

Лабораторная работа №9

Использование протокола STP. Агрегирование каналов.

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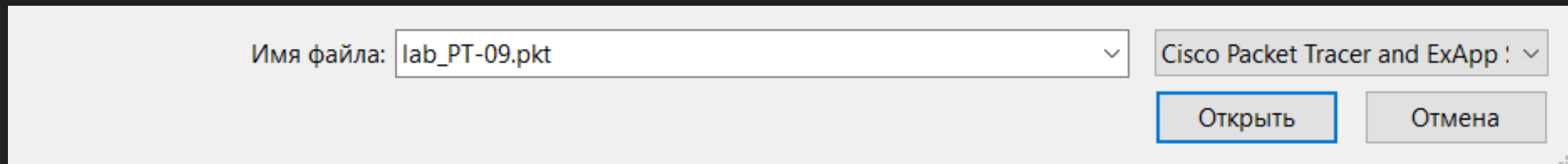
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НПИБД-02-21

Протокол STP

- Основное назначение протокола STP (Spanning Tree Protocol, протокол остовного дерева) — устранение петель в топологии сети на базе технологии Ethernet при наличии избыточных соединений.

Новый проект



Имя файла: lab_PT-09.pkt

Cisco Packet Tracer and ExApp !

Открыть Отмена

The image shows a standard Windows-style file dialog box. On the left, there is a text label 'Имя файла:' followed by a text input field containing 'lab_PT-09.pkt'. To the right of the input field is a small downward-pointing arrow. Further to the right is a button labeled 'Cisco Packet Tracer and ExApp !' with its own downward arrow. Below these elements are two buttons: 'Открыть' (Open) and 'Отмена' (Cancel). The 'Открыть' button is highlighted with a blue border. The entire dialog box has a light gray background and is set against a dark background with a teal header.

Рис. 1.1. Открытие проекта lab_PT-09.pkt.

Резервное соединение

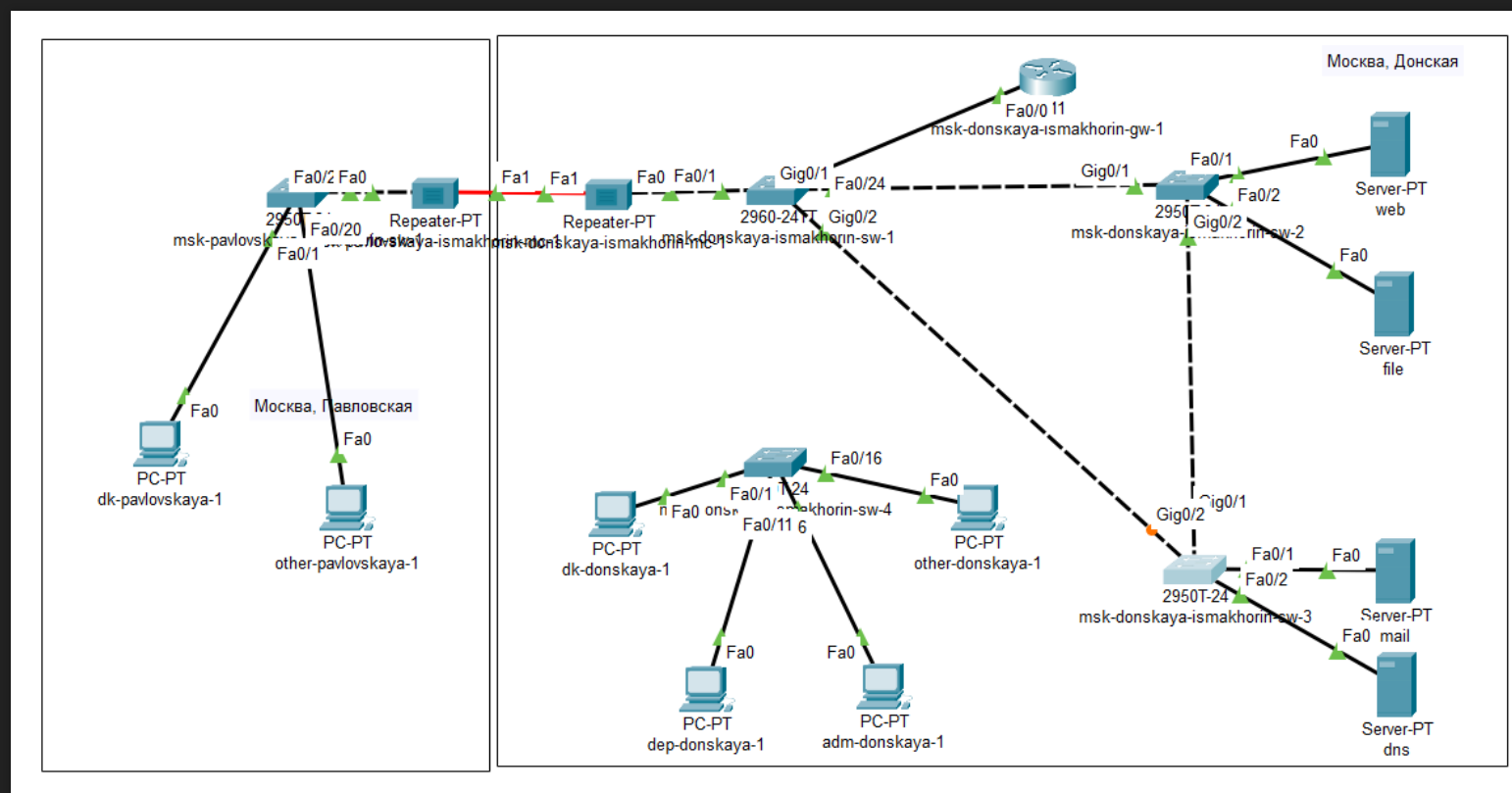


Рис. 1.2. Формирование резервного соединения между коммутаторами **msk-donskaya-ismakhorin-sw-1** и **msk-donskaya-ismakhorin-sw-3** (замена соединения между коммутаторами).

Настройка порта

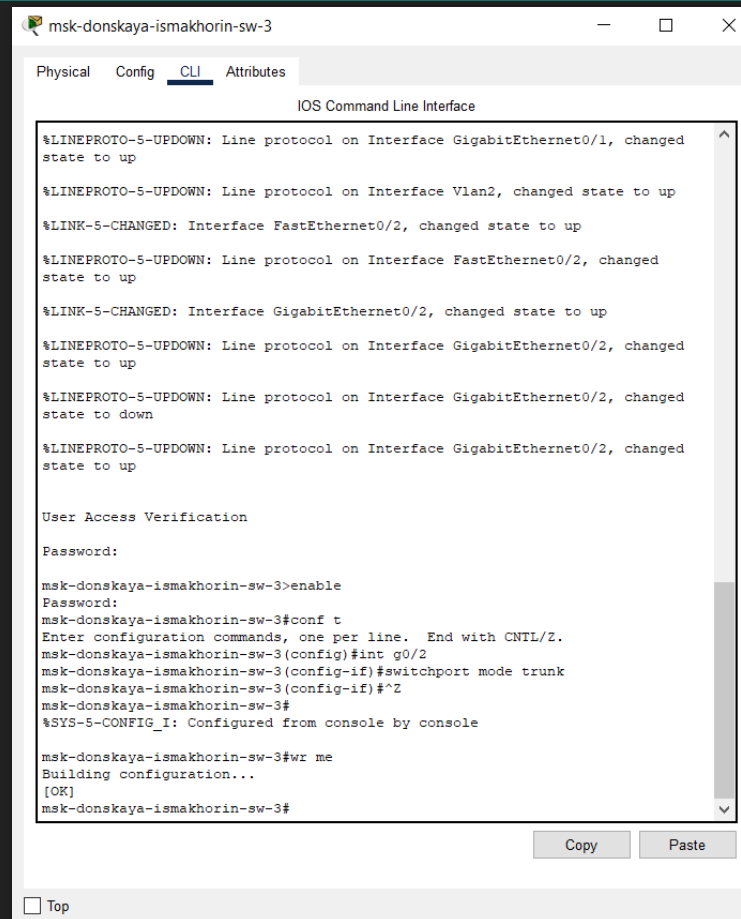


Рис. 1.3. Настройка порта на интерфейсе Gig0/2 коммутатора msk-donskaya-ismakhorin-sw-3 как транковый.

Соединение

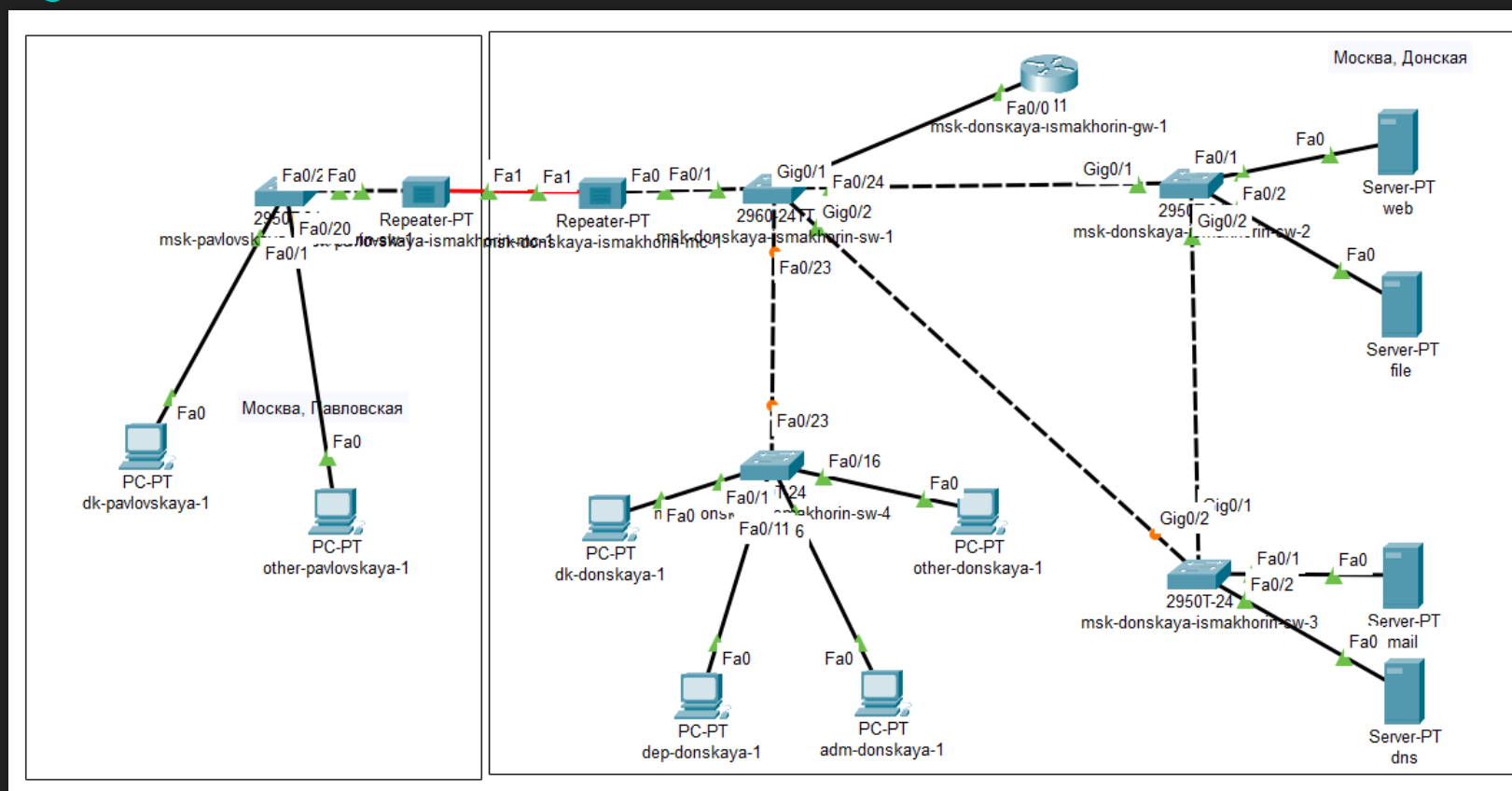



Рис. 1.4. Соединение между коммутаторами `msk-donskaya-ismakhorin-sw-1` и `msk-donskaya-ismakhorin-sw-4` через интерфейсы `Fa0/23`.

Активация (транковый режим)



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

state to up
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
FastEthernet0/23 (1), with msk-donskaya-ismakhorin-sw-4 FastEthernet0/23
(104).

User Access Verification

Password:

msk-donskaya-ismakhorin-sw-1>enable
Password:
msk-donskaya-ismakhorin-sw-1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-ismakhorin-sw-1(config)#int fa0/23
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
FastEthernet0/23 (1), with msk-donskaya-ismakhorin-sw-4 FastEthernet0/23
(104).

msk-donskaya-ismakhorin-sw-1(config-if)#int fa0/23
msk-donskaya-ismakhorin-sw-1(config-if)#switchport mode trunk

msk-donskaya-ismakhorin-sw-1(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed
state to down

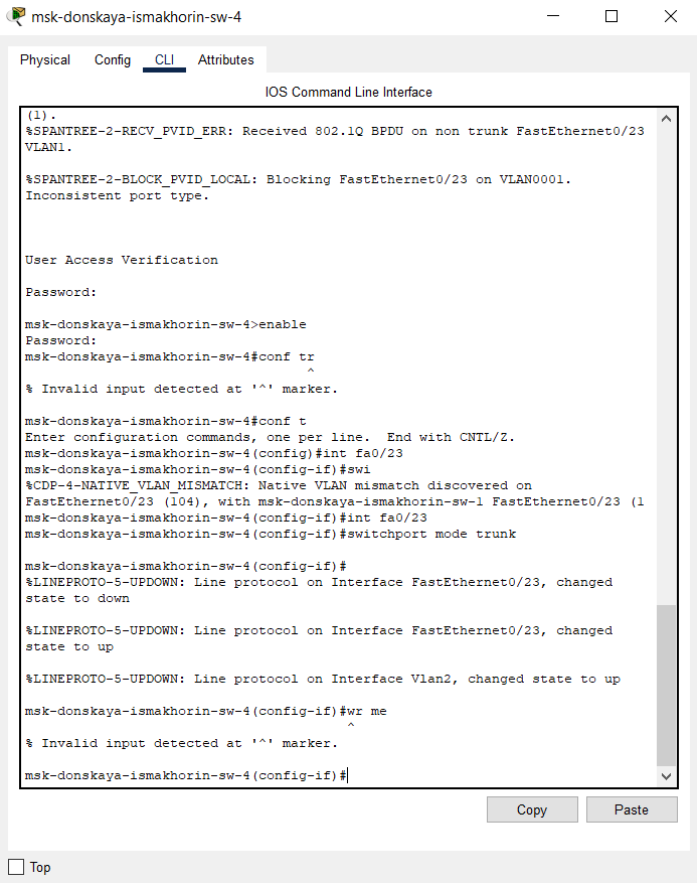
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed
state to up

msk-donskaya-ismakhorin-sw-1(config-if)#^Z
msk-donskaya-ismakhorin-sw-1#
%SYS-5-CONFIG_I: Configured from console by console

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

Рис. 1.5. Активация в транковом режиме интерфейса Fa0/23 на коммутаторе msk-donskaya-ismakhorin-sw-1.

Активация (транковый режим)



```
(1).
%SPANTREE-2-RECV_PVID_ERR: Received 802.1Q BPDU on non trunk FastEthernet0/23
VLAN1.

%SPANTREE-2-BLOCK_PVID_LOCAL: Blocking FastEthernet0/23 on VLAN0001.
Inconsistent port type.

User Access Verification

Password:
msk-donskaya-ismakhorin-sw-4>enable
Password:
msk-donskaya-ismakhorin-sw-4#conf tr
^
% Invalid input detected at '^' marker.

msk-donskaya-ismakhorin-sw-4#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-ismakhorin-sw-4(config)#int fa0/23
msk-donskaya-ismakhorin-sw-4(config-if)#swi
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
FastEthernet0/23 (104), with msk-donskaya-ismakhorin-sw-1 FastEthernet0/23 (1
msk-donskaya-ismakhorin-sw-4(config-if)#int fa0/23
msk-donskaya-ismakhorin-sw-4(config-if)#switchport mode trunk

msk-donskaya-ismakhorin-sw-4(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed
state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed
state to up

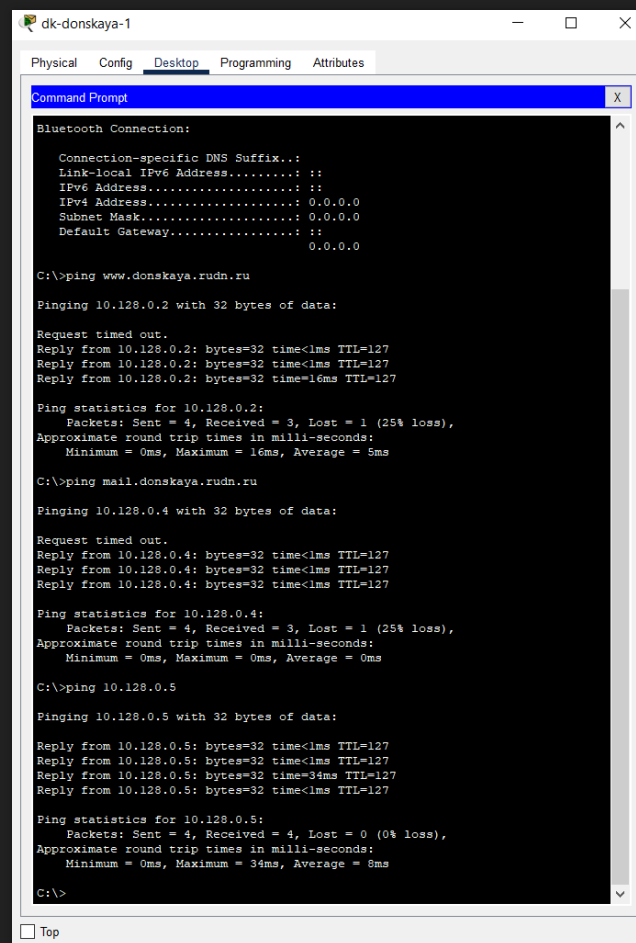
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan2, changed state to up

msk-donskaya-ismakhorin-sw-4(config-if)#wr me
^
% Invalid input detected at '^' marker.

msk-donskaya-ismakhorin-sw-4(config-if)#
```

Рис. 1.6. Активация в транковом режиме интерфейса Fa0/23 на коммутаторе msk-donskaya-ismakhorin-sw-4.

Ping mail и web



```
dk-donskaya-1
Physical Config Desktop Programming Attributes
Command Prompt

Bluetooth Connection:

Connection-specific DNS Suffix...:
Link-local IPv6 Address.....: ::
IPv6 Address.....: ::
IPv4 Address.....: 0.0.0.0
Subnet Mask.....: 0.0.0.0
Default Gateway.....: ::
0.0.0.0

C:\>ping www.donskaya.rudn.ru

Pinging 10.128.0.2 with 32 bytes of data:

Request timed out.
Reply from 10.128.0.2: bytes=32 time<1ms TTL=127
Reply from 10.128.0.2: bytes=32 time<1ms TTL=127
Reply from 10.128.0.2: bytes=32 time=16ms TTL=127

Ping statistics for 10.128.0.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 16ms, Average = 5ms

C:\>ping mail.donskaya.rudn.ru

Pinging 10.128.0.4 with 32 bytes of data:

Request timed out.
Reply from 10.128.0.4: bytes=32 time<1ms TTL=127
Reply from 10.128.0.4: bytes=32 time<1ms TTL=127
Reply from 10.128.0.4: bytes=32 time<1ms TTL=127

Ping statistics for 10.128.0.4:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 10.128.0.5

Pinging 10.128.0.5 with 32 bytes of data:

Reply from 10.128.0.5: bytes=32 time<1ms TTL=127
Reply from 10.128.0.5: bytes=32 time<1ms TTL=127
Reply from 10.128.0.5: bytes=32 time=34ms TTL=127
Reply from 10.128.0.5: bytes=32 time<1ms TTL=127

Ping statistics for 10.128.0.5:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 34ms, Average = 8ms

C:\>
```

Рис. 1.7. Проверка командой ping серверов mail и web с оконечного устройства dk-donskaya-1.

Отслеживание пакетов ICMP

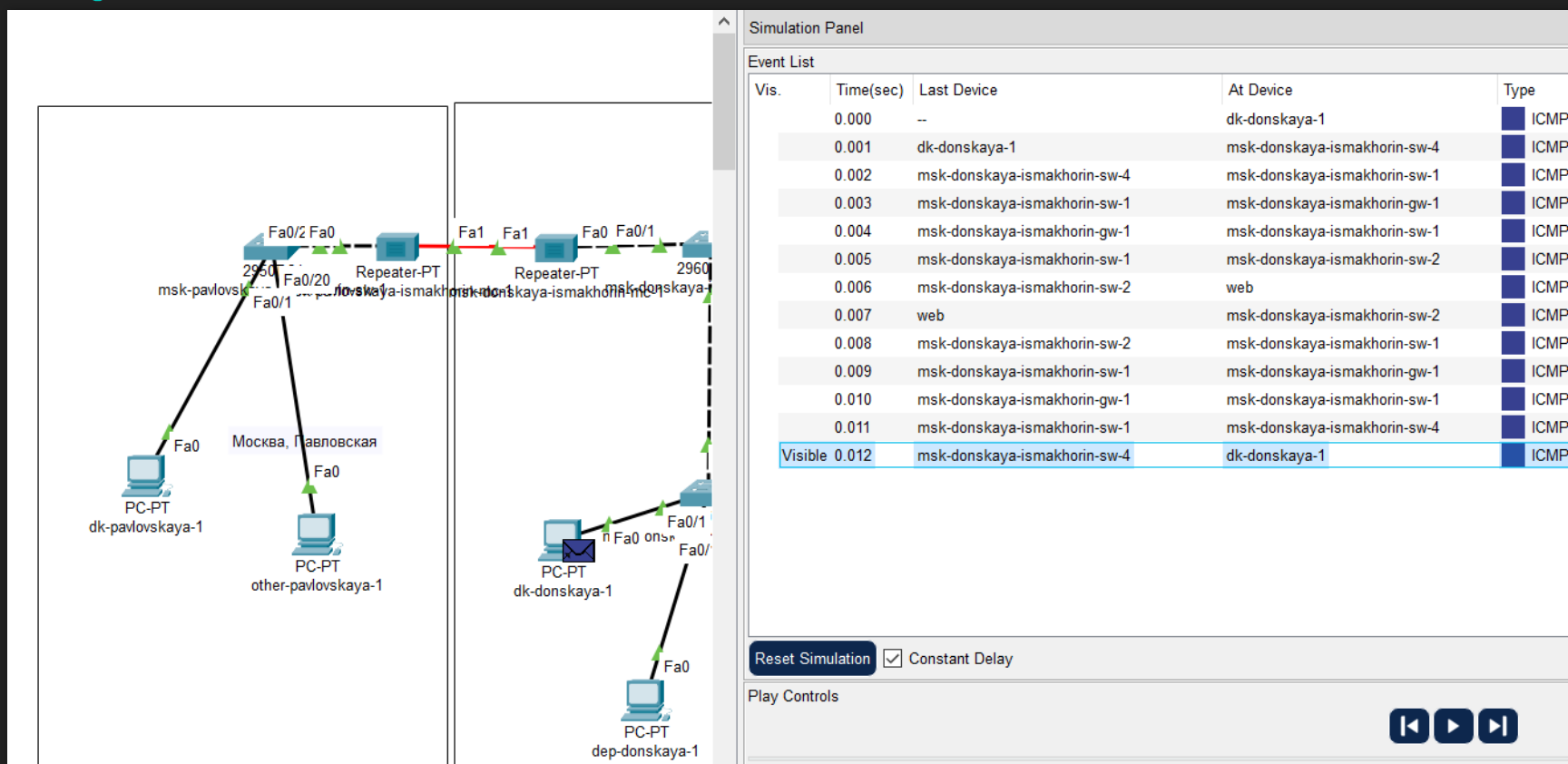


Рис. 1.8. Отслеживание пакетов ICMP в режиме симуляции (web) (движение пакетов происходит через коммутатор msk-donskaya-ismakhorin-sw-2).

Отслеживание пакетов ICMP

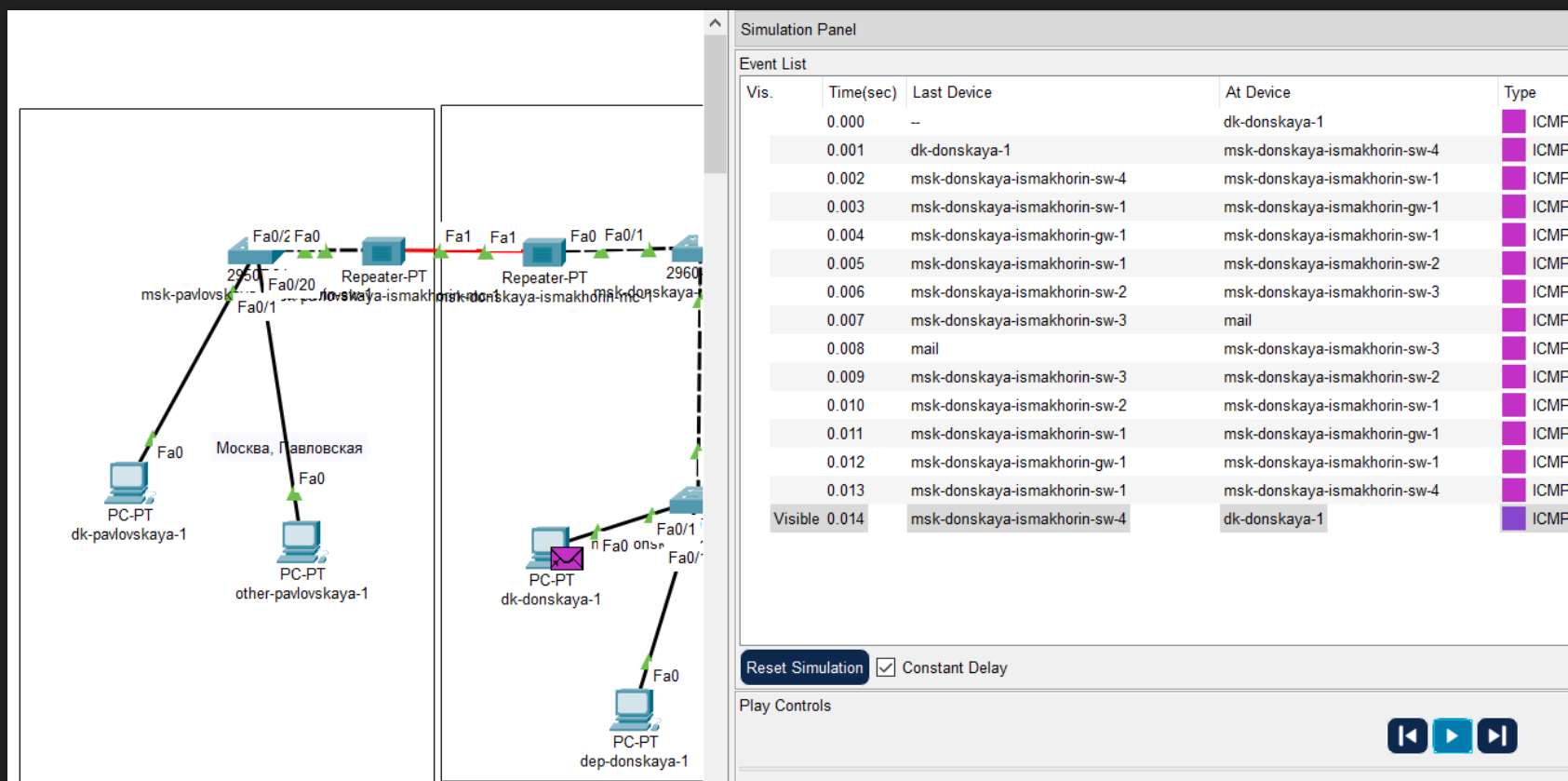
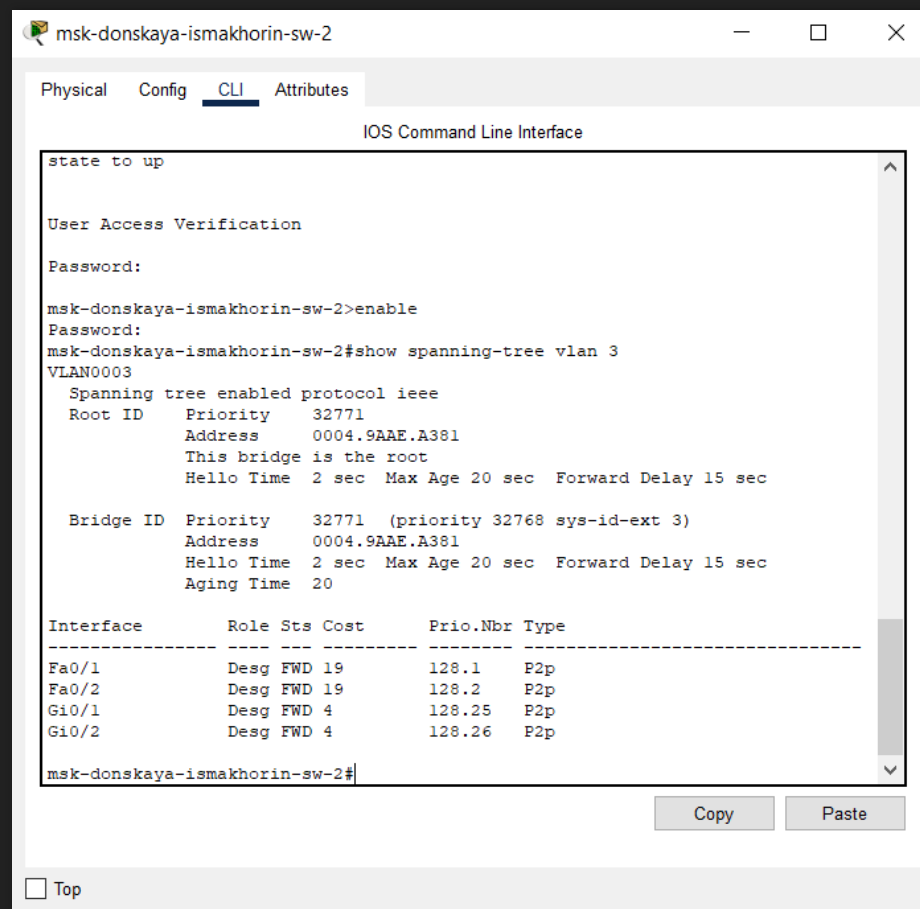


Рис. 1.9. Отслеживание пакетов ICMP в режиме симуляции (mail) (движение пакетов происходит через коммутатор msk-donskaya-ismakhorin-sw-2).

Просмотр состояния STP



```
msk-donskaya-ismakhorin-sw-2
Physical Config CLI Attributes
IOS Command Line Interface

state to up

User Access Verification

Password:

msk-donskaya-ismakhorin-sw-2>enable
Password:
msk-donskaya-ismakhorin-sw-2#show spanning-tree vlan 3
VLAN0003
  Spanning tree enabled protocol ieee
  Root ID    Priority    32771
             Address     0004.9AAE.A381
             This bridge is the root
             Hello Time 2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32771 (priority 32768 sys-id-ext 3)
             Address     0004.9AAE.A381
             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
Gi0/1        Desg FWD 4      128.25   P2p
Gi0/2        Desg FWD 4      128.26   P2p

msk-donskaya-ismakhorin-sw-2#
```

Рис. 1.10. Просмотр на коммутаторе msk-donskaya-ismakhorin-sw-2 состояния протокола STP для vlan 3 (указывается, что данное устройство является корневым (This bridge is the root)).

Настройка корневого коммутатора STP

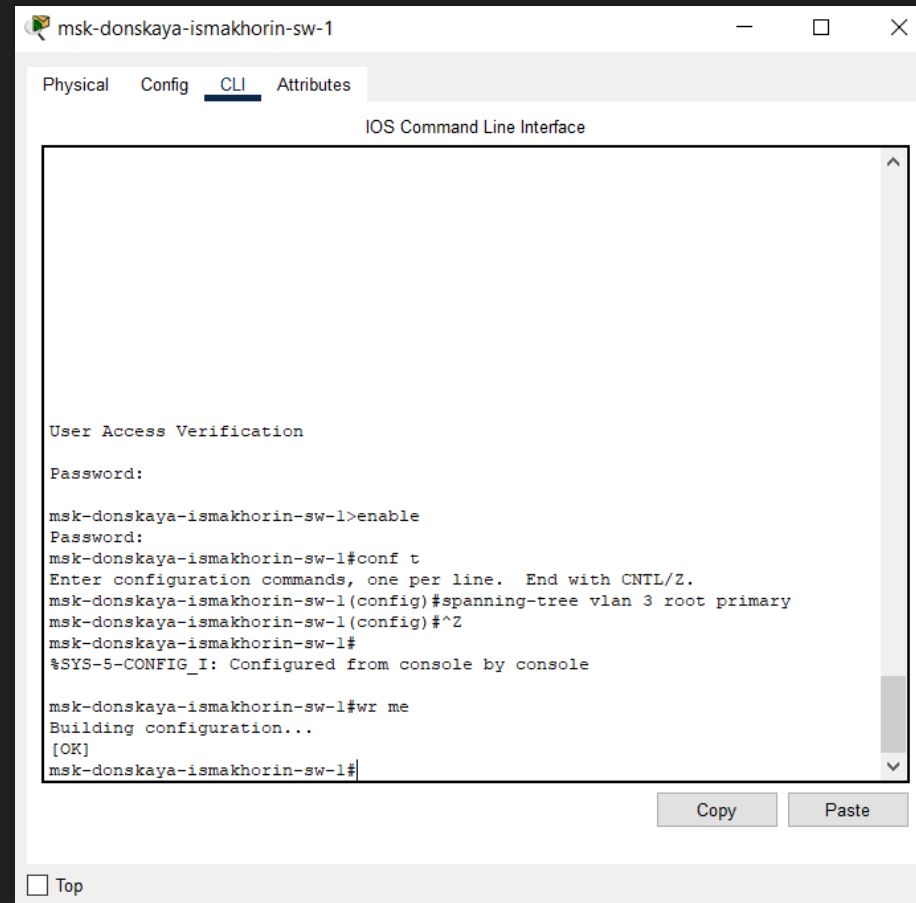


Рис. 1.11. Настройка в качестве корневого коммутатора STP коммутатора msk-donskaya-ismakhorin-sw-1.

Путь пакетов

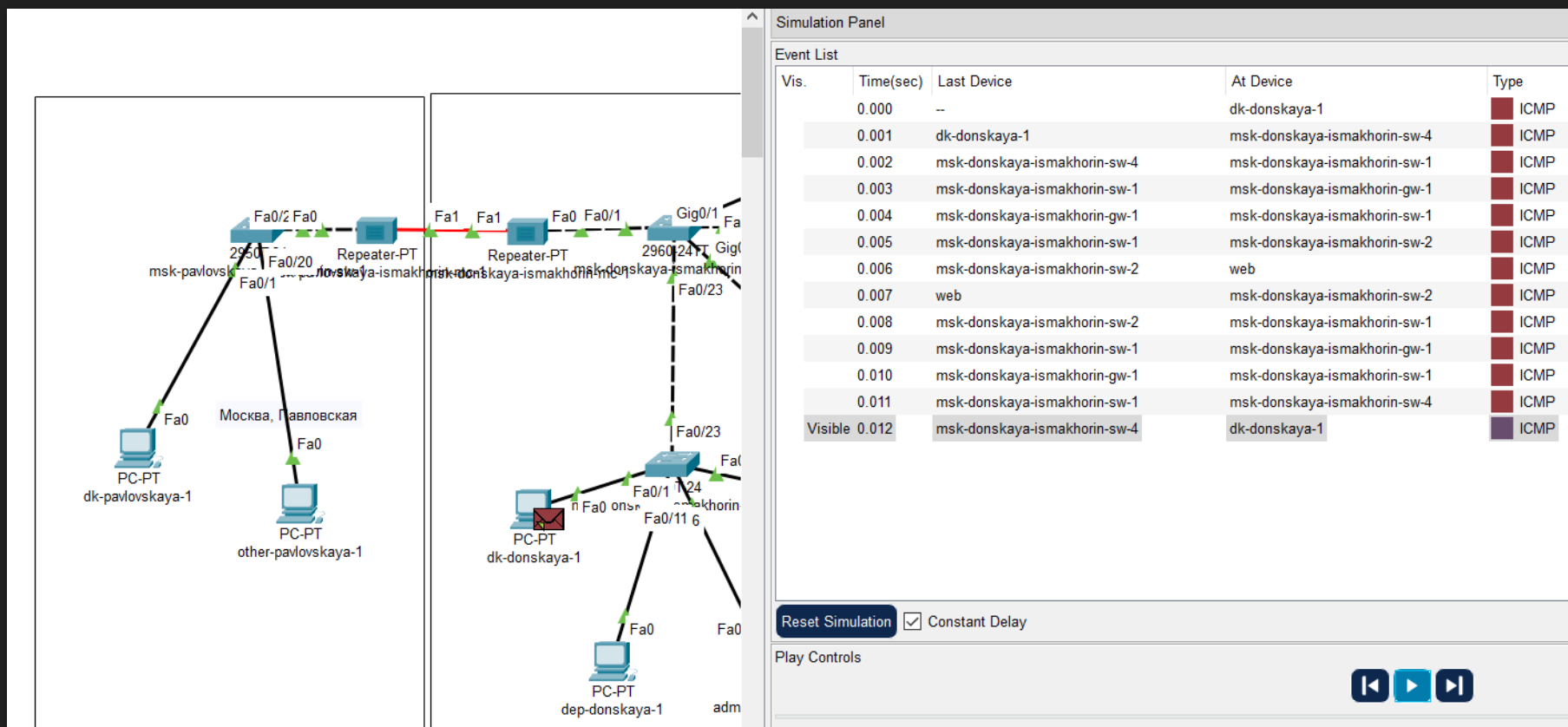


Рис. 1.12. Путь пакетов ICMP от хоста dk-donskaya-1 до web через коммутаторы msk-donskaya-ismakhorin-sw-1 и msk-donskaya-ismakhorin-sw-2.

Путь пакетов

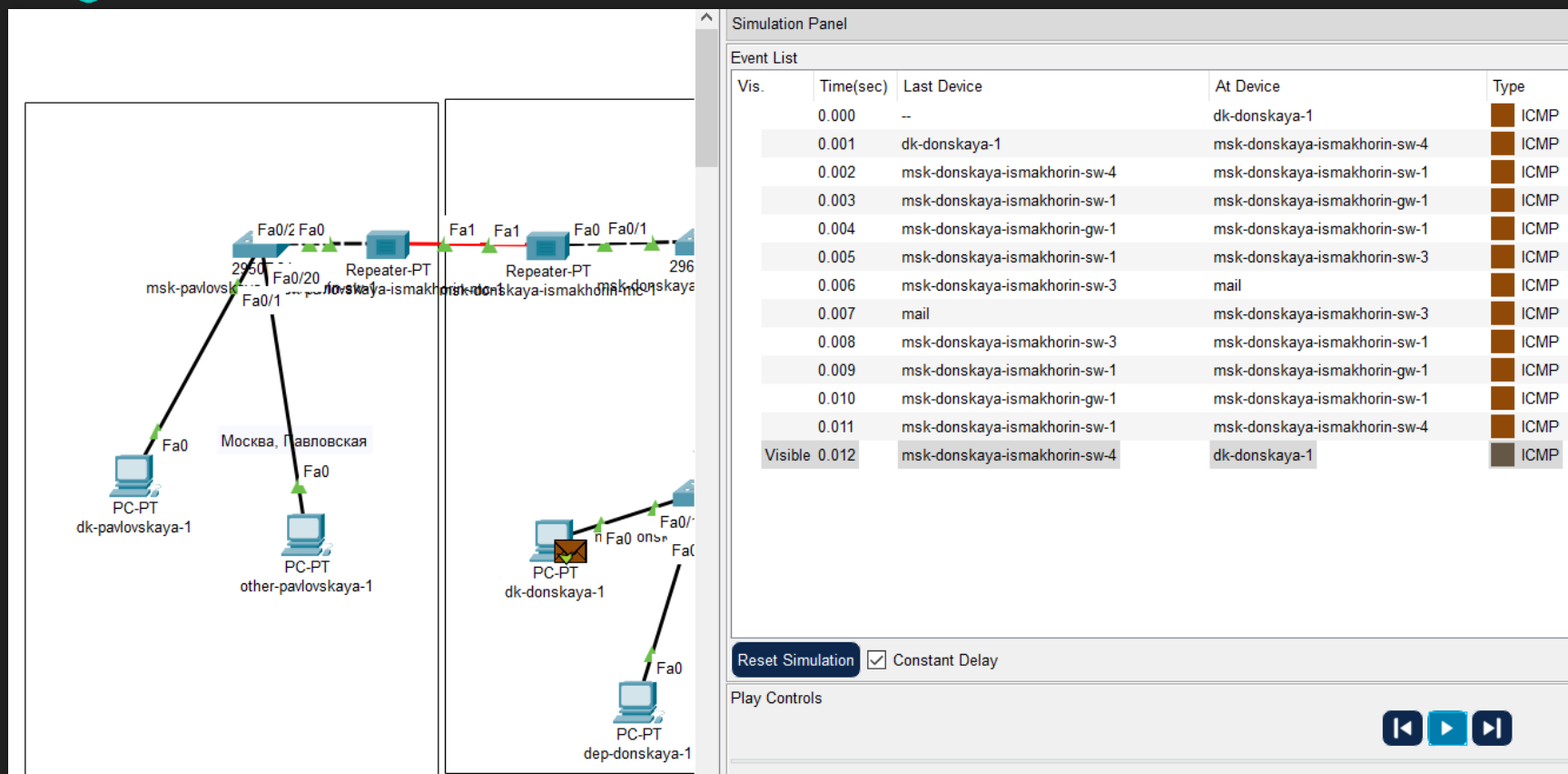
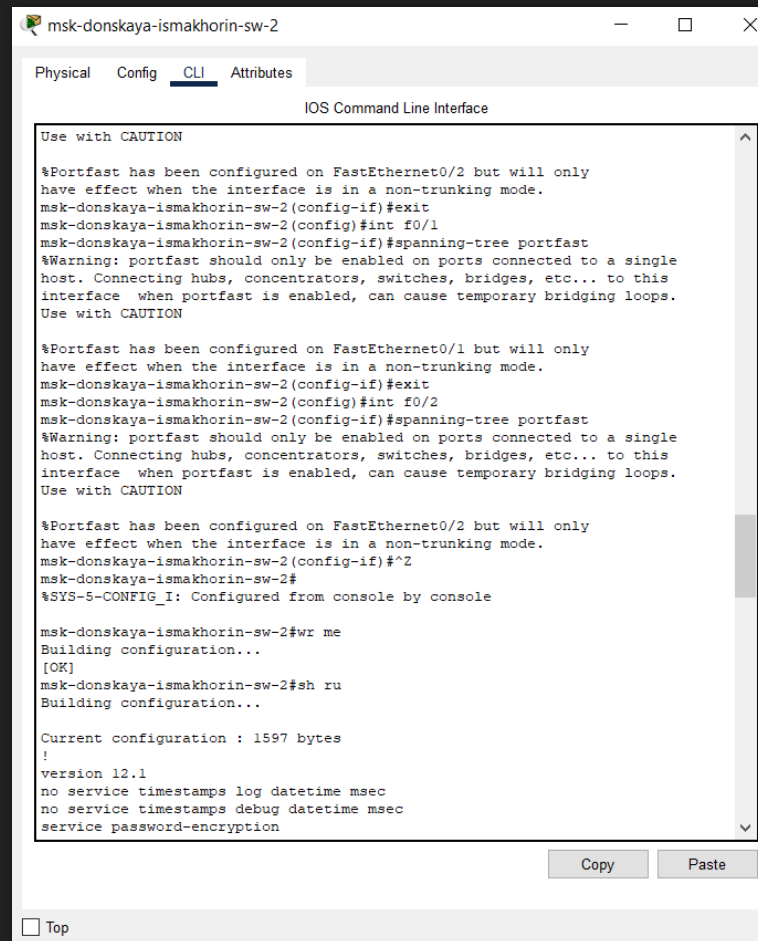


Рис. 1.13. Путь пакетов ICMP от хоста dk-donskaya-1 до mail через коммутаторы msk-donskaya-ismakhorin-sw-1 и msk-donskaya-ismakhorin-sw-3.

Настройка режима Portfast



The screenshot shows a network configuration window titled "msk-donskaya-ismakhorin-sw-2". It has tabs for "Physical", "Config", "CLI", and "Attributes", with "CLI" selected. The main area is labeled "IOS Command Line Interface" and contains the following text:

```
Use with CAUTION

%Portfast has been configured on FastEthernet0/2 but will only
have effect when the interface is in a non-trunking mode.
msk-donskaya-ismakhorin-sw-2(config-if)#exit
msk-donskaya-ismakhorin-sw-2(config)#int f0/1
msk-donskaya-ismakhorin-sw-2(config-if)#spanning-tree portfast
%Warning: portfast should only be enabled on ports connected to a single
host. Connecting hubs, concentrators, switches, bridges, etc... to this
interface when portfast is enabled, can cause temporary bridging loops.
Use with CAUTION

%Portfast has been configured on FastEthernet0/1 but will only
have effect when the interface is in a non-trunking mode.
msk-donskaya-ismakhorin-sw-2(config-if)#exit
msk-donskaya-ismakhorin-sw-2(config)#int f0/2
msk-donskaya-ismakhorin-sw-2(config-if)#spanning-tree portfast
%Warning: portfast should only be enabled on ports connected to a single
host. Connecting hubs, concentrators, switches, bridges, etc... to this
interface when portfast is enabled, can cause temporary bridging loops.
Use with CAUTION

%Portfast has been configured on FastEthernet0/2 but will only
have effect when the interface is in a non-trunking mode.
msk-donskaya-ismakhorin-sw-2(config-if)#^2
msk-donskaya-ismakhorin-sw-2#
%SYS-5-CONFIG_I: Configured from console by console

msk-donskaya-ismakhorin-sw-2#wr me
Building configuration...
[OK]
msk-donskaya-ismakhorin-sw-2#sh ru
Building configuration...

Current configuration : 1597 bytes
!
version 12.1
no service timestamps log datetime msec
no service timestamps debug datetime msec
service password-encryption
```

At the bottom of the window, there are "Copy" and "Paste" buttons, and a checkbox labeled "Top".

Рис. 1.14. Настройка режима Portfast на интерфейсах коммутатора msk-donskaya-ismakhorin-sw-2.

Настройка режима Portfast



```
msk-donskaya-ismakhorin-sw-3
Physical Config CLI Attributes
IOS Command Line Interface

Password:
msk-donskaya-ismakhorin-sw-3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-ismakhorin-sw-3(config)#int f0/1
msk-donskaya-ismakhorin-sw-3(config-if)#spanning tree portfast
^
% Invalid input detected at '^' marker.

msk-donskaya-ismakhorin-sw-3(config-if)#spanning-tree portfast
%Warning: portfast should only be enabled on ports connected to a single
host. Connecting hubs, concentrators, switches, bridges, etc... to this
interface when portfast is enabled, can cause temporary bridging loops.
Use with CAUTION

%Portfast has been configured on FastEthernet0/1 but will only
have effect when the interface is in a non-trunking mode.
msk-donskaya-ismakhorin-sw-3(config-if)#exit
msk-donskaya-ismakhorin-sw-3(config)#int f0/2
msk-donskaya-ismakhorin-sw-3(config-if)#spanning-tree portfast
%Warning: portfast should only be enabled on ports connected to a single
host. Connecting hubs, concentrators, switches, bridges, etc... to this
interface when portfast is enabled, can cause temporary bridging loops.
Use with CAUTION

%Portfast has been configured on FastEthernet0/2 but will only
have effect when the interface is in a non-trunking mode.
msk-donskaya-ismakhorin-sw-3(config-if)#^Z
msk-donskaya-ismakhorin-sw-3#
%SYS-5-CONFIG_I: Configured from console by console

msk-donskaya-ismakhorin-sw-3#wr me
Building configuration...
[OK]
msk-donskaya-ismakhorin-sw-3#sh ru
Building configuration...

Current configuration : 1597 bytes
!
version 12.1
no service timestamps log datetime msec
no service timestamps debug datetime msec
```

Рис. 1.15. Настройка режима Portfast на интерфейсах коммутатора msk-donskaya-ismakhorin-sw-3.

Изучение отказоустойчивости

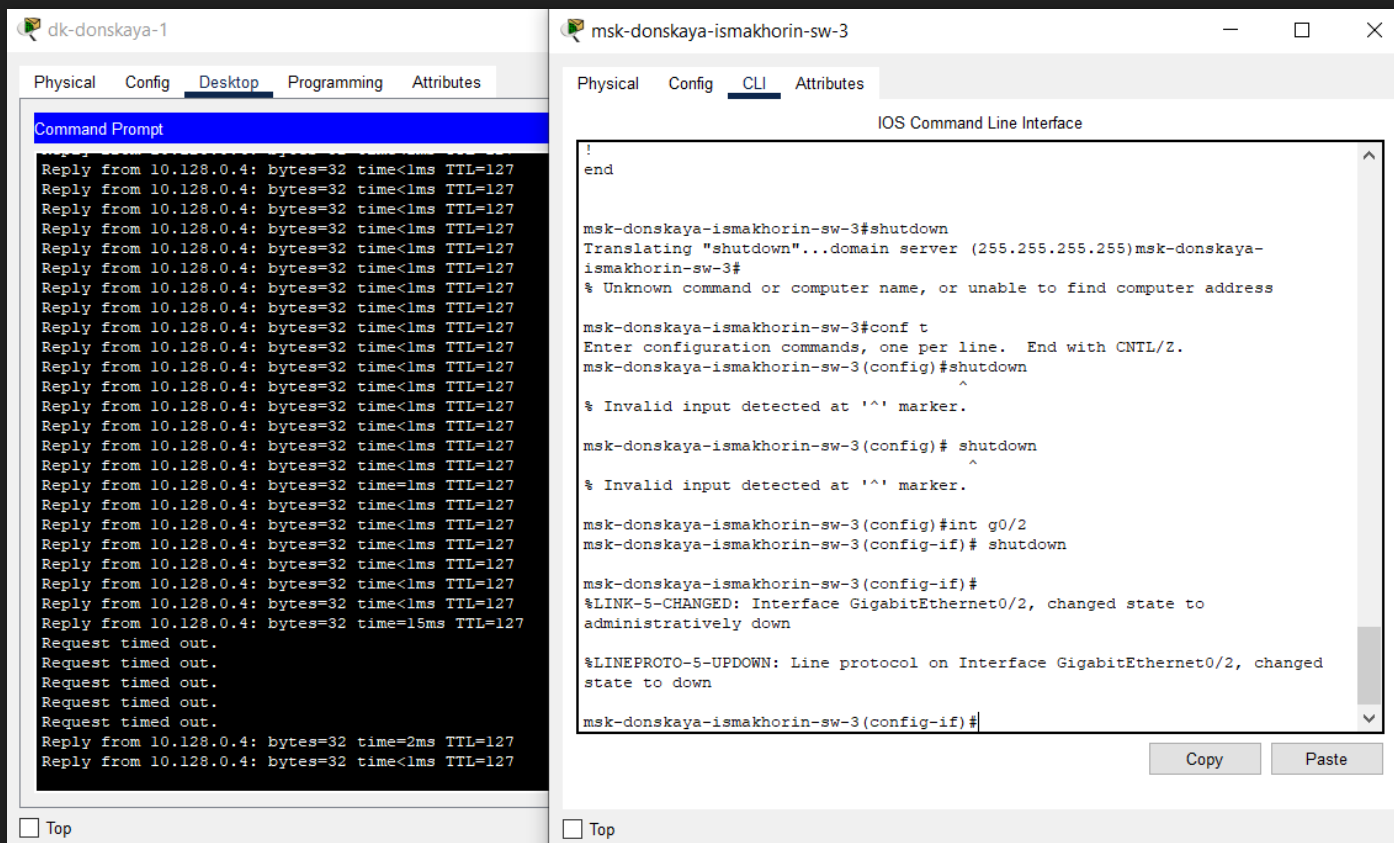


Рис. 1.16. Изучение отказоустойчивости протокола STP и времени восстановления соединения при переключении на резервное соединение.

Изучение отказоустойчивости

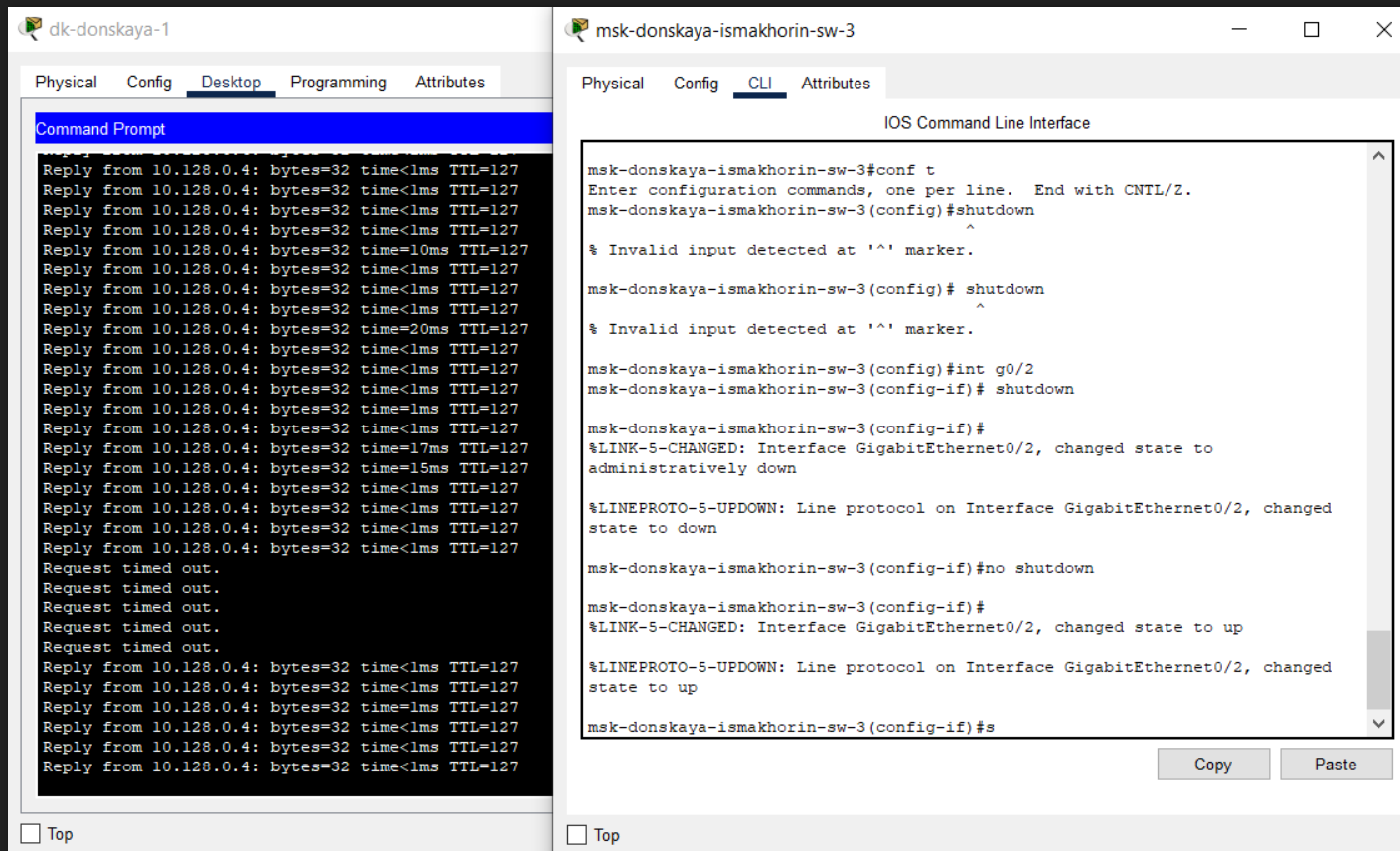
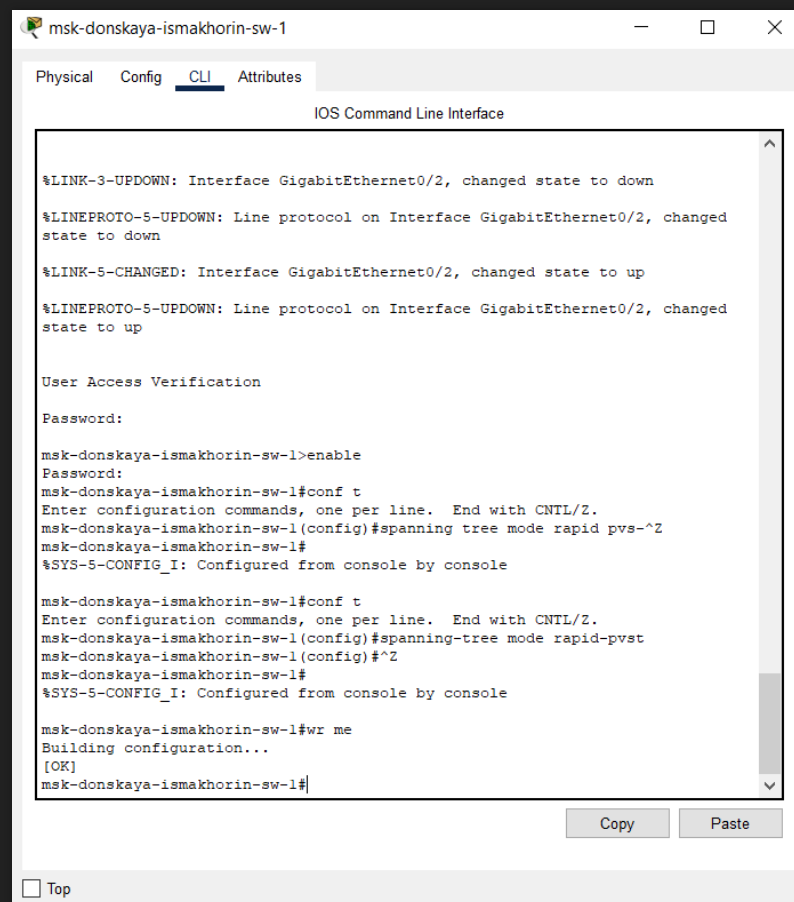


Рис. 1.17. Изучение отказоустойчивости протокола STP и времени восстановления соединения при переключении на резервное соединение.

Переключение в Rapid PVST+



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

%LINK-3-UPDOWN: Interface GigabitEthernet0/2, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to down
%LINK-5-CHANGED: Interface GigabitEthernet0/2, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to up

User Access Verification
Password:

msk-donskaya-ismakhorin-sw-1>enable
Password:
msk-donskaya-ismakhorin-sw-1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-ismakhorin-sw-1(config)#spanning tree mode rapid pvs-^Z
msk-donskaya-ismakhorin-sw-1#
%SYS-5-CONFIG_I: Configured from console by console

msk-donskaya-ismakhorin-sw-1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-ismakhorin-sw-1(config)#spanning-tree mode rapid-pvst
msk-donskaya-ismakhorin-sw-1(config)#^Z
msk-donskaya-ismakhorin-sw-1#
%SYS-5-CONFIG_I: Configured from console by console

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

Рис. 1.18. Переключение коммутаторов в режим работы по протоколу Rapid PVST+ (на примере msk-donskaya-ismakhorin-sw-1).

Изучение отказоустойчивости

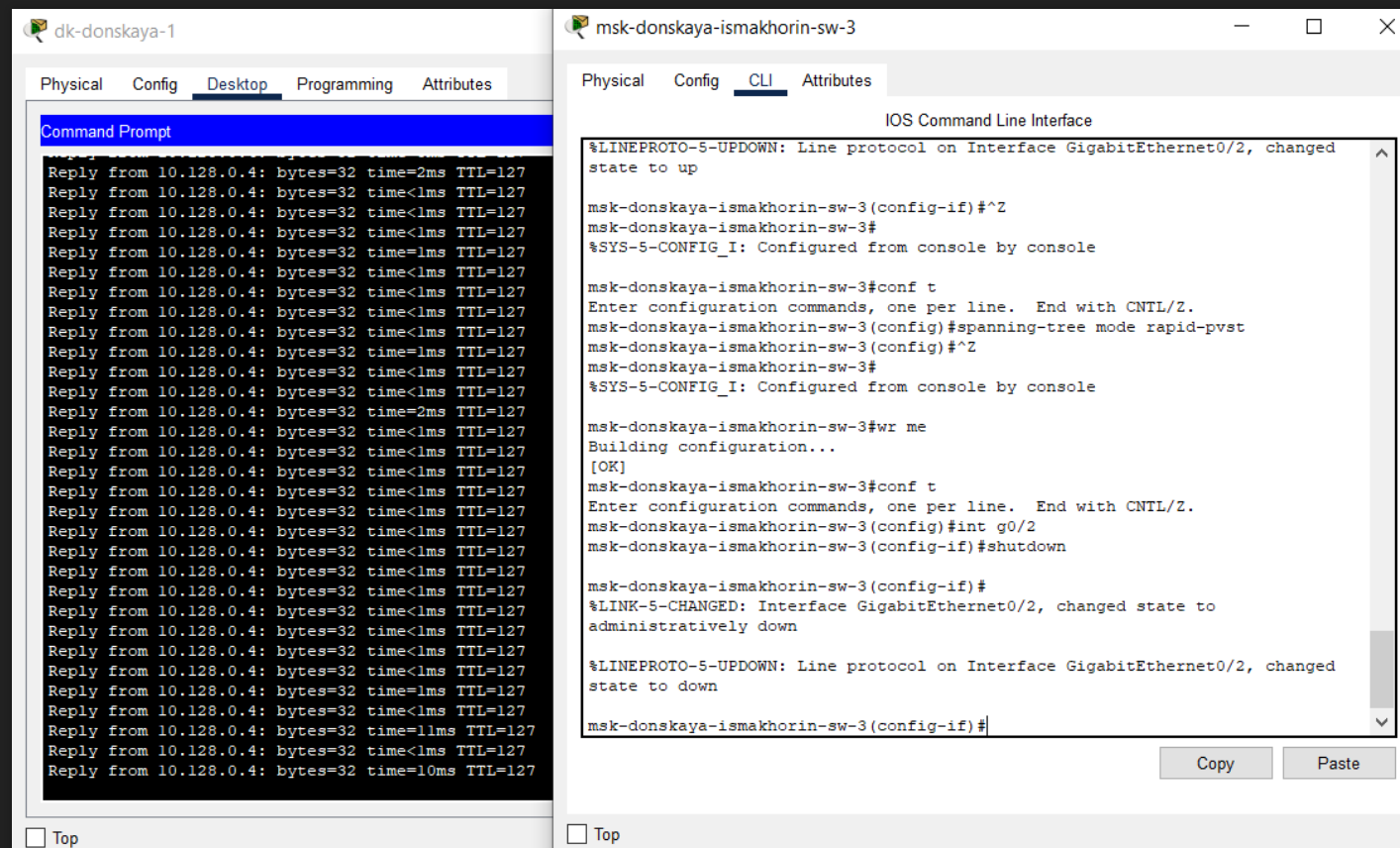


Рис. 1.19. Изучение отказоустойчивости протокола Rapid PVST+ и времени восстановления соединения при переключении на резервное соединение.

Изучение отказоустойчивости

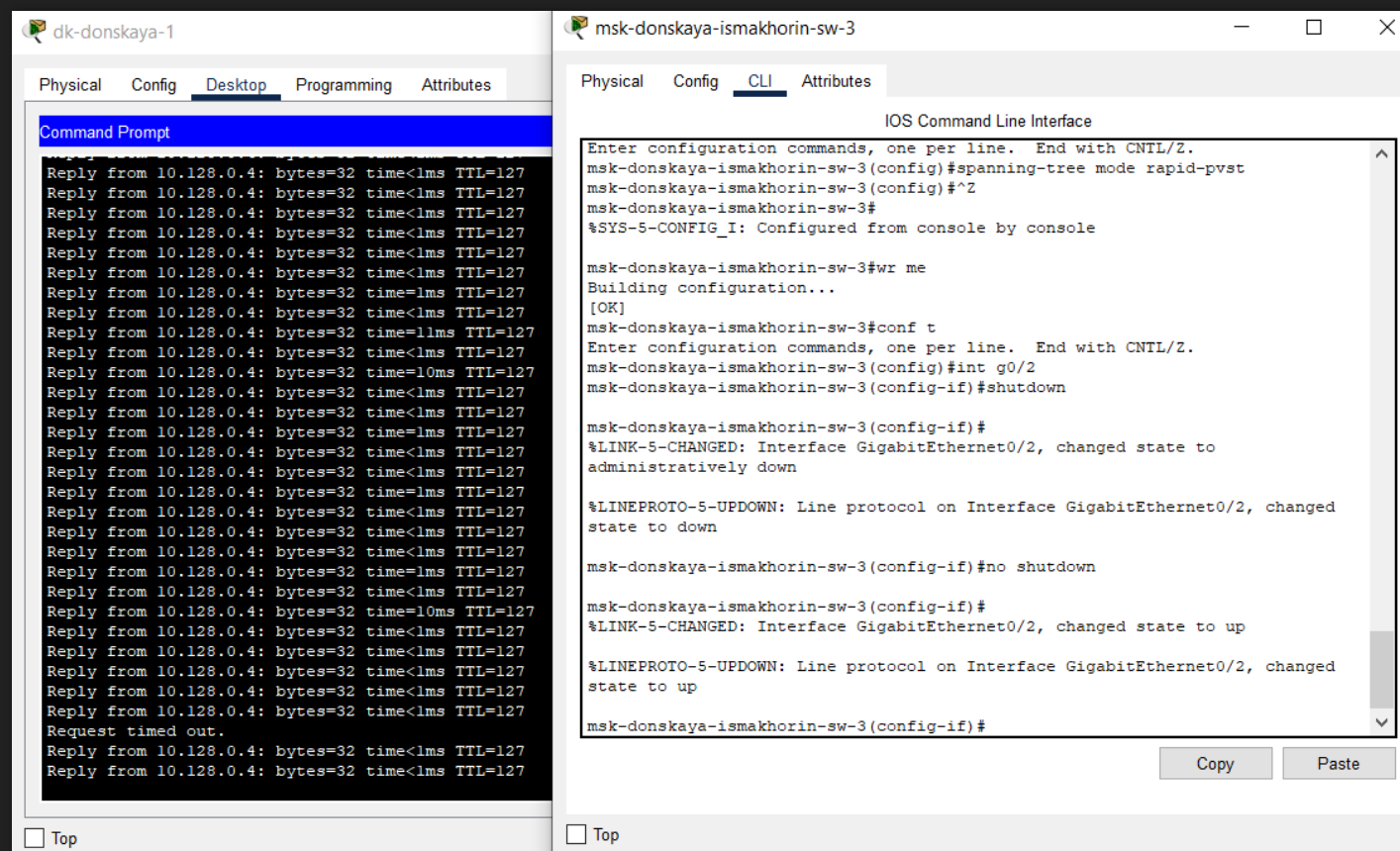


Рис. 1.20. Изучение отказоустойчивости протокола Rapid PVST+ и времени восстановления соединения при переключении на резервное соединение.

Агрегированное соединение

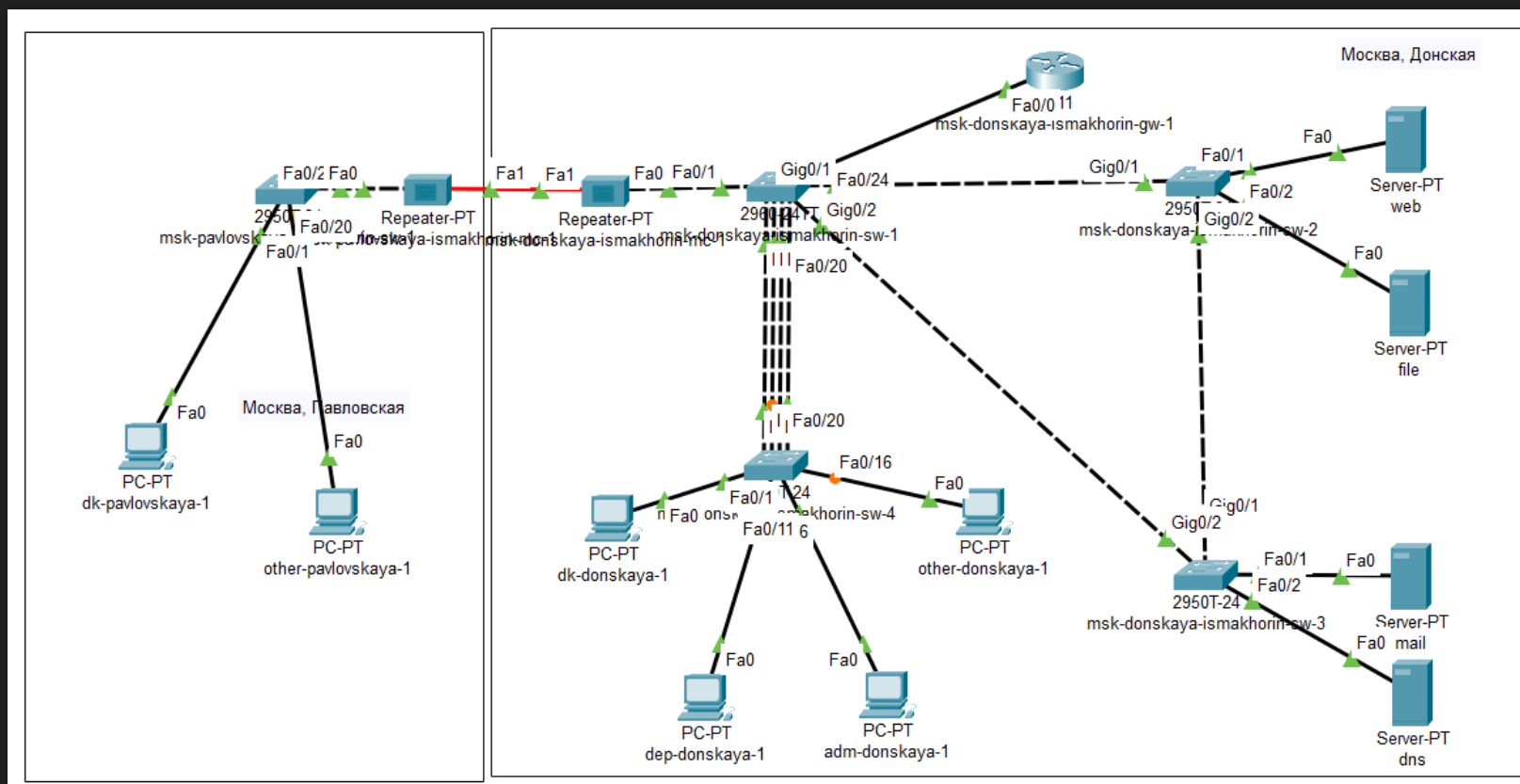
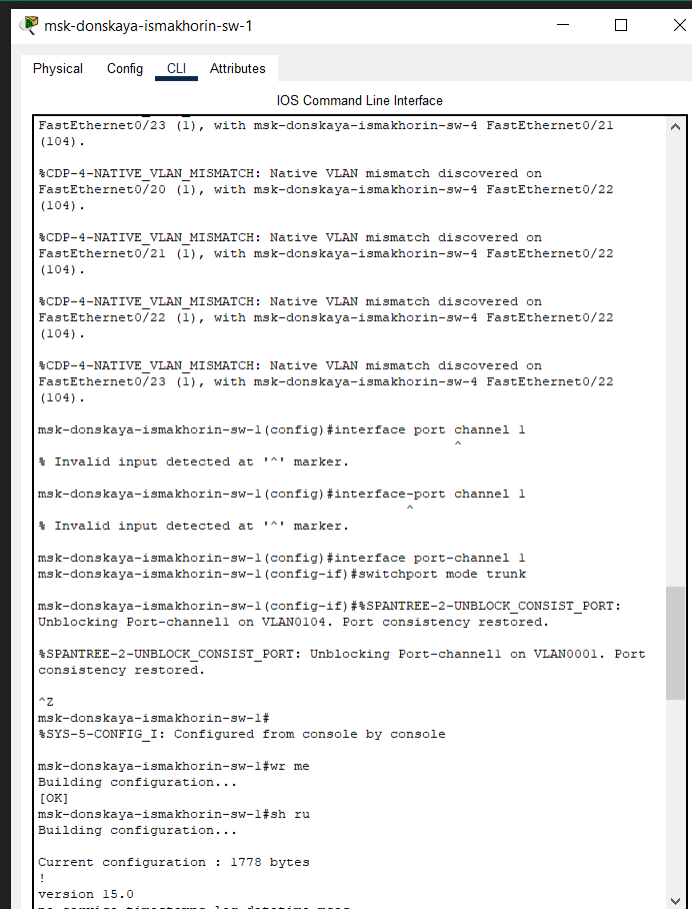


Рис. 1.21. Формирование агрегированного соединения интерфейсов Fa0/20 – Fa0/23 между коммутаторами msk-donskaya-ismakhorin-sw-1 и msk-ismakhorin-donskaya-sw-4.

Агрегированное соединение



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

FastEthernet0/23 (1), with msk-donskaya-ismakhorin-sw-4 FastEthernet0/21
(104).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
FastEthernet0/20 (1), with msk-donskaya-ismakhorin-sw-4 FastEthernet0/22
(104).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
FastEthernet0/21 (1), with msk-donskaya-ismakhorin-sw-4 FastEthernet0/22
(104).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
FastEthernet0/22 (1), with msk-donskaya-ismakhorin-sw-4 FastEthernet0/22
(104).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
FastEthernet0/23 (1), with msk-donskaya-ismakhorin-sw-4 FastEthernet0/22
(104).

msk-donskaya-ismakhorin-sw-1(config)#interface port channel 1
^
% Invalid input detected at '^' marker.

msk-donskaya-ismakhorin-sw-1(config)#interface-port channel 1
^
% Invalid input detected at '^' marker.

msk-donskaya-ismakhorin-sw-1(config)#interface port-channel 1
msk-donskaya-ismakhorin-sw-1(config-if)#switchport mode trunk

msk-donskaya-ismakhorin-sw-1(config-if)#%SPANTREE-2-UNBLOCK_CONSIST_PORT:
Unblocking Port-channell on VLAN0104. Port consistency restored.

%SPANTREE-2-UNBLOCK_CONSIST_PORT: Unblocking Port-channell on VLAN0001. Port
consistency restored.

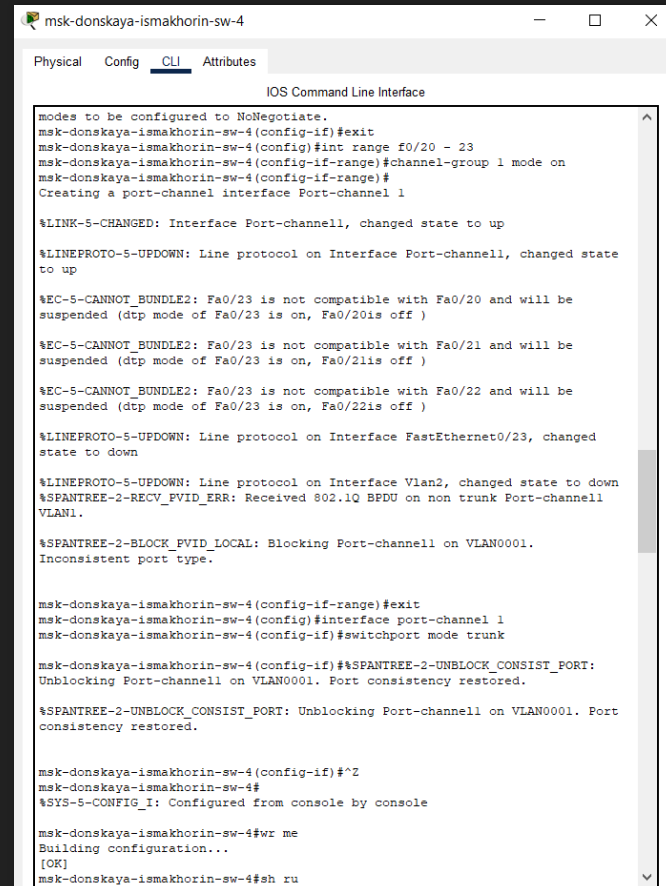
^Z
msk-donskaya-ismakhorin-sw-1#
%SYS-5-CONFIG_I: Configured from console by console

msk-donskaya-ismakhorin-sw-1#wr me
Building configuration...
[OK]
msk-donskaya-ismakhorin-sw-1#sh ru
Building configuration...

Current configuration : 1778 bytes
!
version 15.0
no service timestamps log datetime msec
```

Рис. 1.22. Формирование агрегированного соединения интерфейсов Fa0/20 – Fa0/23 между коммутаторами msk-donskaya-ismakhorin-sw-1 и msk-ismakhorin-donskaya-sw-4.

Агрегированное соединение



```
msk-donskaya-ismakhorin-sw-4
Physical Config CLI Attributes
IOS Command Line Interface

modes to be configured to NoNegotiate.
msk-donskaya-ismakhorin-sw-4(config-if)#exit
msk-donskaya-ismakhorin-sw-4(config)#int range f0/20 - 23
msk-donskaya-ismakhorin-sw-4(config-if-range)#channel-group 1 mode on
msk-donskaya-ismakhorin-sw-4(config-if-range)#
Creating a port-channel interface Port-channel 1

%LINK-5-CHANGED: Interface Port-channel1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel1, changed state
to up

%EC-5-CANNOT_BUNDLE2: Fa0/23 is not compatible with Fa0/20 and will be
suspended (dtp mode of Fa0/23 is on, Fa0/20is off )

%EC-5-CANNOT_BUNDLE2: Fa0/23 is not compatible with Fa0/21 and will be
suspended (dtp mode of Fa0/23 is on, Fa0/21is off )

%EC-5-CANNOT_BUNDLE2: Fa0/23 is not compatible with Fa0/22 and will be
suspended (dtp mode of Fa0/23 is on, Fa0/22is off )

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed
state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan2, changed state to down
%SPANNTREE-2-RECV_FVID_ERR: Received 802.1Q BPDU on non trunk Port-channel1
VLAN1.

%SPANNTREE-2-BLOCK_FVID_LOCAL: Blocking Port-channel1 on VLAN0001.
Inconsistent port type.

msk-donskaya-ismakhorin-sw-4(config-if-range)#exit
msk-donskaya-ismakhorin-sw-4(config)#interface port-channel 1
msk-donskaya-ismakhorin-sw-4(config-if)#switchport mode trunk

msk-donskaya-ismakhorin-sw-4(config-if)#%SPANNTREE-2-UNBLOCK_CONSIST_PORT:
Unblocking Port-channel1 on VLAN0001. Port consistency restored.

%SPANNTREE-2-UNBLOCK_CONSIST_PORT: Unblocking Port-channel1 on VLAN0001. Port
consistency restored.

msk-donskaya-ismakhorin-sw-4(config-if)#^Z
msk-donskaya-ismakhorin-sw-4#
%SYS-5-CONFIG_I: Configured from console by console

msk-donskaya-ismakhorin-sw-4#wr me
Building configuration...
[OK]
msk-donskaya-ismakhorin-sw-4#sh ru
```

Рис. 1.23. Формирование агрегированного соединения интерфейсов Fa0/20 – Fa0/23 между коммутаторами msk-donskaya-ismakhorin-sw-1 и msk-ismakhorin-donskaya-sw-4.

ВЫВОД

- В ходе выполнения лабораторной работы мы изучили возможности протокола STP и его модификаций по обеспечению отказоустойчивости сети, агрегированию интерфейсов и перераспределению нагрузки между ними.

Спасибо за внимание!