

Лабораторная работа № 9

Использование протокола STP. Агрегирование каналов

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

1. Сформировать резервное соединение между коммутаторами msk-donskayasw-1 и msk-donskaya-sw-3.
2. Настроить балансировку нагрузки между резервными соединениями.
3. Настроить режим Portfast на тех интерфейсах коммутаторов, к которым подключены серверы.

4. Изучить отказоустойчивость резервного соединения.
5. Сформировать и настроить 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.

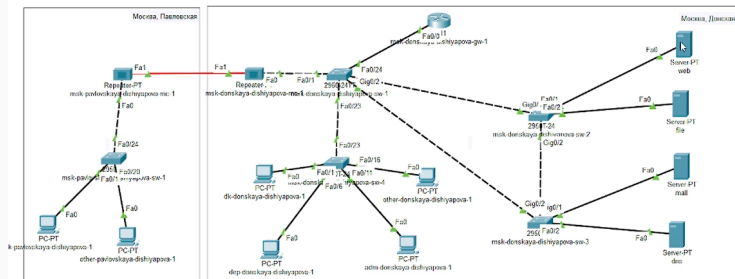


Рис. 1: Логическая схема локальной сети с резервным соединением

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

Рис. 2: Настройка trunk-порта на интерфейсе Gig0/2 коммутатора msk-donskaya-sw-3

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

Рис. 3: Настройка trunk-порта на интерфейсе Fa0/23 коммутатора msk-donskaya-sw-1


```

Password:
msk-donskaya-dishiyapova-sw-4#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-dishiyapova-sw-4(config)#int fa0/23
msk-donskaya-dishiyapova-sw-4(config-if)#switchport mode trunk

msk-donskaya-dishiyapova-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

```

Рис. 4: Настройка trunk-порта на интерфейсе Fa0/23 коммутатора msk-donskaya-sw-4

dk-donskaya-dishiyapova-1

Physical Config Desktop Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 10.128.0.2

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:\>ping 10.128.0.2

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=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 = 1ms, Average = 0ms

C:\>
```

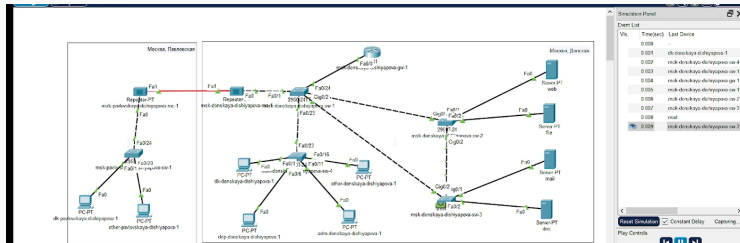



Рис. 6: Режим симуляции движения пакетов ICMP

Event List

Vis.	Time(sec)	Last Device
	0.000	--
	0.001	dk-donskaya-dishiyapova-1
	0.002	msk-donskaya-dishiyapova-sw-4
	0.003	msk-donskaya-dishiyapova-sw-1
	0.004	msk-donskaya-dishiyapova-gw-1
	0.005	msk-donskaya-dishiyapova-sw-1
	0.006	msk-donskaya-dishiyapova-sw-2
	0.007	msk-donskaya-dishiyapova-sw-3
	0.008	mail
	0.009	msk-donskaya-dishiyapova-sw-3
	0.010	msk-donskaya-dishiyapova-sw-2
	0.011	msk-donskaya-dishiyapova-sw-1
	0.012	msk-donskaya-dishiyapova-gw-1
	0.013	msk-donskaya-dishiyapova-sw-1
	0.014	msk-donskaya-dishiyapova-sw-4

```

Hello Time 2 sec  Max Age 20 sec  Forward
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
Gi0/2	Desg	FWD	4	128.26	P2p
Gi0/1	Root	FWD	4	128.25	P2p

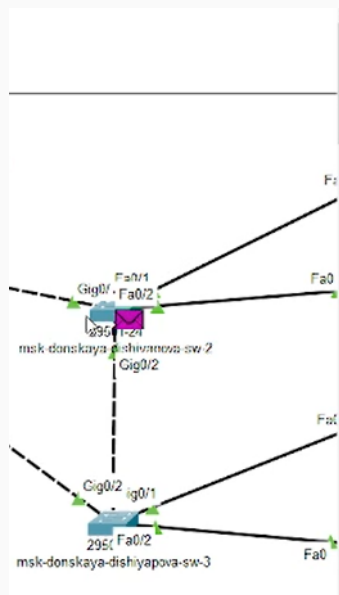
msk-donskaya-dishiyapova-sw-2#

Рис. 8: Просмотр состояния протокола STP для vlan 3

```
-3-CONFIG_1: Configured from console by console  
  
donskaya-dishiyapova-sw-1#wr m  
ding configuration...  
  
donskaya-dishiyapova-sw-1#  
-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered o  
kaya-dishiyapova-sw-4 FastEthernet0/23 (104).  
  
donskaya-dishiyapova-sw-1#conf t  
t configuration commands, one per line. End with CNTL/Z.  
donskaya-dishiyapova-sw-1(config)#spanning tree vlan 3 ro  
^  
valid input detected at '^' marker.  
  
donskaya-dishiyapova-sw-1(config)#spanning-tree vlan 3 ro  
donskaya-dishiyapova-sw-1(config)#
```

Рис. 9: Настройка коммутатора msk-donskaya-sw-1 корневым

Выполнение лабораторной работы



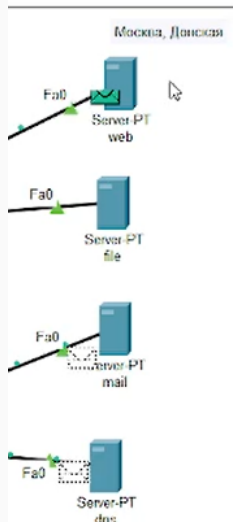
Simulation Panel

Event List

Vis.	Time(sec)	Last Device
	0.000	—
	0.001	dk-donskaya-dishiyapova-1
	0.002	msk-donskaya-dishiyapova-sw-4
	0.003	msk-donskaya-dishiyapova-sw-1
	0.004	msk-donskaya-dishiyapova-gw-1
	0.005	msk-donskaya-dishiyapova-sw-1
	0.005	msk-donskaya-dishiyapova-sw-1
	0.006	msk-donskaya-dishiyapova-sw-2
	0.006	msk-donskaya-dishiyapova-sw-2
	0.006	msk-donskaya-dishiyapova-sw-2
	0.007	msk-donskaya-dishiyapova-sw-3
	0.007	msk-donskaya-dishiyapova-sw-3
	0.007	msk-donskaya-dishiyapova-sw-3
	0.008	mail
	0.009	msk-donskaya-dishiyapova-sw-3

Reset Simulation ☒ Constant Delay Captured to: 0.009 s

Выполнение лабораторной работы



Simulation Panel

Event List

Vis.	Time(sec)	Last Device
	0.000	--
	0.001	dk-donskaya-dishiyapova-1
	0.002	msk-donskaya-dishiyapova-sw-4
	0.003	msk-donskaya-dishiyapova-sw-1
	0.004	msk-donskaya-dishiyapova-gw-1
	0.005	msk-donskaya-dishiyapova-sw-1
	0.005	msk-donskaya-dishiyapova-sw-1
	0.006	msk-donskaya-dishiyapova-sw-2
	0.006	msk-donskaya-dishiyapova-sw-2
	0.006	msk-donskaya-dishiyapova-sw-2
	0.007	web
	0.007	msk-donskaya-dishiyapova-sw-3
	0.007	msk-donskaya-dishiyapova-sw-3
	0.007	msk-donskaya-dishiyapova-sw-3



Reset Simulation

☒ Constant Delay

Capturing...

Password:

```
msk-donskaya-dishiyapova-sw-2>enable
```

Password:

```
msk-donskaya-dishiyapova-sw-2#conf t
```

Enter configuration commands, one per line. End with CNTL/Z.

```
msk-donskaya-dishiyapova-sw-2(config)#interface f0/1
```

```
msk-donskaya-dishiyapova-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-dishiyapova-sw-2(config-if)#interface f0/2
```

```
msk-donskaya-dishiyapova-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-dishiyapova-sw-2(config-if)#exit
```

```
msk-donskaya-dishiyapova-sw-2(config)#exit
```

```
msk-donskaya-dishiyapova-sw-2#
```

%SYS-5-CONFIG_I: Configured from console by console

msk

Building configuration...

[OK]

```
msk-donskaya-dishiyapova-sw-2#
```



```

Password:

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

```
C:\>ping -n 1000 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
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
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
```

Рис. 14: Пингование mail.donskaya.rudn.ru

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

msk-donskaya-dishiyapova-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
```

Рис. 15: Разрыв соединения

```
msk-donskaya-dishiyapova-sw-1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-dishiyapova-sw-1(config)#spanning-tree mode rapid-pvst
msk-donskaya-dishiyapova-sw-1(config)#exit
msk-donskaya-dishiyapova-sw-1#
%SYS-1-CONFIG_1: Configured from console by console
sh ru
Building configuration...
```

Рис. 16: Режим работы по протоколу Rapid PVST+

```
msk-donskaya-dishiyapova-sw-2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
msk-donskaya-dishiyapova-sw-2(config)#spanning-tree mode rapid-pvst
msk-donskaya-dishiyapova-sw-2(config)#exit
msk-donskaya-dishiyapova-sw-2#
%SYS-5-CONFIG_I: Configured from console by console
WR M
Building configuration...
[OK]
```

Рис. 17: Режим работы по протоколу Rapid PVST+

```
msk-donskaya-dishiyapova-sw-3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
msk-donskaya-dishiyapova-sw-3(config)#spanning-tree mode rapid-pvst
msk-donskaya-dishiyapova-sw-3(config)#^Z
msk-donskaya-dishiyapova-sw-3#
%SYS-5-CONFIG_I: Configured from console by console
VR M
Building configuration...
```

Рис. 18: Режим работы по протоколу Rapid PVST+

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

Рис. 19: Режим работы по протоколу Rapid PVST+


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

Рис. 20: Режим работы по протоколу Rapid PVST+

```
C:\>ping -n 1000 mail.donskaya.rudn.ru

Pinging 10.128.0.4 with 32 bytes of data:

Reply from 10.128.0.4: bytes=32 time=10ms 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
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
```

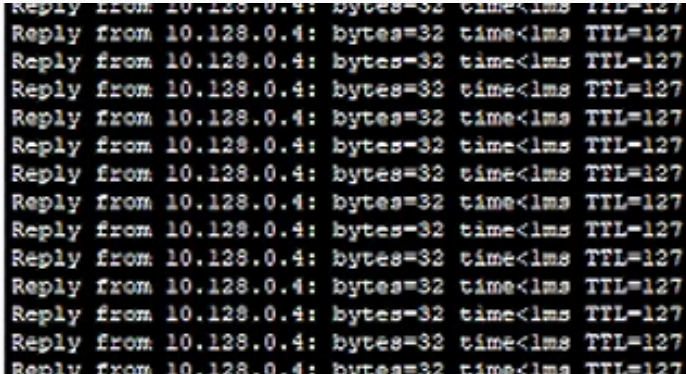
Рис. 21: Пингование mail.donskaya.rudn.ru

```
msk-donskaya-dishiyapova-sw-3#en
msk-donskaya-dishiyapova-sw-3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-dishiyapova-sw-3(config)#int g0/2
msk-donskaya-dishiyapova-sw-3(config-if)#shutdown

msk-donskaya-dishiyapova-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
msk-donskaya-dishiyapova-sw-3(config-if)#no shutdown
```

Рис. 22: Разрыв соединения



```
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
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
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
```

Рис. 23: Время восстановления соединения

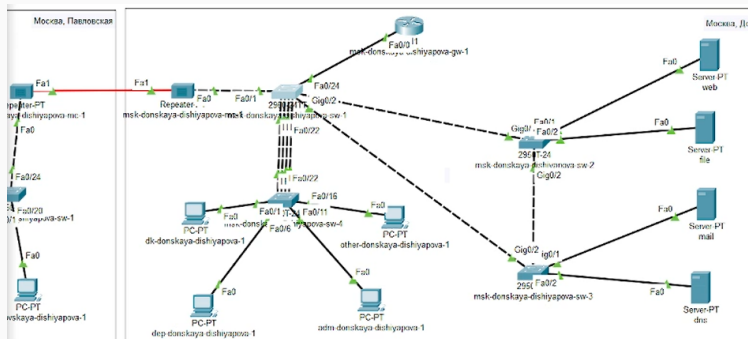
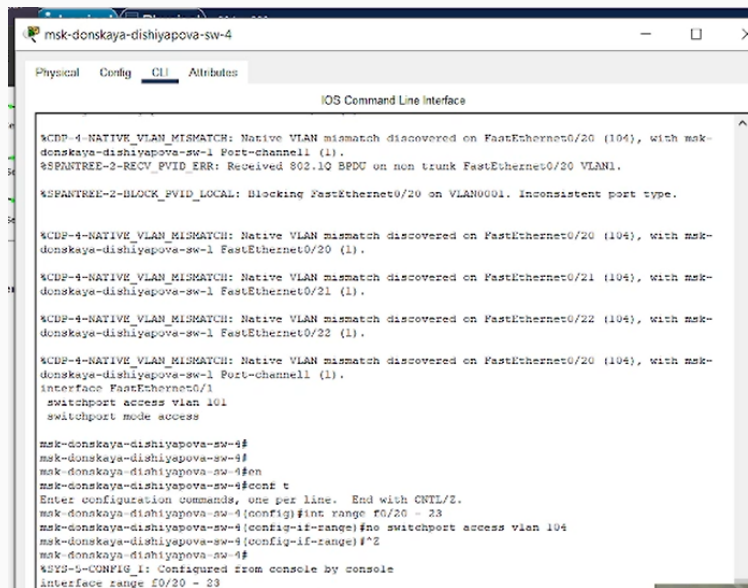


Рис. 24: Логическая схема локальной сети с агрегированным соединением

```
msk-donskaya-dishiyapova-sw-1
Physical Config CLI Attributes
IOS Command Line Interface
Fa0/23 is on, Fa0/22 is off )
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state to down
exit
msk-donskaya-dishiyapova-sw-1(config)#interface port-channel 1
msk-donskaya-dishiyapova-sw-1(config-if)#
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/20 (1), wi
donskaya-dishiyapova-sw-4 FastEthernet0/20 (104).
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/21 (1), wi
donskaya-dishiyapova-sw-4 FastEthernet0/20 (104).
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/22 (1), wi
donskaya-dishiyapova-sw-4 FastEthernet0/20 (104).
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/20 (1), wi
donskaya-dishiyapova-sw-4 FastEthernet0/21 (104).
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/21 (1), wi
donskaya-dishiyapova-sw-4 FastEthernet0/21 (104).
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/22 (1), wi
donskaya-dishiyapova-sw-4 FastEthernet0/21 (104).
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/20 (1), wi
donskaya-dishiyapova-sw-4 FastEthernet0/22 (104).
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/21 (1), wi
donskaya-dishiyapova-sw-4 FastEthernet0/22 (104).
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/22 (1), wi
donskaya-dishiyapova-sw-4 FastEthernet0/22 (104).
switchport mode trunk
msk-donskaya-dishiyapova-sw-1(config-if)#switchport mode trunk
msk-donskaya-dishiyapova-sw-1(config-if)#^Z
msk-donskaya-dishiyapova-sw-1#
%SYS-5-CONFIG_I: Configured from console by console
ms m
Building configuration...
[OK]
msk-donskaya-dishiyapova-sw-1#
```



The screenshot shows a network switch CLI window titled "msk-donskaya-dishiyapova-sw-4". The window has tabs for "Physical", "Config", "CLI", and "Attributes", with "CLI" being the active tab. The title bar also includes standard window controls (minimize, maximize, close). The main content area is titled "IOS Command Line Interface" and displays a series of error messages and configuration commands. The errors include "CDP-4-NATIVE_VLAN_MISMATCH" for ports 104, 20, 21, and 22, and "SPANNTREE-2-RECV_PVID_ERR" and "SPANNTREE-2-BLOCK_PVID_LOCAL" for port 20. The configuration commands show the setup of interface FastEthernet0/1 as an access port in VLAN 101. The session ends with a confirmation message from the user.

```
msk-donskaya-dishiyapova-sw-4#
msk-donskaya-dishiyapova-sw-4#
msk-donskaya-dishiyapova-sw-4#en
msk-donskaya-dishiyapova-sw-4#conf t
Enter configuration commands, one per line. End with CNTL/Z.
msk-donskaya-dishiyapova-sw-4(config)#int range f0/20 - 23
msk-donskaya-dishiyapova-sw-4(config-if-range)#no switchport access vlan 104
msk-donskaya-dishiyapova-sw-4(config-if-range)#^Z
msk-donskaya-dishiyapova-sw-4#
%SYS-5-CONFIG_I: Configured from console by console
interface range f0/20 - 23
```

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