

**РОССИЙСКИЙ УНИВЕРСИТЕТ ДРУЖБЫ НАРОДОВ**  
**Факультет физико-математических и естественных наук**  
**Кафедра прикладной информатики и теории вероятностей**

**ОТЧЕТ**  
**ПО ЛАБОРАТОРНОЙ РАБОТЕ № 9**

дисциплина: Администрирование локальных сетей

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Группа: НФИ-бд-03-19

**МОСКВА**

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Цель работы:

Изучение возможностей протокола STP и его модификаций по обеспечению отказоустойчивости сети, агрегированию интерфейсов и перераспределению нагрузки между ними.

### 9.3. Задание

1. Сформируйте резервное соединение между коммутаторами msk-donskayasw-1 и msk-donskaya-sw-3.
2. Настройте балансировку нагрузки между резервными соединениями.
3. Настройте режим Portfast на тех интерфейсах коммутаторов, к которым подключены серверы.
4. Изучите отказоустойчивость резервного соединения.
5. Сформируйте и настройте агрегированное соединение интерфейсов Fa0/20 – Fa0/23 между коммутаторами msk-donskaya-sw-1 и msk-donskaya-sw-4.
6. При выполнении работы необходимо учитывать соглашение об именовании (см. раздел 2.5).

### Ход работы

1. Сформировала резервное соединение между коммутаторами msk-donskayasw-1 и msk-donskaya-sw-3 (рис. 9.1). Для этого:
  - заменила соединение между коммутаторами msk-donskaya-sw-1 (Gig0/2) и msk-donskaya-sw-4 (Gig0/1) на соединение между коммутаторами msk-donskaya-sw-1 (Gig0/2) и msk-donskaya-sw-3 (Gig0/2);
  - сделала порт на интерфейсе Gig0/2 коммутатора msk-donskaya-sw-3 транковым:

```
msk-donskaya-sw-3(config)#int g0/2  
msk-donskaya-sw-3(config-if)#switchport mode trunk
```

The screenshot shows a terminal window titled "msk-donskaya-vmshutenko-sw-3". The tab bar at the top includes "Physical", "Config", "CLI" (which is selected), and "Attributes". Below the title, it says "IOS Command Line Interface". The main area displays the following CLI session:

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

User Access Verification

Password:
msk-donskaya-vmshutenko-sw-3>en
Password:
msk-donskaya-vmshutenko-sw-3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-vmshutenko-sw-3(config)#int g0/2
msk-donskaya-vmshutenko-sw-3(config-if)#switchport mode trunk
msk-donskaya-vmshutenko-sw-3(config-if)#^Z
msk-donskaya-vmshutenko-sw-3#
%SYS-5-CONFIG_I: Configured from console by console
wr mem
Building configuration...
[OK]
msk-donskaya-vmshutenko-sw-3#
```

At the bottom left, it says "Command+F6 to exit CLI focus". On the right side, there are "Copy" and "Paste" buttons. At the very bottom left, there is a "Top" button.

Рисунок 1. Поднятие порта g0/2.

– соединение между коммутаторами msk-donskaya-sw-1 и mskdonskaya-sw-4 сделала через интерфейсы Fa0/23, не забыв активировать их в транковом режиме.

msk-donskaya-vmshutenko-sw-1

Physical    Config    **CLI**    Attributes

IOS Command Line Interface

```
User Access Verification

Password:
msk-donskaya-vmshutenko-sw-1>en
Password:
msk-donskaya-vmshutenko-sw-1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-vmshutenko-sw-1(config)#int f0/23
msk-donskaya-vmshutenko-sw-1(config-if)#switchport mode trunk

msk-donskaya-vmshutenko-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
^Z
msk-donskaya-vmshutenko-sw-1#
%SYS-5-CONFIG_I: Configured from console by console
wr mem
Building configuration...
[OK]
msk-donskaya-vmshutenko-sw-1#
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
FastEthernet0/23 (1), with msk-donskaya-vmshutenko-sw-1 FastEthernet0/23
(104).
```

Command+F6 to exit CLI focus

Top

**Copy**    **Paste**

Рисунок 2. Активирование портов на sw-1

msk-donskaya-vmshutenko-sw-4

Physical Config CLI Attributes

IOS Command Line Interface

```

msk-donskaya-vmshutenko-sw-1>en
Password:
msk-donskaya-vmshutenko-sw-1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-vmshutenko-sw-1(config)#int
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
FastEthernet0/23 (104), with msk-donskaya-vmshutenko-sw-1 FastEthernet0/23
(1).
f0/23
^
% Invalid input detected at '^' marker.

msk-donskaya-vmshutenko-sw-1(config)#int f0/23
msk-donskaya-vmshutenko-sw-1(config-if)#switchport mode trunk

msk-donskaya-vmshutenko-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

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan2, changed state to up
^Z
msk-donskaya-vmshutenko-sw-1#
%SYS-5-CONFIG_I: Configured from console by console
wr mem
Building configuration...
[OK]
msk-donskaya-vmshutenko-sw-1#

```

Command+F6 to exit CLI focus

Top

Copy Paste

Рисунок 3. Активирование портов на sw-4.

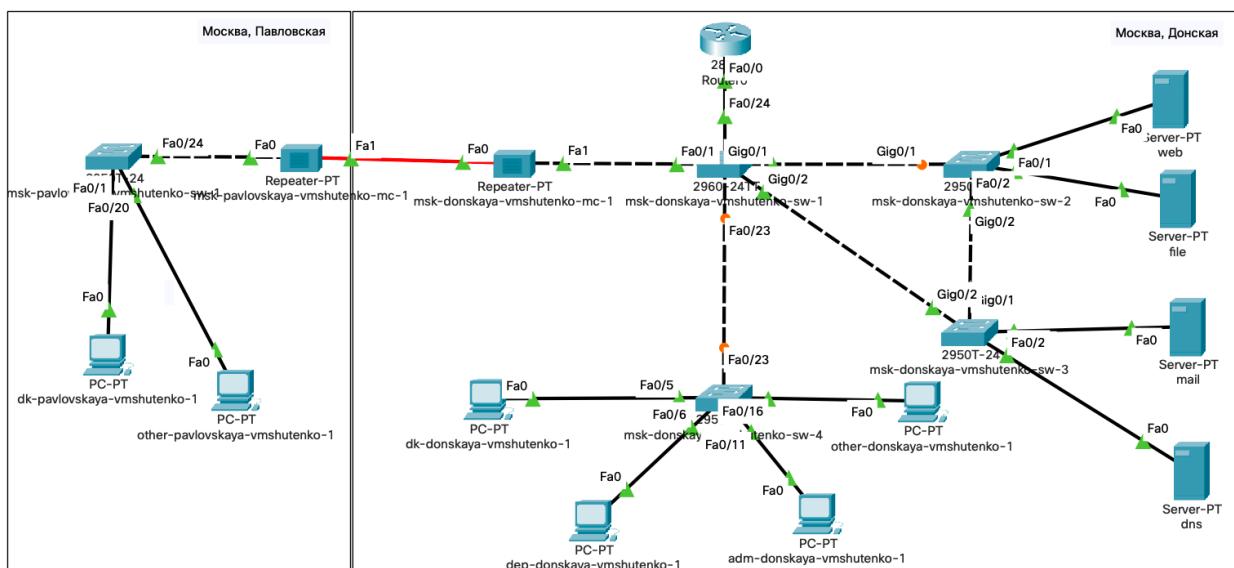
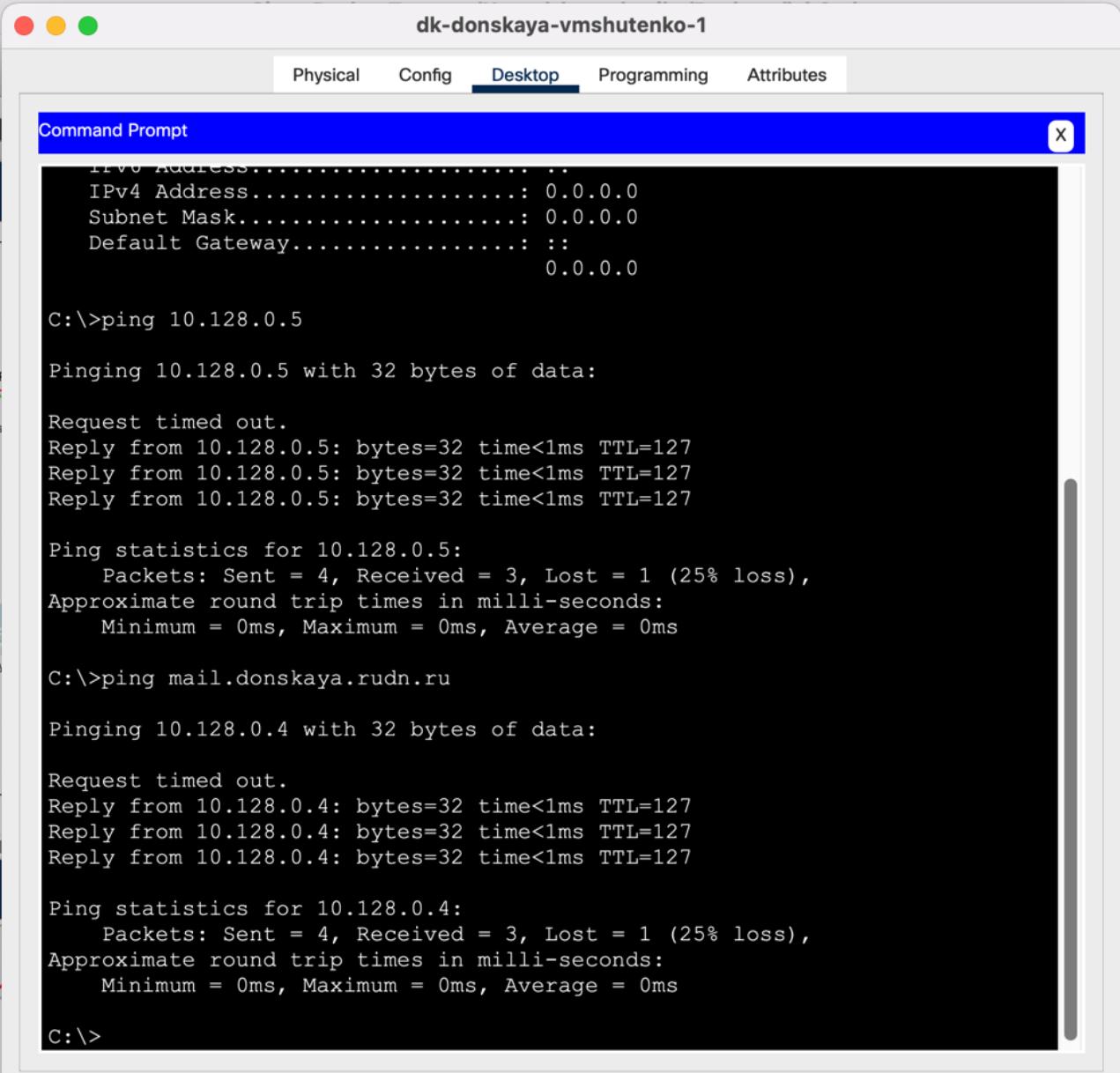


Рисунок 4. Схема сети

2. С оконечного устройства dk-donskaya-1 пропинговала серверы mail и web.

В режиме симуляции проследила движение пакетов ICMP. Убедилась, что движение пакетов происходит через коммутатор msk-donskaya-sw-2.



The screenshot shows a window titled "dk-donskaya-vmshutenko-1" with tabs for Physical, Config, Desktop (selected), Programming, and Attributes. A Command Prompt window is open, displaying the following output:

```
IPv4 Address..... .
IPv4 Address..... : 0.0.0.0
Subnet Mask..... : 0.0.0.0
Default Gateway..... : ::

C:\>ping 10.128.0.5

Pinging 10.128.0.5 with 32 bytes of data:

Request timed out.
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<1ms TTL=127

Ping statistics for 10.128.0.5:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

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:\>
```

Рисунок 5. Пинг mail

The screenshot shows a desktop interface with a window titled "dk-donskaya-vmshutenko-1". Inside the window, there is a tab bar with "Physical", "Config", "Desktop" (which is selected), "Programming", and "Attributes". Below the tab bar is a blue header bar with the text "Command Prompt" and a close button ("X"). The main area of the window contains a terminal session output:

```
Ping statistics for 10.128.0.5:  
Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),  
Approximate round trip times in milli-seconds:  
    Minimum = 0ms, Maximum = 0ms, Average = 0ms  
  
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 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<1ms 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 = 0ms, Average = 0ms  
  
C:\>
```

Рисунок 6. Пинг web

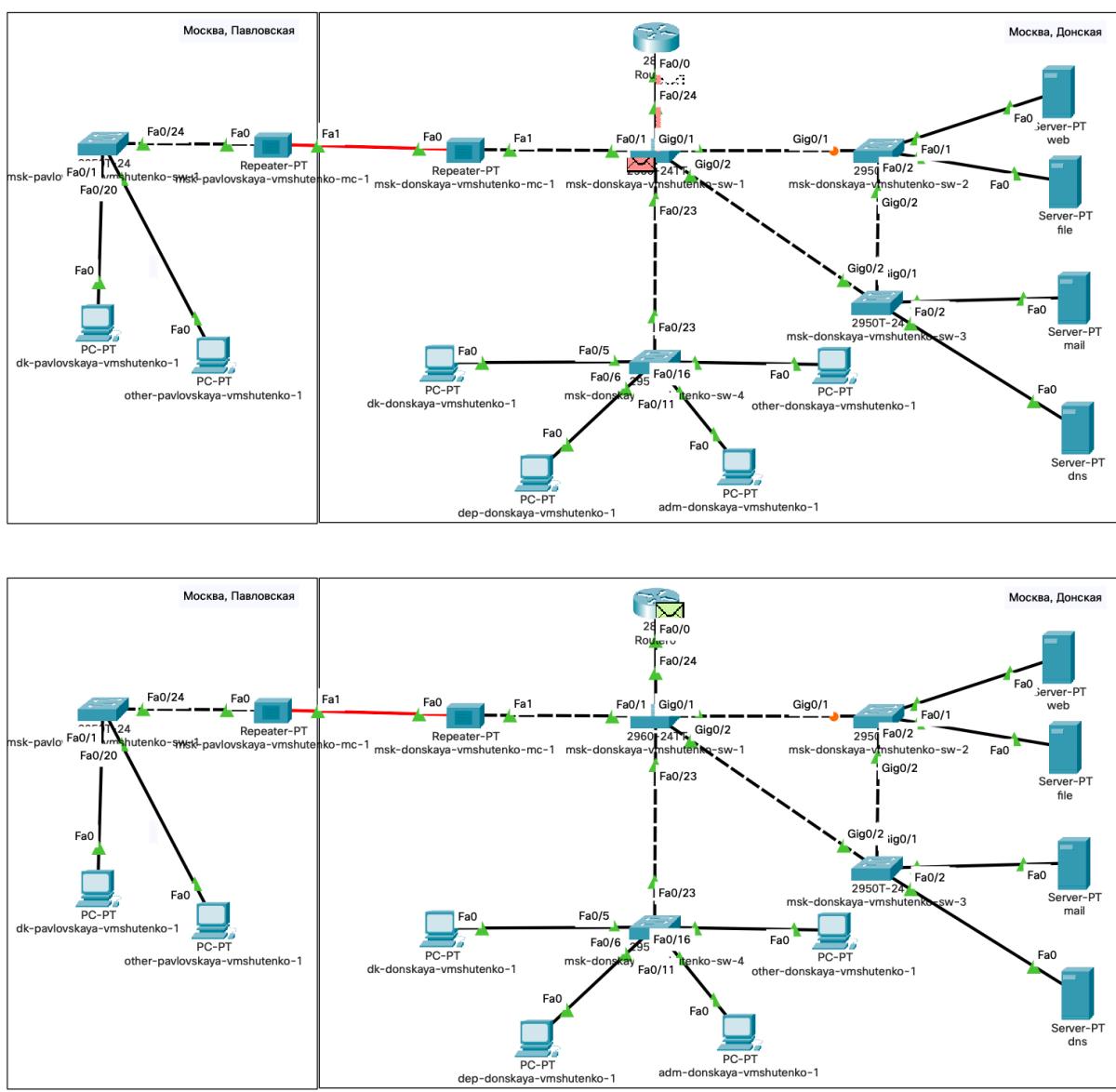


Рисунок 7-8. Режим симуляции. Движение пакетов происходит через коммутатор msk-donskaya-sw-2.

3. На коммутаторе msk-donskaya-sw-2 посмотрела состояние протокола STP для vlan 3:  
**msk-donskaya-sw-2#show spanning-tree vlan 3**

В результате вывела следующая информация, связанная с протоколом STP:

```
msk-donskaya-vmshutenko-sw-2>show spanningtree vlan 3
^
% Invalid input detected at '^' marker.

msk-donskaya-vmshutenko-sw-2>show spanning-tree vlan 3
VLAN0003
  Spanning tree enabled protocol ieee
    Root ID      Priority    32771
                  Address    0001.4220.B819
                  Cost        4
                  Port       26 (GigabitEthernet0/2)
                  Hello Time  2 sec   Max Age 20 sec   Forward Delay 15 sec

    Bridge ID    Priority    32771  (priority 32768 sys-id-ext 3)
                  Address    0090.0C35.D53A
                  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          Altn BLK 4      128.25     P2p
  Gi0/2          Root FWD 4      128.26     P2p

msk-donskaya-vmshutenko-sw-2>
```

Command+F6 to exit CLI focus

Top

Copy   Paste

Рисунок 9. Состояние протокола STP для VLAN 3.

4. В качестве корневого коммутатора STP настроила коммутатор mskdonskaya-sw-1:

**msk-donskaya-sw-1#configure terminal**

**msk-donskaya-sw-1(config)#spanning-tree vlan 3 root primary**

The screenshot shows a Cisco IOS Command Line Interface window titled "msk-donskaya-vmshutenko-sw-1". The window has tabs for Physical, Config, CLI (which is selected), and Attributes. The main area displays the following configuration commands:

```
msk-donskaya-vmshutenko-sw-1>en
Password:
msk-donskaya-vmshutenko-sw-1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-vmshutenko-sw-1(config)#spanning-tree vlan 3 root primary
msk-donskaya-vmshutenko-sw-1(config)#^Z
msk-donskaya-vmshutenko-sw-1#
%SYS-5-CONFIG_I: Configured from console by console
wr mem
Building configuration...
[OK]
msk-donskaya-vmshutenko-sw-1#
```

At the bottom left, there is a note: "Command+F6 to exit CLI focus". On the right side, there are "Copy" and "Paste" buttons. A checkbox labeled "Top" is located at the bottom left of the main window area.

Рисунок 10. Настройка корневого коммутатора STP.

5. Используя режим симуляции, убедилась, что пакеты ICMP пойдут от хоста dk-donskaya-1 до mail через коммутаторы msk-donskaya-sw-1 и msk-donskaya-sw-3, а от хоста dk-donskaya-1 до web через коммутаторы msk-donskaya-sw-1 и msk-donskaya-sw-2.

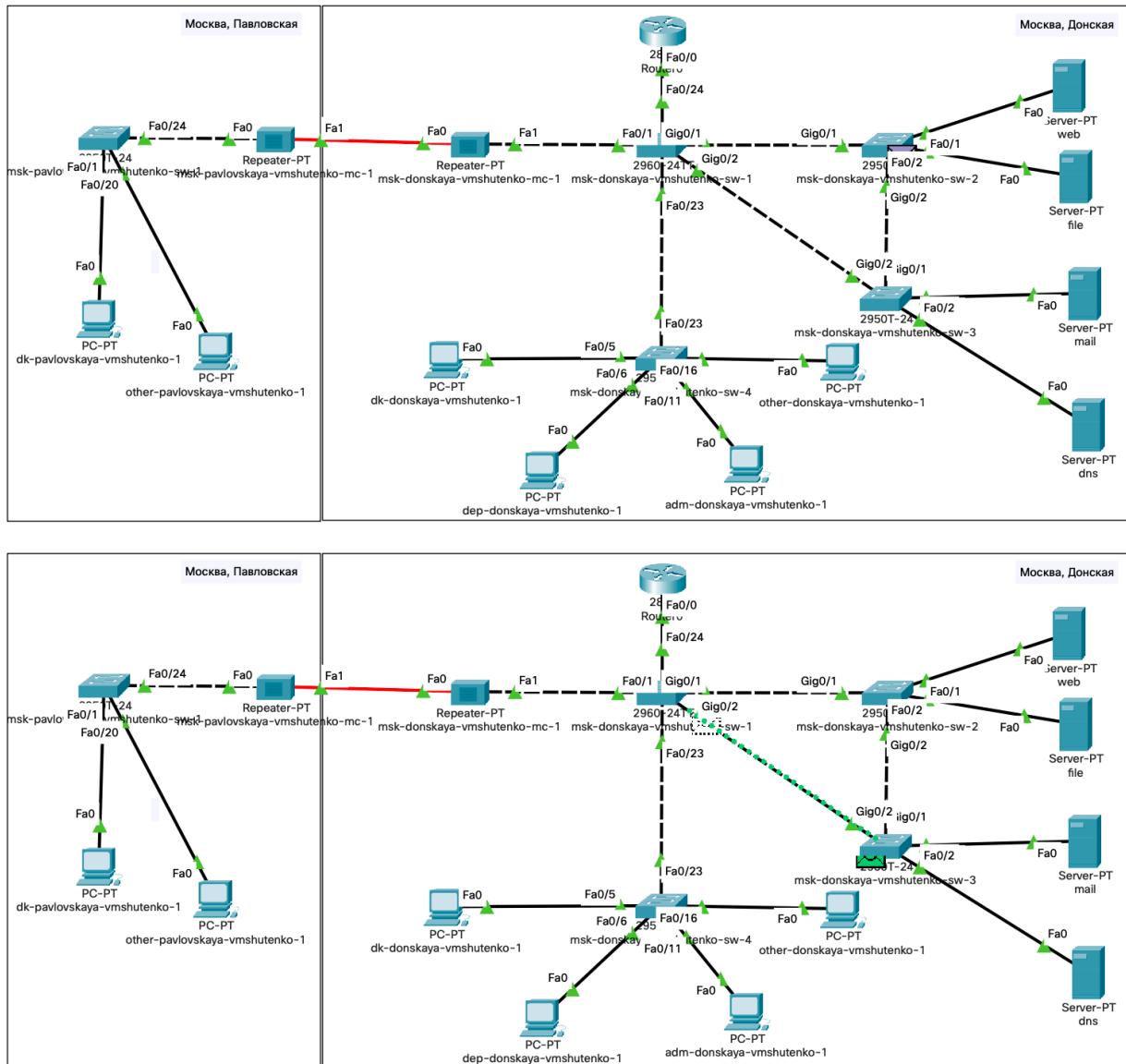


Рисунок 11-12. Режим симуляции. Здесь пакеты ICMP идут от хоста dk-donskaya-1 до mail через коммутаторы msk-donskaya-sw-1 и msk-donskaya-sw-3, а от хоста dk-donskaya-1 до web через коммутаторы msk-donskaya-sw-1 и msk-donskaya-sw-2.

6. Настроила режим Portfast на тех интерфейсах коммутаторов, к которым подключены серверы:

```

msk-donskaya-sw-2(config)#interface f0/1
msk-donskaya-sw-2(config-if)#spanning-tree portfast
msk-donskaya-sw-2(config)#interface f0/2
msk-donskaya-sw-2(config-if)#spanning-tree portfast
msk-donskaya-sw-3(config)#interface f0/1
msk-donskaya-sw-3(config-if)#spanning-tree portfast
msk-donskaya-sw-3(config)#interface f0/2
msk-donskaya-sw-3(config-if)#spanning-tree portfast

```

The image shows two separate Cisco IOS Command Line Interface (CLI) windows. Both windows have a title bar with the switch name followed by '-cli'. The top window is for 'msk-donskaya-vmshutenko-sw-2' and the bottom window is for 'msk-donskaya-vmshutenko-sw-3'. Both windows are set to the 'CLI' tab. The CLI interface includes tabs for 'Physical', 'Config', 'CLI' (which is selected), and 'Attributes'. Below the tabs is a status bar with icons for signal strength, battery, and other system information.

**msk-donskaya-vmshutenko-sw-2 CLI Output:**

```
% Invalid input detected at '^' marker.

msk-donskaya-vmshutenko-sw-2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-vmshutenko-sw-2(config)#int f0/1
msk-donskaya-vmshutenko-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-vmshutenko-sw-2(config-if)#
msk-donskaya-vmshutenko-sw-2#
%SYS-5-CONFIG_I: Configured from console by console
wr mem
Building configuration...
[OK]
msk-donskaya-vmshutenko-sw-2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-vmshutenko-sw-2(config)#int f0/2
msk-donskaya-vmshutenko-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-vmshutenko-sw-2(config-if)#
msk-donskaya-vmshutenko-sw-2(config-if)#

Command+F6 to exit CLI focus
```

**msk-donskaya-vmshutenko-sw-3 CLI Output:**

```
Password:
msk-donskaya-vmshutenko-sw-3>en
Password:
msk-donskaya-vmshutenko-sw-3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-vmshutenko-sw-3(config)#int f0/1
msk-donskaya-vmshutenko-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-vmshutenko-sw-3(config-if)#int f0/2
msk-donskaya-vmshutenko-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-vmshutenko-sw-3(config-if)^Z
msk-donskaya-vmshutenko-sw-3#
%SYS-5-CONFIG_I: Configured from console by console
wr mem
Building configuration...
[OK]
msk-donskaya-vmshutenko-sw-3#
```

Рисунок 13-14. Настройка режима Portfast.

7. Изучила отказоустойчивость протокола STP и время восстановления соединения при переключении на резервное соединение. Для этого использовала команду ping -n 1000 mail.donskaya.rudn.ru на хосте dkdonskaya-1, а разрыв соединения обеспечила переводом соответствующего интерфейса коммутатора в состояние shutdown.

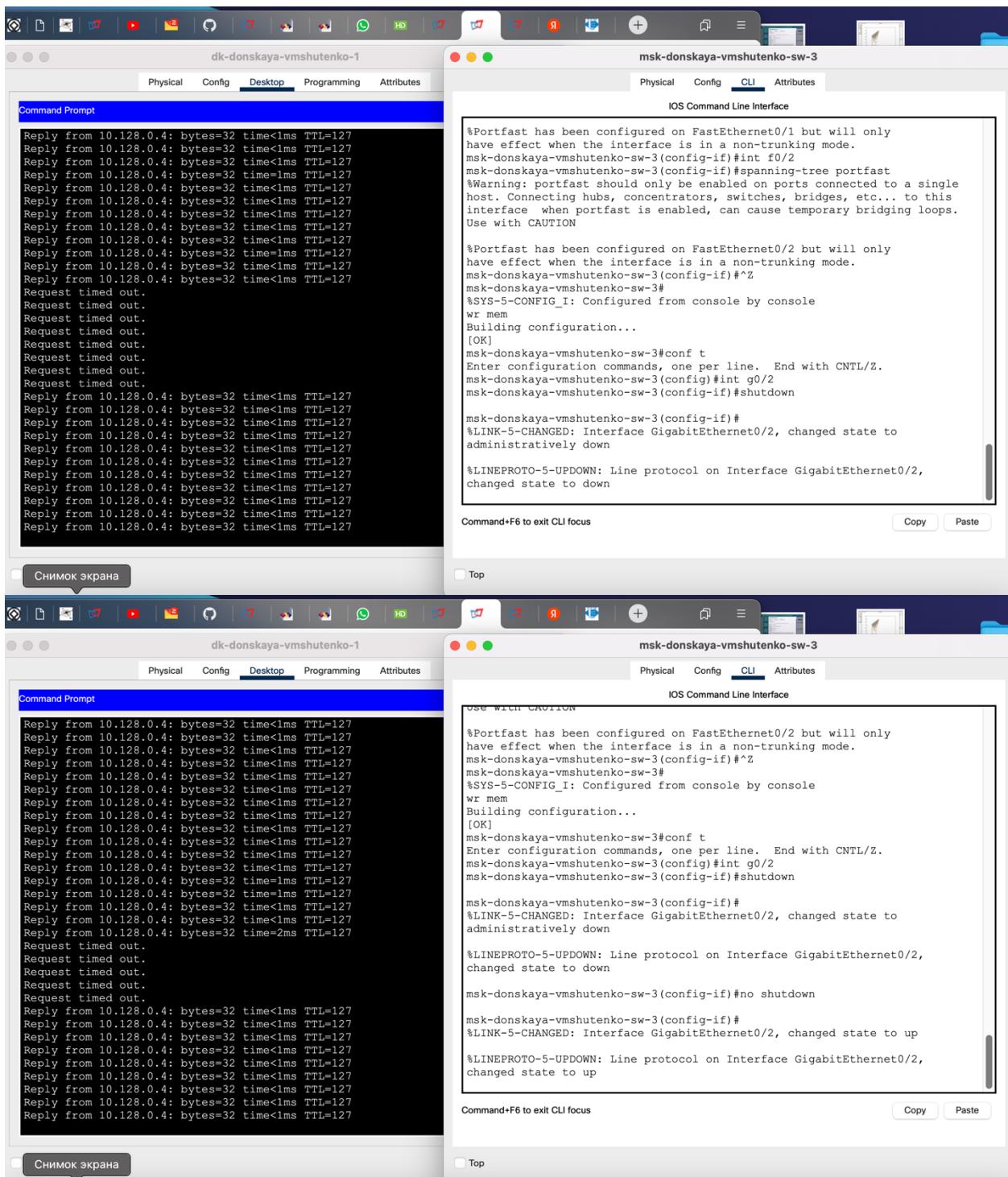


Рисунок 15-16. Работа с отказоустойчивостью протокола STP.

8. Переключила коммутаторы режим работы по протоколу Rapid PVST+:

msk-donskaya-sw-1(config)#spanning-tree mode rapid-pvst

msk-donskaya-sw-2(config)#spanning-tree mode rapid-pvst

msk-donskaya-sw-3(config)#spanning-tree mode rapid-pvst

msk-donskaya-sw-4(config)#spanning-tree mode rapid-pvst

```

%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-vmshutenko-sw-1>en
Password:
msk-donskaya-vmshutenko-sw-1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-vmshutenko-sw-1(config)#spanning-tree mode rapid-pvst
msk-donskaya-vmshutenko-sw-1(config)#^Z
msk-donskaya-vmshutenko-sw-1#
%SYS-5-CONFIG_I: Configured from console by console
wr mem
Building configuration...
[OK]
msk-donskaya-vmshutenko-sw-1#

Command+F6 to exit CLI focus      Copy

User Access Verification
Password:
msk-donskaya-vmshutenko-sw-2>en
Password:
msk-donskaya-vmshutenko-sw-2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-vmshutenko-sw-2(config)#spanning-tree mode rapid-pvst
msk-donskaya-vmshutenko-sw-2(config)#^Z
msk-donskaya-vmshutenko-sw-2#
%SYS-5-CONFIG_I: Configured from console by console
msk-donskaya-vmshutenko-sw-2#wr mem
Building configuration...
[OK]
msk-donskaya-vmshutenko-sw-2#

Command+F6 to exit CLI focus      Copy      Paste

Top
Снимок экрана
Copper Cross-Over
msk-donskaya-vmshutenko-sw-4
Physical Config CLI Attributes
IOS Command Line Interface
[OK]
msk-donskaya-vmshutenko-sw-3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-vmshutenko-sw-3(config)#int g0/2
msk-donskaya-vmshutenko-sw-3(config-if)#shutdown

msk-donskaya-vmshutenko-sw-3(config-if)#^Z
%LINK-5-CHANGED: Interface GigabitEthernet0/2, changed state to administratively down
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to down
msk-donskaya-vmshutenko-sw-3(config-if)#no shutdown

msk-donskaya-vmshutenko-sw-3(config-if)#^Z
%LINK-5-CHANGED: Interface GigabitEthernet0/2, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to up

msk-donskaya-vmshutenko-sw-3(config-if)#exit
msk-donskaya-vmshutenko-sw-3(config)#spanning-tree mode rapid-pvst
msk-donskaya-vmshutenko-sw-3(config)#^Z
msk-donskaya-vmshutenko-sw-3#
%SYS-5-CONFIG_I: Configured from console by console
wr mem
Building configuration...
[OK]
msk-donskaya-vmshutenko-sw-3#

Command+F6 to exit CLI focus      Copy      Paste

Top
Снимок экрана
Copper Cross-Over
Toggle PDU List Window
msk-donskaya-vmshutenko-sw-3
Physical Config CLI Attributes
IOS Command Line Interface

```

Рисунок 17-18. Переключение коммутаторов в режим работы по протоколу Rapid PVST+.

9. Изучила отказоустойчивость протокола Rapid PVST+ и время восстановления соединения при переключении на резервное соединение.

The image shows two Cisco routers, msk-donskaya-sw-3 and msk-donskaya-sw-4, connected via their GigabitEthernet0/2 interfaces. Both routers are configured to be the root bridge for the STP domain.

**Router msk-donskaya-sw-3 Configuration:**

```

msk-donskaya-vmshtutenko-sw-3(config-if)#exit
msk-donskaya-vmshtutenko-sw-3(config)#spanning-tree mode rapid-pvst
msk-donskaya-vmshtutenko-sw-3(config)#^Z
%SYS-5-CONFIG_I: Configured from console by console
wr mem
Building configuration...
[OK]
msk-donskaya-vmshtutenko-sw-3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-vmshtutenko-sw-3(config)#shutdown
^C
% Invalid input detected at '^' marker.

msk-donskaya-vmshtutenko-sw-3(config)#int g0/2
msk-donskaya-vmshtutenko-sw-3(config-if)#shutdown

msk-donskaya-vmshtutenko-sw-3(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/2, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2,
changed state to up

%SYS-5-CONFIG_I: Configured from console by console
wr mem
Building configuration...
[OK]
msk-donskaya-vmshtutenko-sw-3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-vmshtutenko-sw-3(config)#shutdown
^C
% Invalid input detected at '^' marker.

msk-donskaya-vmshtutenko-sw-3(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/2, changed state to administratively down
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2,
changed state to down

```

**Router msk-donskaya-sw-4 Configuration:**

```

msk-donskaya-vmshtutenko-sw-4(config)#
msk-donskaya-vmshtutenko-sw-4(config)#
%SYS-5-CONFIG_I: Configured from console by console
wr mem
Building configuration...
[OK]
msk-donskaya-vmshtutenko-sw-4#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-vmshtutenko-sw-4(config)#shutdown
^C
% Invalid input detected at '^' marker.

msk-donskaya-vmshtutenko-sw-4(config)#
%LINK-5-CHANGED: Interface GigabitEthernet0/2, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2,
changed state to up

%SYS-5-CONFIG_I: Configured from console by console
wr mem
Building configuration...
[OK]
msk-donskaya-vmshtutenko-sw-4#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-vmshtutenko-sw-4(config)#shutdown
^C
% Invalid input detected at '^' marker.

msk-donskaya-vmshtutenko-sw-4(config)#
%LINK-5-CHANGED: Interface GigabitEthernet0/2, changed state to administratively down
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2,
changed state to down

```

Рисунок 19-20. Работа с отказоустойчивостью протокола STP.

10. Сформировала агрегированное соединение интерфейсов Fa0/20 – Fa0/23 между коммутаторами msk-donskaya-sw-1 и msk-donskaya-sw-4.

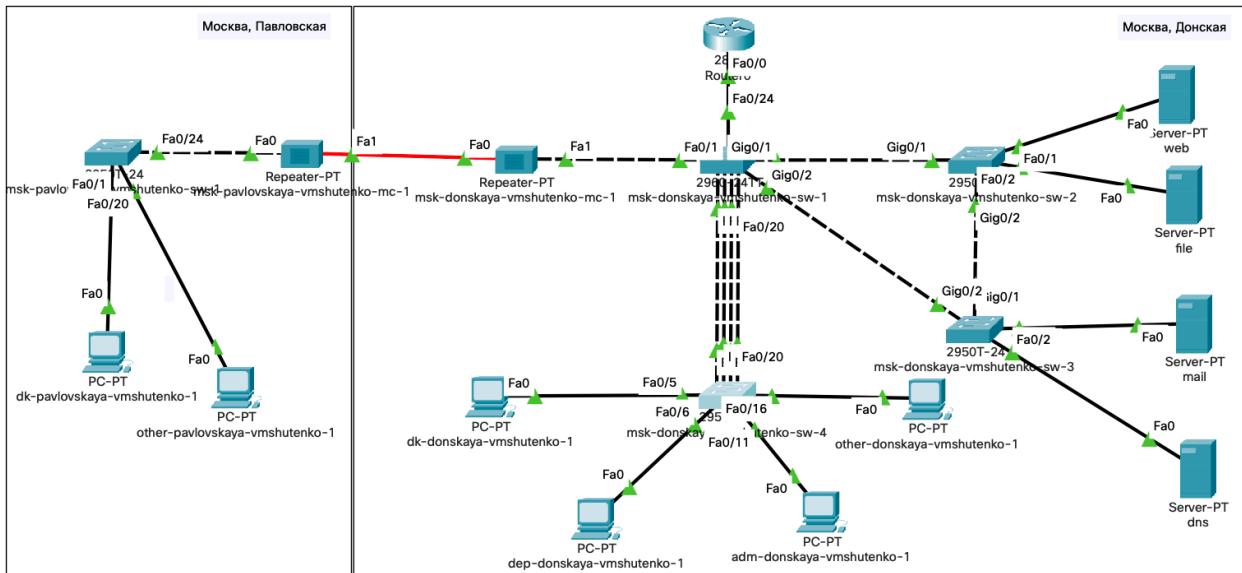


Рисунок 21. Агрегированное соединение интерфейсов Fa0/20 – Fa0/23 между коммутаторами msk-donskaya-sw-1 и msk-donskaya-sw-4

11. Настроила агрегирование каналов (режим EtherChannel):

```
msk-donskaya-sw-1(config)#interface range f0/20 – 23
msk-donskaya-sw-1(config-if-range)#channel-group 1 mode on
msk-donskaya-sw-1(config-if-range)#exit
msk-donskaya-sw-1(config)#interface port-channel 1
msk-donskaya-sw-1(config-if)#switchport mode trunk
```

The image shows two terminal windows side-by-side, both titled "msk-donskaya-vmshutenko-sw-1".

**Top Terminal Window:**

```

IOS Command Line Interface
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-vmshutenko-sw-1(config)#int f0/23
msk-donskaya-vmshutenko-sw-1(config-if)#no switchport mode trunk
msk-donskaya-vmshutenko-sw-1(config-if)#
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
FastEthernet0/20 (1), with msk-donskaya-vmshutenko-sw-1 FastEthernet0/20
(104).

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

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

msk-donskaya-vmshutenko-sw-1#
%SYS-5-CONFIG_I: Configured from console by console
wr mem
Building configuration...
[OK]
msk-donskaya-vmshutenko-sw-1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-vmshutenko-sw-1(config)#interface range f0/20 - 23
msk-donskaya-vmshutenko-sw-1(config-if-range)#channel-group 1 mode on
msk-donskaya-vmshutenko-sw-1(config-if-range)#

```

**Bottom Terminal Window:**

```

IOS Command Line Interface
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
FastEthernet0/23 (1), with msk-donskaya-vmshutenko-sw-1 FastEthernet0/21
(104).

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

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

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

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
FastEthernet0/23 (1), with msk-donskaya-vmshutenko-sw-1 FastEthernet0/22
(10)
msk-donskaya-vmshutenko-sw-1(config)#interface port-channel 1
msk-donskaya-vmshutenko-sw-1(config-if)#
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
FastEthernet0/20 (1), with msk-donskaya-vmshutenko-sw-1 FastEthernet0/20
(104).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
FastEthernet0/21 (1), with msk-donskaya-vmshutenko-sw-1 FastEthernet0/20
(104).

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

```

Рисунок 22-23. Агрегирование каналов sw-1.

```

msk-donskaya-sw-4(config)#int range f0/20 - 23
msk-donskaya-sw-4(config-if-range)#no switchport access vlan 104
msk-donskaya-sw-4(config-if-range)#exit
msk-donskaya-sw-4(config)#interface range f0/20 - 23
msk-donskaya-sw-4(config-if-range)#channel-group 1 mode on
msk-donskaya-sw-4(config-if-range)#exit
msk-donskaya-sw-4(config)#interface port-channel 1
msk-donskaya-sw-4(config-if)#switchport mode trunk

```

msk-donskaya-vmshutenko-sw-4

Physical Config **CLI** Attributes

IOS Command Line Interface

```

msk-donskaya-vmshutenko-sw-1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-vmshutenko-sw-1(config)#int f0/23
msk-donskaya-vmshutenko-sw-1(config-if)#no switchport mode trunk
Command rejected: An interface must be configured to the Access or Trunk
modes to be configured to NoNegotiate.
msk-donskaya-vmshutenko-sw-1(config-if)#
msk-donskaya-vmshutenko-sw-1#
%SYS-5-CONFIG_I: Configured from console by console
wr
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
FastEthernet0/20 (104), with msk-donskaya-vmshutenko-sw-1 FastEthernet0/20
(1).

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

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

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
FastEthernet0/22 (104), with msk-donskaya-vmshutenko-sw-1 Port-channel1
(1).
mem
Building configuration...
[OK]
msk-donskaya-vmshutenko-sw-1#

```

Command+F6 to exit CLI focus

**Copy**

**Paste**

Top

Toggle PDU List Window

msk-donskaya-vmshutenko-sw-4

Physical Config **CLI** Attributes

IOS Command Line Interface

```

(1).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
FastEthernet0/22 (104), with msk-donskaya-vmshutenko-sw-1 int f0/23
msk-donskaya-vmshutenko-sw-1(config-if)#int range f0/20 - 23
msk-donskaya-vmshutenko-sw-1(config-if-range)#no switchport access vlan
104
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
FastEthernet0/20 (104), with msk-donskaya-vmshutenko-sw-1 FastEthernet0/20
(1).

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

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

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
FastEthernet0/22 (104), with msk-donskaya-vmshutenko-sw-1 Port-channel1
(1).

msk-donskaya-vmshutenko-sw-1(config-if-range)#exit
msk-donskaya-vmshutenko-sw-1(config)#interface range f0/20 - 23
msk-donskaya-vmshutenko-sw-1(config-if-range)#channel-group 1 mode on
msk-donskaya-vmshutenko-sw-1(config-if-range)#
Creating a port-channel interface Port-channel 1

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

```

Command+F6 to exit CLI focus

**Copy**

**Paste**

Top

Рисунок 24-25. Агрегирование каналов на sw-4.

The screenshot shows a terminal window titled "msk-donskaya-vmshutenko-sw-4". The tab bar at the top includes "Physical", "Config", "CLI" (which is selected), and "Attributes". Below the tabs, it says "IOS Command Line Interface". The main area displays the following CLI session and log output:

```
%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  
%SPANTREE-2-RECV_PVID_ERR: Received 802.1Q BPDU on non trunk Port-channel1 VLAN1.  
%SPANTREE-2-BLOCK_PVID_LOCAL: Blocking Port-channel1 on VLAN0001. Inconsistent port type.  
  
msk-donskaya-vmshutenko-sw-1(config-if-range)#exit  
msk-donskaya-vmshutenko-sw-1(config)#interface port-channel 1  
msk-donskaya-vmshutenko-sw-1(config-if)#switchport mode trunk  
  
msk-donskaya-vmshutenko-sw-1(config-if)#%SPANTREE-2-UNBLOCK_CONSIST_PORT:  
Unblocking Port-channel1 on VLAN0001. Port consistency restored.  
  
%SPANTREE-2-UNBLOCK_CONSIST_PORT: Unblocking Port-channel1 on VLAN0001.  
Port consistency restored.
```

Command+F6 to exit CLI focus

Top

Рисунок 26. Агрегирование каналов на sw-4.

#### Контрольные вопросы

1. Какую информацию можно получить, воспользовавшись командой определения состояния протокола STP для VLAN (на корневом и не на корневом устройстве)? Приведите примеры вывода подобной информации на устройствах. show spanning-tree – данная команда выводит информацию о всех процессах STP (то есть за каждый VLAN), в которых участвует коммутатор.

msk-donskaya-vmshutenko-sw-1

Physical Config **CLI** Attributes

IOS Command Line Interface

```
msk-donskaya-vmshutenko-sw-1>en
Password:
msk-donskaya-vmshutenko-sw-1#show spanning-tree
VLAN0001
  Spanning tree enabled protocol rstp
  Root ID    Priority      32769
              Address       0001.4220.B819
              Cost          4
              Port          26(GigabitEthernet0/2)
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority      32769  (priority 32768 sys-id-ext 1)
              Address       0060.3EEB.09A8
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time   20

  Interface    Role Sts Cost      Prio.Nbr Type
  ----- ----- ----- -----
  Po1          Desg FWD 7      128.28  Shr
  Fa0/1        Desg FWD 19     128.1   Shr
  Fa0/24       Desg FWD 19     128.24  P2p
  Gi0/1        Desg FWD 4      128.25  P2p
  Gi0/2        Root FWD 4      128.26  P2p

VLAN0002
  Spanning tree enabled protocol rstp
  Root ID    Priority      32770
              Address       0001.4220.B819
              Cost          4
              Port          26(GigabitEthernet0/2)
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
```

2. При помощи какой команды можно узнать, в каком режиме, STP или Rapid PVST+, работает устройство? Приведите примеры вывода подобной информации на устройствах.

```
show spanning-tree summary
```

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

Password:
msk-donskaya-vmshutenko-sw-1>en
Password:
msk-donskaya-vmshutenko-sw-1#show spanning-tree summary
Switch is in rapid-pvst mode
Root bridge for: dk departaments adm other
Extended system ID      is enabled
Portfast Default        is disabled
PortFast BPDU Guard Default  is disabled
Portfast BPDU Filter Default is disabled
Loopguard Default       is disabled
EtherChannel misconfig guard is disabled
UplinkFast              is disabled
BackboneFast             is disabled
Configured Pathcost method used is short

Name          Blocking Listening Learning Forwarding STP Active
-----
VLAN0001      7          0          0          1          8
VLAN0101      3          0          0          5          8
VLAN0102      3          0          0          5          8
VLAN0103      3          0          0          5          8
VLAN0104      6          0          0          2          8
-----
7 vlans       22         0          0          18         40

msk-donskaya-vmshutenko-sw-1#
```

Command+F6 to exit CLI focus      [Copy](#)      [Paste](#)

3. Для чего и в каких случаях нужно настраивать режим Portfast?

При подключении устройства к такому порту, он, минуя промежуточные стадии, сразу переходит к forwarding-состоянию. Само собой, portfast следует включать только на интерфейсах, ведущих к конечным устройствам (рабочим станциям, серверам, телефонам и т.д.), но не к другим свичам.

4. В чем состоит принцип работы агрегированного интерфейса? Для чего он используется?

Агрегация — это объединение нескольких физических каналов в один логический. Это объединение решает две задачи: увеличение пропускной способности канала и усиление надежности канала на физический отказ. Агрегирование не является заменой такого протокола как STP, так как при работе STP активным является только один канал, а дополнительные физические каналы находятся в резерве.

5. В чём принципиальные отличия при использовании протоколов LACP (Link Aggregation Control Protocol), PAgP (Port Aggregation Protocol) и статического агрегирования без использования протоколов?

LACP (Link Aggregation Control Protocol) стандартный протокол  
PAgP (Port Aggregation Protocol) проприетарный протокол Cisco

Статическое агрегирование без использования протоколов

Так как LACP и PAgP решают одни и те же задачи (с небольшими различиями по возможностям), то лучше использовать стандартный протокол. Фактически остается выбор между LACP и статическим агрегированием.

- Статическое агрегирование:
  - Преимущества:
    - Не вносит дополнительную задержку при поднятии агрегированного канала или изменении его настроек
    - Вариант, который рекомендует использовать Cisco
  - Недостатки:
    - Нет согласования настроек с удаленной стороной. Ошибки в настройке могут привести к образованию петель
- Агрегирование с помощью LACP:
  - Преимущества:
    - Согласование настроек с удаленной стороной позволяет избежать ошибок и петель в сети.
    - Поддержка standby-интерфейсов позволяет агрегировать до 16ти портов, 8 из которых будут активными, а остальные в режиме standby
  - Недостатки:
    - Вносит дополнительную задержку при поднятии агрегированного канала или изменении его настроек

6. При помощи каких команд можно узнать состояние агрегированного канала EtherChannel?

- show etherchannel summary
- show etherchannel 1 port-channel
- show interfaces etherchannel