

# Лабораторная работа № 9

Использование протокола STP. Агрегирование каналов

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## Вводная часть

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## Цели

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

## Задачи

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

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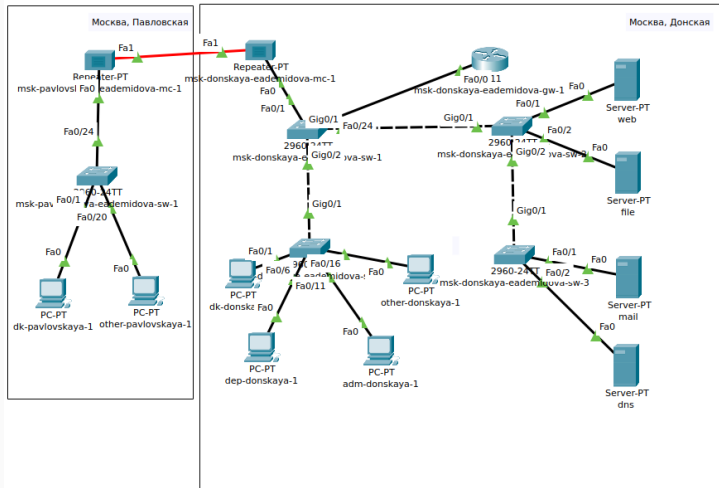


Рис. 1: Схема сети в логической рабочей области Packet Tracer

## Настройка резервного соединения

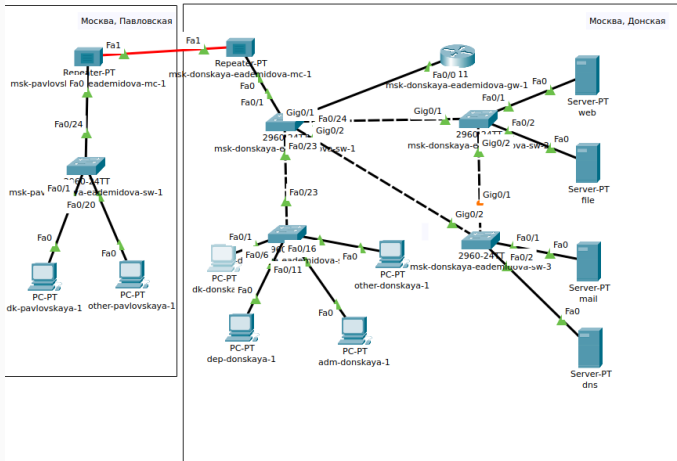
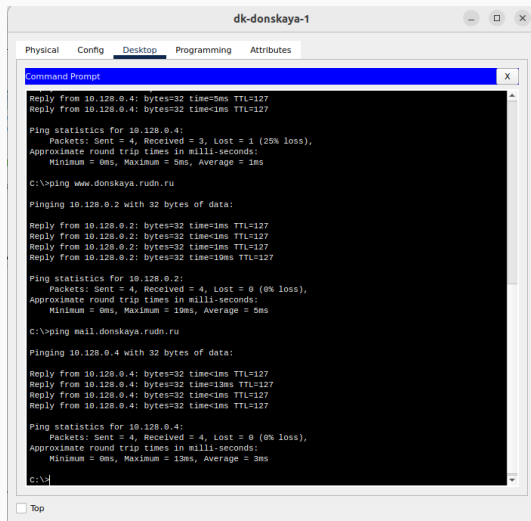


Рис. 2: Логическая схема локальной сети с резервным соединением

# Настройка резервного соединения



The screenshot shows a Windows Command Prompt window titled "dk-donskaya-1" with tabs for Physical, Config, Desktop, Programming, and Attributes. The Desktop tab is active, showing a Command Prompt window with the following text:

```
Command Prompt
Reply from 10.128.0.4: bytes=32 time=5ms 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 = 5ms, Average = 1ms

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=1ms TTL=127
Reply from 10.128.0.2: bytes=32 time=10ms 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 = 5ms

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

Pinging 10.128.0.4 with 32 bytes of data:

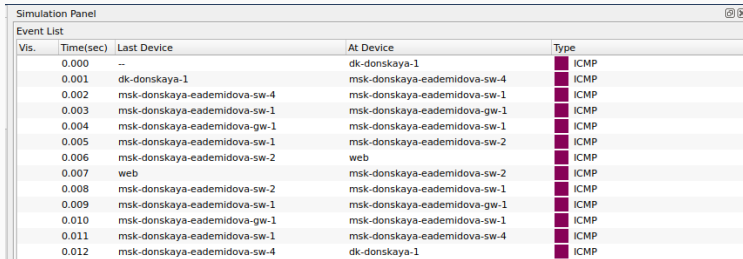
Reply from 10.128.0.4: bytes=32 time=1ms TTL=127
Reply from 10.128.0.4: bytes=32 time=13ms TTL=127
Reply from 10.128.0.4: bytes=32 time=1ms TTL=127
Reply from 10.128.0.4: bytes=32 time=1ms TTL=127

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 = 13ms, Average = 3ms

C:\>
```

At the bottom of the window, there is a checkbox labeled "Top" which is currently unchecked.

Рис. 3: Проверка доступности устройств с помощью команды ping



Simulation Panel

Event List

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

Рис. 4: Проверка доступности устройств в режиме симуляции



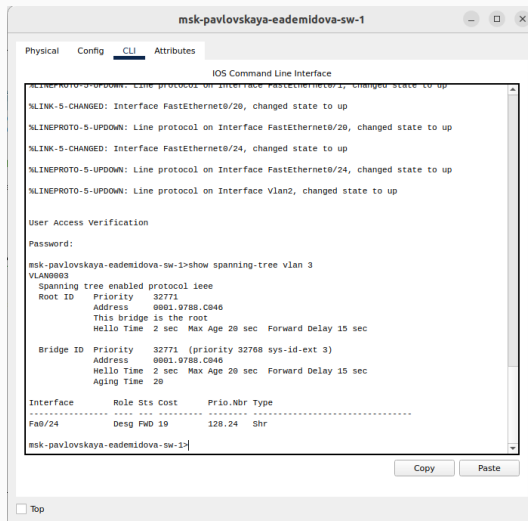


Рис. 5: Просмотр информации о STP для vlan 3 на msk-pavlovskaya-eademidova-sw-1

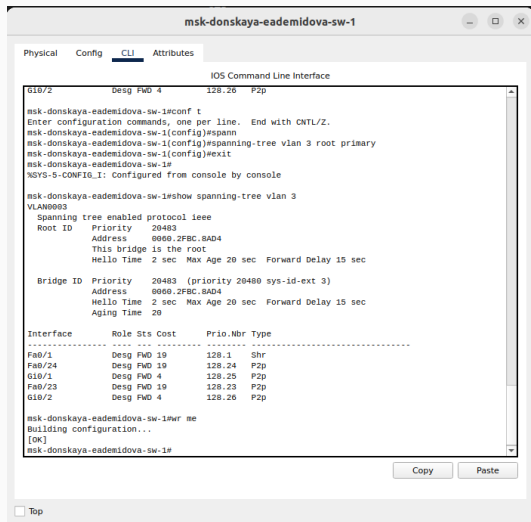






Рис. 6: Просмотр информации о STP для vlan 3 на msk-donskaya-eademidova-sw-1

Simulation Panel  

Event List

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

Рис. 7: Проверка пути от хоста dk-donskaya-1 до mail

Simulation Panel  

Event List














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

Рис. 8: Проверка пути от хоста dk-donskaya-1 до web

# Настройка Portfast

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

Copy Paste

Рис. 9: Настройка режима Portfast на msk-donskaya-eademidova-sw-2

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

Рис. 10: Настройка режима Portfast на msk-donskaya-eademidova-sw-3

# Изучение отказоустойчивости

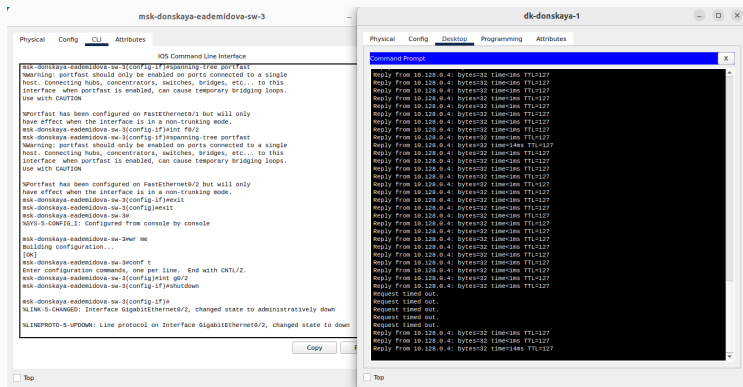


Рис. 11: Изучение отказоустойчивости протокола STP и время восстановления соединения

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



## Настройка Rapid PVST+

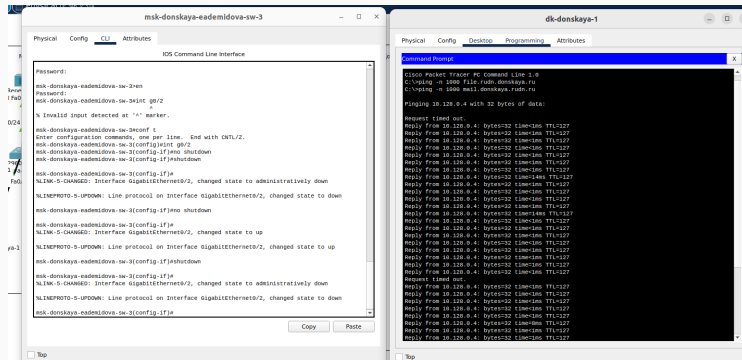


Рис. 12: Изучение отказоустойчивость протокола Rapid PVST+ и время восстановления соединения

# Агрегирование каналов

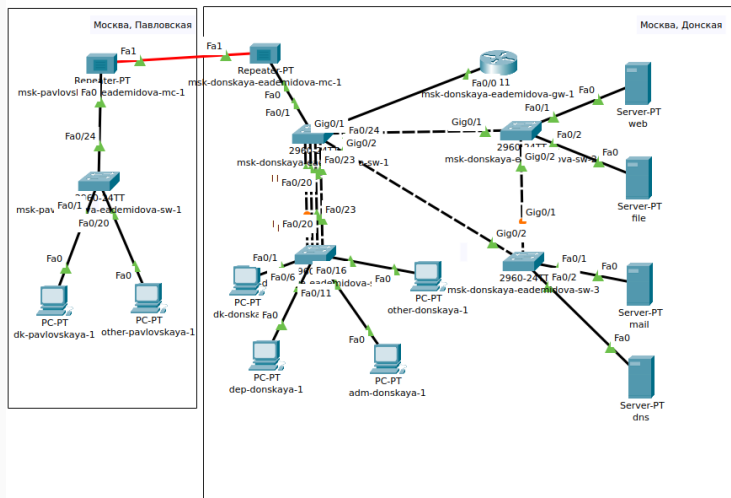


Рис. 13: Логическая схема локальной сети с агрегированным соединением



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

msk-donskaya-eademidova-sw-1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-eademidova-sw-1(config)#interface range fa0/20 - 23
msk-donskaya-eademidova-sw-1(config-if-range)#channel-group 1 mode on
msk-donskaya-eademidova-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
%NEC-5-CANNOT_BUNDLE2: Fa0/23 is not compatible with Fa0/20 and will be suspended (dtp mode of
Fa0/23 is on, Fa0/20/23 is off)
%NEC-5-CANNOT_BUNDLE2: Fa0/23 is not compatible with Fa0/21 and will be suspended (dtp mode of
Fa0/23 is on, Fa0/23/21 is off)
%NEC-5-CANNOT_BUNDLE2: Fa0/23 is not compatible with Fa0/22 and will be suspended (dtp mode of
Fa0/23 is on, Fa0/23/22 is off)
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state to down

msk-donskaya-eademidova-sw-1(config-if-range)#exit
msk-donskaya-eademidova-sw-1(config)#
NCDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/20 (1), with msk-
donskaya-eademidova-sw-4 FastEthernet0/20 (104).
NCDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/21 (1), with msk-
donskaya-eademidova-sw-4 FastEthernet0/20 (104).
NCDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/22 (1), with msk-
donskaya-eademidova-sw-4 FastEthernet0/20 (104).
NCDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/20 (1), with msk-
donskaya-eademidova-sw-4 FastEthernet0/21 (104).
NCDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/21 (1), with msk-
donskaya-eademidova-sw-4 FastEthernet0/21 (104).
NCDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/22 (1), with msk-
donskaya-eademidova-sw-4 FastEthernet0/21 (104).
NCDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/20 (1), with msk-
donskaya-eademidova-sw-4 FastEthernet0/22 (104).
NCDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/21 (1), with msk-
donskaya-eademidova-sw-4 FastEthernet0/22 (104).
NCDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/22 (1), with msk-
donskaya-eademidova-sw-4 FastEthernet0/22 (104).

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

msk-donskaya-eademidova-sw-1(config-if)#exit
msk-donskaya-eademidova-sw-1(config)#exit
msk-donskaya-eademidova-sw-1#
%SYS-5-CONFIG_I: Configured from console by console

msk-donskaya-eademidova-sw-1#sh me
Multicast configuration...
```

Рис. 14: Настройка агрегирования каналов на msk-donskaya-eademidova-sw-1



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

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet6/22 (104), with
msk-donskaya-eademidova-sw-1 FastEthernet6/22 (1).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet6/20 (104), with
msk-donskaya-eademidova-sw-1 Port-channel1 (1).

msk-donskaya-eademidova-sw-4(config-if)#int fa/23
msk-donskaya-eademidova-sw-4(config-if)#no switchpo
msk-donskaya-eademidova-sw-4(config-if)#no switchport mode trunk
msk-donskaya-eademidova-sw-4(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan2, changed state to down

msk-donskaya-eademidova-sw-4(config-if)#int range fa/20 - 23
msk-donskaya-eademidova-sw-4(config-if-range)#no switchport access vlan 104
msk-donskaya-eademidova-sw-4(config-if-range)#exit
msk-donskaya-eademidova-sw-4(config)#int range fa/20 - 23
msk-donskaya-eademidova-sw-4(config-if-range)#channel-group 1 mode on
msk-donskaya-eademidova-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
%SPANTREE-2-RECV_PVID_ERR: Received 002.1Q BPDU on non trunk Port-channel1 VLAN1.

%SPANTREE-2-BLOCK_PVID_LOCAL: Blocking Port-channel1 on VLAN0001. Inconsistent port type.

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

msk-donskaya-eademidova-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-eademidova-sw-4(config-if)#exit
msk-donskaya-eademidova-sw-4(config)#exit
msk-donskaya-eademidova-sw-4#
%SYS-5-CONFID_I: Configured from console by console

msk-donskaya-eademidova-sw-4#wr me
Building configuration...
[OK]
msk-donskaya-eademidova-sw-4#
```

Рис. 15: Настройка агрегирования каналов на msk-donskaya-eademidova-sw-1

## Выводы

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