

Лабораторная работа 9

Использование протокола STP. Агрегирование каналов

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Информация

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Цель работы

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

Задание

1. Сформируйте резервное соединение между коммутаторами msk-donskaya-sw-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.

Выполнение лабораторной работы

Выполнение лабораторной работы

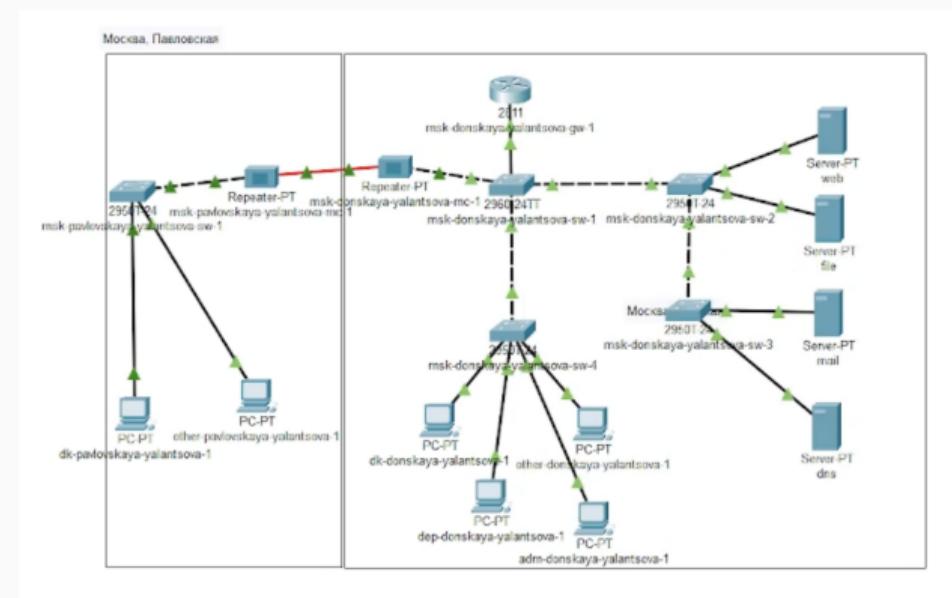


Рис. 1: Схема сети в логической рабочей области Packet Tracer

Выполнение лабораторной работы

```
mak-donakaya-yalantsova-sw-3>en
Password:
msk-donskaya-yalantsova-sw-3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-yalantsova-sw-3(config)#int q0/2
msk-donskaya-yalantsova-sw-3(config-if)#switchport mode trunk
msk-donakaya-yalantsova-sw-3(config-if)#
[
```

Рис. 2: настройка порта на коммутаторе msk-donskaya-yalantsova-sw-3

Выполнение лабораторной работы

```
msk-donskaya-yalantsova-sw-1>en
Password:
msk-donskaya-yalantsova-sw-1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-yalantsova-sw-1(config)#int f0/23
msk-donskaya-yalantsova-sw-1(config-if)#switchport mode
%CDP-t-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/23 (1), with msk-
donskaya-yalantsova-sw-4 FastEthernet0/23 (104)
* Incomplete command.
msk-donskaya-yalantsova-sw-1(config-if)#
msk-donskaya-yalantsova-sw-1(config-if)#switchport mode trunk

msk-donskaya-yalantsova-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
```

Рис. 3: настройка порта на коммутаторе msk-donskaya-yalantsova-sw-1

Выполнение лабораторной работы

```
msk-donskaya-yalantsova-sw-4>en
Password:
msk-donskaya-yalantsova-sw-4#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-yalantsova-sw-4(config)#int f0/23
msk-donskaya-yalantsova-sw-4(config-if)#switchport
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/23 (104), with msk-
donskaya-yalantsova-sw-1 FastEthernet0/23 (1).
% Incomplete command.
msk-donskaya-yalantsova-sw-4(config-if)#switchport mode trunk
```

Рис. 4: настройка порта на коммутаторе msk-donskaya-yalantsova-sw-4

Выполнение лабораторной работы

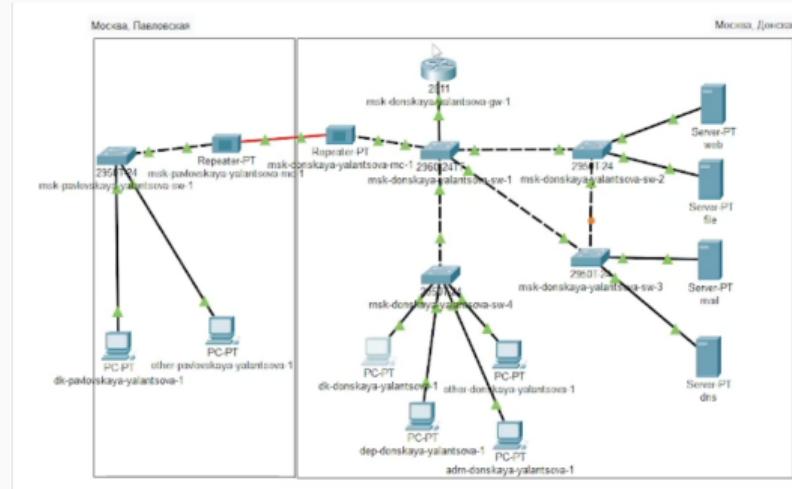


Рис. 5: Логическая схема локальной сети с резервным соединением

Выполнение лабораторной работы

```
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=32ms 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 = 32ms, Average = 8ms

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=2ms 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
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 = 2ms, Average = 0ms

C:\>
```

Рис. 6: Проверка доступности устройств с помощью команды ping

Выполнение лабораторной работы

Event List				
Vis.	Time(sec)	Last Device	At Device	Type
	0.000	--	dk.donskaya.yalantsova.1	ICMP
	0.001	dk.donskaya.yalantsova.1	msk.donskaya.yalantsova.sw.4	ICMP
	0.002	msk.donskaya.yalantsova.sw.4	msk.donskaya.yalantsova.sw.1	ICMP
	0.003	msk.donskaya.yalantsova.sw.1	msk.donskaya.yalantsova.gw.1	ICMP
	0.004	msk.donskaya.yalantsova.gw.1	msk.donskaya.yalantsova.sw.1	ICMP
	0.005	msk.donskaya.yalantsova.sw.1	msk.donskaya.yalantsova.sw.2	ICMP
	0.006	msk.donskaya.yalantsova.sw.2	web	ICMP
	0.007	web	msk.donskaya.yalantsova.sw.2	ICMP
	0.008	msk.donskaya.yalantsova.sw.2	msk.donskaya.yalantsova.sw.1	ICMP
	0.009	msk.donskaya.yalantsova.sw.1	msk.donskaya.yalantsova.gw.1	ICMP
	0.010	msk.donskaya.yalantsova.gw.1	msk.donskaya.yalantsova.sw.1	ICMP
	0.011	msk.donskaya.yalantsova.sw.1	msk.donskaya.yalantsova.sw.4	ICMP
	0.012	msk.donskaya.yalantsova.sw.4	dk.donskaya.yalantsova.1	ICMP

Рис. 7: Проверка доступности устройств в режиме симуляции

Выполнение лабораторной работы

```
msk-donskaya-yalantsova-sw-1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-yalantsova-sw-1(config)#spanning-tree vlan 3
msk-donskaya-yalantsova-sw-1(config)#spanning-tree vlan 3 root primary
^
% Invalid input detected at '^' marker.

msk-donskaya-yalantsova-sw-1(config)#spanning-tree vlan 3 root primary
msk-donskaya-yalantsova-sw-1(config)#?
msk-donskaya-yalantsova-sw-1#sh spanning-tree vlan 3
VLAN0003
  Spanning tree enabled protocol ieee
    Root ID      Priority  24579
                  Address   00D0.BCA3.A97D
                  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   00D0.BCA3.A97D
                  Hello Time 2 sec  Max Age 20 sec  Forward Delay 15 sec
                  Aging Time 20

    Interface      Role Sts Cost      Prio.Nbr Type
    -----
    Fa0/23        Desg FWD 19      128.23    P2p
    Gi0/1         Desg FWD 4       128.25    P2p
    Gi0/2         Desg FWD 4       128.26    P2p
    Fa0/24        Desg FWD 19      128.24    P2p
    Fa0/1         Desg FWD 19      128.1     Shz

msk-donskaya-yalantsova-sw-1#wr mem
Building configuration...
```

Рис. 8: Просмотр информации о STP для vlan 3 на msk-pavlovskaya-yalantsova-sw-1

Выполнение лабораторной работы

Event List			
Vis.	Time(sec)	Last Device	At Device
0.000	--		dk-donskaya-yalantsova-1
0.001	--	dk-donskaya-yalantsova-1	msk-donskaya-yalantsova-sw-4
0.002	--	msk-donskaya-yalantsova-sw-4	msk-donskaya-yalantsova-sw-1
0.003	--	msk-donskaya-yalantsova-sw-1	msk-donskaya-yalantsova-gw-1
0.004	--	msk-donskaya-yalantsova-gw-1	msk-donskaya-yalantsova-sw-1
0.005	--	msk-donskaya-yalantsova-sw-1	msk-donskaya-yalantsova-sw-3
0.006	--	msk-donskaya-yalantsova-sw-3	mail
0.007	--	mail	msk-donskaya-yalantsova-sw-3
0.008	--	msk-donskaya-yalantsova-sw-3	msk-donskaya-yalantsova-sw-1
0.009	--	msk-donskaya-yalantsova-sw-1	msk-donskaya-yalantsova-gw-1
0.010	--	msk-donskaya-yalantsova-gw-1	msk-donskaya-yalantsova-sw-1
0.011	--	msk-donskaya-yalantsova-sw-1	msk-donskaya-yalantsova-sw-4
0.012	--	msk-donskaya-yalantsova-sw-4	dk-donskaya-yalantsova-1

Рис. 9: Проверка пути от хоста dk-donskaya-1 до mail

Выполнение лабораторной работы

Vis.	Time(sec)	Last Device	At Device	Type
	0.000	--	dk-donskaya-yalantsova-1	ICMP
	0.001	dk-donskaya-yalantsova-1	msk-donskaya-yalantsova-sw-4	ICMP
	0.002	msk-donskaya-yalantsova-sw-4	msk-donskaya-yalantsova-sw-1	ICMP
	0.003	msk-donskaya-yalantsova-sw-1	msk-donskaya-yalantsova-gw-1	ICMP
	0.004	msk-donskaya-yalantsova-gw-1	msk-donskaya-yalantsova-sw-1	ICMP
	0.005	msk-donskaya-yalantsova-sw-1	msk-donskaya-yalantsova-sw-2	ICMP
	0.006	msk-donskaya-yalantsova-sw-2	web	ICMP
	0.007	web	msk-donskaya-yalantsova-sw-2	ICMP
	0.008	msk-donskaya-yalantsova-sw-2	msk-donskaya-yalantsova-sw-1	ICMP
	0.009	msk-donskaya-yalantsova-sw-1	msk-donskaya-yalantsova-gw-1	ICMP
	0.010	msk-donskaya-yalantsova-gw-1	msk-donskaya-yalantsova-sw-1	ICMP
	0.011	msk-donskaya-yalantsova-sw-1	msk-donskaya-yalantsova-sw-4	ICMP
	0.012	msk-donskaya-yalantsova-sw-4	dk-donskaya-yalantsova-1	ICMP

Рис. 10: Проверка пути от хоста dk-donskaya-1 до web

Выполнение лабораторной работы

```
msk-donskaya-yalantsova-sw-2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-yalantsova-sw-2(config)#interface f0/1
msk-donskaya-yalantsova-sw-2(config-if)#spanning tree portfast
^
* Invalid input detected at '^' marker.

msk-donskaya-yalantsova-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-yalantsova-sw-2(config-if)#interface f0/2
msk-donskaya-yalantsova-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-yalantsova-sw-2(config-if) #^Z
msk-donskaya-yalantsova-sw-2#wr m
```

Рис. 11: Настройка режима Portfast на msk-donskaya-yalantsova-sw-2

Выполнение лабораторной работы

```
Enter configuration commands, one per line. End with CRTL/Z.  
msk-donskaya-yalantsova-sw-3(config)#interface f0/1  
msk-donskaya-yalantsova-sw-3(config-if)#spanning-tree portfast  
^  
% Invalid input detected at '^' marker.  
  
msk-donskaya-yalantsova-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-yalantsova-sw-3(config-if)#interface f0/2  
msk-donskaya-yalantsova-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-yalantsova-sw-3(config-if)^Z  
msk-donskaya-yalantsova-sw-3#wr mem  
Building configuration...
```

Рис. 12: Настройка режима Portfast на msk-donskaya-yalantsova-sw-3

Выполнение лабораторной работы

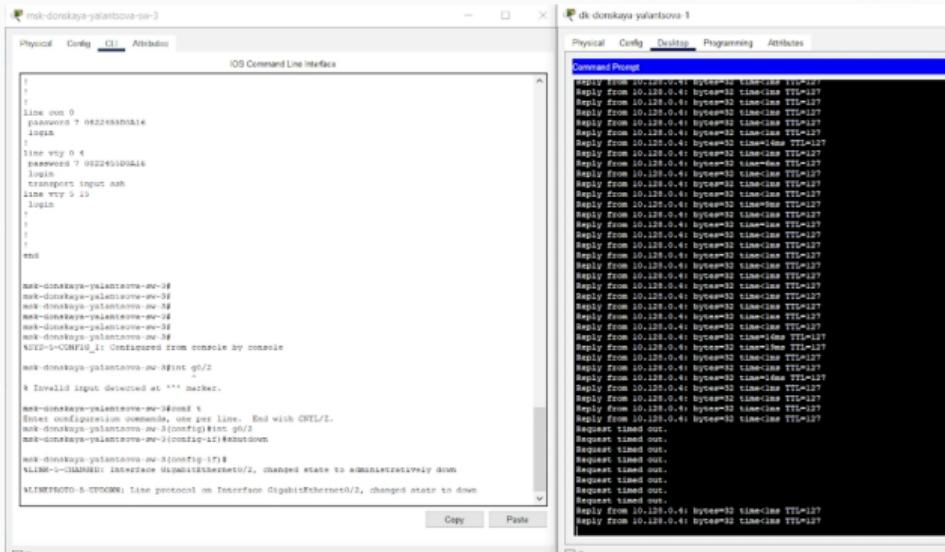
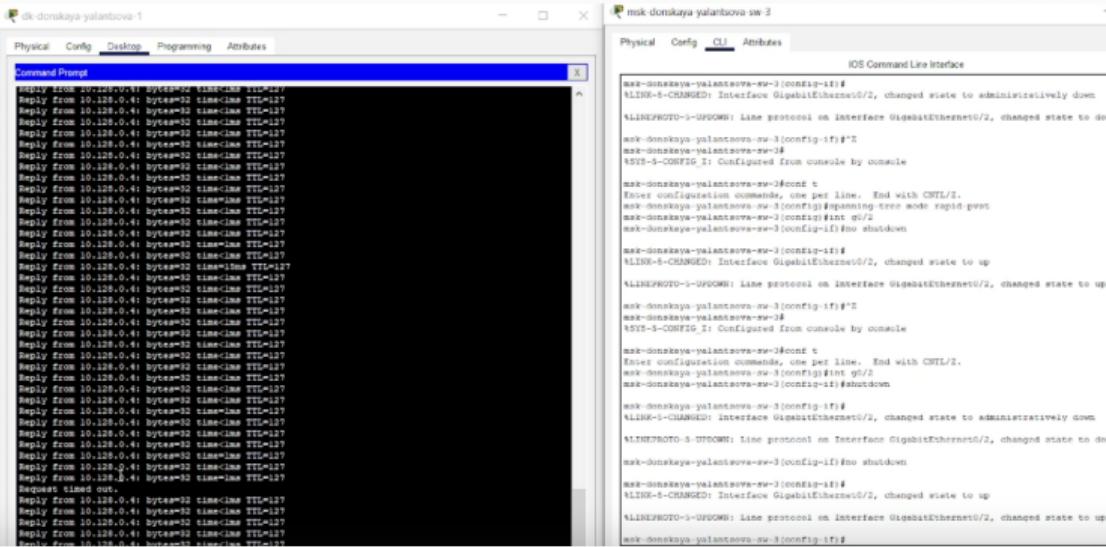


Рис. 13: Изучение отказоустойчивости протокола STP и время восстановления соединения

Выполнение лабораторной работы

```
msk-donskaya-yalantsova-sw-1( config )#spanning-tree mode rapid-pvst
msk-donskaya-yalantsova-sw-2( config )#spanning-tree mode rapid-pvst
msk-donskaya-yalantsova-sw-3( config )#spanning-tree mode rapid-pvst
msk-donskaya-yalantsova-sw-4( config )#spanning-tree mode rapid-pvst
msk-pavlovskaya-yalantsova-sw-1( config )#spanning-tree mode rapid-pvst
```

Выполнение лабораторной работы



The image shows two terminal windows side-by-side. The left window is titled 'Physical Config Desktop Programming Attributes' and has a 'Command Prompt' tab selected. It displays a continuous stream of network traffic logs from interface 'GigabitEthernet0/2'. The right window is titled 'Physical Config CLI Attributes' and has a 'IOS Command Line Interface' tab selected. It shows configuration logs for interface 'GigabitEthernet0/2', including commands like 'no shutdown' and 'no admin down'. Both windows have a blue header bar with the title and tabs.

```
msk-domskaya-yalantsova#sw-3(config-if)#  
%LINK-5-CHANGED: Interface GigabitEthernet0/2, changed state to administratively down  
%LINK-MTU-3-UPDOWN: Line protocol on interface GigabitEthernet0/2, changed state to down  
msk-domskaya-yalantsova#sw-3(config-if)#  
msk-domskaya-yalantsova#sw-3#  
4095-5-CONFIG: I2 Configured from console by console  
  
msk-domskaya-yalantsova#sw-3(config-if)t  
Enter configuration commands, one per line. End with CNTL/Z.  
msk-domskaya-yalantsova#sw-3(config)#spanning-tree mode rapid-pvst  
msk-domskaya-yalantsova#sw-3(config)#spanning-tree gcf2  
msk-domskaya-yalantsova#sw-3(config)#line shutdown  
  
msk-domskaya-yalantsova#sw-3(config-if)#  
%LINK-5-CHANGED: Interface GigabitEthernet0/2, changed state to up  
%LINK-MTU-3-UPDOWN: Line protocol on interface GigabitEthernet0/2, changed state to up  
msk-domskaya-yalantsova#sw-3(config-if)#  
msk-domskaya-yalantsova#sw-3#  
4095-5-CONFIG: I2 Configured from console by console  
  
msk-domskaya-yalantsova#sw-3(config-t)  
Enter configuration commands, one per line. End with CNTL/Z.  
msk-domskaya-yalantsova#sw-3(config-if)int gcf2  
msk-domskaya-yalantsova#sw-3(config-if)shutdown  
  
msk-domskaya-yalantsova#sw-3(config-if)#  
%LINK-5-CHANGED: Interface GigabitEthernet0/2, changed state to administratively down  
%LINK-MTU-3-UPDOWN: Line protocol on interface GigabitEthernet0/2, changed state to down  
msk-domskaya-yalantsova#sw-3(config-if)no shutdown  
  
msk-domskaya-yalantsova#sw-3(config-if)#  
%LINK-5-CHANGED: Interface GigabitEthernet0/2, changed state to up  
%LINK-MTU-3-UPDOWN: Line protocol on interface GigabitEthernet0/2, changed state to up  
msk-domskaya-yalantsova#sw-3(config-if)#
```

Рис. 14: Изучение отказоустойчивость протокола Rapid PVST+ и время восстановления соединения

Выполнение лабораторной работы

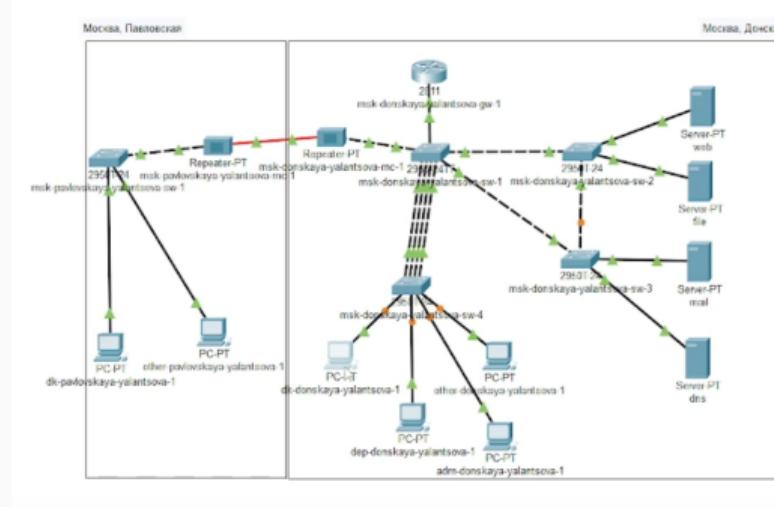


Рис. 15: Логическая схема локальной сети с агрегированным соединением

Выполнение лабораторной работы

```
msk-donskaya-yalantsova-sw-4(config)#int range fa0/20 - 23
msk-donskaya-yalantsova-sw-4(config-if-range)#no switchport access vlan 104
msk-donskaya-yalantsova-sw-4(config-if-range)#exit
msk-donskaya-yalantsova-sw-4(config)#
msk-donskaya-yalantsova-sw-4#  
tSYS-5-CONFIG_I: Configured from console by console

msk-donskaya-yalantsova-sw-4#wr mem
Building configuration...
[OK]
msk-donskaya-yalantsova-sw-4#interface range fa0/20 - 23
^
% Invalid input detected at '^' marker.

msk-donskaya-yalantsova-sw-4#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-yalantsova-sw-4(config)#interface range fa0/20 - 23
msk-donskaya-yalantsova-sw-4(config-if-range)#channel-group 1 mode on
msk-donskaya-yalantsova-sw-4(config-if-range)#
Creating a port-channel interface Port-channel 1

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

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

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

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

Рис. 16: Настройка агрегирования каналов на msk-donskaya-yalantsova-sw-1

Выполнение лабораторной работы

```
msk-donskaya-yalantsova-sw-1(config)#interface range f0/20 - 23
msk-donskaya-yalantsova-sw-1(config-if-range)#channel group 1 mode on
% Ambiguous command: "channel group 1 mode on"
msk-donskaya-yalantsova-sw-1(config-if-range)#exit
msk-donskaya-yalantsova-sw-1(config)#interface port channel 1
^
% Invalid input detected at '^' marker.

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

Рис. 17: Настройка агрегирования каналов на msk-donskaya-yalantsova-sw-1

Выводы

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