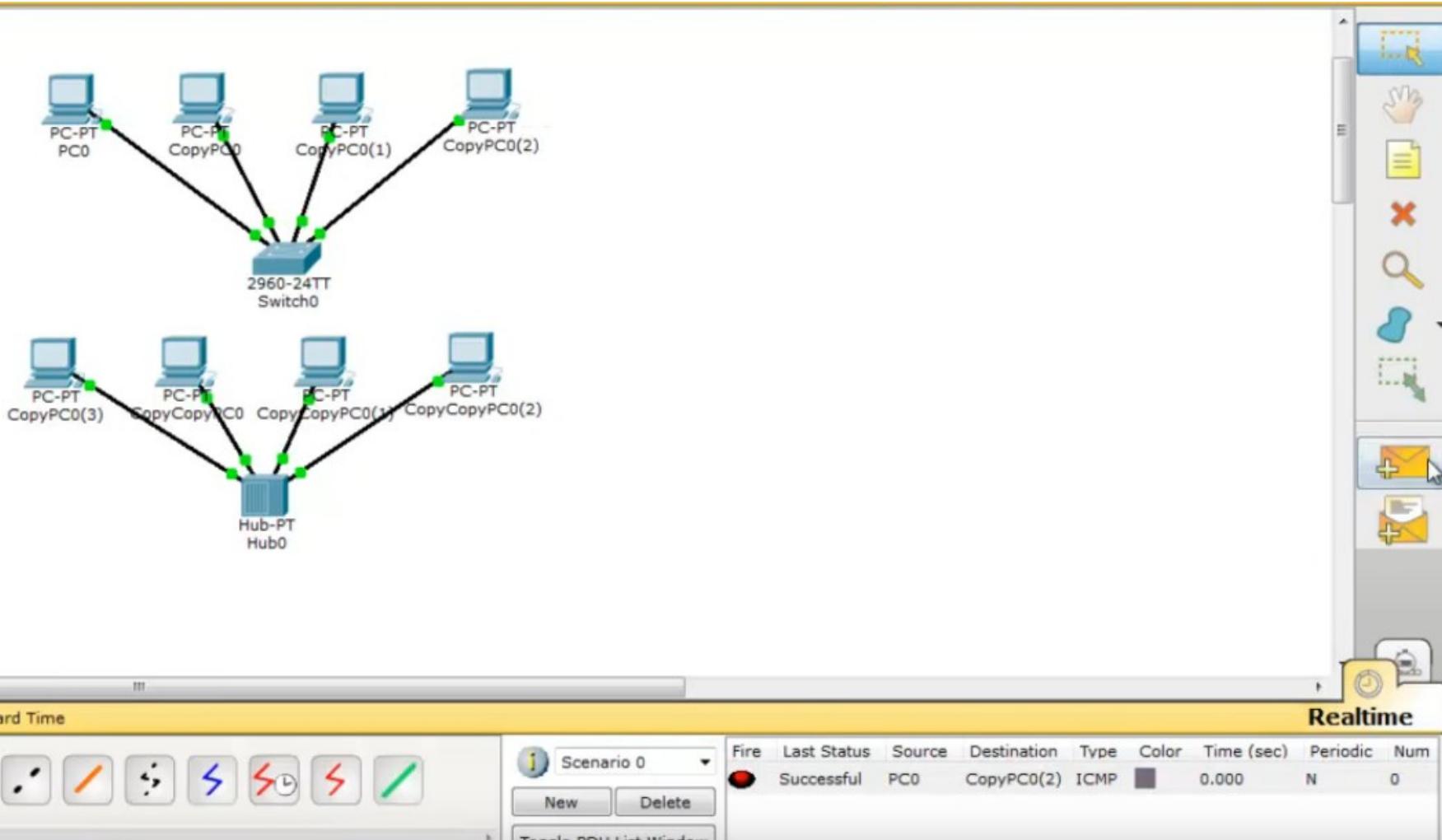
Концентратор (hub), коммутатор (switch)



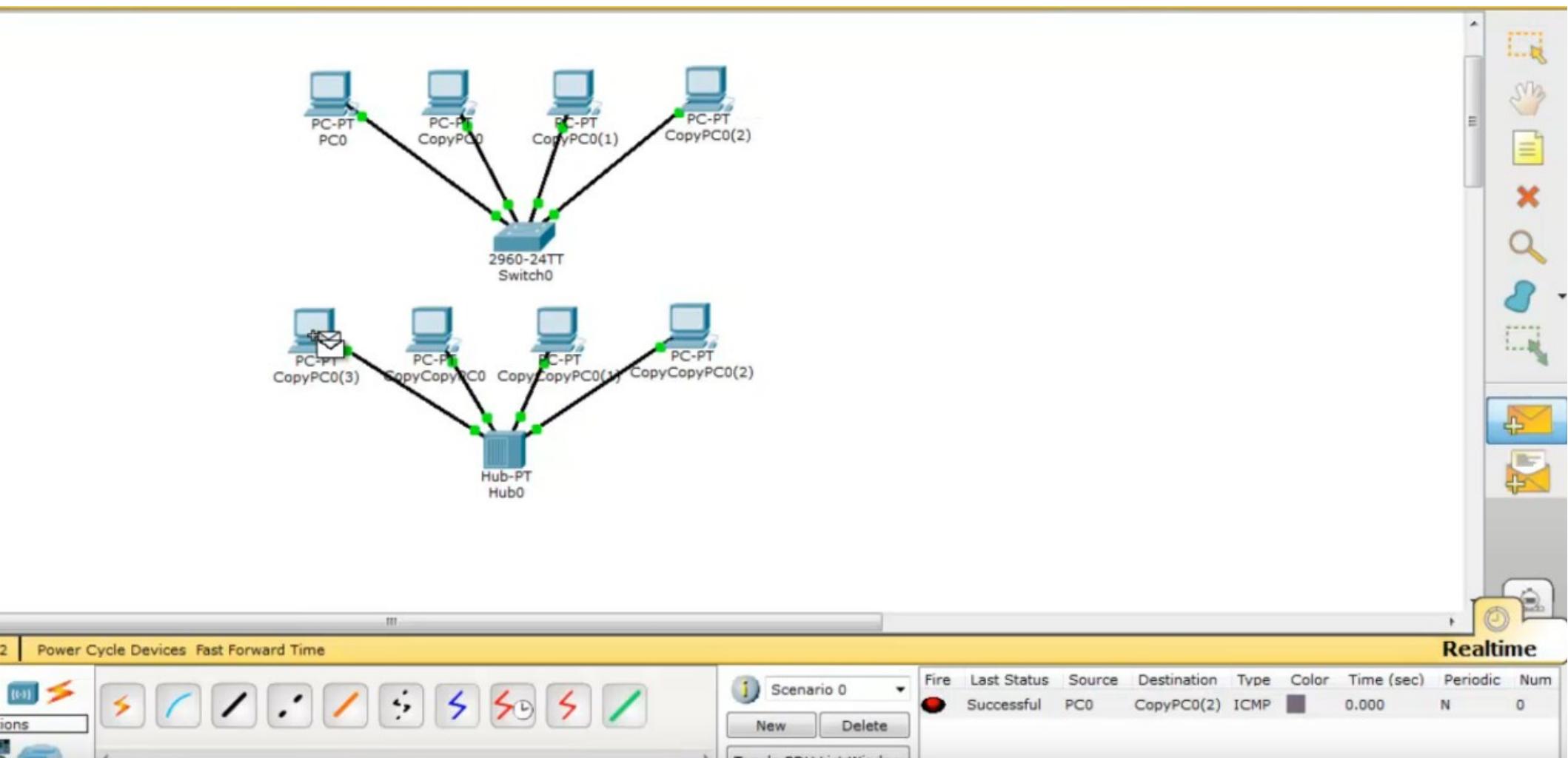
Концентратор (hub), коммутатор (switch)



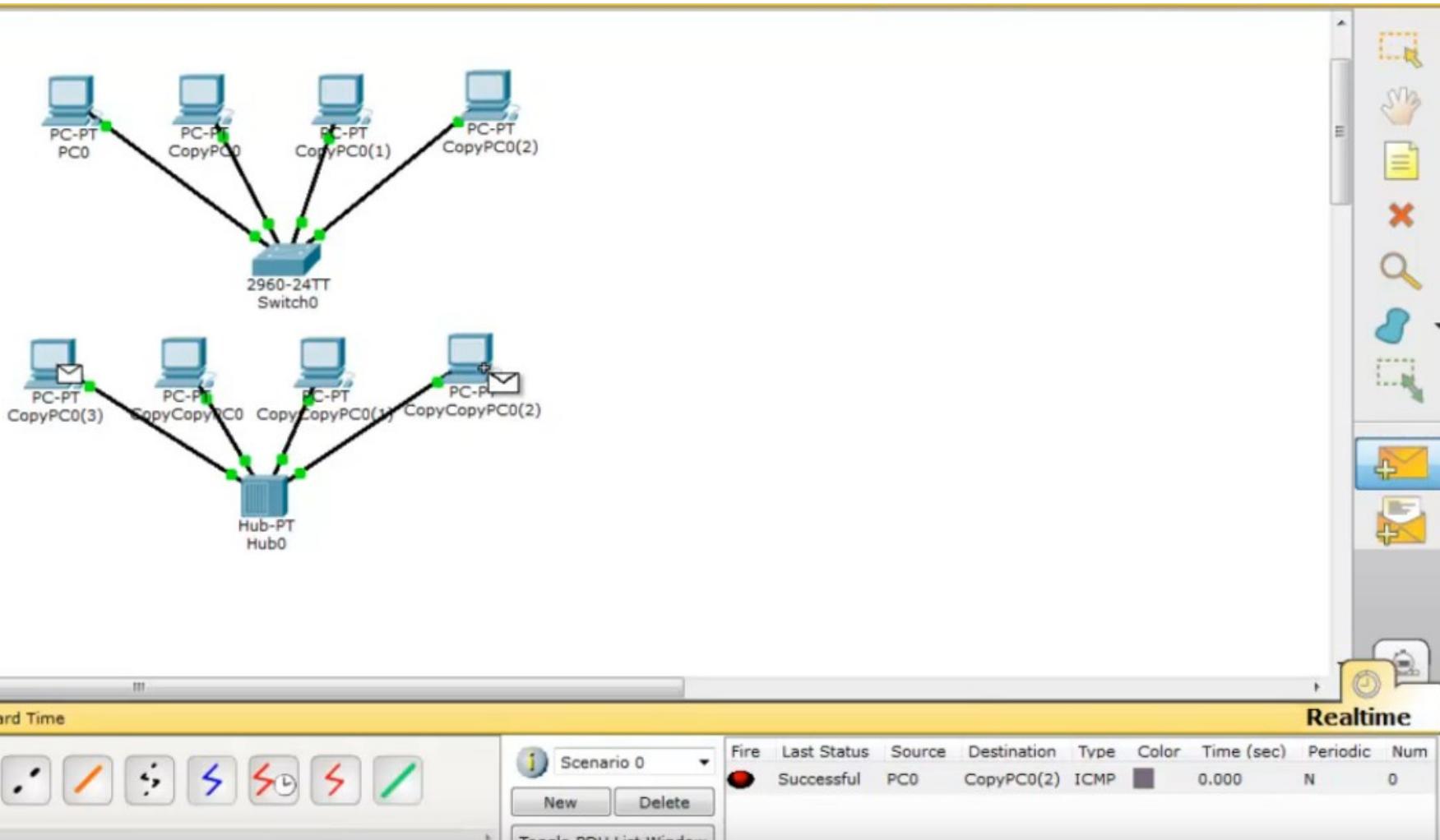
Концентратор (hub), коммутатор (switch)



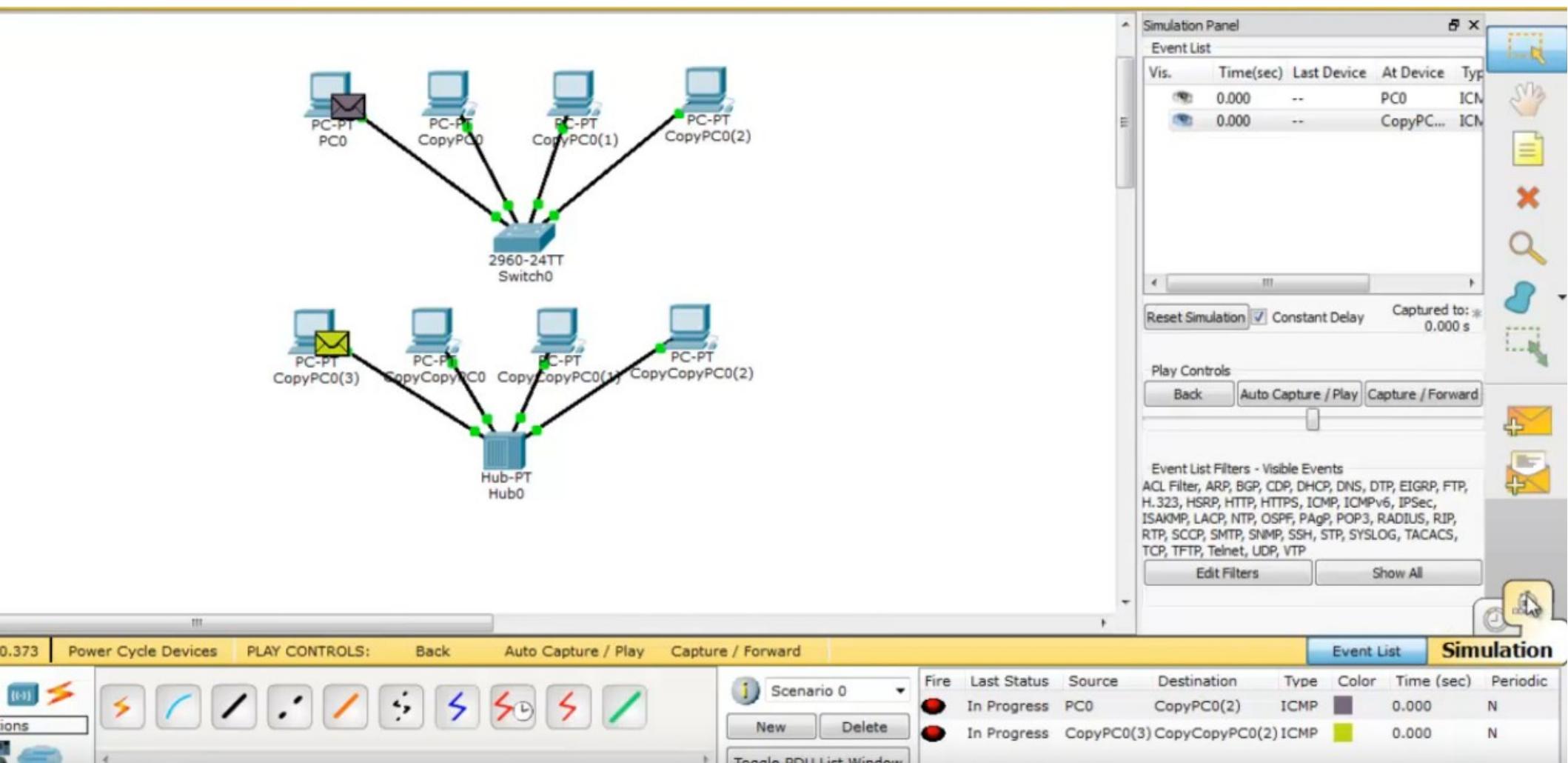
Концентратор (hub), коммутатор (switch)



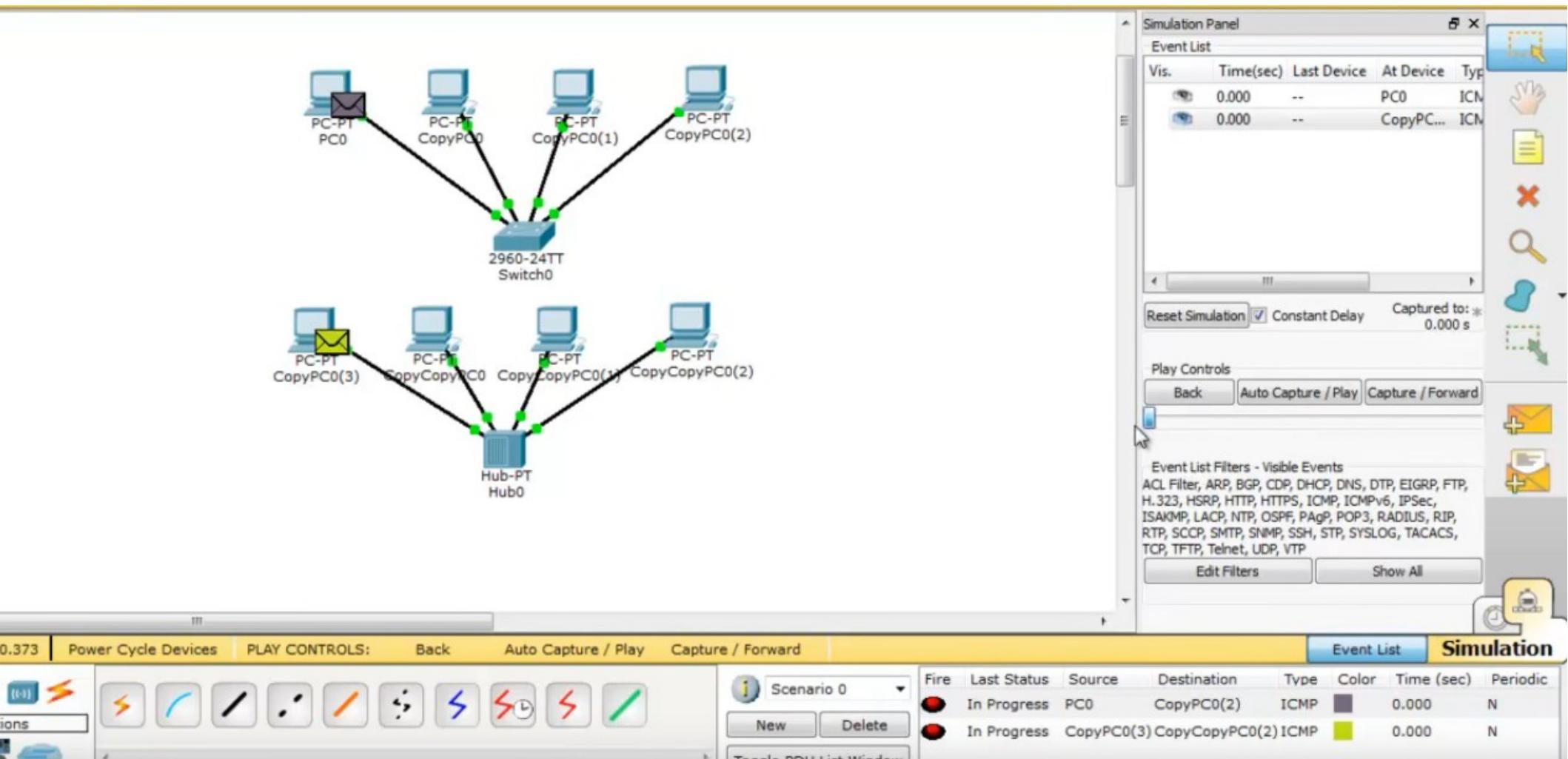
Концентратор (hub), коммутатор (switch)



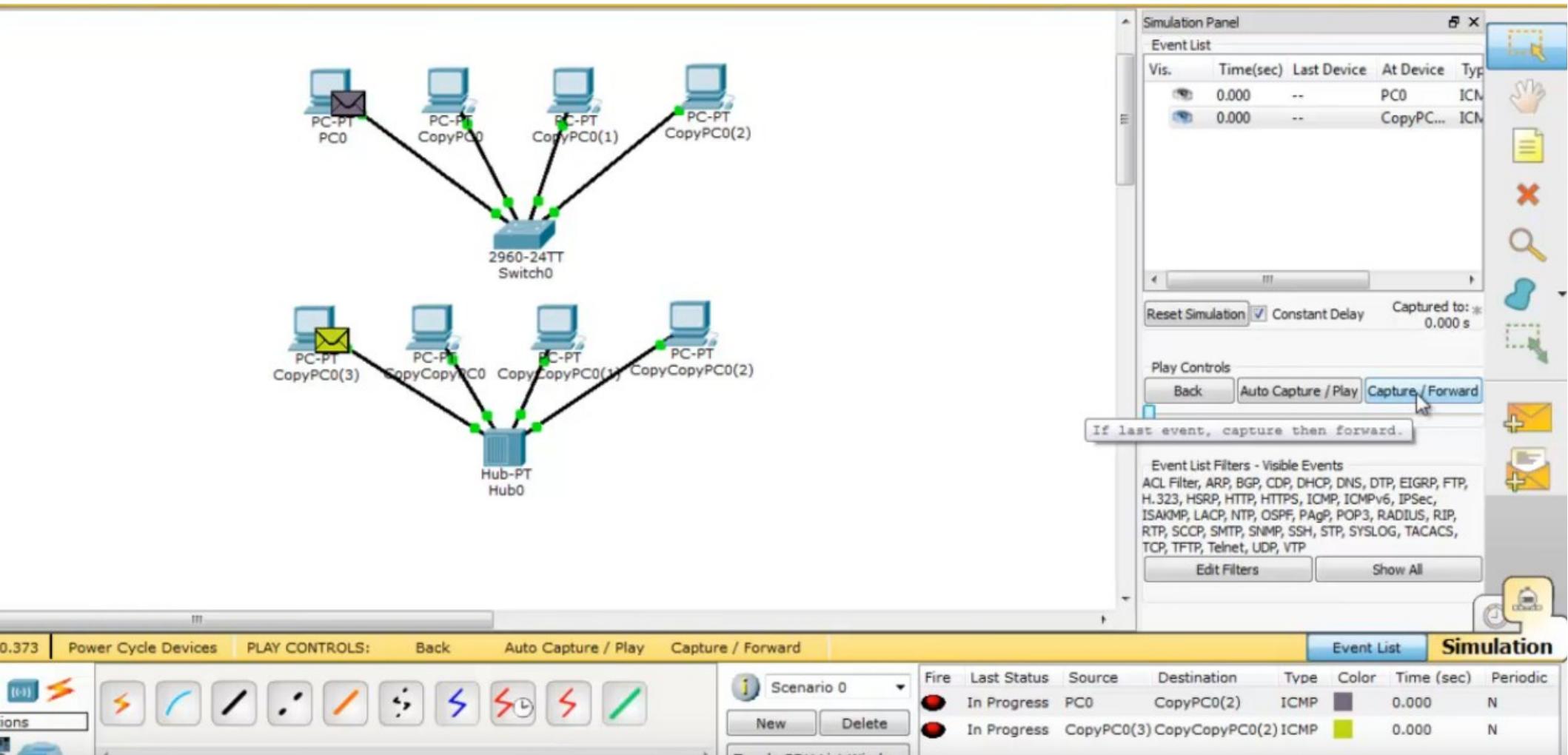
Концентратор (hub), коммутатор (switch)



Концентратор (hub), коммутатор (switch)



Концентратор (hub), коммутатор (switch)



VLAN — Virtual Local Area Network

VLAN - Virtual Local Area Network

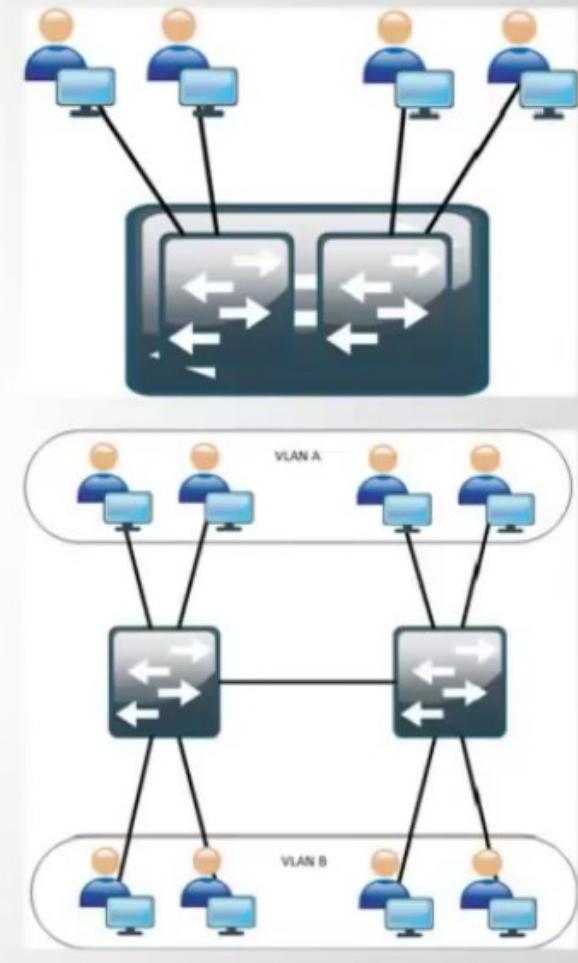
Коммутатор внутри коммутатора. Преимущества:

- VLAN помогает структурировать сеть
- VLAN используется для обеспечения безопасности
- VLAN используют для объединения
- VLAN уменьшает кол-во широковещательного трафика

Типы портов:

- Access Port - для подключения конечных устройств
- Trunk Port - для соединений между коммутаторами

Подробнее о [VLAN](#)



VLAN — Virtual Local Area Network

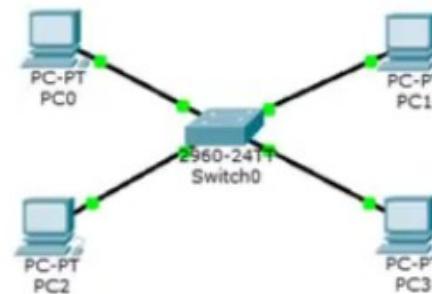
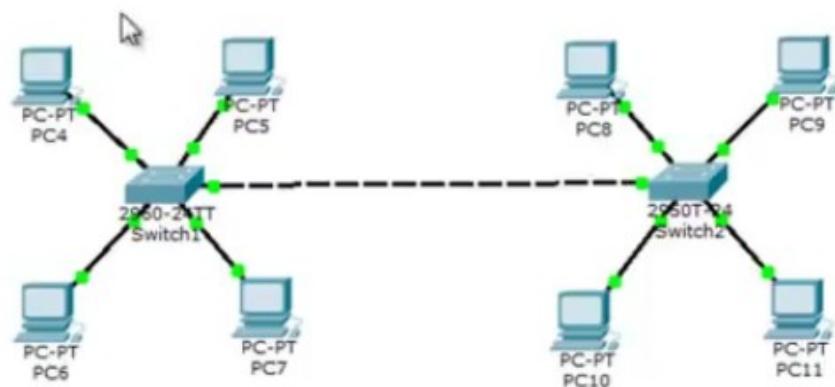


Схема с одним коммутатором:

1. Создаем VLAN
2. Определяем Access порты

Схема с двумя коммутаторами:

1. Создаем VLAN
2. Определяем Access порты
3. Определяем Trunk порты



STP — Spanning Tree Protocol

Методы организации отказоустойчивых каналов

СВЯЗИ:

- Резервирование соединений. Традиционная избыточная топология.
- Агрегирование каналов - объединение нескольких физических каналов в один логический.

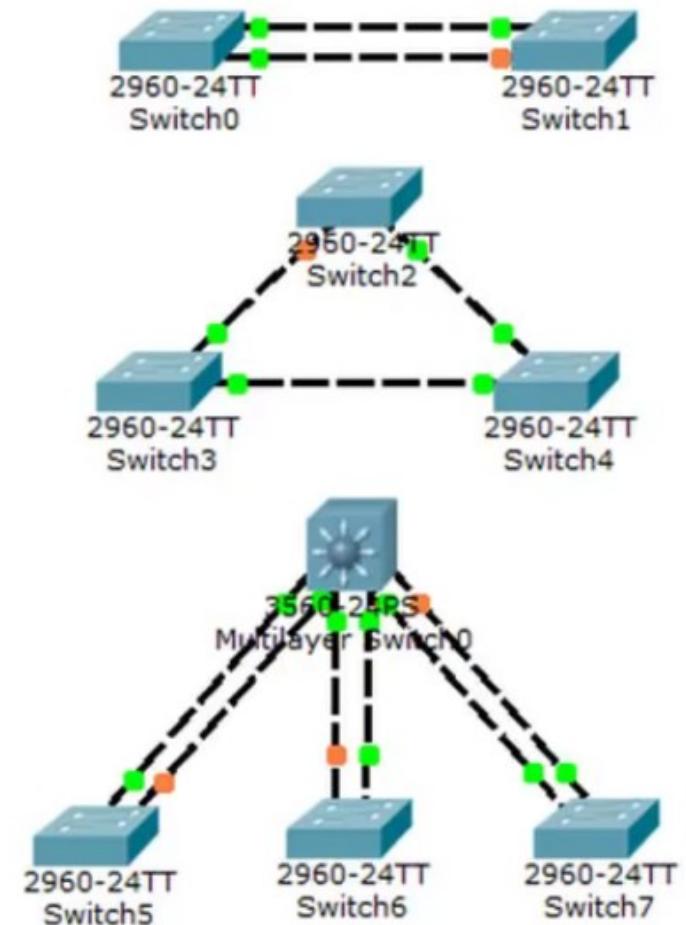
Коммутационная петля. Создаваемые проблемы:

- Широковещательные штормы
- Множественные копии кадров
- Множественные петли

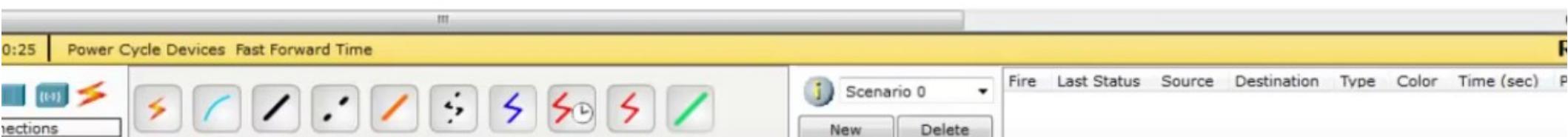
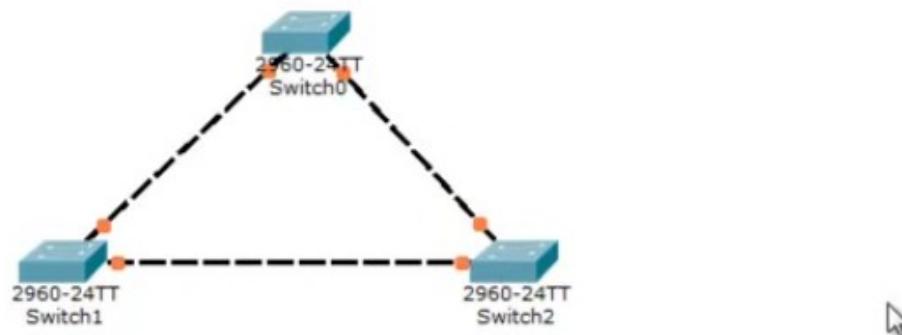
Spanning Tree Protocol (STP):

- Протокол 2-го уровня модели OSI
- Защита от петель в сети
- Автоматическое резервирование каналов
- Время сходимости 30-50 секунд
- Альтернативы: RSTP, MSTP (менее секунды)

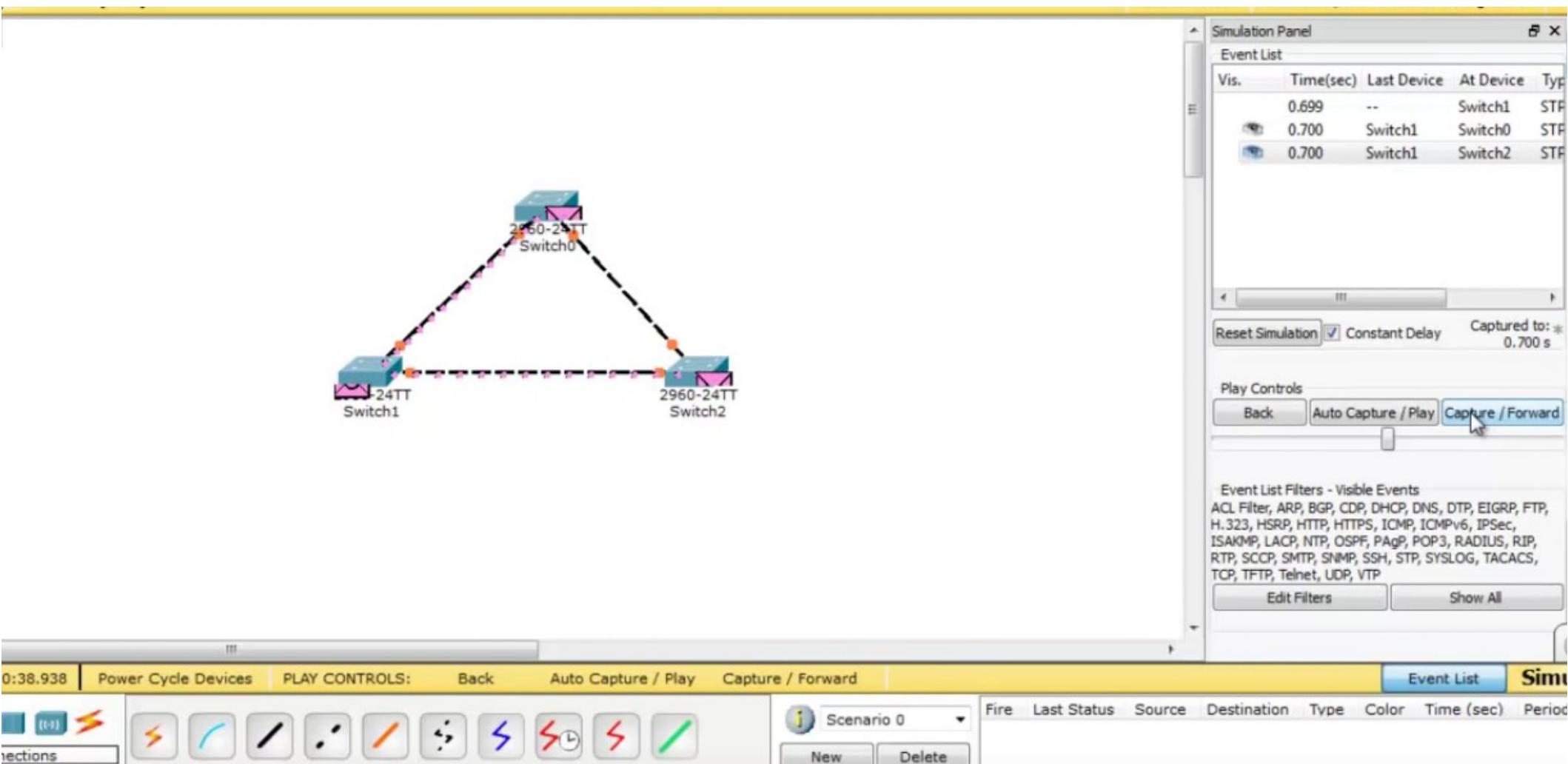
Подробнее о STP [здесь](#), [здесь](#) и [здесь](#)



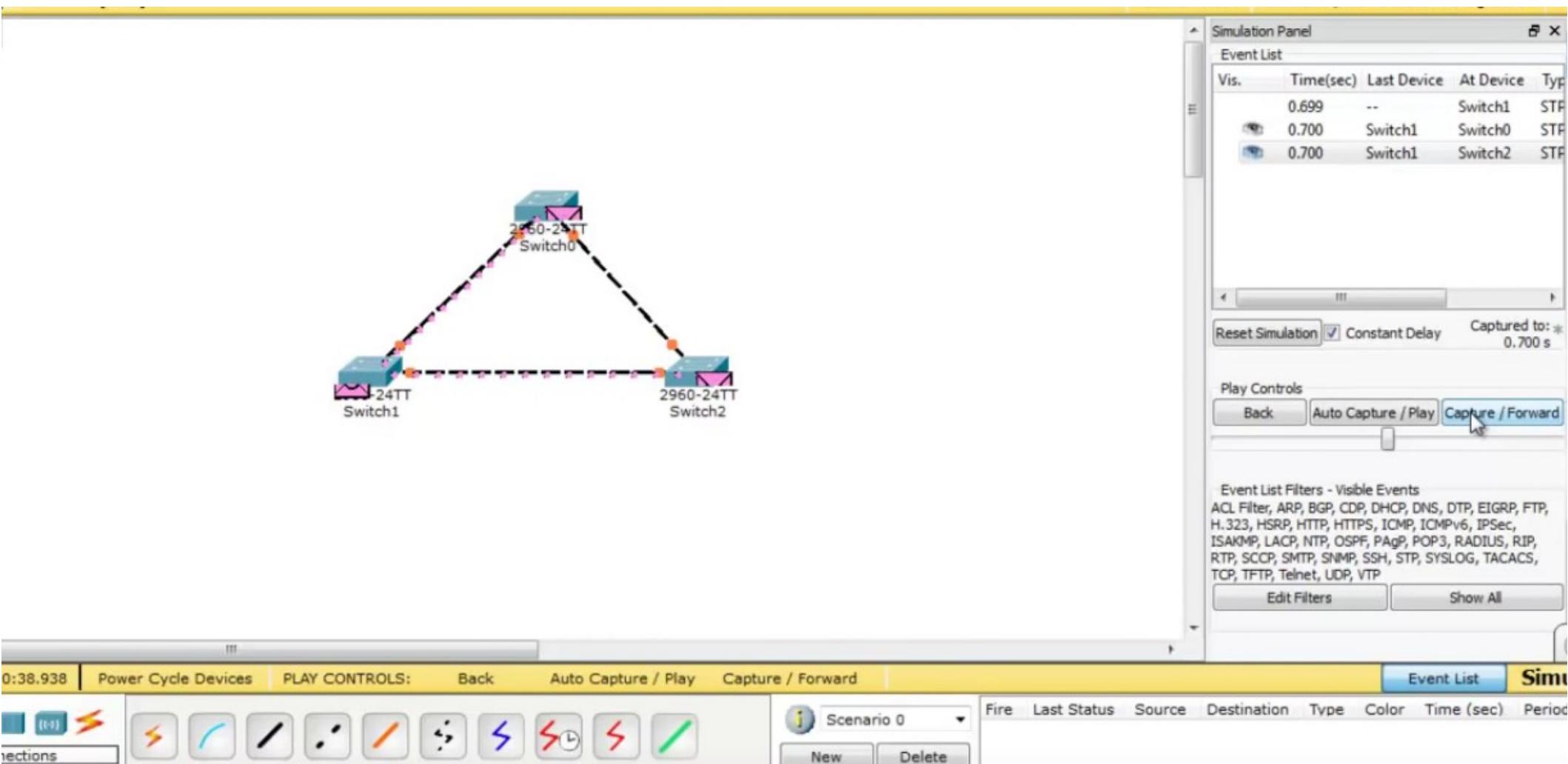
STP — Spanning Tree Protocol



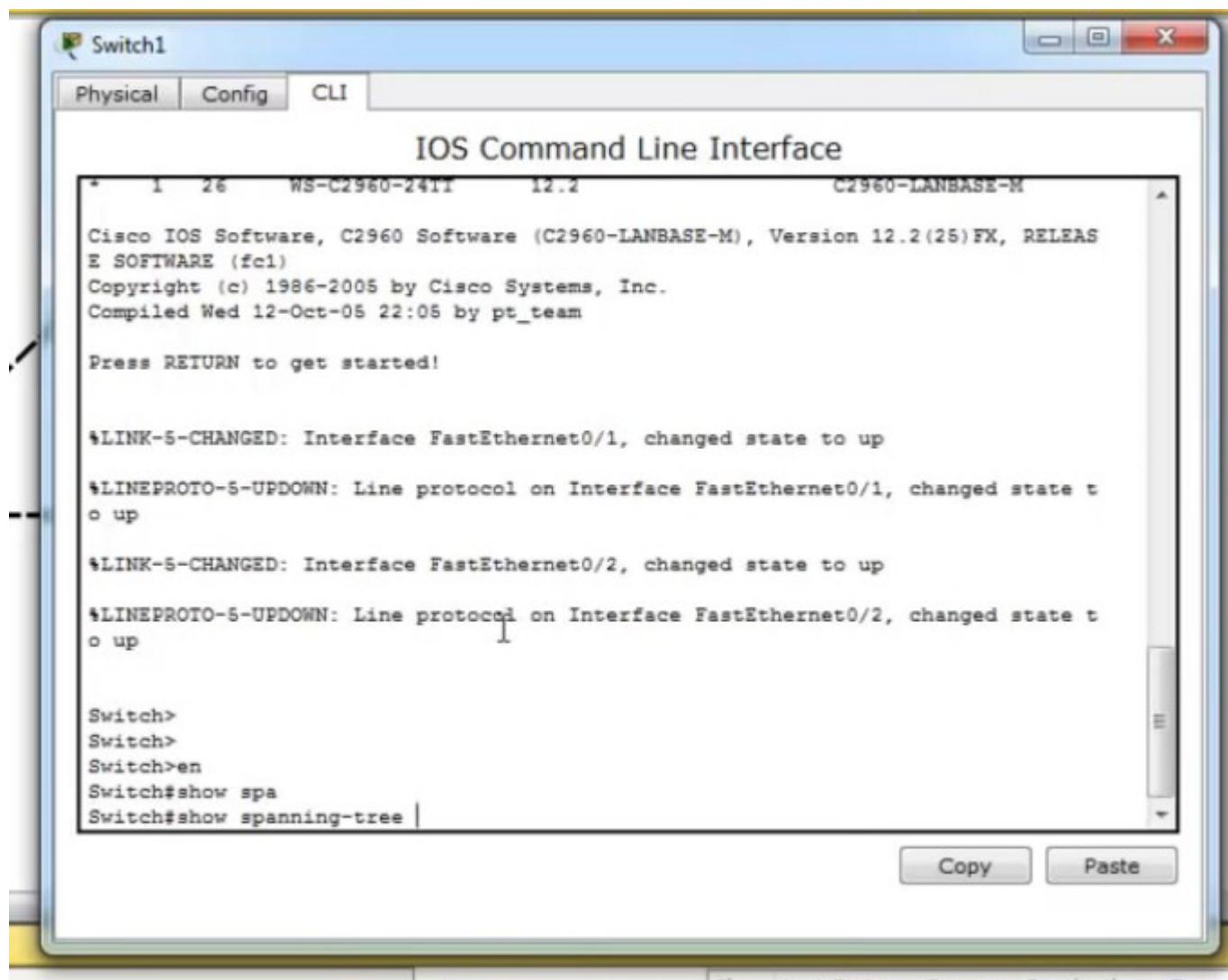
STP — Spanning Tree Protocol



STP — Spanning Tree Protocol



STP — Spanning Tree Protocol



Switch1

Physical Config CLI

IOS Command Line Interface

```
* 1 26 WS-C2960-24TT 12.2 C2960-LANBASE-M
Cisco IOS Software, C2960 Software (C2960-LANBASE-M), Version 12.2(25)FX, RELEASE SOFTWARE (fc1)
Copyright (c) 1986-2005 by Cisco Systems, Inc.
Compiled Wed 12-Oct-05 22:05 by pt_team

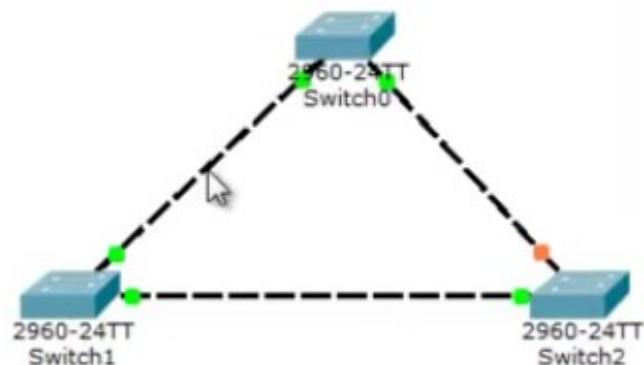
Press RETURN to get started!

%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
%LINK-5-CHANGED: Interface FastEthernet0/2, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2, changed state to up

Switch>
Switch>
Switch>en
Switch#show spa
Switch#show spanning-tree |
```

Copy Paste

STP — Spanning Tree Protocol



Switch1

Physical Config CLI

IOS Command Line Interface

```
o up

Switch>
Switch>
Switch>en
Switch#show spa
Switch#show spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
              Address     0001.6417.5771
              This bridge is the root
              Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

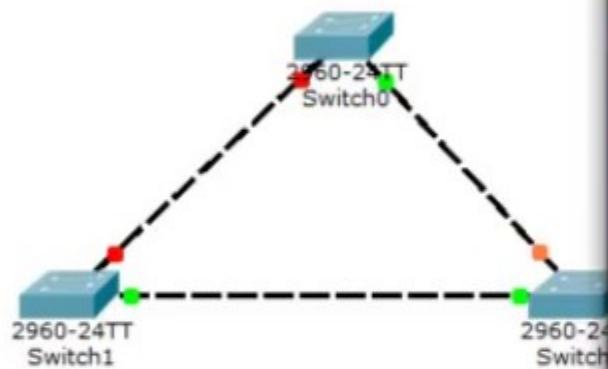
  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
              Address     0001.6417.5771
              Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  20

  Interface      Role Sts Cost      Prio.Nbr Type
  -----  -----
  Fa0/1          Desg FWD 19      128.1    P2p
  Fa0/2          Desg FWD 19      128.2    P2p

Switch#
```

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STP — Spanning Tree Protocol



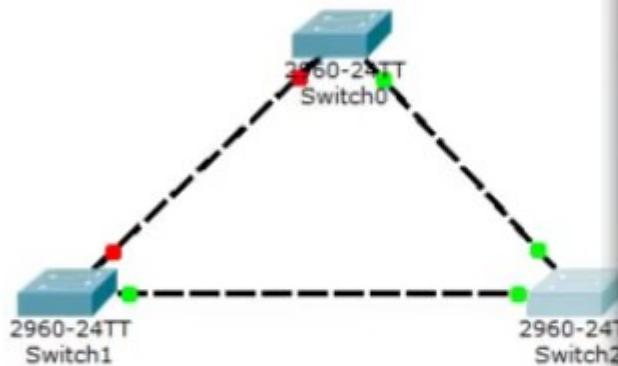
```
IOS Command Line Interface
Bridge ID Priority 32769 (priority 32768 sys-id-ext 1)
          Address 0002.4ADC.B936
          Hello Time 2 sec  Max Age 20 sec  Forward Delay 15 sec
          Aging Time 20

Interface      Role Sts Cost      Prio.Nbr Type
-----
Fa0/1          Root FWD 19      128.1    P2p
Fa0/2          Desg FWD 19      128.2    P2p

Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#int
Switch(config)#interface fa0/1
Switch(config-if)#
Switch(config-if)#
Switch(config-if)#shut
Switch(config-if)#shutdown

Switch(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to administratively do
wn
I
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to
o down
```

STP — Spanning Tree Protocol



Switch2

Physical Config CLI

IOS Command Line Interface

```
Interface          Role Sts Cost      Prio.Nbr Type
-----  -----
Fa0/1             Desg LRN 19        128.1    P2p
Fa0/2             Root FWD 19        128.2    P2p

Switch#show spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority 32769
              Address 0001.6417.5771
              Cost 19
              Port 2 (FastEthernet0/2)
              Hello Time 2 sec  Max Age 20 sec  Forward Delay 15 sec

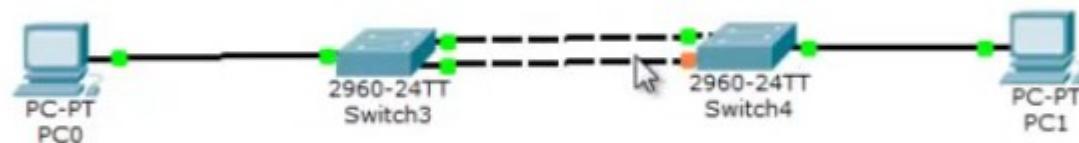
  Bridge ID  Priority 32769 (priority 32768 sys-id-ext 1)
              Address 00D0.FF04.5D86
              Hello Time 2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time 20

  Interface          Role Sts Cost      Prio.Nbr Type
-----  -----
Fa0/1             Desg FWD 19        128.1    P2p
Fa0/2             Root FWD 19        128.2    P2p

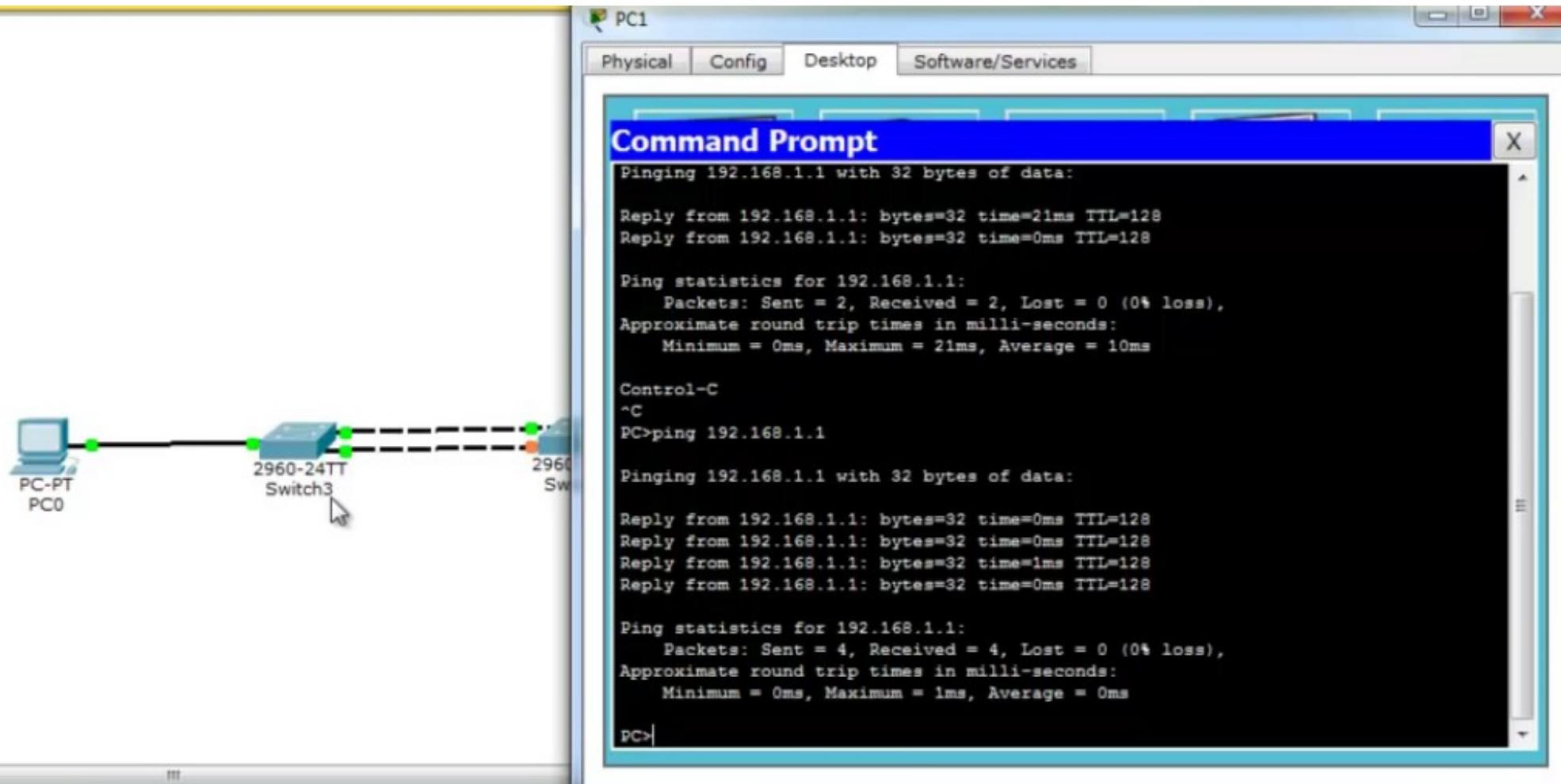
Switch#
```

Copy Paste

RSTP — Rapid Spanning Tree Protocol



RSTP — Rapid Spanning Tree Protocol



RSTP — Rapid Spanning Tree Protocol

Switch3

Physical Config CLI

IOS Command Line Interface

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/3	Desg	FWD	19	128.3	P2p
Fa0/2	Desg	FWD	19	128.2	P2p
Fa0/1	Desg	FWD	19	128.1	P2p

```
Switch#  
Switch#  
Switch#  
Switch#  
Switch#  
Switch#conf t  
Enter configuration commands, one per line.  End with CNTL/Z.  
Switch(config)#int fa  
Switch(config)#int fastEthernet 0/1  
Switch(config-if)#  
Switch(config-if)#shut  
Switch(config-if)#shutdown  
  
Switch(config-if)#  
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to administratively do  
wn  
  
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to  
down
```

Copy Paste

PC1

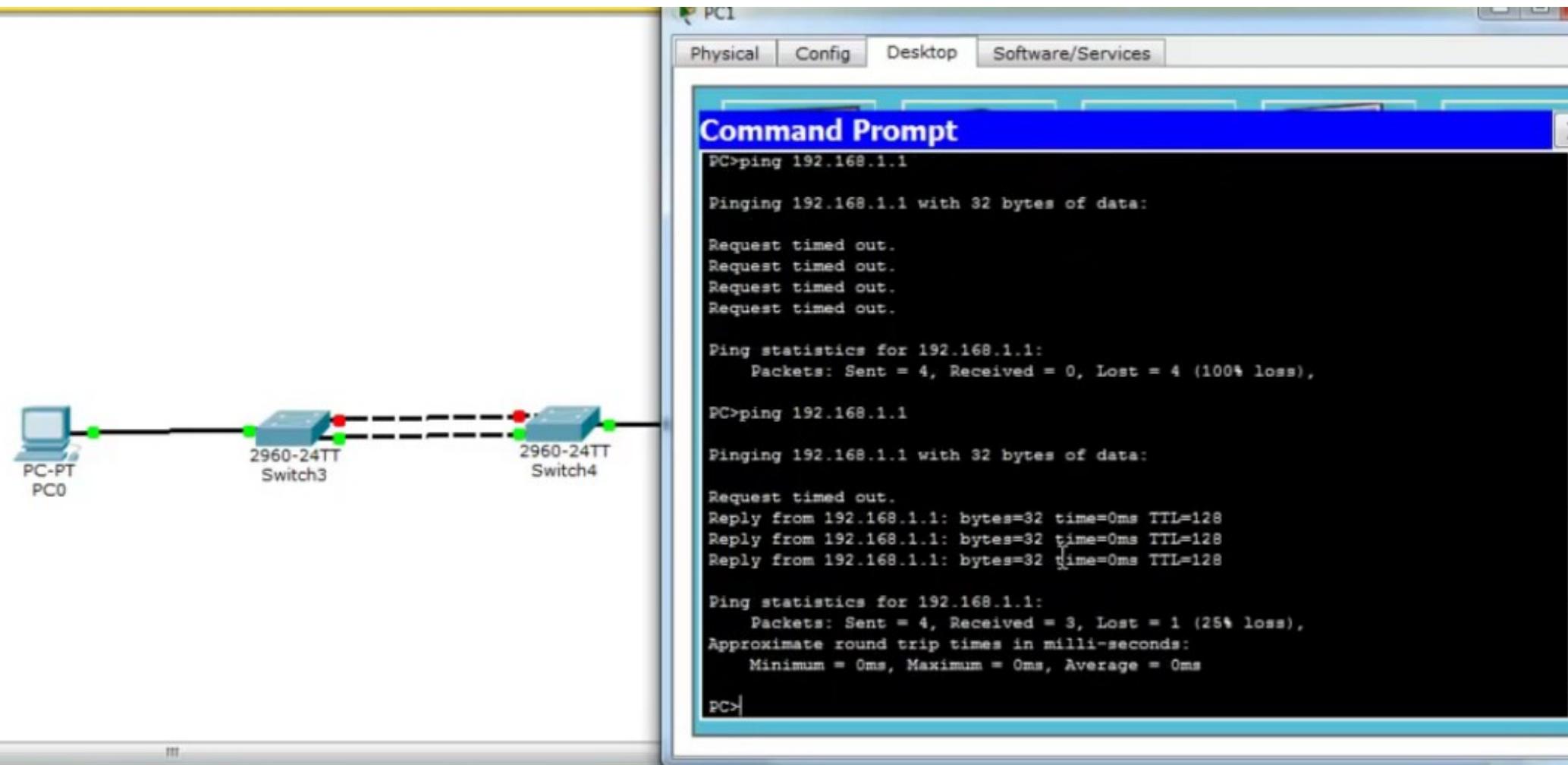
Physical Config Desktop Software/Services

Command Prompt

```
Reply from 192.168.1.1: bytes=32 time=1ms TTL=128  
Reply from 192.168.1.1: bytes=32 time=0ms TTL=128  
  
Ping statistics for 192.168.1.1:  
  Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),  
  Approximate round trip times in milli-seconds:  
    Minimum = 0ms, Maximum = 1ms, Average = 0ms  
  
PC>ping 192.168.1.1  
  
Pinging 192.168.1.1 with 32 bytes of data:  
  
Reply from 192.168.1.1: bytes=32 time=0ms TTL=128  
Reply from 192.168.1.1: bytes=32 time=0ms TTL=128  
Reply from 192.168.1.1: bytes=32 time=0ms TTL=128  
Reply from 192.168.1.1: bytes=32 time=9ms TTL=128  
  
Ping statistics for 192.168.1.1:  
  Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),  
  Approximate round trip times in milli-seconds:  
    Minimum = 0ms, Maximum = 9ms, Average = 2ms  
  
PC>ping 192.168.1.1  
  
Pinging 192.168.1.1 with 32 bytes of data:
```

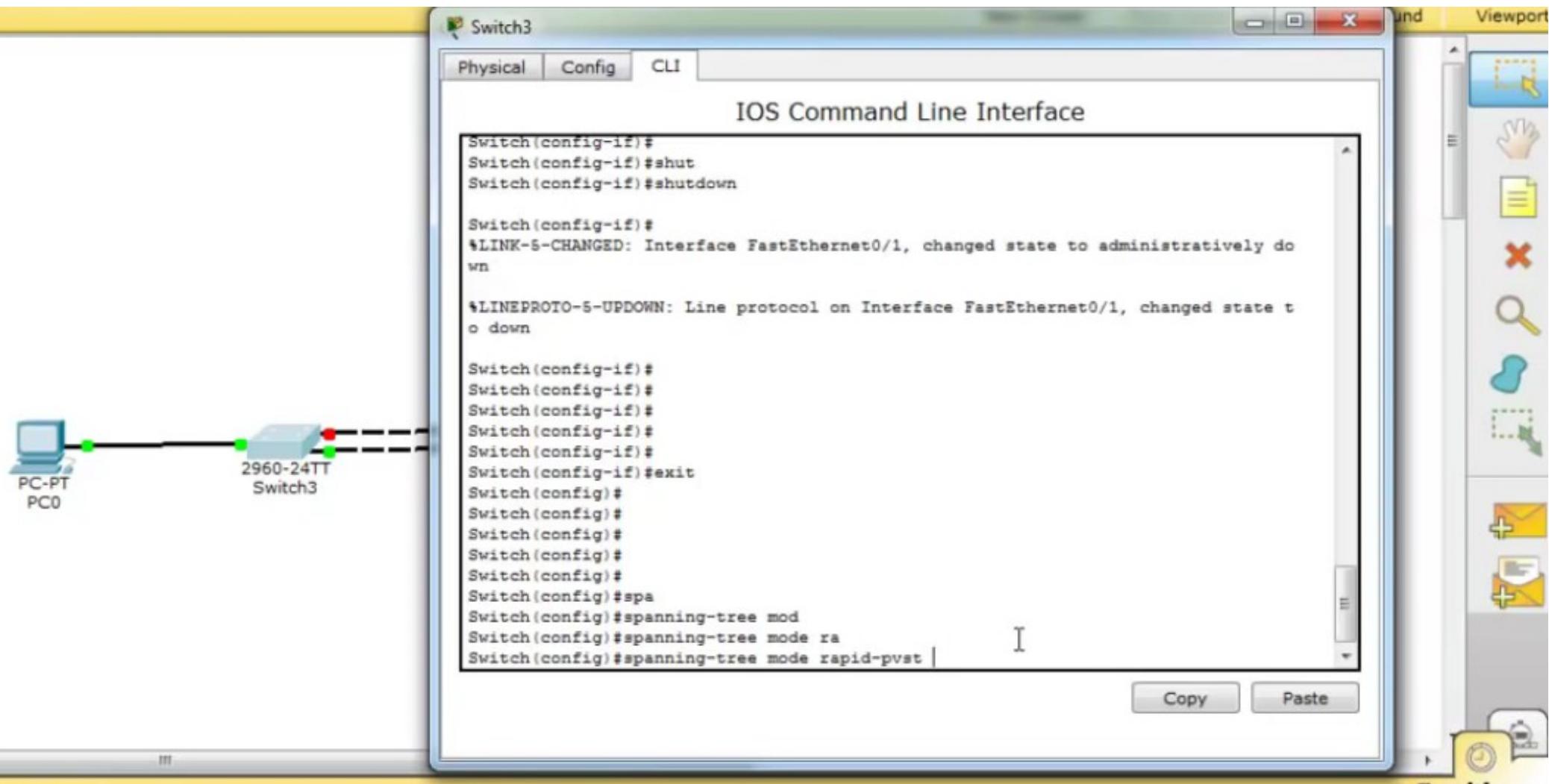
Выключаем порт fastEthernet 0/1 на Switch 3
PC1 перестает видеть PC2

RSTP — Rapid Spanning Tree Protocol



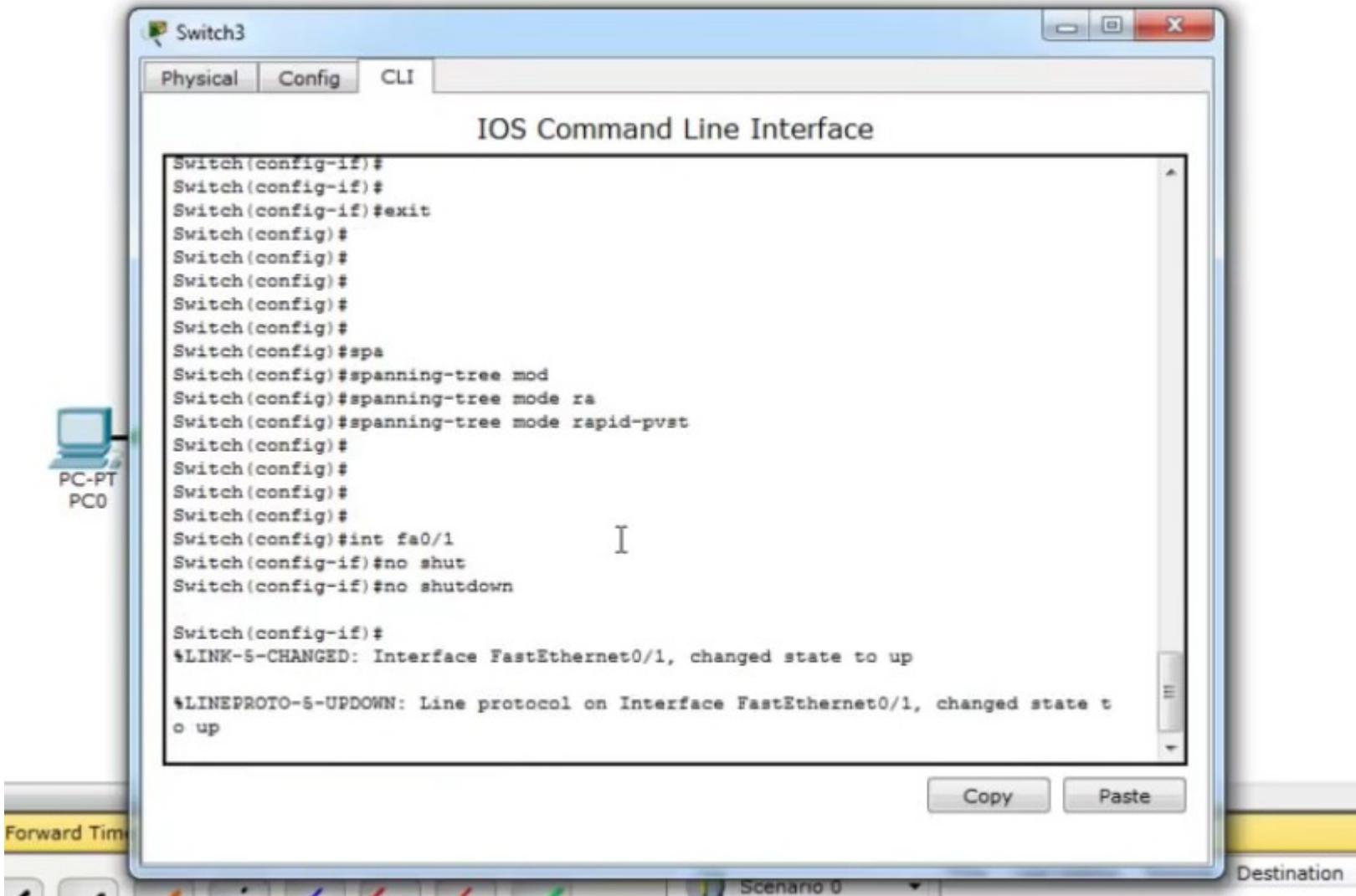
Через некоторое время связь между PC1 и PC2 восстанавливается

RSTP — Rapid Spanning Tree Protocol



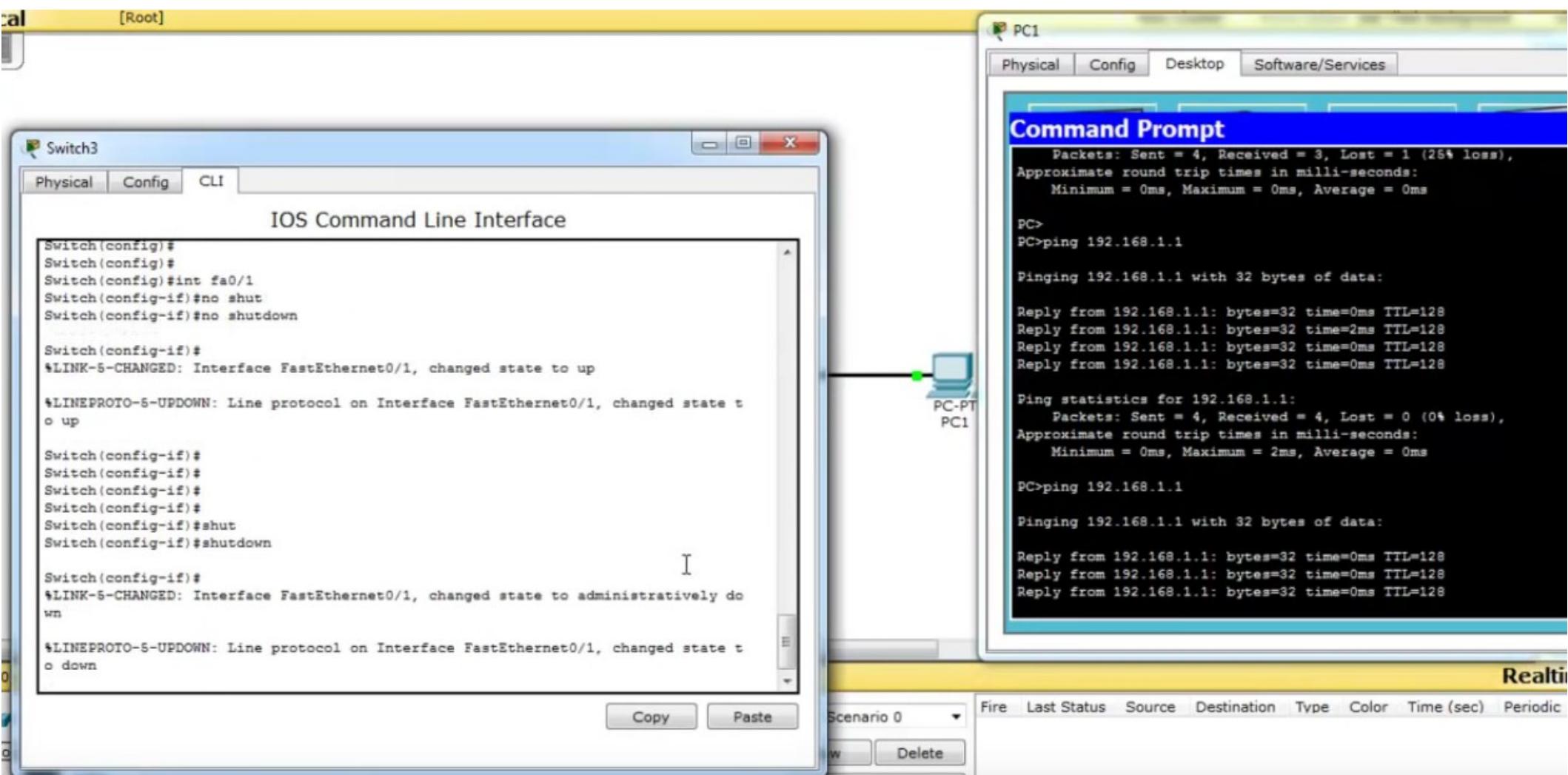
Включаем RSTP на каждом коммутаторе. PVST = Per VLAN STP
(config) # spanning-tree mode rapid-pvst

RSTP — Rapid Spanning Tree Protocol



Вернем потушенный порт ...

RSTP — Rapid Spanning Tree Protocol



Снова выключаем порт и при этом пингуем ...
... и связь не прерывается

Агрегация каналов

Методы организации отказоустойчивых каналов

Связи:

- Резервирование соединений. Традиционная избыточная топология.
- Агрегирование каналов - объединение нескольких физических каналов в один логический.

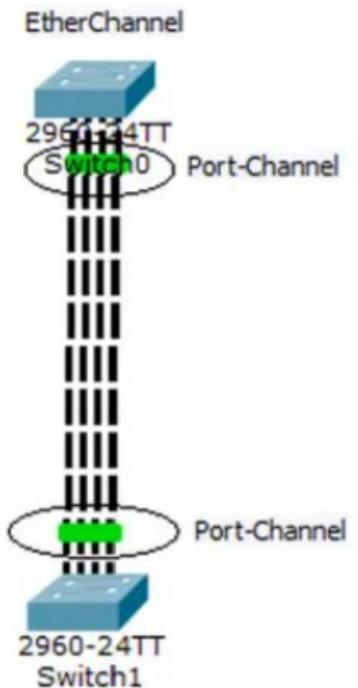
Агрегирование каналов. Варианты:

- Динамическое агрегирование
 - LACP (Link Aggregation Control Protocol)
 - PAgP (Port Aggregation Protocol)
- Статическое агрегирование

Порты должны иметь одинаковые:

- скоростью (speed),
- режимом дуплекса (duplex mode),
- native VLAN,
- диапазон разрешенных VLAN,
- trunking status,
- типом интерфейса.

Подробнее о EtherChannel [здесь](#)



Агрегация каналов

Настройка статического агрегирования:

На Switch0:

```
int range fa0/1-2
channel-group 1 mode on
```

На Switch1:

```
int range fa0/1-2
channel-group 1 mode on
```

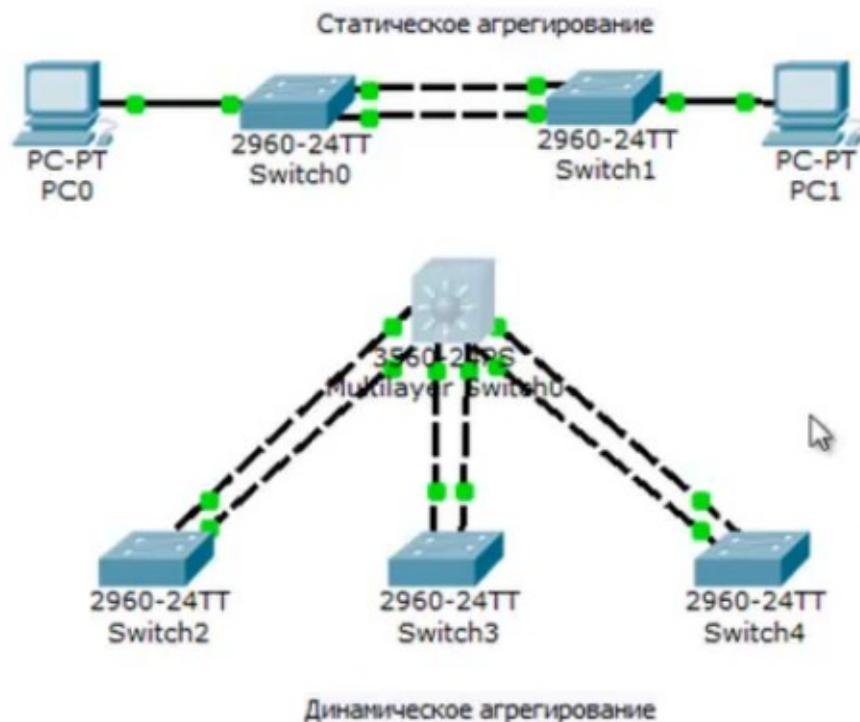
Настройка динамического агрегирования LACP:

На Multilayer-Switch0:

```
int range fa0/1-2
channel-protocol lacp
channel-group 1 mode active
int range fa0/3-4
channel-protocol lacp
channel-group 2 mode active
int range fa0/5-6
channel-protocol lacp
channel-group 3 mode active
```

На Switch2, Switch3 и Switch4:

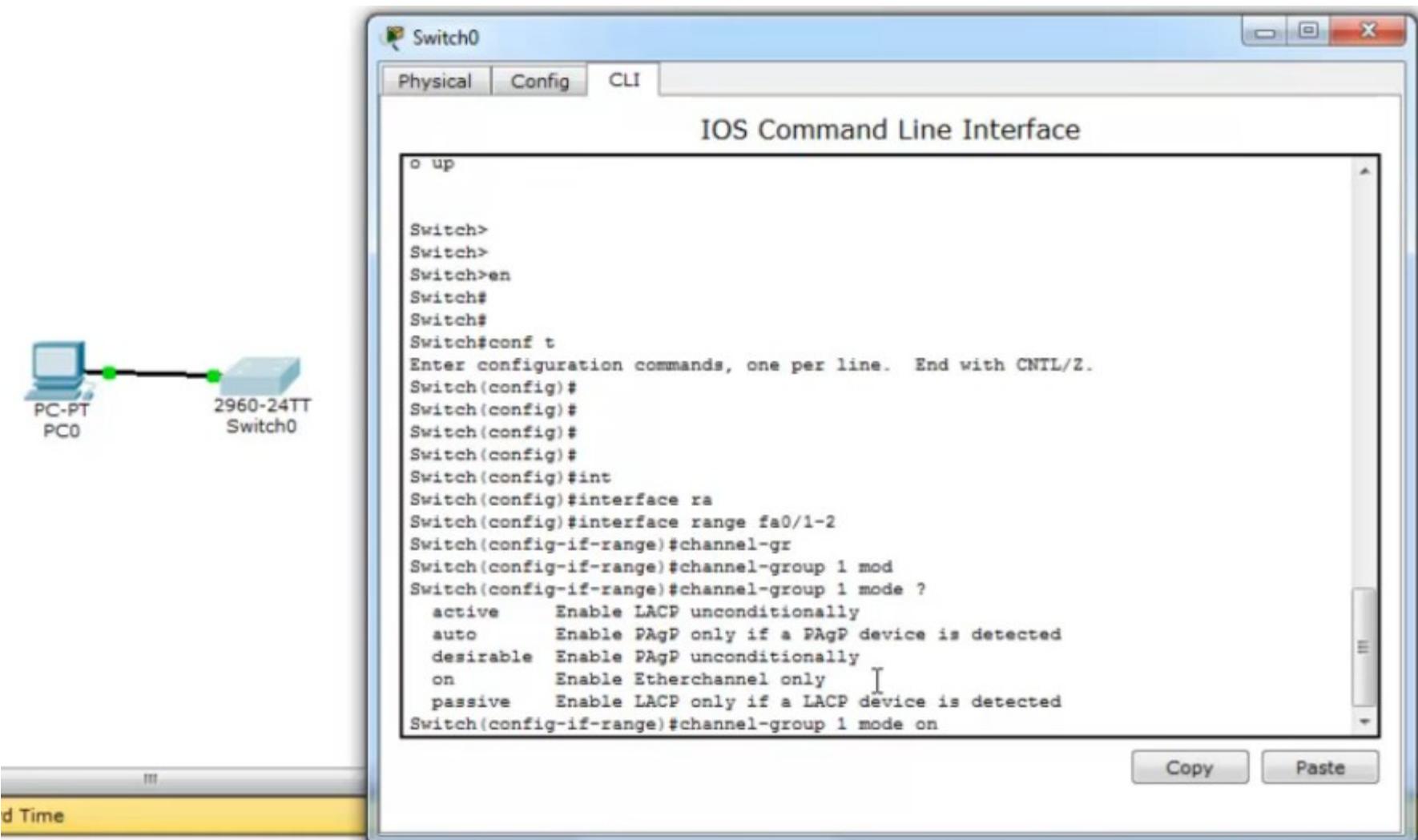
```
int range fa0/1-2
channel-protocol lacp
channel-group 1 mode passive
```



Агрегация каналов



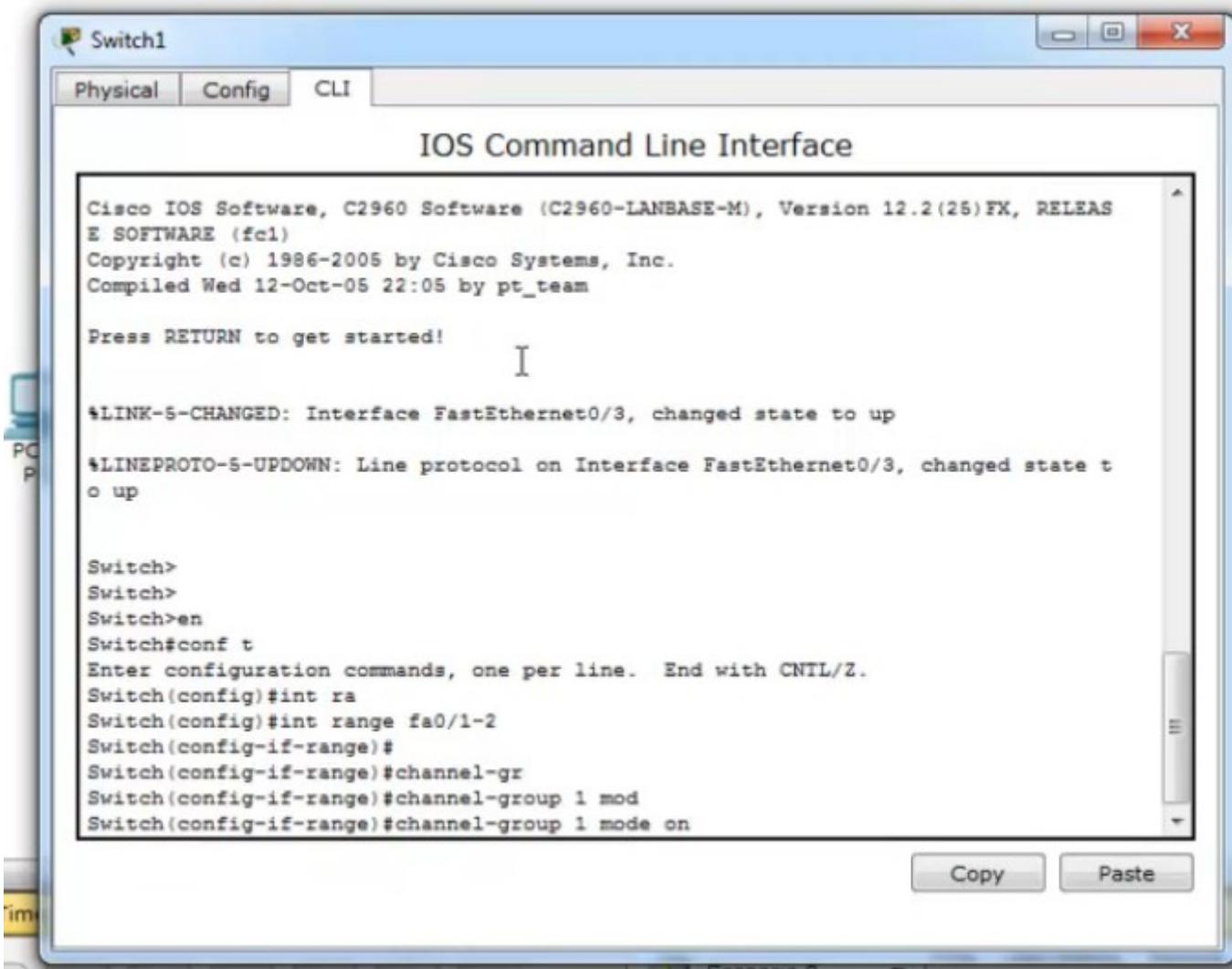
Агрегация каналов



Создаем логический интерфейс канал.

Для одновременного редактирования двух портов используем
(config) # interface range fa0/1-2

Агрегация каналов



The screenshot shows a Windows application window titled "Switch1" with three tabs: "Physical", "Config" (which is selected), and "CLI". The "CLI" tab displays the "IOS Command Line Interface". The terminal window shows the following text:

```
Cisco IOS Software, C2960 Software (C2960-LANBASE-M), Version 12.2(25)FX, RELEASE SOFTWARE (fc1)
Copyright (c) 1986-2005 by Cisco Systems, Inc.
Compiled Wed 12-Oct-05 22:05 by pt_team

Press RETURN to get started!
```

At the bottom of the terminal window, a configuration session is in progress:

```
*LINK-5-CHANGED: Interface FastEthernet0/3, changed state to up
*LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to up

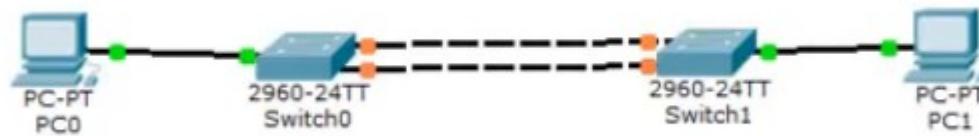
Switch>
Switch>
Switch>en
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#int ra
Switch(config)#int range fa0/1-2
Switch(config-if-range)#
Switch(config-if-range)#channel-gr
Switch(config-if-range)#channel-group 1 mod
Switch(config-if-range)#channel-group 1 mode on
```

At the bottom right of the terminal window, there are "Copy" and "Paste" buttons.

Аналогично создаем логический интерфейс на втором коммутаторе.

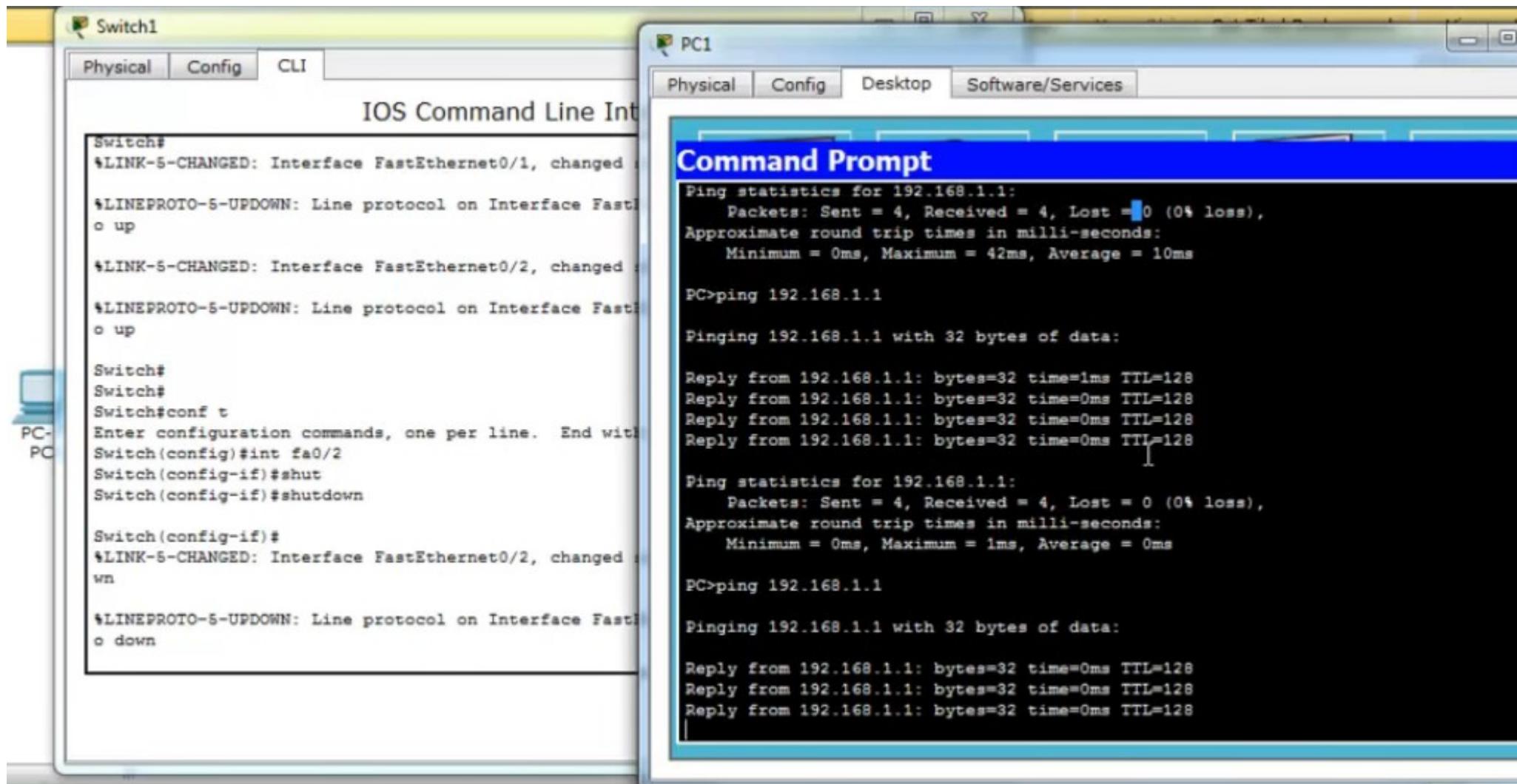
Агрегация каналов

13



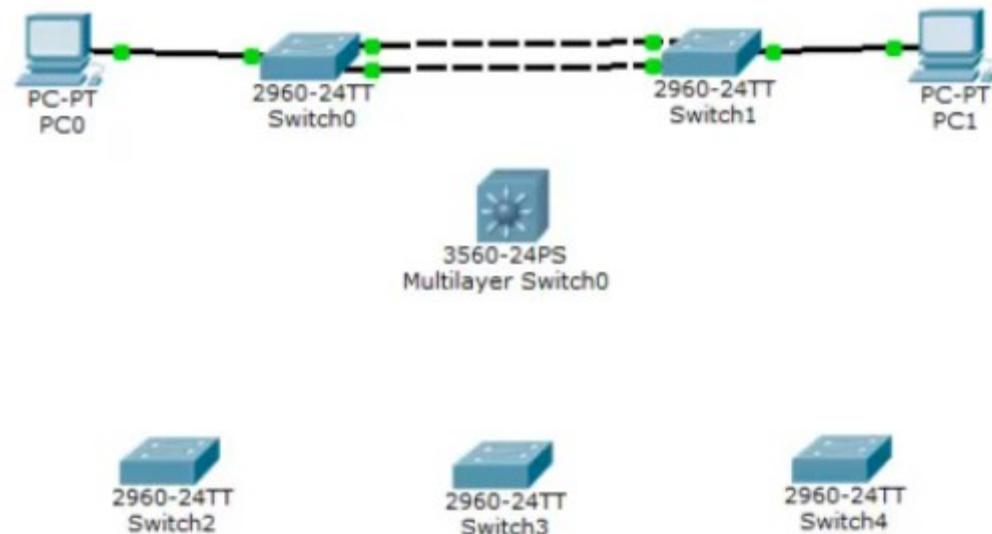
Соединяем.
Добавляем ip адреса на компьютеры.

Агрегация каналов



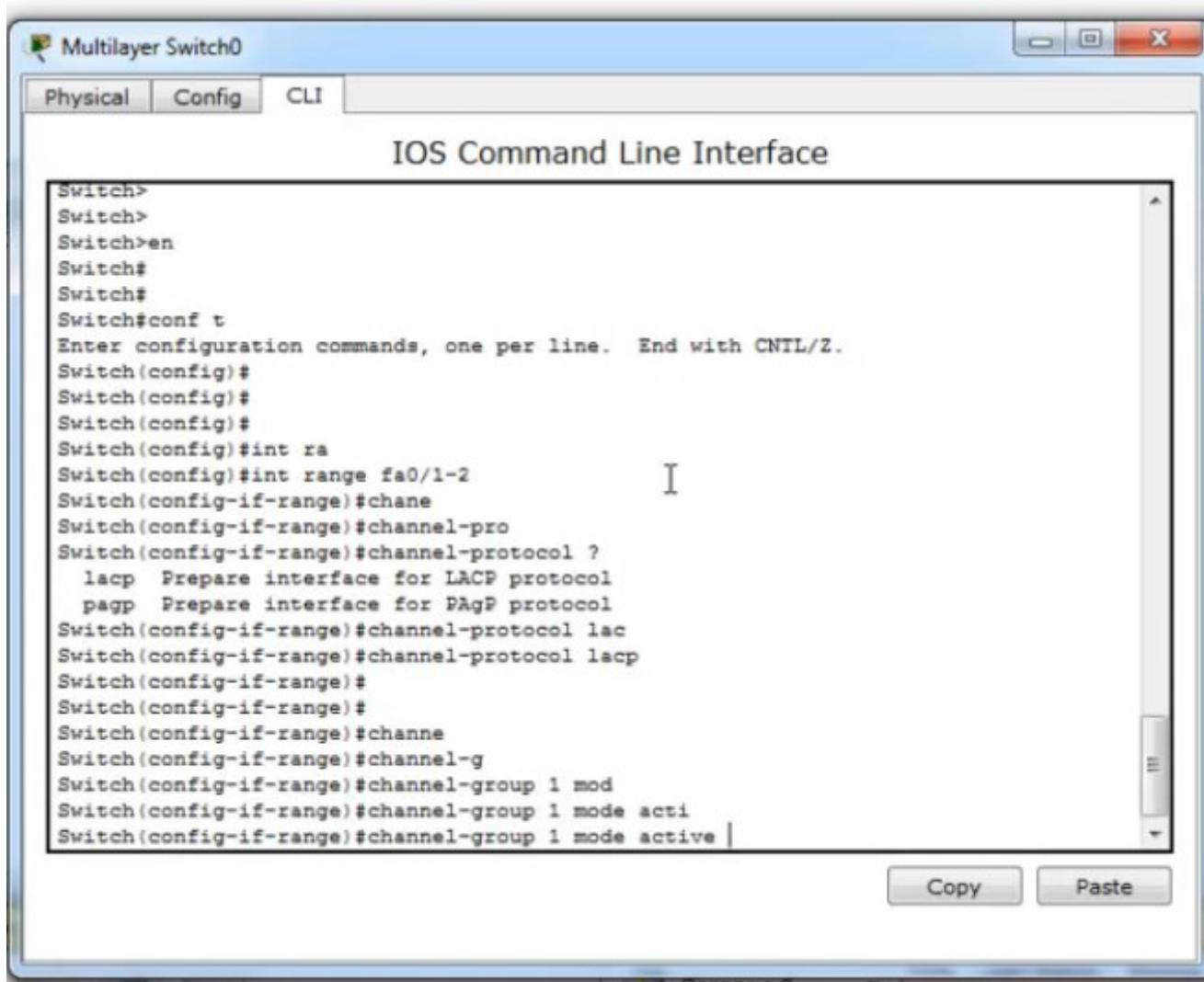
Выключаем один из интерфейсов на коммутаторе.
При этом проверяем пингом связь между компьютерами.
Связь между компьютерами не прервалась.

Агрегация каналов



Второй пример.

Агрегация каналов



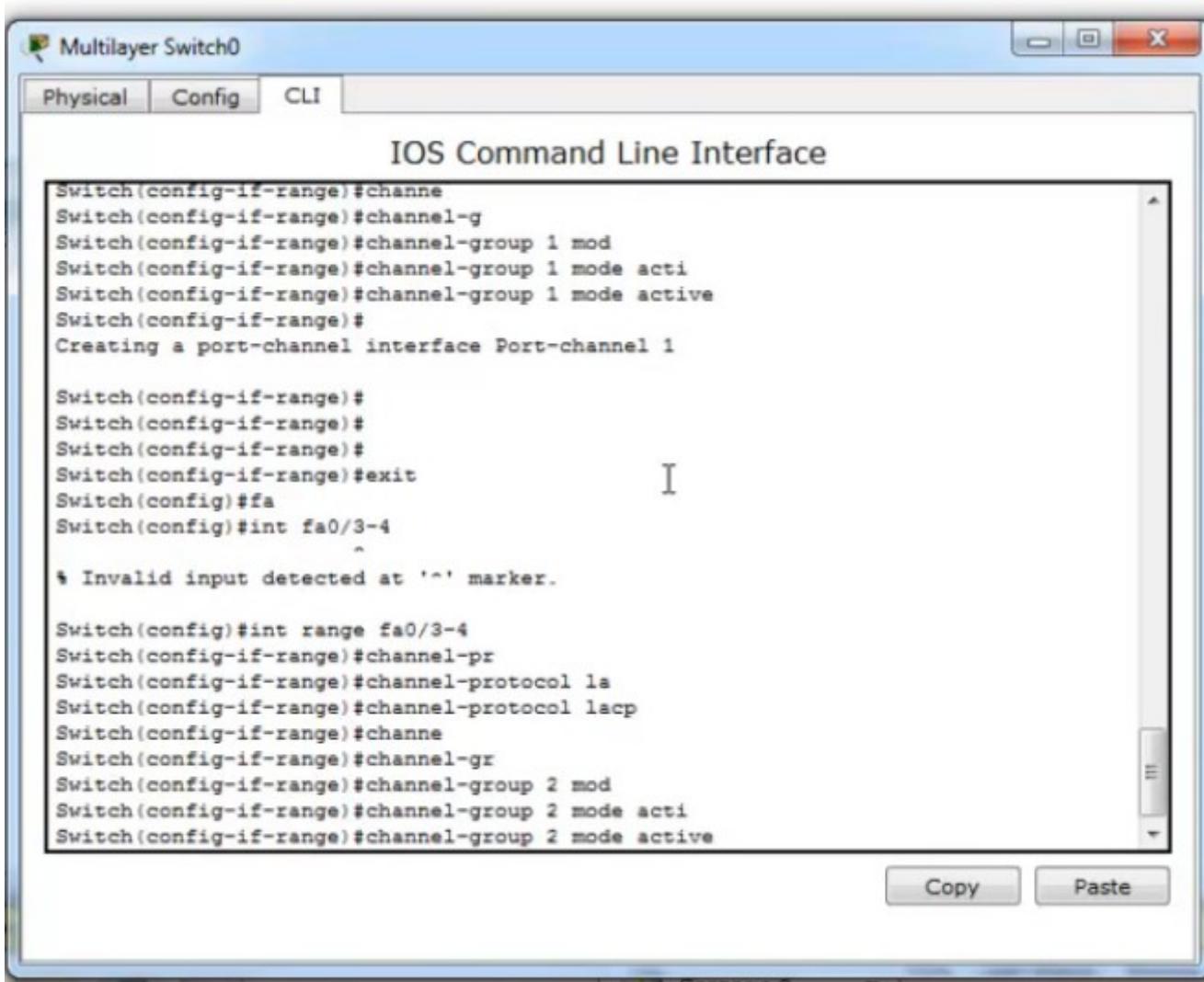
The screenshot shows a Windows application window titled "Multilayer Switch0" with three tabs: "Physical", "Config" (which is selected), and "CLI". The "CLI" tab displays the "IOS Command Line Interface". The terminal window shows the following configuration command being entered:

```
Switch>
Switch>
Switch>en
Switch#
Switch#
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#
Switch(config)#
Switch(config)#
Switch(config)#int ra
Switch(config)#int range fa0/1-2
Switch(config-if-range)#channe
Switch(config-if-range)#channel-pro
Switch(config-if-range)#channel-protocol ?
  lacp Prepare interface for LACP protocol
  pagp Prepare interface for PAgP protocol
Switch(config-if-range)#channel-protocol lacp
Switch(config-if-range)#channel-protocol lacp
Switch(config-if-range)#
Switch(config-if-range)#
Switch(config-if-range)#channe
Switch(config-if-range)#channel-g
Switch(config-if-range)#channel-group 1 mod
Switch(config-if-range)#channel-group 1 mode acti
Switch(config-if-range)#channel-group 1 mode active |
```

At the bottom of the terminal window, there are "Copy" and "Paste" buttons.

Настраиваем главный коммутатор.
Создаем первый логический канал из интерфейсов 1 и 2

Агрегация каналов



The screenshot shows a Windows application window titled "Multilayer Switch0" with a tab bar containing "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". The terminal window displays the following configuration command sequence:

```
Switch(config-if-range)#channe
Switch(config-if-range)#channel-g
Switch(config-if-range)#channel-group 1 mod
Switch(config-if-range)#channel-group 1 mode acti
Switch(config-if-range)#channel-group 1 mode active
Switch(config-if-range)#
Creating a port-channel interface Port-channel 1

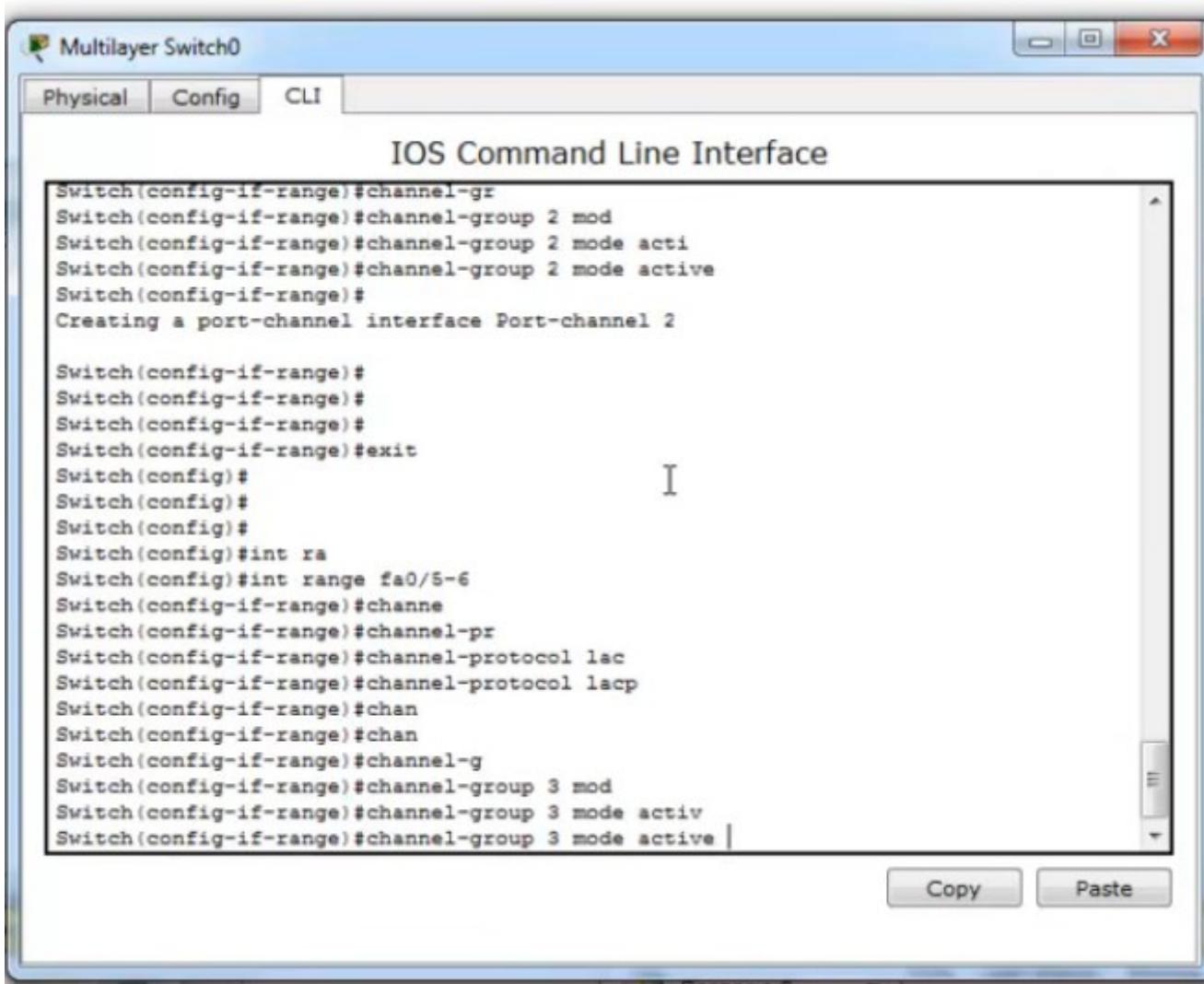
Switch(config-if-range)#
Switch(config-if-range)#
Switch(config-if-range)#
Switch(config-if-range)#exit
Switch(config)#fa
Switch(config)#int fa0/3-4
^
* Invalid input detected at '^' marker.

Switch(config)#int range fa0/3-4
Switch(config-if-range)#channel-pr
Switch(config-if-range)#channel-protocol 1a
Switch(config-if-range)#channel-protocol lacp
Switch(config-if-range)#channe
Switch(config-if-range)#channel-gr
Switch(config-if-range)#channel-group 2 mod
Switch(config-if-range)#channel-group 2 mode acti
Switch(config-if-range)#channel-group 2 mode active
```

At the bottom of the terminal window, there are "Copy" and "Paste" buttons.

Аналогично создаем второй логический канал из интерфейсов 3 и 4.

Агрегация каналов



The screenshot shows a window titled "Multilayer Switch0" with three tabs: "Physical", "Config" (which is selected), and "CLI". The "CLI" tab displays the "IOS Command Line Interface". The terminal window contains the following configuration commands:

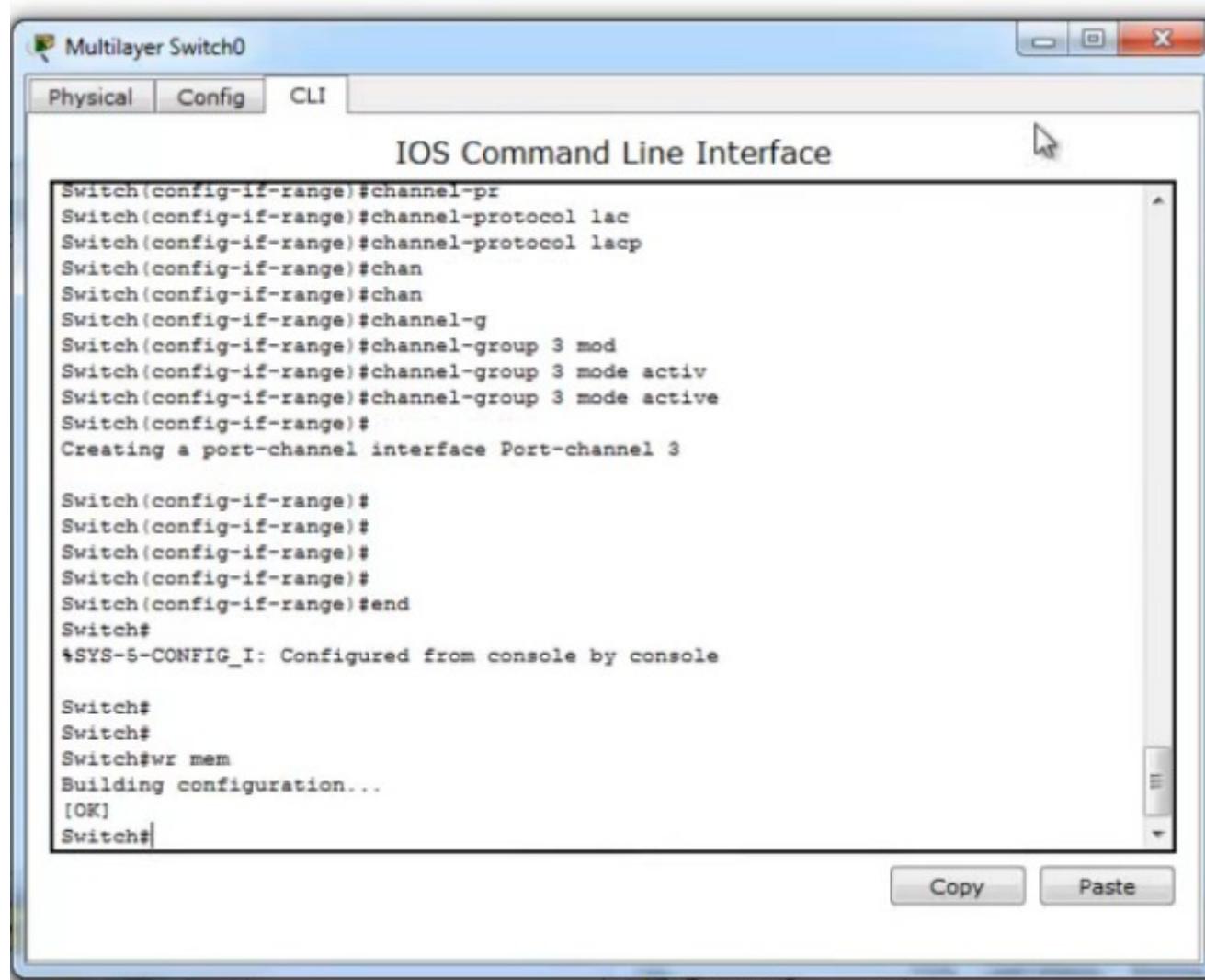
```
Switch(config-if-range)#channel-gr
Switch(config-if-range)#channel-group 2 mod
Switch(config-if-range)#channel-group 2 mode acti
Switch(config-if-range)#channel-group 2 mode active
Switch(config-if-range)#
Creating a port-channel interface Port-channel 2

Switch(config-if-range)#
Switch(config-if-range)#
Switch(config-if-range)#
Switch(config-if-range)#exit
Switch(config)#
Switch(config)#
Switch(config)#
Switch(config)#
Switch(config)#int ra
Switch(config)#int range fa0/5-6
Switch(config-if-range)#channe
Switch(config-if-range)#channel-pr
Switch(config-if-range)#channel-protocol lac
Switch(config-if-range)#channel-protocol lacp
Switch(config-if-range)#chan
Switch(config-if-range)#chan
Switch(config-if-range)#channel-g
Switch(config-if-range)#channel-group 3 mod
Switch(config-if-range)#channel-group 3 mode activ
Switch(config-if-range)#channel-group 3 mode active |
```

At the bottom of the terminal window, there are "Copy" and "Paste" buttons.

Аналогично создаем второй логический канал из интерфейсов 5 и 6.

Агрегация каналов



The screenshot shows a Windows application window titled "Multilayer Switch0" with a tab bar containing "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". The terminal window displays the following configuration commands:

```
Switch(config-if-range)#channel-pr
Switch(config-if-range)#channel-protocol lac
Switch(config-if-range)#channel-protocol lacp
Switch(config-if-range)#chan
Switch(config-if-range)#chan
Switch(config-if-range)#channel-g
Switch(config-if-range)#channel-group 3 mod
Switch(config-if-range)#channel-group 3 mode activ
Switch(config-if-range)#channel-group 3 mode active
Switch(config-if-range)#
Creating a port-channel interface Port-channel 3

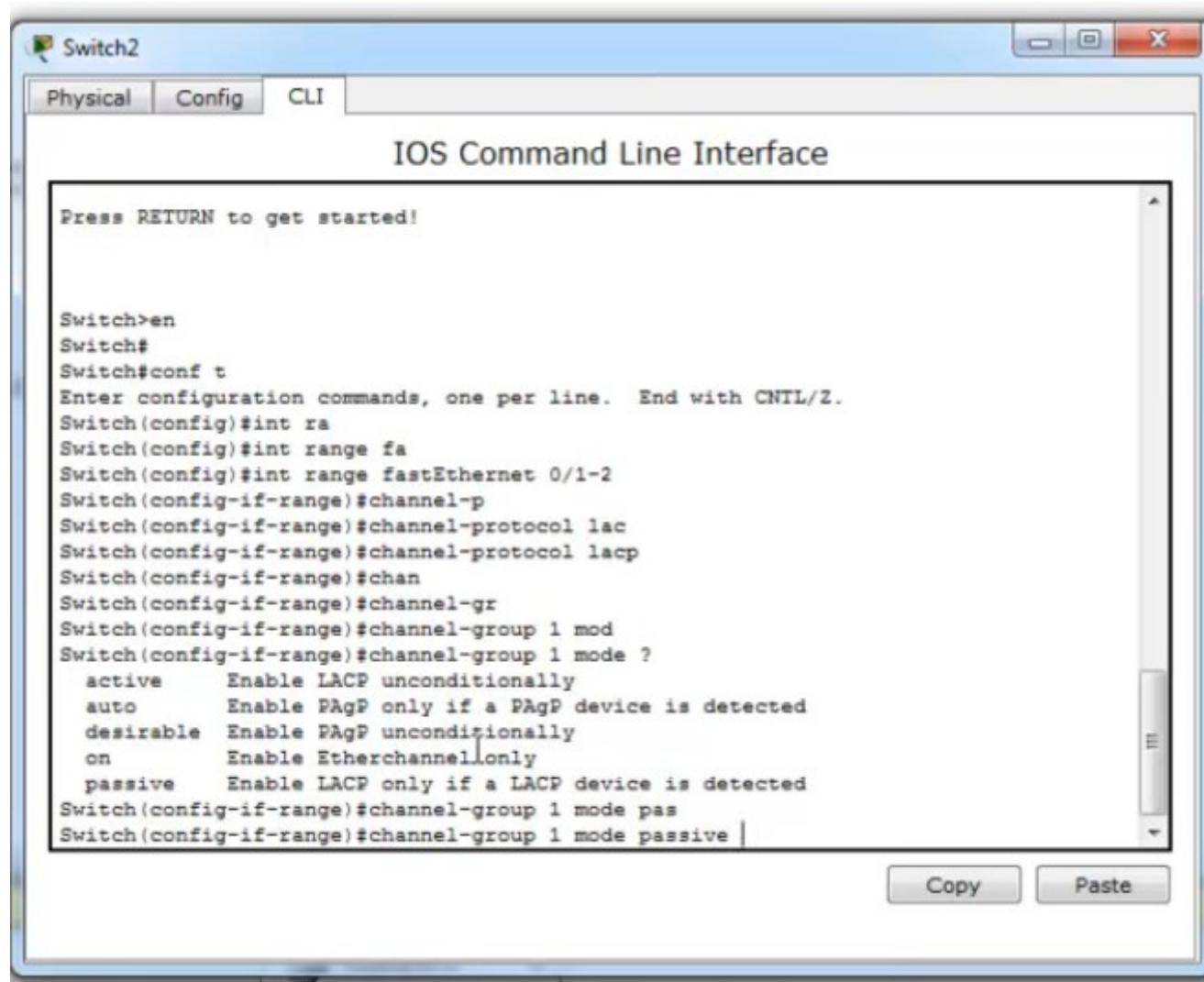
Switch(config-if-range)#
Switch(config-if-range)#
Switch(config-if-range)#
Switch(config-if-range)#
Switch(config-if-range)#end
Switch#
*SYS-5-CONFIG_I: Configured from console by console

Switch#
Switch#
Switch#wr mem
Building configuration...
[OK]
Switch#
```

At the bottom of the terminal window, there are "Copy" and "Paste" buttons.

Выходим, сохраняем настройки.

Агрегация каналов

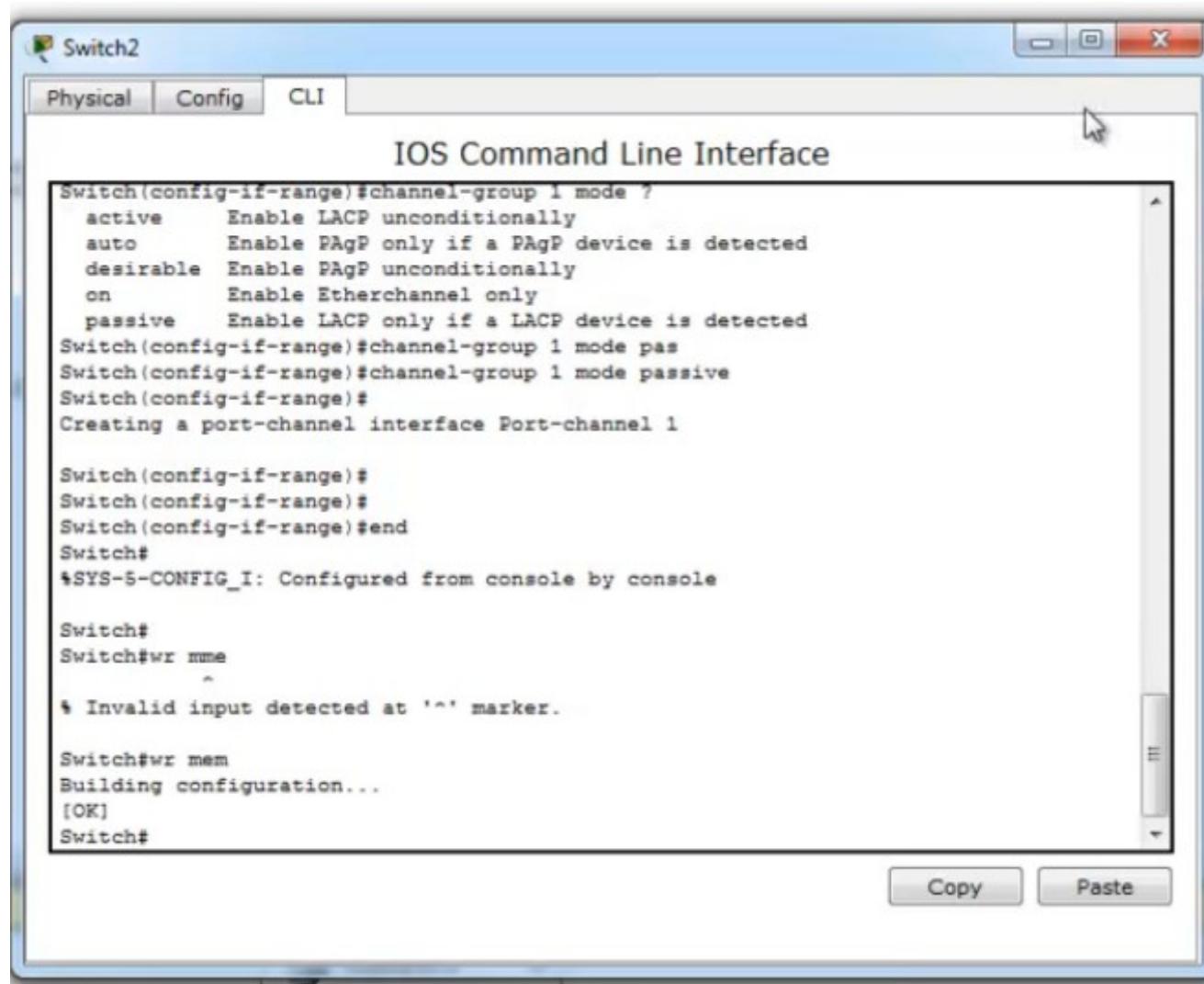


```
Switch>en
Switch#
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#int ra
Switch(config)#int range fa
Switch(config)#int range fastEthernet 0/1-2
Switch(config-if-range)#channel-p
Switch(config-if-range)#channel-protocol lac
Switch(config-if-range)#channel-protocol lacp
Switch(config-if-range)#chan
Switch(config-if-range)#channel-gr
Switch(config-if-range)#channel-group 1 mod
Switch(config-if-range)#channel-group 1 mode ?
  active  Enable LACP unconditionally
  auto    Enable PAgP only if a PAgP device is detected
  desirable  Enable PAgP unconditionally
  on      Enable Etherchannel only
  passive  Enable LACP only if a LACP device is detected
Switch(config-if-range)#channel-group 1 mode pas
Switch(config-if-range)#channel-group 1 mode passive |
```

Настраиваем Switch2.

Также создаем логический канал, но в режиме `passive`, т. к. на одном канале рекомендуется использовать режим `active` только с одной стороны.

Агрегация каналов



The screenshot shows a Windows application window titled "Switch2" with a tab bar containing "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". The CLI output is as follows:

```
Switch(config-if-range)#channel-group 1 mode ?
  active    Enable LACP unconditionally
  auto      Enable PAgP only if a PAgP device is detected
  desirable Enable PAgP unconditionally
  on        Enable Etherchannel only
  passive   Enable LACP only if a LACP device is detected
Switch(config-if-range)#channel-group 1 mode pas
Switch(config-if-range)#channel-group 1 mode passive
Switch(config-if-range)#
Creating a port-channel interface Port-channel 1

Switch(config-if-range)#
Switch(config-if-range)#
Switch(config-if-range)#end
Switch#
*SYS-5-CONFIG_I: Configured from console by console

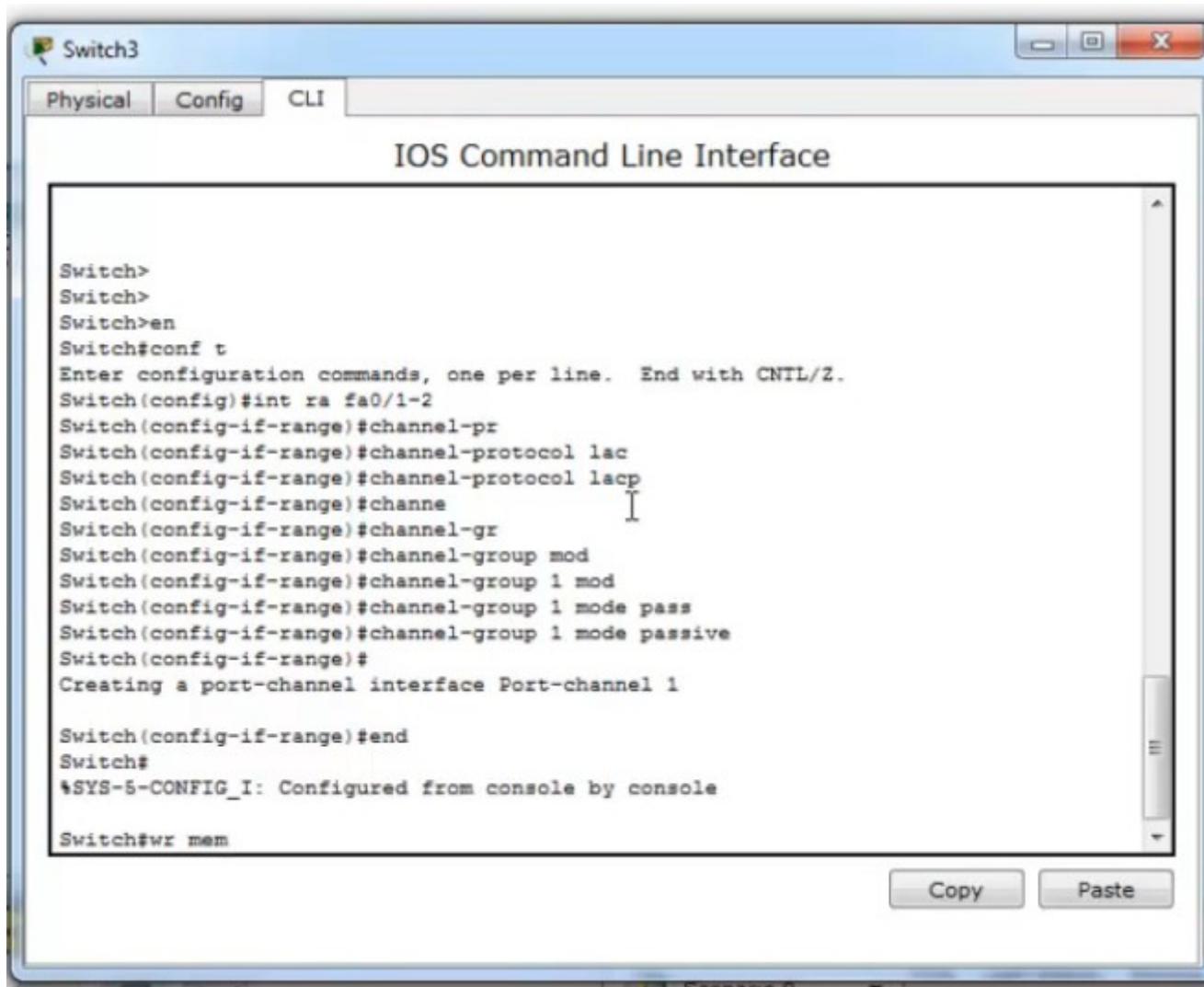
Switch#
Switch#wr mme
  ^
* Invalid input detected at '^' marker.

Switch#wr mem
Building configuration...
[OK]
Switch#
```

At the bottom of the window are "Copy" and "Paste" buttons.

Сохраняем.
wr mem

Агрегация каналов



The screenshot shows a window titled "Switch3" with three tabs: "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". The CLI session shows the following configuration commands:

```
Switch>
Switch>
Switch>en
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#int ra fa0/1-2
Switch(config-if-range)#channel-pr
Switch(config-if-range)#channel-protocol lac
Switch(config-if-range)#channel-protocol lacp
Switch(config-if-range)#channe
Switch(config-if-range)#channel-gr
Switch(config-if-range)#channel-group mod
Switch(config-if-range)#channel-group 1 mod
Switch(config-if-range)#channel-group 1 mode pass
Switch(config-if-range)#channel-group 1 mode passive
Switch(config-if-range)#
Creating a port-channel interface Port-channel 1

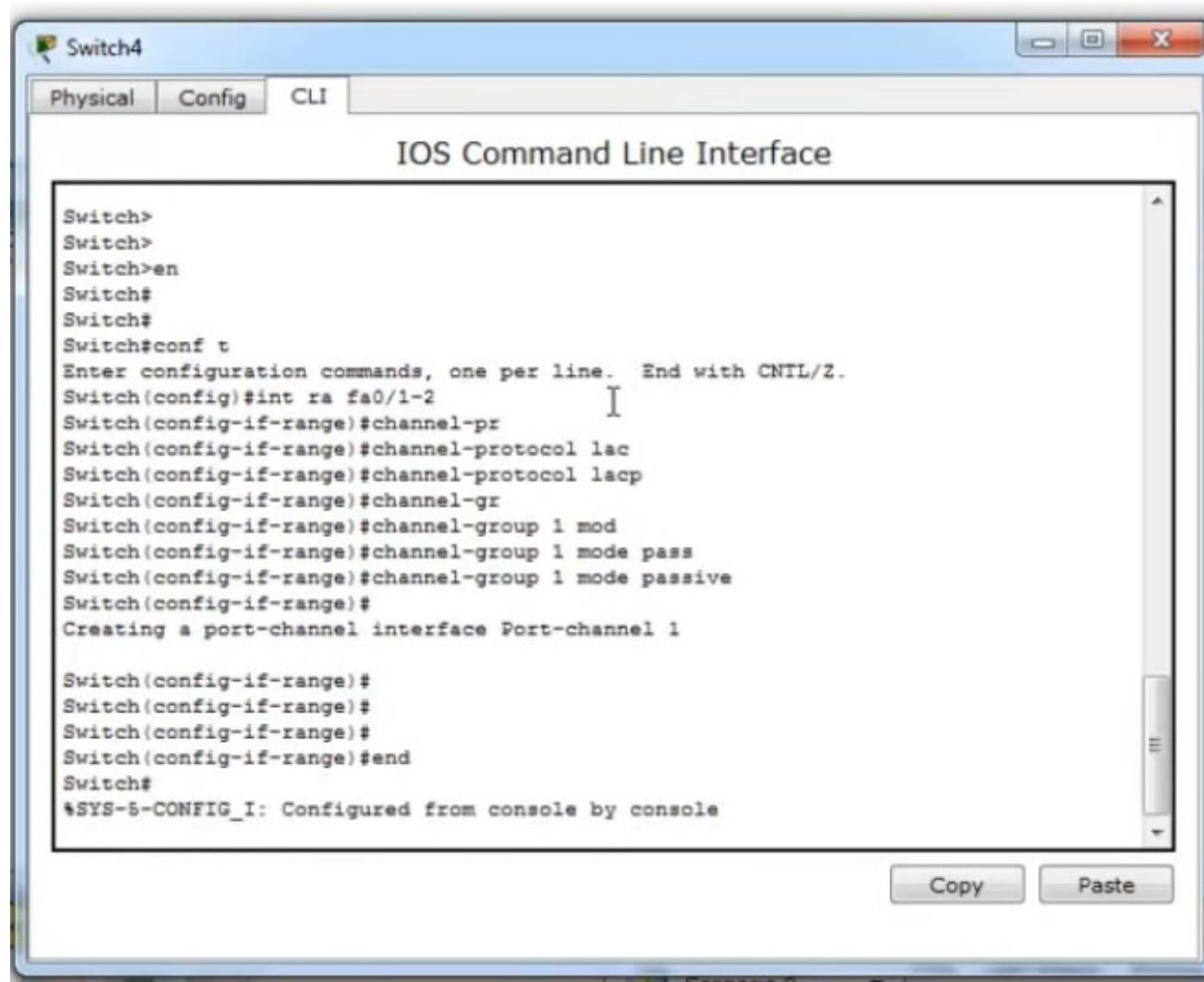
Switch(config-if-range)#end
Switch#
*SYS-5-CONFIG_I: Configured from console by console

Switch#wr mem
```

At the bottom of the window, there are "Copy" and "Paste" buttons.

Аналогичные действия выполняем на остальных двух коммутаторах.

Агрегация каналов



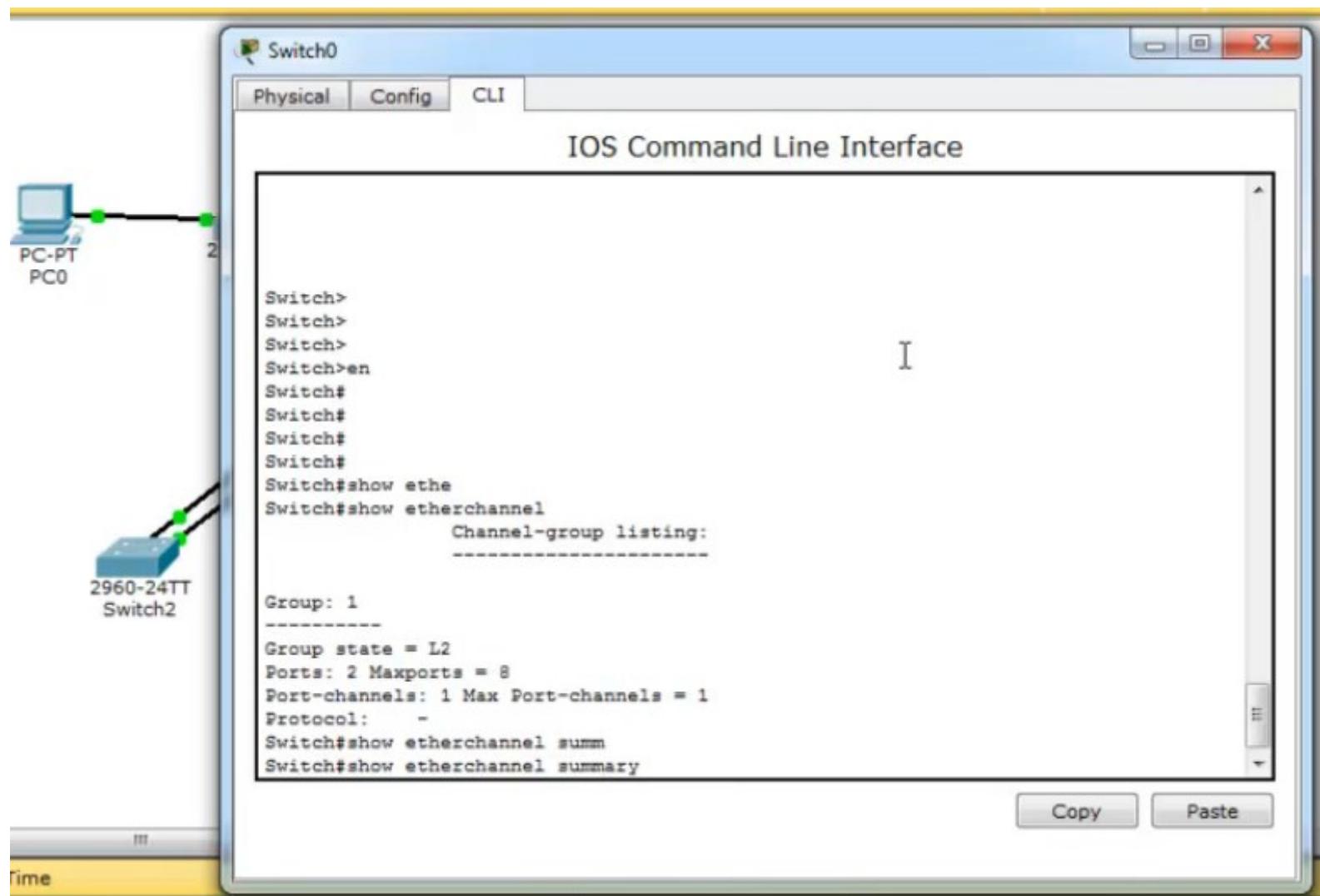
The screenshot shows a Windows application window titled "Switch4" with a tab bar containing "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". The terminal window displays the following configuration command sequence:

```
Switch>
Switch>
Switch>en
Switch#
Switch#
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#int ra fa0/1-2
Switch(config-if-range)#channel-pr
Switch(config-if-range)#channel-protocol lac
Switch(config-if-range)#channel-protocol lacp
Switch(config-if-range)#channel-gr
Switch(config-if-range)#channel-group 1 mod
Switch(config-if-range)#channel-group 1 mode pass
Switch(config-if-range)#channel-group 1 mode passive
Switch(config-if-range)#
Creating a port-channel interface Port-channel 1

Switch(config-if-range)#
Switch(config-if-range)#
Switch(config-if-range)#
Switch(config-if-range)#end
Switch#
*SYS-5-CONFIG_I: Configured from console by console
```

At the bottom of the window are two buttons: "Copy" and "Paste".

Агрегация каналов

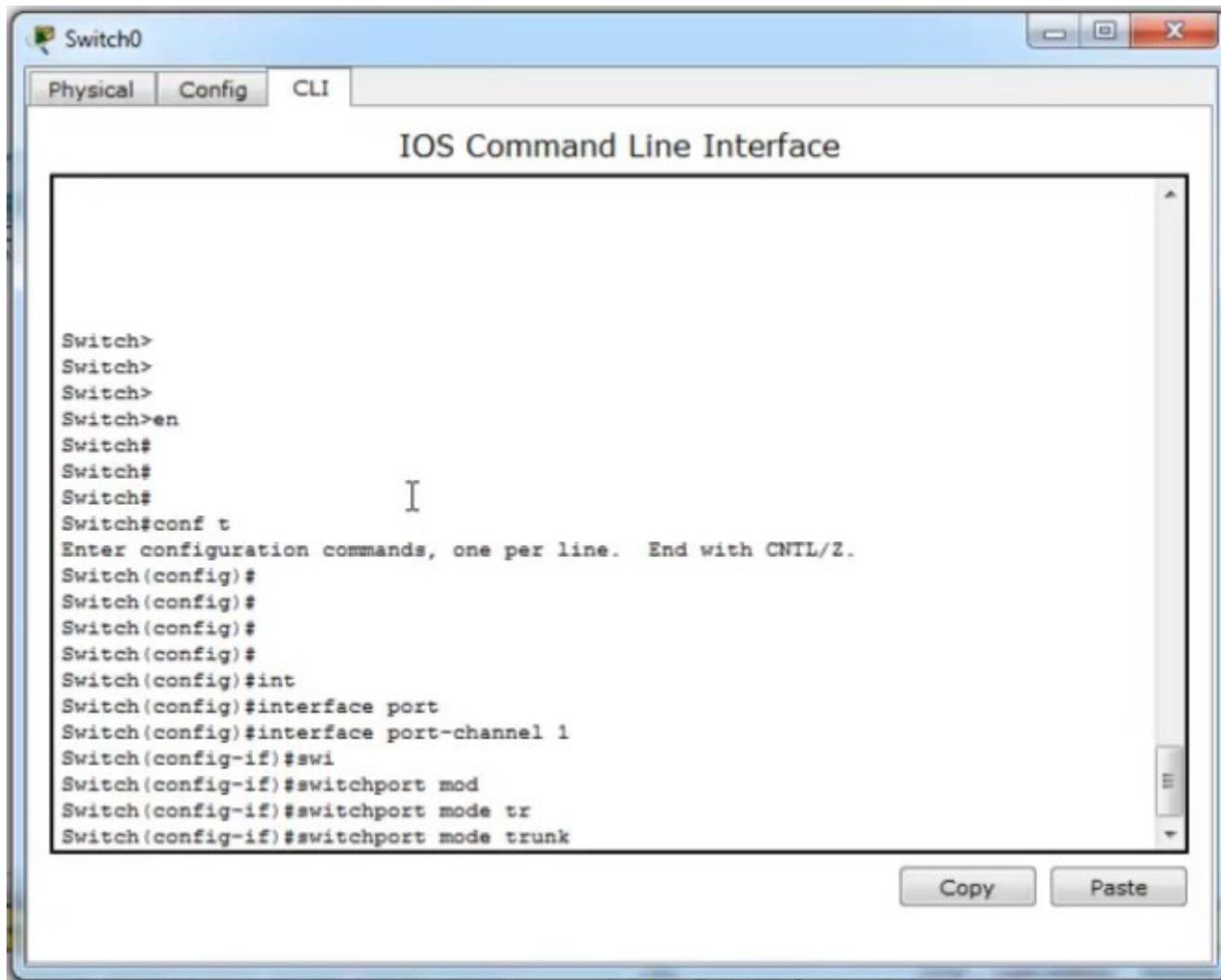


Соединяем узлы в сеть.

Чтобы посмотреть состояние каналов

show etherchannel summary

Агрегация каналов



Можем настроить логические каналы на Switch0 Switch1 как trunk.

Коммутатор третьего уровня

Коммутаторы второго уровня модели OSI (L2):

- Коммутируют трафик на основе MAC адресов
- Используются в качестве коммутаторов уровня доступа
- Производят первичное сегментирование сети (VLAN)
- Самая маленькая стоимость за порт/пользователя

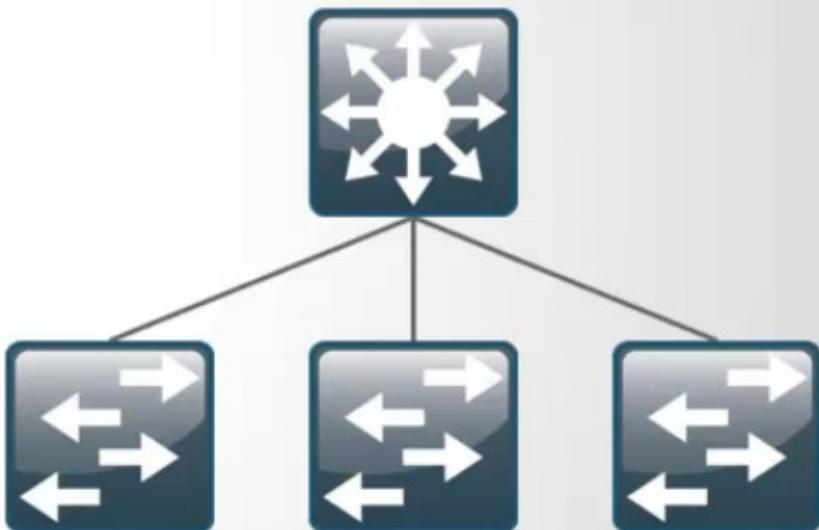


VS



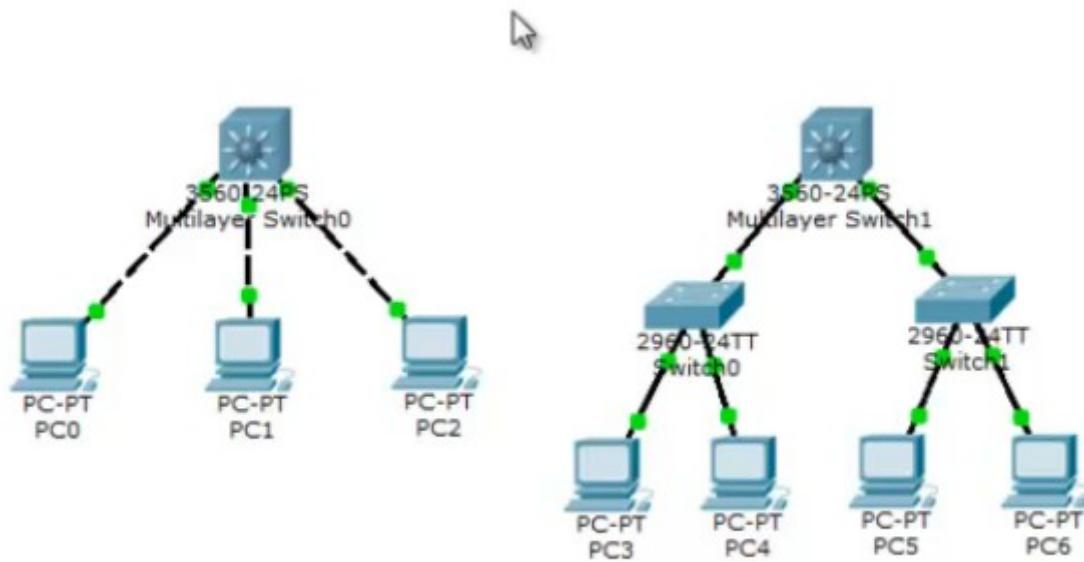
Коммутаторы третьего уровня модели OSI (L3):

- IP маршрутизация
- Агрегирование коммутаторов уровня доступа
- Используются в качестве коммутаторов уровня распределения
- Высокая производительность

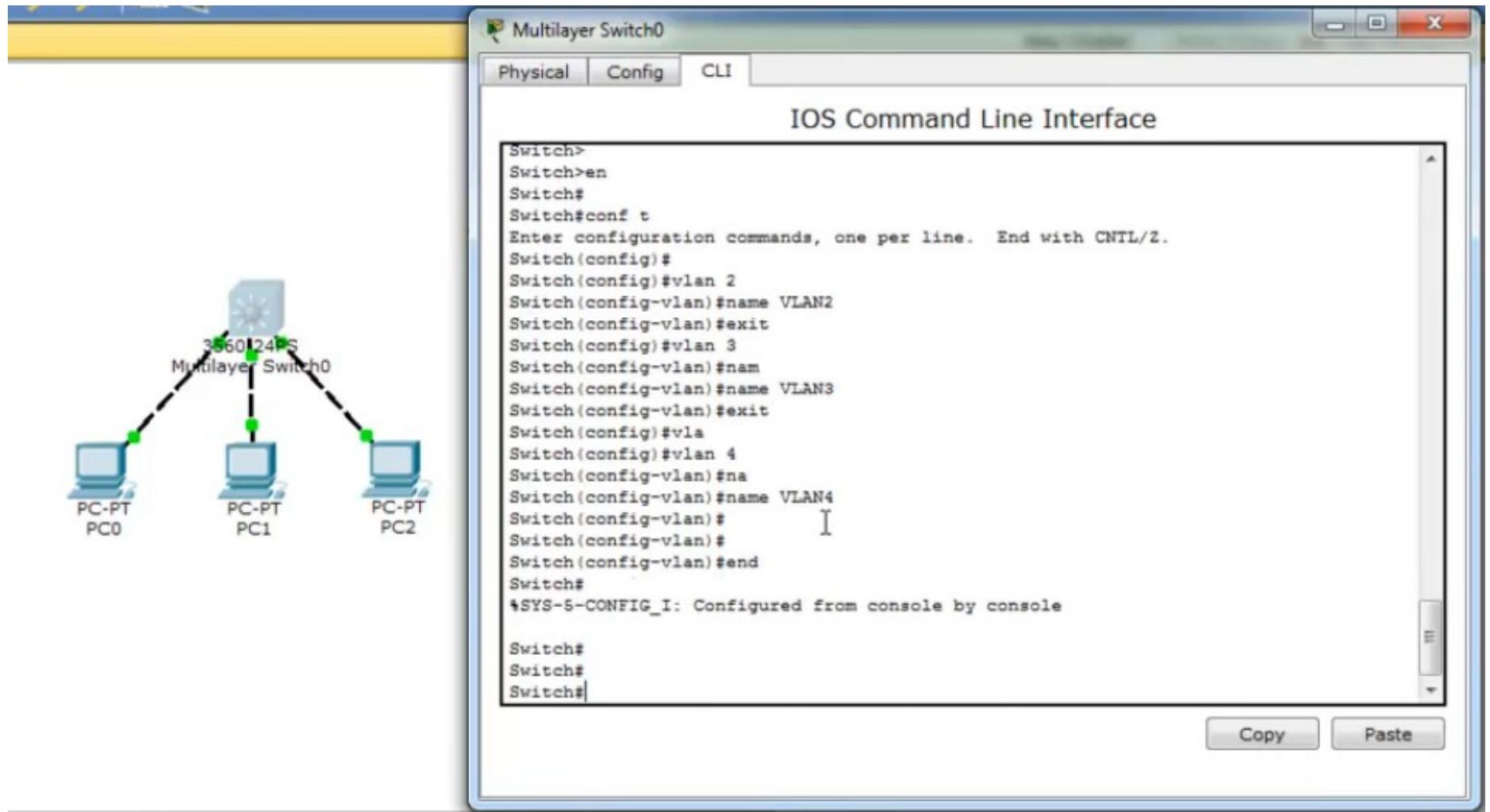


Более подробно о уровне доступа, уровне распределения и уровне ядра можно прочитать [здесь](#)

Коммутатор третьего уровня



Коммутатор третьего уровня



Мы хотим поместить каждый из компьютеров в отдельную VLAN.
При этом хотим, чтобы компьютеры могли связываться друг с другом.

Коммутатор третьего уровня

Multilayer Switch0

Physical Config CLI

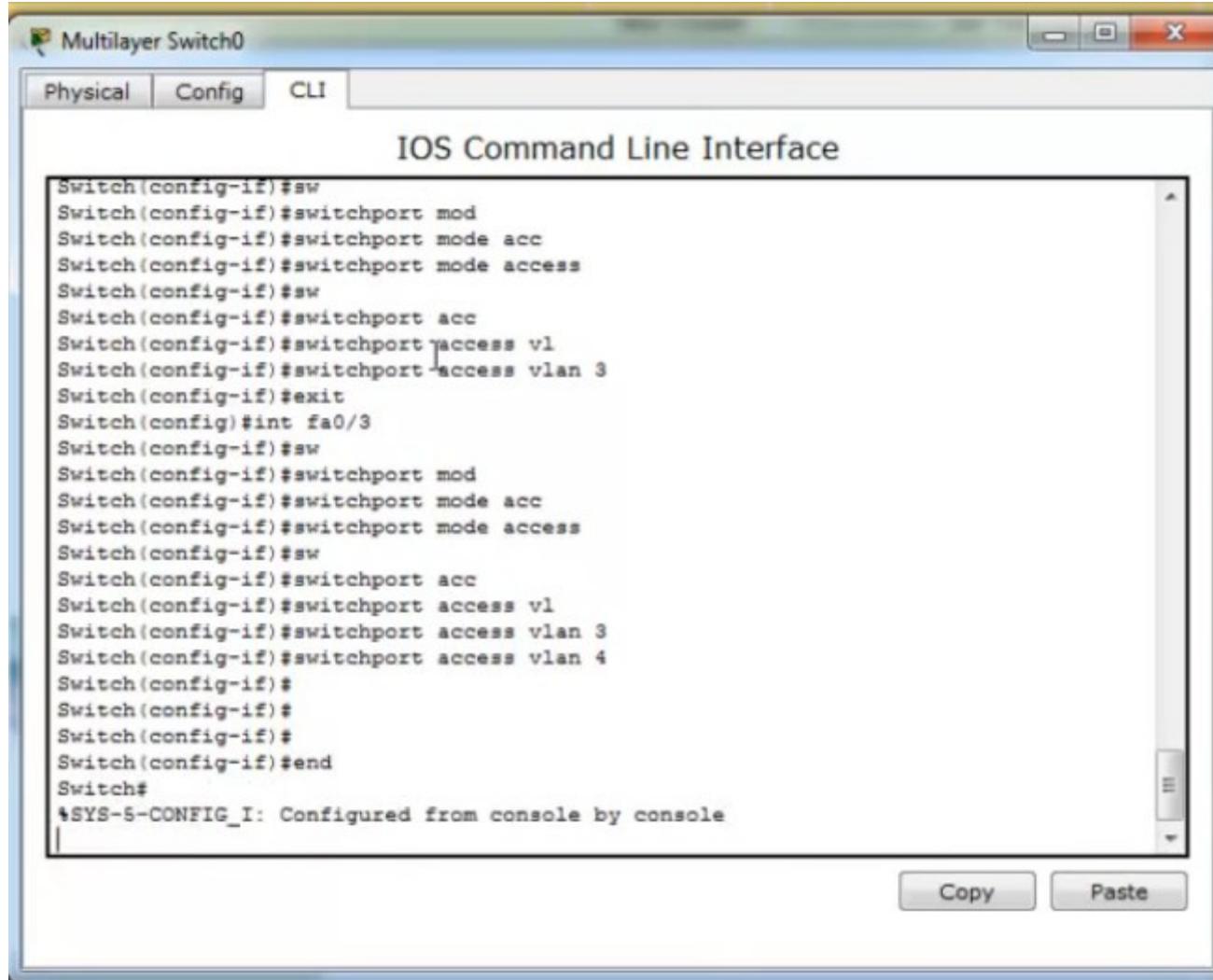
IOS Command Line Interface

```
Switch#
Switch#
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#
Switch(config)#
Switch(config)#int fa0/1      [
Switch(config-if)#sw
Switch(config-if)#switchport mod
Switch(config-if)#switchport mode acc
Switch(config-if)#switchport mode access
Switch(config-if)#sw
Switch(config-if)#switchport acc
Switch(config-if)#switchport access vl
Switch(config-if)#switchport access vlan 2
Switch(config-if)#
Switch(config-if)#exit
Switch(config)#int fa0/2
Switch(config-if)#sw
Switch(config-if)#switchport mod
Switch(config-if)#switchport mode acc
Switch(config-if)#switchport mode access
Switch(config-if)#sw
Switch(config-if)#switchport acc
Switch(config-if)#switchport access vl
Switch(config-if)#switchport access vlan 3
```

Copy Paste

Порт fa0/1 определяем в VLAN 2, fa0/2 в VLAN 3 ...

Коммутатор третьего уровня



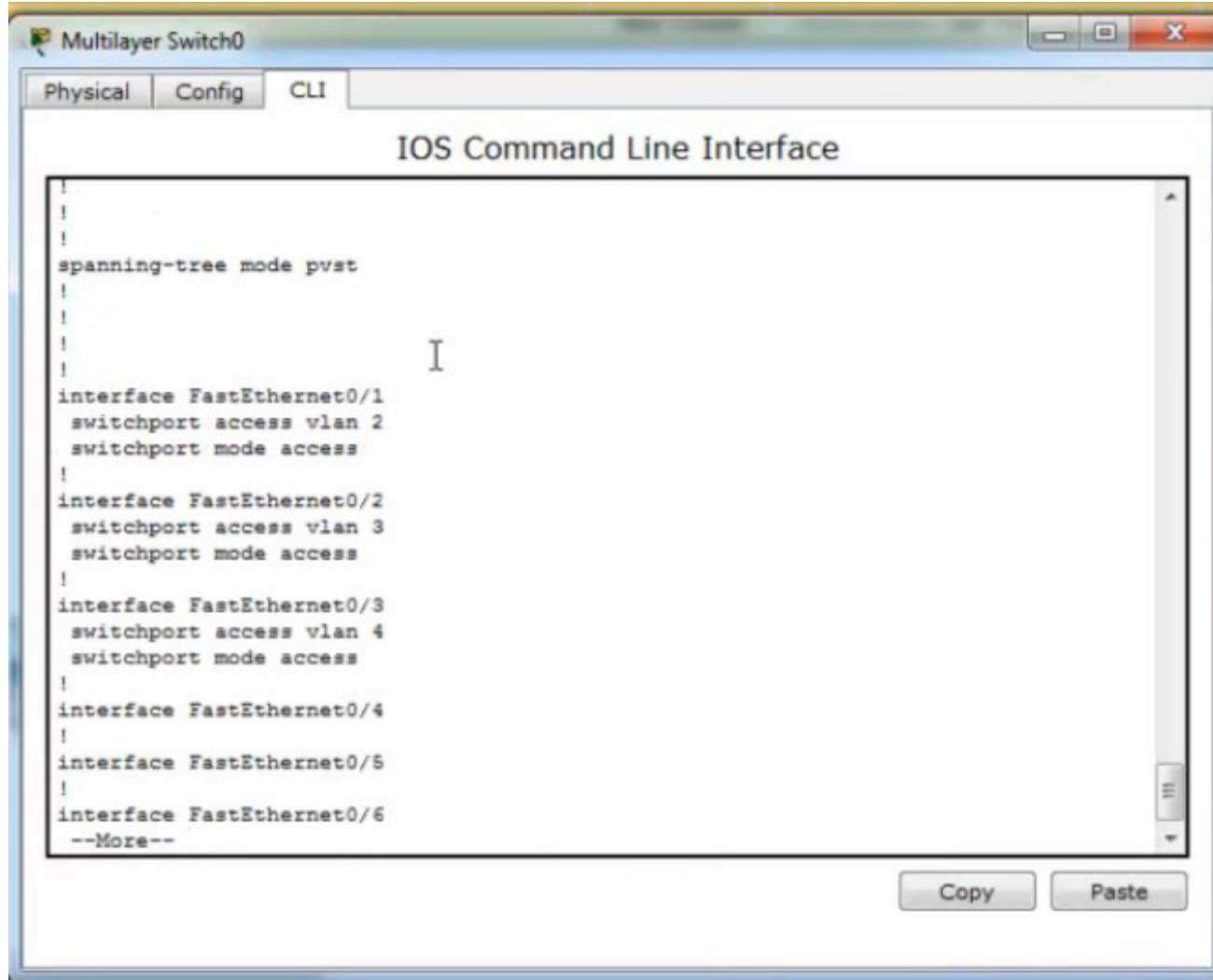
The screenshot shows a Windows application window titled "Multilayer Switch0" with a tab bar containing "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". The terminal window displays the following configuration commands:

```
Switch(config-if)#sw
Switch(config-if)#switchport mod
Switch(config-if)#switchport mode acc
Switch(config-if)#switchport mode access
Switch(config-if)#sw
Switch(config-if)#switchport acc
Switch(config-if)#switchport access vl
Switch(config-if)#switchport access vlan 3
Switch(config-if)#exit
Switch(config)#int fa0/3
Switch(config-if)#sw
Switch(config-if)#switchport mod
Switch(config-if)#switchport mode acc
Switch(config-if)#switchport mode access
Switch(config-if)#sw
Switch(config-if)#switchport acc
Switch(config-if)#switchport access vl
Switch(config-if)#switchport access vlan 3
Switch(config-if)#switchport access vlan 4
Switch(config-if)#
Switch(config-if)#
Switch(config-if)#
Switch(config-if)#end
Switch#
*SYS-5-CONFIG_I: Configured from console by console
```

At the bottom of the terminal window, there are "Copy" and "Paste" buttons.

... fa0/3 в VLAN 4.

Коммутатор третьего уровня



The screenshot shows a window titled "Multilayer Switch0" with a tab bar containing "Physical", "Config", and "CLI". The "CLI" tab is selected, displaying the "IOS Command Line Interface". The interface shows the following configuration commands:

```
!
!
!
spanning-tree mode pvst
!
!
!
interface FastEthernet0/1
  switchport access vlan 2
  switchport mode access
!
interface FastEthernet0/2
  switchport access vlan 3
  switchport mode access
!
interface FastEthernet0/3
  switchport access vlan 4
  switchport mode access
!
interface FastEthernet0/4
!
interface FastEthernet0/5
!
interface FastEthernet0/6
--More--
```

At the bottom of the window are "Copy" and "Paste" buttons.

Проверяем конфигурацию
show run

Коммутатор третьего уровня

Multilayer Switch0

Physical Config CLI

IOS Command Line Interface

```
switchport access vlan 4
switchport mode access
!
interface FastEthernet0/4
!
interface FastEthernet0/5
!
interface FastEthernet0/6
!

Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#int v1a
Switch(config)#int vlan 2
Switch(config-if)#
*LINK-5-CHANGED: Interface Vlan2, changed state to up

*LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan2, changed state to up

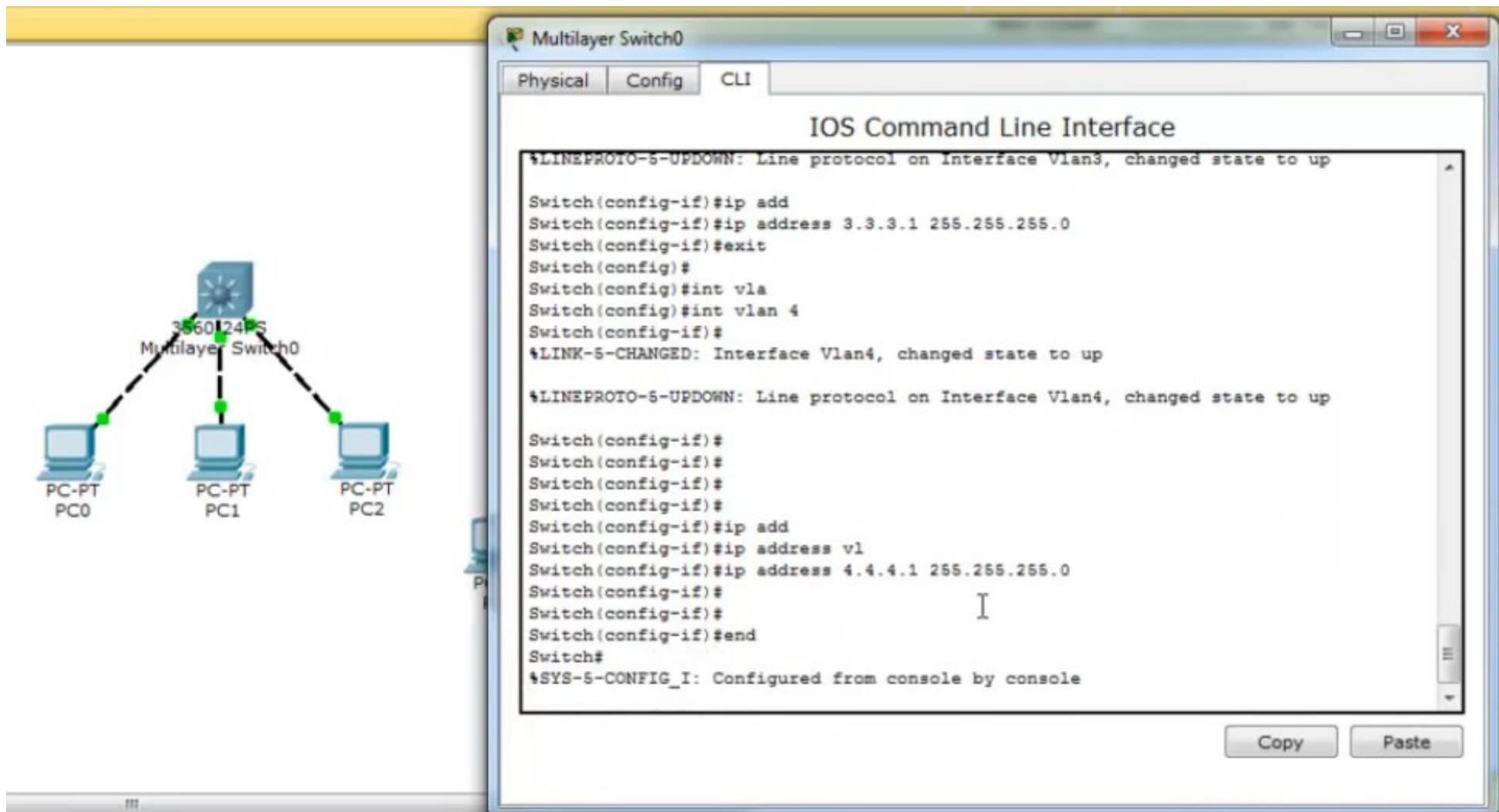
Switch(config-if)#
Switch(config-if)#
Switch(config-if)#
Switch(config-if)#ip add
Switch(config-if)#ip address 2.2.2.1 255.255.255.0
Switch(config-if)#exit
Switch(config)#

```

Copy Paste

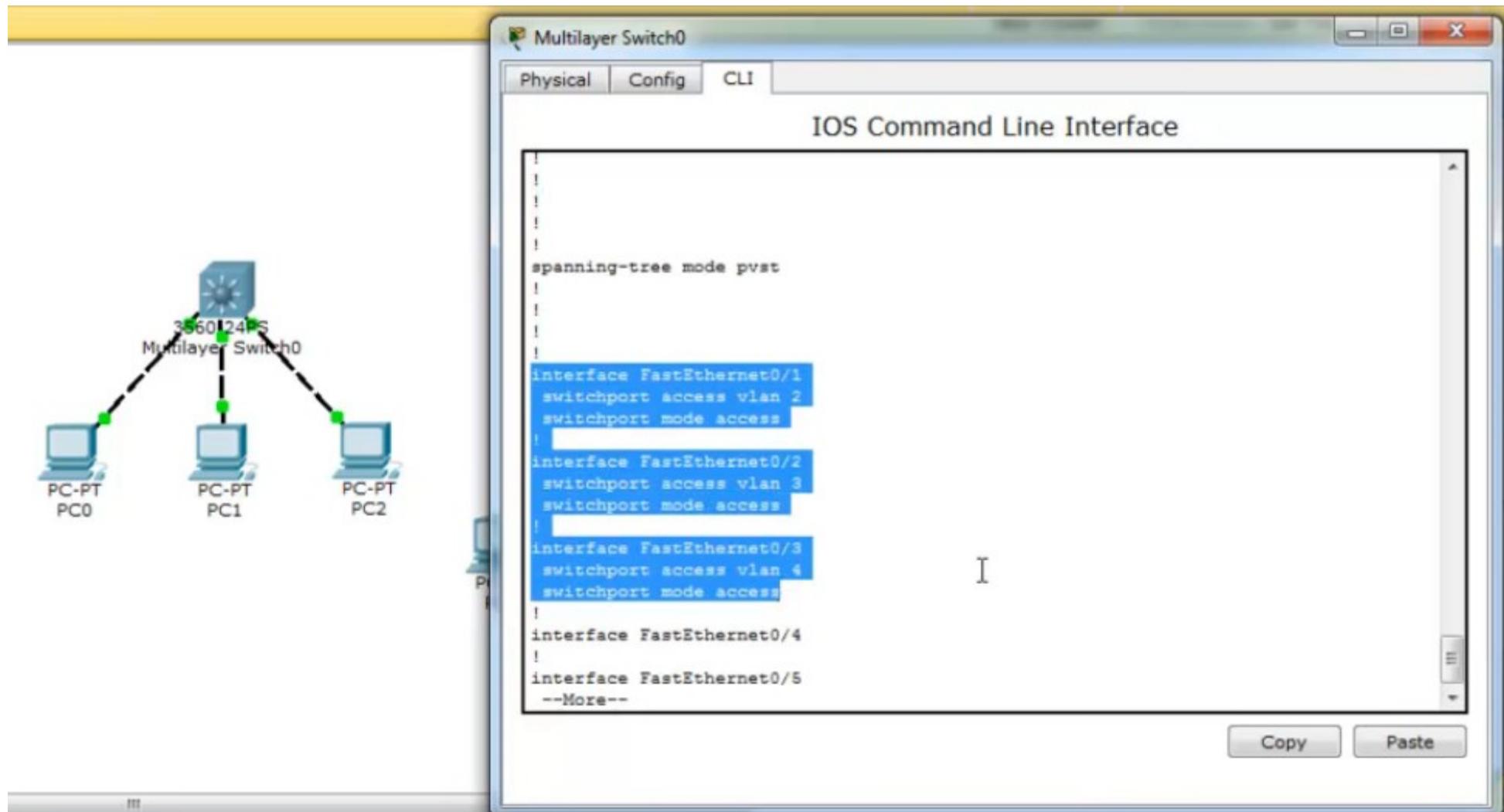
На каждый интерфейс-vlan назначим ip адрес.
На Vlan2 будет 2.2.2.1 ...

Коммутатор третьего уровня



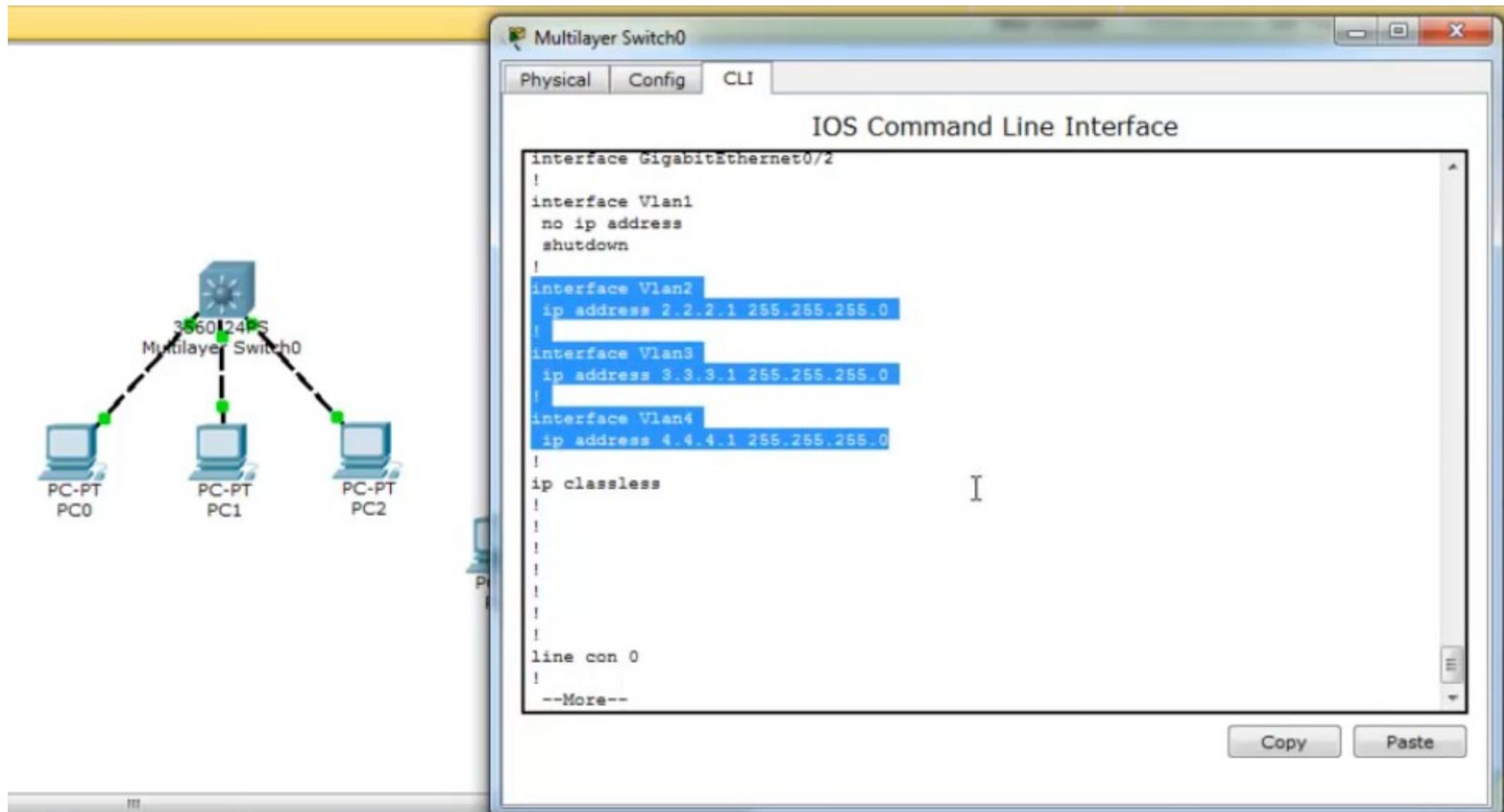
На Vlan4 будет 3.3.3.1,
Vlan1 4.4.4.1

Коммутатор третьего уровня

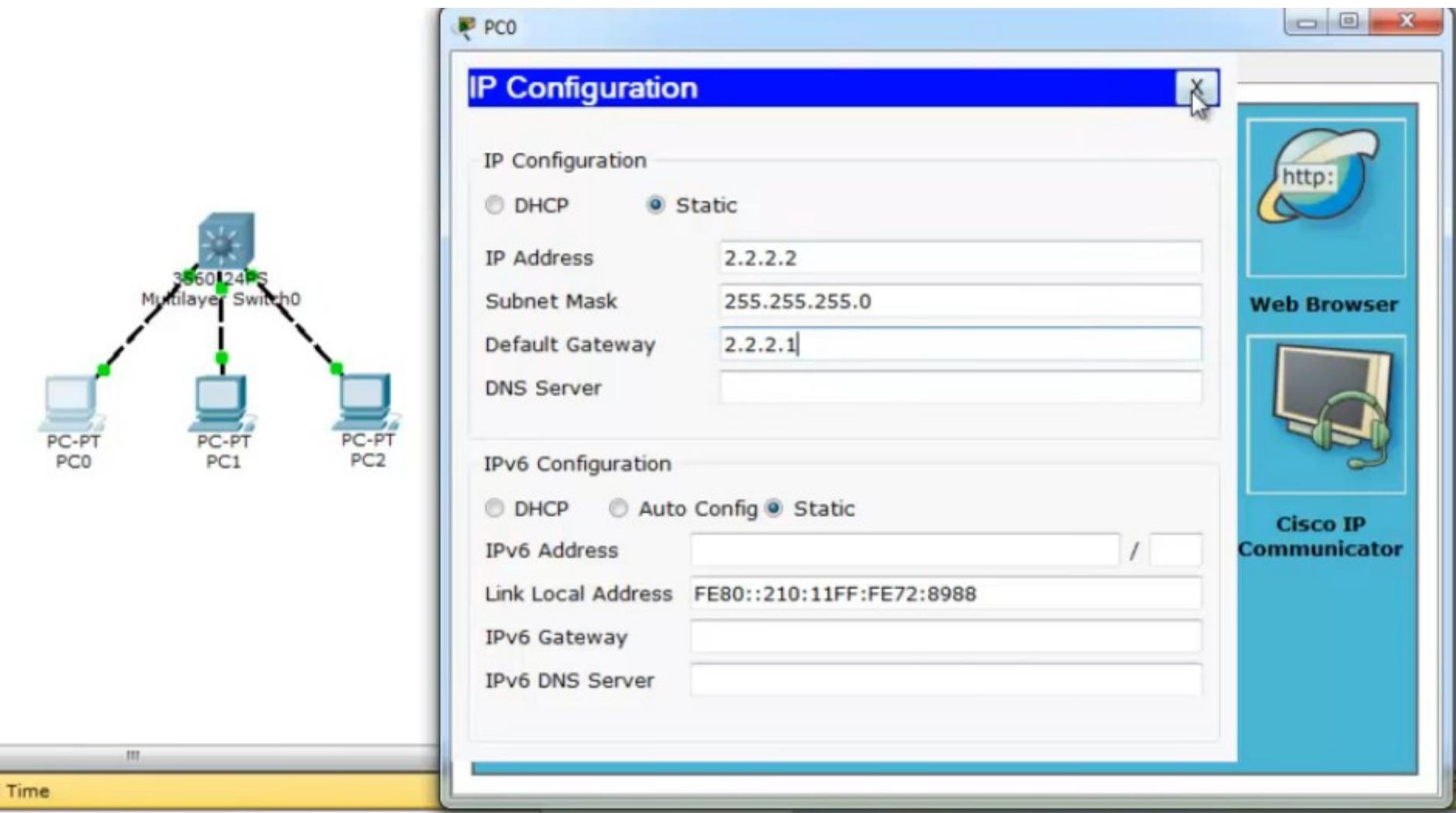


Проверяем конфигурацию
show run

Коммутатор третьего уровня

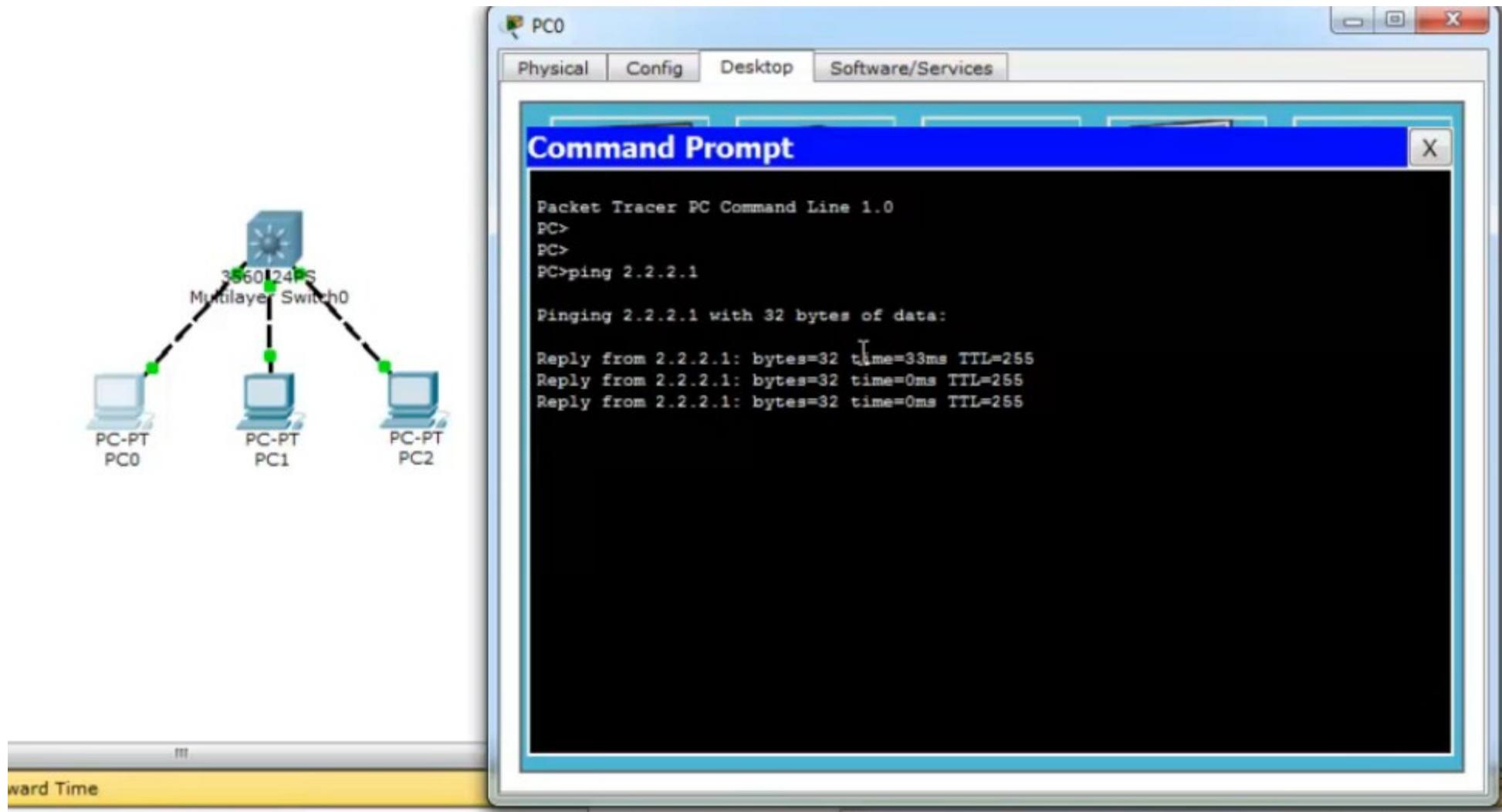


Коммутатор третьего уровня



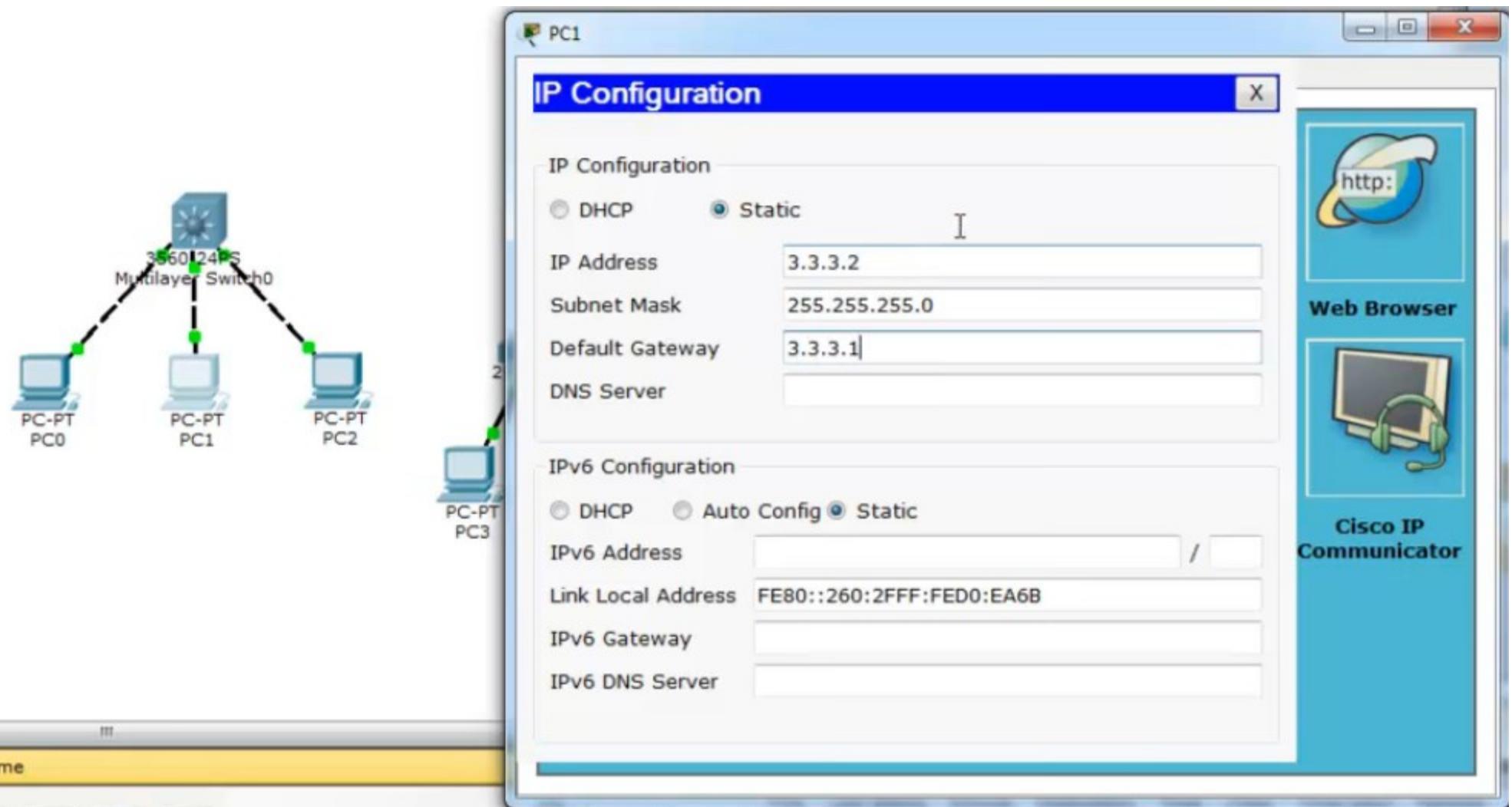
Задаем ір для PC0

Коммутатор третьего уровня



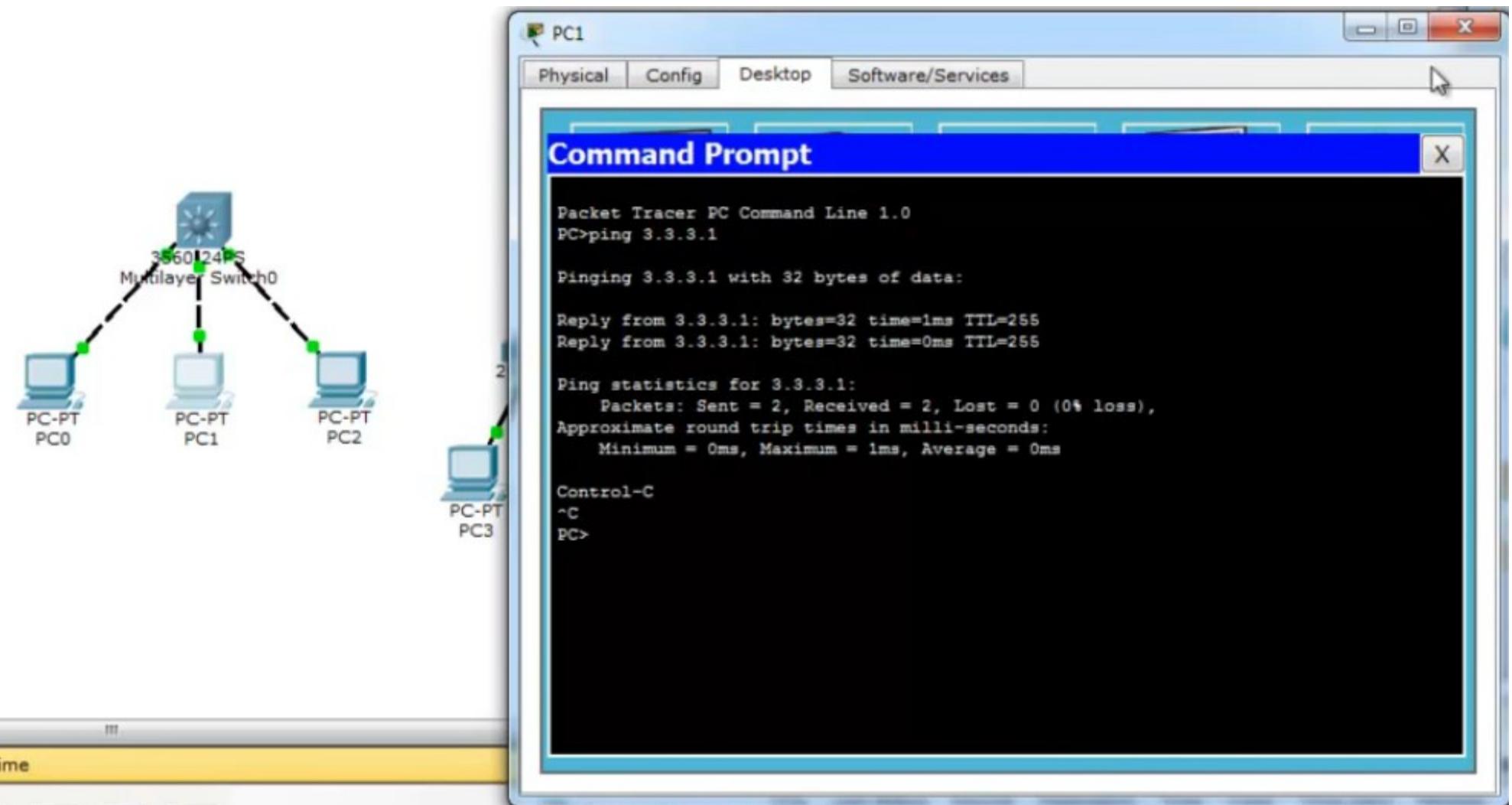
Проверяем связь

Коммутатор третьего уровня



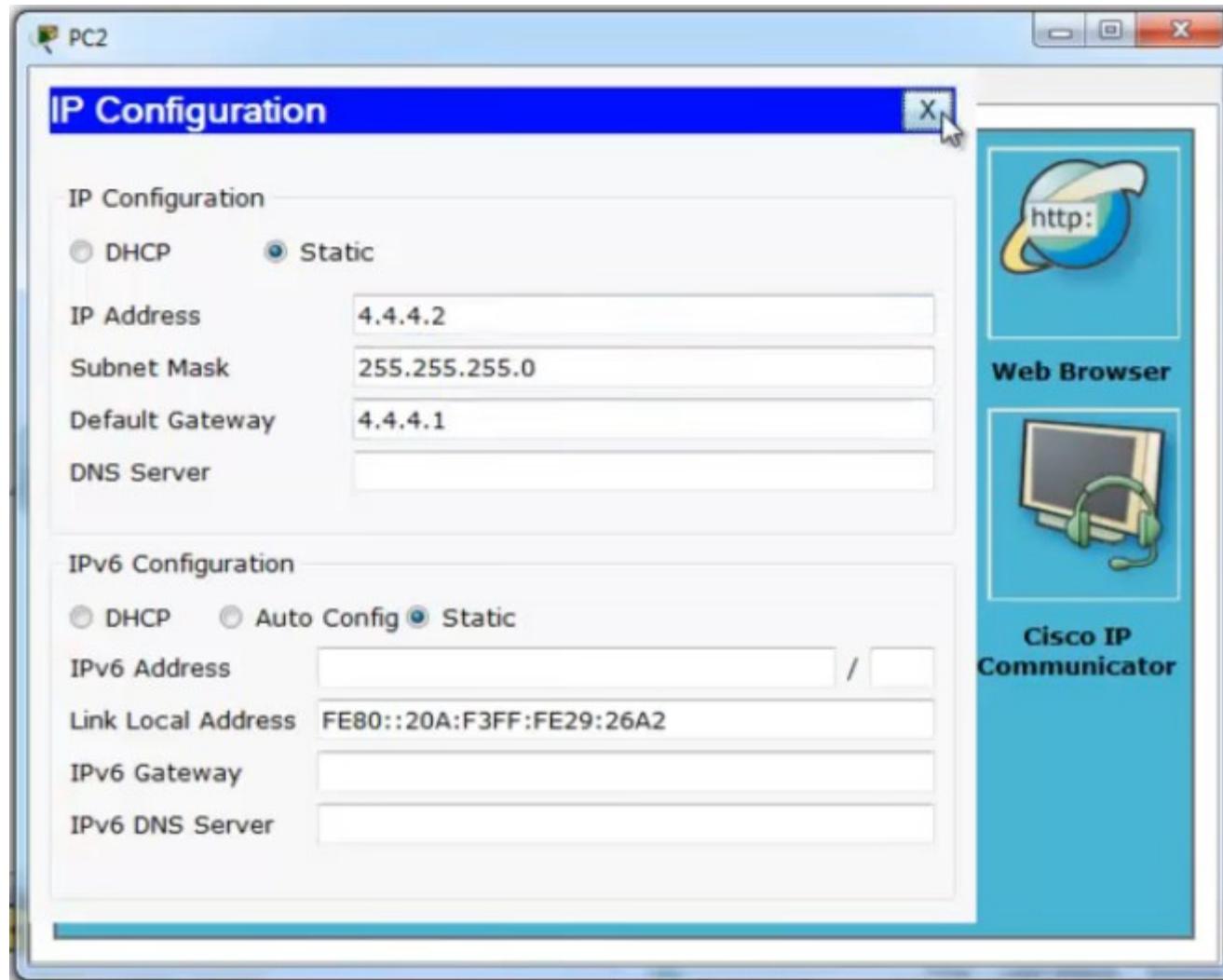
Задаем ip для PC1

Коммутатор третьего уровня



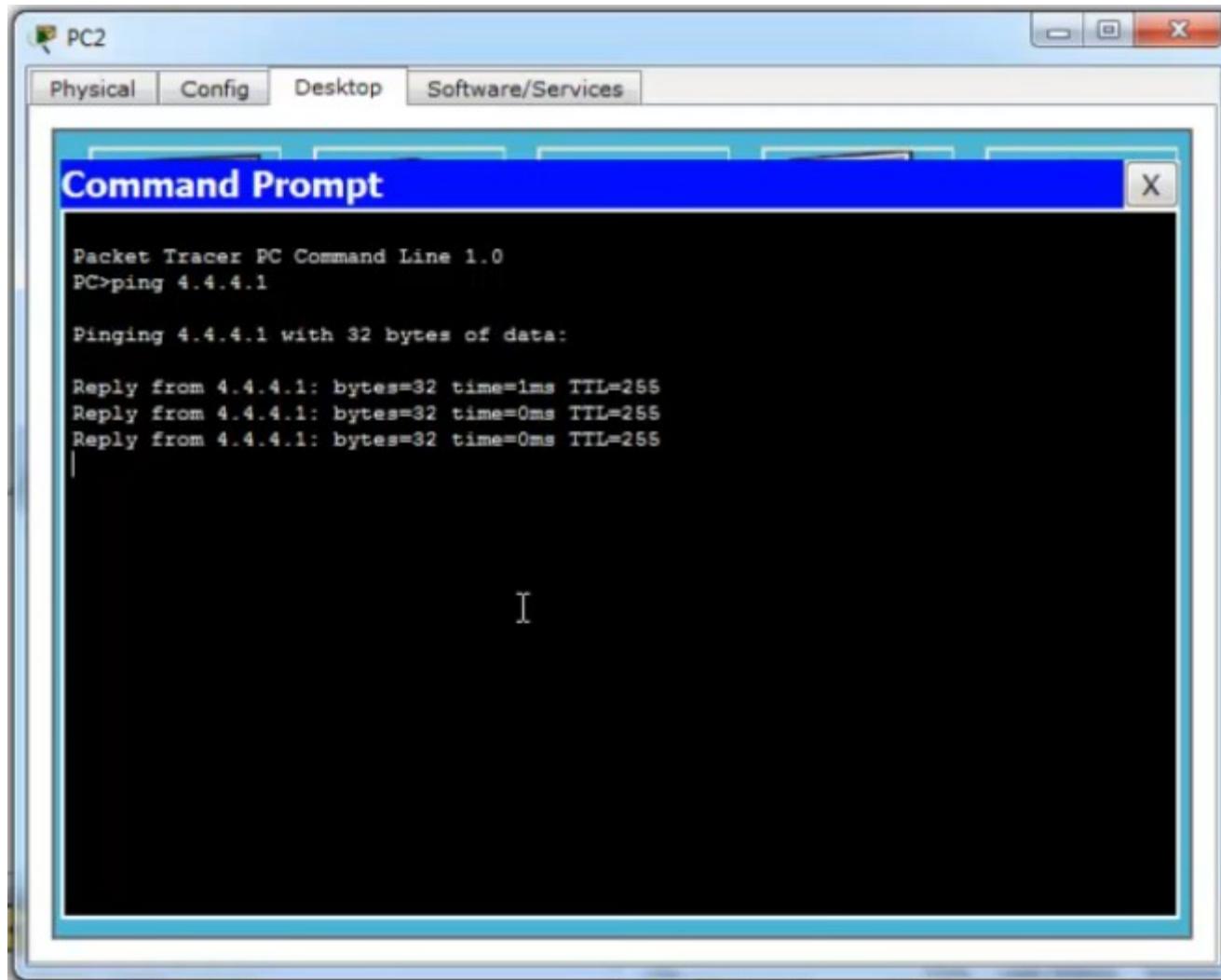
Проверяем

Коммутатор третьего уровня



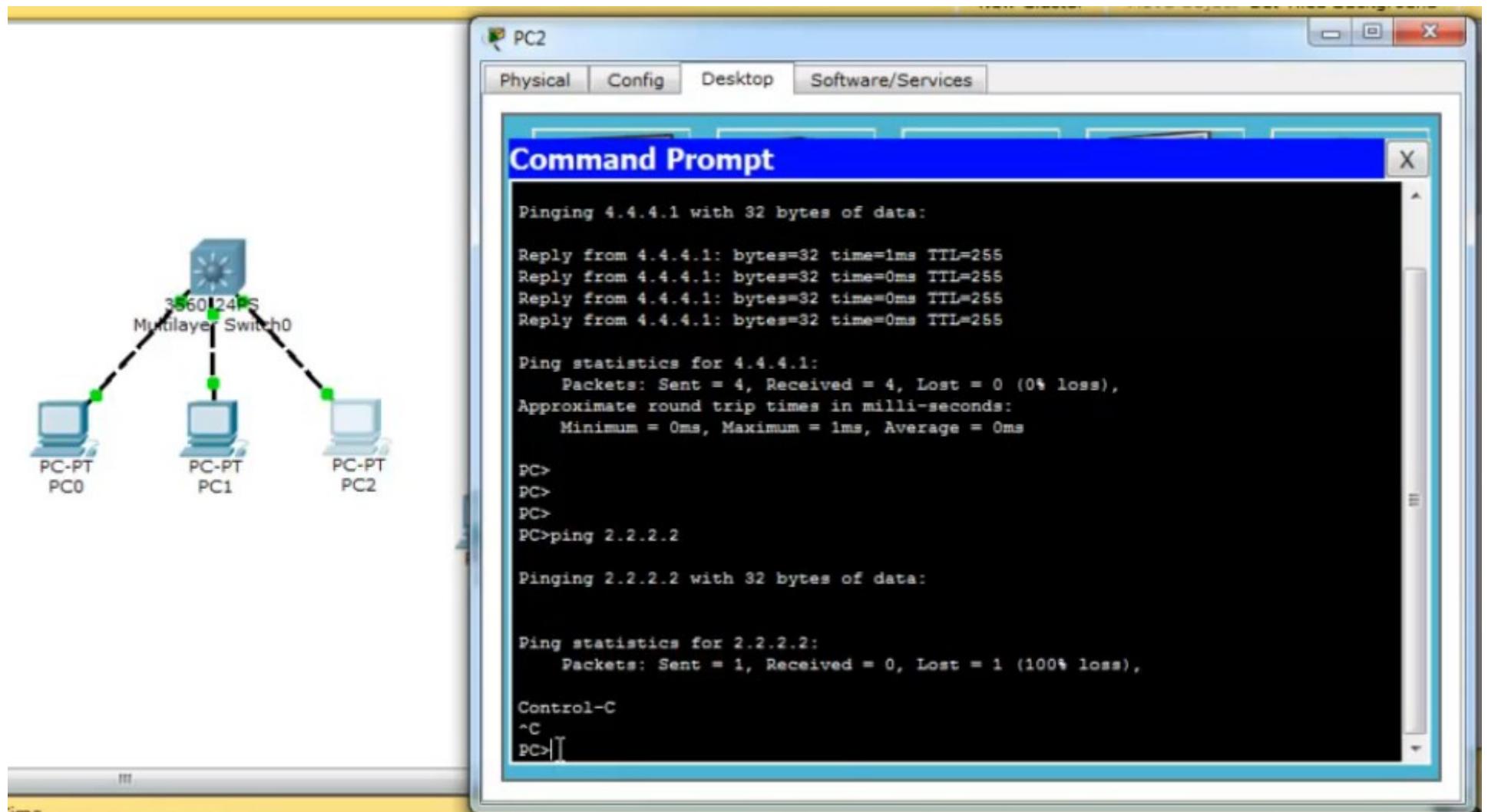
Задаем ір для PC2

Коммутатор третьего уровня



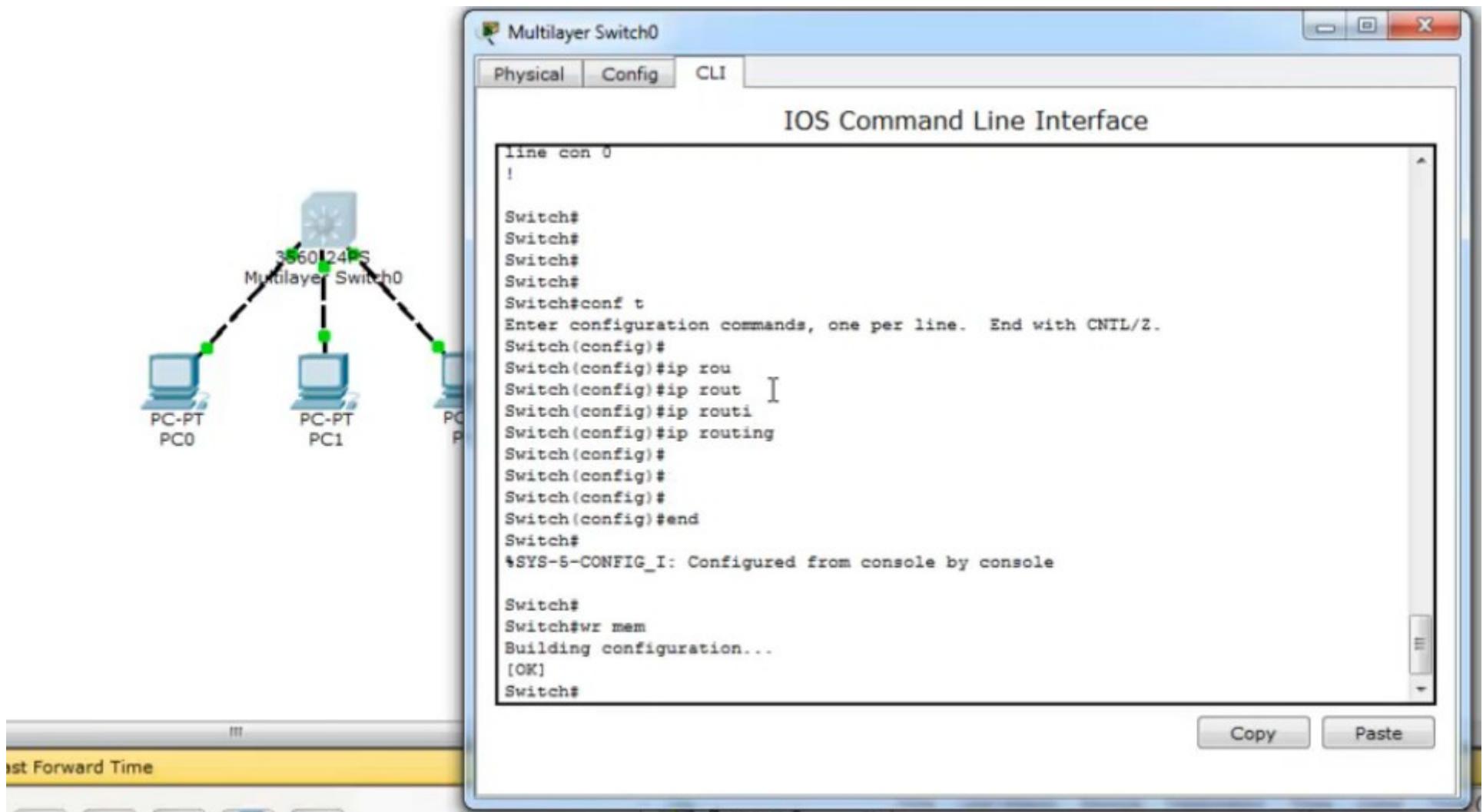
Проверяем

Коммутатор третьего уровня



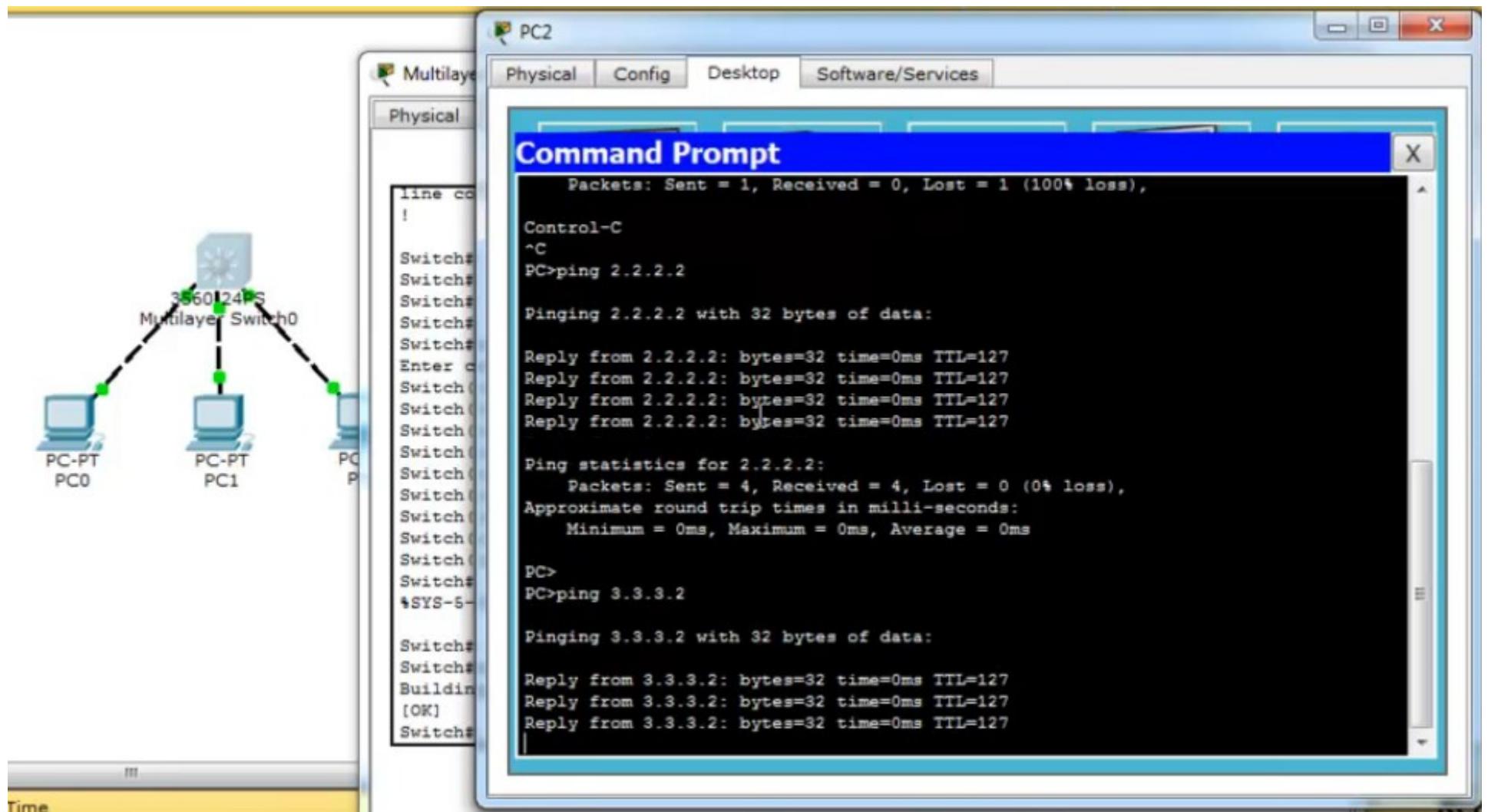
Межсетевое взаимодействие не работает

Коммутатор третьего уровня



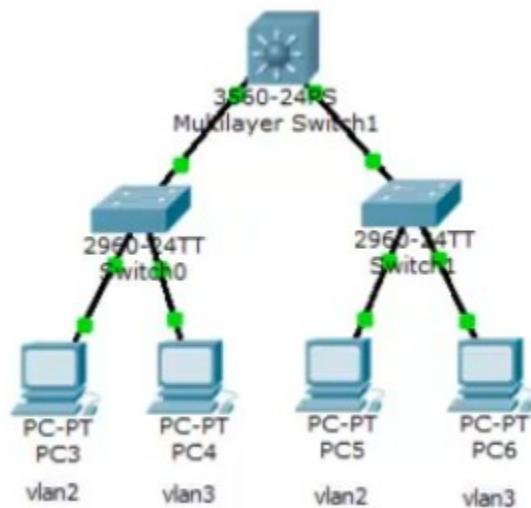
Включаем на коммутаторе роутинг.

Коммутатор третьего уровня



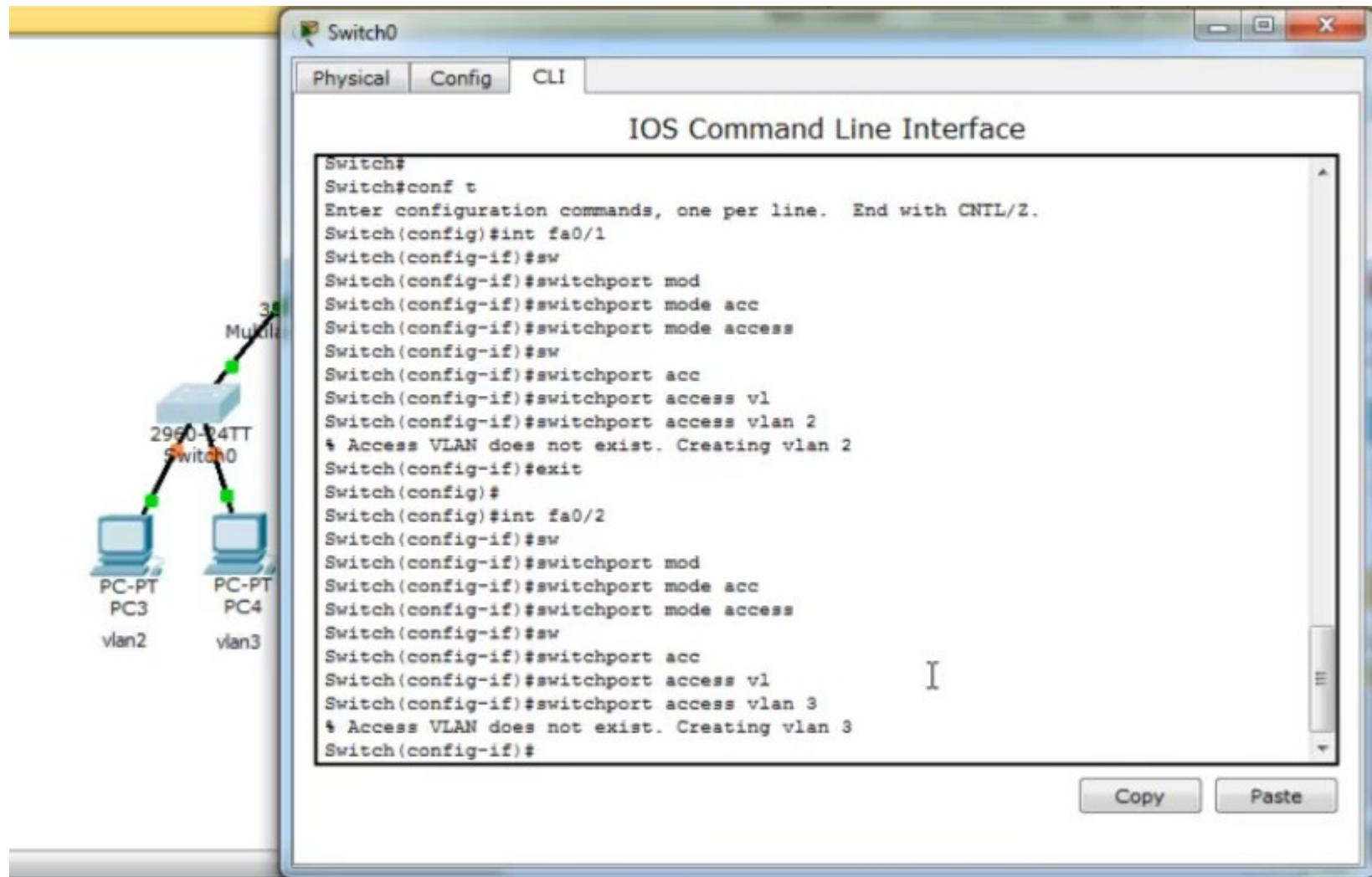
Проверяем, работает.

Коммутатор третьего уровня



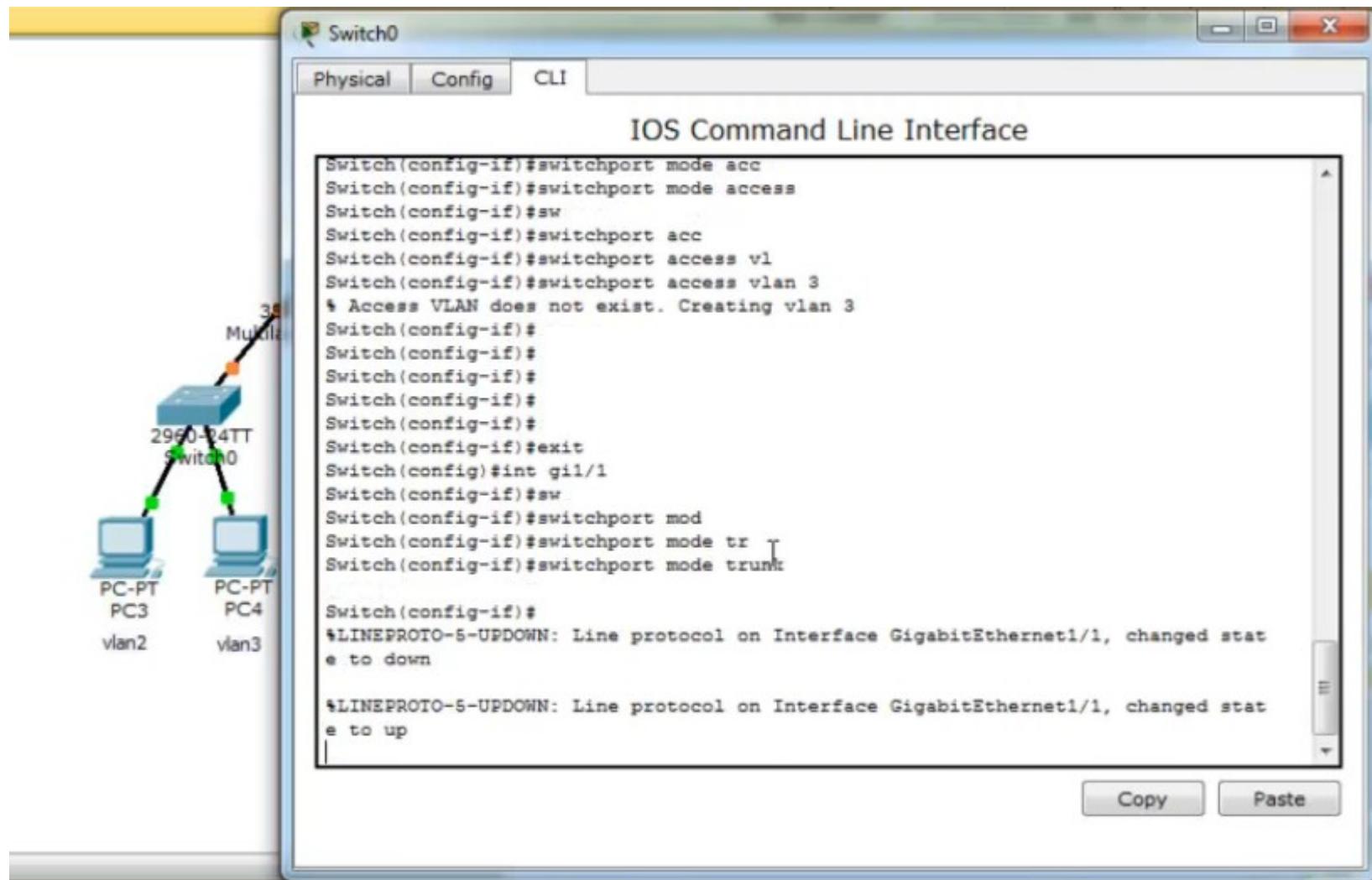
Второй пример. Два компьютера в одном VLAN, два в другом.

Коммутатор третьего уровня



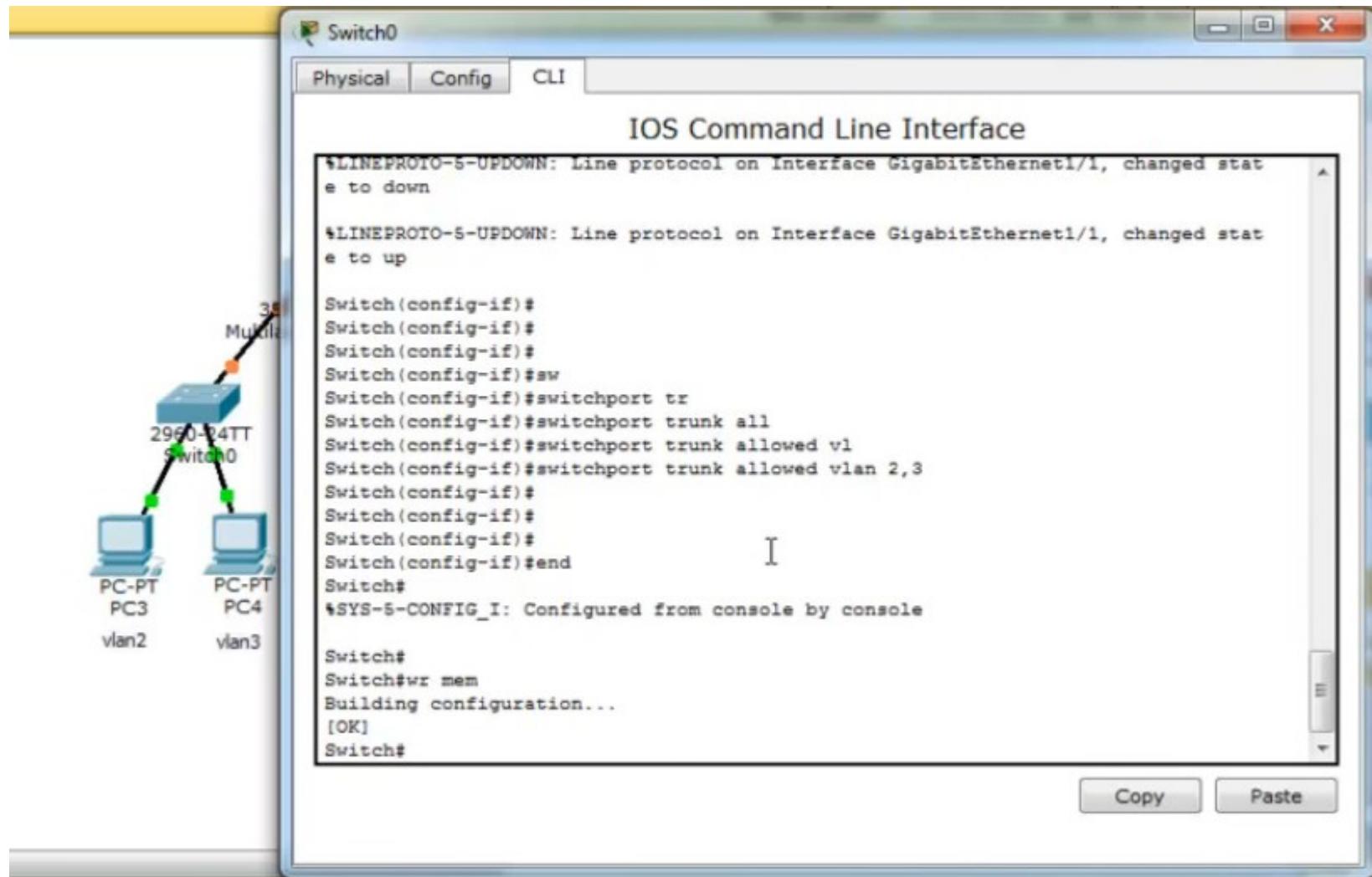
Соответственно создаем VLAN'ы в коммутаторе 0

Коммутатор третьего уровня



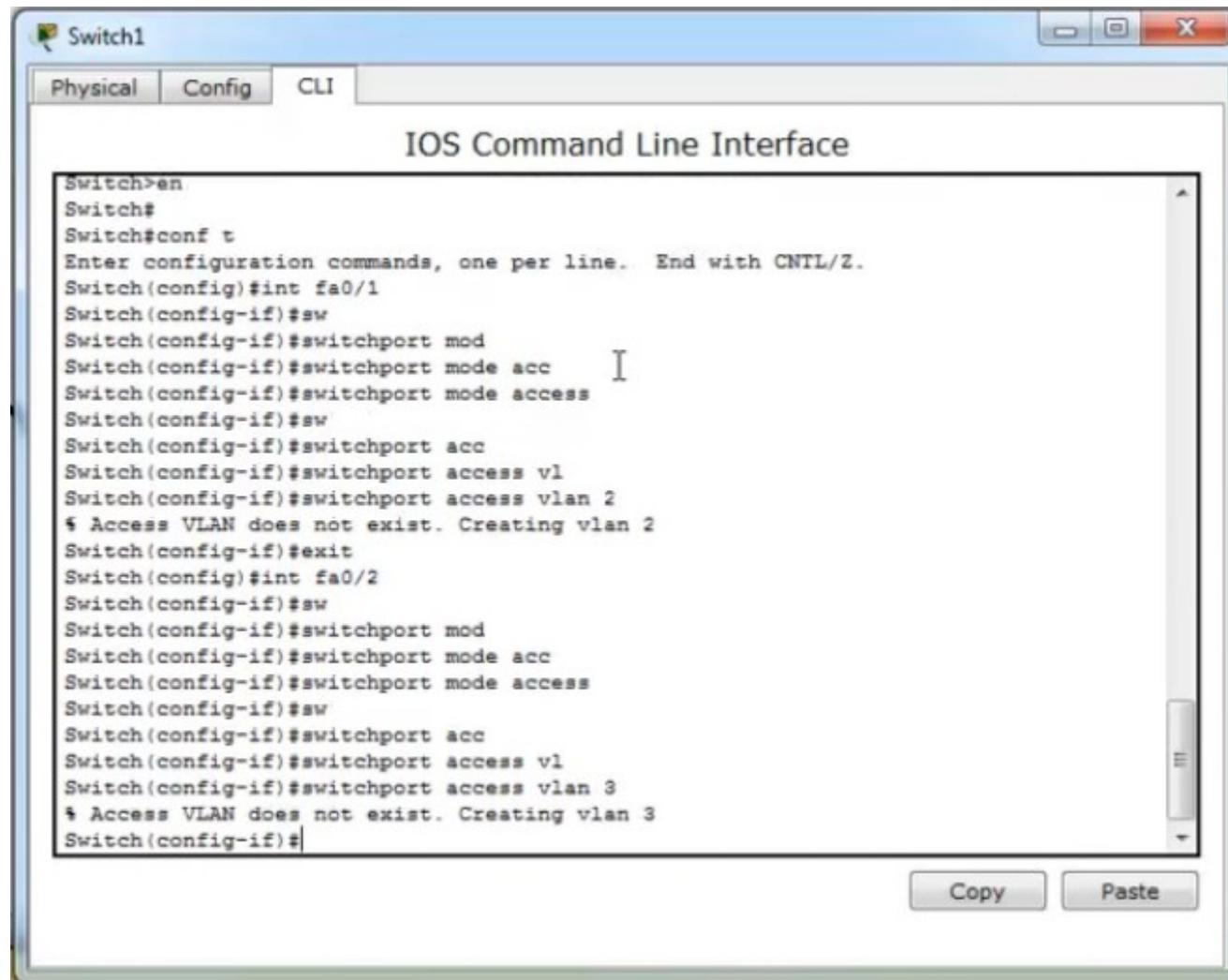
Настраиваем trunk-порт до коммутатора третьего уровня.

Коммутатор третьего уровня



В этот trunk-порт добавляем vlan 2 и vlan 3

Коммутатор третьего уровня



The screenshot shows a Windows application window titled "Switch1" with a tab bar containing "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". The terminal window displays the following configuration commands:

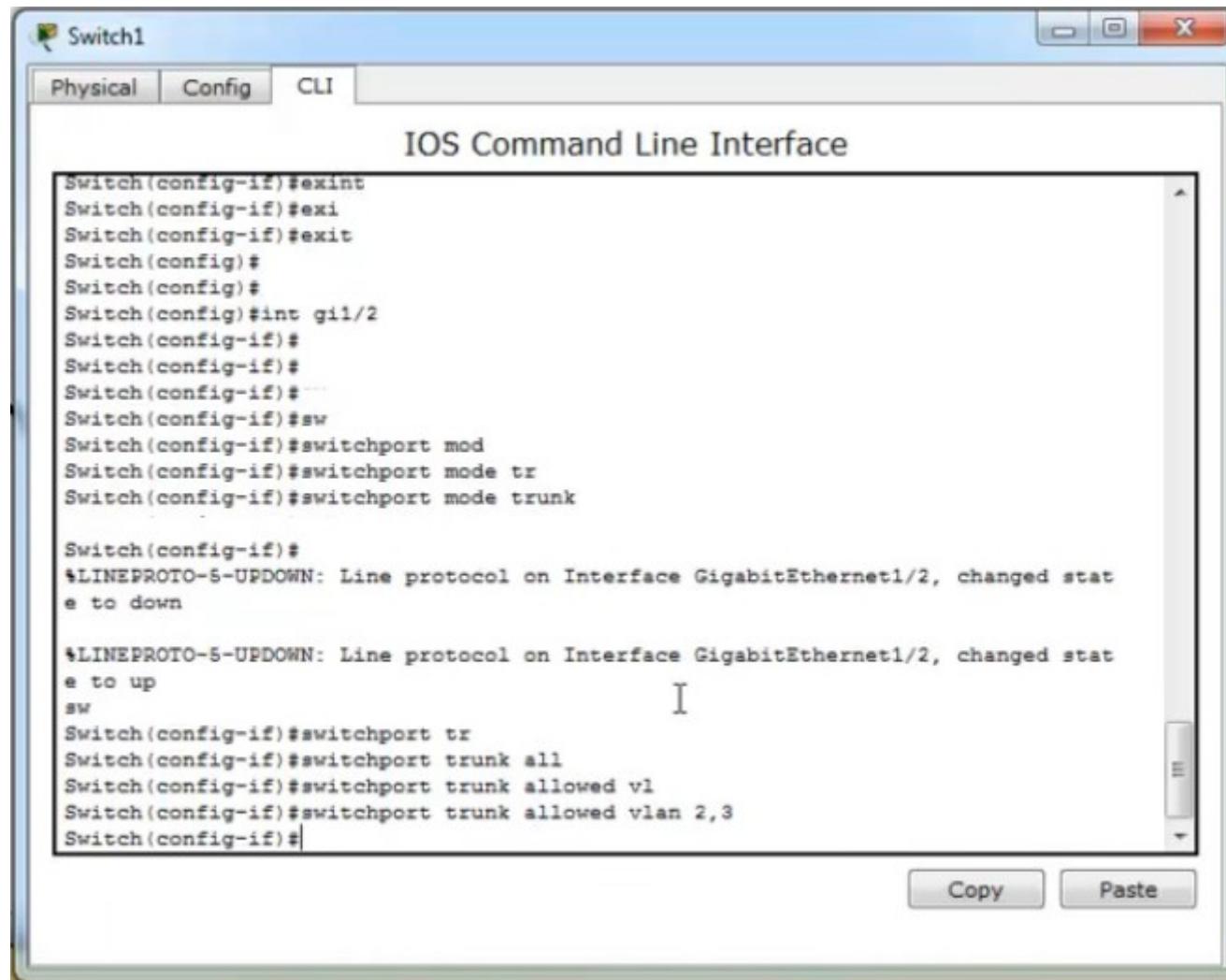
```
Switch>en
Switch#
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#int fa0/1
Switch(config-if)#sw
Switch(config-if)#switchport mod
Switch(config-if)#switchport mode acc
Switch(config-if)#switchport mode access
Switch(config-if)#sw
Switch(config-if)#switchport acc
Switch(config-if)#switchport access vl
Switch(config-if)#switchport access vlan 2
* Access VLAN does not exist. Creating vlan 2
Switch(config-if)#exit
Switch(config)#int fa0/2
Switch(config-if)#sw
Switch(config-if)#switchport mod
Switch(config-if)#switchport mode acc
Switch(config-if)#switchport mode access
Switch(config-if)#sw
Switch(config-if)#switchport acc
Switch(config-if)#switchport access vl
Switch(config-if)#switchport access vlan 3
* Access VLAN does not exist. Creating vlan 3
Switch(config-if)#

```

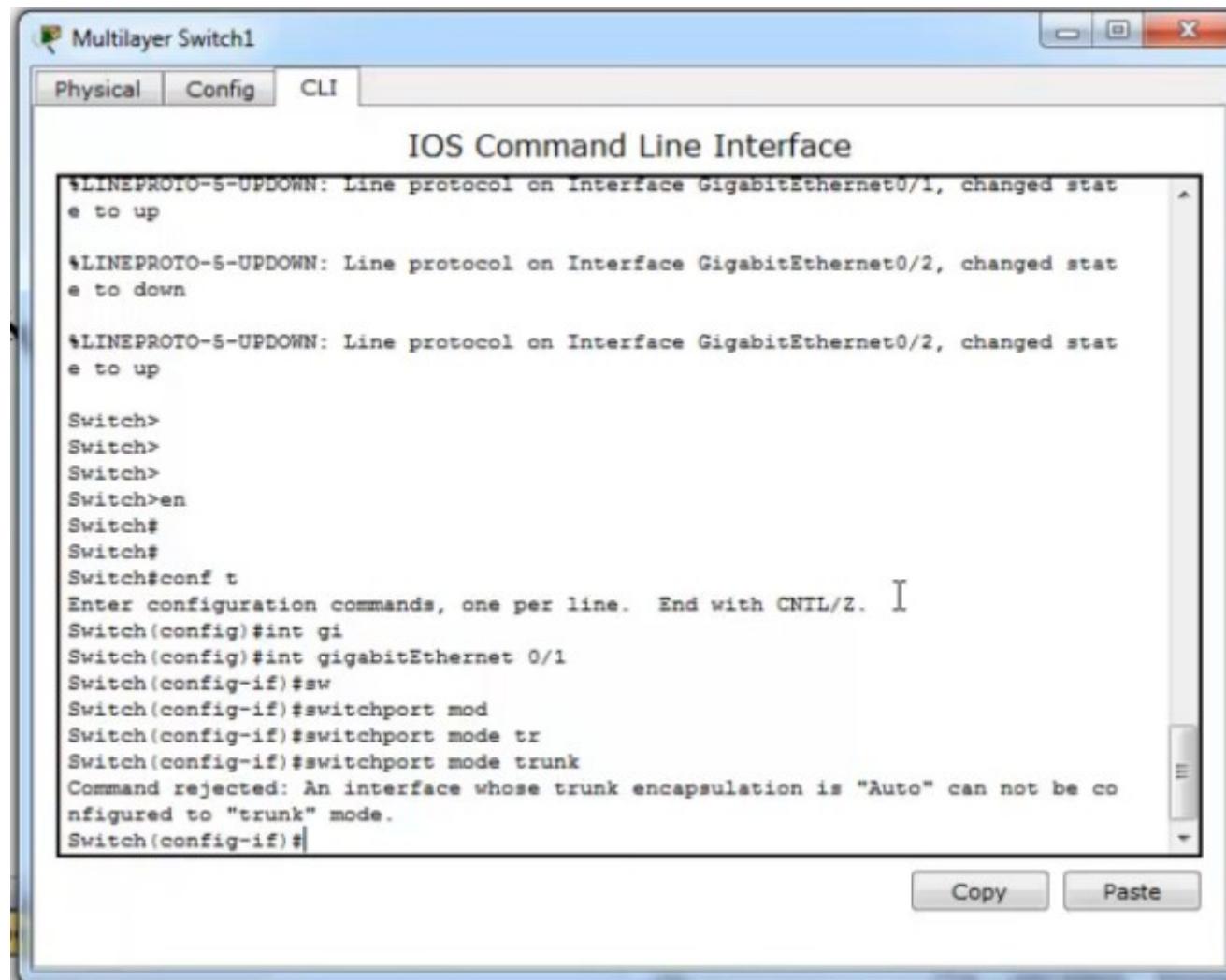
At the bottom of the terminal window, there are "Copy" and "Paste" buttons.

То же самое проделаем на втором коммутаторе.

Коммутатор третьего уровня



Коммутатор третьего уровня



The screenshot shows a Windows application window titled "Multilayer Switch1" with a tab bar containing "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". The terminal window displays the following text:

```
$LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

$LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to down

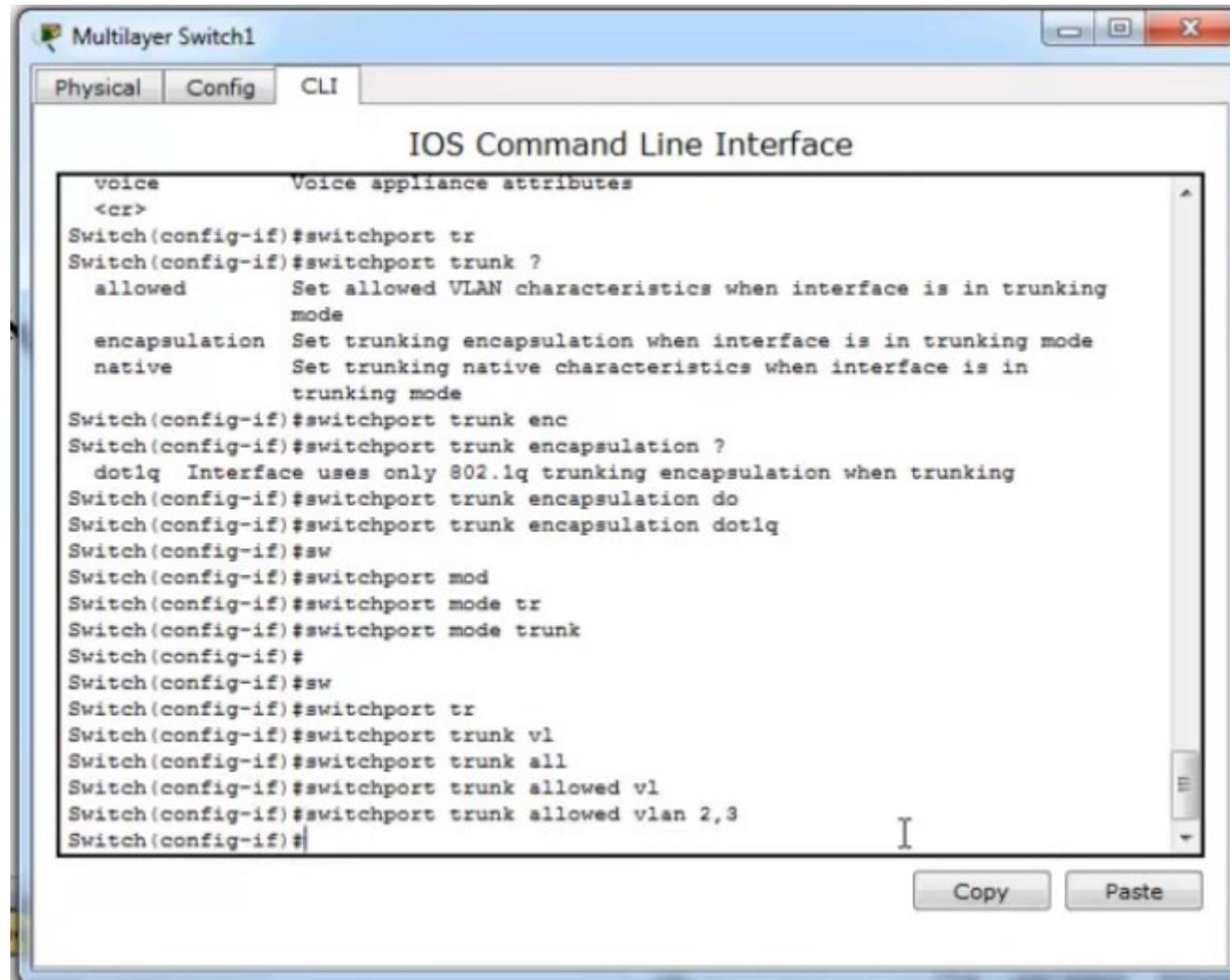
$LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to up

Switch>
Switch>
Switch>
Switch>en
Switch#
Switch#
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#int gi
Switch(config)#int gigabitEthernet 0/1
Switch(config-if)#sw
Switch(config-if)#switchport mod
Switch(config-if)#switchport mode tr
Switch(config-if)#switchport mode trunk
Command rejected: An interface whose trunk encapsulation is "Auto" can not be configured to "trunk" mode.
Switch(config-if)#
```

At the bottom of the terminal window are "Copy" and "Paste" buttons.

Настроим L3 коммутатор

Коммутатор третьего уровня



The screenshot shows a Windows application window titled "Multilayer Switch1" with a tab bar containing "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". The terminal window displays the following configuration commands:

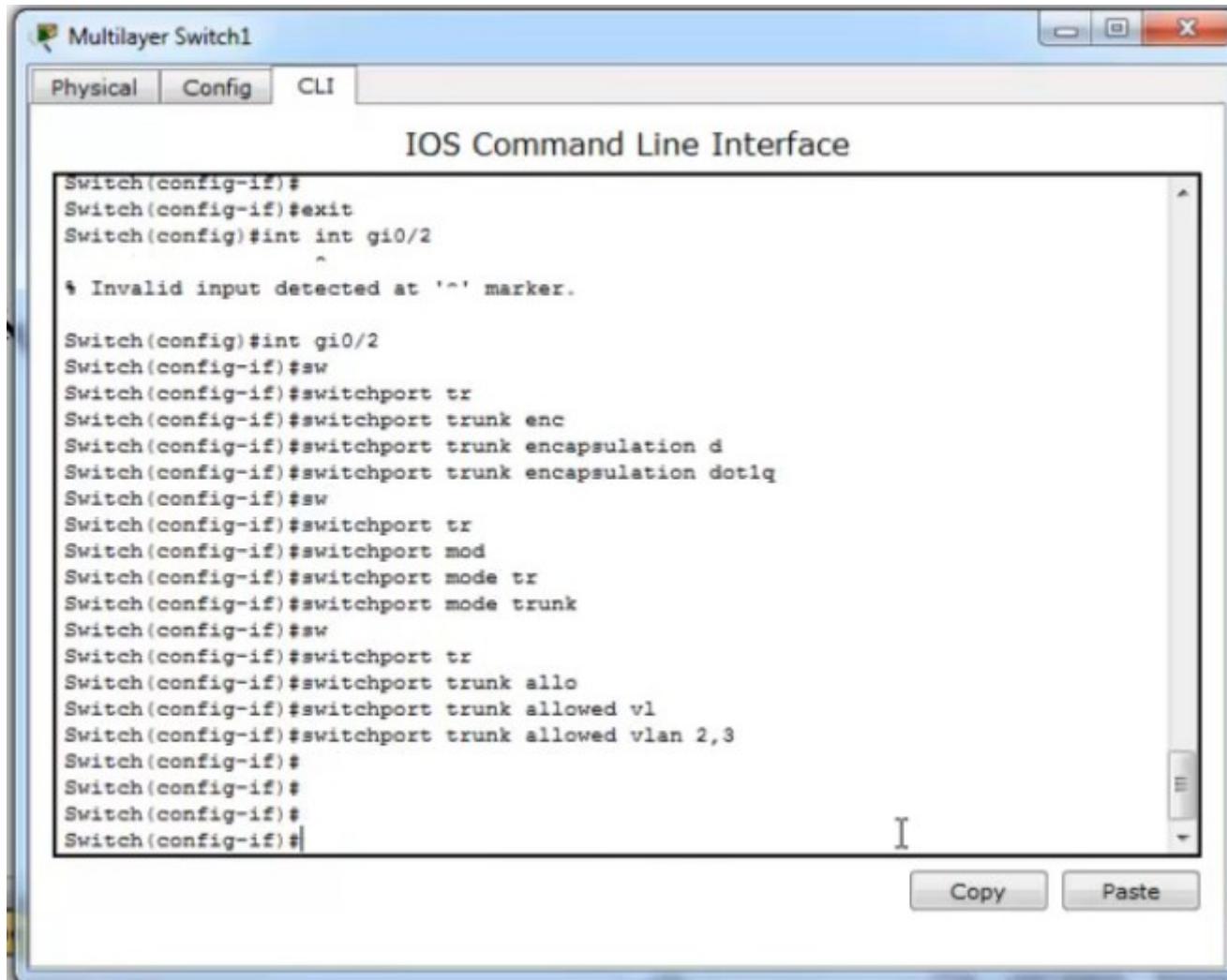
```
voice          Voice appliance attributes
<cr>
Switch(config-if)#switchport tr
Switch(config-if)#switchport trunk ?
  allowed      Set allowed VLAN characteristics when interface is in trunking
               mode
  encapsulation Set trunking encapsulation when interface is in trunking mode
  native       Set trunking native characteristics when interface is in
               trunking mode
Switch(config-if)#switchport trunk enc
Switch(config-if)#switchport trunk encapsulation ?
  dot1q        Interface uses only 802.1q trunking encapsulation when trunking
Switch(config-if)#switchport trunk encapsulation do
Switch(config-if)#switchport trunk encapsulation dot1q
Switch(config-if)#sw
Switch(config-if)#switchport mod
Switch(config-if)#switchport mode tr
Switch(config-if)#switchport mode trunk
Switch(config-if)#
Switch(config-if)#sw
Switch(config-if)#switchport tr
Switch(config-if)#switchport trunk vl
Switch(config-if)#switchport trunk all
Switch(config-if)#switchport trunk allowed vl
Switch(config-if)#switchport trunk allowed vlan 2,3
Switch(config-if)#

```

At the bottom of the terminal window are "Copy" and "Paste" buttons.

Включаем инкапсуляцию

Коммутатор третьего уровня



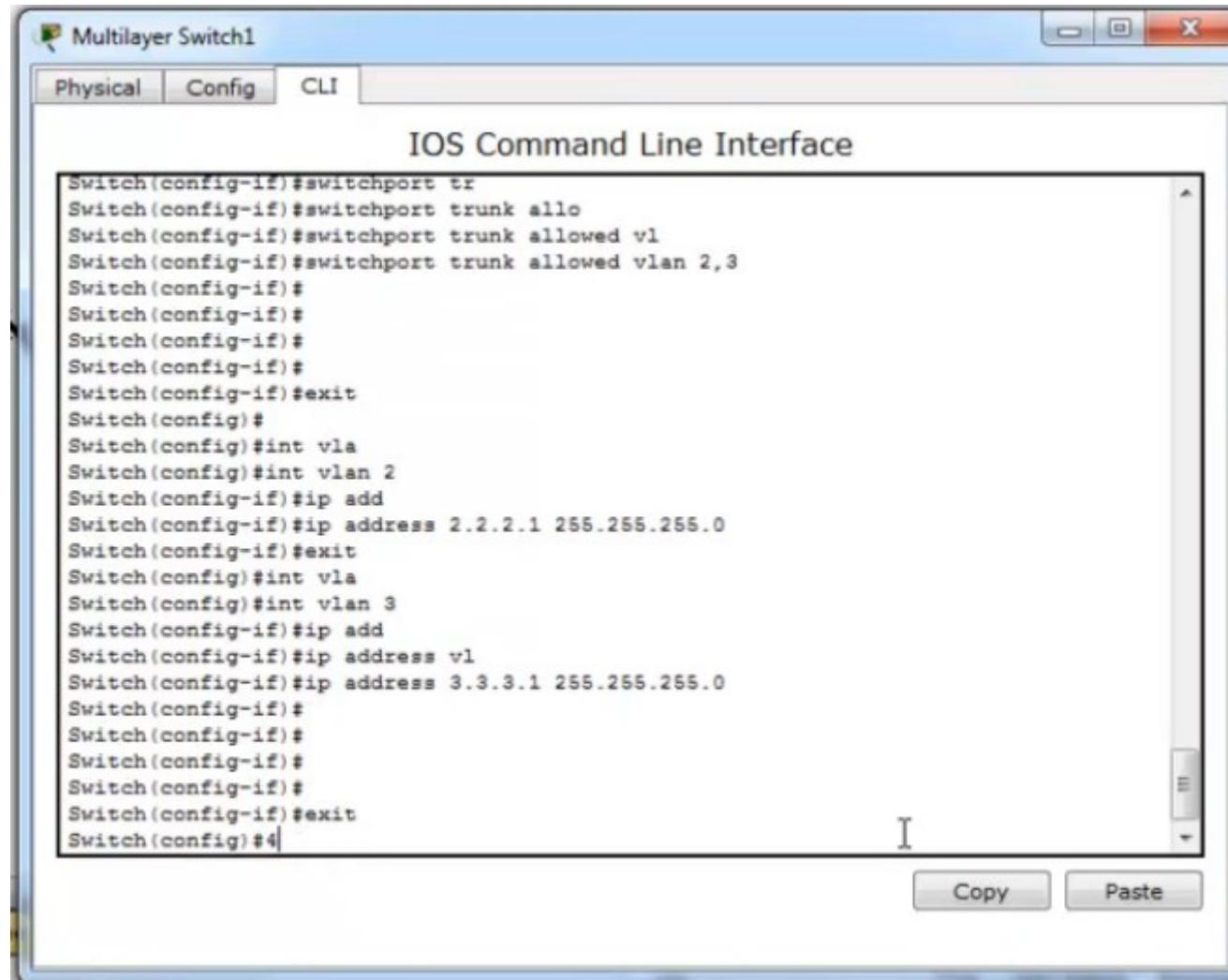
The screenshot shows a software window titled "Multilayer Switch1" with a tab bar containing "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". The CLI output is as follows:

```
Switch(config-if)#  
Switch(config-if)#exit  
Switch(config)#int int gi0/2  
^  
% Invalid input detected at '^' marker.  
  
Switch(config)#int gi0/2  
Switch(config-if)#sw  
Switch(config-if)#switchport tr  
Switch(config-if)#switchport trunk enc  
Switch(config-if)#switchport trunk encapsulation d  
Switch(config-if)#switchport trunk encapsulation dot1q  
Switch(config-if)#sw  
Switch(config-if)#switchport tr  
Switch(config-if)#switchport mod  
Switch(config-if)#switchport mode tr  
Switch(config-if)#switchport mode trunk  
Switch(config-if)#sw  
Switch(config-if)#switchport tr  
Switch(config-if)#switchport trunk allo  
Switch(config-if)#switchport trunk allowed vl  
Switch(config-if)#switchport trunk allowed vlan 2,3  
Switch(config-if)#  
Switch(config-if)#  
Switch(config-if)#  
Switch(config-if)#
```

At the bottom of the window are "Copy" and "Paste" buttons.

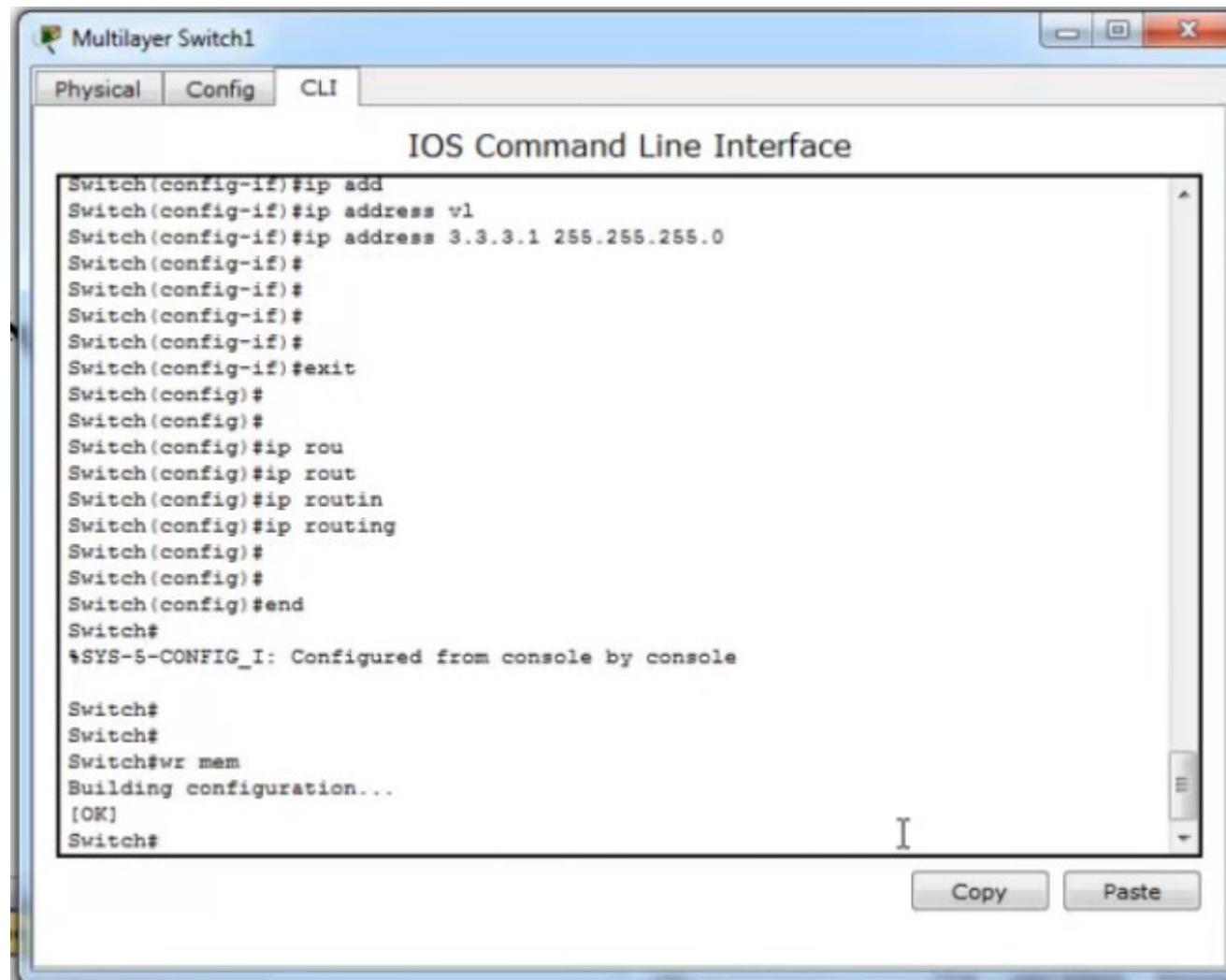
Аналогично включаем инкапсуляцию на trunk-порте gi0/2

Коммутатор третьего уровня



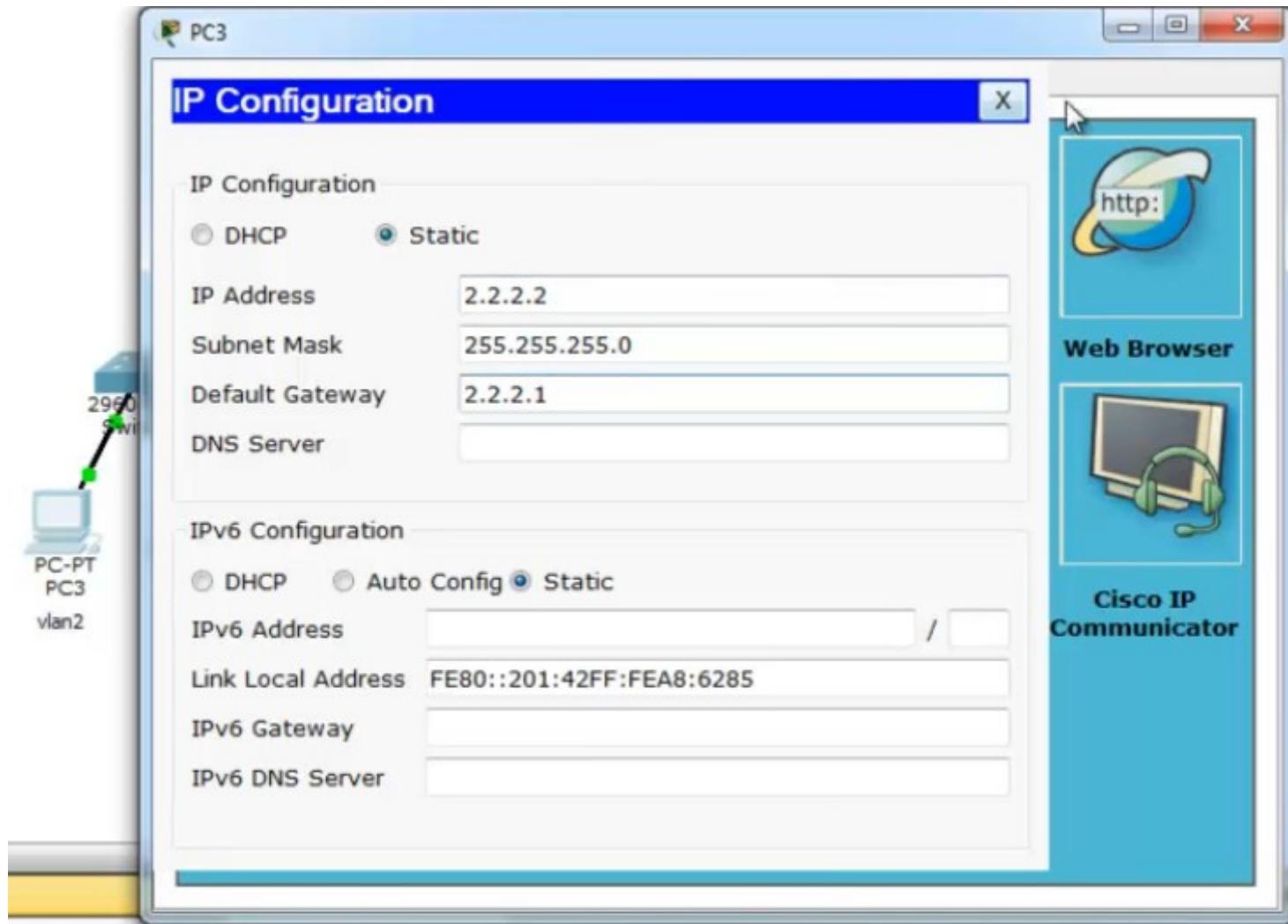
Добавляем ip адреса для vlan

Коммутатор третьего уровня



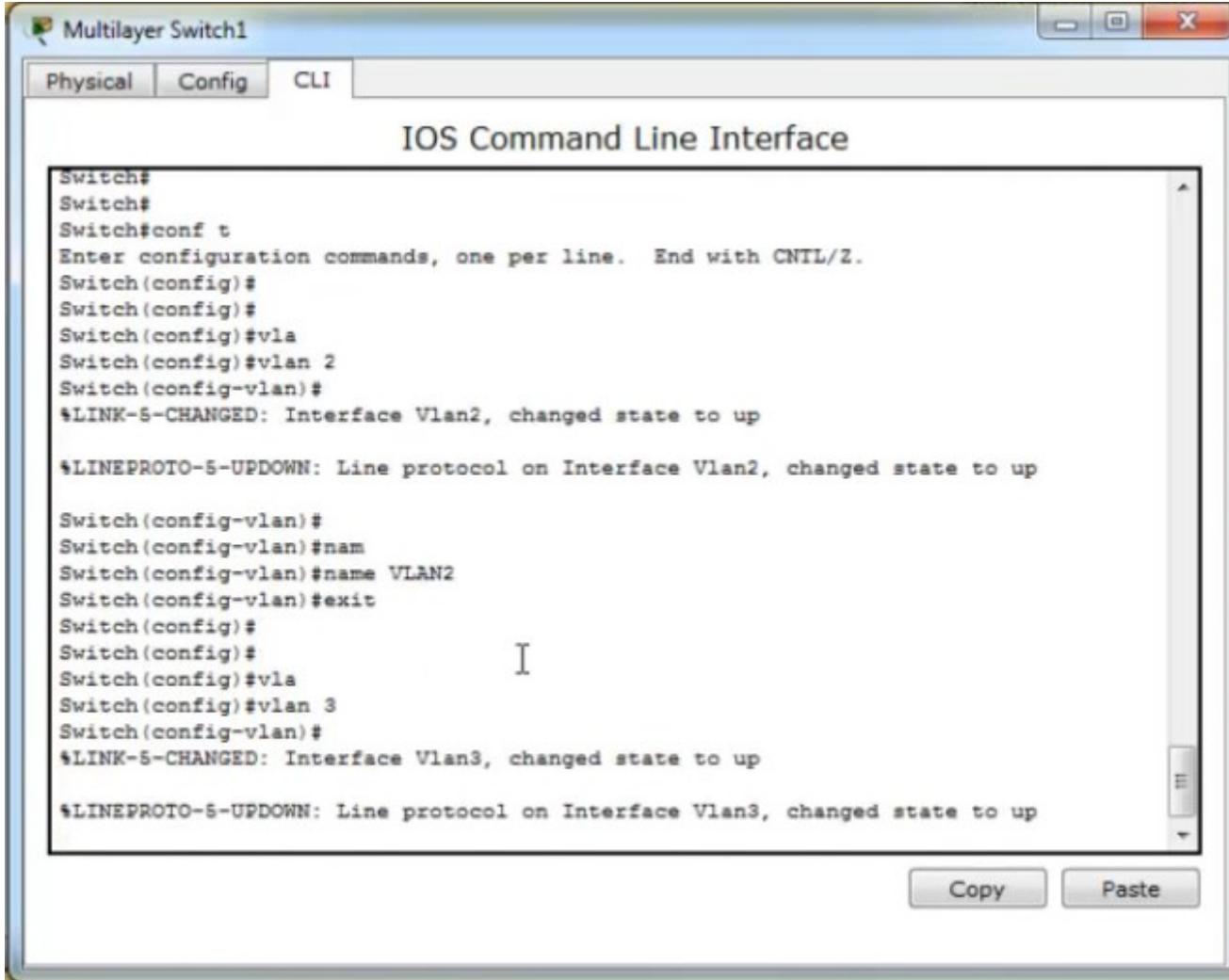
Включаем роутинг

Коммутатор третьего уровня



Задаем ip на компьютерах

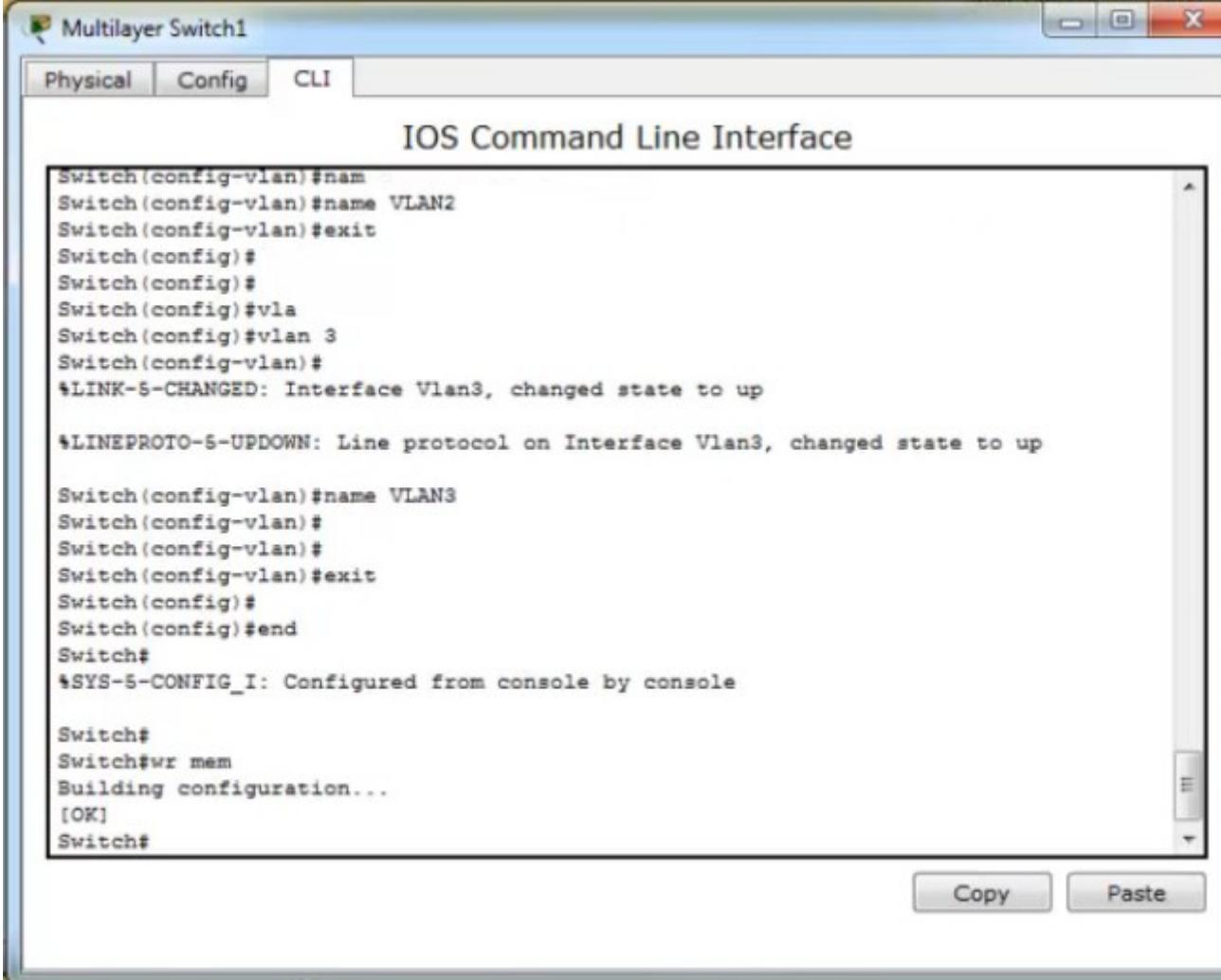
Коммутатор третьего уровня



```
Switch#  
Switch#  
Switch#conf t  
Enter configuration commands, one per line. End with CNTL/Z.  
Switch(config)#  
Switch(config)#  
Switch(config)#v1a  
Switch(config)#vlan 2  
Switch(config-vlan)#  
%LINK-5-CHANGED: Interface Vlan2, changed state to up  
  
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan2, changed state to up  
  
Switch(config-vlan)#  
Switch(config-vlan)#nam  
Switch(config-vlan)#name VLAN2  
Switch(config-vlan)#exit  
Switch(config)#  
Switch(config)#  
Switch(config)#v1a  
Switch(config)#vlan 3  
Switch(config-vlan)#  
%LINK-5-CHANGED: Interface Vlan3, changed state to up  
  
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan3, changed state to up
```

Добавляем vlan'ы в L3 коммутаторе

Коммутатор третьего уровня



The screenshot shows a Windows-style application window titled "Multilayer Switch1". The window has three tabs at the top: "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". The text in the window is as follows:

```
switch(config-vlan)#nam
Switch(config-vlan)#name VLAN2
Switch(config-vlan)#exit
Switch(config)#
Switch(config)#
Switch(config)#vla
Switch(config)#vlan 3
Switch(config-vlan)#
%LINK-5-CHANGED: Interface Vlan3, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan3, changed state to up

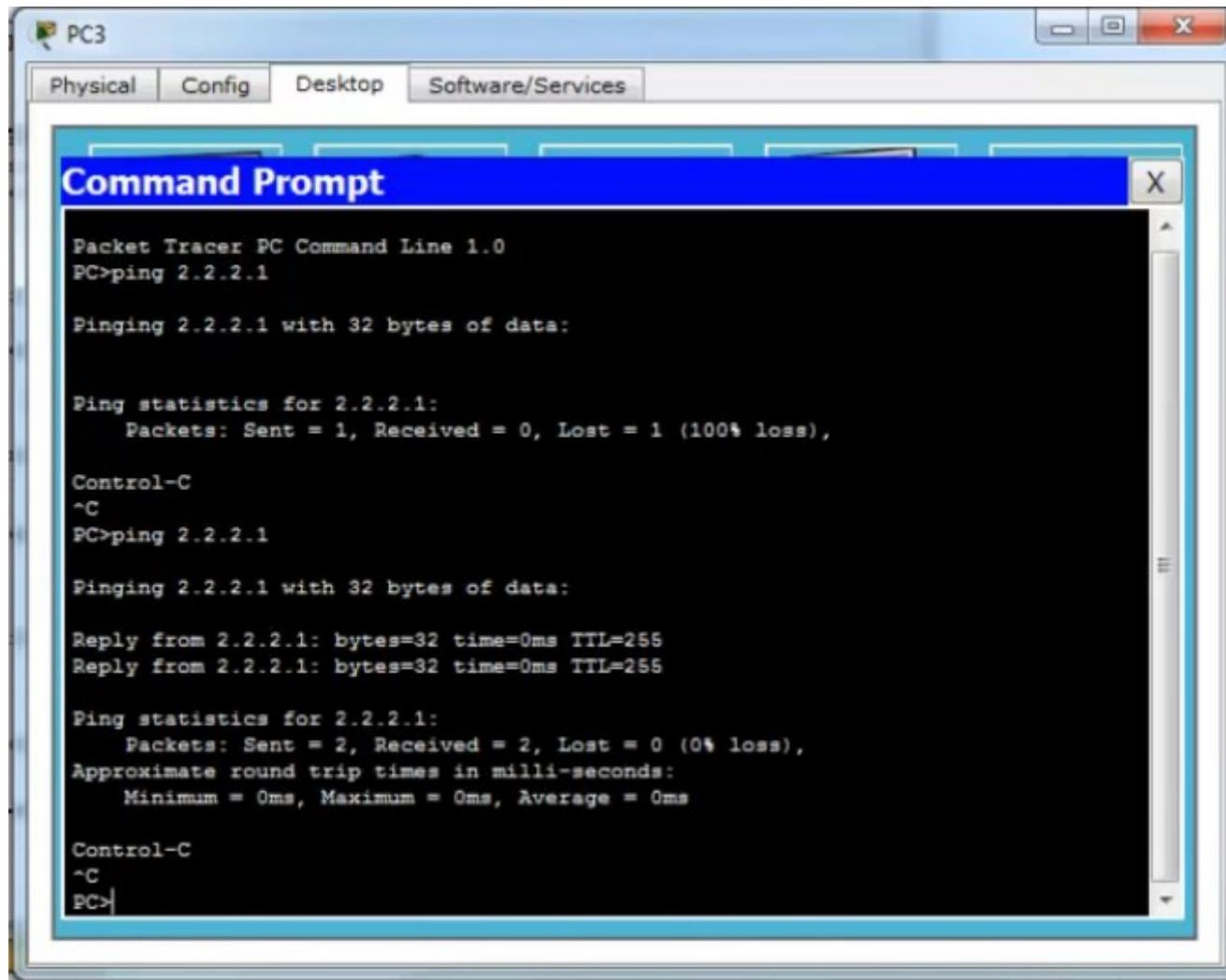
Switch(config-vlan)#name VLAN3
Switch(config-vlan)#
Switch(config-vlan)#
Switch(config-vlan)#exit
Switch(config)#
Switch(config)#end
Switch#
%SYS-5-CONFIG_I: Configured from console by console

Switch#
Switch#wr mem
Building configuration...
[OK]
Switch#
```

At the bottom of the window, there are "Copy" and "Paste" buttons.

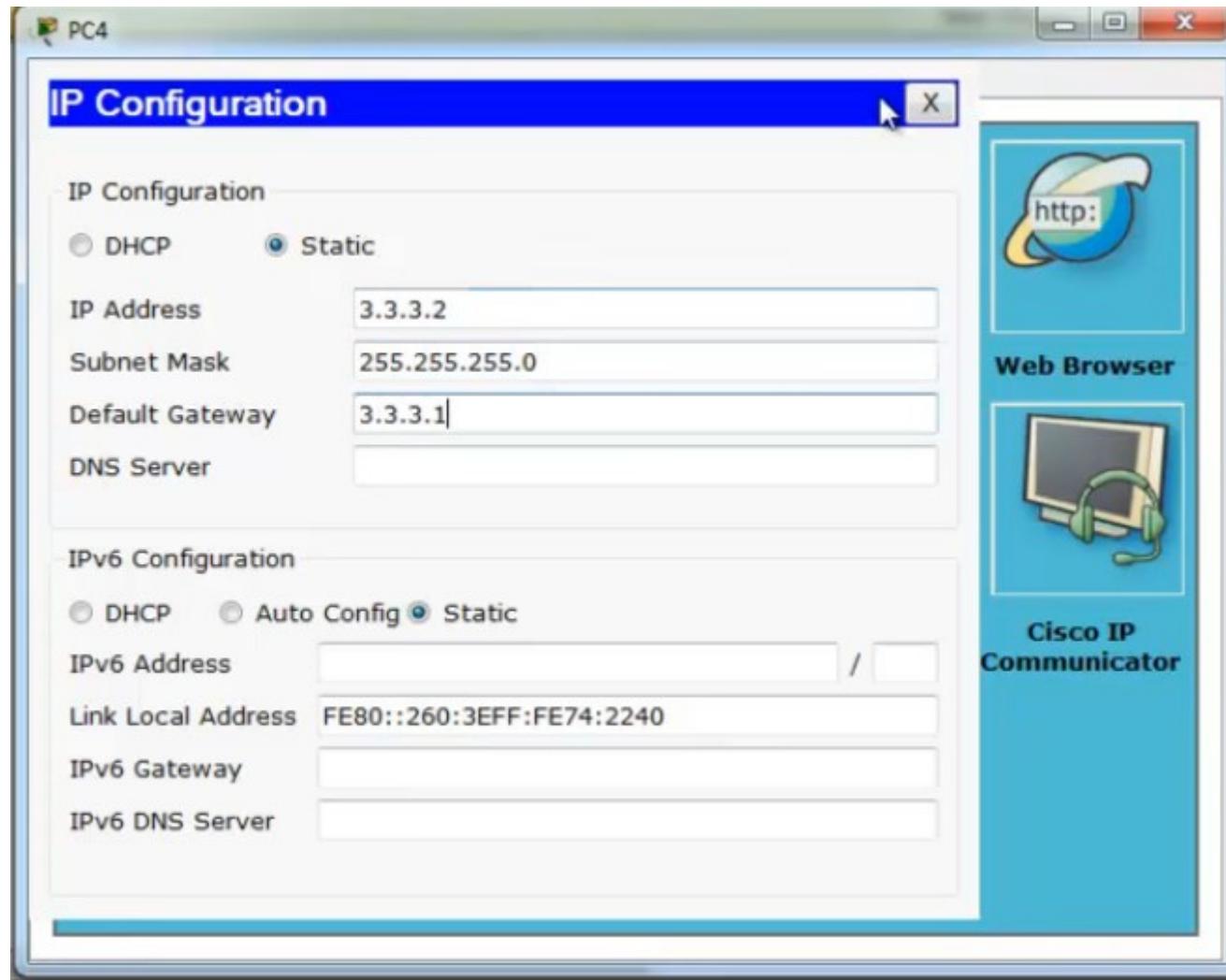
Сохраняем

Коммутатор третьего уровня



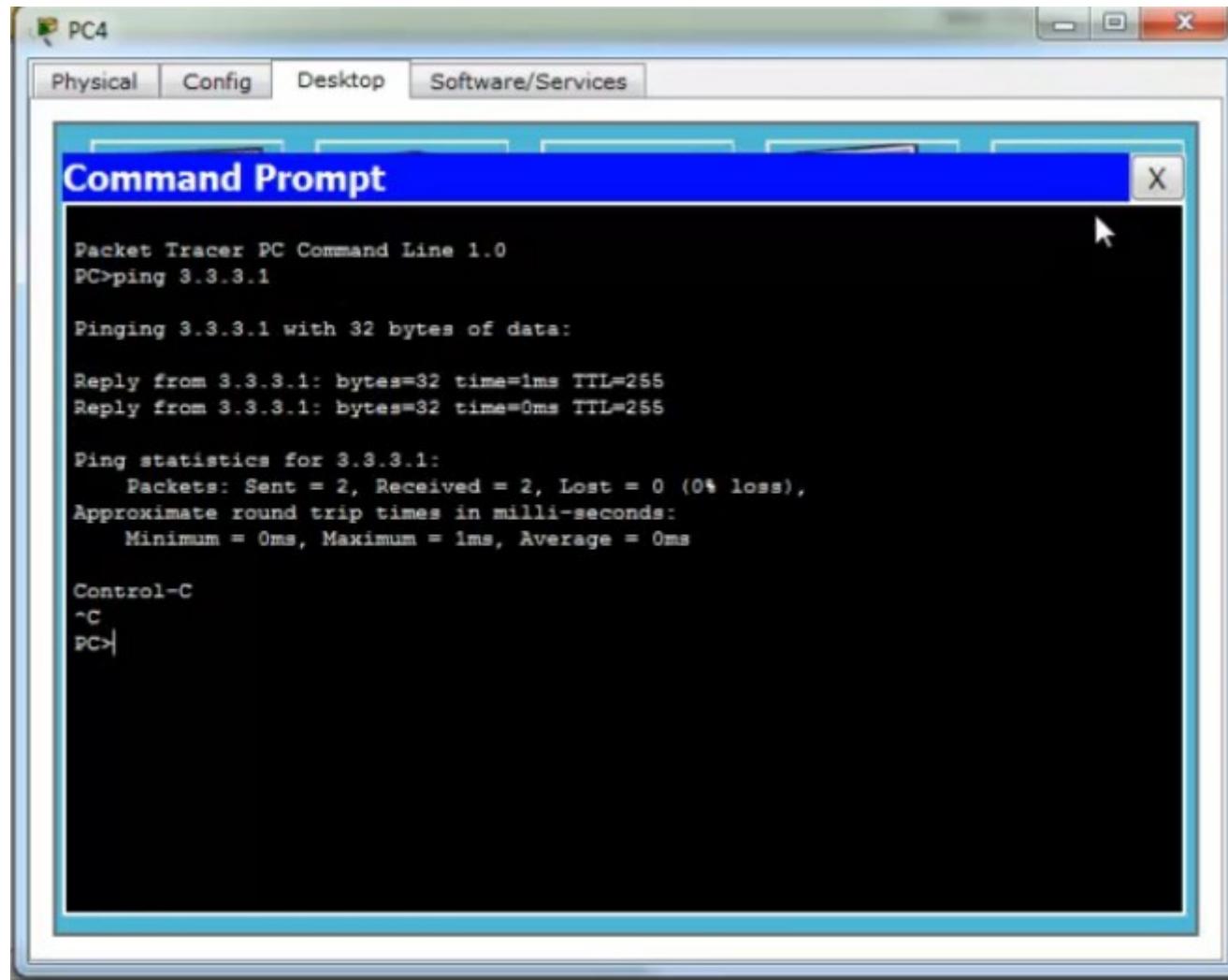
Проверяем доступность с PC3 — работает.

Коммутатор третьего уровня



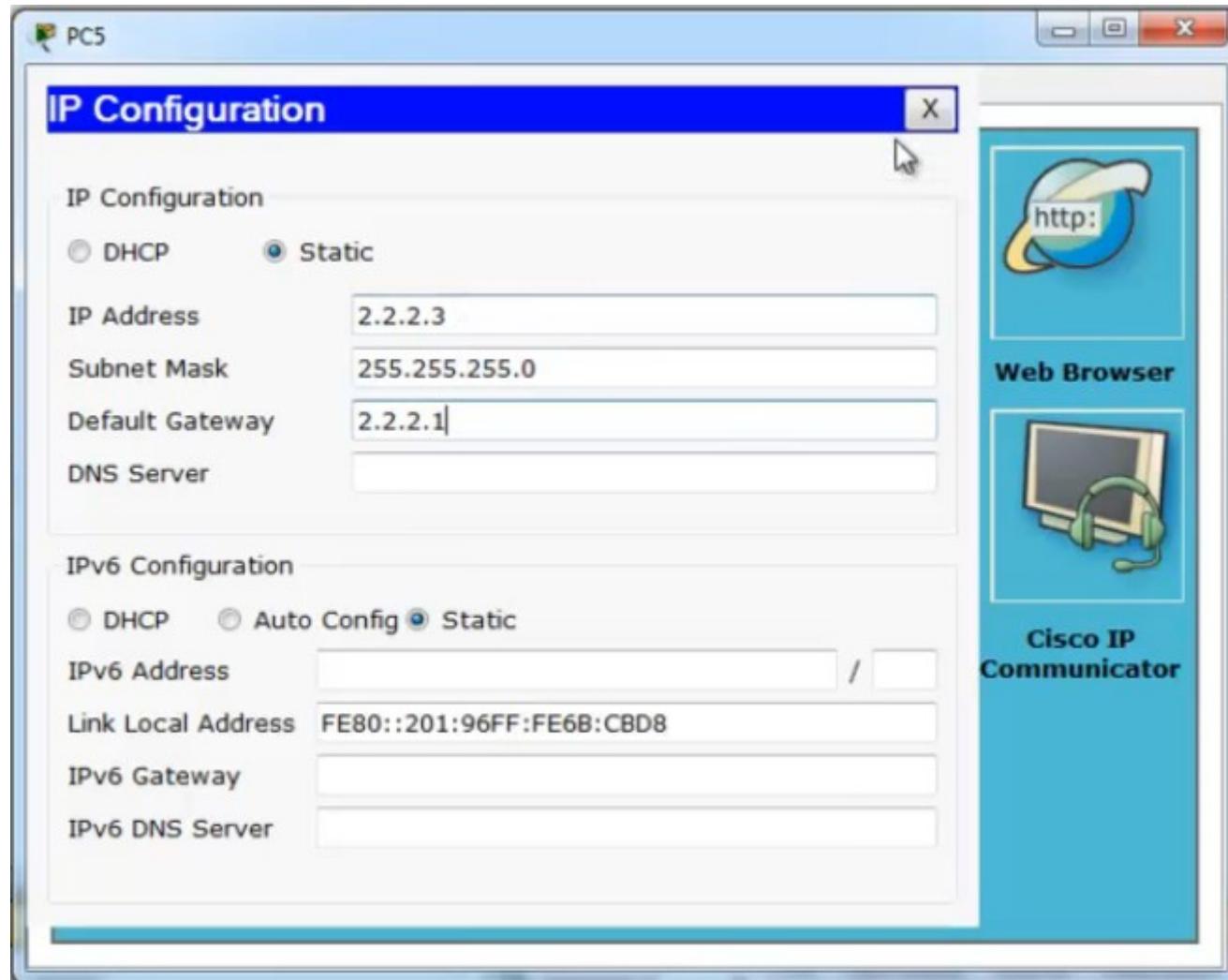
Задаем ip для PC4

Коммутатор третьего уровня



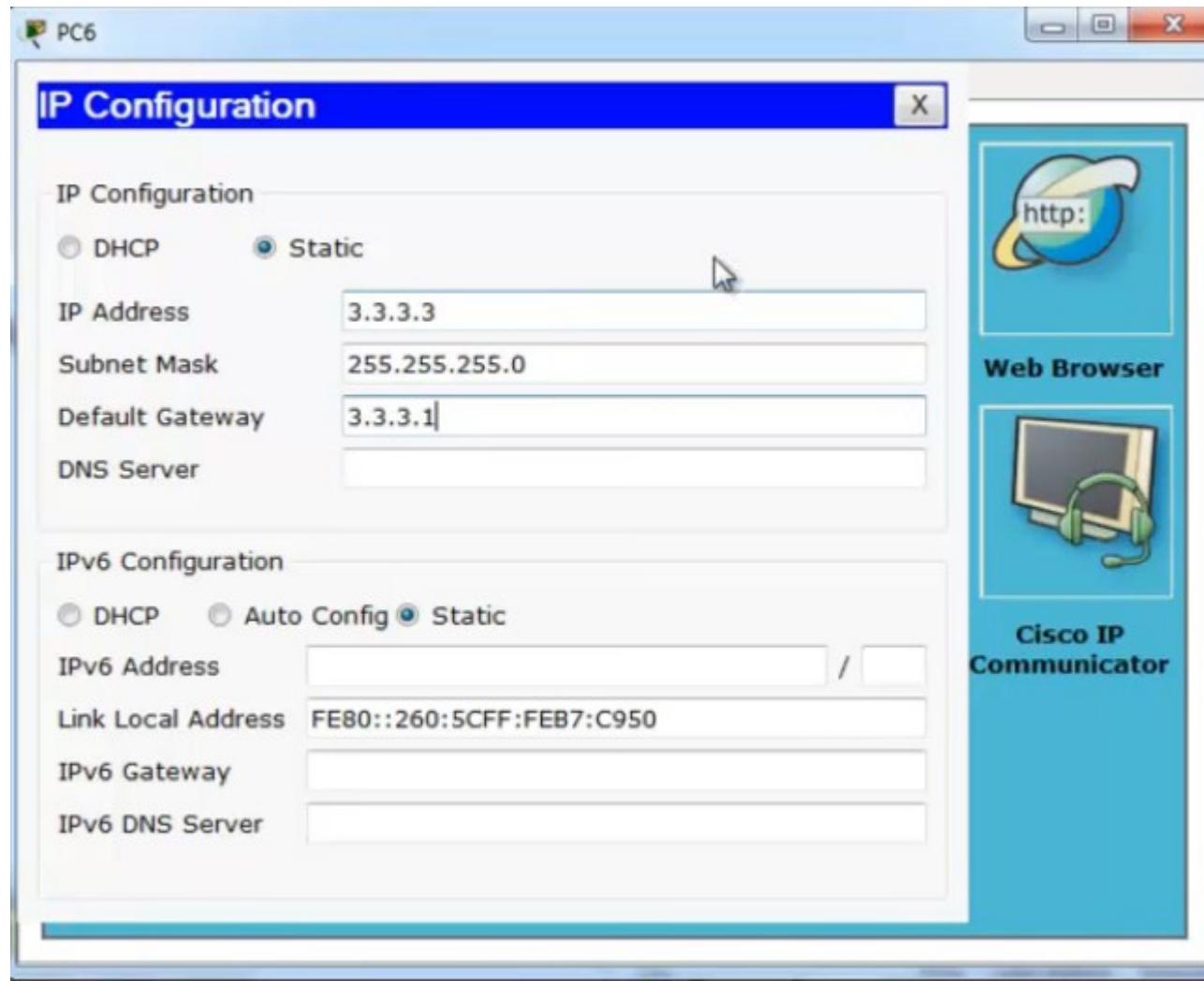
Проверяем связь - работает

Коммутатор третьего уровня



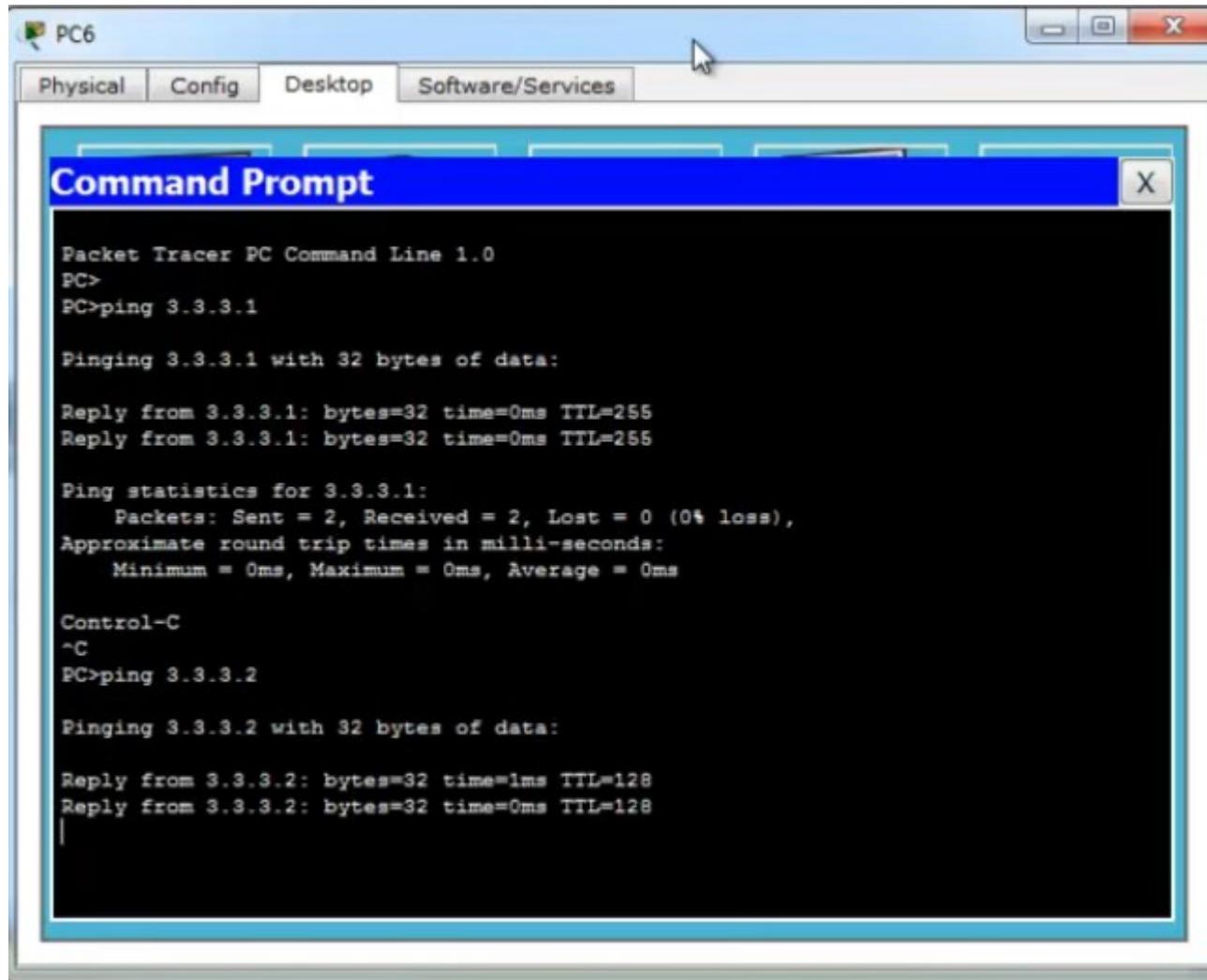
Задаем ір для PC5

Коммутатор третьего уровня



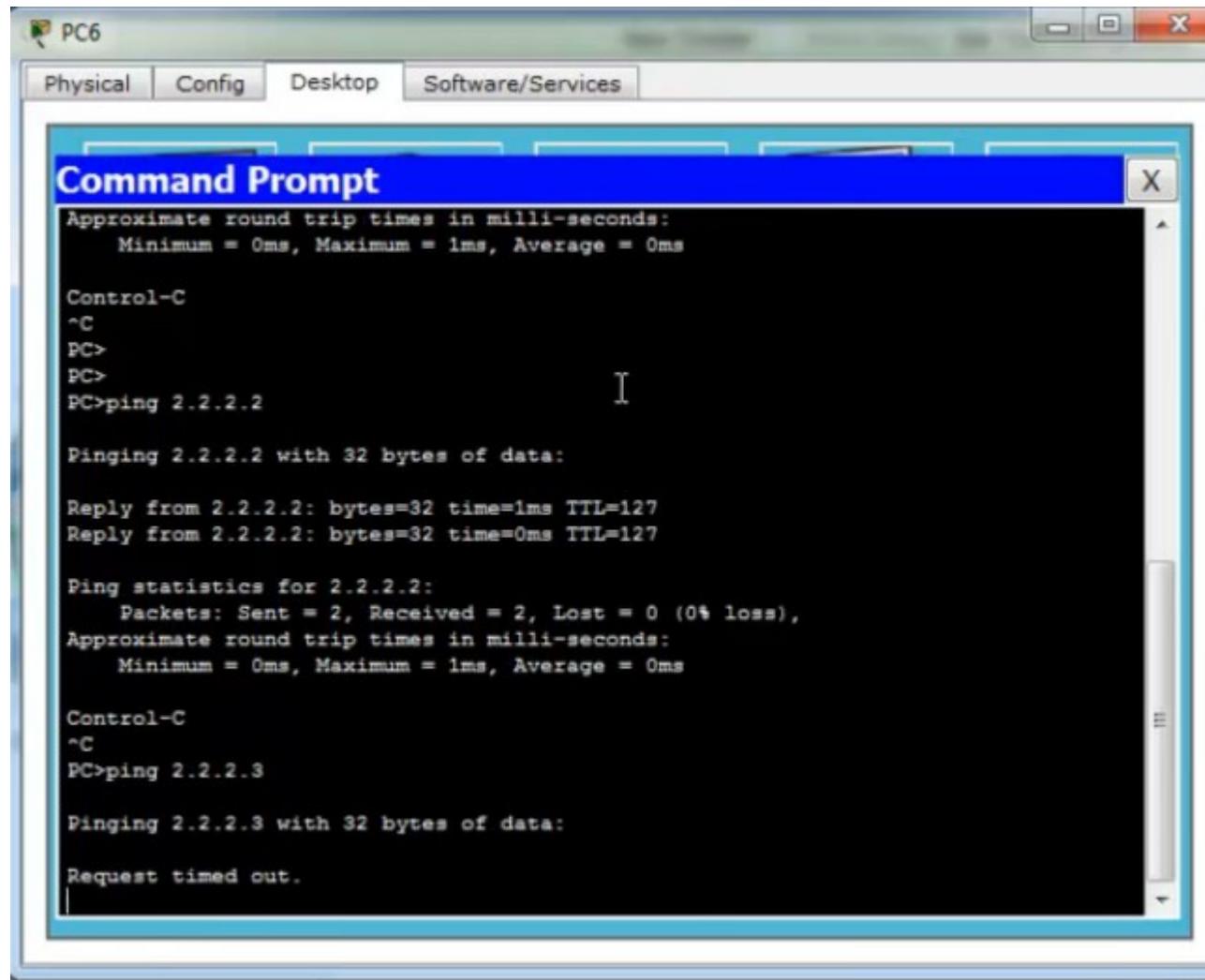
Задаем ір для PC6

Коммутатор третьего уровня



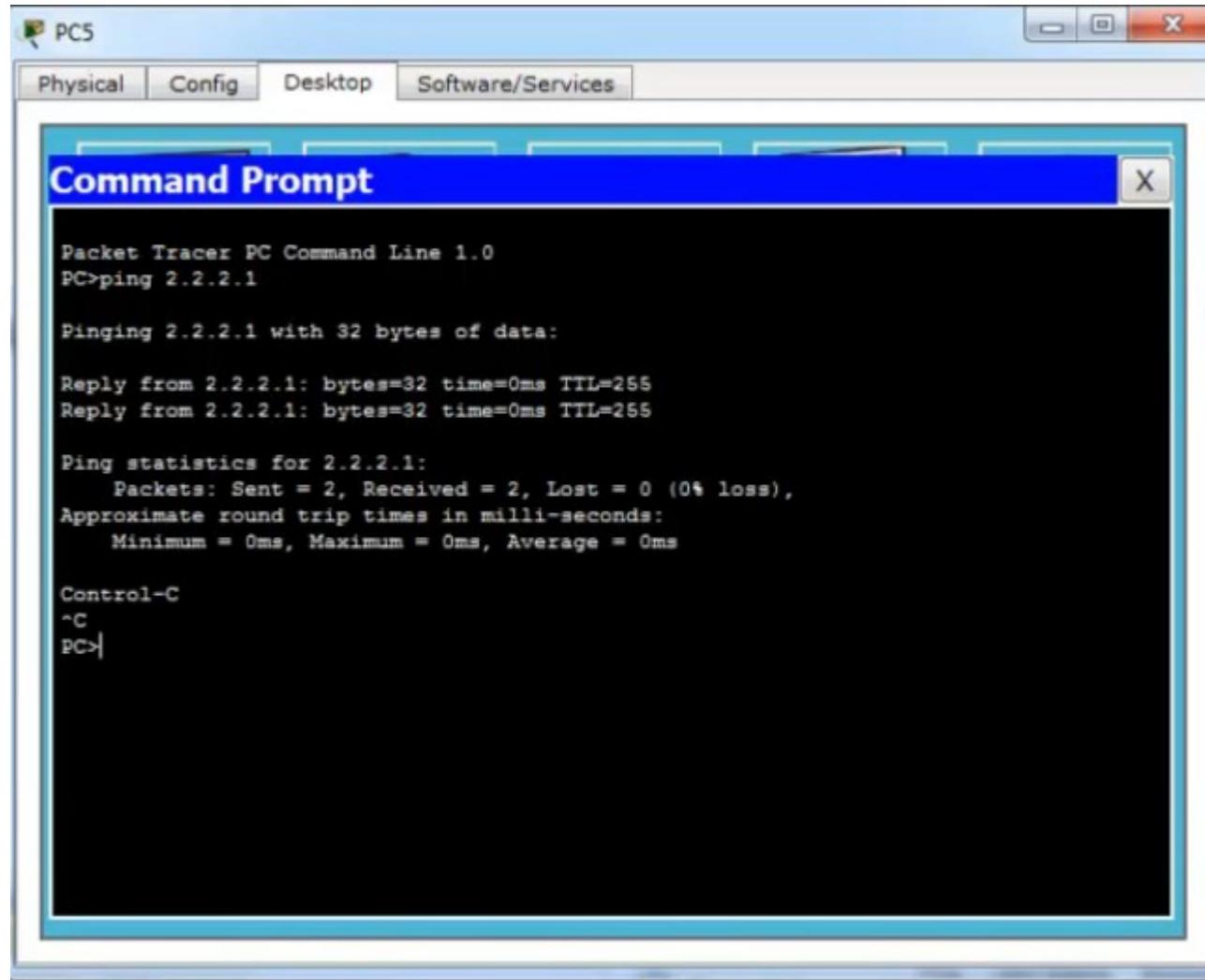
Пингуем с PC6 компьютер PC3

Коммутатор третьего уровня



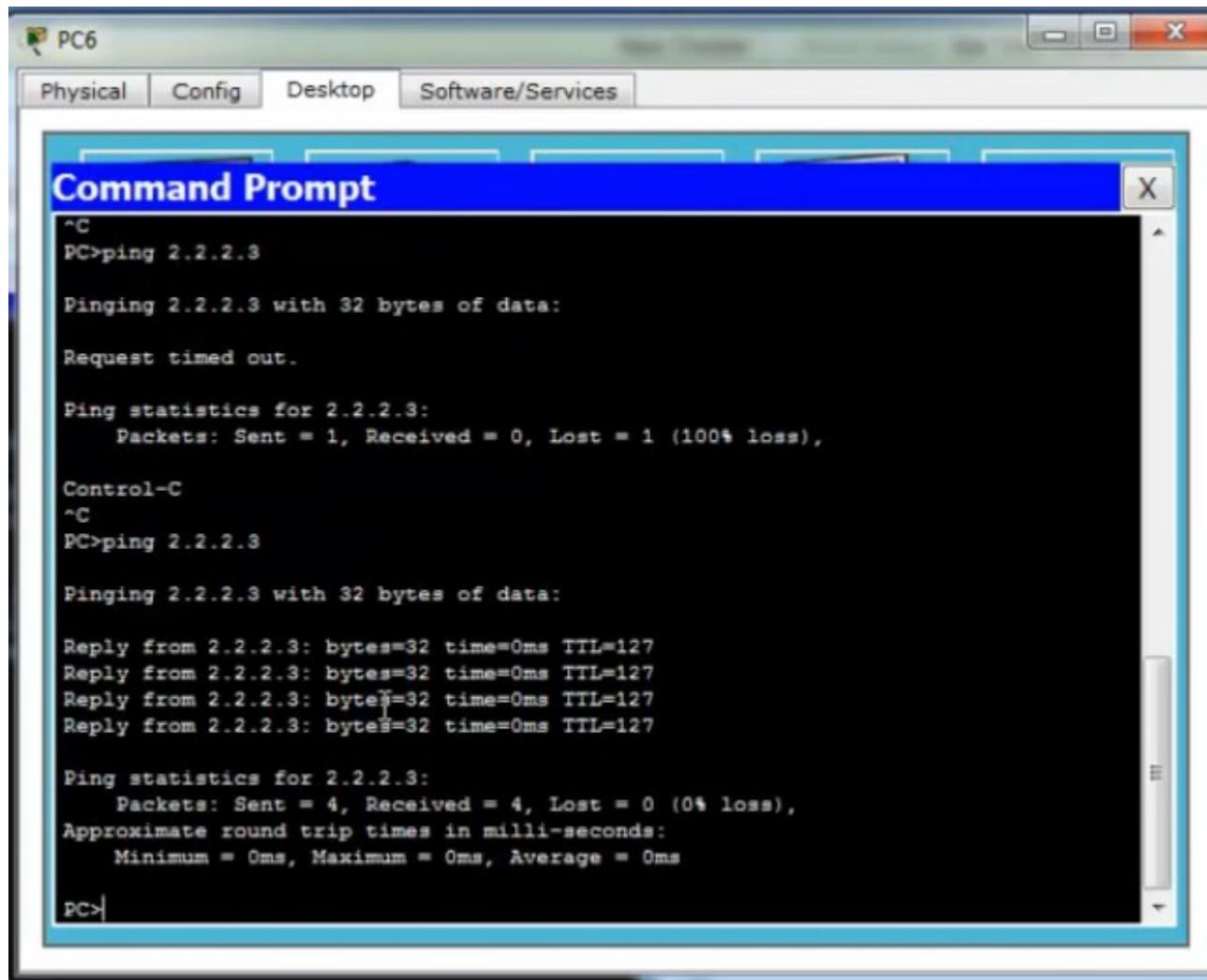
Пингуем с PC6 компьютер PC5 — не работает.

Коммутатор третьего уровня



Пингуем с PC5 шлюз.

Коммутатор третьего уровня



Пингуем с PC6 компьютер PC5 — теперь работает.

Маршрутизатор

Коммутаторы третьего уровня модели OSI (L3):

- IP маршрутизация
- Агрегирование коммутаторов уровня доступа
- Используются в качестве коммутаторов уровня распределения
- Высокая производительность



VS



Маршрутизатор (Router)

- IP маршрутизация
- NAT
- VPN
- Межсетевой экран



Коммутатор третьего уровня Cisco Catalyst 3750-X

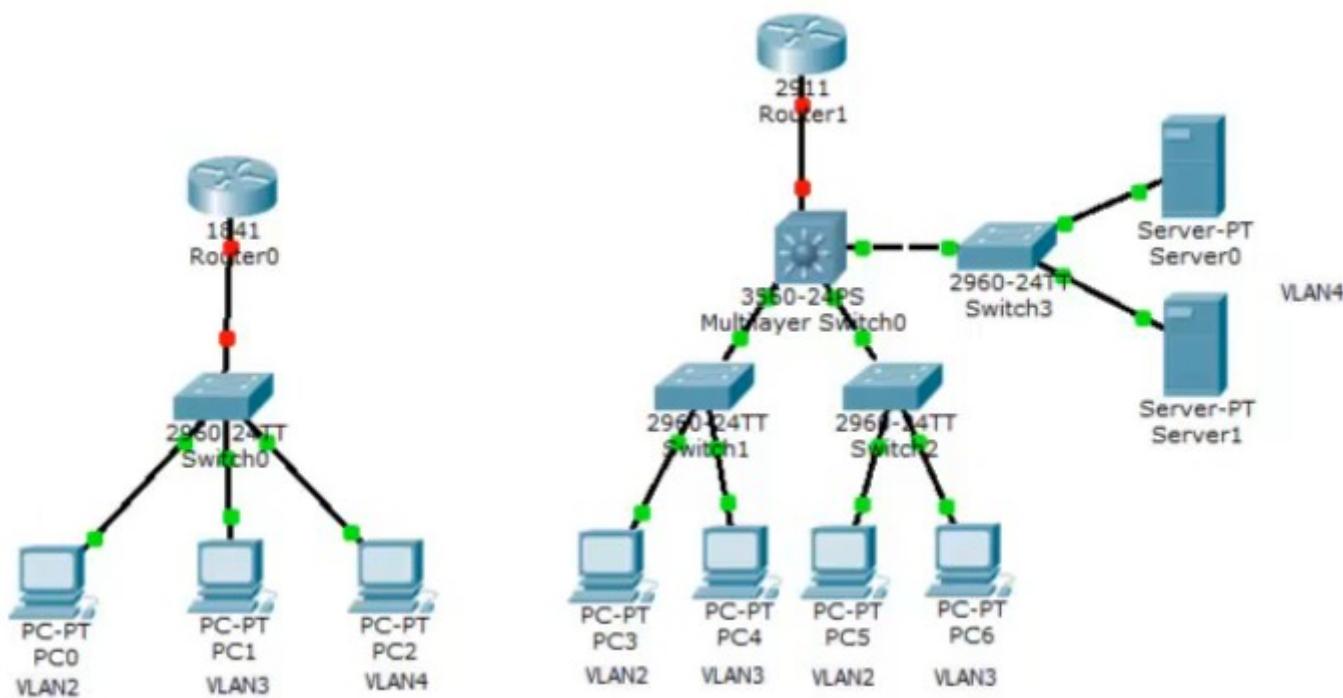
Более подробно о маршрутизаторе можно почитать [здесь](#) и [здесь](#)

Более подробно об отличии L3 коммутатора от маршрутизатора можно почитать [здесь](#)

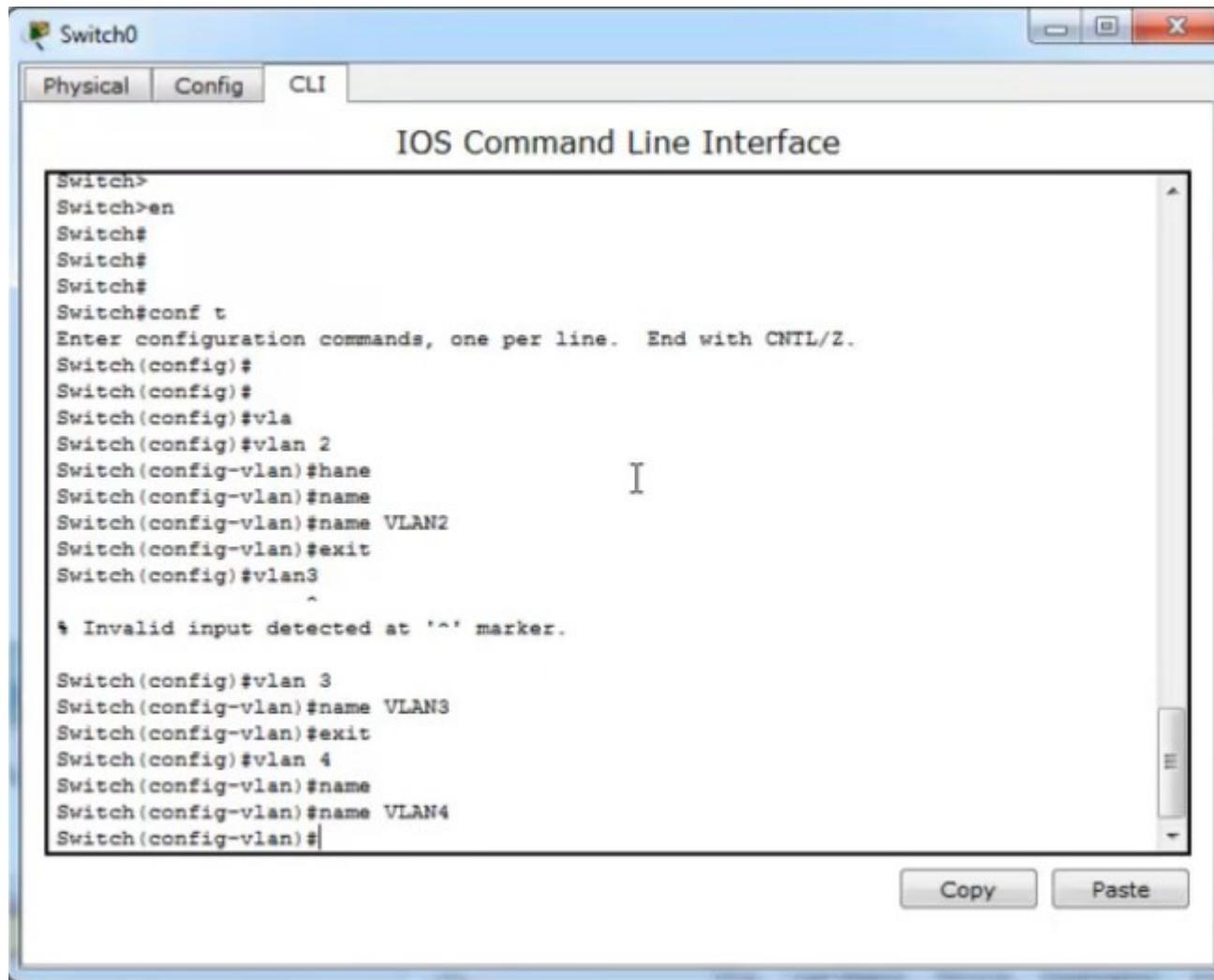


Маршрутизатор Cisco ISR G2 2921

Маршрутизатор



Маршрутизатор



The screenshot shows a Windows application window titled "Switch0" with three tabs: "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". The terminal window displays the following configuration commands:

```
switch>
Switch>en
Switch#
Switch#
Switch#
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#
Switch(config)#
Switch(config)#v1a
Switch(config)#vlan 2
Switch(config-vlan)#name
Switch(config-vlan)#name VLAN2
Switch(config-vlan)#exit
Switch(config)#vlan3
^
* Invalid input detected at '^' marker.

Switch(config)#vlan 3
Switch(config-vlan)#name VLAN3
Switch(config-vlan)#exit
Switch(config)#vlan 4
Switch(config-vlan)#name
Switch(config-vlan)#name VLAN4
Switch(config-vlan)#

```

At the bottom of the window are "Copy" and "Paste" buttons.

Добавляем VLAN'ы в коммутаторе 0

Маршрутизатор

Назначаем VLAN'ы на интерфейсы в коммутаторе 0

Маршрутизатор

Switch0

Physical Config CLI

IOS Command Line Interface

```
Switch(config)#  
Switch(config)#  
Switch(config)#int fa0/2  
Switch(config-if)#sw  
Switch(config-if)#switchport mod  
Switch(config-if)#switchport mode acc  
Switch(config-if)#switchport mode access  
Switch(config-if)#sw  
Switch(config-if)#switchport acc  
Switch(config-if)#switchport access vl  
Switch(config-if)#switchport access vlan 3  
Switch(config-if)#exit  
Switch(config)#int fa  
Switch(config)#int fastEthernet 0/3  
Switch(config-if)#sw  
Switch(config-if)#switchport mod  
Switch(config-if)#switchport mode acc  
Switch(config-if)#switchport mode access  
Switch(config-if)#sw  
Switch(config-if)#switchport acc  
Switch(config-if)#switchport access vl  
Switch(config-if)#switchport access vlan 4  
Switch(config-if)#  
Switch(config-if)#  
Switch(config-if)#  
Switch(config-if)#[
```

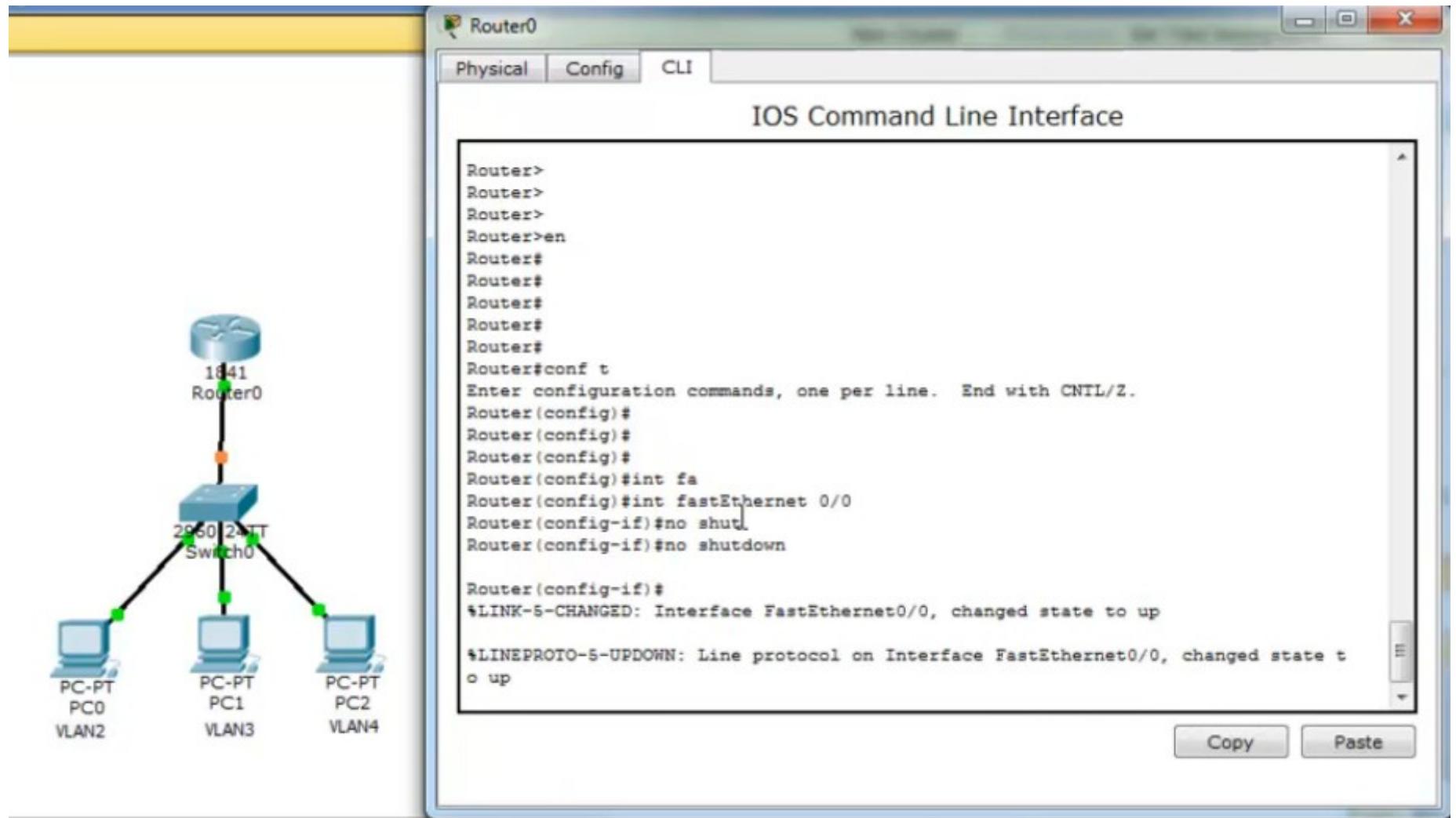
Copy Paste

Назначаем VLAN'ы на интерфейсы в коммутаторе 0

Маршрутизатор

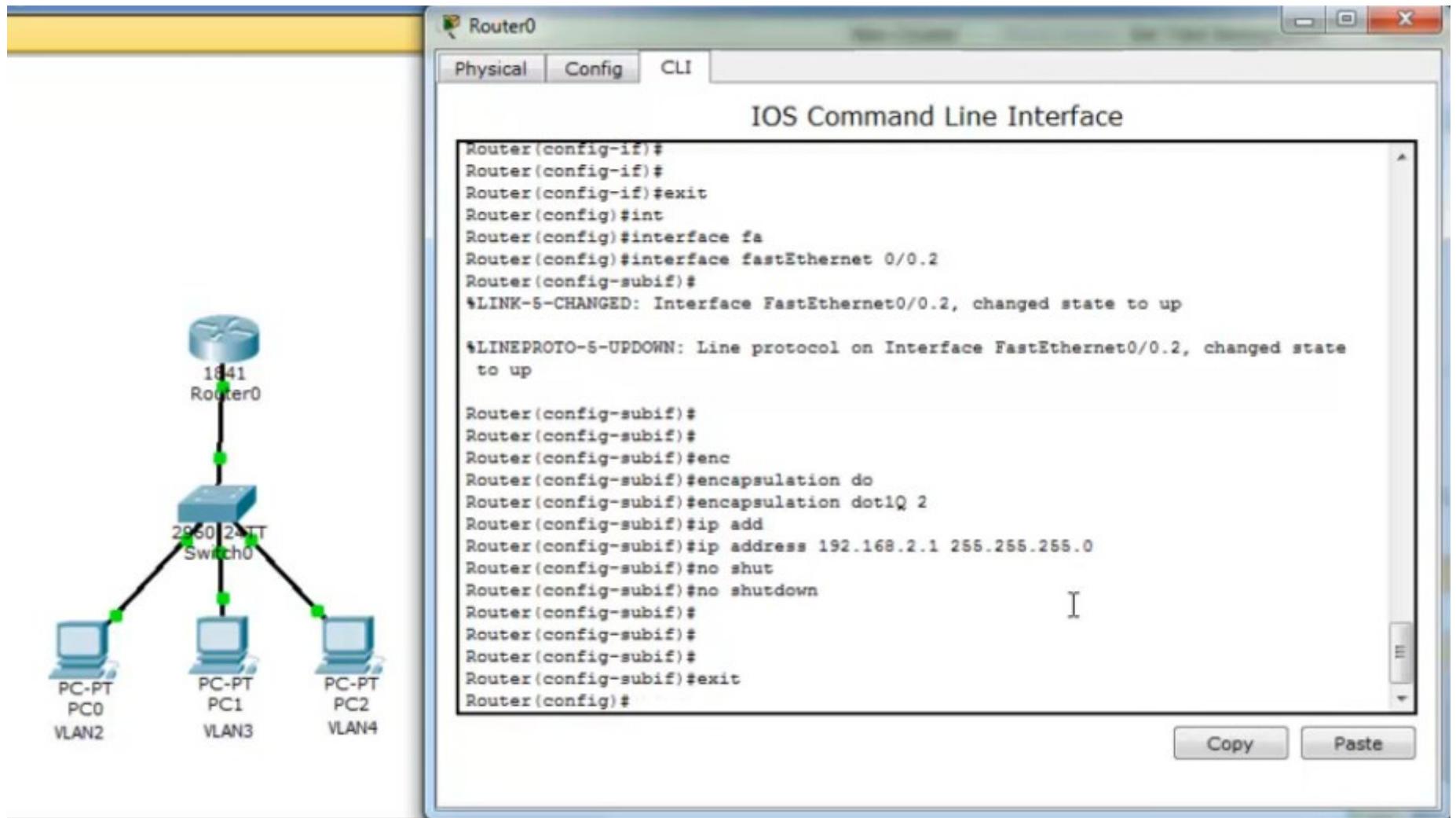
Создаем trunk-порт от коммутатора 0 до маршрутизатора и сохраняем настройки.

Маршрутизатор



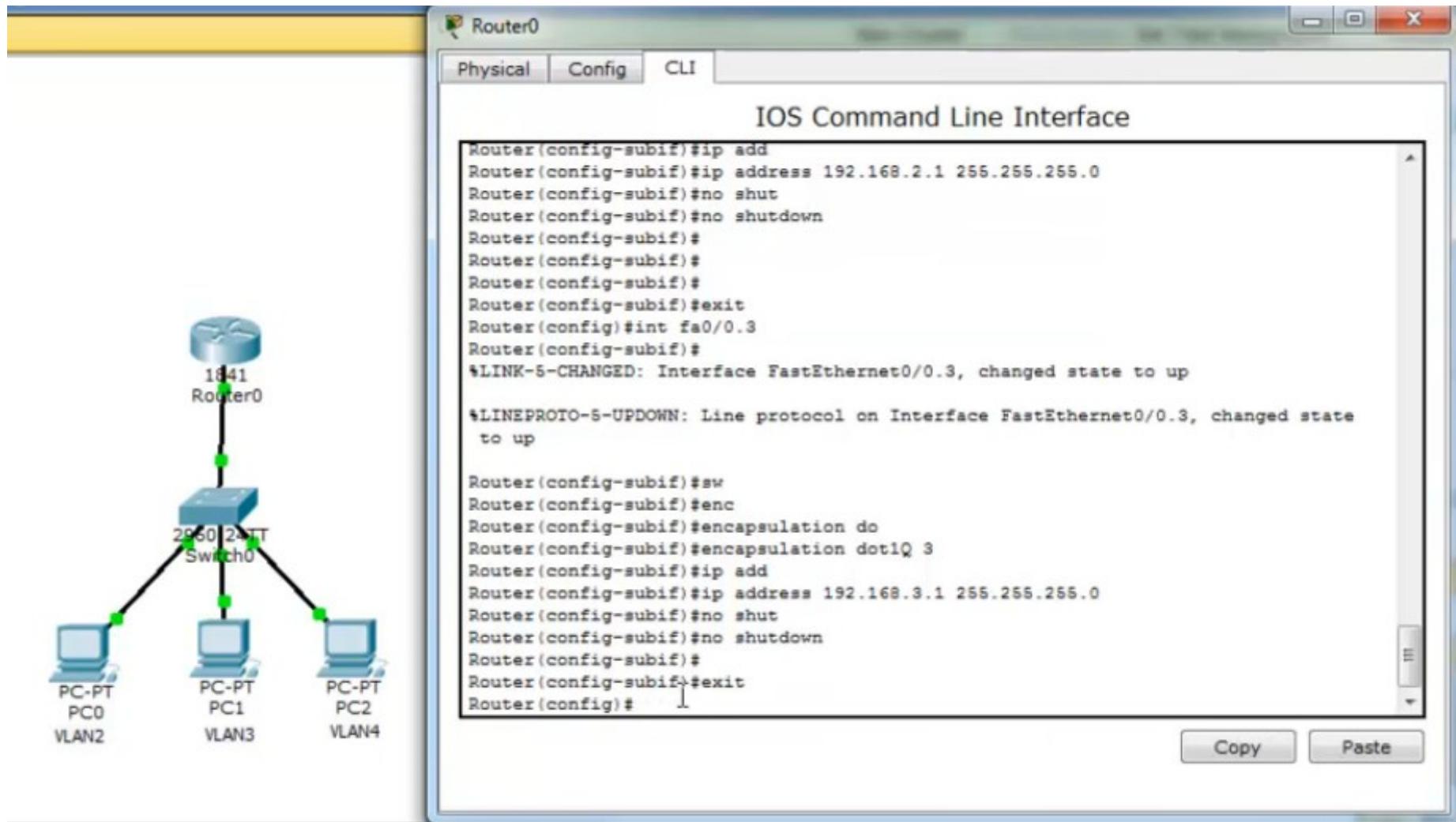
Поднимаем порт на маршрутизаторе, т. к. по умолчанию они на нем не запущены.

Маршрутизатор

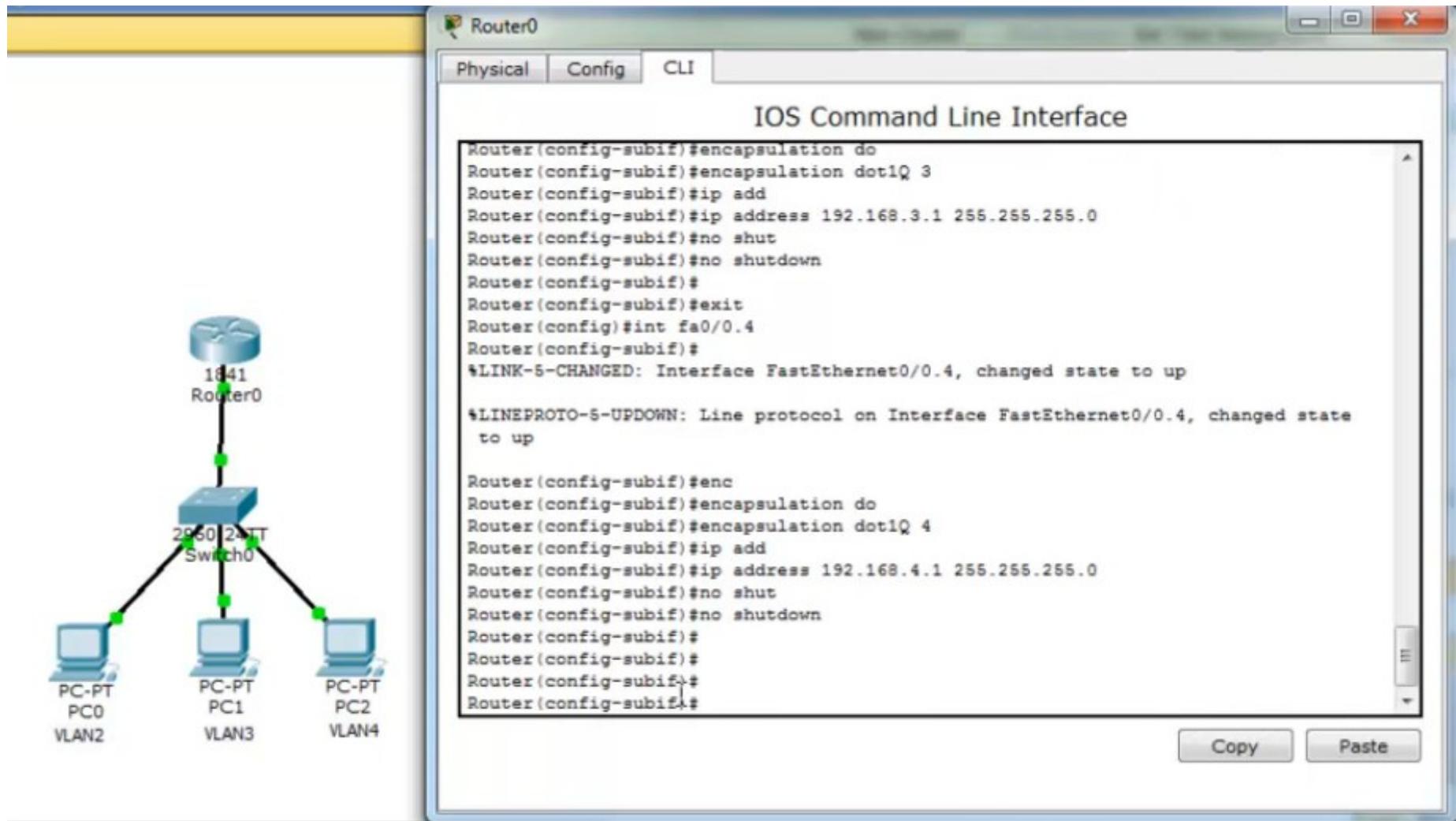


Создадим на роутере 3 под-интерфейса, каждому под-интерфейсу будет соответствовать VLAN.

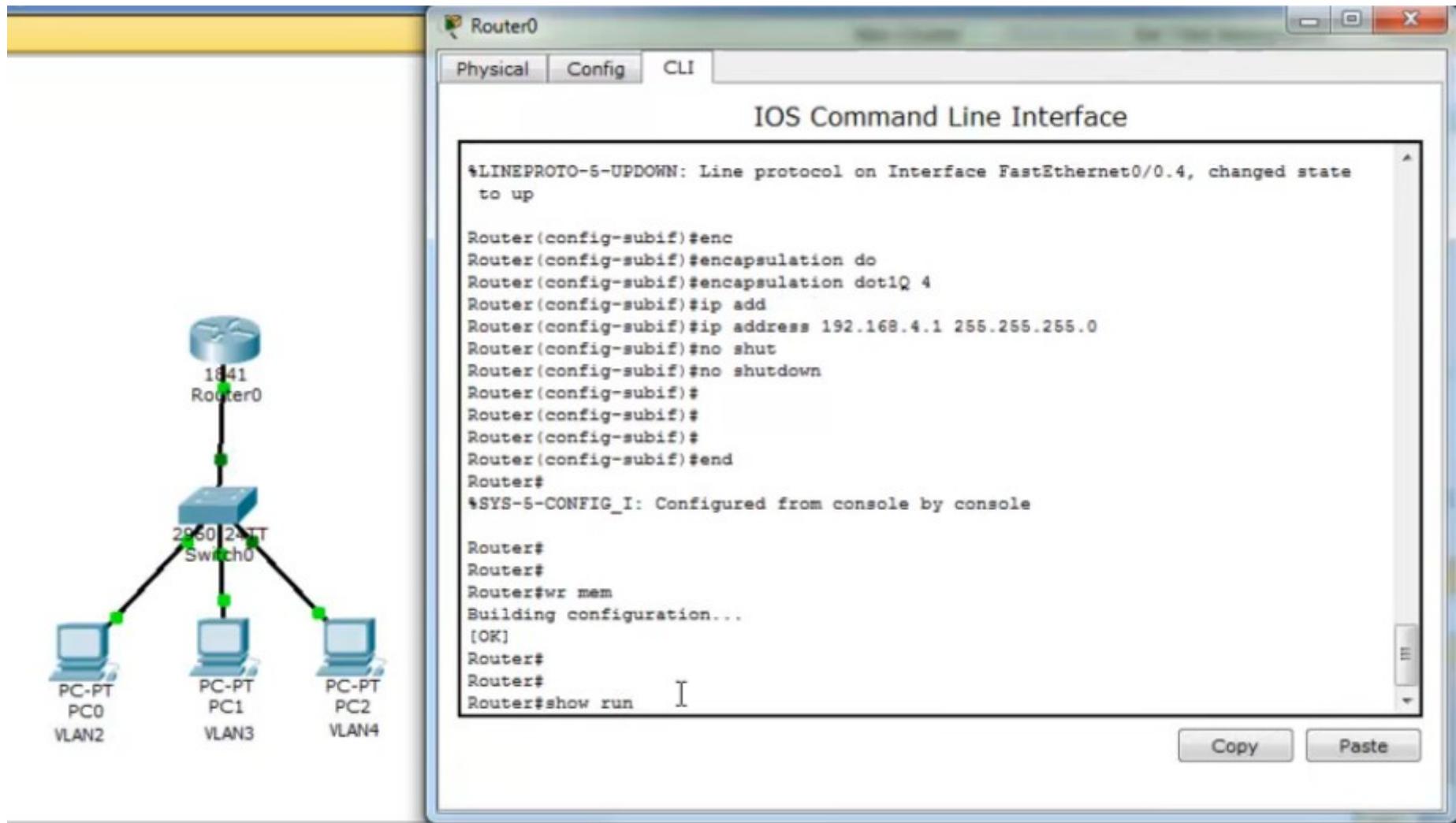
Маршрутизатор



Маршрутизатор

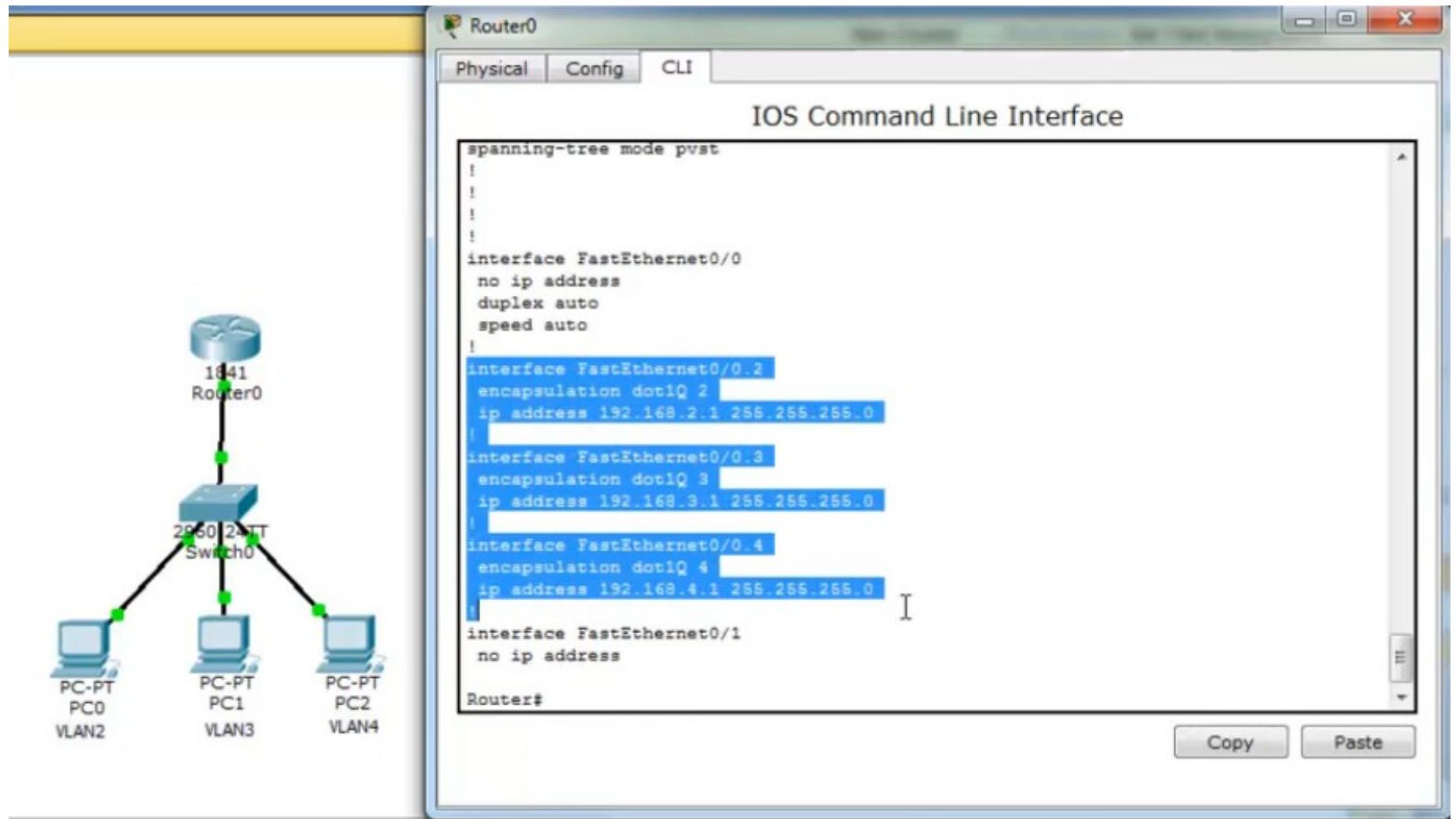


Маршрутизатор



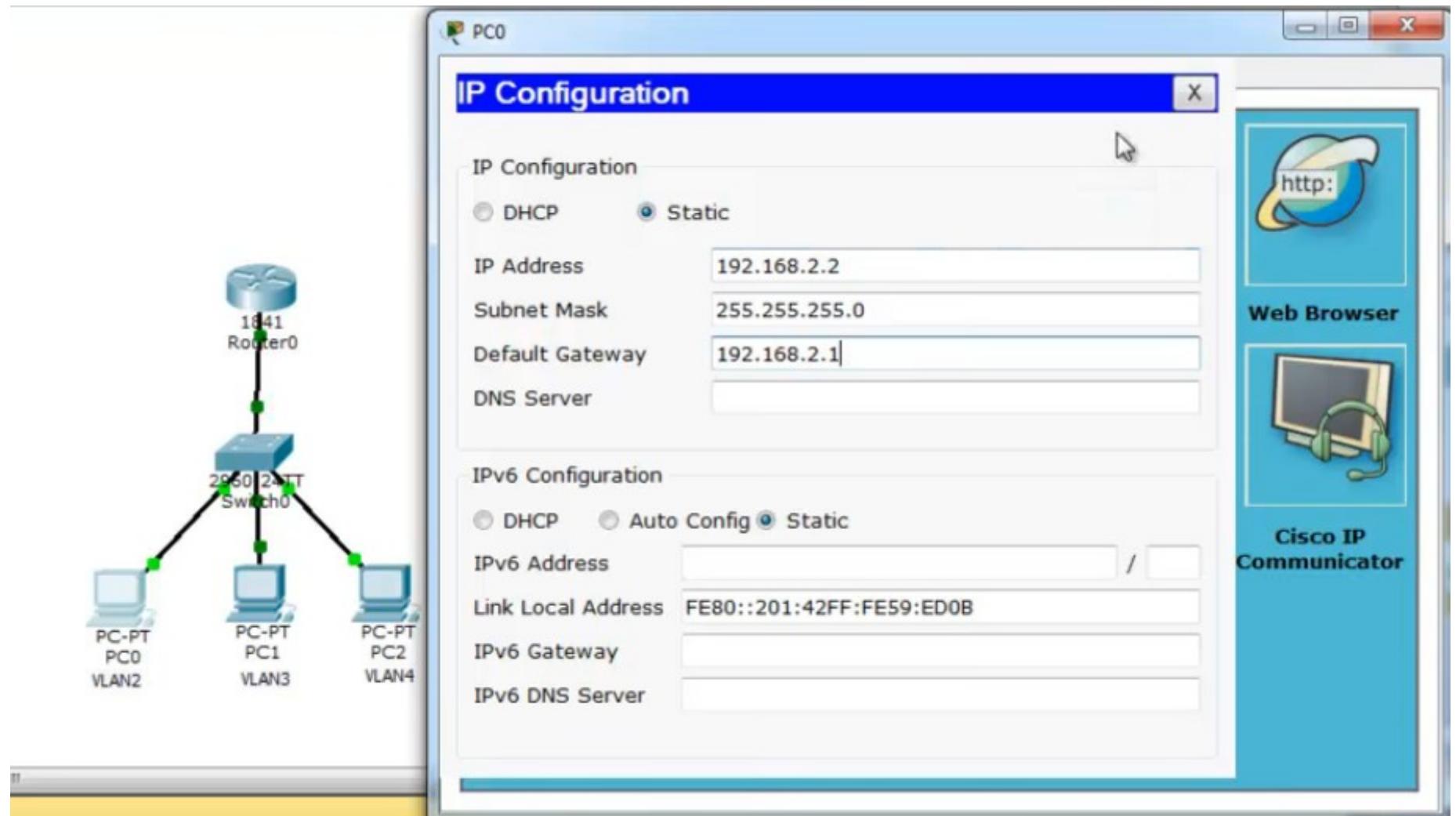
Сохраняем настройки и проверяем их.

Маршрутизатор



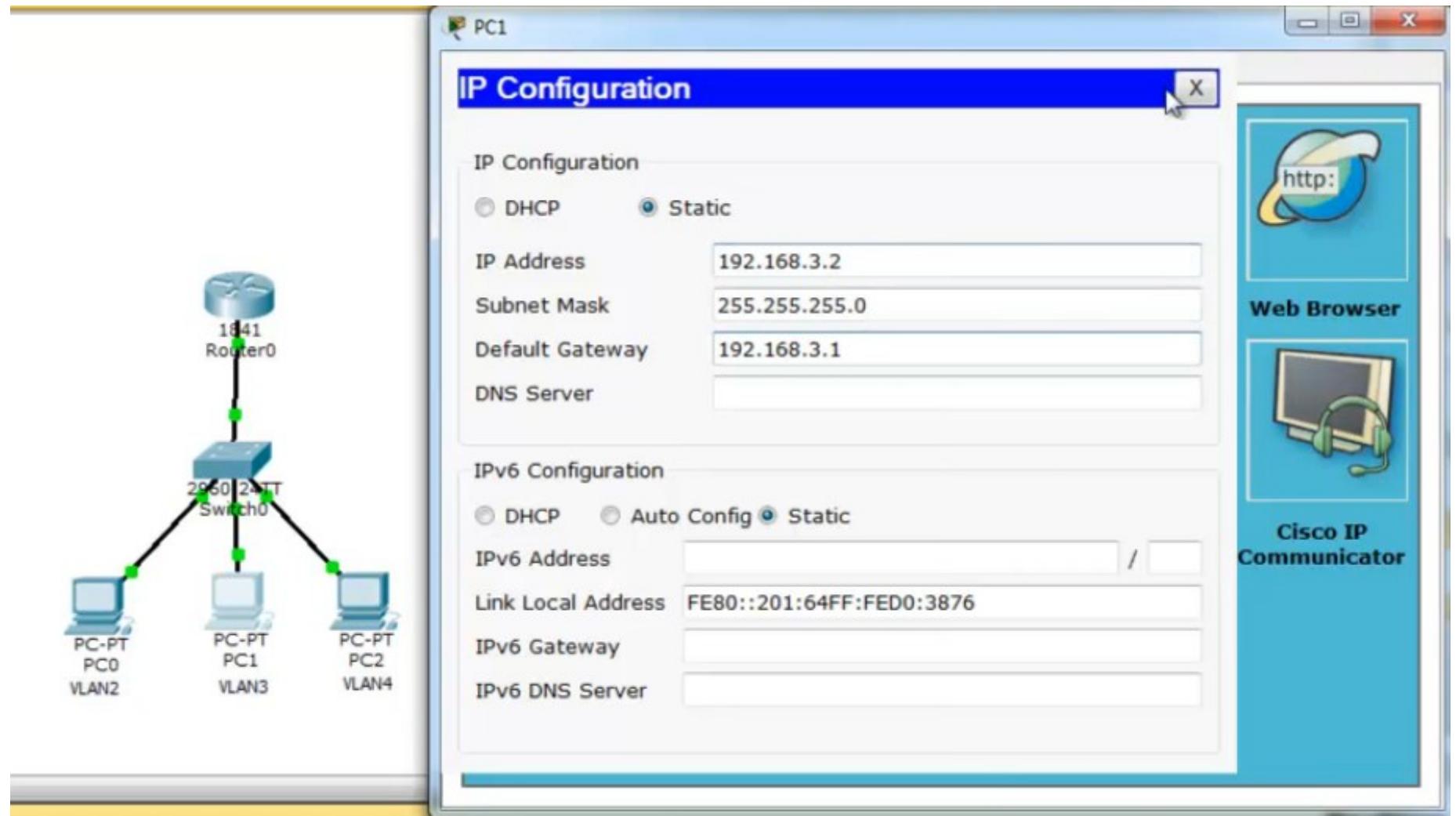
Под-интерфейсы на месте.

Маршрутизатор



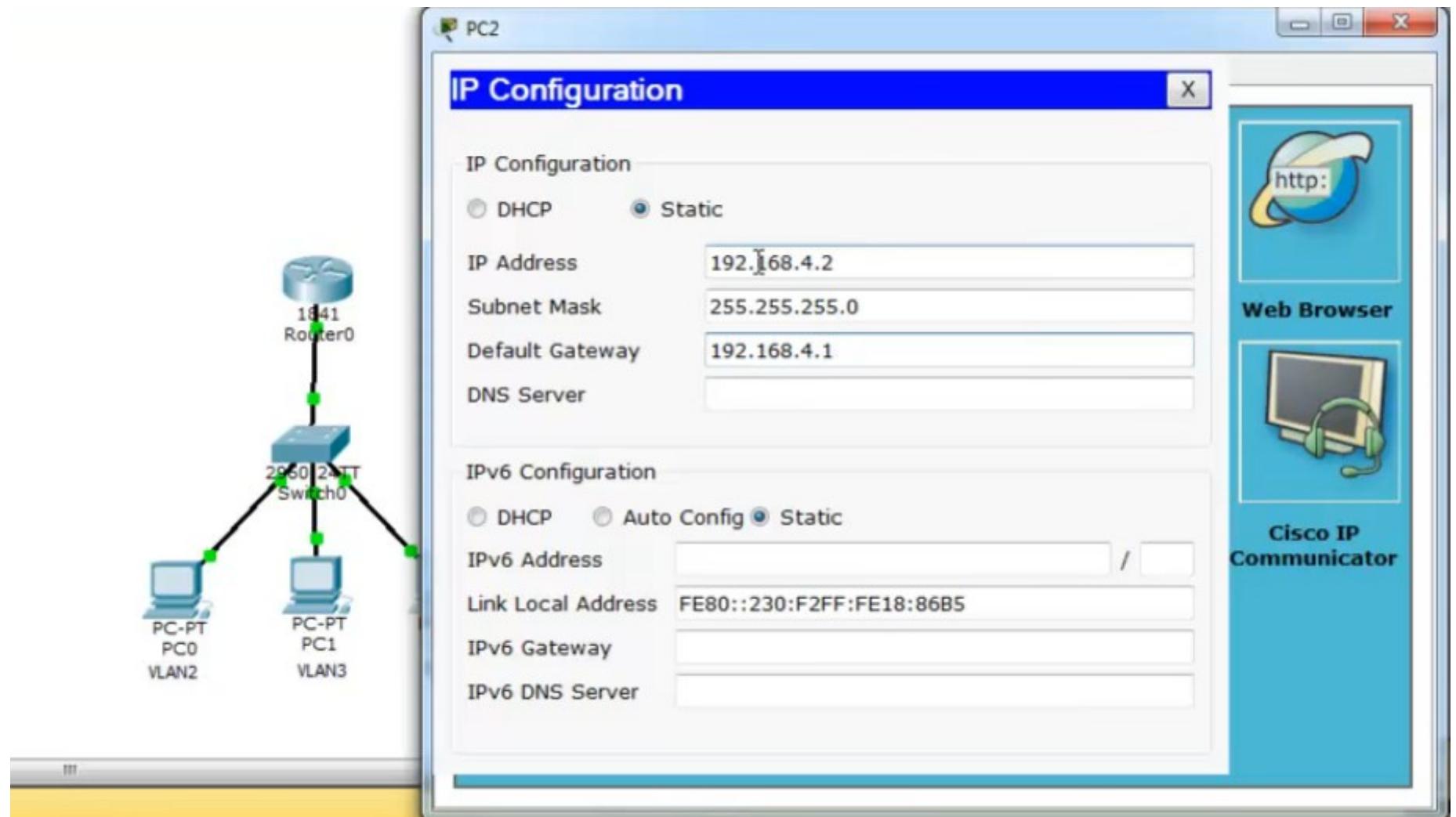
Задаем ip на компьютере 0.

Маршрутизатор



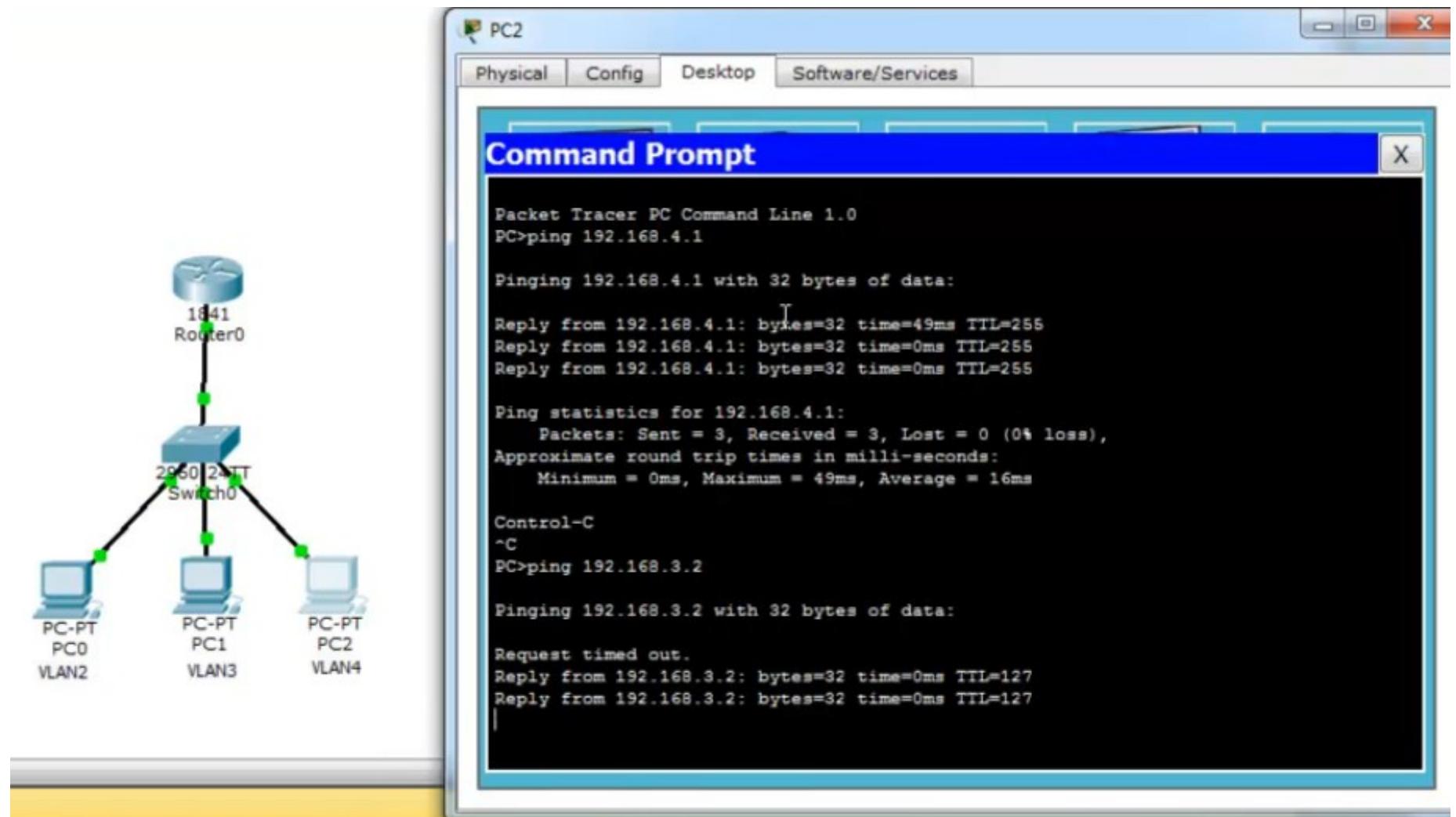
Задаем ip на компьютере 1.

Маршрутизатор



Задаем ip на компьютере 2.

Маршрутизатор



Пингуем шлюз — ОК.

Пингуем PC1 — ОК.

Маршрутизатор

Switch1

New Cluster Move Object

Physical Config CLI

IOS Command Line Interface

```
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname Switch
!
!
!
!
spanning-tree mode pvst
!
interface FastEthernet0/1
switchport access vlan 2
switchport mode access
!
interface FastEthernet0/2
switchport access vlan 3
switchport mode access
!
interface FastEthernet0/3
switchport trunk allowed vlan 2-3
switchport mode trunk
!
interface FastEthernet0/4
Switch#
```

Copy Paste

Router1 (2911) is connected to Multilayer Switch0 (3560-24PS). Multilayer Switch0 is connected to Switch1 (2960-24TT) and Switch2 (2960-24TT). Switch1 is connected to PCs PC3 (VLAN2) and PC4 (VLAN3). Switch2 is connected to PCs PC5 (VLAN2) and PC6 (VLAN3). Switch3 (2960-241) is connected to PCs PC1 (VLAN4) and PC2 (VLAN4). Router1 is also connected to Server-PT Server0 (VLAN4) and Server-PT Server1 (VLAN4).

Второй пример.
Конфигурация Коммутатора 1.

Маршрутизатор

Switch2

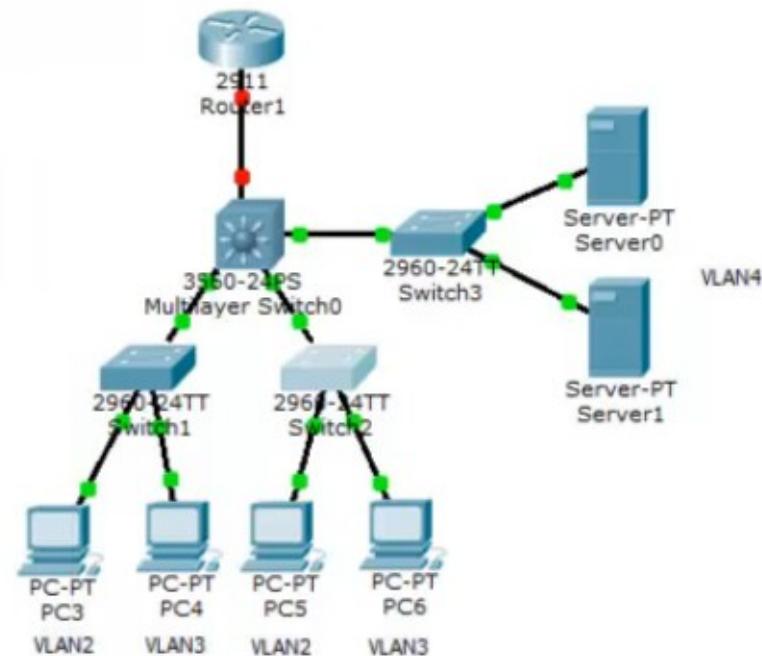
Physical Config CLI

IOS Command Line Interface

```
!
!
!
spanning-tree mode pvst
!
interface FastEthernet0/1
switchport access vlan 2
switchport mode access
!
interface FastEthernet0/2
switchport access vlan 3
switchport mode access
!
interface FastEthernet0/3
switchport trunk allowed vlan 2-3
switchport mode trunk
!
interface FastEthernet0/4
!
interface FastEthernet0/5
!
interface FastEthernet0/6
!
interface FastEthernet0/7

Switch#
```

Copy Paste



Конфигурация Коммутатора 2.

Маршрутизатор

Switch3

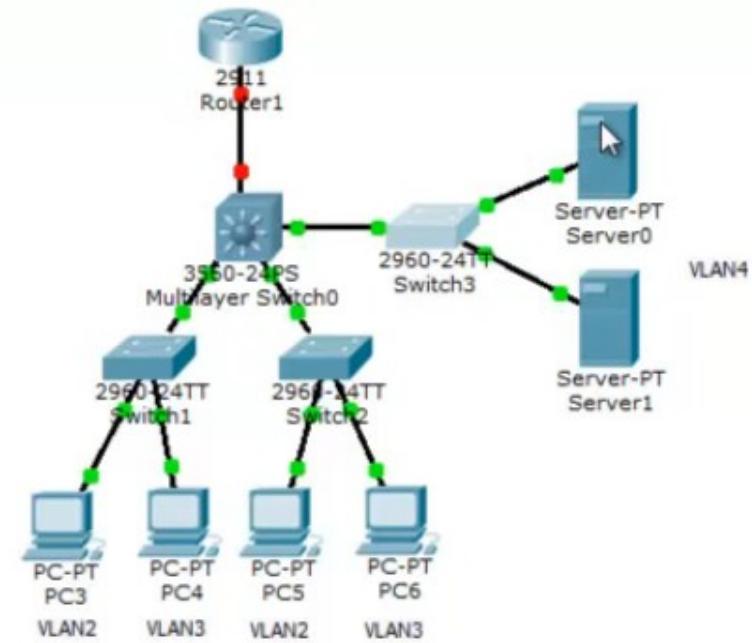
Physical Config CLI

IOS Command Line Interface

```
no service password-encryption
!
hostname Switch
!
!
!
spanning-tree mode pvst
!
interface FastEthernet0/1
switchport access vlan 4
switchport mode access
!
interface FastEthernet0/2
switchport access vlan 4
switchport mode access
!
interface FastEthernet0/3
switchport trunk allowed vlan 4
switchport mode trunk
!
interface FastEthernet0/4
!
interface FastEthernet0/5

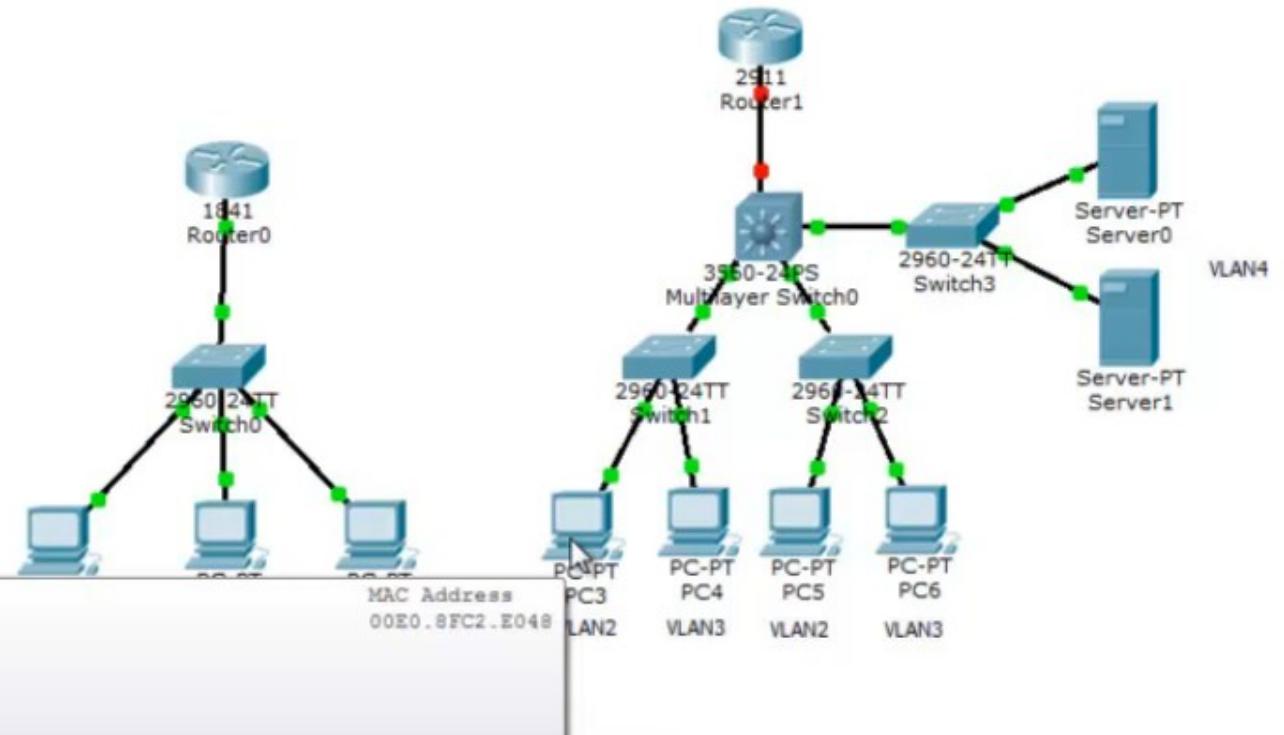
Switch#
```

Copy Paste



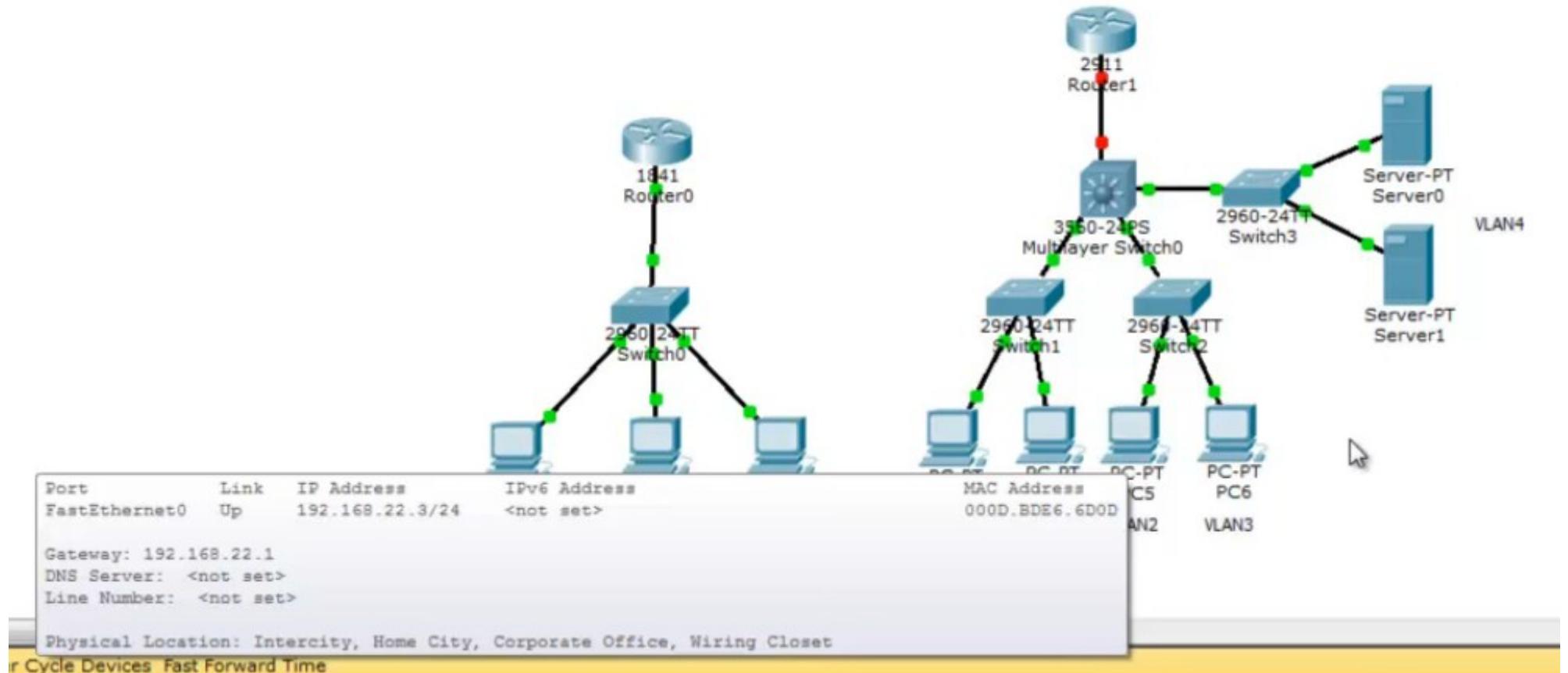
Конфигурация Коммутатора 3.

Маршрутизатор



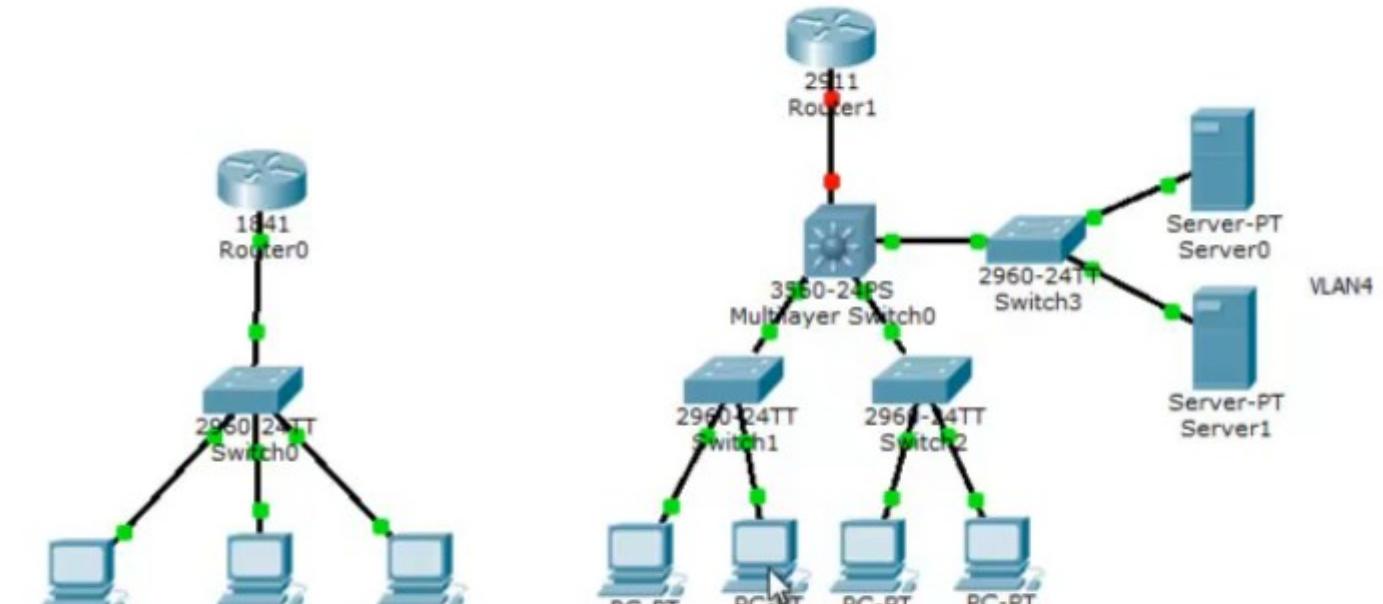
ip адрес PC3

Маршрутизатор



ip адрес PC5

Маршрутизатор



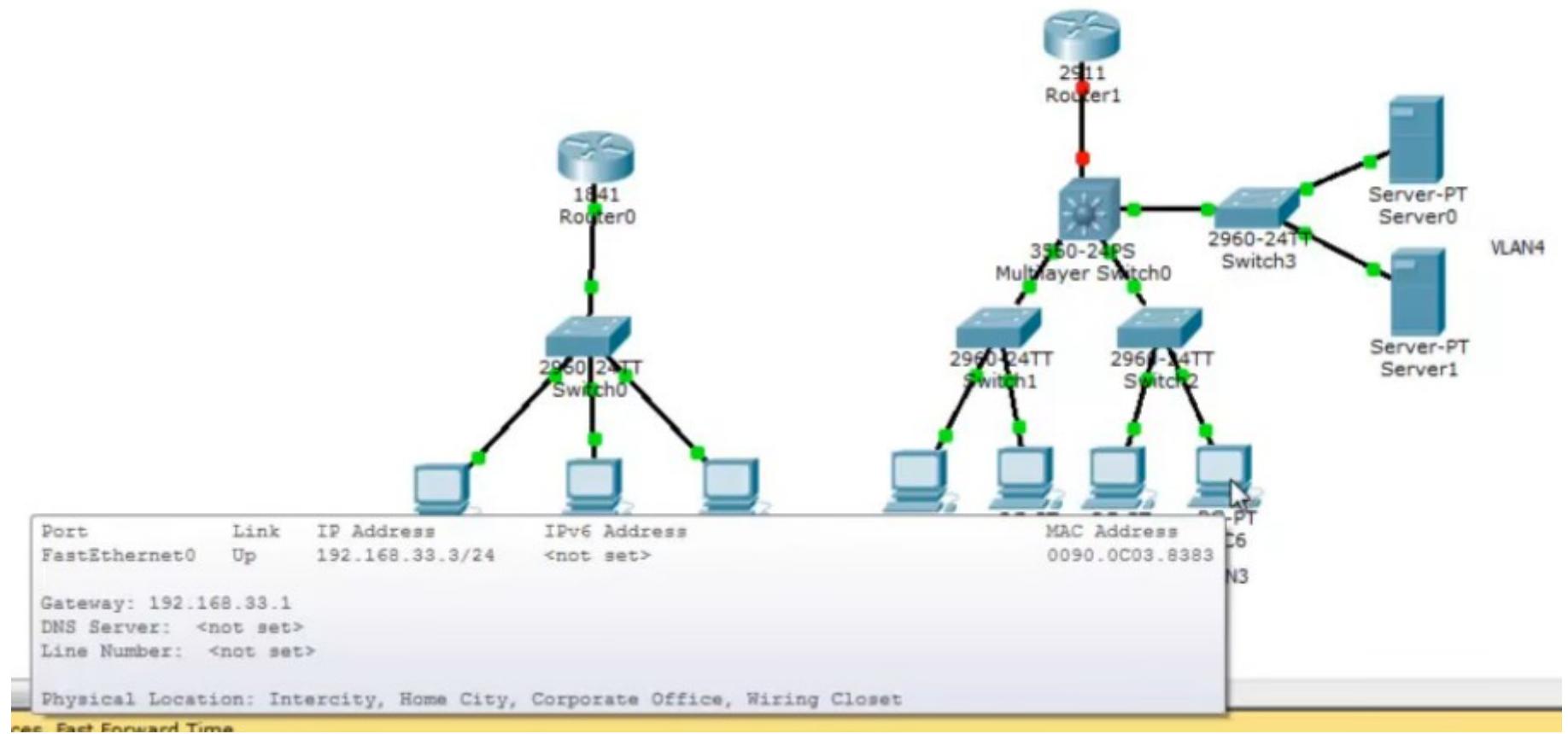
Port	Link	IP Address	IPv6 Address
FastEthernet0	Up	192.168.33.2/24	<not set>

Gateway: 192.168.33.1
DNS Server: <not set>
Line Number: <not set>

Physical Location: Intercity, Home City, Corporate Office, Wiring Closet
Power Cycle Devices Fast Forward Time

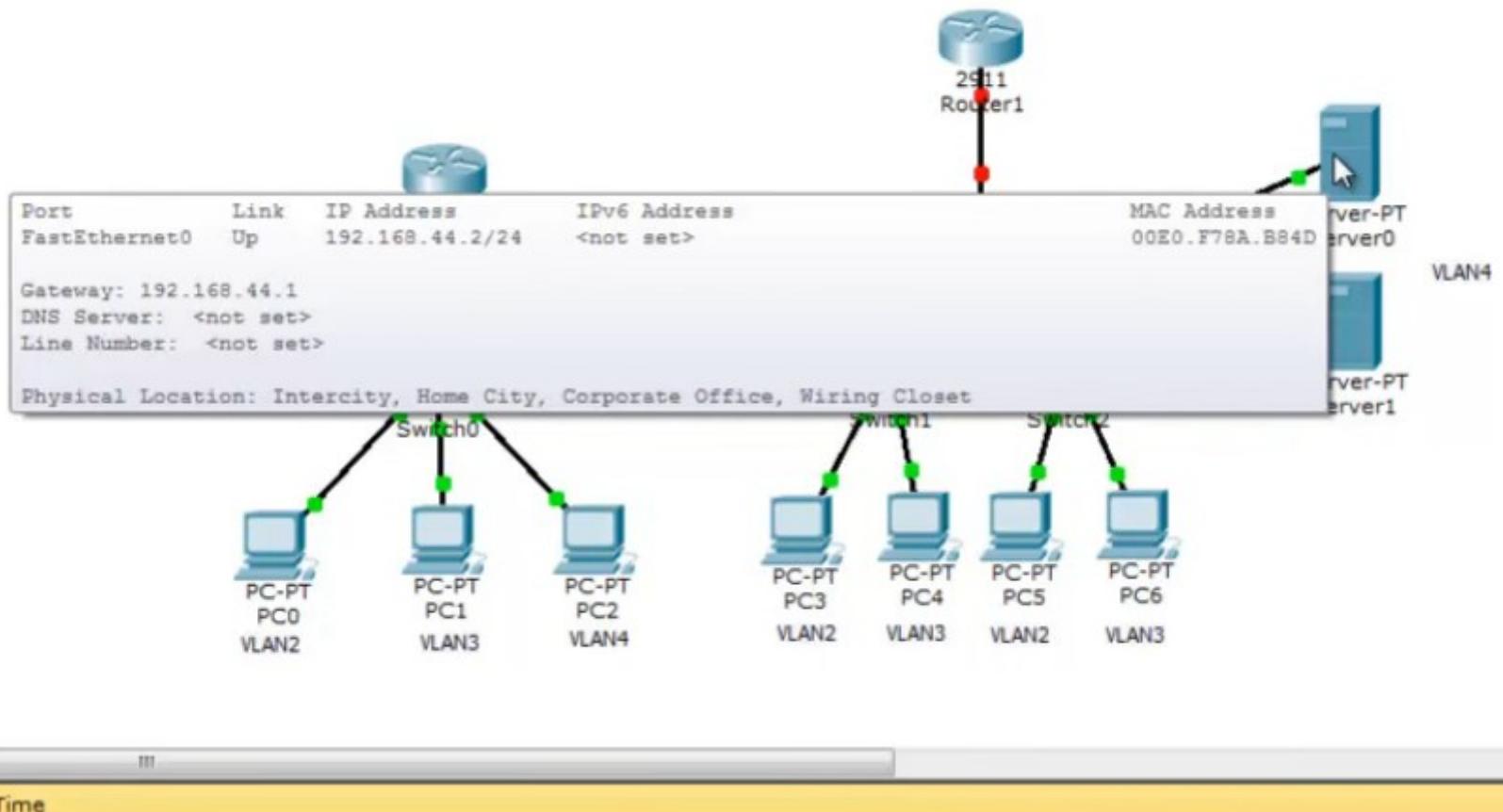
ip адрес PC4

Маршрутизатор



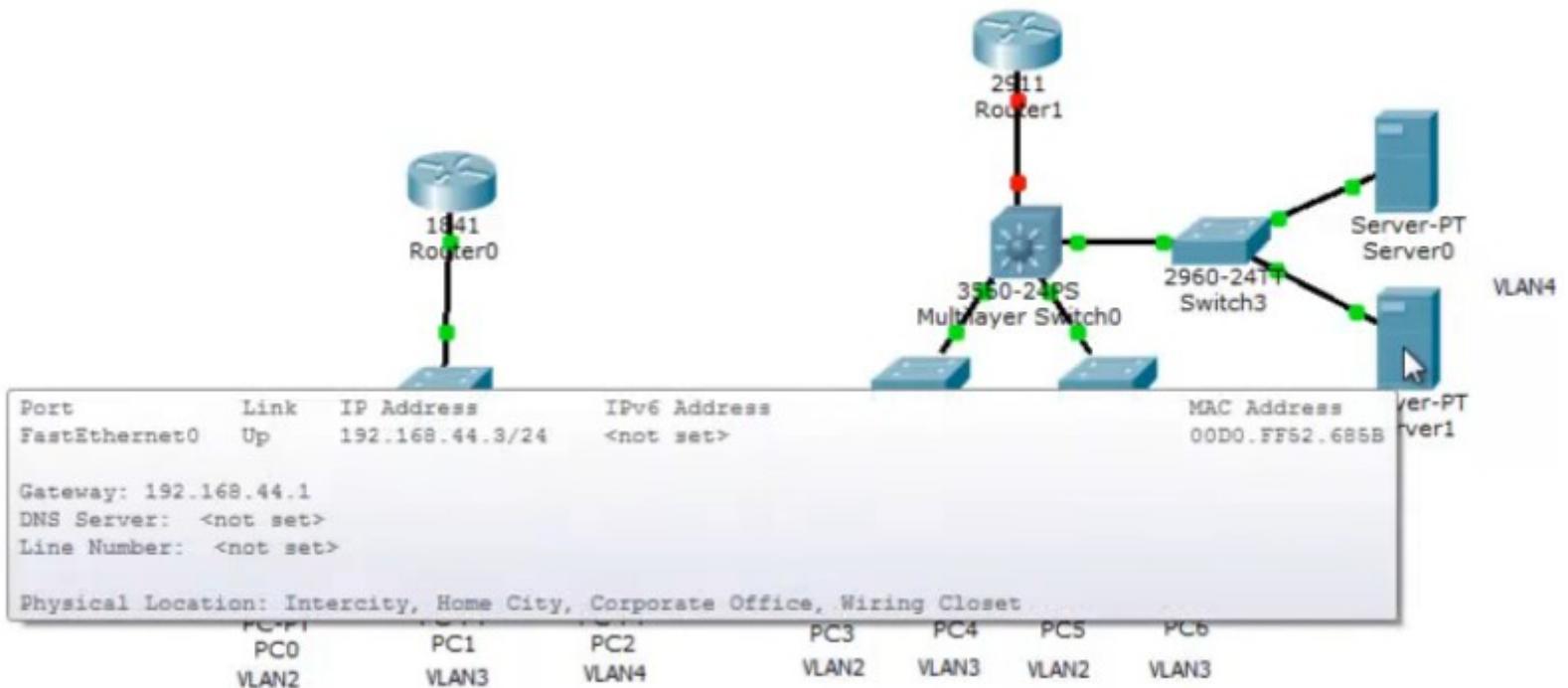
ip адрес PC6

Маршрутизатор



ip адрес Server0

Маршрутизатор



ip адрес Server1

Маршрутизатор

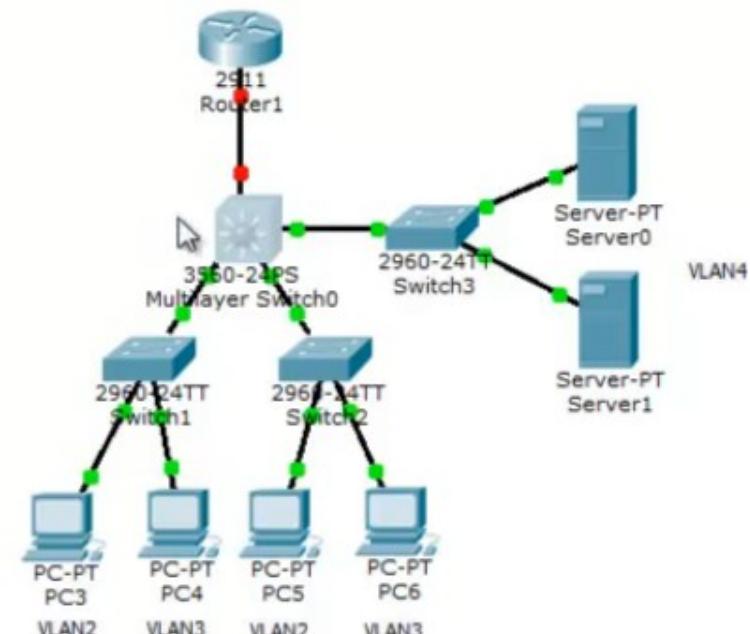
Multilayer Switch0

Physical Config CLI

IOS Command Line Interface

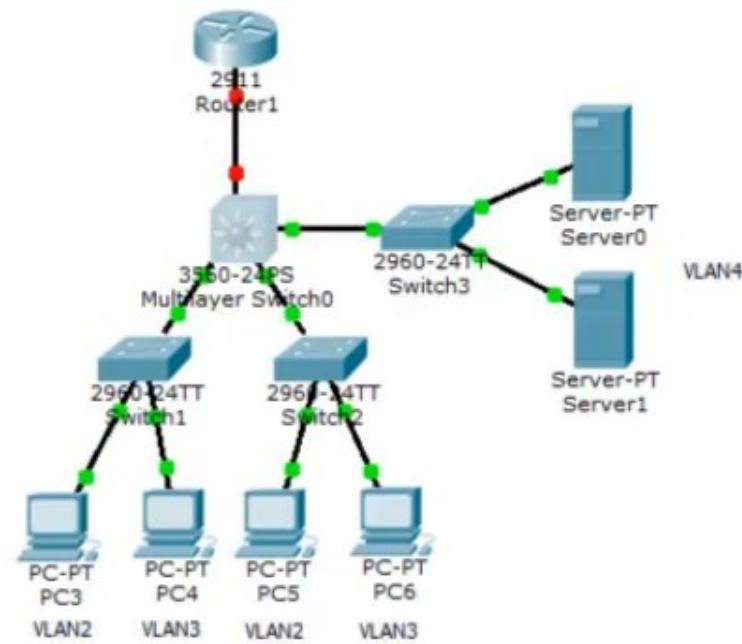
```
!
!
!
interface FastEthernet0/1
switchport trunk allowed vlan 2-3
switchport trunk encapsulation dot1q
!
interface FastEthernet0/2
switchport trunk allowed vlan 2-3
switchport trunk encapsulation dot1q
!
interface FastEthernet0/3
switchport trunk allowed vlan 4
switchport trunk encapsulation dot1q
!
interface FastEthernet0/4
!
interface FastEthernet0/5
!
interface FastEthernet0/6
!
interface FastEthernet0/7
!
Switch#
```

Copy Paste



Настройки коммутатора 0

Маршрутизатор



Настройки коммутатора 0

Маршрутизатор

Multilayer Switch0

Physical Config CLI

IOS Command Line Interface

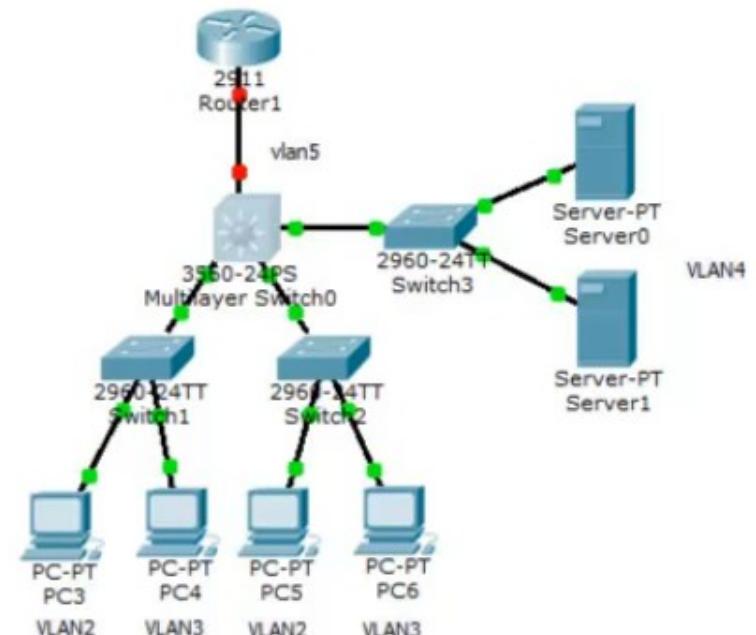
```
!
!
!

Switch#
Switch#
Switch#
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#int vla
Switch(config)#int vlan 5
Switch(config-if)#name
Switch(config-if)#name v1
Switch(config-if)#exit
Switch(config)#
Switch(config)#
Switch(config)#vlan 5
Switch(config-vlan)#
%LINK-5-CHANGED: Interface Vlan5, changed state to up

Switch(config-vlan)#name
Switch(config-vlan)#name vlan5
Switch(config-vlan)#
Switch(config-vlan)#exit
Switch(config)#

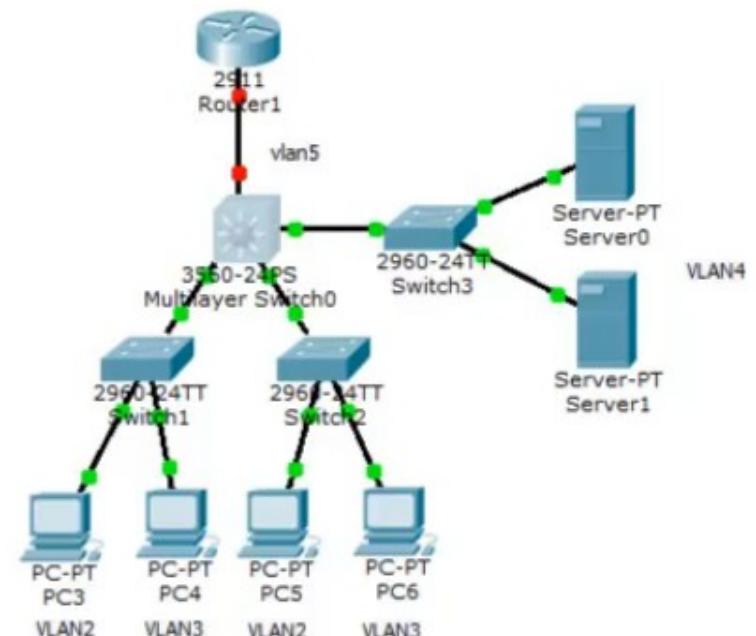
```

Copy Paste



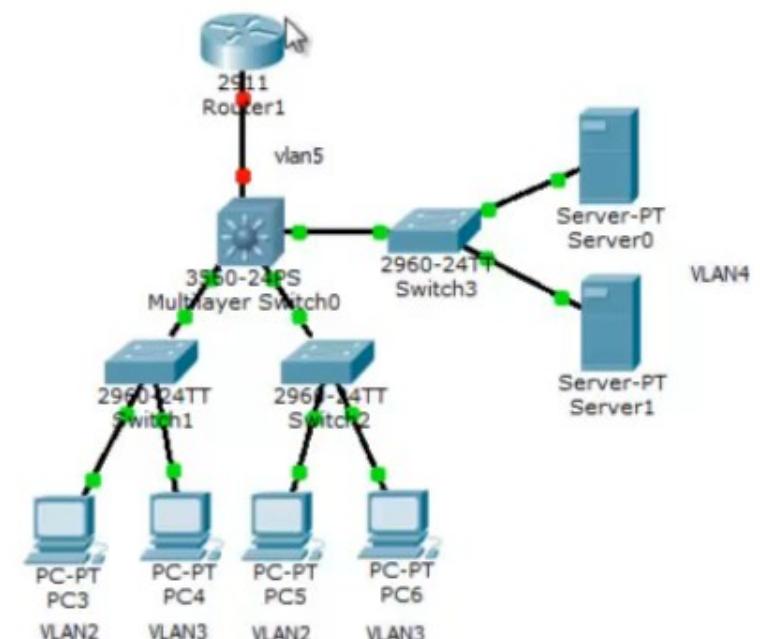
Создадим VLAN5 для роутера

Маршрутизатор



Зададим коммутатору ір и поднимем интерфейс.

Маршрутизатор



Назначим интерфейс `gi0/1` в `vlan 5`

Маршрутизатор

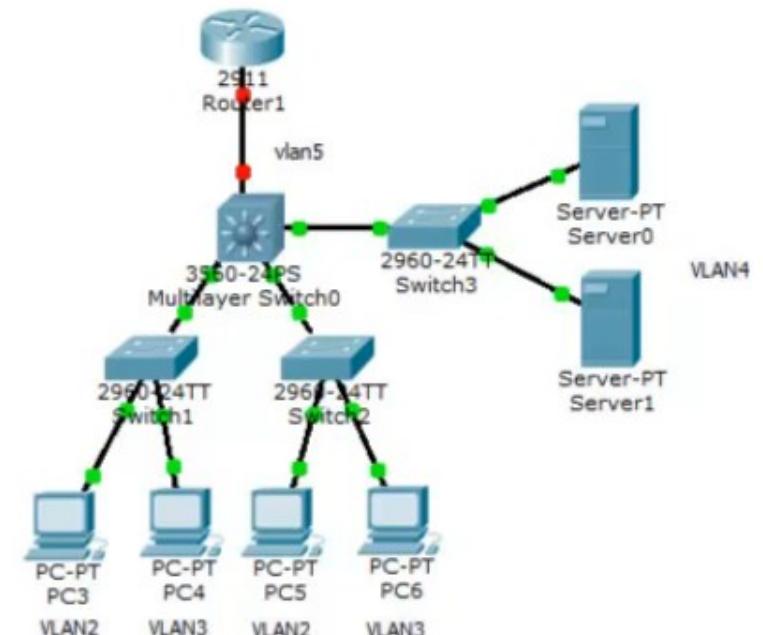
Multilayer Switch0

Physical Config CLI

IOS Command Line Interface

```
!interface FastEthernet0/17
!
interface FastEthernet0/18
!
interface FastEthernet0/19
!
interface FastEthernet0/20
!
interface FastEthernet0/21
!
interface FastEthernet0/22
!
interface FastEthernet0/23
!
interface FastEthernet0/24
!
interface GigabitEthernet0/1
  switchport access vlan 5
  switchport mode access
!
interface GigabitEthernet0/2
!
interface Vlan1
  no ip address
--More--
```

Copy Paste



Проверяем конфигурацию

Маршрутизатор

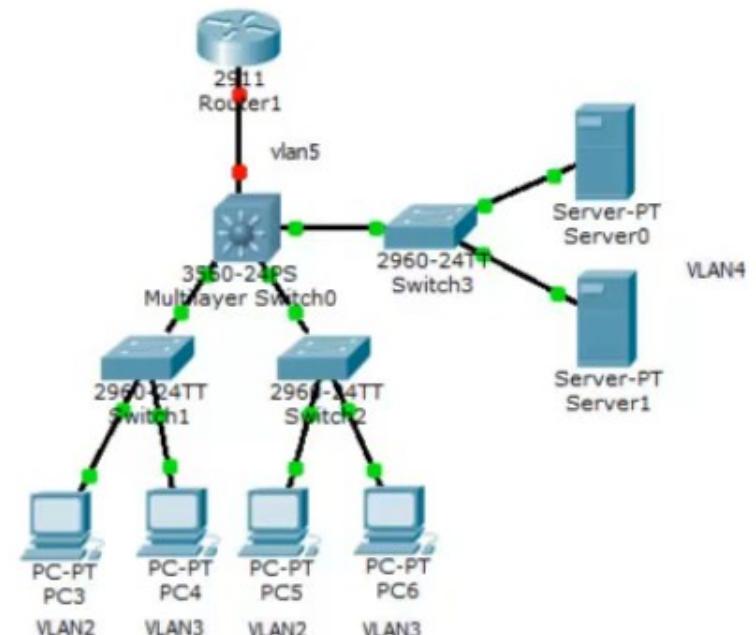
Multilayer Switch0

Physical Config CLI

IOS Command Line Interface

```
!interface Vlan1
no ip address
shutdown
!
interface Vlan2
ip address 192.168.22.1 255.255.255.0
!
interface Vlan3
ip address 192.168.33.1 255.255.255.0
!
interface Vlan4
ip address 192.168.44.1 255.255.255.0
!
interface Vlan5
ip address 192.168.55.2 255.255.255.0
!
ip classless
!
!
!
Switch#wr mem
Building configuration...
[OK]
Switch#
```

Copy Paste



Проверяем конфигурацию, сохраняем.

Маршрутизатор

Router1

Physical Config CLI

IOS Command Line Interface

```
Router>
Router>
Router>en
Router#
Router#
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#
Router(config)#
Router(config)#int gi
Router(config)#int gigabitEthernet 0/0
Router(config-if)#no shut
Router(config-if)#no shutdown

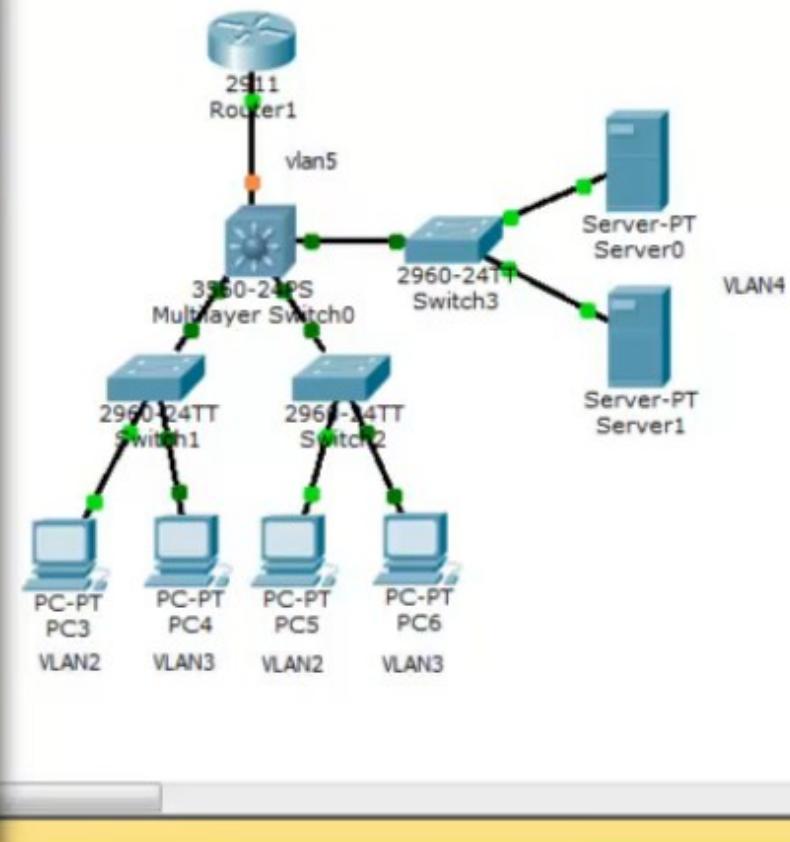
Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up

Router(config-if)#
Router(config-if)#
Router(config-if)#
Router(config-if)#ip add
Router(config-if)#ip address 192.168.55.1 255.255.255.0
Router(config-if)#

```

Copy Paste



На роутере поднимаем интерфейс, задаем ему ip

Маршрутизатор

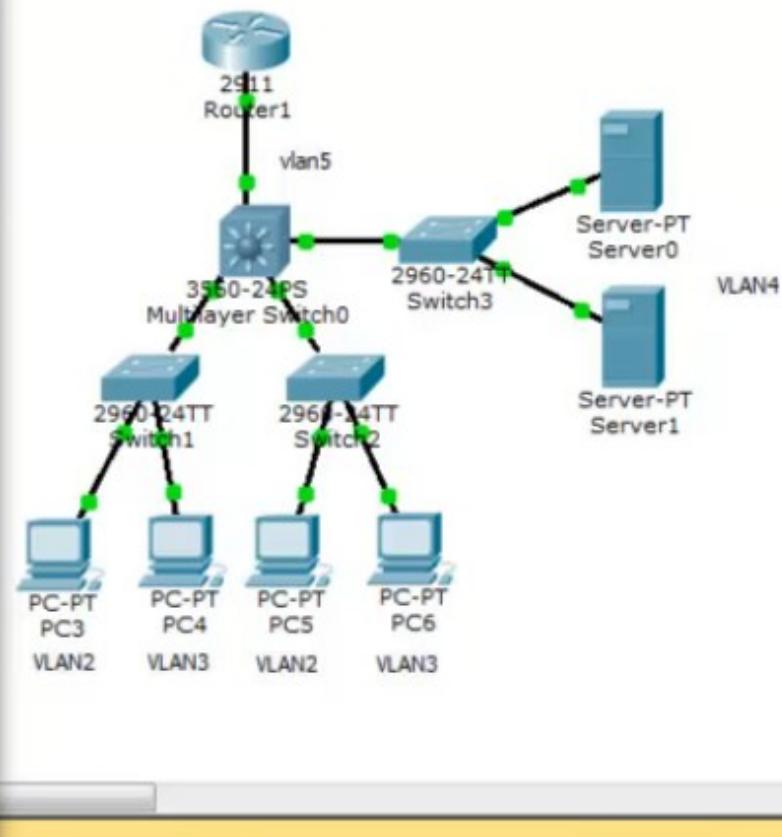
Router1

Physical Config CLI

IOS Command Line Interface

```
Router(config-if)#  
Router(config-if)#  
Router(config-if)#  
Router(config-if)#ip add  
Router(config-if)#ip address 192.168.55.1 255.255.255.0  
Router(config-if)#no shut  
Router(config-if)#no shutdown  
Router(config-if)#  
Router(config-if)#end  
Router#  
%SYS-5-CONFIG_I: Configured from console by console  
  
Router#  
Router#  
Router#ping 192.168.55.2  
  
Type escape sequence to abort.  
Sending 5, 100-byte ICMP Echos to 192.168.55.2, timeout is 2 seconds:  
..!!!!  
Success rate is 80 percent (4/5), round-trip min/avg/max = 0/0/0 ms  
  
Router#ping 192.168.55.2  
  
Type escape sequence to abort.  
Sending 5, 100-byte ICMP Echos to 192.168.55.2, timeout is 2 seconds:  
|
```

Copy Paste



Пингуем коммутатор — ОК.

Маршрутизатор

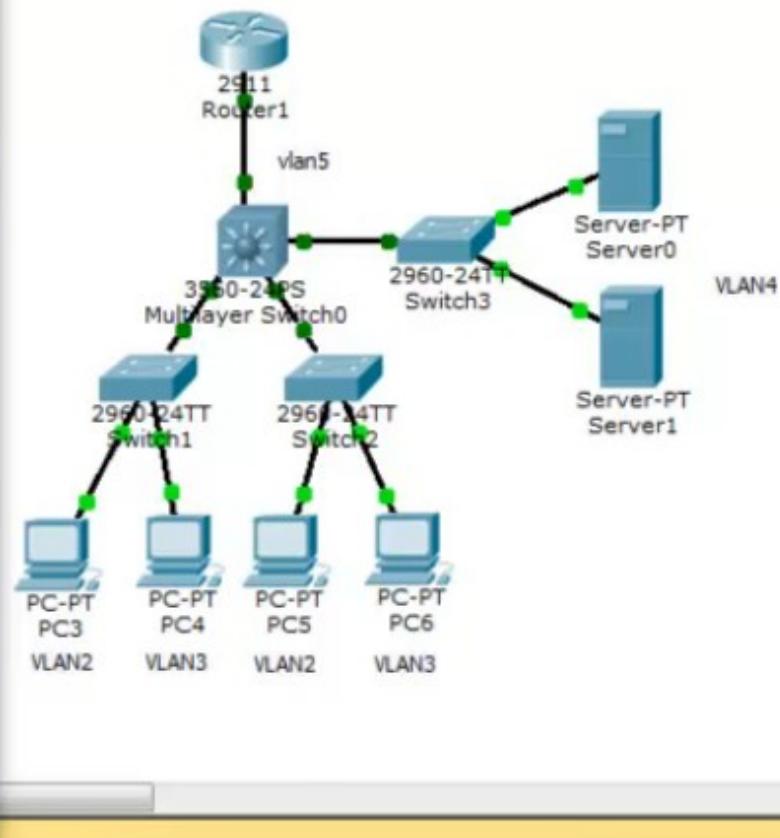
Router1

Physical Config CLI

IOS Command Line Interface

```
Router#  
Router#ping 192.168.55.2  
  
Type escape sequence to abort.  
Sending 5, 100-byte ICMP Echos to 192.168.55.2, timeout is 2 seconds:  
!!!!  
Success rate is 80 percent (4/5), round-trip min/avg/max = 0/0/0 ms  
  
Router#ping 192.168.55.2  
  
Type escape sequence to abort.  
Sending 5, 100-byte ICMP Echos to 192.168.55.2, timeout is 2 seconds:  
!!!!  
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms  
  
Router#  
Router#  
Router#  
Router#ping 192.168.22.2  
  
Type escape sequence to abort.  
Sending 5, 100-byte ICMP Echos to 192.168.22.2, timeout is 2 seconds:  
----  
Success rate is 0 percent (0/5)  
  
Router#
```

Copy Paste



Пингуем компьютер из локальной сети — не проходит.

Статическая маршрутизация

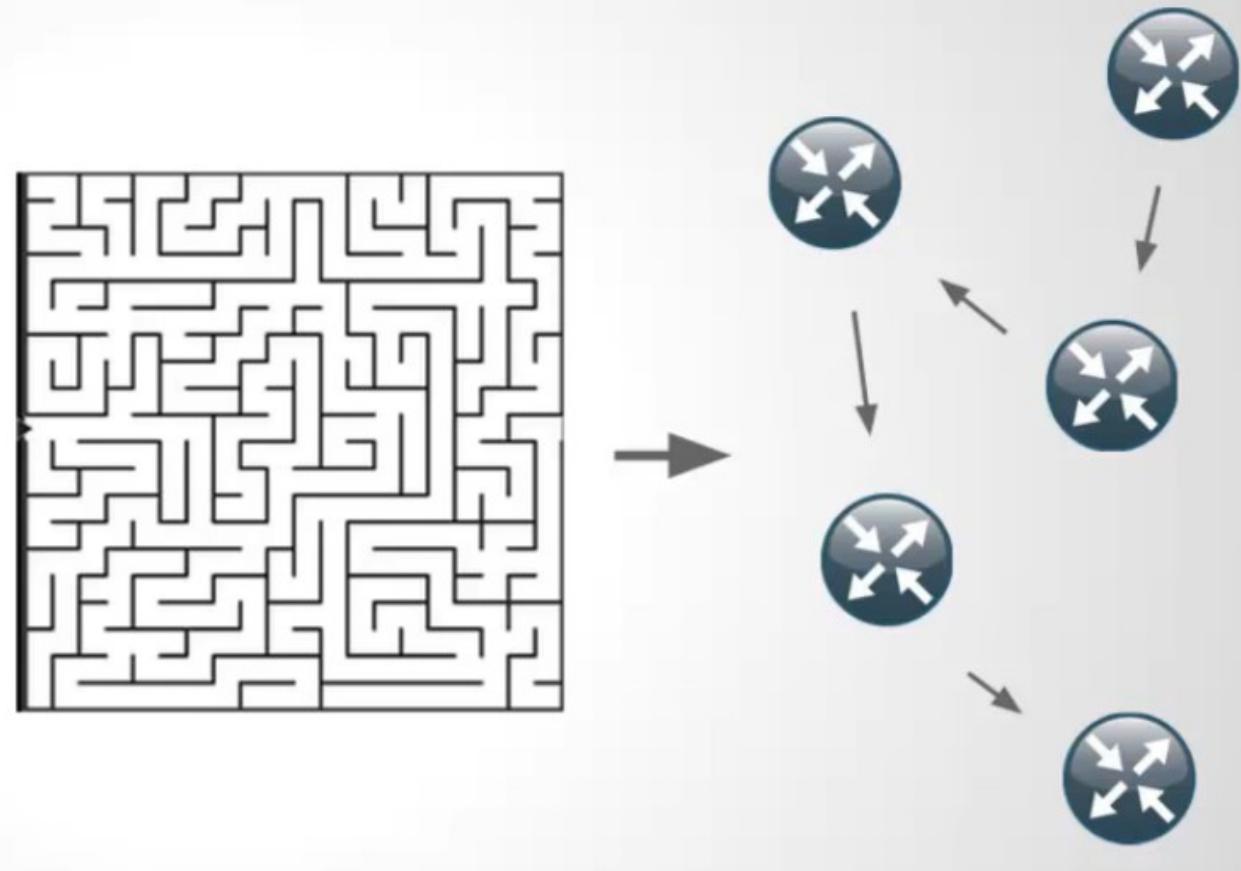
[Маршрутизация](#)

[Маршрут по умолчанию](#)

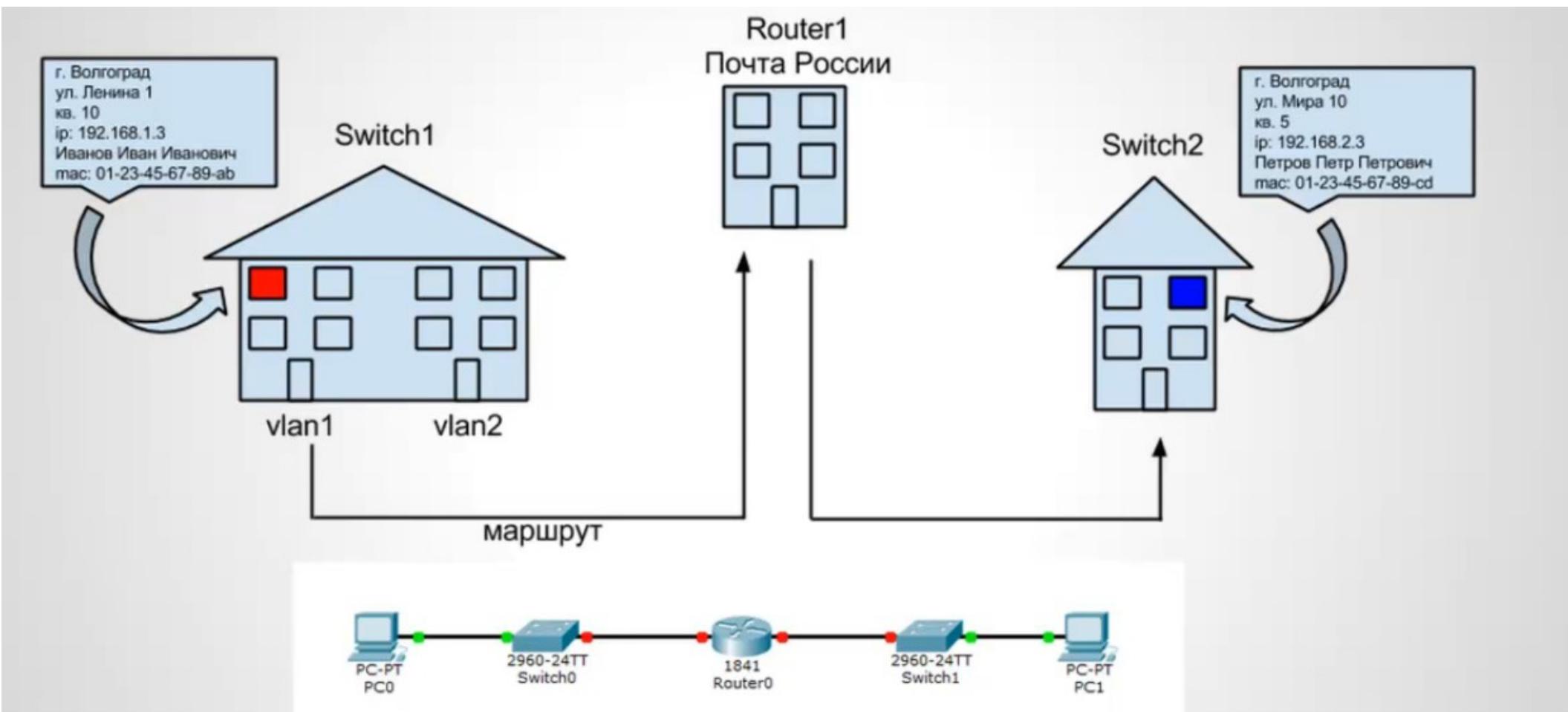
[Таблица маршрутизации](#)

Статическая маршрутизация

Динамическая маршрутизация



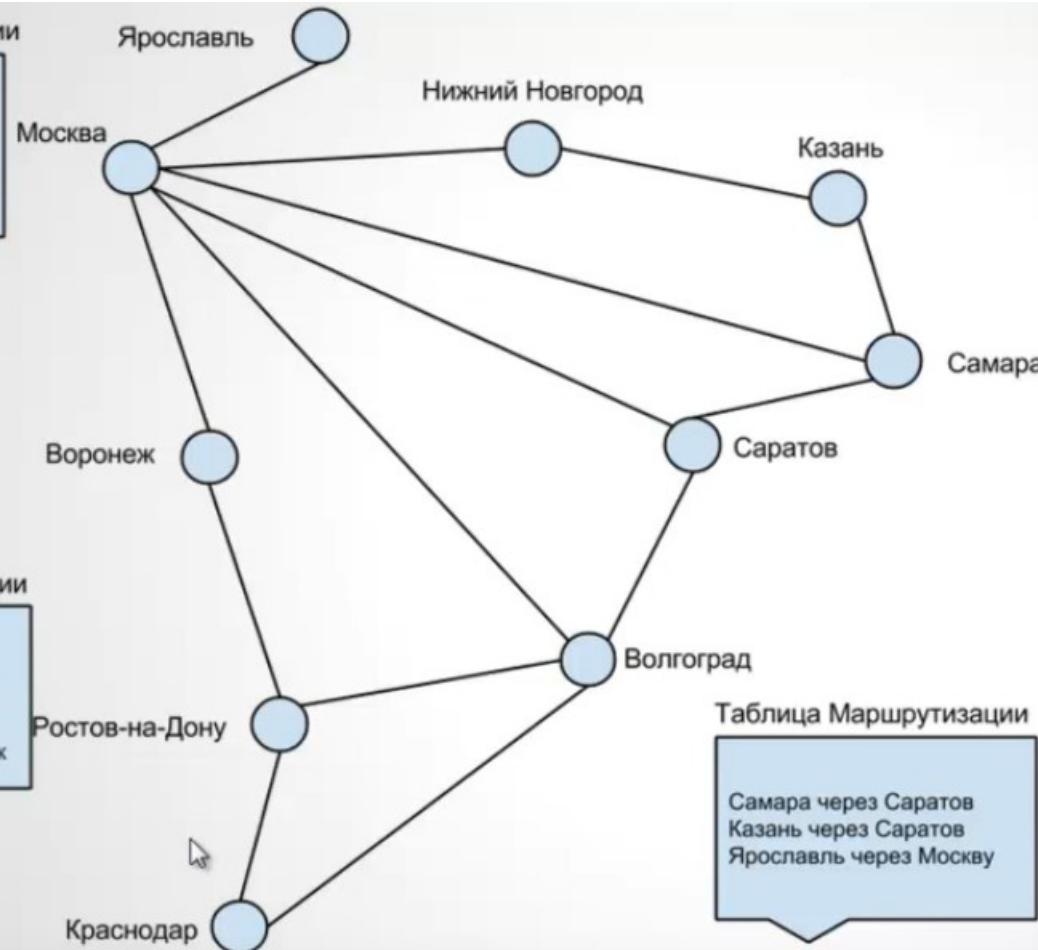
Статическая маршрутизация



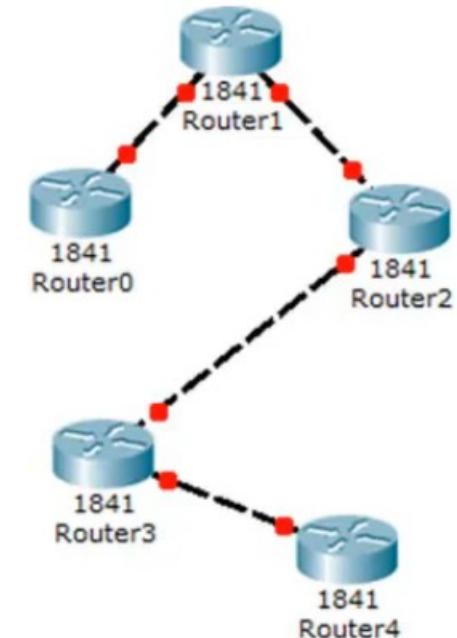
Статическая маршрутизация

Таблица Маршрутизации

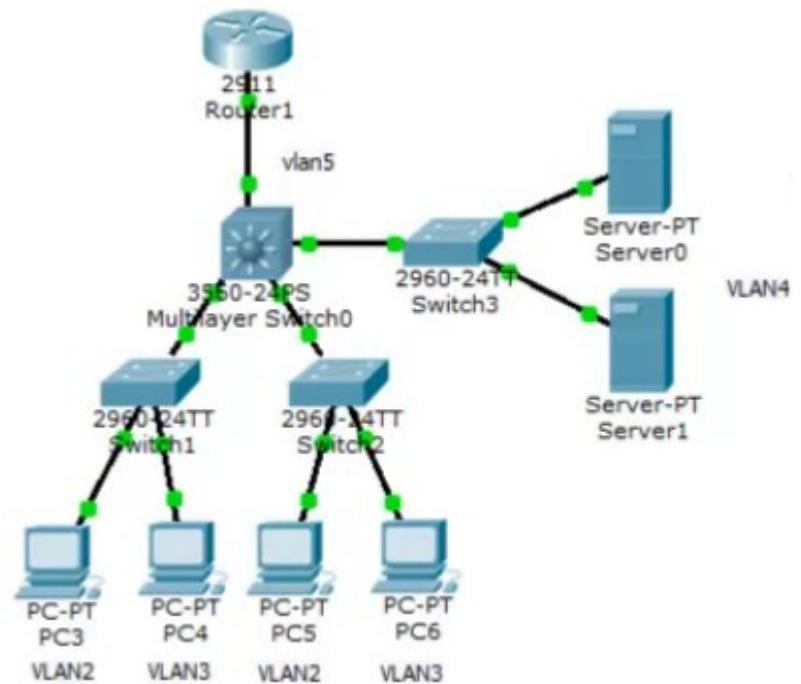
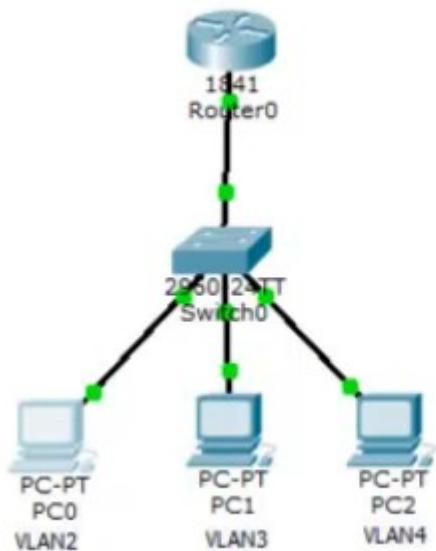
```
Казань через Нижний Новгород
Ростов-на-Дону через Воронеж
Краснодар через Воронеж
```



```
C 192.168.0.0/24 is directly connected, FastEthernet0/0
S 192.168.1.0/24 [1/0] via 192.168.0.2
S 192.168.3.0/24 [1/0] via 192.168.0.2
C 192.168.4.0/24 is directly connected, FastEthernet0/1
S 192.168.5.0/24 [1/0] via 192.168.4.2
S 192.168.6.0/24 [1/0] via 192.168.4.2
```



Статическая маршрутизация



Пусть эти две сети = два филиала.

Статическая маршрутизация

PC3

Physical Config Desktop Software/Services

Command Prompt

```
Ping statistics for 192.168.55.2:
  Packets: Sent = 3, Received = 3, Lost = 0 (0% loss),
  Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

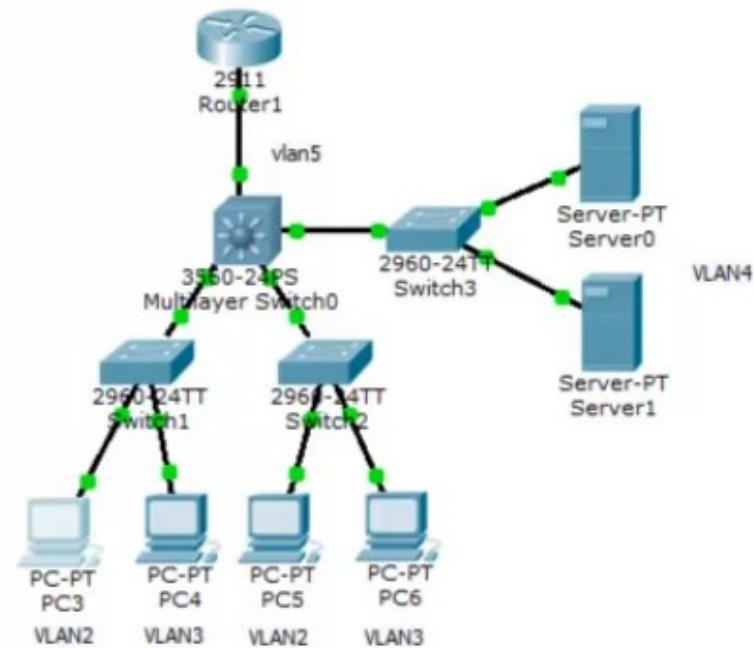
Control-C
^C
PC>ping 192.168.55.1

Pinging 192.168.55.1 with 32 bytes of data:

Ping statistics for 192.168.55.1:
  Packets: Sent = 1, Received = 0, Lost = 1 (100% loss),
  Control-C
  ^C
  PC>ipconfig

FastEthernet0 Connection:(default port)
Link-local IPv6 Address.....: FE80::2E0:8FFF:FE2:E048
IP Address.....: 192.168.22.2
Subnet Mask.....: 255.255.255.0
Default Gateway.....: 192.168.22.1

PC>
```



Посмотрим ip компьютера PC3

Статическая маршрутизация

PC3

Physical Config Desktop Software/Services

Command Prompt

```
Pinging 192.168.33.2 with 32 bytes of data:
Reply from 192.168.33.2: bytes=32 time=1ms TTL=127
Reply from 192.168.33.2: bytes=32 time=0ms TTL=127

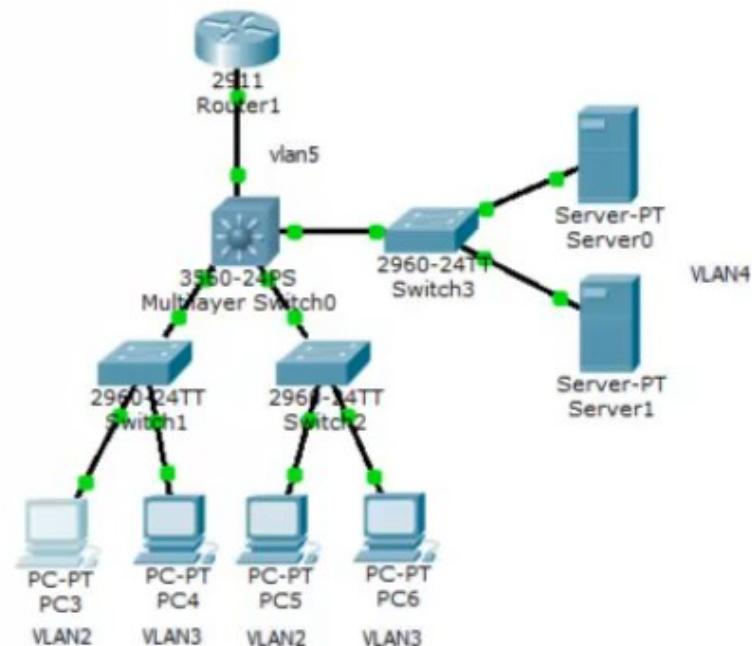
Ping statistics for 192.168.33.2:
  Packets: Sent = 2, Received = 2, Lost = 0 (0% loss),
  Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

Control-C
^C
PC>ping 192.168.33.3

Pinging 192.168.33.3 with 32 bytes of data:
Reply from 192.168.33.3: bytes=32 time=1ms TTL=127
Reply from 192.168.33.3: bytes=32 time=0ms TTL=127

Ping statistics for 192.168.33.3:
  Packets: Sent = 2, Received = 2, Lost = 0 (0% loss),
  Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

Control-C
^C
PC>
```



Соседние сегменты пингуются

Статическая маршрутизация

Router1

Physical Config CLI

IOS Command Line Interface

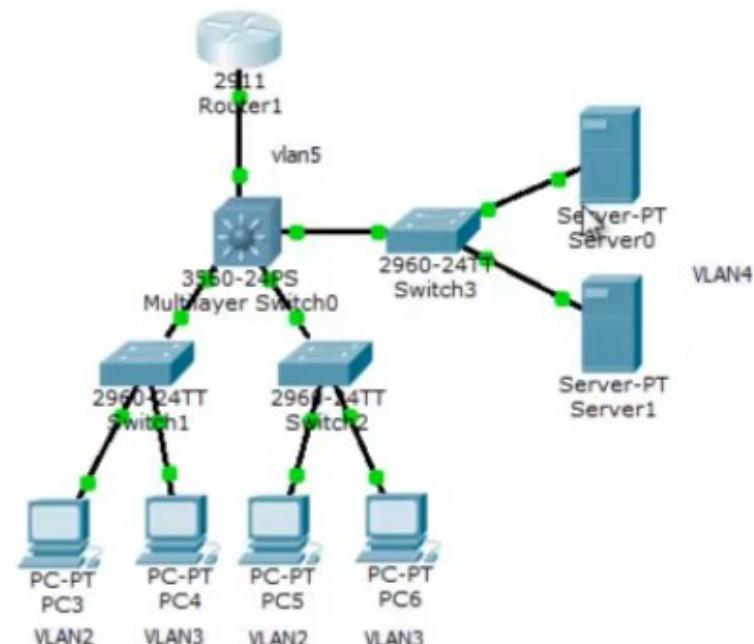
```
speed auto
!
interface GigabitEthernet0/1
no ip address
duplex auto
speed auto
shutdown
!
interface GigabitEthernet0/2
no ip address

Router#ping 192.168.55.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.55.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms

Router#ping 192.168.22.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.22.2, timeout is 2 seconds:
...
Success rate is 0 percent (0/4)

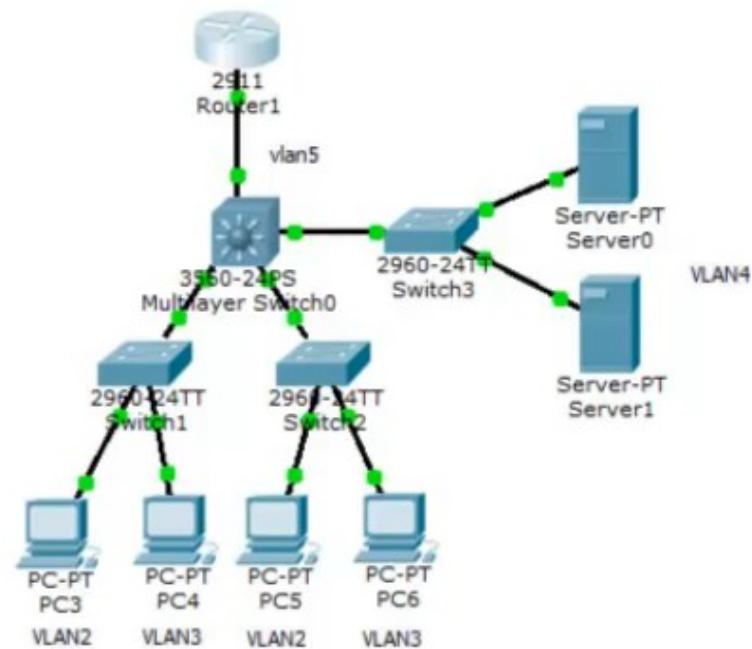
Router#
```

Copy Paste



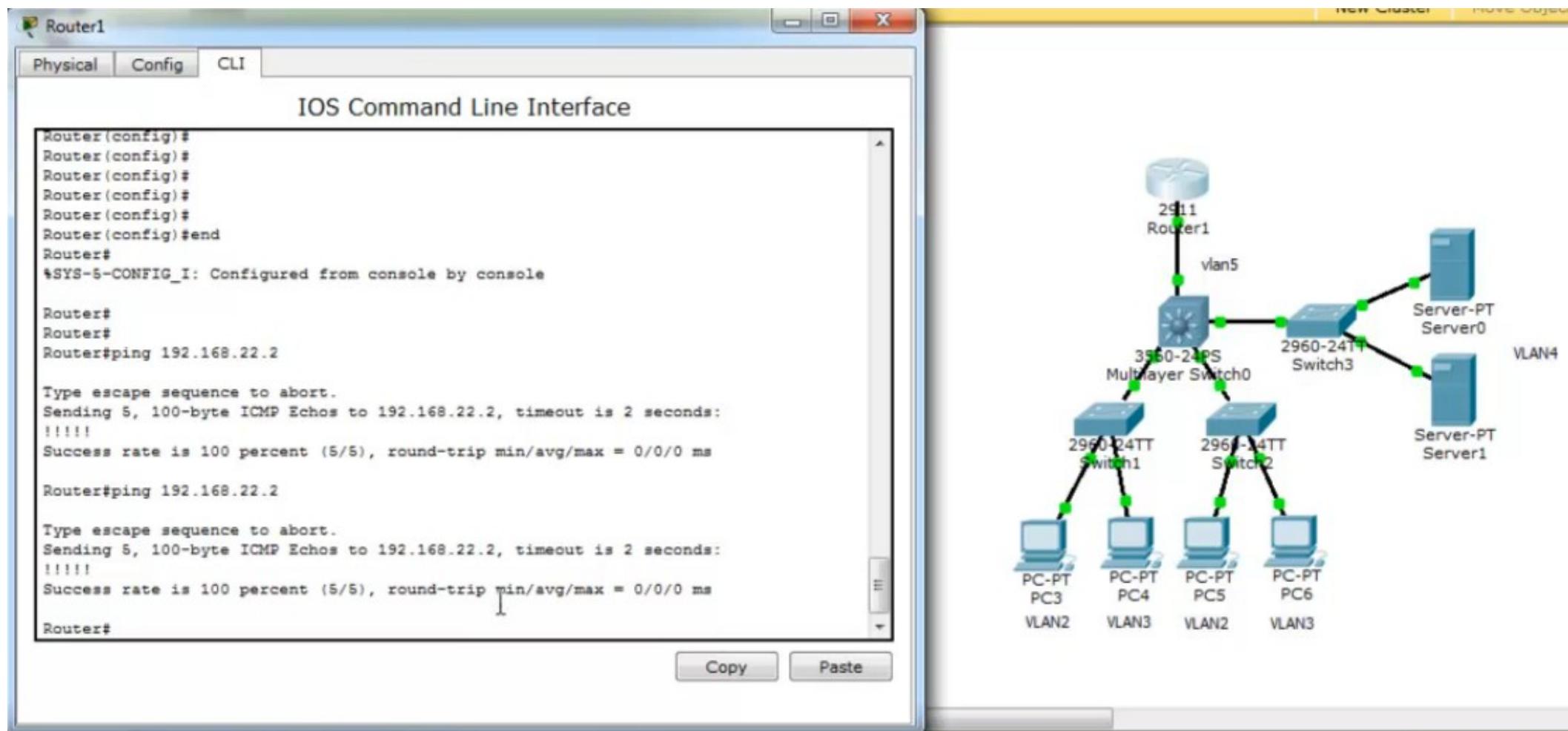
С роутера компьютеры не пингуются, т. к. нет прямого линка, а только через L3-коммутатор

Статическая маршрутизация



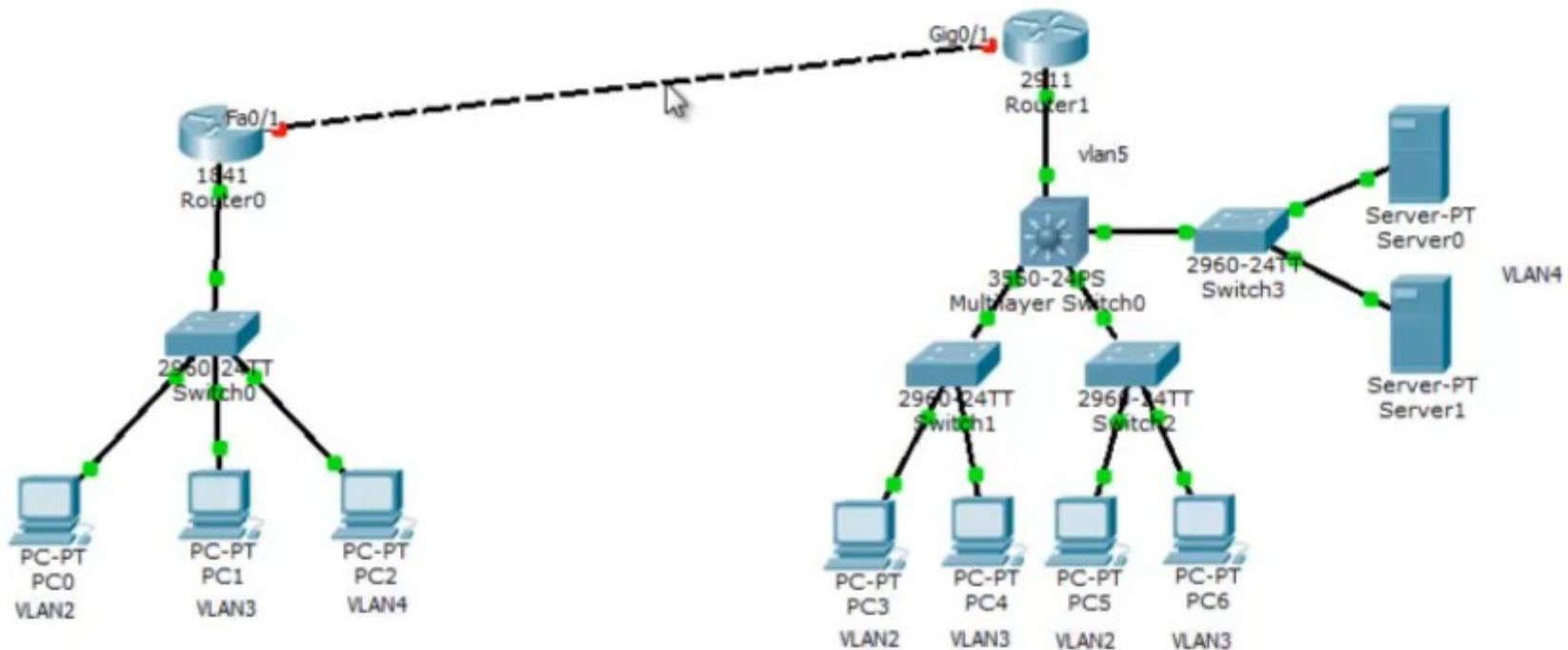
Добавим информацию о маршруте в роутер

Статическая маршрутизация



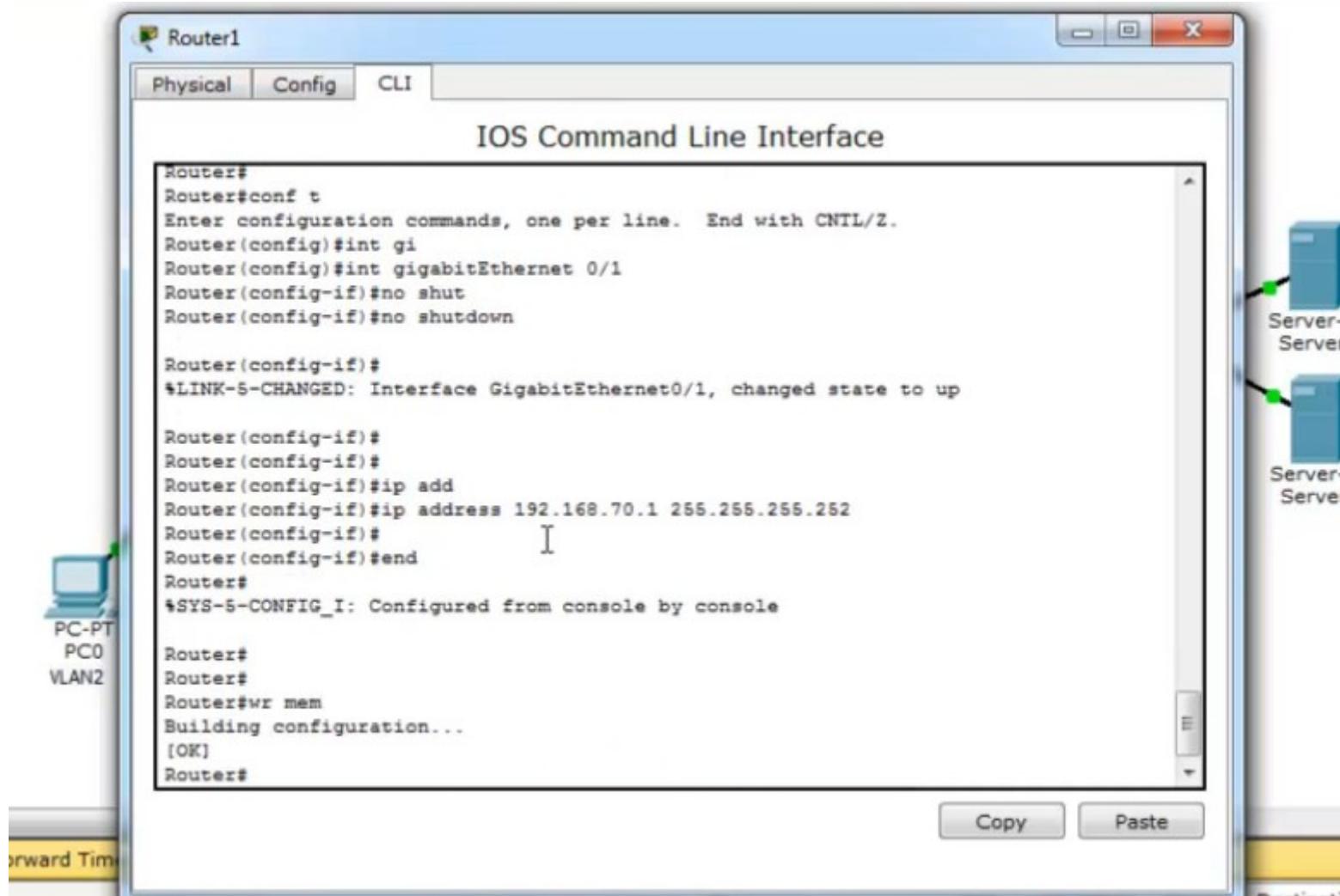
Теперь компьютеры пингуются

Статическая маршрутизация



Добавим связь и настроим порт на Router1

Статическая маршрутизация

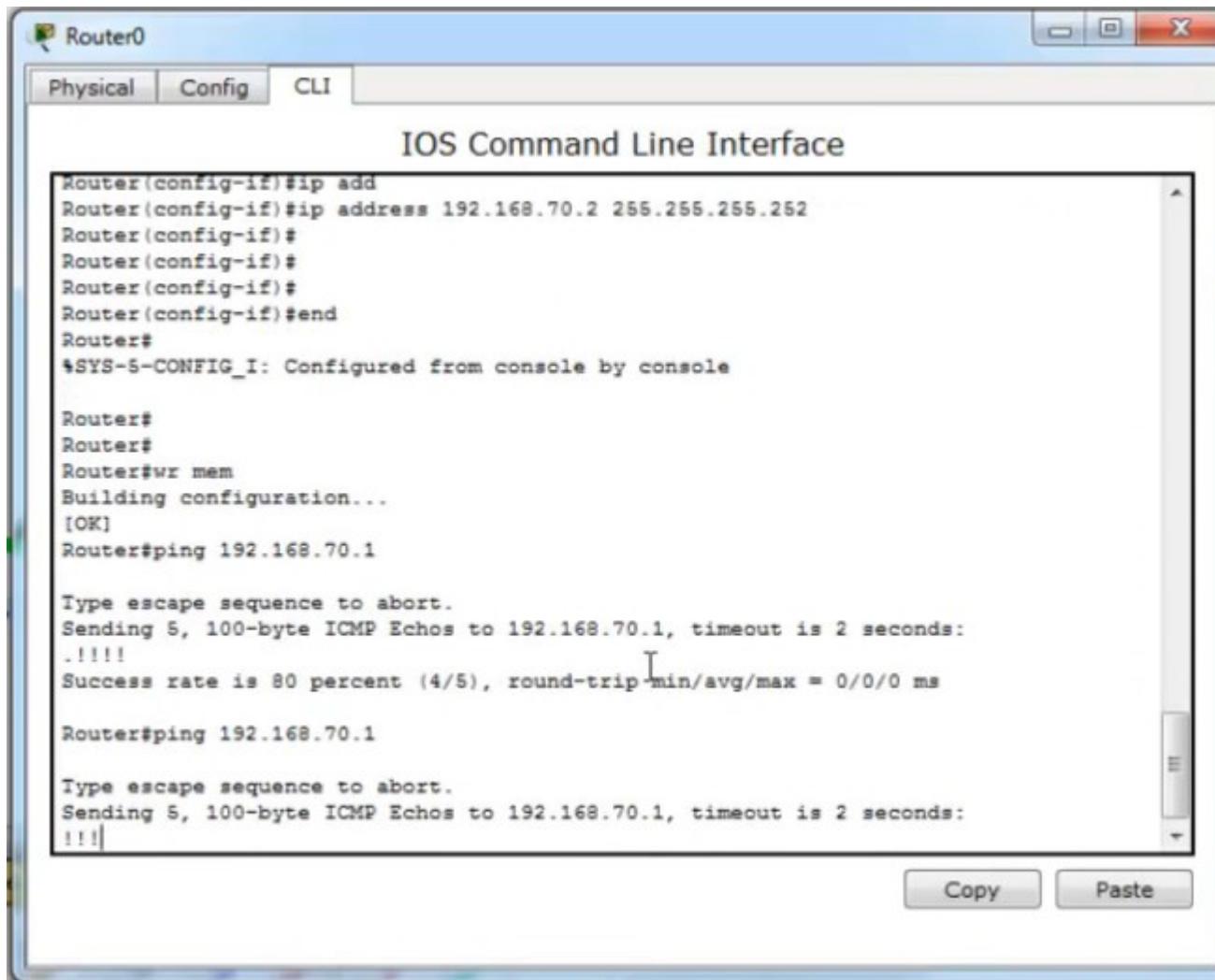


Назначаем IP адрес и шлюз

Статическая маршрутизация

Назначаем IP адрес и шлюз на маршрутизаторе 0

Статическая маршрутизация



The screenshot shows a Windows application window titled "Router0" with three tabs: "Physical", "Config", and "CLI". The "CLI" tab is selected, displaying the "IOS Command Line Interface". The terminal window contains the following text:

```
Router(config-if)#ip add
Router(config-if)#ip address 192.168.70.2 255.255.255.252
Router(config-if)#
Router(config-if)#
Router(config-if)#
Router(config-if)#end
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#
Router#
Router#wr mem
Building configuration...
[OK]
Router#ping 192.168.70.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.70.1, timeout is 2 seconds:
!!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 0/0/0 ms

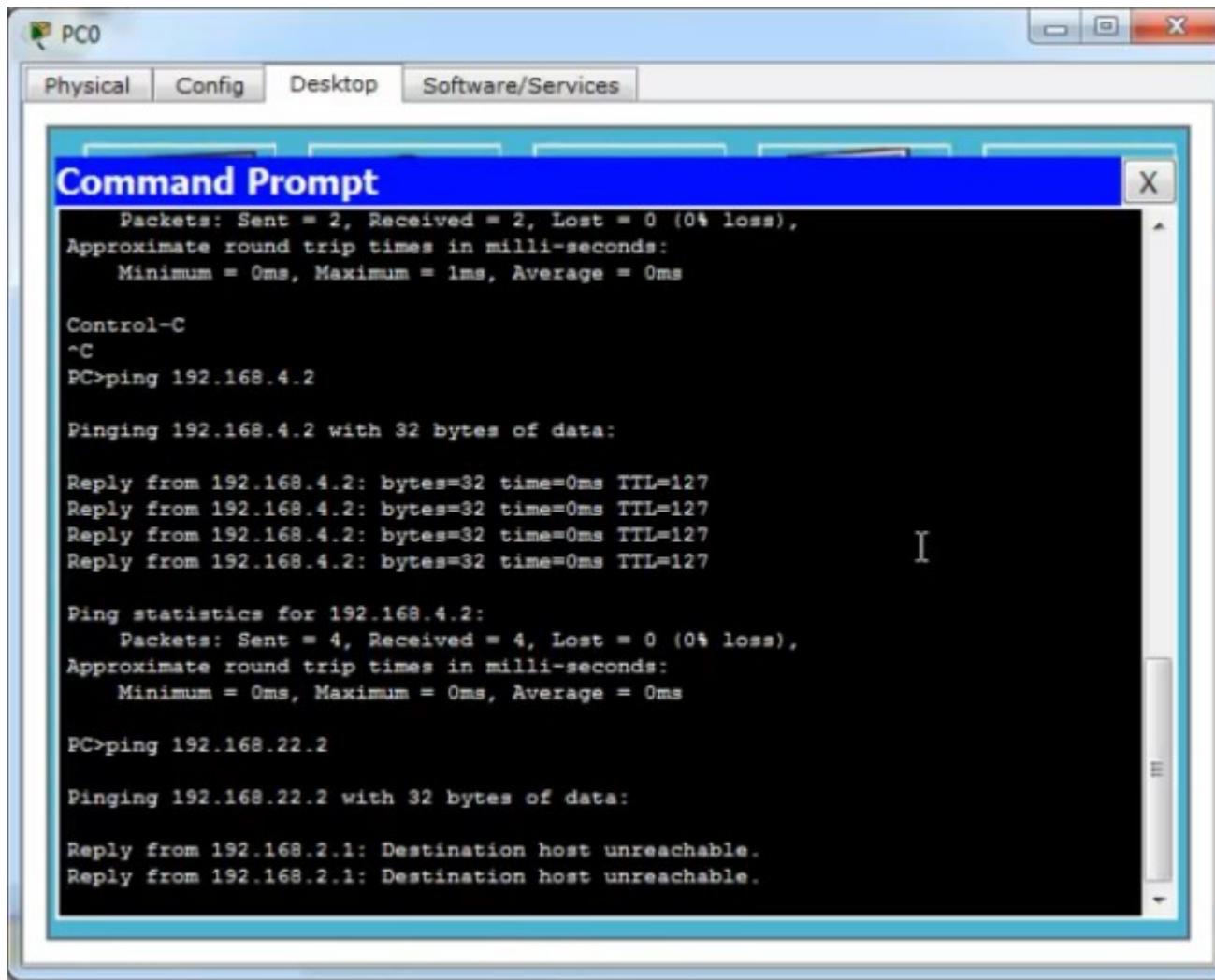
Router#ping 192.168.70.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.70.1, timeout is 2 seconds:
!!!
```

At the bottom of the window are "Copy" and "Paste" buttons.

Сохраняем настройки, пингуем маршрутизатор 1 — работает.

Статическая маршрутизация



```
PC0
Physical Config Desktop Software/Services

Command Prompt
Packets: Sent = 2, Received = 2, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

Control-C
^C
PC>ping 192.168.4.2

Pinging 192.168.4.2 with 32 bytes of data:

Reply from 192.168.4.2: bytes=32 time=0ms TTL=127

Ping statistics for 192.168.4.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

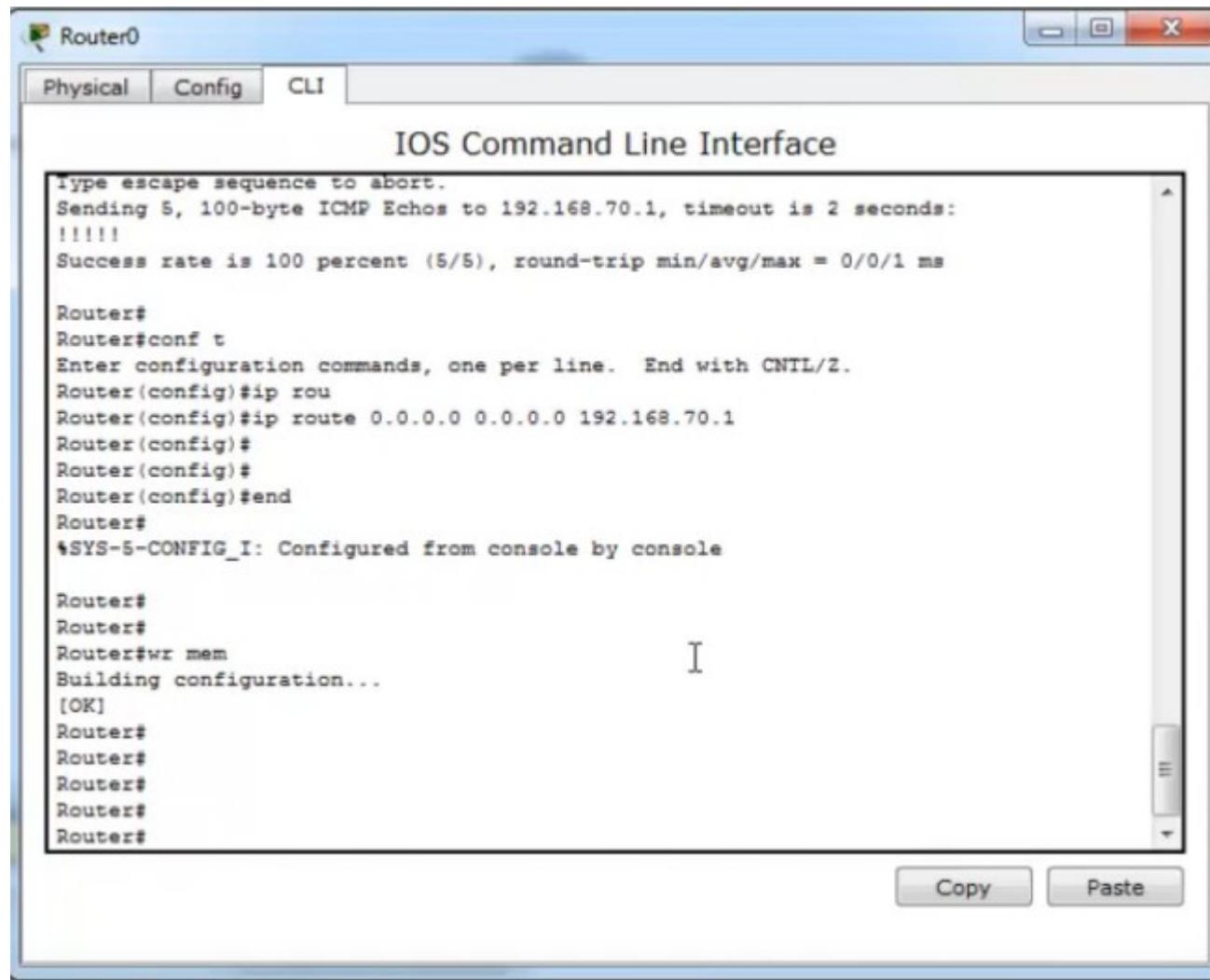
PC>ping 192.168.22.2

Pinging 192.168.22.2 with 32 bytes of data:

Reply from 192.168.2.1: Destination host unreachable.
Reply from 192.168.2.1: Destination host unreachable.
```

Пробуем пинг с PC0 на PC3 — не проходит.
Т.к. нет подходящих маршрутов на роутере0.

Статическая маршрутизация



The screenshot shows a Windows application window titled "Router0" with three tabs: "Physical", "Config", and "CLI". The "CLI" tab is selected, displaying the "IOS Command Line Interface". The terminal window shows the following command-line session:

```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.70.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms

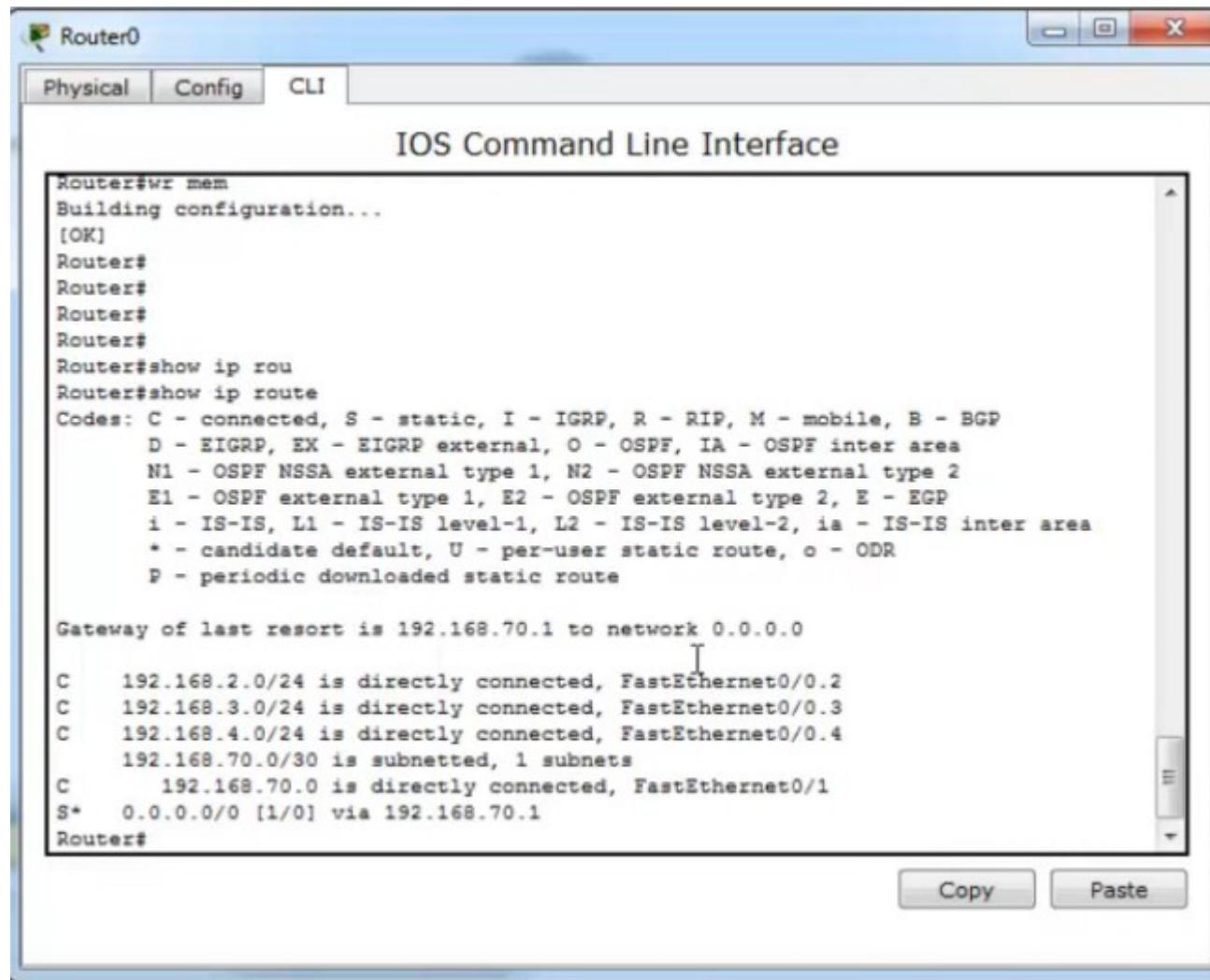
Router#
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#ip rou
Router(config)#ip route 0.0.0.0 0.0.0.0 192.168.70.1
Router(config)#
Router(config)#
Router(config)#end
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#
Router#
Router#wr mem
Building configuration...
[OK]
Router#
Router#
Router#
Router#
Router#
```

At the bottom of the window are "Copy" and "Paste" buttons.

Добавляем маршрут по умолчанию.

Статическая маршрутизация

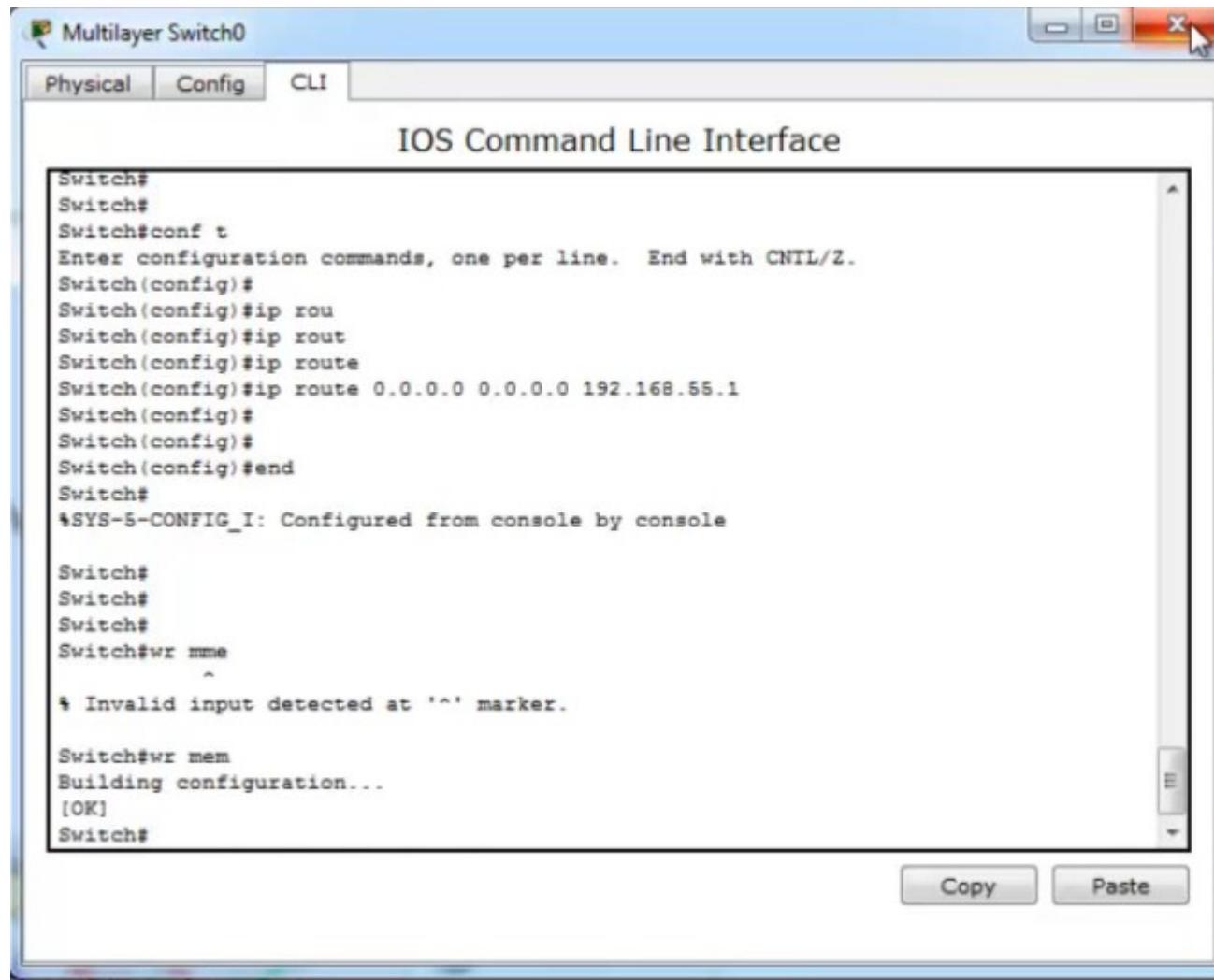


```
Router#wr mem
Building configuration...
[OK]
Router#
Router#
Router#
Router#
Router#show ip rou
Router#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
      i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
      * - candidate default, U - per-user static route, o - ODR
      P - periodic downloaded static route

Gateway of last resort is 192.168.70.1 to network 0.0.0.0
          |
C    192.168.2.0/24 is directly connected, FastEthernet0/0.2
C    192.168.3.0/24 is directly connected, FastEthernet0/0.3
C    192.168.4.0/24 is directly connected, FastEthernet0/0.4
      192.168.70.0/30 is subnetted, 1 subnets
C      192.168.70.0 is directly connected, FastEthernet0/1
S*    0.0.0.0/0 [1/0] via 192.168.70.1
Router#
```

Смотрим конфигурацию маршрутов

Статическая маршрутизация



The screenshot shows a Windows application window titled "Multilayer Switch0" with a tab bar at the top: "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". The terminal window displays the following configuration commands:

```
Switch#
Switch#
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#
Switch(config)#ip rou
Switch(config)#ip rout
Switch(config)#ip route
Switch(config)#ip route 0.0.0.0 0.0.0.0 192.168.55.1
Switch(config)#
Switch(config)#
Switch(config)#end
Switch#
*SYS-5-CONFIG_I: Configured from console by console

Switch#
Switch#
Switch#
Switch#wr mme
^
* Invalid input detected at '^' marker.

Switch#wr mem
Building configuration...
[OK]
Switch#
```

At the bottom of the window are two buttons: "Copy" and "Paste".

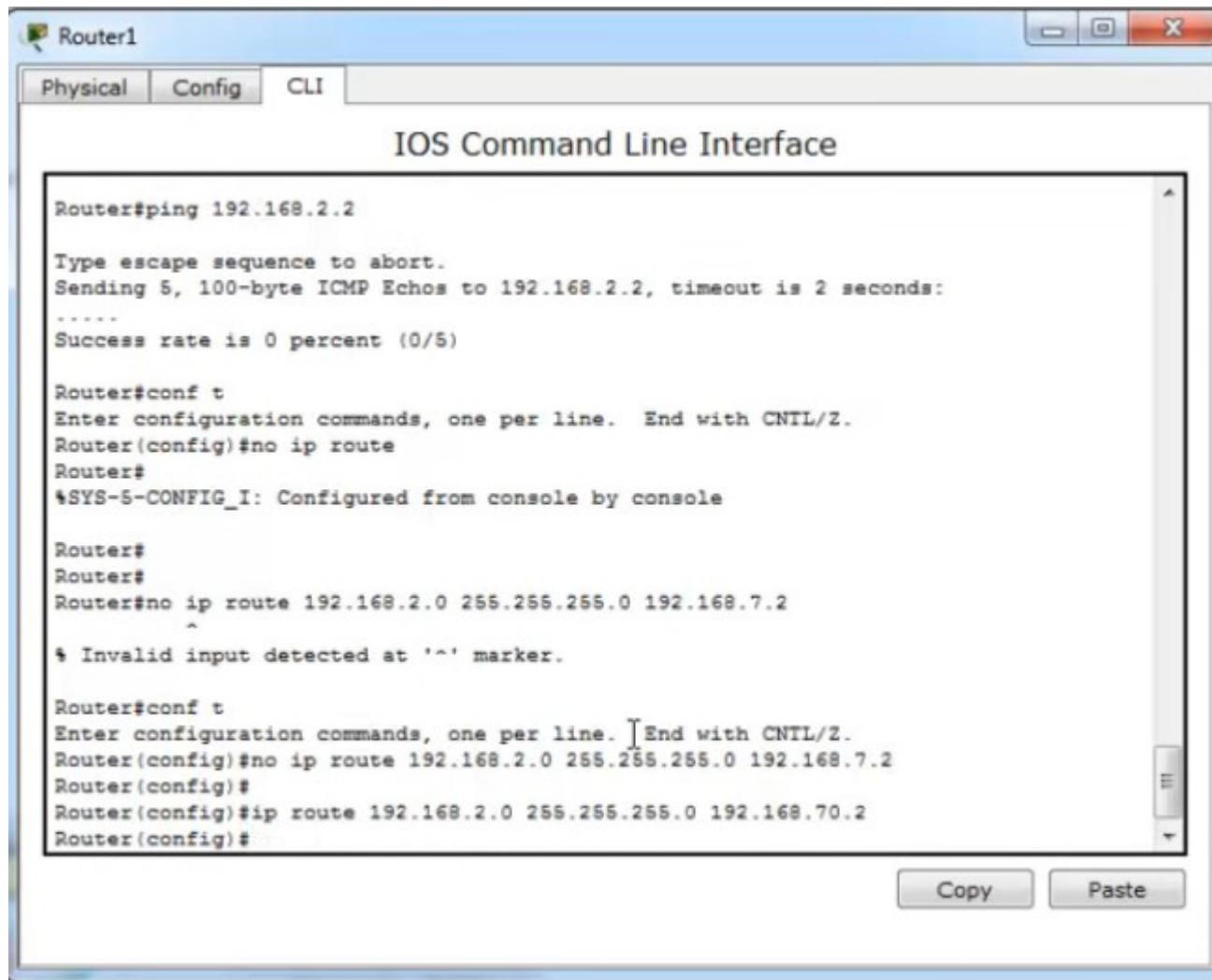
Зададим маршрут по умолчанию на коммутаторе 0.

Статическая маршрутизация

Добавим маршрут на роутер1

Проверим доступность узла 192.168.2.2

Статическая маршрутизация



The screenshot shows a Cisco IOS Command Line Interface (CLI) window titled "Router1". The window has tabs for "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface".

```
Router#ping 192.168.2.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.2.2, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)

Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#no ip route
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#
Router#
Router#no ip route 192.168.2.0 255.255.255.0 192.168.7.2
^
% Invalid input detected at '^' marker.

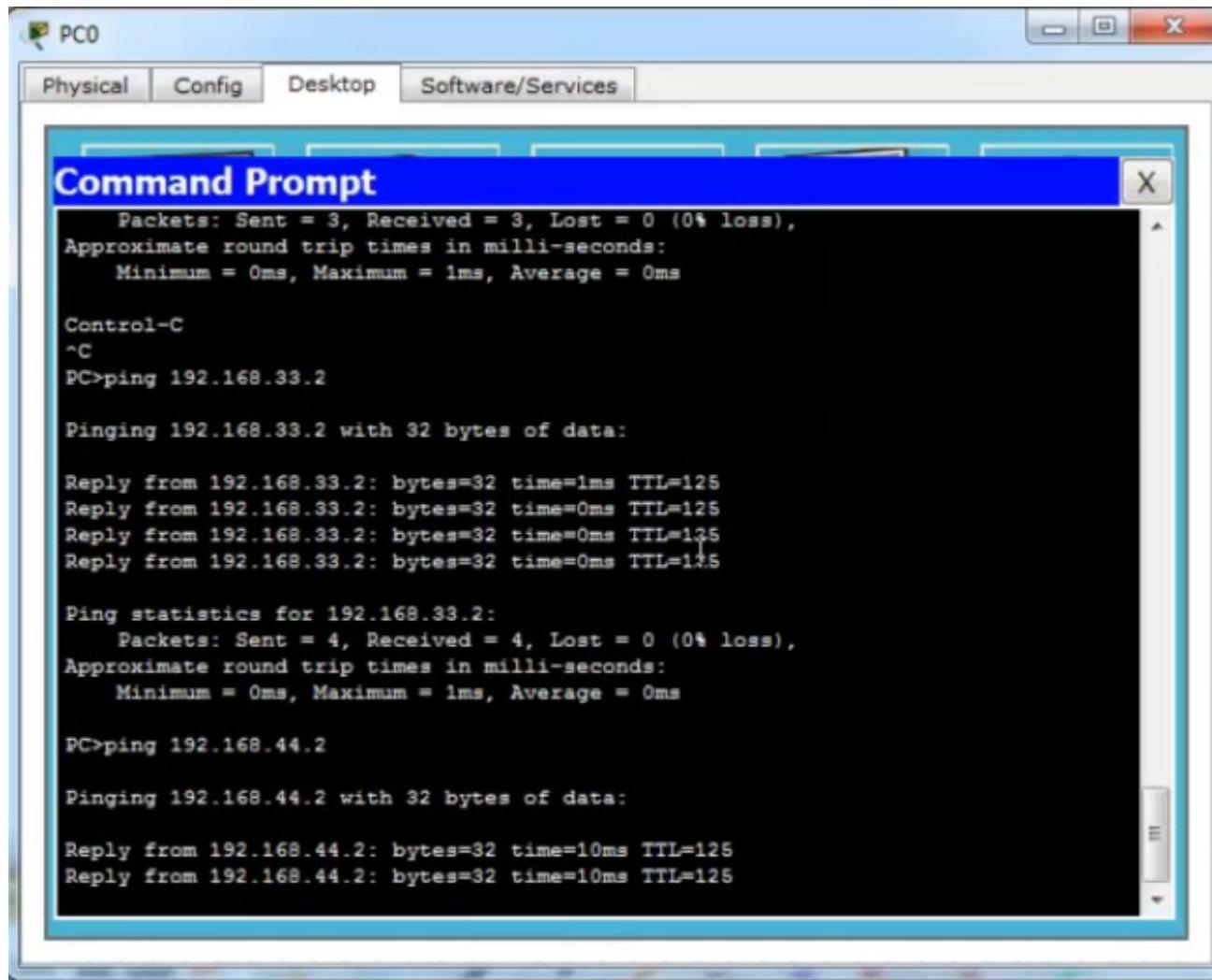
Router#conf t
Enter configuration commands, one per line. ]End with CNTL/Z.
Router(config)#no ip route 192.168.2.0 255.255.255.0 192.168.7.2
Router(config)#
Router(config)#ip route 192.168.2.0 255.255.255.0 192.168.70.2
Router(config)#

```

At the bottom of the window are "Copy" and "Paste" buttons.

Недоступен. Удалим неверный маршрут.
Добавим верный.

Статическая маршрутизация



PC0

Physical Config Desktop Software/Services

Command Prompt

```
Packets: Sent = 3, Received = 3, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

Control-C
^C
PC>ping 192.168.33.2

Pinging 192.168.33.2 with 32 bytes of data:

Reply from 192.168.33.2: bytes=32 time=1ms TTL=125
Reply from 192.168.33.2: bytes=32 time=0ms TTL=125
Reply from 192.168.33.2: bytes=32 time=0ms TTL=125
Reply from 192.168.33.2: bytes=32 time=0ms TTL=125

Ping statistics for 192.168.33.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

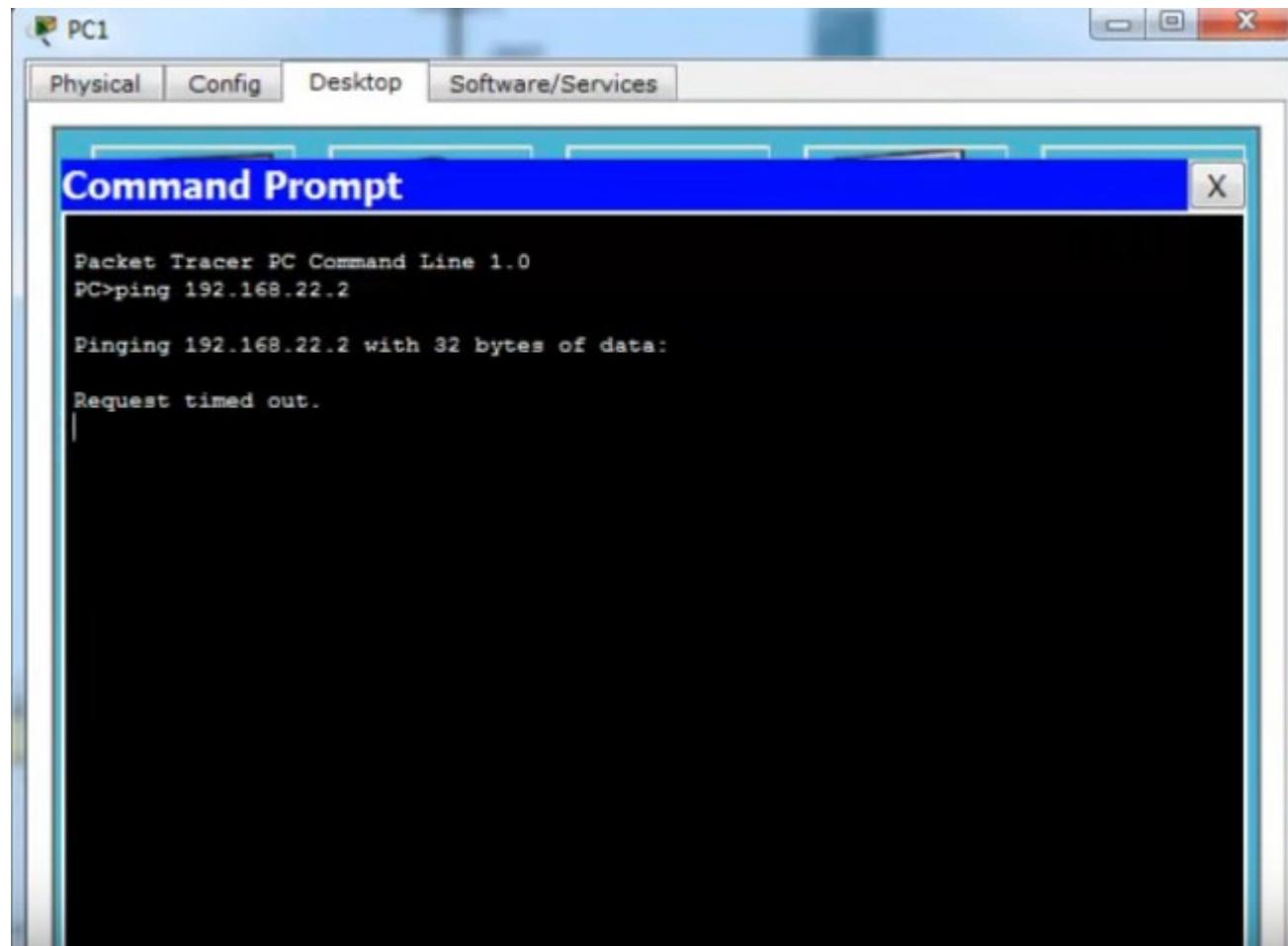
PC>ping 192.168.44.2

Pinging 192.168.44.2 with 32 bytes of data:

Reply from 192.168.44.2: bytes=32 time=10ms TTL=125
Reply from 192.168.44.2: bytes=32 time=10ms TTL=125
```

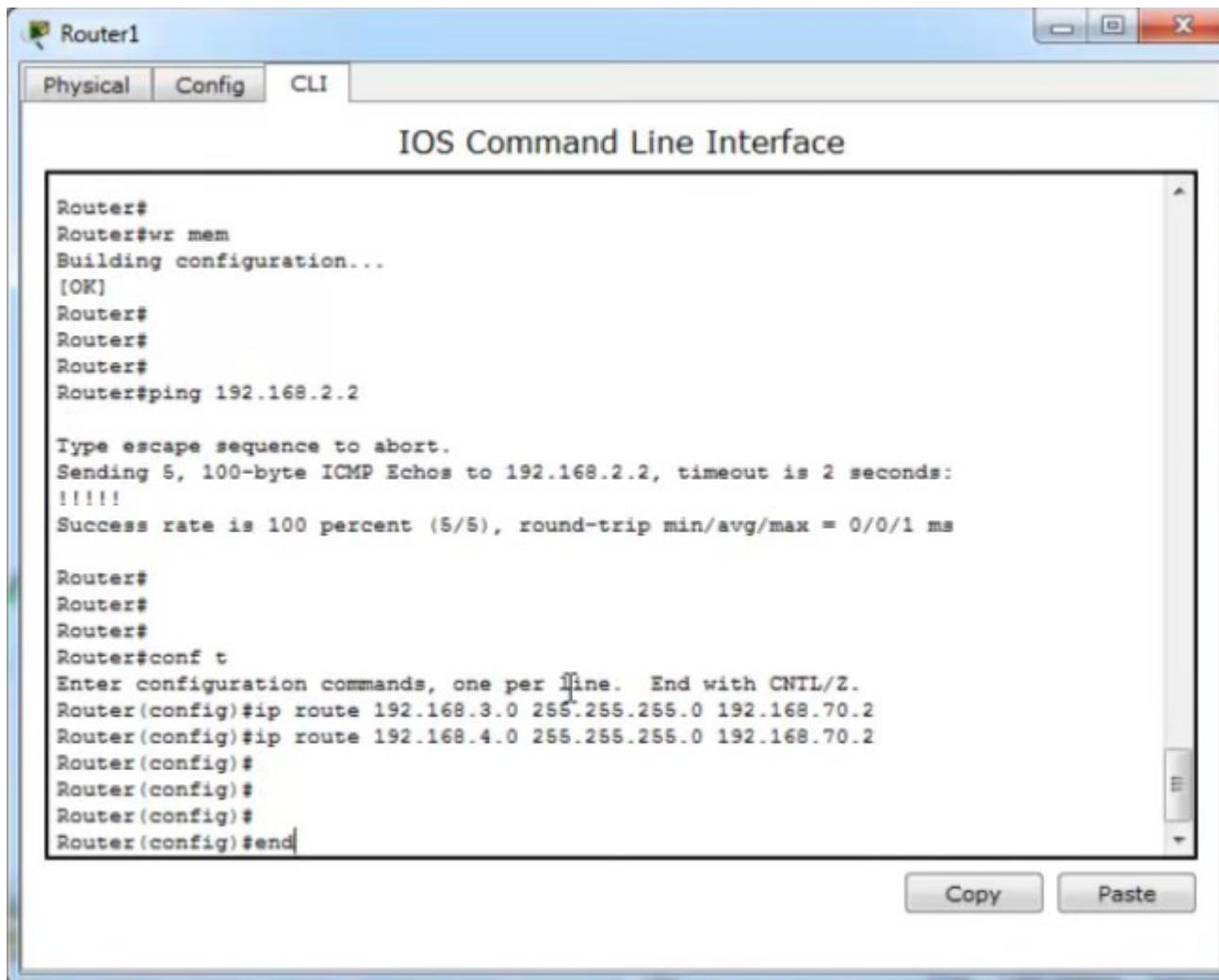
Пингуем узлы с PC0 — работает.

Статическая маршрутизация



Пингуем узлы с PC1 — нет.

Статическая маршрутизация



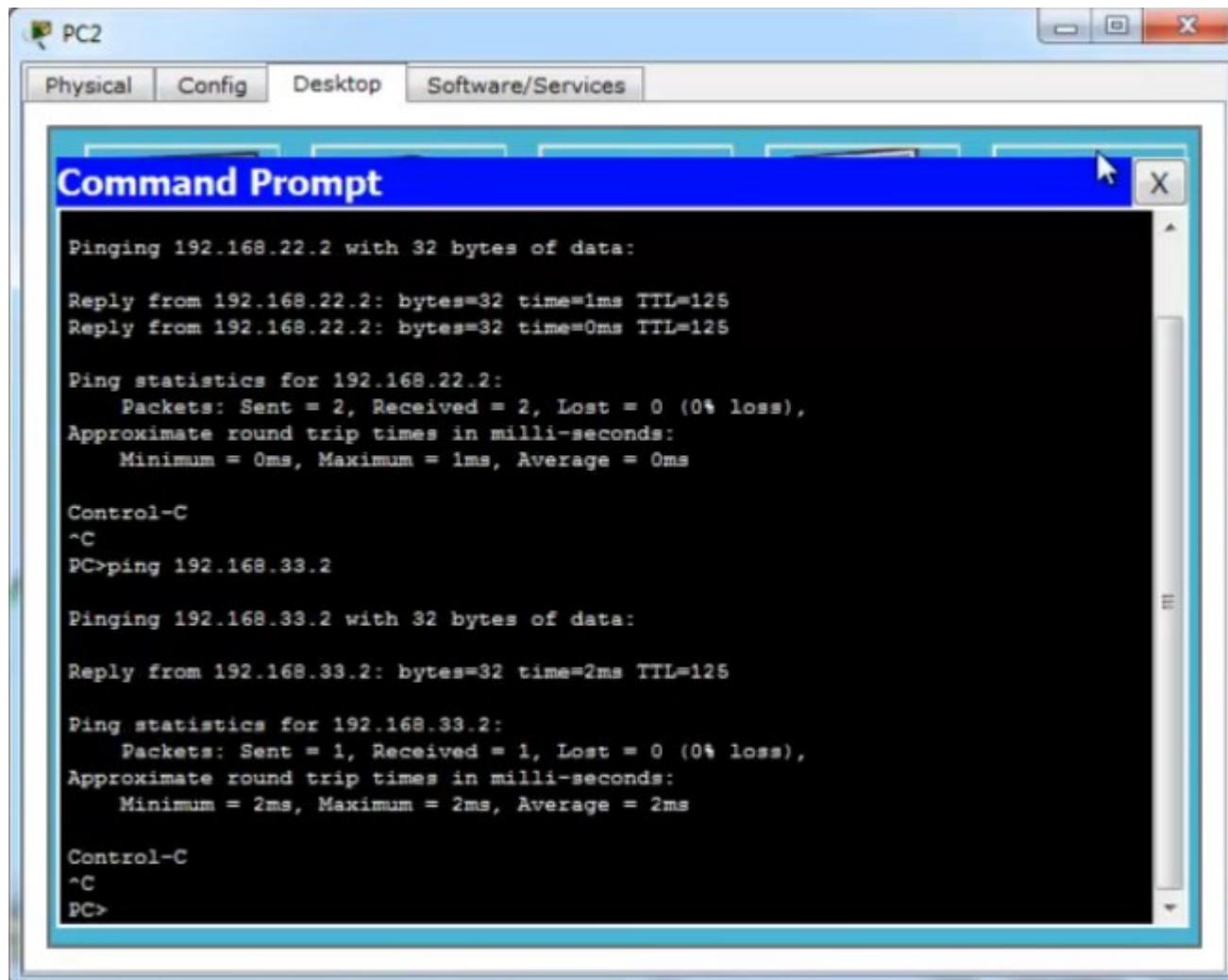
The screenshot shows a Windows application window titled "Router1". The window has three tabs at the top: "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". The terminal window displays the following command-line session:

```
Router#  
Router#wr mem  
Building configuration...  
[OK]  
Router#  
Router#  
Router#  
Router#ping 192.168.2.2  
  
Type escape sequence to abort.  
Sending 5, 100-byte ICMP Echos to 192.168.2.2, timeout is 2 seconds:  
!!!!!!  
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms  
  
Router#  
Router#  
Router#  
Router#conf t  
Enter configuration commands, one per line. End with CNTL/Z.  
Router(config)#ip route 192.168.3.0 255.255.255.0 192.168.70.2  
Router(config)#ip route 192.168.4.0 255.255.255.0 192.168.70.2  
Router(config)#  
Router(config)#  
Router(config)#  
Router(config)#end
```

At the bottom of the terminal window, there are "Copy" and "Paste" buttons.

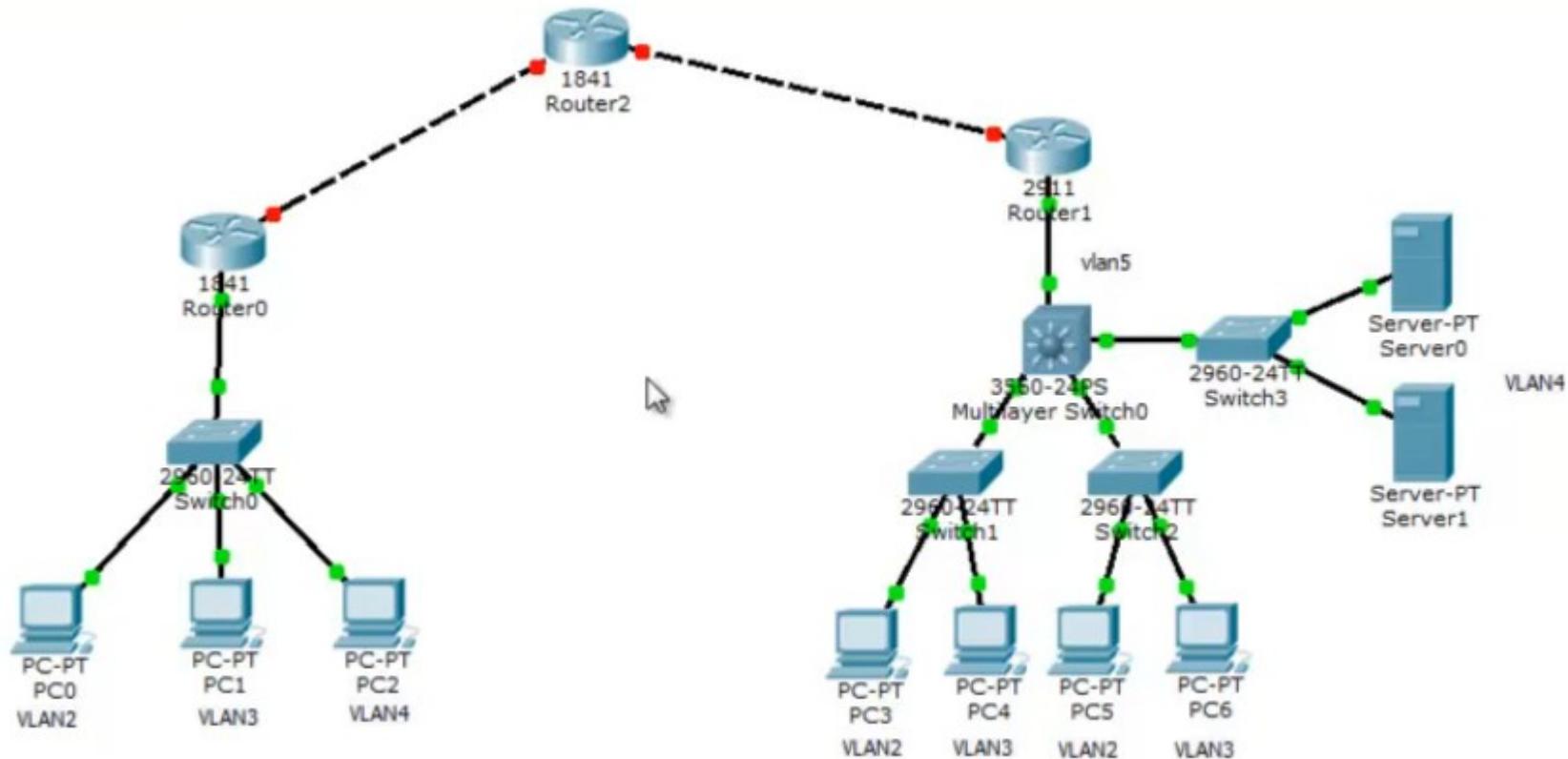
Добавляем необходимые маршруты на роутер1

Статическая маршрутизация



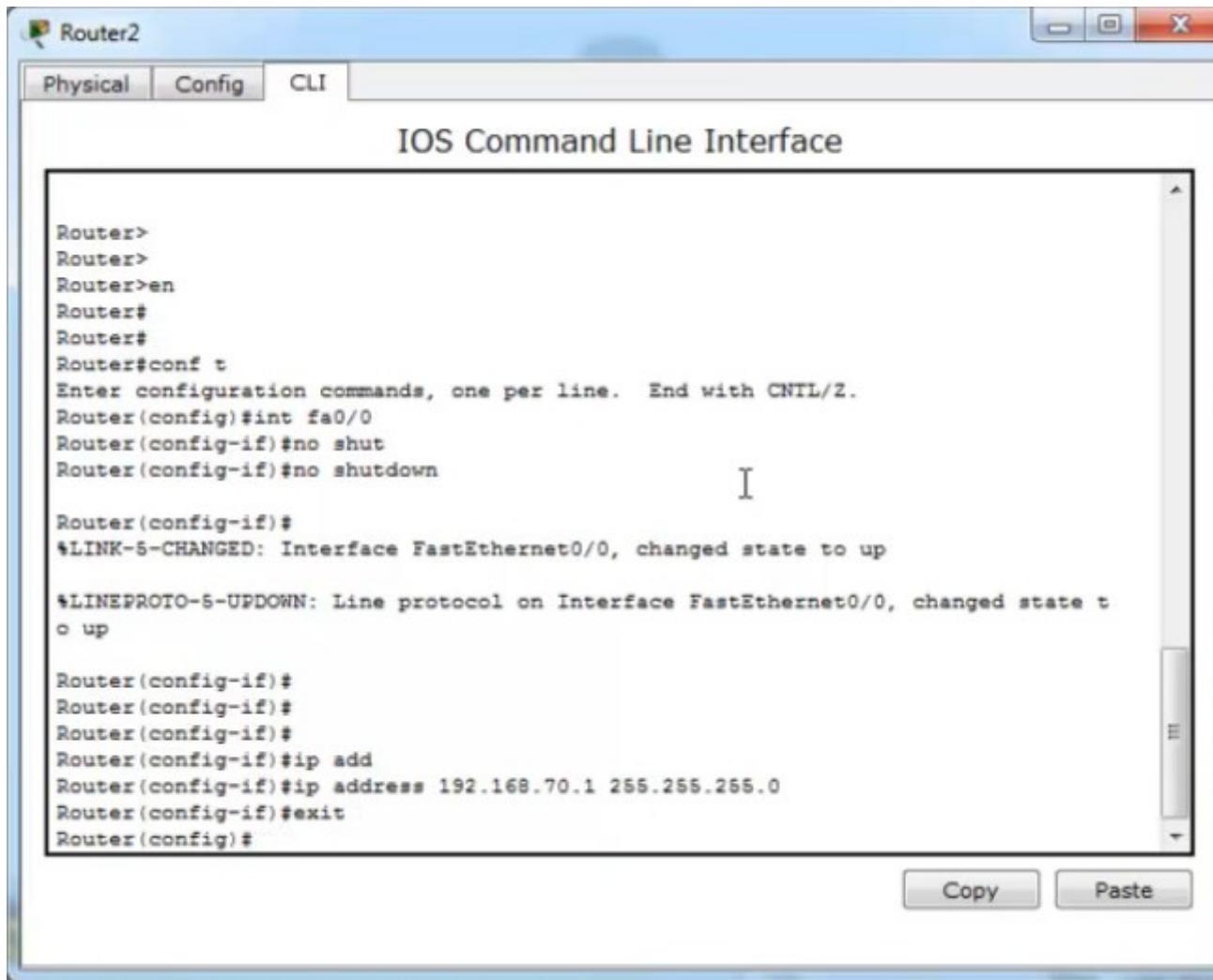
Пингуем с PC2 узлы — работает.

Статическая маршрутизация



Добавим еще один роутер

Статическая маршрутизация



The screenshot shows the Cisco IOS Command Line Interface (CLI) running on a device named 'Router2'. The window title is 'Router2'. The tabs at the top are 'Physical', 'Config' (which is selected), and 'CLI'. The main area is titled 'IOS Command Line Interface'. The CLI session shows the following configuration commands:

```
Router>
Router>
Router>en
Router#
Router#
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#int fa0/0
Router(config-if)#no shut
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

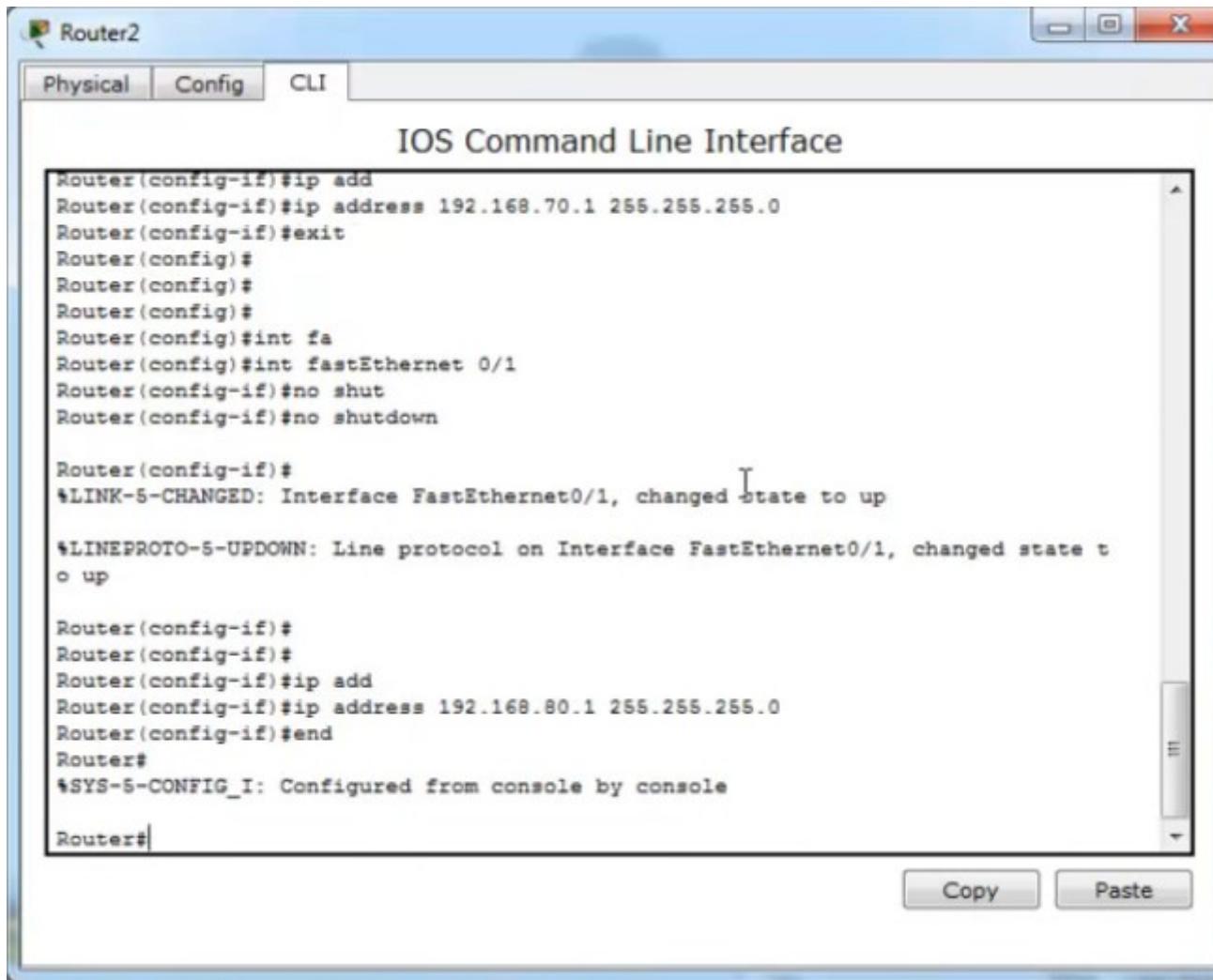
Router(config-if)#
Router(config-if)#
Router(config-if)#
Router(config-if)#ip add
Router(config-if)#ip address 192.168.70.1 255.255.255.0
Router(config-if)#exit
Router(config)#

```

At the bottom of the window are 'Copy' and 'Paste' buttons.

Настраиваем интерфейс на роутере2

Статическая маршрутизация



The screenshot shows a Windows-style application window titled "Router2". The window has three tabs at the top: "Physical", "Config", and "CLI". The "CLI" tab is selected, displaying the "IOS Command Line Interface". The terminal window contains the following configuration commands:

```
Router(config-if)#ip add
Router(config-if)#ip address 192.168.70.1 255.255.255.0
Router(config-if)#exit
Router(config)#
Router(config)#
Router(config)#
Router(config-if)#int fa
Router(config-if)#int fastEthernet 0/1
Router(config-if)#no shut
Router(config-if)#no shutdown

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

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up

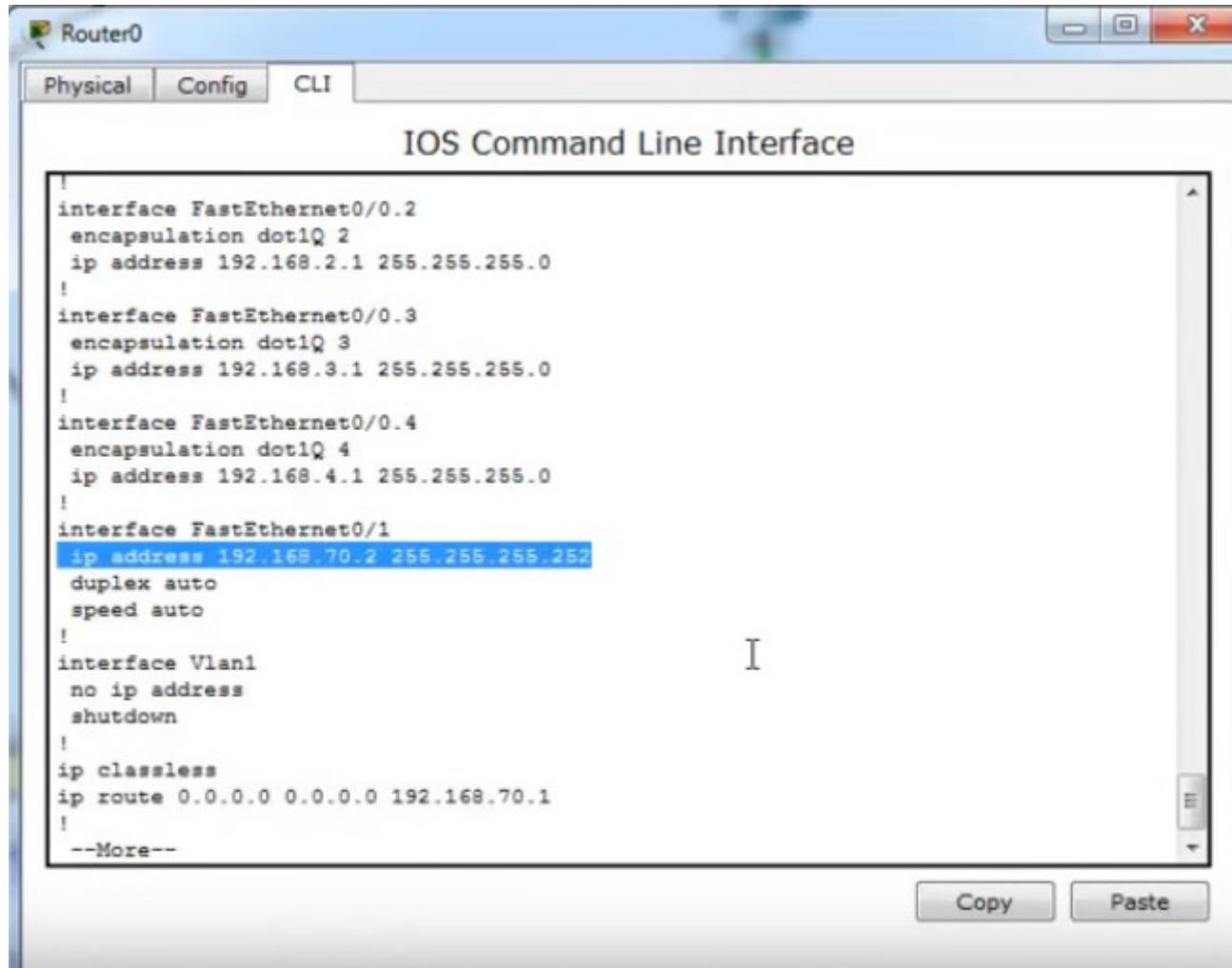
Router(config-if)#
Router(config-if)#
Router(config-if)#ip add
Router(config-if)#ip address 192.168.80.1 255.255.255.0
Router(config-if)#end
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#
```

At the bottom of the window, there are "Copy" and "Paste" buttons.

Настраиваем второй интерфейс на роутере2

Статическая маршрутизация



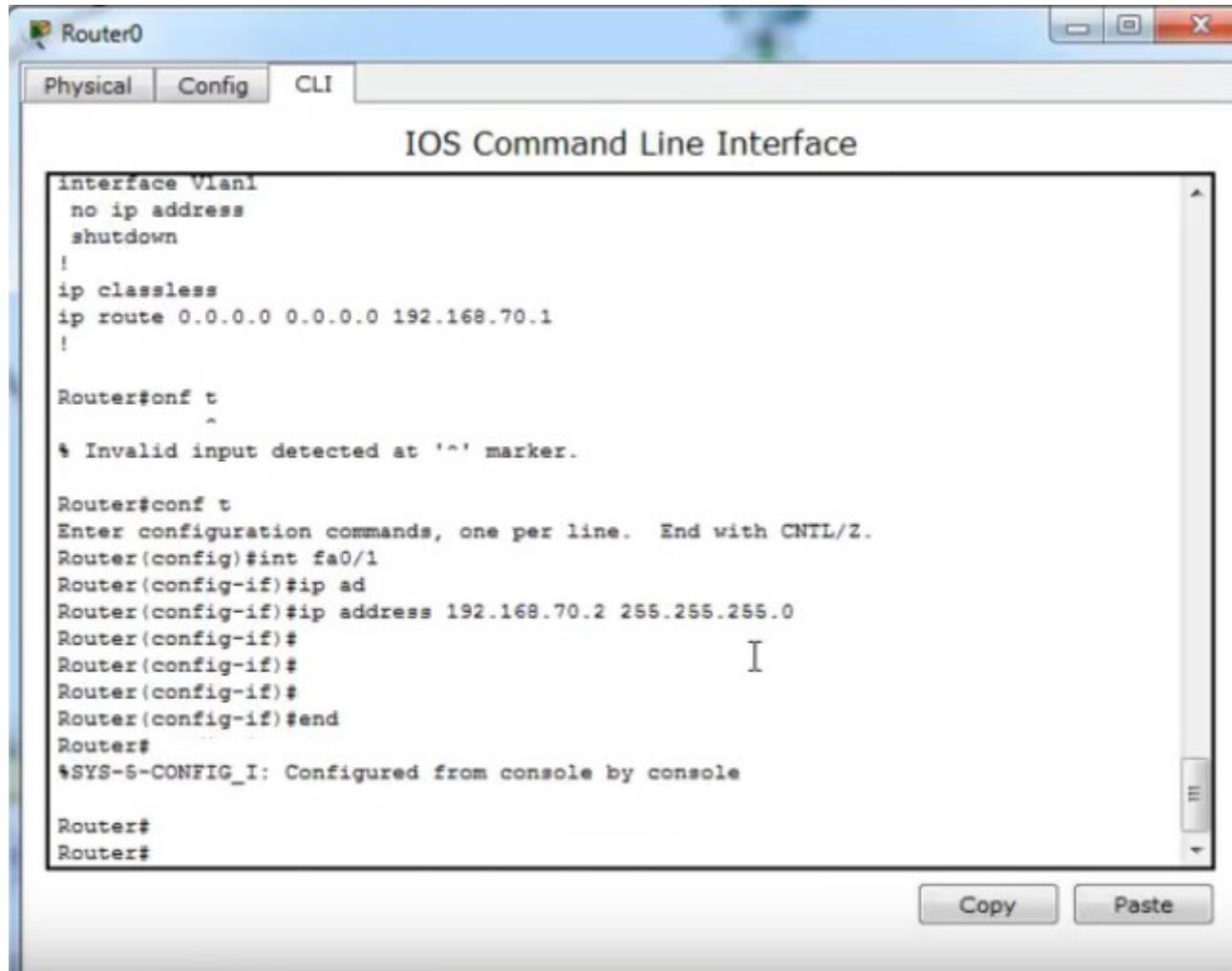
The screenshot shows a Windows-style application window titled "Router0". The window has three tabs at the top: "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". The configuration commands displayed are:

```
!
interface FastEthernet0/0.2
encapsulation dot1Q 2
ip address 192.168.2.1 255.255.255.0
!
interface FastEthernet0/0.3
encapsulation dot1Q 3
ip address 192.168.3.1 255.255.255.0
!
interface FastEthernet0/0.4
encapsulation dot1Q 4
ip address 192.168.4.1 255.255.255.0
!
interface FastEthernet0/1
ip address 192.168.70.2 255.255.255.252
duplex auto
speed auto
!
interface Vlan1
no ip address
shutdown
!
ip classless
ip route 0.0.0.0 0.0.0.0 192.168.70.1
!
--More--
```

At the bottom of the window are two buttons: "Copy" and "Paste".

Необходимо изменить маску в маршруте на роутер0

Статическая маршрутизация



The screenshot shows a Windows-style application window titled "Router0". The window has three tabs at the top: "Physical", "Config" (which is selected), and "CLI". The main area is titled "IOS Command Line Interface". The terminal window displays the following configuration commands and errors:

```
interface Vlan1
no ip address
shutdown
!
ip classless
ip route 0.0.0.0 0.0.0.0 192.168.70.1
!

Router#conf t
      ^
* Invalid input detected at '^' marker.

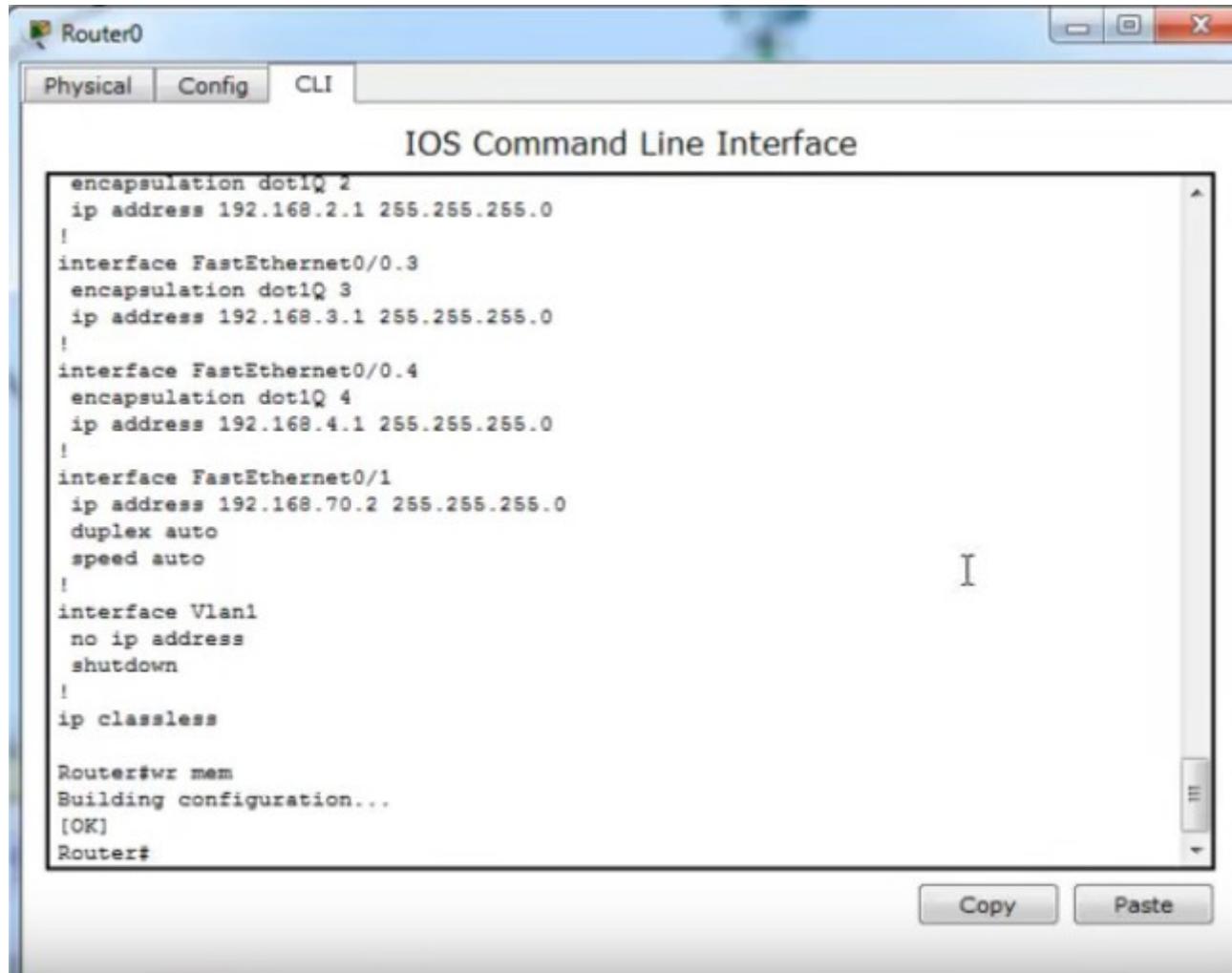
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#int fa0/1
Router(config-if)#ip ad
Router(config-if)#ip address 192.168.70.2 255.255.255.0
Router(config-if)#
Router(config-if)#
Router(config-if)#
Router(config-if)#end
Router#
*SYS-5-CONFIG_I: Configured from console by console

Router#
Router#
```

At the bottom of the window are two buttons: "Copy" and "Paste".

Исправляем ...

Статическая маршрутизация



Router0

Physical Config CLI

IOS Command Line Interface

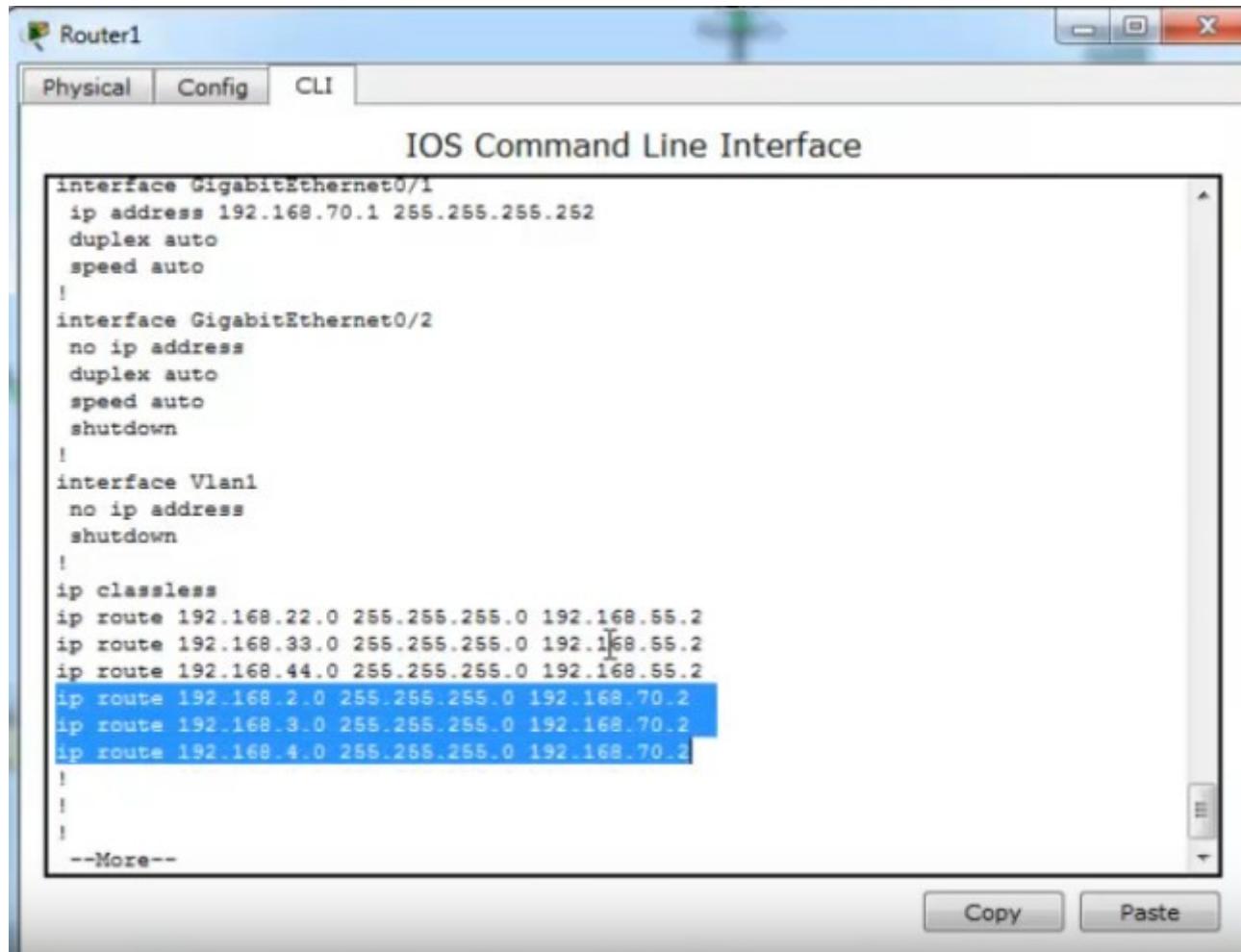
```
encapsulation dot1Q 2
ip address 192.168.2.1 255.255.255.0
!
interface FastEthernet0/0.3
encapsulation dot1Q 3
ip address 192.168.3.1 255.255.255.0
!
interface FastEthernet0/0.4
encapsulation dot1Q 4
ip address 192.168.4.1 255.255.255.0
!
interface FastEthernet0/1
ip address 192.168.70.2 255.255.255.0
duplex auto
speed auto
!
interface Vlan1
no ip address
shutdown
!
ip classless

Router#wr mem
Building configuration...
[OK]
Router#
```

Copy Paste

Проверяем, сохраняем ...

Статическая маршрутизация



The screenshot shows a Cisco IOS Command Line Interface window titled "Router1". The window has tabs for "Physical", "Config", and "CLI", with "CLI" selected. The main area displays the following configuration:

```
IOS Command Line Interface
interface GigabitEthernet0/1
ip address 192.168.70.1 255.255.255.252
duplex auto
speed auto
!
interface GigabitEthernet0/2
no ip address
duplex auto
speed auto
shutdown
!
interface Vlan1
no ip address
shutdown
!
ip classless
ip route 192.168.22.0 255.255.255.0 192.168.55.2
ip route 192.168.33.0 255.255.255.0 192.168.55.2
ip route 192.168.44.0 255.255.255.0 192.168.55.2
ip route 192.168.2.0 255.255.255.0 192.168.70.2
ip route 192.168.3.0 255.255.255.0 192.168.70.2
ip route 192.168.4.0 255.255.255.0 192.168.70.2
!
!
!
--More--
```

At the bottom of the window are "Copy" and "Paste" buttons.

Необходимо поменять маршруты на роутере1, т. к. соседний роутер поменялся.

Статическая маршрутизация

Добавляем ...

Статическая маршрутизация

Router1

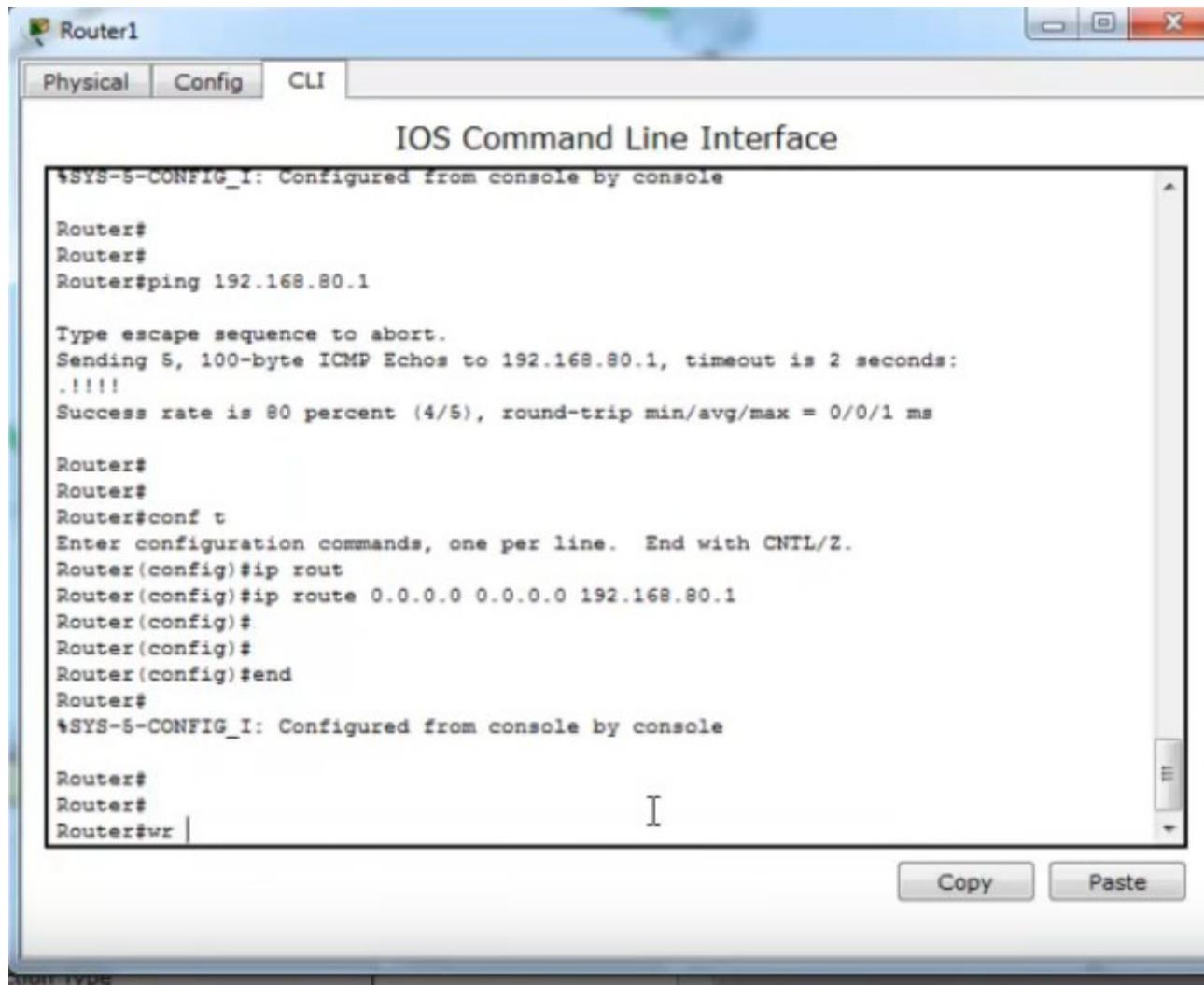
Physical Config CLI

IOS Command Line Interface

```
ip route 192.168.33.0 255.255.255.0 192.168.55.2
ip route 192.168.44.0 255.255.255.0 192.168.55.2
ip route 192.168.2.0 255.255.255.0 192.168.70.2
ip route 192.168.3.0 255.255.255.0 192.168.70.2
ip route 192.168.4.0 255.255.255.0 192.168.70.2
!
!
!
!
!
!
!
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#no ip route 192.168.2.0 255.255.255.0 192.168.70.2
Router(config)#no ip route 192.168.3.0 255.255.255.0 192.168.70.2
Router(config)#no ip route 192.168.4.0 255.255.255.0 192.168.70.2
Router(config)#
Router(config)#
Router(config)#
Router(config)#end
Router#
%SYS-5-CONFIG_I: Configured from console by console
Router#
Router#
```

Удаляем старые ...

Статическая маршрутизация



The screenshot shows a Cisco IOS Command Line Interface (CLI) window titled "Router1". The window has three tabs: "Physical", "Config", and "CLI", with "CLI" selected. The main area displays the following command-line session:

```
*SYS-5-CONFIG_I: Configured from console by console

Router#
Router#
Router#ping 192.168.80.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.80.1, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 0/0/1 ms

Router#
Router#
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#ip rout
Router(config)#ip route 0.0.0.0 0.0.0.0 192.168.80.1
Router(config)#
Router(config)#
Router(config)#end
Router#
*SYS-5-CONFIG_I: Configured from console by console

Router#
Router#
Router#wr |
```

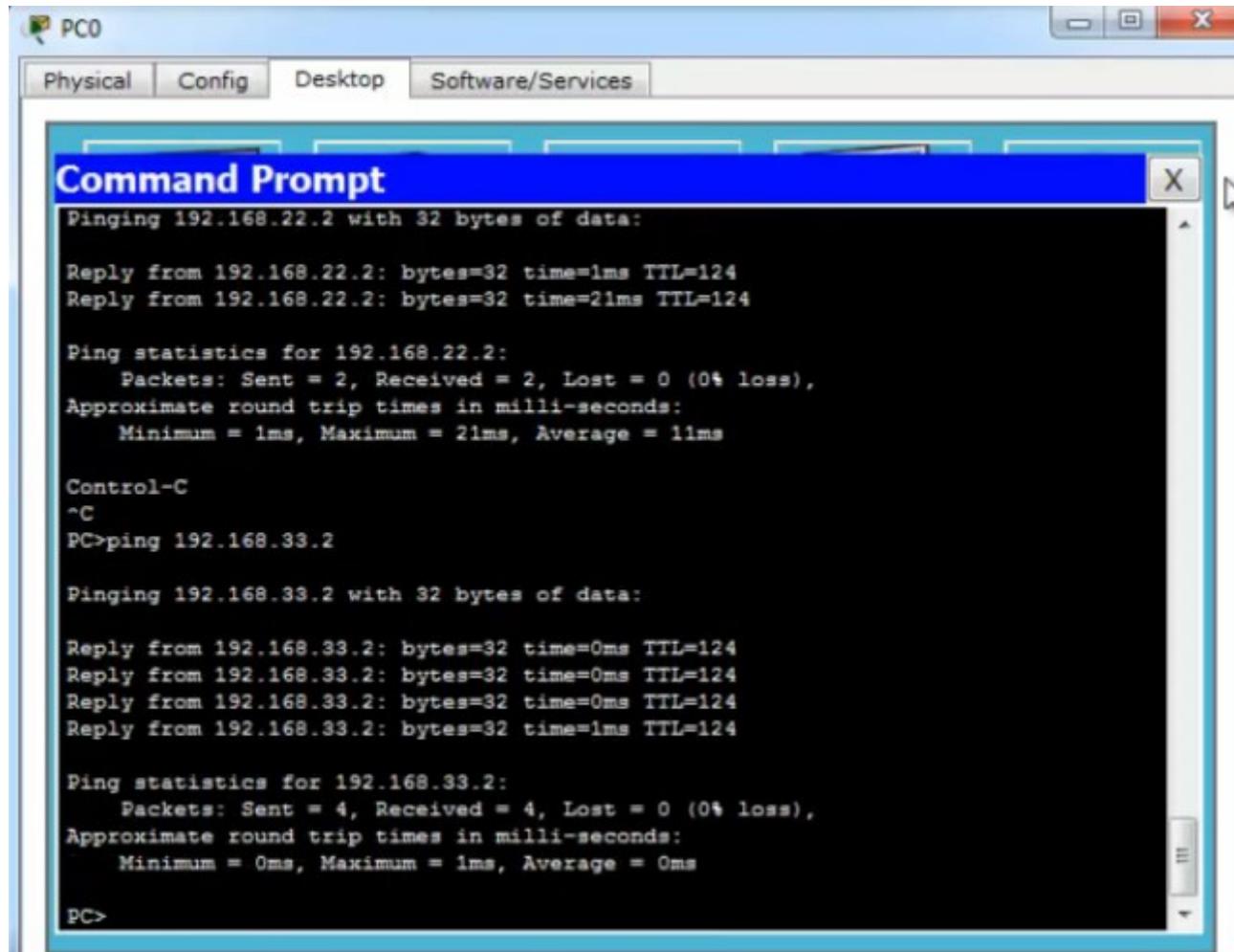
At the bottom of the window, there are "Copy" and "Paste" buttons.

Добавляем маршрут по умолчанию.

Статическая маршрутизация

Добавляем маршруты в роутер2.

Статическая маршрутизация



```
PC0
Physical Config Desktop Software/Services

Command Prompt
X
Pinging 192.168.22.2 with 32 bytes of data:
Reply from 192.168.22.2: bytes=32 time=1ms TTL=124
Reply from 192.168.22.2: bytes=32 time=21ms TTL=124

Ping statistics for 192.168.22.2:
  Packets: Sent = 2, Received = 2, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
  Minimum = 1ms, Maximum = 21ms, Average = 11ms

Control-C
^C
PC>ping 192.168.33.2

Pinging 192.168.33.2 with 32 bytes of data:
Reply from 192.168.33.2: bytes=32 time=0ms TTL=124
Reply from 192.168.33.2: bytes=32 time=0ms TTL=124
Reply from 192.168.33.2: bytes=32 time=0ms TTL=124
Reply from 192.168.33.2: bytes=32 time=1ms TTL=124

Ping statistics for 192.168.33.2:
  Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
  Minimum = 0ms, Maximum = 1ms, Average = 0ms

PC>
```

Пингуем узлы с PC0 — работает.