РОССИЙСКИЙ УНИВЕРСИТЕТ ДРУЖБЫ НАРОДОВ

Факультет физико-математических и естественных наук

Кафедра прикладной информатики и теории вероятностей

ОТЧЕТ
ПО ЛАБОРАТОРНОЙ РАБОТЕ № 9

Использование протокола STP. Агрегирование каналов

дисциплина: Администрирование локальных сетей

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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.

Выполнение работы

1. Сформируйте резервное соединение между коммутаторами msk-donskaya-sw-1 и msk-donskaya-sw-3. Для этого:
   - замените 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) (Рис. 1);
   - сделайте порт на интерфейсе Gig0/2 коммутатора msk-donskaya-sw-3 транковым (Рис. 2):

     msk−donskaya−sw−3(config)#int g0/2

     msk−donskaya −sw −3(config −if)#switchport mode trunk
   - соединение между коммутаторами msk-donskaya-sw-1 и msk-donskaya-sw-4 сделайте через интерфейсы Fa0/23, активировать их в транковом режиме (Рис. 3-4).

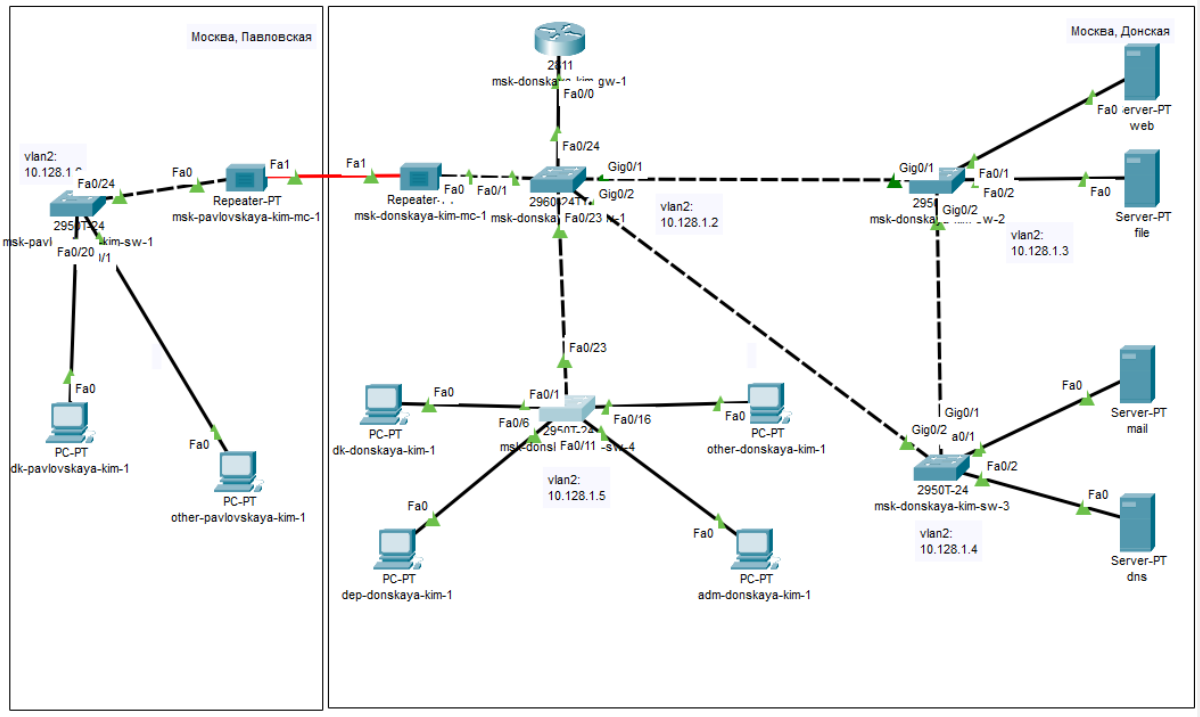

Рисунок 1

```
msk-donskaya-kim-sw-3>en
Password:
msk-donskaya-kim-sw-3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
msk-donskaya-kim-sw-3(config)#int g0/2
msk-donskaya-kim-sw-3(config-if)#switchport mode trunk
```

Рисунок 2

```
msk-donskaya-kim-sw-1(config)#interface f0/23
msk-donskaya-kim-sw-1(config-if)#switchport mode trunk

msk-donskaya-kim-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
```

Рисунок 3

```
msk-donskaya-kim-sw-4(config)#interface f0/23
msk-donskaya-kim-sw-4(config-if)#switchport mode trunk

msk-donskaya-kim-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
```

Рисунок 4

2. С оконечного устройства dk-donskaya-1 пропингуйте серверы mail и web (Рис. 5). В режиме симуляции проследите движение пакетов ICMP. Убедитесь, что движение пакетов происходит через коммутатор msk-donskaya-sw-2 (Рис. 6).

```
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<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 = 4, Lost = 0 (0% 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:

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
Reply from 10.128.0.4: bytes=32 time<1ms TTL=127

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

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

Pinging 10.128.0.2 with 32 bytes of data:

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=10ms 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 = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 2ms
```

Рисунок 5

0.005	msk-donskaya-kim-sw-1	msk-donskaya-kim-sw-3	ICMP
0.006	msk-donskaya-kim-sw-3	msk-donskaya-kim-sw-2	ICMP
0.007	msk-donskaya-kim-sw-2	web	ICMP
0.008	web	msk-donskaya-kim-sw-2	ICMP
0.009	msk-donskaya-kim-sw-2	msk-donskaya-kim-sw-3	ICMP

Рисунок 6

3. На коммутаторе msk-donskaya-sw-2 посмотрите состояние протокола STP для vlan 3 (Рис. 7):

   msk−donskaya −sw −2#show spanning −tree vlan 3

В результате будет выведена примерно следующая информация, связанная с протоколом STP:

```
msk-donskaya-kim-sw-2#show spanning-tree vlan 3
VLAN0003
  Spanning tree enabled protocol rstp
  Root ID     Priority    20483
              Address     0060.3EBC.3AAE
              This bridge is the root
              Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    20483  (priority 20480 sys-id-ext 3)
              Address     0060.3EBC.3AAE
              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
```

Рисунок 7

Здесь, в частности, указывается, что данное устройство является корневым (строка This bridge is the root).

4. В качестве корневого коммутатора STP настройте коммутатор msk-donskaya-kim-sw-1 (Рис. 8):

   msk−donskaya-kim-sw −1#configure terminal

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

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

msk-donskaya-kim-sw-1#sh spanning-tree vlan 3
VLAN0003
  Spanning tree enabled protocol ieee
  Root ID     Priority    24579
              Address     0060.5C9E.C4DA
              This bridge is the root
              Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    24579  (priority 24576 sys-id-ext 3)
              Address     0060.5C9E.C4DA
              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    Shr
Fa0/24           Desg FWD 19        128.24   P2p
Fa0/23           Desg FWD 19        128.23   P2p
Gi0/1            Desg LRN 4         128.25   P2p
Gi0/2            Desg FWD 4         128.26   P2p
```

Рисунок 8

5. Используя режим симуляции, убедитесь, что пакеты ICMP пойдут от хоста dk-

donskaya-1 до mail через коммутаторы msk-donskaya-sw-1 и mskdonskaya-sw-3, а от хоста dk-donskaya-1 до web через коммутаторы msk-donskaya-sw-1 и msk-donskaya-sw-2 (Рис. 9-10).

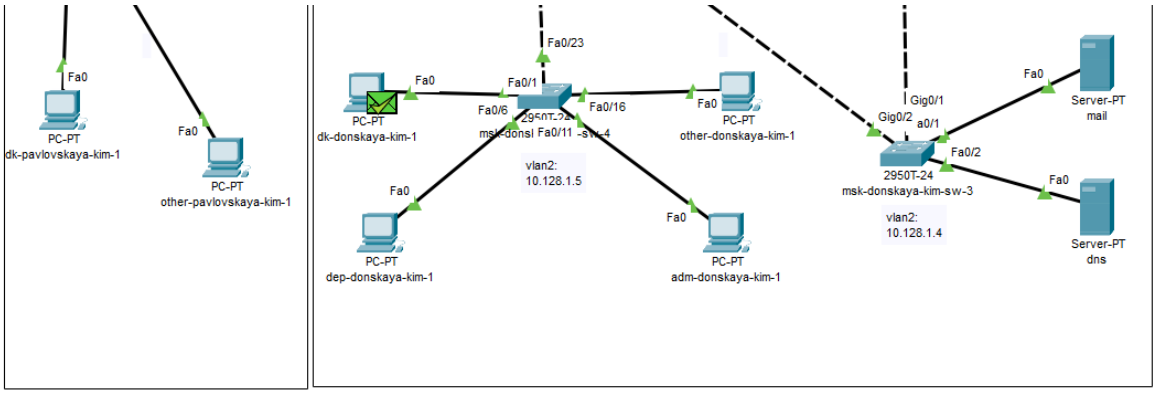

Рисунок 9

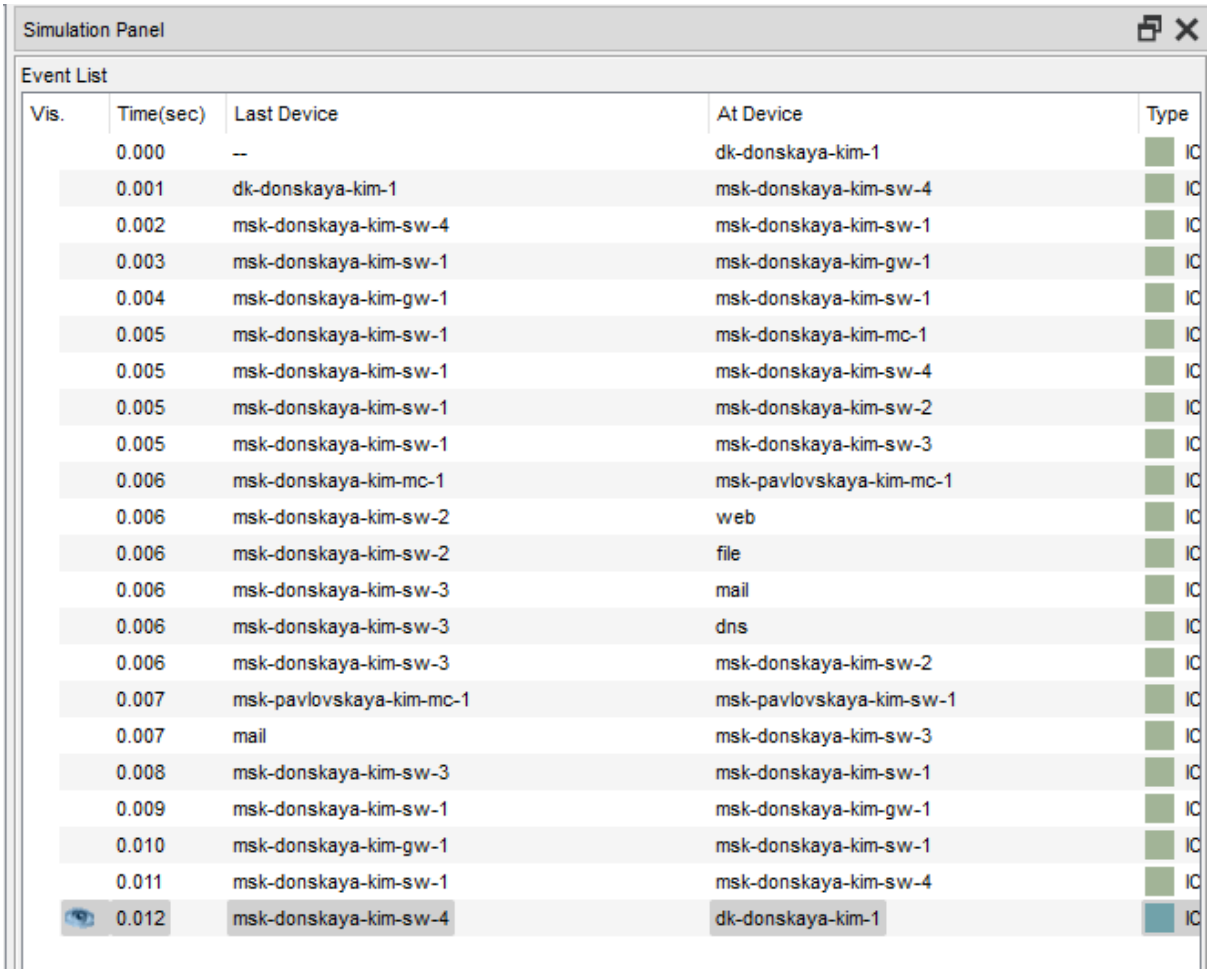

Рисунок 10

6. Настройте режим Portfast на тех интерфейсах коммутаторов, к которым подключены серверы (Рис. 10-11):

```
msk-donskaya-kim-sw-2(config)#int f0/1
msk-donskaya-kim-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-kim-sw-2(config-if)#int f0/2
msk-donskaya-kim-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-kim-sw-2(config-if)#
```

Рисунок 11

```
msk-donskaya-kim-sw-3>en
Password:
msk-donskaya-kim-sw-3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
msk-donskaya-kim-sw-3(config)#int f0/1
msk-donskaya-kim-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-kim-sw-3(config-if)#int f0/2
msk-donskaya-kim-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-kim-sw-3(config-if)#
```

Рисунок 12

7. Изучите отказоустойчивость протокола STP и время восстановления соединения при переключении на резервное соединение. Для этого используйте команду ping -n 1000 mail.donskaya.rudn.ru на хосте dk-donskaya-1, а разрыв соединения обеспечьте переводом соответствующего интерфейса коммутатора в состояние shutdown (Рис. 13).

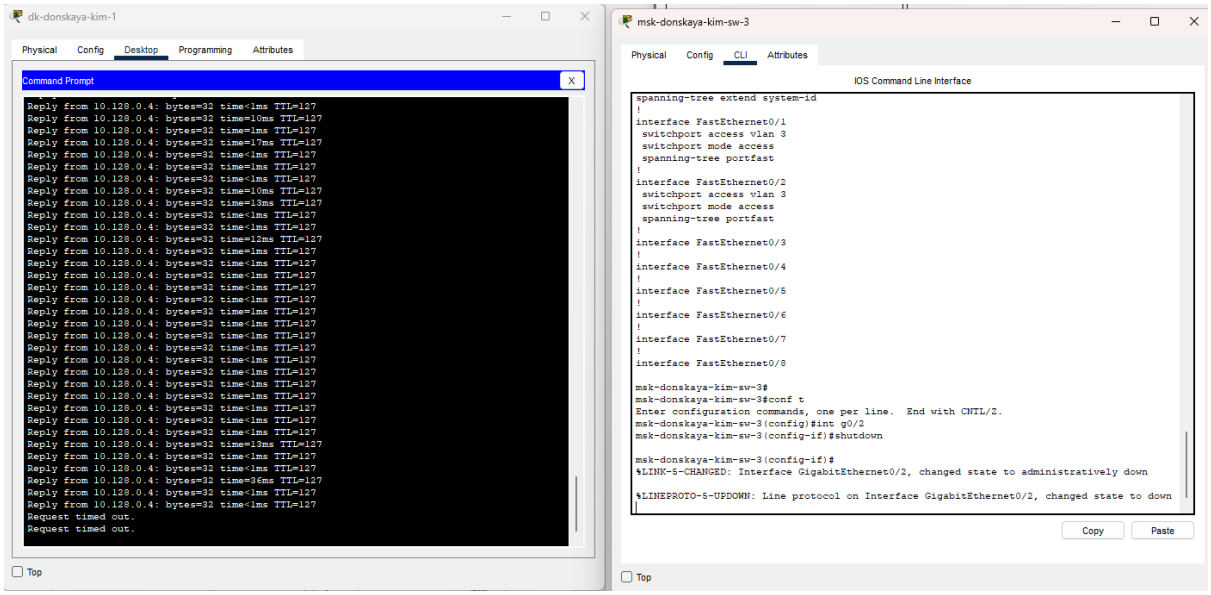

Рисунок 13

8. Переключите коммутаторы режим работы по протоколу Rapid PVST+ (Рис. 14-18):

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

msk-donskaya-kim-sw-1#wr m
Building configuration...
[OK]
```

Рисунок 14

```
msk-donskaya-kim-sw-2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
msk-donskaya-kim-sw-2(config)#spanning-tree mode rapid-pvst
msk-donskaya-kim-sw-2(config)#^Z
msk-donskaya-kim-sw-2#
%SYS-5-CONFIG_I: Configured from console by console

msk-donskaya-kim-sw-2#wr m
Building configuration...
[OK]
```

Рисунок 15

```
msk-donskaya-kim-sw-3(config)#spanning-tree mode rapid-pvst
msk-donskaya-kim-sw-3(config)#^Z
msk-donskaya-kim-sw-3#
%SYS-5-CONFIG_I: Configured from console by console

msk-donskaya-kim-sw-3#wr m
Building configuration...
[OK]
```

Рисунок 16

```
msk-donskaya-kim-sw-4#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
msk-donskaya-kim-sw-4(config)#spanning-tree mode rapid-pvst
msk-donskaya-kim-sw-4(config)#^Z
msk-donskaya-kim-sw-4#
%SYS-5-CONFIG_I: Configured from console by console

msk-donskaya-kim-sw-4#wr m
Building configuration...
[OK]
```

Рисунок 17

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

msk-pavlovskaya-kim-sw-1#wr m
Building configuration...
[OK]
```

Рисунок 18

9. Изучите отказоустойчивость протокола Rapid PVST+ и время восстановления соединения при переключении на резервное соединение (Рис. 19)

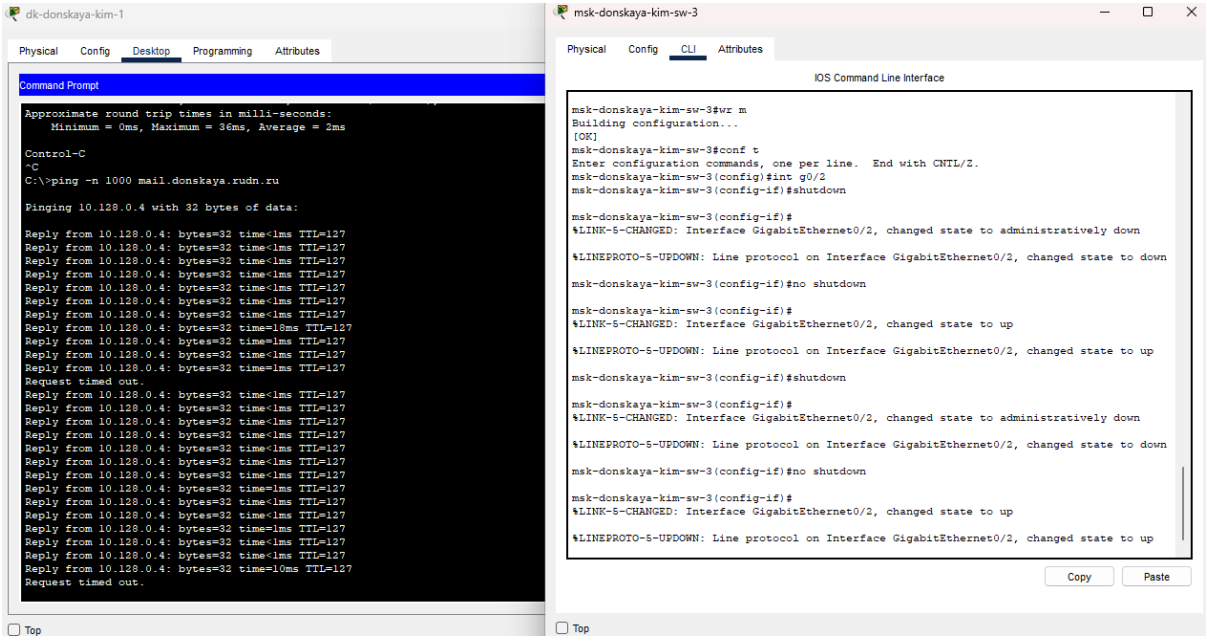

Рисунок 19

10. Сформируйте агрегированное соединение интерфейсов Fa0/20 – Fa0/23 между коммутаторами msk-donskaya-sw-1 и msk-donskaya-sw-4 (Рис. 20).

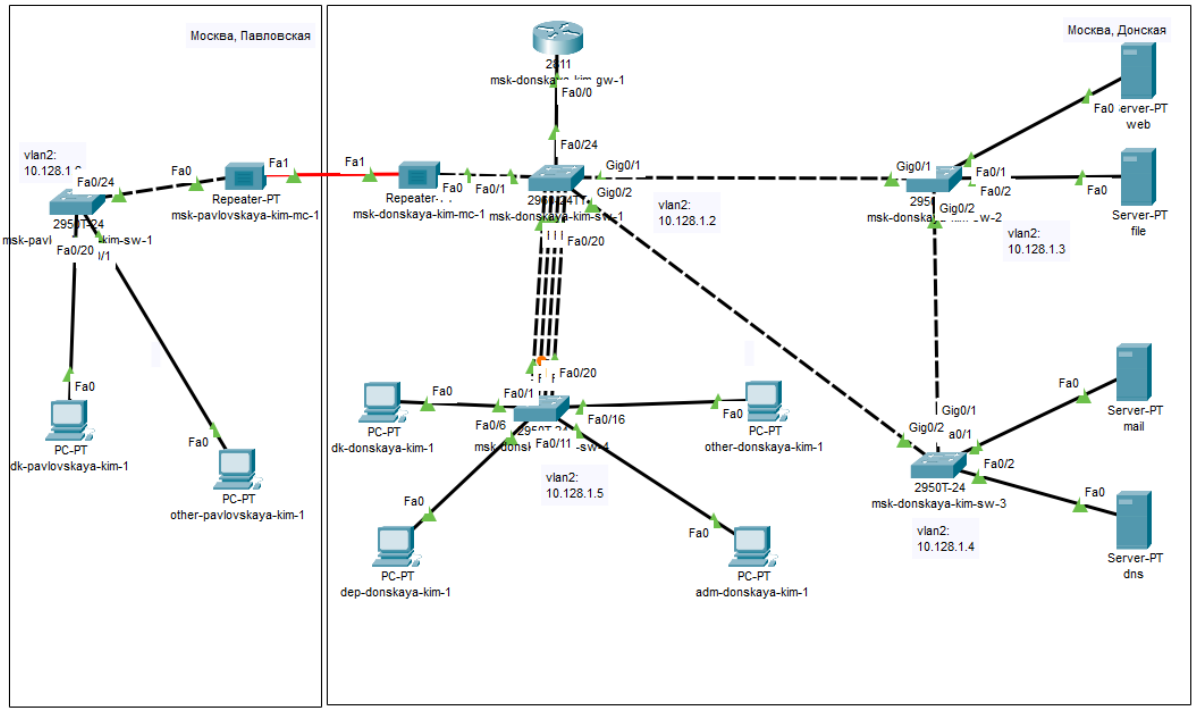

Рисунок 20

11. Настройте агрегирование каналов (режим EtherChannel) (Рис. 21-22):

```
msk-donskaya-kim-sw-1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
msk-donskaya-kim-sw-1(config)#interface range f0/20 - 23
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/20 (1), with msk-donskaya-kim-sw-4 FastEthernet0/20 (104).

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

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

msk-donskaya-kim-sw-1(config-if-range)#channel-group 1 mode on
msk-donskaya-kim-sw-1(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

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

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

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

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

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

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

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

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

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

msk-donskaya-kim-sw-1(config-if)#switchport mode trunk

msk-donskaya-kim-sw-1(config-if)#
```

Рисунок 21

```
msk-donskaya-kim-sw-4#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
msk-donskaya-kim-sw-4(config)#int range f0/20 - 23
msk-donskaya-kim-sw-4(config-if-range)#
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/20 (104), with msk-donskaya-kim-sw-1 FastEthernet0/20 (1).

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

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

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/20 (104), with msk-donskaya-kim-sw-1 Port-channel1 (1).

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

msk-donskaya-kim-sw-4(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.


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

msk-donskaya-kim-sw-4#wr m
Building configuration...
[OK]
msk-donskaya-kim-sw-4#
```

Рисунок 22

Конфигурации оборудования

- **msk-donskaya-kim-sw-1**

!

version 15.0

no service timestamps log datetime msec

no service timestamps debug datetime msec

service password-encryption

!

hostname msk-donskaya-kim-sw-1

!

enable secret 5 1mERr$hx5rVt7rPNoS4wqbXKX7m0

!

!

!

ip domain-name donskaya.rudn.edu

!

username admin secret 5 1mERr$hx5rVt7rPNoS4wqbXKX7m0

```
!
!
!
spanning-tree mode rapid-pvst
spanning-tree extend system-id
spanning-tree vlan 3 priority 24576
!
interface Port-channel1
 switchport mode trunk
!
interface FastEthernet0/1
 switchport mode trunk
!
interface FastEthernet0/2
!
interface FastEthernet0/3
!
interface FastEthernet0/4
!
interface FastEthernet0/5
!
interface FastEthernet0/6
!
interface FastEthernet0/7
!
interface FastEthernet0/8
!
interface FastEthernet0/9
!
interface FastEthernet0/10
!
interface FastEthernet0/11
!
interface FastEthernet0/12
```

```
!
interface FastEthernet0/13
!
interface FastEthernet0/14
!
interface FastEthernet0/15
!
interface FastEthernet0/16
!
interface FastEthernet0/17
!
interface FastEthernet0/18
!
interface FastEthernet0/19
!
interface FastEthernet0/20
 switchport mode trunk
 channel-group 1 mode on
!
interface FastEthernet0/21
 switchport mode trunk
 channel-group 1 mode on
!
interface FastEthernet0/22
 switchport mode trunk
 channel-group 1 mode on
!
interface FastEthernet0/23
 switchport mode trunk
 channel-group 1 mode on
!
interface FastEthernet0/24
 switchport mode trunk
!
```

```
interface GigabitEthernet0/1
 switchport mode trunk
!
interface GigabitEthernet0/2
 switchport mode trunk
!
interface Vlan1
 no ip address
 shutdown
!
interface Vlan2
 ip address 10.128.1.2 255.255.255.0
!
ip default-gateway 10.128.1.1
!
!
!
!
line con 0
 password 7 0822455D0A16
 login
!
line vty 0 4
 password 7 0822455D0A16
 login
 transport input ssh
line vty 5 15
 login
!
!
!
!
end
```

- **msk-doskaya-kim-sw-2**

```
!
version 12.1
no service timestamps log datetime msec
no service timestamps debug datetime msec
service password-encryption
!
hostname msk-donskaya-kim-sw-2
!
enable secret 5 $1$mERr$hx5rVt7rPNoS4wqbXKX7m0
!
!
!
ip domain-name donskaya.rudn.edu
!
username admin secret 5 $1$mERr$hx5rVt7rPNoS4wqbXKX7m0
!
!
!
spanning-tree mode rapid-pvst
spanning-tree extend system-id
spanning-tree vlan 3 priority 20480
!
interface FastEthernet0/1
 switchport access vlan 3
 switchport mode access
 spanning-tree portfast
!
interface FastEthernet0/2
 switchport access vlan 3
 switchport mode access
 spanning-tree portfast
!
interface FastEthernet0/3
!
```

```
interface FastEthernet0/4
!
interface FastEthernet0/5
!
interface FastEthernet0/6
!
interface FastEthernet0/7
!
interface FastEthernet0/8
!
interface FastEthernet0/9
!
interface FastEthernet0/10
!
interface FastEthernet0/11
!
interface FastEthernet0/12
!
interface FastEthernet0/13
!
interface FastEthernet0/14
!
interface FastEthernet0/15
!
interface FastEthernet0/16
!
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 mode trunk
!
interface GigabitEthernet0/2
 switchport mode trunk
!
interface Vlan1
 no ip address
 shutdown
!
interface Vlan2
 ip address 10.128.1.3 255.255.255.0
!
ip default-gateway 10.128.1.1
!
!
!
!
line con 0
 password 7 0822455D0A16
 login
!
line vty 0 4
 password 7 0822455D0A16
 login
 transport input ssh
```

line vty 5 15
 login
!
!
!
!
end

- **msk-donskaya-kim-sw-3**

!
version 12.1
no service timestamps log datetime msec
no service timestamps debug datetime msec
service password-encryption
!
hostname msk-donskaya-kim-sw-3
!
enable secret 5 1mERr$hx5rVt7rPNoS4wqbXKX7m0
!
!
!
ip domain-name donskaya.rudn.edu
!
username admin secret 5 1mERr$hx5rVt7rPNoS4wqbXKX7m0
!
!
!
spanning-tree mode rapid-pvst
spanning-tree extend system-id
!
interface FastEthernet0/1
 switchport access vlan 3
 switchport mode access
 spanning-tree portfast
!

```
interface FastEthernet0/2
 switchport access vlan 3
 switchport mode access
 spanning-tree portfast
!
interface FastEthernet0/3
!
interface FastEthernet0/4
!
interface FastEthernet0/5
!
interface FastEthernet0/6
!
interface FastEthernet0/7
!
interface FastEthernet0/8
!
interface FastEthernet0/9
!
interface FastEthernet0/10
!
interface FastEthernet0/11
!
interface FastEthernet0/12
!
interface FastEthernet0/13
!
interface FastEthernet0/14
!
interface FastEthernet0/15
!
interface FastEthernet0/16
!
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 mode trunk
!
interface GigabitEthernet0/2
 switchport mode trunk
!
interface Vlan1
 no ip address
 shutdown
!
interface Vlan2
 ip address 10.128.1.4 255.255.255.0
!
ip default-gateway 10.128.1.1
!
!
!
!
line con 0
```

```
 password 7 0822455D0A16
 login
!
line vty 0 4
 password 7 0822455D0A16
 login
 transport input ssh
line vty 5 15
 login
!
!
!
!
end
```

- **msk-donskaya-kim-sw-4**

```
!
version 12.1
no service timestamps log datetime msec
no service timestamps debug datetime msec
service password-encryption
!
hostname msk-donskaya-kim-sw-4
!
enable secret 5 $1$mERr$hx5rVt7rPNoS4wqbXKX7m0
!
!
!
ip domain-name donskaya.rudn.edu
!
username admin secret 5 $1$mERr$hx5rVt7rPNoS4wqbXKX7m0
!
!
!
spanning-tree mode rapid-pvst
```

```
spanning-tree extend system-id
!
interface Port-channel1
 switchport mode trunk
!
interface FastEthernet0/1
 switchport access vlan 101
 switchport mode access
!
interface FastEthernet0/2
 switchport access vlan 101
 switchport mode access
!
interface FastEthernet0/3
 switchport access vlan 101
 switchport mode access
!
interface FastEthernet0/4
 switchport access vlan 101
 switchport mode access
!
interface FastEthernet0/5
 switchport access vlan 101
 switchport mode access
!
interface FastEthernet0/6
 switchport access vlan 102
 switchport mode access
!
interface FastEthernet0/7
 switchport access vlan 102
 switchport mode access
!
interface FastEthernet0/8
```

```
 switchport access vlan 102
 switchport mode access
!
interface FastEthernet0/9
 switchport access vlan 102
 switchport mode access
!
interface FastEthernet0/10
 switchport access vlan 102
 switchport mode access
!
interface FastEthernet0/11
 switchport access vlan 103
 switchport mode access
!
interface FastEthernet0/12
 switchport access vlan 103
 switchport mode access
!
interface FastEthernet0/13
 switchport access vlan 103
 switchport mode access
!
interface FastEthernet0/14
 switchport access vlan 103
 switchport mode access
!
interface FastEthernet0/15
 switchport access vlan 103
 switchport mode access
!
interface FastEthernet0/16
 switchport access vlan 104
 switchport mode access
```

```
!
interface FastEthernet0/17
 switchport access vlan 104
 switchport mode access
!
interface FastEthernet0/18
 switchport access vlan 104
 switchport mode access
!
interface FastEthernet0/19
 switchport access vlan 104
 switchport mode access
!
interface FastEthernet0/20
 switchport mode trunk
 channel-group 1 mode on
!
interface FastEthernet0/21
 switchport mode trunk
 channel-group 1 mode on
!
interface FastEthernet0/22
 switchport mode trunk
 channel-group 1 mode on
!
interface FastEthernet0/23
 switchport mode trunk
 channel-group 1 mode on
!
interface FastEthernet0/24
 switchport access vlan 104
 switchport mode trunk
!
interface GigabitEthernet0/1
```

```
 switchport mode trunk
!
interface GigabitEthernet0/2
!
interface Vlan1
 no ip address
 shutdown
!
interface Vlan2
 ip address 10.128.1.5 255.255.255.0
!
ip default-gateway 10.128.1.1
!
!
!
!
line con 0
 password 7 0822455D0A16
 login
!
line vty 0 4
 password 7 0822455D0A16
 login
 transport input ssh
line vty 5 15
 login
!
!
!
!
end
```

Ответы на 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.

- VLAN… // Номер VLAN
- STP … // Тип протокола
- Root ID/Bridge ID // Ближайший коммутатор/Текущий коммутатор
- Priority … // Приоритет
- Address … // MAC-адрес
- Cost … // «Затраты» до этого коммутатора
- Port … // Порт
- Hello Time … Max Age … Forward Delay … Aging Time … // Время работы STP //Свойства портов

```
msk-donskaya-kim-sw-2#show spanning-tree vlan 3
VLAN0003
  Spanning tree enabled protocol rstp
  Root ID     Priority    20483
              Address     0060.3EBC.3AAE
              This bridge is the root
              Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    20483  (priority 20480 sys-id-ext 3)
              Address     0060.3EBC.3AAE
              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
```

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-kim-sw-1#show spanning-tree summary
Switch is in rapid-pvst mode
Root bridge for:
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                      1         0        0          8          9
VLAN0002                      1         0        0          8          9
VLAN0003                      0         0        0          9          9
VLAN0101                      1         0        0          8          9
VLAN0102                      1         0        0          8          9
VLAN0103                      1         0        0          8          9
VLAN0104                      1         0        0          8          9

---------------------- -------- --------- -------- ---------- ----------
7 vlans                       6         0        0         57         63
```

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

Режим Portfast в настройках интерфейсов коммутатора используется для ускорения процесса установления связи на портах, которые не будут подключаться к другим коммутаторам или маршрутизаторам, а только к хостам.

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

Агрегированный канал объединяет параллельные каналы для увеличения пропускной способности, а также не теряет соединение при обрыве одного из каналов, перенаправляя трафик.

5. В чём принципиальные отличия при использовании протоколов LACP (Link Aggregation Control Protocol), PAgP (Port Aggregation Protocol) и статического агрегирования без использования протоколов?
   - LACP общий стандарт IEEE 802.3ad
   - PAgP — локальный протокол Cisco. Для них обязательна настройка сторон (активная, пассивная, авто).
   - При статическом агрегировании коммутатор обрабатывает данные как с магистрали, даже если она не настроена на другой стороне.
6. При помощи каких команд можно узнать состояние агрегированного канала EtherChannel?

show etherchannel summary

show etherchannel port-channel

show interfaces port-channel <номер>

show running-config interface port-channel <номер>

Вывод

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